National Institute for Health and Care Excellence

Guideline version (Final)

Weight management suite

[B] Evidence review for accuracy of anthropometric measures in assessing health risks associated with overweight and obesity in children and young people

NICE guideline CG189

Evidence reviews underpinning recommendations 1.2.21 to 1.2.22 and 1.2.24 to 1.2.29 and research recommendations in the NICE guideline

September 2022

FINAL

National Institute for Health and Care Excellence

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ISBN: 978-1-4731-0854-7

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1.1 Review question

What are the most accurate and suitable anthropometric methods and associated boundary values for different ethnicities, to assess the health risk associated with overweight, and obesity in children and young people, particularly those in black, Asian and minority ethnic groups?

1.1.1 Introduction

Overweight and obesity, as well as a person's central adiposity is a risk factor for the development of health problems such as cardiovascular disease, type 2 diabetes, hypertension, dyslipidaemia, and some types of cancers.

The 2014 NICE guideline on obesity identification, assessment and management (CG189) recommended using body mass index (BMI) as a practical estimate of adiposity in children but to interpret BMI with caution because it is not a direct measure of adiposity. The guideline also recommended utilising the Royal College of Paediatrics and Child Health UK-WHO growth charts to calculate BMIs for children and young people. Additionally, waist circumference was not recommended as a routine measure, but it can offer additional information when sought.

This topic was reviewed by NICE's surveillance team and evidence and expert feedback indicated the discriminatory value of waist-to-height ratio (WHtR) as an alternative measure for adiposity.

In line with this, the main purpose of this review is to identify the most accurate anthropometric measures, or combination of measures, in measuring health risk associated with overweight and obesity, particularly those in black, Asian and minority ethnic groups. Additionally, the aim of the review is to identify optimal boundary values for different anthropometric measures that are associated with overweight, obesity, and central adiposity in children and young people.

1.1.2 Summary of the protocol

Table 1: PICO table for accuracy of different anthropometric methods in assessing health risks in children and young people

PICO Table	
Population	Children and young people aged under 18 years Population will be stratified by ethnicity: • White • Black African/ Caribbean • Asian

PICO Table	
	○ South Asian ○ Chinese ○ Other Asian background • Other ethnic group ○ Arab ○ Any other ethnic background • Multiple/mixed ethnic group
Test	Method of measurement: • BMI z-score/BMI-for-age percentile • Waist-to-height ratio (WHtR) • Waist-to-hip ratio (WHR) • Waist circumference (WC) Combinations of methods of measurement.
Reference standard	Development of a condition of interest: • Type 2 diabetes (T2DM) • Cardiovascular disease (including coronary heart disease (CVD)) • Cancer • Dyslipidaemia • Hypertension • All-cause Mortality
Outcomes	Prediction of people later developing: • Type 2 diabetes (T2DM) • Cardiovascular disease (including coronary heart disease (CVD))) • Cancer • Dyslipidaemia • Hypertension • All-cause mortality Prognostic/ diagnostic accuracy: • Sensitivity • Specificity • Likelihood ratios • Predictive values Optimal boundary values will be explored using the following methods: • Area under the curve (c-statistic) • Youden's index

1.1.3 Methods and process

This evidence review was developed using the methods and process described in Developing NICE guidelines: the manual. Methods specific to this review question are described in the review protocol in appendix A and appendix B .

Declarations of interest were recorded according to NICE's conflicts of interest policy.

1.1.4 Prognostic and Diagnostic evidence

1.1.4.1 Included studies

A combined search was conducted for the adults and children and young people review. A total of 14,299 studies were identified in the search. Following title and abstract screening, 24 studies were identified as being potentially relevant prognostic accuracy studies in the children and young people population. These studies were retrieved in full text and were reviewed against the inclusion criteria as described in the review protocol (Appendix A). Overall, 4 studies were included. These studies covered the following populations and health risks:

- Chinese population (1 study)
  - Hypertension (1 study)
- White population (3 studies)
  - Type 2 diabetes (2 studies)
  - Hypertension (2 studies)
  - Cancer

Insufficient prognostic accuracy studies were identified for all population groups. Diagnostic accuracy studies were explored to further provide evidence on accuracy of anthropometric measures. From the 14,299 records, an additional 110 diagnostic accuracy studies were potentially relevant based on title and abstract. These studies were retrieved in full text and were reviewed against the inclusion criteria as described in the review protocol (Appendix A). Overall, 23 studies were included. These studies covered the following populations and health risks:

- Black African/ Caribbean population (1 study)
  - Hypertension (1 study)
- Chinese population (7 studies)
  - Hypertension (7 studies)
  - Dyslipidaemia (1 study)
- South Asian population (2 studies)
  - Hypertension (2 studies)
- Other Asian population (Malaysian and Vietnamese) (3 studies)
  - Hypertension (2 studies)
  - Dyslipidaemia (1 study)
- White population (4 studies)
  - Hypertension (4 studies)
- Other ethnicities (Brazilian, Argentinian, Peruvian and Iranian ethnicities) (6 studies)
  - Hypertension (5 studies)
  - Dyslipidaemia (1 study)

No studies were identified in the Arab population or multiple/mixed populations.

See appendix E for full evidence tables for the prognostic and diagnostic studies and the reference list of included studies in section 1.1.14.

1.1.4.2 Excluded studies

See appendix K for the list of excluded studies with reasons for their exclusion.

1.1.5 Summary of studies included in the prognostic and diagnostic evidence

Prognostic accuracy evidence

Table 2: Prospective cohort studies included in the review

Study (number of participants)	Country	Population	Anthropometric measure	Condition of interest	Accuracy outcomes	Other information
Chinese population						
Fan 2019 (n=2180)	China	The cohort from the China Health and Nutrition Survey 1993-2011	• BMI • WC • WHtR • WHR	A person develops hypertension during follow-up	Sensitivity Specificity C-statistic	Risk of bias: high Applicability: direct
White population						
Cheung 2004 (n=12327)	UK	People born in England, Scotland, or Wales during a single week in 1958	• BMI	Developing a condition during follow-up: • Type II diabetes • Hypertension • Cancer	Sensitivity Specificity C-statistic	Risk of bias: low Applicability: direct
Koskinen 2010 (n=1781)	Finland and USA	9-18 years old at baseline and followed until 24-41 years old.	• BMI	A person develops Type II diabetes during follow-up	Sensitivity Specificity C-statistic	Risk of bias: moderate Applicability: direct
Li 2011 (n=9377)	UK	People born in England, Scotland, or Wales during a single week in 1958	• BMI	Developing a condition during follow-up: • Type II diabetes • Hypertension	Sensitivity Specificity C-statistic	Risk of bias: high Applicability: direct

Diagnostic accuracy evidence

Table 3: Diagnostic accuracy studies included in the review

Study (number of participants)	Country/setting	Population	Anthropometric measure	Condition(s) of interest	Accuracy outcomes	Other information
Black African/ Caribbean population studies						
Wariri 2018 (n=667)	Nigeria: secondary school adolescents in the Gombe area	Children 10-18 years old	• BMI • WHtR • WC	Hypertension	C-statistic	Risk of bias: low Applicability: direct
Chinese population studies						
Dong 2015 (n= 99583)	China: 2010 Chinese National Survey on Students' Constitution and Health	Children 7-17 years old	• BMI z-score • WHR z-score • WHtR z-score • WC z-score	Hypertension	C-statistic	Risk of bias: low Applicability: direct
Hsu 2020 (n=340)	Taiwan: data from a database of a school-based health promotion project	Children 7-12 years old	• BMI z-score • BMI • WHtR	Hypertension	Sensitivity Specificity C-statistic	Risk of bias: moderate Applicability: direct
Li 2014 (n=2828)	China: 2 cities were randomly selected from 22 cities. 5 primary schools were then randomly selected from the cities.	Children 7-17 years old	• BMI • WHR • WHtR • WC	Hypertension	C-statistic	Risk of bias: low Applicability: direct
Li 2020 (n=15698)	China: survey conducted in 7 provinces in China.	Children 6-17 years old	• BMI z-score • WC z-score • WHR WHtR	Hypertension Dyslipidaemia	C-statistic	Risk of bias: low Applicability: direct
Liang 2015 (n=5601)	China: pupils from 7 primary schools in Guangzhou	Children 6-10 years old	• BMI • WC • WHR • WHtR	Hypertension	C-statistic	Risk of bias: low Applicability: direct
Ma 2015 (n=1352)	China: random sample of	Children 7-12	• BMI • WC	Hypertension	C-statistic	Risk of bias: low

Study (number of participants)	Country/setting	Population	Anthropometric measure	Condition(s) of interest	Accuracy outcomes	Other information
	primary schools in Qinhuangdao	years old				Applicability: direct
Zheng 2016 (n=773)	China: health and nutrition survey conducted in 7 urban areas and 2 rural areas in China	Children attending primary school	• BMI z-score • WC • WHR • WHtR	Dyslipidaemia	Sensitivity Specificity C-statistic Likelihood ratios (calculated)	Risk of bias: high Applicability: direct
South Asian population studies						
Brar 2013 (n=1225)	India: children from schools in 10 urban areas in the Punjab region	Children 10-18 years old	• BMI • WC • WHtR	Hypertension	Sensitivity Specificity Likelihood ratios (calculated)	Risk of bias: high Applicability: direct
Fowokan 2019 (n=762)	Canada: community-based recruitment of children of South Asian ethnicity in 2 Canadian cities	Children: under 18 years of age	• BMI z-score • WC z-score • WHtR z-score	Hypertension	Sensitivity Specificity C-statistic Likelihood ratios (calculated)	Risk of bias: moderate Partially applicable
Asian (other) population						
Cheah 2018 (n=2461)	Malaysia: 18 schools from each state to match population.	Children 13-17 years old	• BMI • WC • WHtR	Hypertension	Sensitivity Specificity Likelihood ratios (calculated)	Risk of bias: moderate Applicability: direct
Mai 2020 (n=10949)	Vietnam: data from the Survey of Nutritional Status Among School-aged Children conducted by the HCMC	Children 6-18 years old	• BMI z-score • WC z-score • WHtR	Dyslipidaemia	Sensitivity Specificity C-statistic Likelihood ratios (calculated)	Risk of bias: moderate Applicability: direct
Tee 2020 (n=513)	Malaysia: 2 state secondary schools in Selangor state were	Children 12-16 years old	• BMI z-score • WC z-score • WHtR	Hypertension	Sensitivity Specificity C-statistic	Risk of bias: moderate Applicability: direct

Study (number of participants)	Country/setting	Population	Anthropometric measure	Condition(s) of interest	Accuracy outcomes	Other information
	randomly selected.				Likelihood ratios (calculated)	
White population						
Arellano-Ruiz 2020 (n=848)	Spain: 20 state schools in the province of Cuenca	Children 8-11 years old	• WC • WHtR	Hypertension	Sensitivity Specificity C-statistic Likelihood ratios (calculated)	Risk of bias: moderate Applicability: direct
Chiolero 2013 (n=5207)	Switzerland: all sixth-grade schoolchildren of the canton de Vaud in 2005/06	Children 10-14 years old	• BMI z-score • WHtR • BMI z-score + WHtR	Hypertension	C-statistic	Risk of bias: low Applicability: direct
Kromeyer-Hauschild 2013 (n=3321)	Germany: data from the German Health Interview and Examination Survey for Children and Adolescents (KiGGS)	Children 0-17 years old	• BMI z-score • WHtR z-score • WHtR	Hypertension	Sensitivity Specificity C-statistic Likelihood ratios (calculated)	Risk of bias: moderate Applicability: direct
Vaquero-Álvarez 2020 (n=265)	Spain: children who were studying in primary and secondary schools in Pedro Abad (Córdoba)	Children 6-17 years old	• BMI • WC • WHtR	Hypertension	Sensitivity Specificity C-statistic Likelihood ratios (calculated)	Risk of bias: high Applicability: direct
Other ethnicity populations						
Christofaro 2018 (n=8295)	Brazil: databases from two school based studies involving adolescents	Children 10-17 years old	• BMI • WC • WHtR	Hypertension	Sensitivity Specificity C-statistic Likelihood ratios (calculated)	Risk of bias: low Applicability: direct
de Quadros 2019 (n=1139)	Brazil: random school selection in	Children 6-17 years old	• BMI z-score • WC z-score • WHtR z-score	Hypertension	Sensitivity Specificity C-statistic	Risk of bias: moderate

Study (number of participants)	Country/setting	Population	Anthropometric measure	Condition(s) of interest	Accuracy outcomes	Other information
	Amargosa, Bahia					Applicability: direct
Hirschler 2011 (n=1261)	Argentina: 10 schools randomly selected from 51 schools in the west side of Buenos Aires	Children 5-15 years old	• BMI z-score • WC • WHtR	Dyslipidaemia	Sensitivity Specificity C-statistic	Risk of bias: moderate Applicability: direct
Lopez-Gonzalez 2016 (n=366)	Mexico: obesity clinic in a hospital in Mexico City.	Children 10-18 years old	• WC • WHtR	Hypertension	C-statistic	Risk of bias: high Applicability: direct
Rosa 2007 (n=456)	Brazil: schools of the Fonseca neighborhood in Niterói, Rio de Janeiro	Children 12-17 years old	• BMI WC	Hypertension	Sensitivity Specificity C-statistic Likelihood ratios (calculated)	Risk of bias: moderate Applicability: direct
Yazdi 2020 (n=14008)	Iran: National school-based project entitled Childhood and Adolescence Surveillance and Prevention of Adult Non-Communicable Disease (CASPIAN-IV).	Children 7-18 years old	• BMI z-score • WHtR z-score • WC centile	Hypertension	Sensitivity Specificity C-statistic Likelihood ratios (calculated)	Risk of bias: moderate Applicability: direct

See appendix E for full evidence table.

1.1.6 Summary of the prognostic and diagnostic evidence

Prognostic accuracy evidence

C-Statistic / area under the curve

The following table was used to aid judgments of classification accuracy.

Table 4: Interpretation of c-statistics

Value of c-statistic	Interpretation
c-statistic <0.6	**Poor classification accuracy**
0.6 ≤ c-statistic <0.7	**Adequate classification accuracy**
0.7 ≤ c-statistic <0.8	**Good classification accuracy**
0.8 ≤ c-statistic <0.9	**Excellent classification accuracy**
0.9 ≤ c-statistic < 1.0	**Outstanding classification accuracy**

Chinese population

Summary of head-to-head comparisons of measures within the same study

The majority of included studies compared the accuracy of relevant measures within the same group of participants. The studies often reported the accuracy in age specific subgroups. The table below indicates which measure offered the best accuracy as determined by its C-statistic / AUC – ROC curve in each study or subgroup within the study.

Table 4: C-statistic/AUC comparisons in the Chinese population

Hypertesnion		Highest c-statistic
BMI vs WC vs WHR vs WHtR	Fan 2009	BMI

Table 5: Hypertension

No. of studies	Study design	Sample size	C-statistic (95%CI)	Quality	Interpretation of effect
BMI					
BMI assessed when under 18 years old. Mean follow-up 10.1 years (range 2 to 18 years)					
Fan 2019	Prospective	1444	0.56 (0.53-0.59)	Low	Poor classification accuracy
Waist circumference (WC)					
WC assessed when under 18 years old. Mean follow-up 10.1 years (range 2 to 18 years)					
Fan 2019	Prospective	1444	0.54 (0.51-0.57)	Low	Poor classification accuracy
Waist-to-hip ratio (WHR)					
WHR assessed when under 18 years old. Mean follow-up 10.1 years (range 2 to 18 years)					
Fan 219	Prospective	1444	0.50 (0.47-0.53)	Low	Poor classification accuracy
Waist-to-height ratio (WHtR)					
WHtR assessed when under 18 years old. Mean follow-up 10.1 years (range 2 to 18 years)					
Fan 2009	Prospective	1444	0.51 (0.48-0.54)	Low	Poor classification accuracy

White population

Summary of head-to-head comparisons of measures within the same study

No included studies compared relevant anthropometric measures. The only anthropometric measure assessed was BMI.

Table 6: Type 2 diabetes

No. of studies	Study design	Sample size	C-statistic (95%CI)	Quality	Interpretation of effect
BMI					
BMI at 7 years of age. Outcome assessed when 42 years old					
Cheung 2004[1]	Prospective	4592	0.58 (0.51 - 0.66)	Moderate	Poor classification accuracy
BMI at 11 years of age. Outcome assessed when 42 years old.					
Cheung 2004[1]	Prospective	4427	0.6 (0.52 - 0.67)	Moderate	Adequate classification accuracy
BMI at 16 years of age. Outcome assessed when 42 years old.					
Cheung 2004[1]	Prospective	4047	0.61 (0.54 - 0.68)	Moderate	Adequate classification accuracy
BMI assessed when 9 to 18 years of age. Mean follow-up: 24.4 years (range 14 to 27 years)					
Koskinen, 2010	Prospective	1767	0.63 (0.55–0.72	Very low	Adequate classification accuracy
BMI at 7 years of age. Outcome assessed when 45 years old					
Li 2011[1]	Prospective	7142 to 8979[2]	0.59 (0.54-0.63)*	Very low	Poor classification accuracy
BMI at 11 years of age. Outcome assessed when 42 years old.					
Li 2011[1]	Prospective	7142 to 8979[2]	0.65 (0.60-0.69)*	Low	Adequate classification accuracy
BMI at 16 years of age. Outcome assessed when 42 years old.					
Li 2011[1]	Prospective	7142 to 8979[2]	0.68 (0.63-0.72)*	Very low	Adequate classification accuracy

[1] Cheung 2004 and Li 2011 utilised the same cohort of participants born in 1958 in the UK.
[2] The paper stated that data was available for between 7142 to 8979 participants depending on the measure.
* Outcome for Li 2011: Type 2 diabetes **or** Hb A1c ≥7%.

Table 7: Hypertension

No. of studies	Study design	Sample size	C-statistic (95%CI)	Quality	Interpretation of effect
BMI					
BMI at 7 years of age. Outcome assessed when 42 years old.					
Cheung 2004[1]	Prospective	4592	0.51 (0.48 - 0.53)	High	Poor classification accuracy
BMI at 11 years of age. Outcome assessed when 42 years old.					
Cheung 2004[1]	Prospective	4427	0.56 (0.53 - 0.59)	High	Poor classification accuracy
BMI at 16 years of age. Outcome assessed when 42 years old.					

Cheung 2004[1]	Prospective	4047	0.6 (0.57 - 0.63)	Moderate	Adequate classification accuracy
BMI at 7 years of age. Outcome assessed when 45 years old					
Li 2011[1]	Prospective	7142 to 8979[1]	0.53 (0.52 - 0.55)	Low	Poor classification accuracy
BMI at 11 years of age. Outcome assessed when 42 years old.					
Li 2011[1]	Prospective	7142 to 8979[1]	0.54 (0.52 - 0.55)	Low	Poor classification accuracy
BMI at 16 years of age. Outcome assessed when 42 years old.					
Li 2011[1]	Prospective	7142 to 8979[1]	0.54 (0.52 - 0.55)	Low	Poor classification accuracy
[1] Cheung 2004 and Li 2011 utilised the same cohort of participants born in 1958 in the UK.					

Table 9: Cancer

No. of studies	Study design	Sample size	C-statistic (95%CI)	Quality	Interpretation of effect
BMI					
BMI at 7 years of age. Outcome assessed when 42 years old.					
Cheung 2004	Prospective	4592	0.46 (0.41 - 0.51)	High	Poor classification accuracy
BMI at 11 years of age. Outcome assessed when 42 years old.					
Cheung 2004	Prospective	4427	0.47 (0.42 - 0.53)	High	Poor classification accuracy
BMI at 16 years of age. Outcome assessed when 42 years old.					
Cheung 2004	Prospective	4047	0.53 (0.47 - 0.58)	High	Poor classification accuracy

Sensitivity, specificity, likelihood ratios

The following table was used to aid judgments of accuracy.

Table 10: Interpretation of LRS

Value of likelihood ratio	Interpretation
LR ≤ 0.1	**Very large** decrease in probability of disease or outcome
0.1 < LR ≤ 0.2	**Large** decrease in probability of disease or outcome
0.2 < LR ≤ 0.5	**Moderate** decrease in probability of disease or outcome
0.5 < LR ≤ 1.0	**Slight** decrease in probability of disease or outcome
1.0 < LR < 2.0	**Slight** increase in probability of disease or outcome
2.0 ≤ LR < 5.0	**Moderate** increase in probability of disease or outcome
5.0 ≤ LR < 10.0	**Large** increase in probability of disease or outcome
LR ≥ 10.0	**Very large** increase in probability of disease or outcome

White population

Table 11: Type 2 diabetes

No. of studies	Cut-off	Diagnostic accuracy			Quality	Interpretation of effect
		Sensitivity	Specificity	Likelihood ratios		
BMI assessed when 9 to 18 years of age. Mean follow-up: 24.4 years (range 14 to 27 years)						
Koskinen 2010	**≥75th percentile**	0.528 (0.368,0.683)	0.751 (0.730,0.771)	LR+ 2.120 (1.541,2.919)	Low	Moderate increase in probability of T2DN
				LR- 0.628 (0.444,0.889)	Low	Slight decrease in probability of T2DN
BMI at 7 years of age. Outcome assessed when 45 years old.						
Li 2011	**Male: 16.2 Female:17.6**	0.419 (0.359,0.482)	0.766 (0.756,0.775)	LR+ 1.791 (1.536,2.088)	Very low	Slight increase in probability of T2DN
				LR- 0.758 (0.681,0.845)	Low	Slight decrease in probability of HTN
BMI at 11 years of age. Outcome assessed when 42 years old.						
Li 2011	**Male: 17.9 Female:18.4**	0.495 (0.433,0.558)	0.730 (0.720,0.740)	LR+ 1.833 (1.606,2.092)	Very low	Slight increase in probability of T2DN
				LR- 0.692 (0.610,0.784)	Low	Slight decrease in probability of T2DN
BMI at 16 years of age. Outcome assessed when 42 years old.						
Li 2011	**Male: 20.4 Female:23.1**	0.602 (0.539,0.662)	0.716 (0.706,0.726)	LR+ 2.120 (1.902,2.362)	Very low	Moderate increase in probability of T2DN
				LR- 0.556 (0.476,0.649)	Low	Slight decrease in probability of T2DN

Table 12: Hypertension

No. of studies	Cut-off	Diagnostic accuracy			Quality	Interpretation of effect
		Sensitivity	Specificity	Likelihood ratios		
BMI at 7 years of age. Outcome assessed when 45 years old.						
Li 2011	**Male: 16.1 Female:16.6**	0.390 (0.371,0.410)	0.697 (0.686,0.708)	LR+ 1.287 (1.210,1.369)	Low	Slight increase in probability of HTN
				LR- 0.875 (0.844,0.907)	Low	Slight decrease in probability of HTN
BMI at 11 years of age. Outcome assessed when 42 years old.						
Li 2011	**Male: 15.9 Female:17.7**	0.557 (0.537,0.577)	0.561 (0.549,0.573)	LR+ 1.269 (1.213,1.327)	Low	Slight increase in probability of HTN
				LR- 0.790 (0.751,0.830)	Low	Slight decrease in probability of HTN
BMI at 16 years of age. Outcome assessed when 42 years old.						
Li 2011	**Male: 19.8 Female:24.3**	0.448 (0.428,0.468)	0.739 (0.729,0.749)	LR+ 1.716 (1.617,1.822)	Low	Slight increase in probability of HTN
				LR- 0.747 (0.718,0.777)	Low	Slight decrease in probability of HTN

Diagnostic accuracy evidence

C-Statistic / area under the curve

The following table was used to aid judgments of classification accuracy.

Table 13: Interpretation of c-statistics

Value of c-statistic	Interpretation
c-statistic <0.6	**Poor classification accuracy**
0.6 ≤ c-statistic <0.7	**Adequate classification accuracy**
0.7 ≤ c-statistic <0.8	**Good classification accuracy**
0.8 ≤ c-statistic <0.9	**Excellent classification accuracy**
0.9 ≤ c-statistic < 1.0	**Outstanding classification accuracy**

Black African/ Caribbean population

Summary of head-to-head comparisons of measures within the same study

The majority of included studies compared the accuracy of relevant measures within the same group of participants. The studies often reported the accuracy in gender or age specific subgroups. The table below indicates which measure offered the best accuracy as determined by its C-statistic / AUC – ROC curve in each study or subgroup within the study.

Table 14: C-statistic/AUC comparisons in the Black African / Caribbean population

Hypertension		Highest C-statistic
BMI vs WC vs WHtR	Wariri 2018 (male / female)	BMI in 2 study subgroups

Table 15: Hypertension

No. of studies	Study design	Sample size	C-statistic (95% CI)	Quality	Interpretation of effect
BMI					
Male children 10-18 years old					
Wariri 2018	Cross-sectional	191	0.770	Low	Good classification accuracy
Female children 10-18 years old					
Wariri 2018	Cross-sectional	176	0.790	Low	Good classification accuracy
Waist circumference					
Male children 10-18 years old					
Wariri 2018	Cross-sectional	191	0.760	Low	Good classification accuracy
Female children 10-18 years old					
Wariri 2018	Cross-sectional	176	0.780	Low	Good classification accuracy
Waist-to-height ratio					
Male children 10-18 years old					
Wariri 2018	Cross-sectional	191	0.750	Low	Good classification accuracy

Female children 10-18 years old					
Wariri 2018	Cross-sectional	176	0.770	Low	Good classification accuracy

Chinese population

Summary of head-to-head comparisons of measures within the same study

The majority of included studies compared the accuracy of relevant measures within the same group of participants. The studies often reported the accuracy in gender or age specific subgroups. The table below indicates which measure offered the best accuracy as determined by its C-statistic / AUC – ROC curve in each study or subgroup within the study.

Table 16: C-statistic/AUC comparisons in the Chinese population

Hypertension		Highest C-statistic
BMI z-score vs WC z-score vs WHtR vs WHR	Li 2020 (male / female)	BMI z-score in 2 study subgroups
BMI vs WC vs WHtR vs WHR	Dong 2015 (male / female), Li 2014 (male / female), Liang (female) Liang (male)	BMI in 5 study subgroups Waist circumference in 1 study subgroup
BMI vs BMI percentile vs BMI z-score vs WHtR	Hsu 2020	BMI in 1 study
BMI vs WC	Ma 2015 (male) Ma 2015 (female)	Waist circumference in 1 study subgroup BMI in 1 study subgroup
Dyslipidaemia		
BMI z-score vs WC z-score vs WHtR vs WHR	Li 2020 (male / female[1]) Li 2020 (female[1]) Li 2020 (female[1])	Waist circumference z-score in 2 study subgroups BMI z-score in 1 study subgroup Waist-to-height ratio in 1 study subgroup
BMI z-score vs WHtR vs WHR	Zheng 2016 (male) Zheng 2016 (female)	Waist-to-hip ratio in 1 study subgroup Not reported
[1] Multiple measures had identical C-statistics		

Table 17: Hypertension

No. of studies	Study design	Sample size	C-statistic (95% CI)	Quality	Interpretation of effect
BMI					
Children 7-12 years old					
Hsu 2020	Cross-sectional	340	0.649 (0.584–0.715)	Very low	Adequate classification accuracy
Male children 7-17 years old					
Dong 2015	Cross-sectional	49514	0.656	High	Adequate classification accuracy
Li 2014	Cross-sectional	1588	0.679 (0.635-0.723)	Moderate	Adequate classification accuracy
Male children 6-10 years old					
2 studies (Liang 2015, Ma 2015)	Cross-sectional	3549	0.83 (0.7-0.95)	Very low	Excellent classification accuracy

Female children 7-17 years old					
Dong 2015	Cross-sectional	49852	0.644	High	Adequate classification accuracy
Li 2014	Cross-sectional	1240	0.629 (0.58-0.628)	Moderate	Adequate classification accuracy
Female children 6-10 years old					
2 studies (Liang 2015, Ma 2015)	Cross-sectional	3345	0.85 (0.7-1)	Very low	Excellent classification accuracy
BMI percentile					
Children 7-12 years old					
Hsu 2020	Cross-sectional	340	0.63 (0.565–0.694)	Low	Adequate classification accuracy
BMI z-score					
Children 7-12 years old					
Hsu 2020	Cross-sectional	340	0.627 (0.562–0.692)	Low	Adequate classification accuracy
Male children 7-17 years old					
Li 2020	Cross-sectional	8004	0.7 (0.68 - 0.72)	Moderate	Good classification accuracy
Female children 7-17 years old					
Li 2020	Cross-sectional	7694	0.65 (0.63 - 0.68)	High	Adequate classification accuracy
Waist circumference					
Male children 7-17 years old					
Dong 2015	Cross-sectional	49514	0.639	High	Adequate classification accuracy
Li 2014	Cross-sectional	1588	0.676 (0.631-0.722)	Moderate	Adequate classification accuracy
Male children 6-10 years old					
2 studies (Liang 2015, Ma 2015)	Cross-sectional	3549	0.85 (0.7-1)	Very low	Excellent classification accuracy
Female children 7-17 years old					
Dong 2015	Cross-sectional	49852	0.631	High	Adequate classification accuracy
Li 2014	Cross-sectional	1240	0.594 (0.543-0.646)	Moderate	Poor classification accuracy
Female children 6-10 years old					
2 studies (Liang 2015, Ma 2015)	Cross-sectional	3345	0.73 (0.58-0.87)	Very low	Good classification accuracy
Waist circumference z-score					
Male children 7-17 years old					
Li 2020	Cross-sectional	8004	0.69 (0.67 - 0.71)	Moderate	Adequate classification accuracy
Female children 7-17 years old					
Li 2020	Cross-sectional	7694	0.62 (0.6 - 0.64)	High	Adequate classification accuracy

Waist-to-hip ratio					
Male children 7-17 years old					
Dong 2015	Cross-sectional	49514	0.611	High	Adequate classification accuracy
2 studies (Li 2014, Li 2020)	Cross-sectional	9592	0.6 (0.56-0.64)	Low	Adequate classification accuracy
Male children 6-10 years old					
Liang 2015	Cross-sectional	2870	0.683 (0.665–0.7)	Moderate	Adequate classification accuracy
Female children 7-17 years old					
Dong 2015	Cross-sectional	49852	0.584	High	Poor classification accuracy
2 studies (Li 2014, Li 2020)	Cross-sectional	8934	0.55 (0.52-0.57)	High	Poor classification accuracy
Female children 6-10 years old					
Liang 2015	Cross-sectional	2672	0.652 (0.634–0.670)	High	Adequate classification accuracy
Waist-to-height ratio					
Children 7-12 years old					
Hsu 2020	Cross-sectional	340	0.614 (0.547–0.681)	Low	Adequate classification accuracy
Male children 7-17 years old					
Dong 2015	Cross-sectional	49514	0.655	High	Adequate classification accuracy
2 studies (Li 2014, Li 2020)	Cross-sectional	9592	0.67 (0.62-0.71)	Low	Adequate classification accuracy
Male children 6-10 years old					
Liang 2015	Cross-sectional	2870	0.754 0.737–0.770	High	Good classification accuracy
Female children 7-17 years old					
Dong 2015	Cross-sectional	49852	0.637	High	Adequate classification accuracy
2 studies (Li 2014, Li 2020)	Cross-sectional	8934	0.59 (0.57 - 0.61)	Moderate	Poor classification accuracy
Female children 6-10 years old					
Liang 2015	Cross-sectional	2672	0.591 (0.572–0.610)	Moderate	Poor classification accuracy

Table 18: Dyslipidaemia

No. of studies	Study design	Sample size	C-statistic (95% CI)	Quality	Interpretation of effect
BMI z-score					
Male children 7-17 years old					
Li 2020	Cross-sectional	8004	0.62 (0.61 - 0.64)	High	Adequate classification accuracy
Male children 7-12 years old					

Zheng 2016	Cross-sectional	399	0.66 (0.57–0.75)	Very low	Adequate classification accuracy
Female children 7-17 years old					
Li 2020	Cross-sectional	7694	0.59 (0.57 - 0.6)	Moderate	Poor classification accuracy
Female children 7-12 years old					
Zheng 2016	Cross-sectional	374	Results not presented for this subgroup		
Waist circumference					
Male children 7-17 years old					
Li 2020	Cross-sectional	8004	0.63 (0.62 - 0.65)	High	Adequate classification accuracy
Female children 7-17 years old					
Li 2020	Cross-sectional	7694	0.59 (0.57 - 0.6)	Moderate	Poor classification accuracy
Waist-to-hip ratio					
Male children 7-17 years old					
Li 2020	Cross-sectional	8004	0.59 (0.58 - 0.61)	Moderate	Poor classification accuracy
Male children 7-12 years old					
Zheng 2016	Cross-sectional	399	0.73 (0.66–0.80)	Very low	Good classification accuracy
Female children 7-17 years old					
Li 2020	Cross-sectional	7694	0.56 (0.55 - 0.58)	High	Poor classification accuracy
Female children 7-12 years old					
Zheng 2016	Cross-sectional	374	Results not presented for this subgroup		
Waist-to-height ratio					
Male children 7-17 years old					
Li 2020	Cross-sectional	8004	0.62 (0.61 - 0.64)	High	Adequate classification accuracy
Male children 7-12 years old					
Zheng 2016	Cross-sectional	399	0.72 (0.65–0.80)	Very low	Good classification accuracy
Female children 7-17 years old					
Li 2020	Cross-sectional	7694	0.59 (0.57 - 0.6)	Moderate	Poor classification accuracy
Female children 7-12 years old					
Zheng 2016	Cross-sectional	374	Results not presented for this subgroup		

South Asian population

Summary of head-to-head comparisons of measures within the same study

The majority of included studies compared the accuracy of relevant measures within the same group of participants. The studies often reported the accuracy in gender or age specific subgroups. The table below indicates which measure offered the best accuracy as determined by its C-statistic / AUC – ROC curve in each study or subgroup within the study.

Table 19: C-statistic/AUC comparisons in the South Asian population

Hypertension		Highest C-statistic
BMI vs WC vs WHtR	Fowokan 2019 (male / female)	BMI in 2 study subgroups

Table 20: Hypertension

No. of studies	Study design	Sample size	C-statistic (95% CI)	Quality	Interpretation of effect
BMI					
Male children 6-17 years old					
Fowokan 2019	Cross-sectional	360	0.79 (0.72–0.85)	Very low	Good classification accuracy
Female children 6-17 years old					
Fowokan 2019	Cross-sectional	402	0.79 (0.70–0.88)	Very low	Good classification accuracy
Waist circumference (WC) percentile					
Male children 6-17 years old					
Fowokan 2019	Cross-sectional	360	0.78 (0.71–0.85)	Low	Good classification accuracy
Female children 6-17 years old					
Fowokan 2019	Cross-sectional	402	0.74 (0.66–0.83)	Very low	Good classification accuracy
Waist-to-height ratio					
Male children 6-17 years old					
Fowokan 2019	Cross-sectional	360	0.78 (0.71–0.85)	Low	Good classification accuracy
Female children 6-17 years old					
Fowokan 2019	Cross-sectional	402	0.74 (0.66–0.83)	Very low	Good classification accuracy

Asian (other) population

Summary of head-to-head comparisons of measures within the same study

The majority of included studies compared the accuracy of relevant measures within the same group of participants. The studies often reported the accuracy in gender or age specific subgroups. The table below indicates which measure offered the best accuracy as determined by its C-statistic / AUC – ROC curve in each study or subgroup within the study.

Table 21: C-statistic/AUC comparisons in the Asian (other) population

Hypertension		Highest C-statistic
BMI z-score, WC z-score, WHtR	Tee 2020 (male) Tee 2020 (female)	BMI z-score in 1 study subgroup Waist circumference 1 study subgroup
Dyslipidaemia		**Highest C-statistic**
BMI z-score, WC z-score, WHtR	Mai 2020 (male and female)	Waist-to-height ratio in 2 study subgroups

Table 22: Hypertension

No. of studies	Study design	Sample size	c- C-statistic (95% CI)	Quality	Interpretation of effect
BMI z-score					
Male children 12-16 years old					
Tee 2020	Cross-sectional	211	0.817 (0.723 - 0.912)	Very low	Excellent classification accuracy
Female children 12-16 years old					
Tee 2020	Cross-sectional	302	0.854 (0.793 - 0.916)	Very low	Excellent classification accuracy
Waist circumference percentile					
Male children 12-16 years old					
Tee 2020	Cross-sectional	211	0.781 (0.671- 0.891)	Very low	Good classification accuracy
Female children 12-16 years old					
Tee 2020	Cross-sectional	302	0.863 (0.798 - 0.927)	Very low	Excellent classification accuracy
Waist-to-height ratio					
Male children 12-16 years old					
Tee 2020	Cross-sectional	211	0.789 (0.675 - 0. 903)	Very low	Good classification accuracy
Female children 12-16 years old					
Tee 2020	Cross-sectional	302	0.854 (0.781 - 0.927)	Very low	Excellent classification accuracy

Table 23: Dyslipidaemia

No. of studies	Study design	Sample size	C-statistic (95% CI)	Quality	Interpretation of effect
BMI z-score					
Male children 6-18 years old					
Mai 2020	Cross-sectional	5540	0.64	Moderate	Adequate classification accuracy
Female children 6-18 years old					
Mai 2020	Cross-sectional	5540	0.65	Moderate	Adequate classification accuracy
Waist circumference z-score					
Male children 6-18 years old					
Mai 2020	Cross-sectional	5540	0.61	Moderate	Adequate classification accuracy

Female children 6-18 years old					
Mai 2020	Cross-sectional	5540	0.62	Moderate	Adequate classification accuracy
Waist-to-height ratio					
Male children 6-18 years old					
Mai 2020	Cross-sectional	5540	0.65	Moderate	Adequate classification accuracy
Female children 6-18 years old					
Mai 2020	Cross-sectional	5540	0.66	Moderate	Adequate classification accuracy

White population

Summary of head-to-head comparisons of measures within the same study

The majority of included studies compared the accuracy of relevant measures within the same group of participants. The studies often reported the accuracy in gender or age specific subgroups. The table below indicates which measure offered the best accuracy as determined by its C-statistic / AUC – ROC curve in each study or subgroup within the study.

Table 34: C-statistic/AUC comparisons in the White population

Hypertension		Highest C-statistic
BMI z-score vs WHtR vs BMI z-score + WHtR	Chiolero 2013	All measures had a C-statistic of 0.62.
BMI z-score vs WHtR z-score vs WHtR	Kromeyer-Hauschild 2013 (male / female)	BMI z-score in 2 study subgroups
BMI vs WC vs WHtR	Vaquero-Álvarez 2020	Waist circumference in 1 study
WC vs WHtR	Arellano-Ruiz 2020	Waist-to-height ratio 1 study

Table 25: Hypertension

No. of studies	Study design	Sample size	C-statistic (95% CI)	Quality	Interpretation of effect
BMI z-score + WHtR					
Children 10-14 years old					
Chiolero 2013	Cross-sectional	5207	0.62 (0.59-0.64)	High	Adequate classification accuracy
BMI z-score					
Children 10-14 years old					
Chiolero 2013	Cross-sectional	5207	0.62 (0.6-0.65)	High	Adequate classification accuracy
Male children 11-17 years old					
Kromeyer-Hauschild 2013	Cross-sectional	3492	0.684 (0.655–0.712)	Low	Adequate classification accuracy
Female children 11-17 years old					
Kromeyer-Hauschild 2013	Cross-sectional	3321	0.607 (0.574–0.641)	Low	Adequate classification accuracy
BMI					
Children 6-17 years old					

Vaquero-Álvarez 2020	Cross-sectional	265	0.718 (0.583–0.853)	Very low	Good classification accuracy
Waist circumference					
Children 6-17 years old					
Vaquero-Álvarez 2020	Cross-sectional	265	0.729 (0.587–0.871)	Very low	Good classification accuracy
Children 8-11 years old					
Arellano-Ruiz 2020	Cross-sectional	848	0.61 (0.48-0.74)	Very low	Adequate classification accuracy
Waist-to-height ratio z-score					
Male children 11-17 years old					
Kromeyer-Hauschild 2013	Cross-sectional	3492	0.667 (0.638–0.695)	Moderate	Adequate classification accuracy
Female children 11-17 years old					
Kromeyer-Hauschild 2013	Cross-sectional	3321	0.604 (0.570–0.638)	Low	Adequate classification accuracy
Waist-to-height ratio					
Children 10-14 years old					
Chiolero 2013	Cross-sectional	5207	0.62 (0.59-0.64)	High	Adequate classification accuracy
Children 6-17 years old					
Vaquero-Álvarez 2020	Cross-sectional	265	0.706 (0.593–0.819)	Very low	Good classification accuracy
Children 8-11 years old					
Arellano-Ruiz 2020	Cross-sectional	848	0.63 (0.51 - 0.76)	Very low	Adequate classification accuracy
Male children 11-17 years old					
Kromeyer-Hauschild 2013	Cross-sectional	3492	0.664 (0.635–0.692)	Moderate	Adequate classification accuracy
Female children 11-17 years old					
Kromeyer-Hauschild 2013	Cross-sectional	3321	0.605 (0.571–0.639)	Low	Adequate classification accuracy

Other population

Summary of head-to-head comparisons of measures within the same study

The majority of included studies compared the accuracy of relevant measures within the same group of participants. The studies often reported the accuracy in gender or age specific subgroups. The table below indicates which measure offered the best accuracy as determined by its C-statistic / AUC – ROC curve in each study or subgroup within the study.

In the table below the populations are from Brazil unless specifically noted.

Table 46: C-statistic/AUC comparisons in the Other ethnicity population

Hypertension		**Highest C-statistic**
BMI z-score vs WC vs WHtR	Yazdi 2020 in Iran (male) Yazdi 2020 in Iran (female)	Waist-to-height ratio in 1 study subgroup BMI z-score in 1 study subgroup
BMI vs WC vs WHtR	Christofaro 2018 in Brazil, de Quadros 2019 in Brazil (6-10 male / 6-10 female / 7-11 male / 7-11 female[1]) de Quadros 2019 in Brazil (7-11 female[1])	BMI in 5 studies/subgroups Waist circumference in 1 study subgroup
WC vs WHtR	Lopez-Gonzlez 2016 in Mexico	Waist circumference in 1 study
BMI vs WC	Rosa 2007 in Brazil	BMI in 1 study
Dyslipidaemia		Highest C-statistic
BMI z-score vs WC vs WHtR	Hirschler 2011 in Argentina	BMI z-score in 1 study
[1] Two subgroups have identical C-statistics		

Table 27: Hypertension

No. of studies	**Study design**	**Sample size**	**C-statistic (95% CI)**	**Quality**	**Interpretation of effect**
BMI z-score					
Male children 7-18 years old in Iran					
Yazdi 2020	Cross-sectional	7091	0.584 (0.562-0.606)	Low	Poor classification accuracy
Female children 7-18 years old in Iran					
Yazdi 2020	Cross-sectional	6817	0.6 (0.579-0.621)	Low	Adequate classification accuracy
BMI					
Children 10-17 years old in Brazil					
2 studies (Christofaro 2018, Rosa 2007)	Cross-sectional	8751	0.60 (0.59-0.61)	Moderate	Adequate classification accuracy
Male children 6-10 years old in Brazil					
de Quadros 2019	Cross-sectional	160	0.81 (0.74-0.87)	Low	Excellent classification accuracy
Male children 11-17 years old in Brazil					
de Quadros 2019	Cross-sectional	341	0.67 (0.62-0.72)	Low	Adequate classification accuracy
Female children 6-10 years old in Brazil					
de Quadros 2019	Cross-sectional	203	0.78 (0.71-0.83)	Low	Good classification accuracy
Female children 11-17 years old in Brazil					
de Quadros 2019	Cross-sectional	435	0.63 (0.59-0.68)	Low	Adequate classification accuracy
Waist circumference percentile					
Male children 7-18 years old in Iran					
Yazdi 2020	Cross-sectional	7091	0.578 (0.556-0.601)	Low	Poor classification accuracy
Female children 7-18 years old in Iran					

Yazdi 2020	Cross-sectional	6817	0.592 (0.571-0.613)	Low	Poor classification accuracy
Waist circumference					
Children 10-17 years old in Brazil					
Christofaro 2018	Cross-sectional	8295	0.59 (0.58-0.60)	Moderate	Poor classification accuracy
Children 10-18 years old in Mexico					
Lopez-Gonzalez 2016 (WHO measure)	Cross-sectional	366	0.691 (0.603-0.779)	Very low	Adequate classification accuracy
Lopez-Gonzalez 2016 (NCHS measure)	Cross-sectional	366	0.59 (0.58-0.60)	Very low	Poor classification accuracy
Children 12-17 years old in Brazil					
Rosa 2007	Cross-sectional	456	0.612 (0.485-0.746)	Very low	Adequate classification accuracy
Male children 6-10 years old in Brazil					
de Quadros 2019	Cross-sectional	160	0.78 (0.71-0.84)	Low	Good classification accuracy
Male children 11-17 years old in Brazil					
de Quadros 2019	Cross-sectional	341	0.65 (0.6-0.7)	Low	Adequate classification accuracy
Female children 6-10 years old in Brazil					
de Quadros 2019	Cross-sectional	203	0.71 (0.64-0.77)	Low	Good classification accuracy
Female children 11-17 years old in Brazil					
de Quadros 2019	Cross-sectional	435	0.63 (0.58-0.68)	Low	Adequate classification accuracy
Waist-to-height ratio					
Children 10-17 years old in Brazil					
Christofaro 2018	Cross-sectional	8295	0.57 (0.56-0.58)	High	Poor classification accuracy
Children 10-18 years old in Mexico					
Lopez-Gonzalez 2016 (WHO measure)	Cross-sectional	366	0.628 (0.539 - 0.717)	Very low	Adequate classification accuracy
Lopez-Gonzalez 2016 (NCHS measure)	Cross-sectional	366	0.625 (0.533 - 0.715)	Very low	Adequate classification accuracy
Male children 6-10 years old in Brazil					
de Quadros 2019	Cross-sectional	160	0.62 (0.54-0.69)	Low	Adequate classification accuracy
Male children 11-17 years old in Brazil					
de Quadros 2019	Cross-sectional	341	0.51 (0.46-0.57)	Low	Poor classification accuracy
Male children 7-18 years old in Iran					
Yazdi 2020	Cross-sectional	7091	0.593 (0.571-0.615)	Low	Poor classification accuracy
Female children 6-10 years old in Brazil					
de Quadros 2019	Cross-sectional	203	0.62 (0.54-0.69)	Low	Adequate classification accuracy

Female children 11-17 years old in Brazil					
de Quadros 2019	Cross-sectional	435	0.62 (0.57-0.63)	Low	Adequate classification accuracy
Female children 7-18 years old in Iran					
Yazdi 2020	Cross-sectional	6817	0.584 (0.562-0.605)	Low	Poor classification accuracy

Table 28: Dyslipidaemia

No. of studies	Study design	Sample size	C-statistic (95% CI)	Quality	Interpretation of effect
BMI z-score					
Children 5-15 years old in Argentina					
Hirschler 2011	Cross-sectional	1261	0.87 (0.78-0.95)	Very low	Excellent classification accuracy
Waist circumference					
Children 5-15 years old in Argentina					
Hirschler 2011	Cross-sectional	1261	0.83 (0.72 - 0.94)	Very low	Excellent classification accuracy
Waist-to-height ratio					
Children 5-15 years old in Argentina					
Hirschler 2011	Cross-sectional	1261	0.84 (0.72 - 0.95)	Very low	Excellent classification accuracy

Sensitivity, specificity, likelihood ratios

The following table was used to aid judgments of accuracy.

Table 29: Interpretation of LRS

Value of likelihood ratio	Interpretation
LR ≤ 0.1	**Very large** decrease in probability of disease or outcome
0.1 < LR ≤ 0.2	**Large** decrease in probability of disease or outcome
0.2 < LR ≤ 0.5	**Moderate** decrease in probability of disease or outcome
0.5 < LR ≤ 1.0	**Slight** decrease in probability of disease or outcome
1.0 < LR < 2.0	**Slight** increase in probability of disease or outcome
2.0 ≤ LR < 5.0	**Moderate** increase in probability of disease or outcome
5.0 ≤ LR < 10.0	**Large** increase in probability of disease or outcome
LR ≥ 10.0	**Very large** increase in probability of disease or outcome

Chinese population

Table 30: Dyslipidaemia

No. of studies	Cut-off	Diagnostic accuracy			Quality	Interpretation of effect
		Sensitivity	Specificity	Likelihood ratios		
BMI z-score						
Male children 7-12 years old						
Zheng 2016	**0.973**	0.596 (0.453,0.724)	0.732 (0.683,0.776)	LR+ 2.224 (1.664,2.972)	Very low	Moderate increase in probability of DYS
				LR- 0.552 (0.389,0.783)	Very low	Slight decrease in probability of DYS
Waist-to-hip ratio						
Male children 7-12 years old						
Zheng 2016	**0.862**	0.702 (0.559,0.814)	0.703 (0.653,0.748)	LR+ 2.364 (1.851,3.019)	Very low	Moderate increase in probability of DYS
				LR- 0.424 (0.273,0.658)	Very low	Moderate decrease in probability of DYS
Waist-to-height ratio						
Male children 7-12 years old						
Zheng 2016	**0.473**	0.596 (0.453,0.724)	0.766 (0.719,0.807)	LR+ 2.547 (1.887,3.439)	Very low	Moderate increase in probability of DYS
				LR- 0.527 (0.372,0.747)	Very low	Slight decrease in probability of DYS

South Asian population

Table 31: Hypertension

No. of studies	Cut-off	Diagnostic accuracy			Quality	Interpretation of effect
		Sensitivity	Specificity	Likelihood ratios		
BMI z-score						
Male children 6-17 years old						

No. of studies	Cut-off	Diagnostic accuracy			Quality	Interpretation of effect
		Sensitivity	Specificity	Likelihood ratios		
Fowokan 2019	**0.92**	0.830 (0.688,0.915)	0.650 (0.596,0.701)	LR+ 2.371 (1.938,2.902)	Very low	Moderate increase in probability of HTN
				LR- 0.262 (0.134,0.509)	Very low	Moderate decrease in probability of HTN
Female children 6-17 years old						
Fowokan 2019	**1.41**	0.720 (0.578,0.828)	0.810 (0.766,0.848)	LR+ 3.789 (2.869,5.005)	Low	Moderate increase in probability of HTN
				LR- 0.346 (0.219,0.546)	Very low	Moderate decrease in probability of HTN
BMI						
Male children 10-18 years old						
Brar 2013	**Not presented**	0.754 (0.701,0.800)	0.582 (0.529,0.633)	LR+ 1.804 (1.567,2.076)	Very low	Slight increase in probability of HTN
				LR- 0.423 (0.339,0.527)	Very low	Moderate decrease in probability of HTN
Female children 10-18 years old						
Brar 2013	**Not presented**	0.581 (0.517,0.642)	0.609 (0.557,0.659)	LR+ 1.486 (1.255,1.760)	Low	Slight increase in probability of HTN
				LR- 0.688 (0.580,0.816)	Low	Slight decrease in probability of HTN
Waist circumference z-score						
Male children 6-17 years old						
Fowokan 2019	**0.85**	0.740 (0.590,0.849)	0.770 (0.720,0.813)	LR+ 3.217 (2.460,4.207)	Low	Moderate increase in probability of HTN
				LR- 0.338 (0.203,0.561)	Very low	Moderate decrease in probability of HTN
Female children 6-17 years old						
Fowokan 2019	**0.39**	0.750 (0.610,0.852)	0.670 (0.619,0.717)	LR+ 2.273 (1.823,2.834)	Very low	Moderate increase in probability of HTN
				LR- 0.373 (0.227,0.612)	Very low	Moderate decrease in probability of HTN
Waist circumference						
Male children 10-18 years old						
Brar 2013	**Not presented**	0.754 (0.701,0.800)	0.582 (0.529,0.633)	LR+ 1.804 (1.567,2.076)	Very low	Slight increase in probability of HTN
				LR- 0.423 (0.339,0.527)	Very low	Moderate decrease in probability of HTN
Female children 10-18 years old						
Brar 2013	**Not presented**	0.581 (0.517,0.642)	0.609 (0.557,0.659)	LR+ 1.486 (1.255,1.760)	Low	Slight increase in probability of HTN
				LR- 0.688 (0.580,0.816)	Low	Slight decrease in probability of HTN
Waist-to-height ratio z-score						
Male children 6-17 years old						

No. of studies	Cut-off	Diagnostic accuracy			Quality	Interpretation of effect
		Sensitivity	Specificity	Likelihood ratios		
Fowokan 2019	**0.43**	0.760 (0.611,0.864)	0.760 (0.710,0.804)	LR+ 3.167 (2.446,4.099)	Low	Moderate increase in probability of HTN
				LR- 0.316 (0.185,0.539)	Very low	Moderate decrease in probability of HTN
Female children 6-17 years old						
Fowokan 2019	**0.32**	0.640 (0.496,0.762)	0.740 (0.692,0.783)	LR+ 2.462 (1.869,3.242)	Very low	Moderate increase in probability of HTN
				LR- 0.486 (0.332,0.713)	Very low	Moderate decrease in probability of HTN
Waist-to-height ratio						
Male children 10-18 years old						
Brar 2013	**Not presented**	0.640 (0.583,0.693)	0.571 (0.518,0.622)	LR+ 1.492 (1.285,1.732)	Low	Slight increase in probability of HTN
				LR- 0.630 (0.527,0.754)	Low	Slight decrease in probability of HTN
Female children 10-18 years old (no cut-off presented)						
Brar 2013	**Not presented**	0.621 (0.558,0.680)	0.607 (0.555,0.657)	LR+ 1.580 (1.342,1.860)	Low	Slight increase in probability of HTN
				LR- 0.624 (0.520,0.750)	Low	Slight decrease in probability of HTN

Asian (other) population

Table 32: Hypertension

No. of studies	Cut-off	Diagnostic accuracy			Quality	Interpretation of effect
		Sensitivity	Specificity	Likelihood ratios		
BMI z-score						
Male children 12-16 years old						
Tee 2020	**1.87**	0.692 (0.494,0.838)	0.843 (0.783,0.889)	LR+ 4.408 (2.893,6.715)	Moderate	Moderate increase in probability of HTN
				LR- 0.365 (0.205,0.652)	Low	Moderate decrease in probability of HTN
Female children 12-16 years old						
Tee 2020	**1.18**	0.714 (0.545,0.839)	0.835 (0.786,0.875)	LR+ 4.327 (3.075,6.090)	Moderate	Moderate increase in probability of HTN
				LR- 0.343 (0.202,0.580)	Low	Moderate decrease in probability of HTN
BMI						
Male children 13-17 years old						
Cheah 2018	**20**	0.754 (0.695,0.805)	0.603 (0.569,0.636)	LR+ 1.899 (1.697,2.126)	Low	Slight increase in probability of HTN
				LR- 0.408 (0.323,0.515)	Low	Moderate decrease in probability of HTN
Female children 13-17 years old						

No. of studies	Cut-off	Diagnostic accuracy			Quality	Interpretation of effect
		Sensitivity	Specificity	Likelihood ratios		
Cheah 2018	**20.7**	0.729 (0.660,0.788)	0.600 (0.572,0.627)	LR+ 1.823 (1.631,2.037)	Low	Slight increase in probability of HTN
				LR- 0.452 (0.355,0.575)	Low	Moderate decrease in probability of HTN
Waist circumference percentile						
Male children 12-16 years old						
Tee 2020	**78th percentile**	0.577 (0.385,0.748)	**0.908 (0.857,0.942)**	LR+ 6.272 (3.584,10.98)	Moderate	Large increase in probability of HTN
				LR- 0.466 (0.297,0.732)	Low	Moderate decrease in probability of HTN
Female children 12-16 years old						
Tee 2020	**73rd percentile**	0.857 (0.699,0.939)	0.742 (0.686,0.791)	LR+ 3.322 (2.602,4.241)	Moderate	Moderate increase in probability of HTN
				LR- 0.193 (0.085,0.435)	Moderate	Large decrease in probability of HTN
Waist circumference						
Male children 13-17 years old						
Cheah 2018	**60.7 cm**	0.773 (0.715,0.822)	0.618 (0.584,0.651)	LR+ 2.024 (1.809,2.264)	Low	Moderate increase in probability of HTN
				LR- 0.367 (0.288,0.469)	Moderate	Moderate decrease in probability of HTN
Female children 13-17 years old						
Cheah 2018	**68.2 cm**	0.713 (0.644,0.774)	0.616 (0.589,0.643)	LR+ 1.857 (1.654,2.084)	Low	Slight increase in probability of HTN
				LR- 0.466 (0.370,0.587)	Low	Moderate decrease in probability of HTN
Waist-to-height ratio						
Male children 12-16 years old						
Tee 2020	**0.52**	0.654 (0.457,0.809)	0.876 (0.820,0.916)	LR+ 5.274 (3.283,8.474)	Moderate	Large increase in probability of HTN
				LR- 0.395 (0.232,0.672)	Low	Moderate decrease in probability of HTN
Male children 13-17 years old						
Cheah 2018	**0.42**	0.712 (0.650,0.767)	0.605 (0.571,0.638)	LR+ 1.803 (1.601,2.029)	Low	Slight increase in probability of HTN
				LR- 0.476 (0.386,0.587)	Low	Moderate decrease in probability of HTN
Female children 12-16 years old						
Tee 2020	**0.45**	0.943 (0.799,0.986)	0.659 (0.600,0.713)	LR+ 2.765 (2.297,3.329)	Moderate	Moderate increase in probability of HTN
				LR- 0.086 (0.022,0.334)	Moderate	Very large decrease in probability of HTN
Female children 13-17 years old						
Cheah 2018	**0.44**	0.719 (0.650,0.779)	0.600 (0.572,0.627)	LR+ 1.798 (1.606,2.012)	Low	Slight increase in probability of HTN

No. of studies	Cut-off	Diagnostic accuracy			Quality	Interpretation of effect
		Sensitivity	Specificity	Likelihood ratios		
				LR- 0.468 (0.370,0.592)	Low	Moderate decrease in probability of HTN

Table 33: Dyslipidaemia

No. of studies	Cut-off	Diagnostic accuracy			Quality	Interpretation of effect
		Sensitivity	Specificity	Likelihood ratios		
BMI z-score						
Male children 6-18 years old						
Mai 2020	**1.39**	0.455 (0.411,0.500)	0.758 (0.746,0.770)	LR+ 1.880 (1.686,2.096)	Low	Slight increase in probability of DYS
				LR- 0.719 (0.662,0.781)	Moderate	Slight decrease in probability of DYS
Female children 6-18 years old						
Mai 2020	**1**	0.411 (0.370,0.454)	0.868 (0.858,0.877)	LR+ 3.114 (2.747,3.529)	Moderate	Moderate increase in probability of DYS
				LR- 0.679 (0.631,0.730)	Moderate	Slight decrease in probability of DYS
Waist circumference z-score						
Male children 6-18 years old						
Mai 2020	**0.7**	0.712 (0.670,0.751)	0.468 (0.454,0.482)	LR+ 1.338 (1.258,1.424)	Moderate	Slight increase in probability of DYS
				LR- 0.615 (0.533,0.710)	Moderate	Slight decrease in probability of DYS
Female children 6-18 years old						
Mai 2020	**0.28**	0.462 (0.420,0.505)	0.777 (0.765,0.788)	LR+ 2.072 (1.863,2.304)	Low	Moderate increase in probability of DYS
				LR- 0.692 (0.639,0.751)	Moderate	Slight decrease in probability of DYS
Waist-to-height ratio						
Male children 6-18 years old						
Mai 2020	**0.44**	0.766 (0.726,0.802)	0.453 (0.439,0.467)	LR+ 1.400 (1.325,1.480)	Moderate	Slight increase in probability of DYS
				LR- 0.517 (0.439,0.608)	Low	Slight decrease in probability of DYS
Female children 6-18 years old						
Mai 2020	**0.47**	0.475 (0.432,0.518)	0.801 (0.790,0.812)	LR+ 2.387 (2.146,2.654)	Moderate	Moderate increase in probability of DYS
				LR- 0.655 (0.603,0.712)	Moderate	Slight decrease in probability of DYS

White population

Table 34: Hypertension

No. of studies	Cut-off	Diagnostic accuracy			Quality	Interpretation of effect
		Sensitivity	Specificity	Likelihood ratios		
BMI z-score						
Male children 11-17 years old						
Kromeyer-Hauschild 2013	**IOTF**	0.192 (0.156,0.234)	0.955 (0.947,0.962)	LR+ 4.267 (3.285,5.541)	Moderate	Moderate increase in probability of HTN
				LR- 0.846 (0.805,0.889)	Moderate	Slight decrease in probability of HTN
Female children 11-17 years old						
Kromeyer-Hauschild 2013	**IOTF**	0.153 (0.118,0.197)	0.958 (0.950,0.965)	LR+ 3.643 (2.675,4.960)	Moderate	Moderate increase in probability of HTN
				LR- 0.884 (0.844,0.927)	Moderate	Slight decrease in probability of HTN
BMI						
Children 6-16 years old						
Vaquero-Álvarez 2020	**23 kg/m²**	0.667 (0.429,0.842)	0.789 (0.734,0.835)	LR+ 3.161 (2.107,4.743)	Low	Moderate increase in probability of HTN
				LR- 0.422 (0.219,0.814)	Very low	Moderate decrease in probability of HTN
Waist circumference percentile						
Children 8-11 years old at cut off (via ROC curve) of						
Arellano-Ruiz 2020	**90th centile**	0.296 (0.156,0.490)	0.905 (0.883,0.923)	LR+ 3.119 (1.680,5.788)	Low	Moderate increase in probability of HTN
				LR- 0.778 (0.608,0.994)	Moderate	Slight decrease in probability of HTN
Waist circumference						
Children 6-16 years old						
Vaquero-Álvarez 2020	**73.5 cm**	0.722 (0.481,0.879)	0.760 (0.703,0.809)	LR+ 3.008 (2.094,4.323)	Low	Moderate increase in probability of HTN
				LR- 0.366 (0.173,0.773)	Very low	Moderate decrease in probability of HTN
Waist-to-height ratio percentile						
Male children 11-17 years old						
Kromeyer-Hauschild 2013	**90th percentile**	0.321 (0.276,0.369)	0.906 (0.895,0.916)	LR+ 3.415 (2.847,4.096)	High	Moderate increase in probability of HTN
				LR- 0.749 (0.699,0.804)	High	Slight decrease in probability of HTN
Female children 11-17 years old						
Kromeyer-Hauschild 2013	**90th percentile**	0.269 (0.223,0.320)	0.903 (0.892,0.913)	LR+ 2.773 (2.247,3.423)	High	Moderate increase in probability of HTN
				LR- 0.810 (0.757,0.866)	High	Slight decrease in probability of HTN
Waist-to-height ratio						
Male children 11-17 years old						
	0.5		0.918 (0.908,0.927)	LR+ 3.610 (2.973,4.383)	Moderate	Moderate increase in probability of HTN

No. of studies	Cut-off	Diagnostic accuracy			Quality	Interpretation of effect
		Sensitivity	Specificity	Likelihood ratios		
Kromeyer-Hauschild 2013		0.296 (0.252,0.344)		LR- 0.767 (0.718,0.819)	Moderate	Slight decrease in probability of HTN
Female children 11-17 years old						
Kromeyer-Hauschild 2013	**0.5**	0.226 (0.184,0.275)	0.936 (0.927,0.944)	LR+ 3.531 (2.766,4.508)	Moderate	Moderate increase in probability of HTN
				LR- 0.827 (0.779,0.878)	Moderate	Slight decrease in probability of HTN
Children 8-11 years old						
Arellano-Ruiz 2020	**0.57**	0.333 (0.183,0.527)	0.918 (0.898,0.935)	LR+ 4.085 (2.285,7.300)	Low	Moderate increase in probability of HTN
				LR- 0.726 (0.556,0.949)	Low	Slight decrease in probability of HTN
Children 6-16 years old						
Vaquero-Álvarez 2020	**0.455**	0.722 (0.481,0.879)	0.646 (0.584,0.703)	LR+ 2.040 (1.463,2.844)	Very low	Moderate increase in probability of HTN
				LR- 0.430 (0.203,0.911)	Very low	Moderate decrease in probability of HTN

Other ethnicity population

Table 35: Hypertension

No. of studies	Cut-off	Diagnostic accuracy			Quality	Interpretation of effect
		Sensitivity	Specificity	Likelihood ratios		
BMI z-score						
Male children 7-18 years old in Iran						
Yazdi 2020	**0.075**	0.541 (0.505,0.577)	0.596 (0.584,0.608)	LR+ 1.339 (1.245,1.440)	Moderate	Slight increase in probability of HTN
				LR- 0.770 (0.710,0.835)	Moderate	Slight decrease in probability of HTN
Female children 7-18 years old in Iran						
Yazdi 2020	**0.245**	0.521 (0.486,0.556)	0.628 (0.616,0.640)	LR+ 1.401 (1.300,1.509)	Moderate	Slight increase in probability of HTN
				LR- 0.763 (0.707,0.823)	Moderate	Slight decrease in probability of HTN
BMI percentile						
Children 12-17 years old in Brazil						
Rosa 2007	**Sichieri and Allam (1996)** [1]	0.524 (0.319,0.722)	0.801 (0.761,0.836)	LR+ 2.633 (1.680,4.126)	Moderate	Moderate increase in probability of HTN
				LR- 0.594 (0.378,0.933)	Moderate	Slight decrease in probability of HTN
Female children 7-18 years old in Brazil						
	95.3rd centile	0.350 (0.324,0.377)	0.860 (0.852,0.868)	LR+ 2.500 (2.272,2.751)	High	Moderate increase in probability of HTN

No. of studies	Cut-off	Diagnostic accuracy			Quality	Interpretation of effect
		Sensitivity	Specificity	Likelihood ratios		
Christofaro 2018	**(males) and 84.8th (37emale)**			LR- 0.756 (0.725,0.788)	High	Slight decrease in probability of HTN
Waist circumference percentile						
Children 12-17 years old in Brazil						
Rosa 2007	**Fernandez et al. (2004)[2]**	0.450 (0.257,0.659)	0.775 (0.733,0.812)	LR+ 2.000 (1.208,3.311)	Low	Moderate increase in probability of HTN
				LR- 0.710 (0.480,1.048)	Very low	Slight decrease in probability of HTN
Female children 7-18 years old in Brazil						
Christofaro 2018	**80th centile**	0.370 (0.343,0.397)	0.820 (0.811,0.829)	LR+ 2.056 (1.882,2.245)	Moderate	Moderate increase in probability of HTN
				LR- 0.768 (0.735,0.803)	High	Slight decrease in probability of HTN
Waist circumference						
Male children 7-18 years old in Iran						
Yazdi 2020	**60.5 cm**	0.501 (0.465,0.537)	0.625 (0.613,0.637)	LR+ 1.336 (1.235,1.445)	Moderate	Slight increase in probability of HTN
				LR- 0.798 (0.741,0.860)	Moderate	Slight decrease in probability of HTN
Female children 7-18 years old in Iran						
Yazdi 2020	**68.5 cm**	0.457 (0.422,0.492)	0.687 (0.675,0.698)	LR+ 1.460 (1.341,1.589)	Moderate	Slight increase in probability of HTN
				LR- 0.790 (0.740,0.845)	Moderate	Slight decrease in probability of HTN
Waist-to-height ratio						
Female children 7-18 years old in Brazil						
Christofaro 2018	**0.5**	0.310 (0.285,0.336)	0.830 (0.821,0.839)	LR+ 1.824 (1.653,2.011)	Moderate	Slight increase in probability of HTN
				LR- 0.831 (0.800,0.864)	High	Slight decrease in probability of HTN
Male children 7-18 years old in Iran						
Yazdi 2020	**0.469**	0.495 (0.459,0.531)	0.659 (0.647,0.671)	LR+ 1.452 (1.339,1.573)	Moderate	Slight increase in probability of HTN
				LR- 0.766 (0.712,0.825)	Moderate	Slight decrease in probability of HTN
Female children 7-18 years old in Iran						
Yazdi 2020	**0.477**	0.417 (0.383,0.452)	0.711 (0.700,0.722)	LR+ 1.443 (1.317,1.581)	Moderate	Slight increase in probability of HTN
				LR- 0.820 (0.771,0.872)	Moderate	Slight decrease in probability of HTN

No. of studies	Cut-off	Diagnostic accuracy			Quality	Interpretation of effect
		Sensitivity	Specificity	Likelihood ratios		
[1] Assessment of the nutritional status of Brazilian adolescents by body mass index [2] Waist circumference percentiles in nationally representative samples of African-American, European-American, and Mexican-American children and adolescents						

Accuracy data where GRADE analysis is not be possible

Chinese population

Table 36: Hypertension

Population and index test	Sample size	Cut-off	Likelihood ratio +/-	Sensitivity	Specificity	Risk of bias
Hsu 2020						
Reference standard: hypertension						
Children 7-12 years old from Taiwan						
BMI z-score	340	0.7	NR	0.627	0.626	Moderate
BMI percentile	340	75.5	NR	0.637	0.622	Moderate
BMI	340	18.75 kg/m^2	NR	0.559	0.739	Moderate
Waist-to-height ratio	340	0.48	NR	0.48	0.748	Moderate

Other ethnicity population

Table 37: Hypertension

Population and index test	Sample size	Cut-off	Likelihood ratio +/-	Sensitivity	Specificity	Risk of bias
de Quadros 2019						
Reference standard: hypertension						
Male children 6-10 years old in Brazil						
BMI	160	IOTF[1]	NR	0.429	0.892	Moderate
Waist circumference	160	Taylor at al.[2]	NR	0.357	0.91	Moderate
Waist circumference	160	Katzmarzyk et al.[3]	NR	0.571	0.637	Moderate
Waist-to-height ratio	160	0.5	NR	0.357	0.878	Moderate
Waist-to-height ratio	160	Kelishadi et al.[4]	NR	0.5	0.628	Moderate
Female children 6-10 years old in Brazil						
BMI	203	WHO[5]	NR	0.55	0.801	Moderate
Waist circumference	203	Katzmarzyk et al.[3]	NR	0.65	0.526	Moderate
Waist-to-height ratio	203	0.5	NR	0.55	0.795	Moderate
Waist-to-height ratio	203	Kelishadi et al.[4]	NR	0.7	0.526	Moderate

Population and index test	Sample size	Cut-off	Likelihood ratio +/-	Sensitivity	Specificity	Risk of bias
Male children 11-17 years old in Brazil						
BMI	341	WHO[5]	NR	0.234	0.865	Moderate
Waist circumference	341	Katzmarzyk et al.[3]	NR	0.45	0.659	Moderate
Waist-to-height ratio	341	"Area under the ROC curve for the variable was not significant enough to predict high blood pressure in male adolescents"				
Female children 11-17 years old in Brazil						
BMI	435	WHO[5]	NR	0.272	0.832	Moderate
Waist circumference	435	Katzmarzyk et al.[3]	NR	0.45	0.659	Moderate
Waist-to-height ratio	435	0.5	NR	0.25	0.349	Moderate
Waist-to-height ratio	435	Kelishadi et al.[4]	NR	0.691	0.432	Moderate
Rosa 2007						
Reference standard: hypertension						
Children 12-17 years old in Brazil						
BMI	456	Sichieri and Allam[6]	NR	0.524 (0.303 - 0.736)	0.801 (0.77 - 0.844)	Moderate
Waist circumference	456	Fernandez et al.[7]	NR	0.45 (0.238 - 0.68)	0.775 (0.73 - 0.813)	Moderate

[1] Extended international (IOTF) body mass index cut-offs for thinness, overweight and obesity

[2] Evaluation of waist circumference, waist-to-hip ratio, and the conicity index as screening tools for high trunk fat mass, as measured by dual-energy X-ray absorptiometry, in children aged 3-19 y.

[3] Body mass index, waist circumference, and clustering of cardiovascular disease risk factors in a biracial sample of children and adolescents

[4] Paediatric metabolic syndrome and associated anthropometric indices: the CASPIAN Study

[5] Measuring obesity: classification and distribution of anthropometric data (1988)

[6] [Assessment of the nutritional status of Brazilian adolescents by body mass index]

[7] Waist circumference percentiles in nationally representative samples of African-American, European-American, and Mexican-American children and adolescents

1.1.7 Economic evidence

1.1.7.1 Included studies

A systematic literature search was undertaken to identify published health economic evidence for both topics included in the scope of this guideline. The search returned 174 records which were sifted against the review protocol, but no economic studies were identified which were applicable to this review question. See the literature search strategy in appendix B and economic study selection flow chart in appendix H.

1.1.7.2 Excluded studies

All papers identified were excluded in the initial review of titles and abstracts. Hence no studies were selected for screening on full text.

1.1.8 Summary of included economic evidence

No economic studies were identified which were applicable to this review question.

1.1.9 Economic model

No economic modelling was conducted for this review question.

1.1.10 Unit costs

Not applicable.

1.1.11 The committee's discussion and interpretation of the evidence

1.1.11.1. The outcomes that matter most

The main objectives of this review were to identify the most accurate anthropometric measure or combination of methods and optimal boundary values in assessing health risks associated with overweight and obesity, including central obesity, in children and young people particularly those in black, Asian and minority ethnic groups. The objectives were linked to implications of acquiring conditions such as type 2 diabetes or cardiovascular disease. The measures were BMI, waist circumference, waist-to-hip ratio, and waist-to-height ratio. Each of these measures can be adjusted for the child's age and sex through utilising a z-score or a percentile.

Based on these objectives, the outcomes that mattered most to the committee were likelihood ratios (which were calculated by obtaining number of true positives, true negatives, false positives and false negatives) and other indicators of accuracy such as C-statistic and the sensitivity and specificity of the test. Sensitivity and specificity were equally important for this review and optimised cut-offs were extracted.

For positive and negative likelihood ratio, the clinical decision threshold was set at 2 and 0.5. For c-statistics, the C-statistic was classified according to a table that interprets C-statistics from 'Poor' to 'Outstanding' (see appendix B for example). A formal decision threshold was not set, but committee were interested in identifying measures that demonstrated a 'Good' classification or higher. The committee concentrated on comparisons of measures in the same study to identify where the interpretation of the accuracy of measures varied.

1.1.11.2 The quality of the evidence

The committee were seeking accuracy data linking the simple measures of obesity and adiposity with a number of health conditions, including, type 2 diabetes, cardiovascular disease, cancer, dyslipidaemia, hypertension and all-cause mortality. The review population was stratified by ethnicity linked to the categories utilised in the UK census. These were Arab, Black African/Caribbean, South Asian, Chinese, Asian (other), White, Other ethnicity, and multiple/mixed ethnic group.

Overall, four prognostic accuracy studies were included in this review. The following number of studies were identified for each ethnic group:

- 1 prognostic accuracy study reported on Chinese population
- 3 prognostic accuracy studies reported on White population.

The single prognostic study in a Chinese population assessed 4 measures for a single condition, hypertension. The committee did not feel single study was sufficient and wished to support this evidence with diagnostic accuracy evidence. Three prognostic accuracy studies in the White population covered prediction of 3 conditions but only assessed BMI as the predicting measure. The committee agreed that assessment of the accuracy of other measures was critical to the question and diagnostic accuracy studies were assessed for this population too.

No prognostic accuracy evidence was found in the other ethnic groups and so diagnostic accuracy evidence was sought for all of the different ethnic groups. Overall, 23 diagnostic accuracy studies were included in the review. The following number of studies were identified for each ethnic group:

- 1 diagnostic accuracy study reported on black African/ Caribbean population
- 7 diagnostic accuracy studies reported on Chinese population
- 2 diagnostic accuracy studies reported on South Asian population
- 3 diagnostic accuracy studies reported on other Asian (2 studies in Malaysia and 1 in Vietnam) population
- 4 diagnostic accuracy studies reported on White population.
- 6 diagnostic accuracy studies reported on other ethnic populations (3 studies were in Brazil, 1 in Iran, 1 Argentina, and 1 in Peru).

The committee understood that prognostic evidence was directly relevant to the clinical question as this review is concerned with how the effects of overweight, obesity and central adiposity) might affect a person’s health over a period of years. Diagnostic evidence does not allow longitudinal evidence to captured as it is a cross-sectional picture of how a person’s degree of overweight, obesity and central adiposity is affecting their health currently. The committee agreed that an assessment of how a person’s adiposity is linked to their currently having a condition of interest is too late to be directly applicable but offers indirectly applicable data on the usefulness of these measures. However, the committee were cautious about over-interpreting cutoff values from the diagnostic accuracy data.

Overall, the quality of the evidence ranged from very low to high with the majority of the evidence graded low or very low. The prognostic accuracy studies were commonly downgraded for attrition bias, for example, Li 2011, where 22% were lost to follow-up. Another reason for downgrading common to prognostic and diagnostic reviews was excluding children due to missing data that are required for analysis. Other reasons for downgrading included a sampling process that was not random or consecutive leading to possible selection bias.

Most studies were judged to be directly applicable though Fowokan 2019 was considered partially applicable due to ethnicity being determined by grandparent’s ethnicity rather than the child's or parent’s.

All but 1 study included in the review, reported area under the curve (c-statistics), however the reporting varied with a number of studies not reporting the 95% confidence intervals. These studies were downgraded as imprecision could not be determined. Meta-analysis was possible for studies which reported 95% confidence intervals. The decision to meta-analyse was based on the similarity of the sample populations and this was mainly influenced by the age and sex of the people in the sample. In 5 of the 8 meta-analyses, high or very high heterogeneity was identified through I^2 results of over 50% and the quality downgraded appropriately.

Reporting of sensitivity, specificity and likelihood ratios varied considerably. Some studies reported information which allowed 2x2 tables to be calculated thus allowing likelihood ratios to be calculated. However, a number of studies did not provide this level of evidence which meant 2x2 tables could not be generated which further meant that GRADE analysis was not possible. While this evidence was useful, we could not apply GRADE which meant that it could not be evaluated alongside other evidence. Additionally, sensitivity, specificity and likelihood ratios were identified for specific cut-off points for the different measures. As no two studies identified the same cut-off point, meta-analysis of this data was not possible.

It was also noted that studies included in the review identified a range of cut- off points for the different anthropometric measures. While the committee noted it was useful to obtain accuracy data on an array of cut-off points, little evidence was identified on the accuracy of published cut-off points. Most of the cut-offs identified were optimum cut-offs calculated via the ROC curve analysis often utilising Youden's index from the study's own accuracy data. These studies were downgraded for risk of bias due to utilising optimum cut-offs calculated from their own results rather than assessing published cut-offs.

These optimum cut-offs found the best trade-off between sensitivity and specificity and emphasized both. 13 of the 23 included diagnostic studies included cut-offs and of those studies such as Kromeyer-Hauschild 2013, Rosa 2007, de Quadros 2019, and Christofaro, 2018, evaluated published cut-off values for the measures they were evaluating. The others all identified optimal cut-offs.

The protocol for this review, listed several different health risks including type 2 diabetes, cardiovascular disease and all-cause mortality. While a number of studies were identified, majority of these studies explored health risks such as hypertension and dyslipidaemia and were diagnostic in nature. As there was a lack of prognostic evidence, particularly for long term health conditions such as type 2 diabetes and cardiovascular disease, the strength of the recommendations was affected (see section 1.1.11.3 Benefits and harms for further information). The committee also noted that while diagnostic accuracy studies were a useful alternative to prognostic accuracy, further research was required to assess the accuracy of different anthropometric measures in predicting future health risks in children and young people. Additionally, as previously highlighted, there was limited data on accuracy of published cut-off points. Based on this understanding, the committee drafted a research recommendation.

1.1.11.3 Benefits and harms

Comparison of anthropometric measures

Comparison of anthropometric measures 2014 guidance on obesity identification, assessment and management (CG189), recommended that BMI should be used (adjusted for age and gender) as a practical estimate of adiposity in children and young people. BMI became the standard index of assessing obesity in 1990s and as such is well integrated into the current health and social care system. However, as the 2014 guidance highlights, BMI should be interpreted with caution because it is not a direct measure of adiposity. The committee further noted that BMI is not a direct measure for central obesity, which is the accumulation of excess fat in the abdominal area and is related to health risks such as type 2 diabetes and cardiovascular disease.

As previously highlighted, a number of studies were identified which reported the area under the curve (c-statistic). This evidence helped identify the classification accuracy of different measures in predicting or identifying different health risks.

In the Black African / Caribbean population, diagnostic accuracy evidence found BMI, WC, and WHtR to be good classifiers for hypertension in 10–18-year-old boys and 10–18-year-old girls. In the Chinese population, prognostic accuracy evidence found BMI, WC, waist-to-hip ratio (WHR), and WHtR were all poor classifiers of hypertension in children who were measured when under 18 years old and followed for a mean of 10 years. Diagnostic accuracy evidence indicated BMI z-score was marginally better than WC z-score, WHR, and WHtR at identifying hypertension. A similar picture could be seen when BMI was compared to WC, WHR, and WHtR. 1 study [Li 2020] indicated an advantage of WHtR and WHR over BMI for identifying dyslipidaemia in boys.

In the South Asian population, a diagnostic study compared BMI z-score, WC z-score, and WHtR z-score in 6–17-year-old children, finding all to be 'good' classifiers for hypertension. In other Asian populations, diagnostic accuracy evidence for diagnosing hypertension in 12–16-year-olds using BMI z-score, WC percentile, and WHtR found BMI z-score to be 'excellent' in boys and 'excellent' in girls. WC percentile and WHtR were classed as 'good'. All 3 measures were 'adequate' when diagnosing dyslipidaemia.

In the white population prognostic evidence classed BMI as 'poor' or 'adequate' for predicting future type 2 diabetes, hypertension, or cancer however no other measures were compared. Diagnostic accuracy evidence compared BMI z-score vs WHtR vs BMI z-score + WHtR to diagnose hypertension and found all 3 to be 'adequate' classifiers. BMI z-score vs WHtR z-score vs WHtR to diagnose hypertension also found all 3 measures to be 'adequate' classifiers.

Six diagnostic accuracy studies were included other ethnic population. Three studies were in Brazil, 1 in Iran, 1 Argentina, and 1 in Peru. Two studies (Brazil) compared BMI, WC, and WHtR to diagnose hypertension found mixed results with BMI fairing much better than WHtR and a little better than WC. One study (Argentina) compared BMI z-score, WC, and WHtR to diagnose dyslipidaemia and found all 3 measures to be 'excellent'. The Iran study compared BMI z-score, WC, and WHtR and found each to be to be 'poor' classifiers for hypertension in 7–18-year-old boys. Similar results were found in girls though BMI was slightly better and an 'adequate' classifier.

The committee agreed the evidence was mixed in terms of ascertaining the best predictive measure. Indeed, much of the evidence was from diagnostic accuracy studies rather than prognostic accuracy studies so the evidence for predicting the outcomes of interest was indirect and interpreted with caution. The evidence indicated that most commonly all the measures being assessed were equally accurate predictors of the conditions of interest. BMI z-score was categorised as a more accurate measure in a number of comparisons.

Based on this understanding, the committee retained existing recommendation on using BMI but amended it to state BMI can be used as a practical estimate of overweight and obesity, but healthcare professionals should ensure that charts used to estimate BMI should be specific to children and young people and adjusted for age and sex. This is because BMI is not calculated and interpreted the same way as adults. It was also noted that BMI should be interpreted with caution because it is not a direct measure of central adiposity.

The committee also stated that in practice, there are several BMI and growth charts that can be used by professionals involved in measuring and assessing degree of overweight and obesity, and this can be confusing. To mitigate this issue, the committee highlighted that it was important to provide reference to the Royal College of Paediatrics and Child Health (RCPCH) UK- World Health Organisation (WHO) growth and BMI charts within the recommendation. The committee also stated that the childhood and puberty close monitoring

(CPCM) form can be used for longitudinal BMI monitoring in children aged 2 and older, especially in instances where puberty is either premature or delayed.

The committee further noted that there are resources available to help professionals to further understand how to plot and assess overweight and obesity. This includes educational resources produced by the RCPCH and the National Child Measurement Programme (NCMP) operational guidance that provides information on how the clinical definitions of BMI link to BMI centiles and BMI SDs.

The 2014 guideline further recommended that waist circumference is not a routine measure but can be used to give additional information on the risk of developing other long-term health problems. The committee reiterated that BMI should be used to define overweight and obesity but waist measurements such as WHtR, offer a more direct estimate of central adiposity which is the excess fat around the abdomen and that is what is understood to be the link to health risks.

Diagnostic accuracy evidence was identified which demonstrated that WHtR, WC and WHR, were, on occasion equally as accurate as BMI. The group wished to recommend a more direct measure of central adiposity to complement BMI z-score and agreed that WHtR should be considered to assess and predict a child or young person's health risk. The group stated that WHtR offers a truer estimate of central adiposity than BMI through the use of waist circumference in the calculation. Unlike other waist measurements, such as waist circumference alone, it utilises the same cutoff points for all ages, sexes and ethnicity (see section: BMI and WHtR boundary values for further information).

The committee did interpret this evidence with caution but highlighted that as there was a lack of prognostic evidence, diagnostic evidence could be used as a proxy to estimate prognostic accuracy. Also, the group had examined prognostic evidence on the use of WHtR in adults. While this evidence was indirect, the committee did take this evidence into consideration as it covered prediction of many conditions including type 2 diabetes and CVD (see evidence review A: accuracy of anthropometric measures in assessing health risks associated with overweight and obesity in adults). Based on this and their clinical understanding, the committee agreed that WHtR should be considered in children and young people aged 5 years to predict health risks associated with central adiposity.

The committee further noted that a benefit of measuring WHtR is that it can be conducted by a parent or carer or by the young person themself. The committee agreed that one of the public health advantages of self-measurement for WHtR is the simple and useful message that a child's waist should be half their height. This can be useful in terms of self-monitoring and can be conducted at home if appointments are conducted virtually. Support for parents and carers may be required to ensure accurate measurements are taken.

During the discussion of recommendation for adults, the committee further highlighted that countries such as Thailand, have adopted the use of waist-to-height ratio and it has worked well in terms of self-measurement and reporting. The string test, in which a piece of string is used to measure height and then folded in half to measure the waist, is a method that has been used in the UK. For example, the Self Help Independence, Nutrition and Exercise (SHINE) health academy, which is a community based tier 3 service, also promoted the use of the string test in children and young people. This is an approach that can further utilised in practice.

The committee also noted that where possible, measurements should be taken by trained personnel, especially if appointments are face to face. With WHtR being a relatively new measure in the field, currently training resources aren't available, however there are resources and videos available online produced by organisations such as the British Heart Foundation and Diabetes UK that offer advice on finding the waist, how to measure it, and where to record it. These resources can also be used by young people, parents and carers. Additionally, the recommendations drafted for the adult's population, also explain how WHtR can be calculated.

The committee noted that WHtR is not regularly measured in children and young people. Based on this understanding they highlighted that the addition of waist-to-height ratio to NICE recommendations may result in more children and young people being identified as at risk of health risks.

As height is already measured as part of BMI measurements, one clear benefit of using WHtR compared to measurements such as WHR is that it only requires one additional measurement of waist circumference to be recorded. However, across adults, children and young people, recording of waist measurements is poor in practice as currently there is no space dedicated to recording a person's waist circumference or waist-to-height ratio a person's electronic patient record. Through the introduction of the measure, the committee hope that there is further development of recording systems to allow healthcare professionals to record waist measurements or WHtR.

BMI and WHtR boundary values

The 2014 guideline also recommended to relate BMI measurement in children and young people to the UK 1990 BMI charts to give age- and gender-specific information. It goes on to say that BMI z-scores or the RCPCHUK-WHO growth charts may be used to calculate BMI in children and young people and the childhood and puberty close monitoring (CPCM) form may be used for longitudinal BMI monitoring in children over 4. The overall intention of this recommendation has been sustained in this guideline, though the committee made minor edits to the phrasing. The group were keen to say that these charts are utilised not to calculate BMI but to plot a child or young person's BMI centile (See section: Comparison of anthropometric measures for further information)

Furthermore, the 2014 guidance included recommendation on how to define overweight and obesity in adults and provided classifications of overweight and obesity. The committee noted that the guideline did not provide specific cut- off points for children and young people.

Studies included in the review identified a number of different cut-offs for the different anthropometric measures. In the Chinese ethnicity the diagnostic likelihood ratios were reported for dyslipidaemia where BMI z-score, WHR, and WHtR were compared. WHR was better by a small margin. The optimal cut-offs were 0.973 for BMI z-score and 0.473 for WHtR. In the South Asian population, the optimal diagnostic BMI z-score cut-offs for hypertension were 0.92 (boys) and 1.41 (girls). The likelihood ratio associated with this cut off points demonstrated a moderate increase and a moderate decrease in the probability of disease. No likelihood ratios or cut-offs were reported for the Black African/ Caribbean population. In the other Asian populations, the BMI z-score cut-offs were 1.87 (boys) and 1.18 (girls) and BMI cut-offs were 20 (boys) and 20.7 (girls). The likelihood ratio associated with the BMI z-score cut off points demonstrated a moderate increase and a moderate decrease in the probability of disease. The likelihood ratio associated with the BMI cut off points demonstrated a slight increase and a moderate decrease in the probability of disease.

In the White population the prognostic cut-offs were ≥75th percentile in a study of 9–18-year-olds. Other optimal cut-offs in 7 years olds were 16.2 kg/m^2 (boys) and 17.6 kg/m^2 (girls) for type 2 diabetes and 16.1 kg/m^2 (boys) and 16.6 kg/m^2 (girls) for hypertension. In 11-year-olds 17.9 kg/m^2 (boys) and 18.4 kg/m^2 (girls) for type 2 diabetes, and 15.9 kg/m^2 (boys) and

17.7 kg/m^2 (girls) for hypertension. In 16-year-olds 20.4 kg/m^2 (boys) and 23.1 kg/m^2 (girls) for type 2 diabetes, and 19.8 kg/m^2 (boys) and 4.3 kg/m^2 for hypertension. The optimal cut-off generated from the diagnostic accuracy study for BMI was 23 kg/m^2 in 6–16-year-olds and a study utilised the IOTF cut-offs in another study. The likelihood ratios associated with the BMI cut off points demonstrated either a moderate or slight increase and a moderate or slight decrease in the probability of disease.

In the other ethnic populations, the diagnostic cut-offs for BMI percentile were Sichieri and Allam Assessment of the nutritional status of Brazilian adolescents by body mass index (1996) and the 95.3rd centile (males) and 84.8th (females). The likelihood ratios associated with the BMI cut off points demonstrated a moderate increase and moderate decrease in the probability of disease. In the Iranian study diagnostic optimal BMI z-score cut-offs were 0.075 (boys) and 0.245 (girls). The likelihood ratios associated with these cut off points demonstrated a slight increase or slight decrease in the probability of disease.

The committee agreed the evidence was mixed in terms of ascertaining the optimal cut-off points for BMI in children and young people from different ethnicities. They also agreed that cu-offs identified in the evidence focused on assessing health risks rather than defining degree of overweight and obesity in children and young people. However, they agreed that it was important to provide healthcare professionals with definitions of overweight and obesity as well as severe obesity, which is an increasing problem, among children and young people.

Based on their clinical understanding and BMI centiles endorsed by the RCPCH, the committee recommended that overweight category should be defined as BMI 91st centile (+1.34 standard deviation (SD) above the mean), clinical obesity as BMI 98th centile (+2.05 SD), and severe obesity BMI 99.6th centile (+2.68 SD). The committee also highlighted that in practice, BMI z-scores may be used but this term is interchangeable with BMI SDs.

The committee also noted that there are population and clinical definitions used to define overweight and obesity in children and young people. Population definitions are used in population surveillance while clinical definitions are used in clinical management. For example, in the National Child Measurement Programme (NCMP), terms such as ‘overweight’, and ‘very overweight’ may be used whereas in the RCPCH growth charts, clinical definitions such as ‘clinically obese’ and ‘severely obese’ are used.

The committee opted to use the clinical definitions of overweight and obesity as these are closely aligned with the BMI growth charts. The committee also agreed that while population definitions of overweight and obesity are used by the NCMP, these definitions have been known to be stigmatising and are communicated differently across the country.

The committee did not include a definition of ‘healthy weight’ category as this can be difficult to define and judgement of this category is based on other factors. Based on this understanding, the committee noted that clinical judgement should be used when interpreting BMI below the 91st centile, especially the healthy weight category because a child or young person in this category may nevertheless have central adiposity.

The committee were also aware of the 3.33 SD which commonly used in practice to define very severe obesity, in children and young people. However, there is limited research behind the exact risks of this level of obesity and the group did not wish to make recommendations linked to this cut-off.

Unlike the adult’s review, where separate BMI cut-offs were identified for people in black, Asian and ethnic minority groups, the committee did not think that the data in children and young people supported identifying specific boundary values for specific minority groups. Additionally, in practice, different boundary values are not used for children and young people of different ethnicities. A research recommendation has been made to investigate this through a prognostic accuracy study investigating the links of the simple measures to predict health conditions of interest stratified by ethnicity. This should allow a judgement to be made on whether the simple measures require different cut-offs depending on a person's ethnic background.

2014 CG819 guidance, highlighted that in adults, different waist circumference thresholds are required for men and women. For children and young people, the committee stressed that it was important to provide simple, universal boundary values that can be applied to all, and therefore opted to identify a measure that could accommodate for this.

The evidence for optimal WHtR cut-offs from the diagnostic accuracy evidence ranged from 0.42 to 0.57 with most clustering around 0.5. In line with the evidence and their clinical knowledge the committee agreed that the evidence supported utilising the same WHtR boundary values in children and young people as were used for adults. They were aware of a linear relationship linking WHtR with health risks. The boundary values agreed were 0.5 and 0.6. The ranges agreed were 0.4-0.49 indicating no increased risk, 0.5-0.59 to indicate increased risk, and 0.6 or more indicating further increased risk.

These boundary values are the same for children and young people of any sex and with any ethnic background. The committee were content that these universal thresholds made it an ideal assessment of risks associated with obesity and promotes equality and equal access to care. The group were keen to avoid the stigma of stating a person is at high risk. Potentially labelling someone as high risk can deter them from seeking out a healthcare professional after becoming concerned about their overweight or obesity.

Utilising BMI and waist-to-height ratio in practice

CG189 also recommended that tailored clinical intervention should be considered for children with BMI at or above the 91st centile, depending on the needs of the individual child and family. While committee agreed with the sentiments outlined in the recommendation but highlighted the complexity of obesity in children and young people. Based on their clinical expertise, the committee amended the recommendation to indicate that when tailoring interventions, healthcare professionals should take weight-related comorbidities, ethnicity, socioeconomic status, social complexity (for example looked after children and young people), family history, mental and emotional health and wellbeing, developmental age and special educational needs and disability (SEND) into consideration. They spoke about wider environmental drivers of obesity that should be addressed to support families maintain healthier weight behaviours.

The committee also stated that the interventions should be considered for children and young people who are living with overweight or obesity or have increased health risk based on their waist-to-height ratio. They were particularly aware that children with weight-related comorbidities, such as type 2 diabetes, may benefit from a higher level of intervention regardless of their waist-to-height ratio. There is great potential benefit to people more quickly achieving remission from these conditions. A recommendation was made matching that made for adults. The committee also stated that the approach may be adjusted, depending on the child's clinical need. This new recommendation cross refers to current recommendations in CG189 for pharmacological treatment for children with comorbidities and surgical treatment for young people with exceptional needs.

The committee also highlighted that, discussions about weight and lifestyle services should be more than just a conversation about a child's adiposity and that there are many other factors to be considered in what service should be offered. The committee stressed the importance of shared decision making where a child or young person works together with their family and healthcare professionals to make an informed decision about the treatment or care option that is best for them. Additionally, the committee noted that the new recommendations should allow children and young people to be identified earlier and treatment being offered earlier which can lead to fewer people with systemic weight related conditions in the future.

Stigma and communication of measures

This review looked for quantitative outcomes linked to the suitability of the measures in children and young people. However, no suitability outcomes were found. The committee discussed suitability when drafting the recommendations. WHtR can be seen as invasive and children and young people may find it uncomfortable. The measurement can potentially be problematic due to different beliefs and cultural practices.

The committee also noted that there is stigma associated with being measured and the subsequent discussion of results. It was mentioned that a potential unintended consequence is it can have a profound effect on how a child or young person feels about themselves and runs a risk of perpetuating or triggering over emphasis on body image and size as well as disordered eating or eating disorders.

The committee noted that is important to have the individual in mind when undertaking these measurements and recognising when it is not appropriate. Therefore, the committee agreed that it is very important for healthcare professionals to ask permission from the child, young people or their parents/carers, before engaging in discussions on the degree of overweight, obesity and central adiposity. Healthcare professionals should also consider a child's (aged under 16 years of age) capacity to consent by determining the Gillick competency.

Discussions should be conducted in a sensitive and positive manner recognising significant stigma associated with obesity which has negative effects on people's mental and physical health. The committee also noted that the discussions should be age appropriate, and judgement should be used to ascertain if the discussion is appropriate for the child or young person and if they should be involved in the discussion. The step-by-step guide to conversations about weight management with children and family for health and care professionals produced by Public Health England (PHE), also reiterates this point and further highlights that healthcare professionals can choose to give feedback to the parent/carer alone or the parent/carer and child or young person together. It should also be noted that there may be situations where the child or young person may not wish to be part of the decision making.

These statements are in line with NICE guidance on babies, children and young people's experiences of healthcare which also highlights children and young people under 16 years can make decisions about their healthcare and consent to treatment if they are assessed to be Gillick competent. Additionally, all methods of communication, information and discussions should be tailored for the age, developmental stage and level of understanding of the child or young person. The guideline further highlights that when involving children and young people in decision making, health care professionals should take into account that the extent and level of their involvement may vary, between individuals and on different occasions.

There are various steps healthcare professionals can take to ensure discussions are conducted in a sensitive manner. This can include healthcare professionals using sensitive language during discussions such as person first language (for example ‘child or young person with obesity’). Professionals should also remain mindful about the language used are there is potential for these conversations to lead to the development or continuation of eating disorders. Additionally, all forms of communication, including written communication should contain non-stigmatising language and images.

During discussions, it may also be useful to rely on accurate facts and figures, for example growth charts to visually demonstrate the child or young person’s weight. Furthermore, the committee noted that there aren’t agreed preferred terms within paediatrics, however healthcare professionals should engage with children, young people, their parents and carers to identify terms that would be acceptable.

The committee also stressed the importance of a person-centred approach which should explore the person’s thoughts and views, previous weight management experience, socioeconomic status, if any comorbidities are present, their level of motivation and cultural, religious/faith and spiritual beliefs about overweight and obesity.

The committee also stated that there needs to be a move from discussions being weight centric to being how health can be improved. These discussions should also be open, positive, supportive and solution centred communication rather than shaming or blaming the child, young person, their families or carers. The committee acknowledged that taking such steps will not only avoid stigma and prejudice, but it also can help to build trust and can also encourage children, young people and their families or carers to engage in conversations about obesity.

It was also highlighted that the guidance on healthier weight competency framework produced by Health Education England states that health and care staff that are involved with engaging with people (including children and young people) about a healthier weight should be able to understand the stigma that is associated with weight, the impact this can have on people, be able to identify implications of the child or young person’s weight status and be able to discuss empathically and accurately.

The committee noted that there are various resources that are available that provide further guidance on the steps healthcare professionals can take to discuss weight in a sensitive manner. This includes the PHE guide to conversations about weight management and guidance produced by Obesity UK on language matters. There are also training courses produced by the Royal College of General Practitioners (RCGP) which explore the effect of weight stigma in children and by World Obesity Federation which explore how to raise the issue about obesity with patients. Additionally, there are webinars available such as those produced by the European Association for the Study of Obesity (EASO) which also focus on how healthcare professionals should talk about weight. While some of the training courses focus on adult population, the committee did consider these as useful tools for health and care professionals working within paediatric weight management. The committee were unable to draft specific recommendations on sensitivity language and weight stigma, but future updates have been planned for this guideline where this will be considered further.

1.1.11.4 Cost effectiveness and resource use

The committee noted that no relevant published economic evaluations had been identified and no additional economic analysis had been undertaken in this area. Therefore, they based the recommendations on the evidence, their knowledge and experience, and on existing NICE guidance.

The committee discussed the use of waist-to-height ratio (WHtR) in addition to BMI to indicate health risk for children and young people. The committee acknowledged the challenge involved in measuring a child's waist, especially in private setting through self-measurements or measurements undertaken by parents or carers. There will be additional costs associated with extra staff time to support waist measurements, but the cost impact should be small and is well justified by long-term health benefits associated with reduction in obesity-related conditions. Additionally, people can also use the string test to measure both height and waist. This test involves an easily accessible string to be used to measure height and then folded in half to measure waist (See committee discussion section on benefits and harms for further information).

When drafting the new recommendations, the committee also noted that there might be additional costs involved to update existing training course to include the measurement of waist circumference and interpretations of waist-to-height ratio for children and young people. However, such additional costs should not result in a significant resource impact and are well-justified if these trainings could improve health care professionals' ability to identify and care for children and young people with overweight or obesity.

1.1.11.5 Other factors the committee took into account

BMI and waist-to-height ratio in subgroups

The committee also noted that 2014 recommendations were not applicable for children with cognitive and physical disabilities as well as children and young people with learning disabilities. It was highlighted that overweight and obesity can be prevalent in these populations however it is often missed. BMI growth charts are available for children with Downs syndrome which is provided by the Centres for Disease Control and Prevention and by the Royal College of Paediatrics and Child Health. It was highlighted that special BMI growth charts are not available for other populations.

The committee discussed the potential challenges in utilising BMI or waist-to-height ratio in children and young people with physical disabilities, physical conditions such as scoliosis and learning disabilities. Children and young people with skeletal dysplasia, scoliosis or inability to stand independently, such as wheelchair users (including moulded wheelchairs), may well be unable to either measure height or waist circumference. It can also be difficult if a person is unable to get on scales independently or be lifted safely. Reasonable adjustments would be required, for example, using seated or hoist scales, or scales that will accept a wheelchair. Committee also noted that in order to measure height accurately a person needs to stand up straight and be still, and this might be difficult in people with mental health issues or learning disabilities. While in adults sitting height or demispan measurement can be utilised, there are no validated proxy measurements in children and young people. Based on this, the committee included children and young people with special educational needs and disability (SEND), physical disabilities and physical conditions as an important subgroup in the research recommendation.

The committee agreed that the person tasked with undertaking these investigations will decide if it is appropriate, or indeed possible, on a person-by-person basis. The committee noted there is published guidance on supporting people with learning disabilities in obesity and weight management. Additionally, people with growth pattern abnormalities may require specialist assessment rather than utilising BMI or WHtR to assess their overweight/obesity or central adiposity.

Weight related co-morbidities

This review focused on several health conditions, but the committee noted that there are several other conditions that need to be considered as potential health risks. For example, the committee noted that in practice, healthcare professionals are seeing more children and young people with musculoskeletal conditions, respiratory conditions such as asthma and dental disease. These conditions are more prevalent in children living with overweight and obesity. While evidence on these long-term health conditions was not reviewed, the committee highlighted that it is important that healthcare professionals discuss these with children and young people as well as their parents and carers. This is captured in the recommendation made on offering tailored interventions, taking factors such as ethnicity, weight-related comorbidities, socioeconomic status, family history, developmental age and special needs into account.

1.1.12 Recommendations supported by this evidence review

This evidence review supports recommendations 1.2.21 to 1.2.22 and 1.2.24 to 1.2.29 and the research recommendation on measurements for assessing health risks in children and young people.

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Appendices

Appendix A – Review protocols

Review protocol for accuracy of anthropometric measures for measuring health risks associated with central adiposity in children

ID	Field	Content
0.	PROSPERO registration number	Not applicable (review not registered)
1.	Review title	Accuracy of simple measures of overweight and obesity to predict health outcomes in children and young people, particularly those in black, Asian and minority ethnic groups.
2.	Review question	What are the most accurate and suitable anthropometric methods and associated boundary values for different ethnicities, to assess the health risk associated with overweight and obesity in children and young people, particularly those in black, Asian and minority ethnic groups?
3.	Objective	1.1 To identify the most accurate anthropometric measures, or combination of methods, in measuring health risks associated with overweight and obesity, including central obesity, in children and young people particularly those in black, Asian and minority ethnic groups 1.2 To identify optimal boundary values for different anthropometric measures that are associated with health risks associated with overweight and obesity, including central obesity, in children and young people particularly those in black, Asian and minority ethnic groups.
4.	Searches	The full search strategy is not required, but may be supplied as a link or attachment.

		Sources include (but are not limited to) bibliographic databases, reference lists of eligible studies and review articles, key journals, trials registers, conference proceedings, Internet resources and contact with experts and manufacturers.] The following databases will be searched: • Cochrane Central Register of Controlled Trials (CENTRAL) • Cochrane Database of Systematic Reviews (CDSR) • Database of Abstracts of Reviews of Effect (DARE) • Embase • MEDLINE • MEDLINE in process • MEDLINE ePub ahead of Print Searches will be restricted by: • Date: 1990 - current • English language • Human studies • Prognosis studies • Diagnosis studies • Observational studies • Systematic reviews The searches will be re-run 6 weeks before final submission of the review and further studies retrieved for inclusion. The full search strategies will be published in the final review.
5.	Condition or domain being studied	Weight management
6.	Population	Inclusion: Children and young people aged under 18 years Population will be stratified by ethnicity: • White • Black African/ Caribbean

		• Asian (South Asian, Chinese, any other Asian background) • Other ethnic groups (Arab, any other ethnic group) • Multiple/mixed ethnic group Further stratification within this group will be informed by the analysis undertaken in the included studies. Exclusion: • Children under the age of 2 years • Children and young people included should not have a condition of interest prior to joining a longitudinal prognostic study
7.	Test	Method of measurement: • BMI z-score /BMI-for-age percentile • Waist-to-height ratio • Waist-to-hip ratio • Waist circumference Combinations of methods of measurement.
8.	Reference standard	Development of a condition of interest • Type 2 diabetes • Cardiovascular disease (including coronary heart disease) • Cancer • Dyslipidaemia • Hypertension • All-cause Mortality
9.	Types of study to be included	**Prognostic accuracy studies:** • Relevant systematic reviews of prognostic accuracy evidence • Prospective/ retrospective cohort studies If insufficient prognostic accuracy studies[1] are identified for different ethnicities, comparative diagnostic accuracy studies will be utilised. Prognostic studies should have a minimum average group follow up of at least 3 years.

		1: This will be assessed for the review. There is no strict definition, but in discussion with the guideline committee we will consider whether we have enough to form the basis for a recommendation. Studies utilising univariate and multivariate analysis on relevant accuracy outcomes will be included.

10.	Other exclusion criteria	• Studies only evaluating bioimpedance
		• *Studies with mixed population (including people of white and BAME backgrounds) will only be considered if:*
		    ○ *Data has been reported for different ethnic groups.*
		    ○ *If study contains ≥80% of population from a particular ethnic group, the data will be extrapolated for that ethnic group.*
		• Studies published prior to 1990.
		• Non-English language studies
		• Conference abstracts

11.	Context	This review is part of an update of the NICE guideline preventing, assessing and managing overweight and obesity (update). Central adiposity is a risk factor for development of CVD, type 2 diabetes, hypertension, dyslipidaemia or some type of cancer in children and young people. This question seeks to find a simple measurement method to assess a child's central adiposity with boundary values that indicate management. These boundary values are thought to vary depending on their ethnic background.
12.	Primary outcomes (critical outcomes)	Prediction of CYP later developing: 1. Type 2 diabetes 2. Cardiovascular disease (including coronary heart disease) 3. Cancer 4. Dyslipidaemia 5. Hypertension 6. All-cause mortality Prognostic/ diagnostic accuracy: • Sensitivity

		• Specificity • Likelihood ratios • Predictive values Optimal boundary values will be explored using the following methods: • Area under the curve (c-statistic) • Youden index
13.	Secondary outcomes (important outcomes)	Suitability of the method of measurement explored using validated questionnaires.
14.	Data extraction (selection and coding)	All references identified by the searches and from other sources will be uploaded into EPPI reviewer and de-duplicated. 10% of the abstracts will be reviewed by two reviewers, with any disagreements resolved by discussion or, if necessary, a third independent reviewer. The full text of potentially eligible studies will be retrieved and will be assessed in line with the criteria outlined above. A standardised form will be used to extract data from studies (see Developing NICE guidelines: the manual section 6.4). [Study investigators may be contacted for missing data where time and resources allow. This review will make use of the priority screening functionality within the EPPI-reviewer software. A stopping rule will also be used. We will sift at least 60% of the database. After that we will stop screening if a further 5% (of the total records) of the records are sifted and not included.
15.	Risk of bias (quality) assessment	Risk of bias will be assessed using the preferred checklist as described in Developing NICE guidelines: the manual.
16.	Strategy for data synthesis	For details please see section 6 of Developing NICE guidelines: the manual. Meta-analysis will be conducted where appropriate. If there is high heterogeneity it will

		not be possible to undertake meta-analysis.Evidence will be stratified according to ethnicity.
17.	Analysis of sub-groups	Evidence will be further stratified by age where possible: • Children aged 2 up to 5 years (Early years) • Children aged 6 up to 11 years (Primary school) • Children and young people aged 12 up to 16 years (Secondary school) • Young people aged 17 up to 18 years (post-16 education) If possible, evidence will be stratified gender.
18.	Type and method of review	☐ Intervention ☐ Diagnostic ☒ Prognostic ☐ Qualitative ☐ Epidemiologic ☐ Service Delivery ☐ Other (please specify)
19.	Language	English
20.	Country	England
21.	Anticipated or actual start date	05th July 2021
22.	Anticipated completion date	8th September 2022

23.	Stage of review at time of this submission	**Review stage**	**Started**
		Preliminary searches	☑
		Piloting of the study selection process	☑
		Formal screening of search results against eligibility criteria	☑
		Data extraction	☐
		Risk of bias (quality) assessment	☐
		Data analysis	☐
24.	Named contact	**5a. Named contact** Guideline Updates Team **5b Named contact e-mail**	

		weightmgt@nice.org.uk **5e Organisational affiliation of the review** National Institute for Health and Care Excellence (NICE) and NICE Guideline Updates Team.
25.	Review team members	From the Guideline Updates Team: • Shreya Shukla • Alexander Allen • Lindsay Claxton • Kusal Lokuge • Miaoqing Yang • Amy Finnegan
26.	Funding sources/sponsor	This systematic review is being completed by the Centre for Guidelines which receives funding from NICE.
27.	Conflicts of interest	All guideline committee members and anyone who has direct input into NICE guidelines (including the evidence review team and expert witnesses) must declare any potential conflicts of interest in line with NICE's code of practice for declaring and dealing with conflicts of interest. Any relevant interests, or changes to interests, will also be declared publicly at the start of each guideline committee meeting. Before each meeting, any potential conflicts of interest will be considered by the guideline committee Chair and a senior member of the development team. Any decisions to exclude a person from all or part of a meeting will be documented. Any changes to a member's declaration of interests will be recorded in the minutes of the meeting. Declarations of interests will be published with the final guideline.
28.	Collaborators	Development of this systematic review will be overseen by an advisory committee who will use the review to inform the development of evidence-based recommendations in line with section 3 of Developing NICE guidelines: the manual. Members of the guideline committee are available on the NICE website: https://www.nice.org.uk/guidance/indevelopment/gid-ng10182

29.	Other registration details	None
30.	Reference/URL for published protocol	None
31.	Dissemination plans	NICE may use a range of different methods to raise awareness of the guideline. These include standard approaches such as: • notifying registered stakeholders of publication • publicising the guideline through NICE's newsletter and alerts • issuing a press release or briefing as appropriate, posting news articles on the NICE website, using social media channels, and publicising the guideline within NICE
32.	Keywords	Anthropometric measures, BMI, Waist-to-height ratio, waist-to-hip ratio, waist circumference, overweight, obesity, diabetes, cardiovascular disease, cancer, dyslipidaemia, hypertension, all-cause mortality
33.	Details of existing review of same topic by same authors	None
34.	Current review status	☒ Ongoing ☐ Completed but not published ☐ Completed and published ☐ Completed, published and being updated ☐ Discontinued
35..	Additional information	None

36.	Details of final publication	www.nice.org.uk

Appendix B – Methods

Reviewing research evidence

Review protocols

Review protocols were developed with the guideline committee to outline the inclusion and exclusion criteria used to select studies for each evidence review. Where possible, review protocols were prospectively registered in the PROSPERO register of systematic reviews.

Searching for evidence

Evidence was searched for each review question using the methods specified in the 2018 NICE guidelines manual.

Selecting studies for inclusion

All references identified by the literature searches and from other sources (for example, previous versions of the guideline or studies identified by committee members) were uploaded into EPPI reviewer software (version 5) and de-duplicated. Titles and abstracts were assessed for possible inclusion using the criteria specified in the review protocol. 10% of the abstracts were reviewed by two reviewers, with any disagreements resolved by discussion or, if necessary, a third independent reviewer.

The following evidence reviews made use of the priority screening functionality within the EPPI-reviewer software: [insert links to evidence reviews that used the priority screening functionality in EPPI]. This functionality uses a machine learning algorithm (specifically, an Stochastic Gradient Descent (SGD) classifier) to take information on features (1, 2 and 3 word blocks) in the titles and abstract of papers marked as being 'includes' or 'excludes' during the title and abstract screening process, and re-orders the remaining records from most likely to least likely to be an include, based on that algorithm. This re-ordering of the remaining records occurs every time 25 additional records have been screened. Research is currently ongoing as to what are the appropriate thresholds where reviewing of abstracts can be stopped, assuming a defined threshold for the proportion of relevant papers it is acceptable to miss on primary screening. As a conservative approach until that research has been completed, the following rules were adopted during the production of this guideline:

- In this review, at least 60% of the identified abstracts were a screened.

After this point, screening was only terminated if 5% of the total records were screened without a single new include being identified.

As an additional check to ensure this approach did not miss relevant studies, systematic reviews (or qualitative evidence syntheses in the case of reviews of qualitative studies) were included in the review protocol and search strategy for all review questions. Relevant systematic reviews were used to identify any papers not found through the primary search. Committee members were also consulted to identify studies that were missed. If additional studies were found that were erroneously excluded during the priority screening process, the full database was subsequently screened.

The decision whether or not to use priority screening was taken by the reviewing team depending on the perceived likelihood that stopping criteria would be met, based on the size of the database, heterogeneity of studies included in the review and predicted number of includes. If it was thought that stopping criteria were unlikely to be met, priority screening was not used, and the full database was screened.

The full text of potentially eligible studies was retrieved and assessed according to the criteria specified in the review protocol. A standardised form was used to extract data from included studies. Study investigators were contacted for missing data when time and resources allowed (when this occurred, this was noted in the evidence review and relevant data was included).

Diagnostic accuracy studies

Individual diagnostic accuracy studies were quality assessed using the QUADAS-2 tool. Each individual study was classified into one of the following three groups:

- Low risk of bias – The true effect size for the study is likely to be close to the estimated effect size.
- Moderate risk of bias – There is a possibility the true effect size for the study is substantially different to the estimated effect size.
- High risk of bias – It is likely the true effect size for the study is substantially different to the estimated effect size.

Each individual study was also classified into one of three groups for directness, based on if there were concerns about the population, index features and/or reference standard in the study and how directly these variables could address the specified review question. Studies were rated as follows:

- Direct – No important deviations from the protocol in population, index feature and/or reference standard.
- Partially indirect – Important deviations from the protocol in one of the population, index feature and/or reference standard.
- Indirect – Important deviations from the protocol in at least two of the population, index feature and/or reference standard.

GRADE for diagnostic accuracy evidence

Evidence from diagnostic accuracy studies was initially rated as high-quality, and then downgraded according to the standard GRADE criteria (risk of bias, inconsistency, imprecision and indirectness) as detailed in Table 39 below.

The choice of primary outcome for decision making was determined by the committee and GRADE assessments were undertaken based on these outcomes.

In all cases, the downstream effects of diagnostic accuracy on patient- important outcomes were considered. This was done explicitly during committee deliberations and reported as part of the discussion section of the review detailing the likely consequences of true positive, true negative, false positive and false negative test results. In reviews where a decision model is being carried (for example, as part of an economic analysis), these consequences were incorporated here in addition.

Using likelihood ratios as the primary outcomes

The following schema (Table 38), adapted from the suggestions of Jaeschke et al. (1994), was used to interpret the likelihood ratio findings from diagnostic test accuracy reviews.

Table 38: Interpretation of likelihood ratios

Value of likelihood ratio	Interpretation
LR ≤ 0.1	**Very large** decrease in probability of disease
0.1 < LR ≤ 0.2	**Large** decrease in probability of disease
0.2 < LR ≤ 0.5	**Moderate** decrease in probability of disease
0.5 < LR ≤ 1.0	**Slight** decrease in probability of disease
1.0 < LR < 2.0	**Slight** increase in probability of disease
2.0 ≤ LR < 5.0	**Moderate** increase in probability of disease
5.0 ≤ LR < 10.0	**Large** increase in probability of disease
LR ≥ 10.0	**Very large** increase in probability of disease

The schema above has the effect of setting a clinical decision threshold for positive likelihoods ratio at 2, and a corresponding clinical decision threshold for negative likelihood ratios at 0.5. Likelihood ratios (whether positive or negative) falling between these thresholds were judged to indicate no meaningful change in the probability of disease.

GRADE assessments were only undertaken for positive and negative likelihood ratios but results for sensitivity and specificity are also presented alongside those data.

The committee were consulted to set 2 clinical decision thresholds for each measure: the likelihood ratio above (or below for negative likelihood ratios) which a test would be recommended, and a second below (or above for negative likelihood ratios) which a test would be considered of no clinical use. These were used to judge imprecision (see below). If the committee were unsure which values to pick, then the default values of 2 for LR+ and 0.5 for LR- were used based on Table 38, with the line of no effect as the second clinical decision line in both cases.

Table 39: Rationale for downgrading quality of evidence for diagnostic accuracy data

If studies could not be pooled in a meta-analysis, GRADE assessments were undertaken for each study individually and reported as separate lines in the GRADE profile.

GRADE criteria	Reasons for downgrading quality
Risk of bias	Not serious: If less than 33.3% of the weight in a meta-analysis came from studies at moderate or high risk of bias, the overall outcome was not downgraded. Serious: If greater than 33.3% of the weight in a meta-analysis came from studies at moderate or high risk of bias, the outcome was downgraded one level. Very serious: If greater than 33.3% of the weight in a meta-analysis came from studies at high risk of bias, the outcome was downgraded two levels.
Indirectness	Not serious: If less than 33.3% of the weight in a meta-analysis came from partially indirect or indirect studies, the overall outcome was not downgraded. Serious: If greater than 33.3% of the weight in a meta-analysis came from partially indirect or indirect studies, the outcome was downgraded one level.

GRADE criteria	Reasons for downgrading quality
	Very serious: If greater than 33.3% of the weight in a meta-analysis came from indirect studies, the outcome was downgraded two levels.
Inconsistency	Concerns about inconsistency of effects across studies, occurring when there is unexplained variability in the treatment effect demonstrated across studies (heterogeneity), after appropriate pre-specified subgroup analyses have been conducted. This was assessed using the I^2 statistic. N/A: Inconsistency was marked as not applicable if data on the outcome was only available from one study. Not serious: If the I^2 was less than 33.3%, the outcome was not downgraded. Serious: If the I^2 was between 33.3% and 66.7%, the outcome was downgraded one level. Very serious: If the I^2 was greater than 66.7%, the outcome was downgraded two levels.
Imprecision	If the 95% confidence interval for the outcome crossed one of the clinical decision thresholds, the outcome was downgraded one level. If the 95% confidence interval spanned both thresholds (crossing line of no effect), the outcome was downgraded twice. See the sections on 'Using sensitivity and specificity as the primary outcome' and 'Using likelihood ratios as the primary outcome' for a description of how clinical decision thresholds were agreed.
Publication bias	If the review team became aware of evidence of publication bias (for example, evidence of unpublished trials where there was evidence that the effect estimate differed in published and unpublished data), the outcome was downgraded once. If no evidence of publication bias was found for any outcomes in a review (as was often the case), this domain was excluded from GRADE profiles to improve readability.

Predictive accuracy studies

Individual prognostic studies that did not assess or develop a prediction model were quality assessed using the QUIPS checklist. Studies that developed or assessed a prediction model were assessed using the PROBAST checklist. Each individual study was classified into one of the following three groups:

- Low risk of bias – The true effect size for the study is likely to be close to the estimated effect size.
- Moderate risk of bias – There is a possibility the true effect size for the study is substantially different to the estimated effect size.
- High risk of bias – It is likely the true effect size for the study is substantially different to the estimated effect size.

Each individual study was also classified into one of three groups for directness, based on if there were concerns about the population, index features and/or reference standard in the study and how directly these variables could address the specified review question. Studies were rated as follows:

- Direct – No important deviations from the protocol in population, index feature and/or outcome to be predicted.
- Partially indirect – Important deviations from the protocol in one of the population, index feature and/or outcome to be predicted.
- Indirect – Important deviations from the protocol in at least two of the population, index feature and/or outcome to be predicted.

Modified GRADE for predictive accuracy data

GRADE has not been developed for use with predictive accuracy data, therefore a modified approach was applied using the GRADE framework. Evidence from cohort, cross sectional or case-control studies was initially rated as high-quality, and then assessed according to the same criteria as described in the section on standard GRADE criteria (risk of bias, inconsistency, imprecision and indirectness) as detailed in Table 41 below.

The choice of primary outcome for decision making was determined by the committee and GRADE assessments were undertaken based on these outcomes.

Using likelihood ratios as the primary outcomes

The following schema (Table 40), adapted from the suggestions of Jaeschke et al. (1994), was used to interpret the likelihood ratio findings from predictive accuracy reviews.

Table 40: Interpretation of likelihood ratios

Value of likelihood ratio	Interpretation
LR ≤ 0.1	**Very large** decrease in probability of disease or outcome
0.1 < LR ≤ 0.2	**Large** decrease in probability of disease or outcome
0.2 < LR ≤ 0.5	**Moderate** decrease in probability of disease or outcome
0.5 < LR ≤ 1.0	**Slight** decrease in probability of disease or outcome
1.0 < LR < 2.0	**Slight** increase in probability of disease or outcome
2.0 ≤ LR < 5.0	**Moderate** increase in probability of disease or outcome
5.0 ≤ LR < 10.0	**Large** increase in probability of disease or outcome
LR ≥ 10.0	**Very large** increase in probability of disease or outcome

The schema above has the effect of setting a clinical decision threshold for positive likelihoods ratio at 2, and a corresponding clinical decision threshold for negative likelihood ratios at 0.5. Likelihood ratios (whether positive or negative) falling between these thresholds were judged to indicate no meaningful change in the probability of disease.

GRADE assessments were only undertaken for positive and negative likelihood ratios but results for sensitivity and specificity are also presented alongside those data.

The committee were consulted to set 2 clinical decision thresholds for each measure: the likelihood ratio above (or below for negative likelihood ratios) which a prognostic feature would be incorporated into a recommendation, and a second below (or above for negative likelihood ratios) which a prognostic feature would be considered of no clinical use. These were used to judge imprecision (see below). If the committee were unsure which values to pick, then the default values of 2 for LR+ and 0.5 for LR- were used based on Table 40, with the line of no effect as the second clinical decision line in both cases.

Table 41: Rationale for downgrading quality of evidence for predictive accuracy data

If studies could not be pooled in a meta-analysis, GRADE assessments were undertaken for each study individually and reported as separate lines in the GRADE profile.

GRADE criteria	Reasons for downgrading quality
Risk of bias	Not serious: If less than 33.3% of the weight in a meta-analysis came from studies at moderate or high risk of bias, the overall outcome was not downgraded. Serious: If greater than 33.3% of the weight in a meta-analysis came from studies at moderate or high risk of bias, the outcome was downgraded one level. Very serious: If greater than 33.3% of the weight in a meta-analysis came from studies at high risk of bias, the outcome was downgraded two levels.
Indirectness	Not serious: If less than 33.3% of the weight in a meta-analysis came from partially indirect or indirect studies, the overall outcome was not downgraded. Serious: If greater than 33.3% of the weight in a meta-analysis came from partially indirect or indirect studies, the outcome was downgraded one level. Very serious: If greater than 33.3% of the weight in a meta-analysis came from indirect studies, the outcome was downgraded two levels.
Inconsistency	Concerns about inconsistency of effects across studies, occurring when there is unexplained variability in the treatment effect demonstrated across studies (heterogeneity), after appropriate pre-specified subgroup analyses have been conducted. This was assessed using the I^2 statistic. N/A: Inconsistency was marked as not applicable if data on the outcome was only available from one study. Not serious: If the I^2 was less than 33.3%, the outcome was not downgraded. Serious: If the I^2 was between 33.3% and 66.7%, the outcome was downgraded one level. Very serious: If the I^2 was greater than 66.7%, the outcome was downgraded two levels.
Imprecision	If the 95% confidence interval for the outcome crossed one of the clinical decision thresholds, the outcome was downgraded one level. If the 95% confidence interval spanned both thresholds, the outcome was downgraded twice. See the sections on ‘Using sensitivity and specificity as the primary outcome’ and ‘Using likelihood ratios as the primary outcome’ for a description of how clinical decision thresholds were agreed.
Publication bias	If the review team became aware of evidence of publication bias (for example, evidence of unpublished trials where there was evidence that the effect estimate differed in published and unpublished data), the outcome was downgraded once. If no evidence of publication bias was found for any outcomes in a review (as was often the case), this domain was excluded from GRADE profiles to improve readability.

Methods for combining c-statistics

C-statistics were assessed in a similar manner to likelihood ratios using the categories in Table 42 below.

Table 42: Interpretation of c-statistics

Value of c-statistic	Interpretation
c-statistic <0.6	**Poor classification accuracy**
0.6 ≤ c-statistic <0.7	**Adequate classification accuracy**
0.7 ≤ c-statistic <0.8	**Good classification accuracy**
0.8 ≤ c-statistic <0.9	**Excellent classification accuracy**
0.9 ≤ c-statistic < 1.0	**Outstanding classification accuracy**

Meta-analyses were carried out using the metamisc package in R v3.4.0, which confines the analysis results to between 0 and 1 matching the limited range of values that c-statistics can take. Random effects meta-analysis was used when the I^2 was 50% or greater.

In any meta-analyses where some (but not all) of the data came from studies at high risk of bias, a sensitivity analysis was conducted, excluding those studies from the analysis. Results from both the full and restricted meta-analyses are reported. Similarly, in any meta-analyses where some (but not all) of the data came from indirect studies, a sensitivity analysis was conducted, excluding those studies from the analysis.

A modified version of GRADE was carried out to assess the quality of the meta-analysed c-statistics as follows:

- imprecision - the 95% CI boundaries were examined and if they crossed 2 categories of test classification accuracy then the study was downgraded once (imprecision rated as serious); if the boundaries crossed 3 (or more) categories then the study was downgraded twice (very serious imprecision).
- Inconsistency, indirectness and risk of bias were determined using the methods in the section on GRADE for prognostic or diagnostic test accuracy evidence.

In cases where meta-analyses could not be carried out due to the large numbers of studies without 95% CI, the following decision rules were used to assess risk of bias, indirectness, imprecision and inconsistency for each outcome:

1. Risk of bias and indirectness were assessed as detailed in table 39 (diagnostic accuracy studies) and table 41 (predictive accuracy studies) but using the study weight by population, rather than weight in the meta-analysis.
2. Imprecision
    a. Single study with 95% CI: the 95% CI boundaries were examined and if they crossed 2 categories of test classification accuracy then the study was downgraded once (imprecision rated as serious); if the boundaries crossed 3 categories then the study was downgraded twice (very serious imprecision).
    b. Multiple studies with 95% CI: the individual studies were rated as in a. and then if >33.3% of the studies by population weight were rated serious then the analysis was downgraded once; if > 33.33% were rated very serious the analysis was downgraded twice.
    c. Single study or multiple studies without 95% CI: the mean sample size was calculated and if this was < 250 then the analysis was downgraded twice (very serious); if it was >250, but < 500 the analysis was downgraded once (serious); if the mean was > 500 people/study then the analysis was not downgraded (not serious).
    d. Multiple studies with and without 95% CI: the studies without 95% CI were analysed as in 2c; those with 95% CI were analysed as in 2b. The results were

averaged, but the number of studies in each group were also taken into account with the result that if there were a lot more studies in one group compared to the other then that group rating would be used. In general, not serious and serious or not serious and very serious were averaged to serious; serious and very serious resulted in a very serious rating.

3. Inconsistency
    a. Single study with or without 95% CI: N/A
    b. Multiple studies with or without 95% CI: the highest and lowest point estimates were examined. If they spanned < 2 categories of c-statistic classification accuracy the analysis was rated as not serious for inconsistency; if they spanned 2 categories this was rated as serious and ≥ 3 categories was rated as very serious.

Appendix C - Literature search strategies

Search design and peer review

A NICE information specialist conducted the literature searches for the evidence review. The searches were originally run on 5th July 2021 and 6th July 2021. This search report is compliant with the requirements of PRISMA-S.

The MEDLINE strategy below was quality assured (QA) by a trained NICE information specialist. All translated search strategies were peer reviewed to ensure their accuracy. Both procedures were adapted from the 2016 PRESS Checklist.

The principal search strategy was developed in MEDLINE (Ovid interface) and adapted, as appropriate, for use in the other sources listed in the protocol, taking into account their size, search functionality and subject coverage.

Review management

The search results were managed in EPPI-Reviewer v5. Duplicates were removed in EPPI-R5 using a two-step process. First, automated deduplication is performed using a high-value algorithm. Second, manual deduplication is used to assess 'low-probability' matches. All decisions made for the review can be accessed via the deduplication history.

Prior work

A set of test papers were gathered from a range of source; one paper had been identified by a committee member, 4 were selected a random from a HTA systematic review (Simmonds M et al 2015), 23 papers were supplied by the analysts. The references were sources from previous surveillance searches.

Limits and restrictions

English language limits were applied in adherence to standard NICE practice and the review protocol.

Limits to exclude [e.g. letters, editorials, news, conferences] were applied in adherence to standard NICE practice and the review protocol.

The search was limited from 1st January 1990 to 5th July 2021 as defined in the review protocol.

The limit to remove animal studies in the searches was the standard NICE practice, which has been adapted from: Dickersin, K., Scherer, R., & Lefebvre, C. (1994). Systematic Reviews: Identifying relevant studies for systematic reviews. *BMJ*, 309(6964), 1286.

Search filters

- Systematic reviews filters:
    - Lee, E. et al. (2012) An optimal search filter for retrieving systematic reviews and meta-analyses. *BMC Medical Research Methodology,* 12(1), 51.

In MEDLINE, the standard NICE modifications were used: pubmed.tw added; systematic review.pt added from MeSH update 2019.

In Embase, the standard NICE modifications were used: pubmed.tw added to line medline.tw.

- Diagnosis filter:
  - McMaster Diagnosis filter [optimal]
- Prognosis filter:
  - McMaster Prognosis filter [sensitive]
- Observational filter:
  - The terms used for observational studies are standard NICE practice that have been developed in house.
  - For the prognosis searches, the observational filter was adapted to remove case-control studies, cross-sectional studies, case series studies.

Clinical/public health searches

Cost effectiveness searches

The NICE cost utility (specific) filter was applied to the Medline and Embase searches to identify cost utility studies.

- Cost Utility filter is available via the ISSG search filters resource

Key decisions

- The searches for this question were done in two parts, the first search was limited to finding systematic reviews and observational studies, from an amended list from a population strategy that had been narrowed using the prognostic filter.
- The second search limited the population terms using a diagnostic filter, this was then limited to systematic review and observational studies. The observational studies filter was not amended for this search.
- The population terms (line 1-47) were the same for both the prognostic and diagnostic searches.
- 40 paper were identified by the analysts and the committee and added were added after the main search. The analysts had identified the papers through citation searching.
- An additional 40 papers were added that were identified by previous guidelines and surveillance searches

Clinical/public health searches

Main search – Databases

Database	Date searched	Database platform	Database segment or version	No. of results downloaded
Cochrane Central Register of Controlled Trials (CENTRAL)	05/07/2021	Cochrane	Issue 7 of 12, July 2021	6195
Cochrane Database of Systematic Reviews (CDSR)	05/07/2021	Cochrane	Issue 7 of 12, July 2021	34
Database of Abstracts of Reviews of Effect (DARE)	05/07/2021	CRD	n/a	138
Embase (Ovid) [prognostic]	05/07/2021	OVID	1974 to 2021 July 02	3991
MEDLINE (Ovid) [prognostic]	05/07/2021	OVID	1946 to July 02, 2021	5211
MEDLINE In-Process (Ovid) [prognostic]	05/07/2021	OVID	1946 to July 02, 2021	55
MEDLINE Epub Ahead of Print [prognostic]	05/07/2021	OVID	July 02, 2021	34
Embase (Ovid) [Diagnostic]	06/07/2021	OVID	1974 to 2021 July 02	1344
MEDLINE (Ovid) [Diagnostic]	06/07/2021	OVID	1946 to July 02, 2021	2059
MEDLINE In-Process (Ovid) [Diagnostic]	06/07/2021	OVID	1946 to July 02, 2021	26
MEDLINE Epub Ahead of Print [Diagnostic]	06/07/2021	OVID	July 02, 2021	14

Main search – Additional methods

Additional method	Date searched	No. of results downloaded
The analysts added an additional 54 records to the EPPI review. These records were found in previous guidelines/surveillance/pubmed searches or were suggested by the committee.	8th July – 1st September 2021	54

Re-run search – Databases

The guideline for weight management adopted a living guideline approach and published recommendations for each review question once they were made. Therefore, re-runs were not required for RQ1.1 and RQ1.2.

Search strategy history

Database name: Cochrane – CDSR and CENTRAL

1 [mh Obesity[mj]] 9567

2 [mh "Body Weight"[mj]] 12380

3 [mh "Body Fat Distribution"[mj]] 163

4 [mh "Body Composition"[mj]] 1043

5 [mh "Adipose Tissue"[mj]] 1267

6 (obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*):ti 23134

7 ((obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*) near/4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)):ab 7819

8 (body near/1 (fat or composit* or weight*)):ti 5268

9 (body near/1 (fat or composit* or weight*) near/4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)):ab4865

10 ((visceral or subcutaneous) near/1 (fat or fatty or tissue*)):ti416

11 ((visceral or subcutaneous) near/1 (fat or fatty or tissue*) near/4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)):ab 293

12 {or 1-11} 39696

13 [mh "body mass index"[mj]] 5

14 ("body mass ind*" or "body fat ind*" or BMI or BFI):ti 650

15 ("body mass ind*" or "body fat ind*" or BMI or BFI):ab 43065

16 [mh "Waist-Hip Ratio"[mj]] 2

17 [mh "Body Weights and Measures"[mj]] 11907

18 (waist near/3 (height* or hip*)):ti 55

19 (waist near/3 (height* or hip*) near/1 (ratio* or measur* or mark* or cut-off* or identify* or identifi* or indicat*)):ab 2136

20 (WHR or WHtR):ti,ab 735

21 (waist near/1 circumference*):ti,ab 7902

22 {or 13-21} 55185

23 12 and 22 21809

24 {or 13-15} 43166

25 {or 16-21} 19958

26 24 and 25 7939

27 23 or 26 23723

28 MeSH descriptor: [Cardiovascular Diseases] explode all trees 111228

29 MeSH descriptor: [Stroke] explode all trees 10417

30 MeSH descriptor: [Hypertension] this term only 17958

31 MeSH descriptor: [Dyslipidemias] this term only 1287

32 ((cardiovascular or cardio* or coronary* or vascular or peripheral or heart* or cardiac* or myocardia*) near/3 (disease* or disorder* or syndrome* or failure* or event* or attack* or arrest* or infarct* or condition* or dysfunct*)):ti,ab 120023

33 (CVD or CHD or IHD or MI):ti,ab 20089

34 (circulatory near/3 (disease* or disorder*)):ti,ab 733

35 (angina* or hypertensi* or atrial-fibrillat* or stroke* or poststroke* or cerebrovascular* or cerebro-vascular*):ti,ab 128534

36 ((brain* or cereb* or lacunar) near/2 (accident* or infarc*)):ti,ab 5482

37 ((high or raised or elevated or increas*) near/2 (blood pressure or bp)):ti,ab 19581

38 high cholesterol:ti,ab 16852

39 (hypercholesterolaemi* or hypercholesterolemi* or hypercholesteraemi* or hypercholesteremi* or hyperlipidaemi* or hyperlipidemi* or Dyslipidaemi* or Dyslipidemi):ti,ab 10839

40 cardiometabolic-risk*:ti,ab 1626

41 {or 28-40} 284015

42 MeSH descriptor: [Diabetes Mellitus, Type 2] this term only 18433

43 MeSH descriptor: [Metabolic Syndrome] this term only 1865

44 (diabetes near/2 type 2):ti,ab 40220

45 (diabetes near/2 type II):ti,ab 3999

46 (diabetes near/2 (non insulin or noninsulin)):ti,ab 4055

47 (NIDDM or T2DM or T2D):ti,ab 11156

48 ((metabolic or dysmetabolic or reaven or insulin resistance) near/2 syndrome*):ti,ab 6702

49 {or 42-48} 53759

50 MeSH descriptor: [Neoplasms] explode all trees 82548

51 (cancer* or neoplas* or oncolog* or malignan* or tumour* or tumor* or carcinoma* or adenocarcinoma*):ti,ab 209034

52 {or 50-51} 226678

53 41 or 49 or 52 528189

54 27 and 53 with Cochrane Library publication date Between Jan 1990 and Jul 2021, in Cochrane Reviews 38

55 27 and 53 with Publication Year from 1990 to 2021, in Trials 9797

56 "conference":pt or (clinicaltrials or trialsearch):so 553775

57 55 not 56 6195

Database name: DARE

1 MeSH DESCRIPTOR Obesity EXPLODE ALL TREES IN DARE 637

2 MeSH DESCRIPTOR Body Weight IN DARE 171

3 MeSH DESCRIPTOR body fat distribution IN DARE3

4 MeSH DESCRIPTOR Body Composition IN DARE 75

5 MeSH DESCRIPTOR Adipose Tissue EXPLODE ALL TREES IN DARE 31

6 ((obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*)):TI IN DARE 385

7 (((obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*))) IN DARE 73

8 ((body adj1 (fat or composit* or weight*))):TI IN DARE 70

9 ((body adj1 (fat or composit* or weight*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*))) IN DARE 31

10 (((visceral or subcutaneous) adj1 (fat or fatty or tissue*))):TI IN DARE 5

11 (((visceral or subcutaneous) adj1 (fat or fatty or tissue*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*))) IN DARE 1

12 #1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 909

13 MeSH DESCRIPTOR body mass index IN DARE 236

14 (("body mass ind*" or "body fat ind*" or BMI or BFI)) IN DARE 786

15 MeSH DESCRIPTOR waist-hip ratio IN DARE 4

16 MeSH DESCRIPTOR body weights and measures IN DARE 6

17 ((waist adj3 (height* or hip*))):TI IN DARE 2

18 ((waist adj3 (height* or hip*) adj1 (ratio* or measur* or mark* or cut-off* or identify* or identifi* or indicat*))) IN DARE 27

19 ((WHR or WHtR)) IN DARE 0

20 ((waist adj1 circumference*)) IN DARE 73

21 #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 803

22 #12 AND #21 351

23 #13 OR #14 786

24 #15 OR #16 OR #17 OR #18 OR #19 OR #20 90

25 #23 AND #24 73

26 #22 OR #25 372

27 MeSH DESCRIPTOR Cardiovascular Diseases EXPLODE ALL TREES IN DARE 5989

28 MeSH DESCRIPTOR Stroke EXPLODE ALL TREES IN DARE 878

29 MeSH DESCRIPTOR Hypertension IN DARE 504

30 MeSH DESCRIPTOR Dyslipidemias IN DARE 40

31 (((cardiovascular or cardio* or coronary* or vascular or peripheral or heart* or cardiac* or myocardia*) adj3 (disease* or disorder* or syndrome* or failure* or event* or attack* or arrest* or infarct* or condition* or dysfunct*))) IN DARE 4324

32 ((CVD or CHD or IHD or MI)) IN DARE 549

33 ((circulatory adj3 (disease* or disorder*))) IN DARE 2

34 ((angina* or hypertensi* or atrial-fibrillat* or stroke* or poststroke* or cerebrovascular* or cerebro-vascular*)) IN DARE 3824

35 (((brain* or cereb* or lacunar) adj2 (accident* or infarc*))) IN DARE 118

36 (((high or raised or elevated or increas*) adj2 (blood pressure or bp))) IN DARE 136

37 (high cholesterol) IN DARE 15

38 ((hypercholesterol?emi* or hypercholester?emi* or hyperlipid?emi* or Dyslipid?emi*)) IN DARE 380

39 (cardiometabolic-risk*) IN DARE 9

40 #27 OR #28 OR #29 OR #30 OR #31 OR #32 OR #33 OR #34 OR #35 OR #36 OR #37 OR #38 OR #39 8375

41 MeSH DESCRIPTOR Diabetes Mellitus, Type 2 IN DARE 685

42 MeSH DESCRIPTOR Metabolic Syndrome IN DARE 0

43 ((diabetes adj2 type 2)) IN DARE 699

44 ((diabetes adj2 type II)) IN DARE 1

45 ((diabetes adj2 (non insulin or noninsulin))) IN DARE 4

46 ((NIDDM or T2DM or T2D)) IN DARE 16

47 (((metabolic or dysmetabolic or reaven or insulin resistance) adj2 syndrome*)) IN DARE 87

48 (#41 OR #42 OR #43 OR #44 OR #45 OR #46 OR #47) IN DARE 775

49 MeSH DESCRIPTOR Neoplasms EXPLODE ALL TREES 12016

50 ((cancer* or neoplas* or oncolog* or malignan* or tumo?r* or carcinoma* or adenocarcinoma*)) IN DARE 8135

51 (#49 OR #50) IN DARE 8428

52 (#40 OR #48 OR #51) IN DARE 16571

53 (#26 and #52) IN DARE FROM 1990 TO 2021 138

Database name: Medline [Prognostic]

1 exp *Obesity/ or *Body Weight/ or *body fat distribution/ or exp *Body Composition/ or exp *Adipose Tissue/ (255863)

2 (obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*).ti. (161823)

3 ((obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (47515)

4 (body adj1 (fat or composit* or weight*)).ti. (27783)

5 (body adj1 (fat or composit* or weight*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (18068)

6 ((visceral or subcutaneous) adj1 (fat or fatty or tissue*)).ti. (3524)

7 ((visceral or subcutaneous) adj1 (fat or fatty or tissue*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (1605)

8 or/1-7 (313457)

9 *body mass index/ (22403)

10 ("body mass ind*" or "body fat ind*" or BMI or BFI).ti. (19123)

11 ("body mass ind*" or "body fat ind*" or BMI or BFI).ab. /freq=2 (111508)

12 *waist-hip ratio/ or *"body weights and measures"/ (3117)

13 (waist adj3 (height* or hip*)).ti. (842)

14 (waist adj3 (height* or hip*) adj1 (ratio* or measur* or mark* or cut-off* or identify* or identifi* or indicat*)).ab. /freq=2 (2500)

15 (WHR or WHtR).ti. (47)

16 (WHR or WHtR).ab. /freq=2 (3765)

17 (waist adj1 circumference*).ti. (1808)

18 (waist adj1 circumference*).ab. /freq=2 (7255)

19 or/9-18 (124530)

20 8 and 19 (58896)

21 or/9-11 (117305)

22 or/12-18 (15378)

23 21 and 22 (8153)

24 20 or 23 (60872)

25 exp Cardiovascular Diseases/ or exp Stroke/ or Hypertension/ or Dyslipidemias/ (2507987)

26 ((cardiovascular or cardio* or coronary* or vascular or peripheral or heart* or cardiac* or myocardia*) adj3 (disease* or disorder* or syndrome* or failure* or event* or attack* or arrest* or infarct* or condition* or dysfunct*)).ti,ab. (870724)

27 (CVD or CHD or IHD or MI).ti,ab. (99281)

28 (circulatory adj3 (disease* or disorder*)).ti,ab. (5434)

29 (angina* or hypertensi* or atrial-fibrillat* or stroke* or poststroke* or cerebrovascular* or cerebro-vascular*).ti,ab. (729583)

30 ((brain* or cereb* or lacunar) adj2 (accident* or infarc*)).ti,ab. (33801)

31 ((high or raised or elevated or increas*) adj2 (blood pressure or bp)).ti,ab. (46855)

32 high cholesterol.ti,ab. (6679)

33 (hypercholesterol?emi* or hypercholester?emi* or hyperlipid?emi* or Dyslipid?emi*).ti,ab. (87349)

34 cardiometabolic-risk*.ti,ab. (5044)

35 or/25-34 (2910858)

36 *Diabetes Mellitus, Type 2/ (117022)

37 *Metabolic Syndrome/ (26728)

38 (diabetes adj2 type 2).ti,ab. (114709)

39 (diabetes adj2 type II).ti,ab. (8250)

40 (diabetes adj2 (non insulin or noninsulin)).ti,ab. (9634)

41 (NIDDM or T2DM or T2D).ti,ab. (33597)

42 ((metabolic or dysmetabolic or reaven or insulin resistance) adj2 syndrome$).ti,ab. (47862)

43 or/36-42 (204638)

44 exp *Neoplasms/ (3073109)

45 (cancer* or neoplas* or oncolog* or malignan$ or tumo?r* or carcinoma* or adenocarcinoma*).ti,ab. (3083040)

46 or/44-45 (3881287)

47 35 or 43 or 46 (6651029)

48 incidence.sh. (278079)

49 exp mortality/ (402176)

50 follow-up studies.sh. (666060)

51 prognos:.tw. (557258)

52 predict:.tw. (1410817)

53 course:.tw. (569117)

54 or/48-53 (3275882)

55 24 and 47 and 54 (8396)

56 Observational Studies as Topic/ (6536)

57 Observational Study/ (103100)

58 Epidemiologic Studies/ (8734)

59 exp Cohort Studies/ (2169797)

60 Comparative Study.pt. (1893237)

61 (cohort adj (study or studies)).tw. (199356)

62 cohort analy$.tw. (7735)

63 (follow up adj (study or studies)).tw. (47130)

64 (observational adj (study or studies)).tw. (99977)

65 longitudinal.tw. (224846)

66 prospective.tw. (535364)

67 retrospective.tw. (497170)

68 or/56-67 (4093532)

69 (MEDLINE or pubmed).tw. (192740)

70 systematic review.tw. (148166)

71 systematic review.pt. (157935)

72 meta-analysis.pt. (136627)

73 intervention$.ti. (137272)

74 or/69-73 (435723)

75 68 or 74 (4426102)

76 55 and 75 (5407)

77 limit 76 to ed=19900101-20211231 (5382)

78 animals/ not humans/ (4822395)

79 77 not 78 (5380)

80 limit 79 to yr="1990-Current" (5380)

81 limit 80 to english language (5243)

82 limit 81 to (letter or historical article or comment or editorial or news or case reports) (32)

83 81 not 82 (5211)

Database name: Medline in process [Prognostic]

1 exp *Obesity/ or *Body Weight/ or *body fat distribution/ or exp *Body Composition/ or exp *Adipose Tissue/ (0)

2 (obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*).ti. (4793)

3 ((obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (1562)

4 (body adj1 (fat or composit* or weight*)).ti. (685)

5 (body adj1 (fat or composit* or weight*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (505)

6 ((visceral or subcutaneous) adj1 (fat or fatty or tissue*)).ti. (85)

7 ((visceral or subcutaneous) adj1 (fat or fatty or tissue*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (38)

8 or/1-7 (6448)

9 *body mass index/ (0)

10 ("body mass ind*" or "body fat ind*" or BMI or BFI).ti. (663)

11 ("body mass ind*" or "body fat ind*" or BMI or BFI).ab. /freq=2 (4061)

12 *waist-hip ratio/ or *"body weights and measures"/ (0)

13 (waist adj3 (height* or hip*)).ti. (22)

14 (waist adj3 (height* or hip*) adj1 (ratio* or measur* or mark* or cut-off* or identify* or identifi* or indicat*)).ab. /freq=2 (70)

15 (WHR or WHtR).ti. (1)

16 (WHR or WHtR).ab. /freq=2 (108)

17 (waist adj1 circumference*).ti. (62)

18 (waist adj1 circumference*).ab. /freq=2 (222)

19 or/9-18 (4309)

20 8 and 19 (1471)

21 or/9-11 (4132)

22 or/12-18 (394)

23 21 and 22 (217)

24 20 or 23 (1536)

25 exp Cardiovascular Diseases/ or exp Stroke/ or Hypertension/ or Dyslipidemias/ (0)

26 ((cardiovascular or cardio* or coronary* or vascular or peripheral or heart* or cardiac* or myocardia*) adj3 (disease* or disorder* or syndrome* or failure* or event* or attack* or arrest* or infarct* or condition* or dysfunct*)).ti,ab. (20472)

27 (CVD or CHD or IHD or MI).ti,ab. (3203)

28 (circulatory adj3 (disease* or disorder*)).ti,ab. (53)

29 (angina* or hypertensi* or atrial-fibrillat* or stroke* or poststroke* or cerebrovascular* or cerebro-vascular*).ti,ab. (16288)

30 ((brain* or cereb* or lacunar) adj2 (accident* or infarc*)).ti,ab. (579)

31 ((high or raised or elevated or increas*) adj2 (blood pressure or bp)).ti,ab. (887)

32 high cholesterol.ti,ab. (122)

33 (hypercholesterol?emi* or hypercholester?emi* or hyperlipid?emi* or Dyslipid?emi*).ti,ab. (2118)

34 cardiometabolic-risk*.ti,ab. (341)

35 or/25-34 (34164)

36 *Diabetes Mellitus, Type 2/ (0)

37 *Metabolic Syndrome/ (0)

38 (diabetes adj2 type 2).ti,ab. (4844)

39 (diabetes adj2 type II).ti,ab. (170)

40 (diabetes adj2 (non insulin or noninsulin)).ti,ab. (22)

41 (NIDDM or T2DM or T2D).ti,ab. (2029)

42 ((metabolic or dysmetabolic or reaven or insulin resistance) adj2 syndrome$).ti,ab. (1530)

43 or/36-42 (6401)

44 exp *Neoplasms/ (0)

45 (cancer* or neoplas* or oncolog* or malignan$ or tumo?r* or carcinoma* or adenocarcinoma*).ti,ab. (73189)

46 or/44-45 (73189)

47 35 or 43 or 46 (108411)

48 incidence.sh. (0)

49 exp mortality/ (0)

50 follow-up studies.sh. (0)

51 prognos:.tw. (18237)

52 predict:.tw. (45122)

53 course:.tw. (8970)

54 or/48-53 (64431)

55 24 and 47 and 54 (166)

56 Observational Studies as Topic/ (0)

57 Observational Study/ (0)

58 Epidemiologic Studies/ (0)

59 exp Cohort Studies/ (0)

60 Comparative Study.pt. (1)

61 (cohort adj (study or studies)).tw. (10631)

62 cohort analy$.tw. (394)

63 (follow up adj (study or studies)).tw. (716)

64 (observational adj (study or studies)).tw. (5245)

65 longitudinal.tw. (8344)

66 prospective.tw. (15611)

67 retrospective.tw. (20721)

68 or/56-67 (47804)

69 (MEDLINE or pubmed).tw. (10453)

70 systematic review.tw. (10000)

71 systematic review.pt. (237)

72 meta-analysis.pt. (60)

73 intervention$.ti. (5456)

74 or/69-73 (19093)

75 68 or 74 (63817)

76 55 and 75 (55)

77 limit 76 to dt=19900101-20211231 (55)

78 animals/ not humans/ (0)

79 77 not 78 (55)

80 limit 79 to yr="1990-Current" (55)

81 limit 80 to english language (55)

82 limit 81 to (letter or historical article or comment or editorial or news or case reports) (0)

83 81 not 82 (55)

Database name: Medline epub ahead [Prognostic]

1 exp *Obesity/ or *Body Weight/ or *body fat distribution/ or exp *Body Composition/ or exp *Adipose Tissue/ (0)

2 (obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*).ti. (2813)

3 ((obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (984)

4 (body adj1 (fat or composit* or weight*)).ti. (433)

5 (body adj1 (fat or composit* or weight*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (318)

6 ((visceral or subcutaneous) adj1 (fat or fatty or tissue*)).ti. (48)

7 ((visceral or subcutaneous) adj1 (fat or fatty or tissue*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (35)

8 or/1-7 (3890)

9 *body mass index/ (0)

10 ("body mass ind*" or "body fat ind*" or BMI or BFI).ti. (488)

11 ("body mass ind*" or "body fat ind*" or BMI or BFI).ab. /freq=2 (2867)

12 *waist-hip ratio/ or *"body weights and measures"/ (0)

13 (waist adj3 (height* or hip*)).ti. (12)

14 (waist adj3 (height* or hip*) adj1 (ratio* or measur* or mark* or cut-off* or identify* or identifi* or indicat*)).ab. /freq=2 (44)

15 (WHR or WHtR).ti. (0)

16 (WHR or WHtR).ab. /freq=2 (80)

17 (waist adj1 circumference*).ti. (21)

18 (waist adj1 circumference*).ab. /freq=2 (114)

19 or/9-18 (3024)

20 8 and 19 (951)

21 or/9-11 (2929)

22 or/12-18 (222)

23 21 and 22 (127)

24 20 or 23 (984)

25 exp Cardiovascular Diseases/ or exp Stroke/ or Hypertension/ or Dyslipidemias/ (0)

26 ((cardiovascular or cardio* or coronary* or vascular or peripheral or heart* or cardiac* or myocardia*) adj3 (disease* or disorder* or syndrome* or failure* or event* or attack* or arrest* or infarct* or condition* or dysfunct*)).ti,ab. (15357)

27 (CVD or CHD or IHD or MI).ti,ab. (2394)

28 (circulatory adj3 (disease* or disorder*)).ti,ab. (55)

29 (angina* or hypertensi* or atrial-fibrillat* or stroke* or poststroke* or cerebrovascular* or cerebro-vascular*).ti,ab. (13038)

30 ((brain* or cereb* or lacunar) adj2 (accident* or infarc*)).ti,ab. (497)

31 ((high or raised or elevated or increas*) adj2 (blood pressure or bp)).ti,ab. (658)

32 high cholesterol.ti,ab. (86)

33 (hypercholesterol?emi* or hypercholester?emi* or hyperlipid?emi* or Dyslipid?emi*).ti,ab. (1331)

34 cardiometabolic-risk*.ti,ab. (206)

35 or/25-34 (26245)

36 *Diabetes Mellitus, Type 2/ (0)

37 *Metabolic Syndrome/ (0)

38 (diabetes adj2 type 2).ti,ab. (2763)

39 (diabetes adj2 type II).ti,ab. (100)

40 (diabetes adj2 (non insulin or noninsulin)).ti,ab. (34)

41 (NIDDM or T2DM or T2D).ti,ab. (1092)

42 ((metabolic or dysmetabolic or reaven or insulin resistance) adj2 syndrome$).ti,ab. (824)

43 or/36-42 (3630)

44 exp *Neoplasms/ (0)

45 (cancer* or neoplas* or oncolog* or malignan$ or tumo?r* or carcinoma* or adenocarcinoma*).ti,ab. (48473)

46 or/44-45 (48473)

47 35 or 43 or 46 (74718)

48 incidence.sh. (0)

49 exp mortality/ (0)

50 follow-up studies.sh. (0)

51 prognos:.tw. (11751)

52 predict:.tw. (36058)

53 course:.tw. (8593)

54 or/48-53 (51004)

55 24 and 47 and 54 (86)

56 Observational Studies as Topic/ (0)

57 Observational Study/ (4)

58 Epidemiologic Studies/ (0)

59 exp Cohort Studies/ (0)

60 Comparative Study.pt. (0)

61 (cohort adj (study or studies)).tw. (9566)

62 cohort analy$.tw. (355)

63 (follow up adj (study or studies)).tw. (642)

64 (observational adj (study or studies)).tw. (4624)

65 longitudinal.tw. (7378)

66 prospective.tw. (13597)

67 retrospective.tw. (19743)

68 or/56-67 (43439)

69 (MEDLINE or pubmed).tw. (9545)

70 systematic review.tw. (9608)

71 systematic review.pt. (126)

72 meta-analysis.pt. (104)

73 intervention$.ti. (4158)

74 or/69-73 (17317)

75 68 or 74 (57796)

76 55 and 75 (35)

77 limit 76 to dt=19900101-20211231 (35)

78 animals/ not humans/ (0)

79 77 not 78 (35)

80 limit 79 to yr="1990-Current" (35)

81 limit 80 to english language (34)

82 limit 81 to (letter or historical article or comment or editorial or news or case reports) (0)

83 81 not 82 (34)

Database name: Embase [Prognostic]

1 exp *obese patient/ or exp *obesity/ or *body weight/ or exp *body composition/ or exp *adipose tissue/ (343970)

2 (obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*).ti. (248280)

3 ((obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (82099)

4 (body adj1 (fat or composit* or weight*)).ti. (38434)

5 (body adj1 (fat or composit* or weight*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (29749)

6 ((visceral or subcutaneous) adj1 (fat or fatty or tissue*)).ti. (4879)

7 ((visceral or subcutaneous) adj1 (fat or fatty or tissue*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (2948)

8 or/1-7 (456102)

9 *body mass/ (35086)

10 ("body mass ind*" or "body fat ind*" or BMI or BFI).ti. (34182)

11 ("body mass ind*" or "body fat ind*" or BMI or BFI).ab. /freq=2 (232692)

12 *waist hip ratio/ or *morphometry/ (3591)

13 (waist adj3 (height* or hip*)).ti. (1390)

14 (waist adj3 (height* or hip*) adj1 (ratio* or measur* or mark* or cut-off* or identify* or identifi* or indicat*)).ab. /freq=2 (4172)

15 (WHR or WHtR).ti. (105)

16 (WHR or WHtR).ab. /freq=2 (6406)

17 (waist adj1 circumference*).ti. (2945)

18 (waist adj1 circumference*).ab. /freq=2 (13709)

19 or/9-18 (252381)

20 8 and 19 (99959)

21 or/9-11 (240433)

22 or/12-18 (26137)

23 21 and 22 (14189)

24 20 or 23 (103619)

25 exp cardiovascular disease/ or exp cerebrovascular accident/ or hypertension/ or dyslipidemia/ (4307322)

26 ((cardiovascular or cardio* or coronary* or vascular or peripheral or heart* or cardiac* or myocardia*) adj3 (disease* or disorder* or syndrome* or failure* or event* or attack* or arrest* or infarct* or condition* or dysfunct*)).ti,ab. (1433748)

27 (CVD or CHD or IHD or MI).ti,ab. (198181)

28 (circulatory adj3 (disease* or disorder*)).ti,ab. (5660)

29 (angina* or hypertensi* or atrial-fibrillat* or stroke* or poststroke* or cerebrovascular* or cerebro-vascular*).ti,ab. (1247242)

30 ((brain* or cereb* or lacunar) adj2 (accident* or infarc*)).ti,ab. (55651)

31 ((high or raised or elevated or increas*) adj2 (blood pressure or bp)).ti,ab. (74728)

32 high cholesterol.ti,ab. (10688)

33 (hypercholesterol?emi* or hypercholester?emi* or hyperlipid?emi* or Dyslipid?emi*).ti,ab. (159260)

34 cardiometabolic-risk*.ti,ab. (9153)

35 or/25-34 (4758959)

36 *non insulin dependent diabetes mellitus/ (152844)

37 *metabolic syndrome X/ (42695)

38 (diabetes adj2 type 2).ti,ab. (214820)

39 (diabetes adj2 type II).ti,ab. (15630)

40 (diabetes adj2 (non insulin or noninsulin)).ti,ab. (11490)

41 (NIDDM or T2DM or T2D).ti,ab. (72312)

42 ((metabolic or dysmetabolic or reaven or insulin resistance) adj2 syndrome$).ti,ab. (88930)

43 or/36-42 (349825)

44 exp *neoplasm/ (3513091)

45 (cancer* or neoplas* or oncolog* or malignan$ or tumo?r* or carcinoma* or adenocarcinoma*).ti,ab. (4707753)

46 or/44-45 (5396085)

47 35 or 43 or 46 (9779627)

48 incidence.sh. (458247)

49 exp mortality/ (1164922)

50 follow-up studies.sh. (107)

51 prognos:.tw. (994903)

52 predict:.tw. (2316883)

53 course:.tw. (877026)

54 or/48-53 (4962613)

55 24 and 47 and 54 (15596)

56 (MEDLINE or pubmed).tw. (304215)

57 exp systematic review/ or systematic review.tw. (362151)

58 meta-analysis/ (219105)

59 intervention$.ti. (220125)

60 or/56-59 (750317)

61 Clinical study/ (155798)

62 Family study/ (25315)

63 Longitudinal study/ (157525)

64 Retrospective study/ (1096542)

65 comparative study/ (905917)

66 Prospective study/ (694714)

67 Randomized controlled trials/ (206139)

68 66 not 67 (686826)

69 Cohort analysis/ (723590)

70 cohort analy$.tw. (14813)

71 (Cohort adj (study or studies)).tw. (348402)

72 (follow up adj (study or studies)).tw. (66443)

73 (observational adj (study or studies)).tw. (193528)

74 (epidemiologic$ adj (study or studies)).tw. (111603)

75 case series.tw. (117588)

76 prospective.tw. (933248)

77 retrospective.tw. (994773)

78 or/61-65,68-77 (4113252)

79 60 or 78 (4707344)

80 55 and 79 (6514)

81 limit 80 to english language (6392)

82 81 not (letter or editorial).pt. (6384)

83 nonhuman/ not (human/ and nonhuman/) (4817226)

84 82 not 83 (6376)

85 limit 84 to yr="1990-Current" (6360)

86 limit 85 to dc=19900101-20211231 (6360)

87 (conference abstract or conference paper or conference proceeding or "conference review").pt. (4892778)

88 86 not 87 (3991)

Database name: Medline [Diagnostic]

1 exp *Obesity/ or *Body Weight/ or *body fat distribution/ or exp *Body Composition/ or exp *Adipose Tissue/ (255863)

2 (obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*).ti. (161823)

3 ((obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (47515)

4 (body adj1 (fat or composit* or weight*)).ti. (27783)

5 (body adj1 (fat or composit* or weight*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (18068)

6 ((visceral or subcutaneous) adj1 (fat or fatty or tissue*)).ti. (3524)

7 ((visceral or subcutaneous) adj1 (fat or fatty or tissue*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (1605)

8 or/1-7 (313457)

9 *body mass index/ (22403)

10 ("body mass ind*" or "body fat ind*" or BMI or BFI).ti. (19123)

11 ("body mass ind*" or "body fat ind*" or BMI or BFI).ab. /freq=2 (111508)

12 *waist-hip ratio/ or *"body weights and measures"/ (3117)

13 (waist adj3 (height* or hip*)).ti. (842)

14 (waist adj3 (height* or hip*) adj1 (ratio* or measur* or mark* or cut-off* or identify* or identifi* or indicat*)).ab. /freq=2 (2500)

15 (WHR or WHtR).ti. (47)

16 (WHR or WHtR).ab. /freq=2 (3765)

17 (waist adj1 circumference*).ti. (1808)

18 (waist adj1 circumference*).ab. /freq=2 (7255)

19 or/9-18 (124530)

20 8 and 19 (58896)

21 or/9-11 (117305)

22 or/13-18 (13014)

23 21 and 22 (7909)

24 20 or 23 (60811)

25 exp Cardiovascular Diseases/ or exp Stroke/ or Hypertension/ or Dyslipidemias/ (2507987)

26 ((cardiovascular or cardio* or coronary* or vascular or peripheral or heart* or cardiac* or myocardia*) adj3 (disease* or disorder* or syndrome* or failure* or event* or attack* or arrest* or infarct* or condition* or dysfunct*)).ti,ab. (870724)

27 (CVD or CHD or IHD or MI).ti,ab. (99281)

28 (circulatory adj3 (disease* or disorder*)).ti,ab. (5434)

29 (angina* or hypertensi* or atrial-fibrillat* or stroke* or poststroke* or cerebrovascular* or cerebro-vascular*).ti,ab. (729583)

30 ((brain* or cereb* or lacunar) adj2 (accident* or infarc*)).ti,ab. (33801)

31 ((high or raised or elevated or increas*) adj2 (blood pressure or bp)).ti,ab. (46855)

32 high cholesterol.ti,ab. (6679)

33 (hypercholesterol?emi* or hypercholester?emi* or hyperlipid?emi* or Dyslipid?emi*).ti,ab. (87349)

34 cardiometabolic-risk*.ti,ab. (5044)

35 or/25-34 (2910858)

36 *Diabetes Mellitus, Type 2/ (117022)

37 *Metabolic Syndrome/ (26728)

38 (diabetes adj2 type 2).ti,ab. (114709)

39 (diabetes adj2 type II).ti,ab. (8250)

40 (diabetes adj2 (non insulin or noninsulin)).ti,ab. (9634)

41 (NIDDM or T2DM or T2D).ti,ab. (33597)

42 ((metabolic or dysmetabolic or reaven or insulin resistance) adj2 syndrome$).ti,ab. (47862)

43 or/36-42 (204638)

44 exp *Neoplasms/ (3073109)

45 (cancer* or neoplas* or oncolog* or malignan$ or tumo?r* or carcinoma* or adenocarcinoma*).ti,ab. (3083040)

46 or/44-45 (3881287)

47 35 or 43 or 46 (6651029)

48 sensitiv:.mp. (1581578)

49 predictive value:.mp. (278127)

50 accurac:.tw. (353278)

51 or/48-50 (1990392)

52 24 and 47 and 51 (3538)

53 Observational Studies as Topic/ (6536)

54 Observational Study/ (103100)

55 Epidemiologic Studies/ (8734)

56 exp Cohort Studies/ (2169797)

57 Comparative Study.pt. (1893237)

58 (cohort adj (study or studies)).tw. (199356)

59 cohort analy$.tw. (7735)

60 (follow up adj (study or studies)).tw. (47130)

61 (observational adj (study or studies)).tw. (99977)

62 longitudinal.tw. (224846)

63 prospective.tw. (535364)

64 retrospective.tw. (497170)

65 Cross-Sectional Studies/ (375692)

66 cross sectional.tw. (323772)

67 or/53-66 (4395385)

68 (MEDLINE or pubmed).tw. (192740)

69 systematic review.tw. (148166)

70 systematic review.pt. (157935)

71 meta-analysis.pt. (136627)

72 intervention$.ti. (137272)

73 or/68-72 (435723)

74 67 or 73 (4722557)

75 52 and 74 (2130)

76 limit 75 to ed=19900101-20211231 (2128)

77 animals/ not humans/ (4822395)

78 76 not 77 (2127)

79 limit 78 to yr="1990-Current" (2127)

80 limit 79 to english language (2064)

81 limit 80 to (letter or historical article or comment or editorial or news or case reports) (5)

82 80 not 81 (2059)

Database name: Medline in process [Diagnostic]

1 exp *Obesity/ or *Body Weight/ or *body fat distribution/ or exp *Body Composition/ or exp *Adipose Tissue/ (0)

2 (obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*).ti. (4793)

3 ((obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (1562)

4 (body adj1 (fat or composit* or weight*)).ti. (685)

5 (body adj1 (fat or composit* or weight*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (505)

6 ((visceral or subcutaneous) adj1 (fat or fatty or tissue*)).ti. (85)

7 ((visceral or subcutaneous) adj1 (fat or fatty or tissue*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (38)

8 or/1-7 (6448)

9 *body mass index/ (0)

10 ("body mass ind*" or "body fat ind*" or BMI or BFI).ti. (663)

11 ("body mass ind*" or "body fat ind*" or BMI or BFI).ab. /freq=2 (4061)

12 *waist-hip ratio/ or *"body weights and measures"/ (0)

13 (waist adj3 (height* or hip*)).ti. (22)

14 (waist adj3 (height* or hip*) adj1 (ratio* or measur* or mark* or cut-off* or identify* or identifi* or indicat*)).ab. /freq=2 (70)

15 (WHR or WHtR).ti. (1)

16 (WHR or WHtR).ab. /freq=2 (108)

17 (waist adj1 circumference*).ti. (62)

18 (waist adj1 circumference*).ab. /freq=2 (222)

19 or/9-18 (4309)

20 8 and 19 (1471)

21 or/9-11 (4132)

22 or/13-18 (394)

23 21 and 22 (217)

24 20 or 23 (1536)

25 exp Cardiovascular Diseases/ or exp Stroke/ or Hypertension/ or Dyslipidemias/ (0)

26 ((cardiovascular or cardio* or coronary* or vascular or peripheral or heart* or cardiac* or myocardia*) adj3 (disease* or disorder* or syndrome* or failure* or event* or attack* or arrest* or infarct* or condition* or dysfunct*)).ti,ab. (20472)

27 (CVD or CHD or IHD or MI).ti,ab. (3203)

28 (circulatory adj3 (disease* or disorder*)).ti,ab. (53)

29 (angina* or hypertensi* or atrial-fibrillat* or stroke* or poststroke* or cerebrovascular* or cerebro-vascular*).ti,ab. (16288)

30 ((brain* or cereb* or lacunar) adj2 (accident* or infarc*)).ti,ab. (579)

31 ((high or raised or elevated or increas*) adj2 (blood pressure or bp)).ti,ab. (887)

32 high cholesterol.ti,ab. (122)

33 (hypercholesterol?emi* or hypercholester?emi* or hyperlipid?emi* or Dyslipid?emi*).ti,ab. (2118)

34 cardiometabolic-risk*.ti,ab. (341)

35 or/25-34 (34164)

36 *Diabetes Mellitus, Type 2/ (0)

37 *Metabolic Syndrome/ (0)

38 (diabetes adj2 type 2).ti,ab. (4844)

39 (diabetes adj2 type II).ti,ab. (170)

40 (diabetes adj2 (non insulin or noninsulin)).ti,ab. (22)

41 (NIDDM or T2DM or T2D).ti,ab. (2029)

42 ((metabolic or dysmetabolic or reaven or insulin resistance) adj2 syndrome$).ti,ab. (1530)

43 or/36-42 (6401)

44 exp *Neoplasms/ (0)

45 (cancer* or neoplas* or oncolog* or malignan$ or tumo?r* or carcinoma* or adenocarcinoma*).ti,ab. (73189)

46 or/44-45 (73189)

47 35 or 43 or 46 (108411)
48 sensitiv:.mp. (25044)
49 predictive value:.mp. (2933)
50 accurac:.tw. (11820)
51 or/48-50 (35127)
52 24 and 47 and 51 (61)
53 Observational Studies as Topic/ (0)
54 Observational Study/ (0)
55 Epidemiologic Studies/ (0)
56 exp Cohort Studies/ (0)
57 Comparative Study.pt. (1)
58 (cohort adj (study or studies)).tw. (10631)
59 cohort analy$.tw. (394)
60 (follow up adj (study or studies)).tw. (716)
61 (observational adj (study or studies)).tw. (5245)
62 longitudinal.tw. (8344)
63 prospective.tw. (15611)
64 retrospective.tw. (20721)
65 Cross-Sectional Studies/ (0)
66 cross sectional.tw. (13909)
67 or/53-66 (58816)
68 (MEDLINE or pubmed).tw. (10453)
69 systematic review.tw. (10000)
70 systematic review.pt. (237)
71 meta-analysis.pt. (60)
72 intervention$.ti. (5456)
73 or/68-72 (19093)
74 67 or 73 (74550)
75 52 and 74 (27)
76 limit 75 to dt=19900101-20211231 (27)

77 animals/ not humans/ (0)

78 76 not 77 (27)

79 limit 78 to yr="1990-Current" (27)

80 limit 79 to english language (26)

81 limit 80 to (letter or historical article or comment or editorial or news or case reports) (0)

82 80 not 81 (26)

Database name: Medline ePub ahead [Diagnostic]

1 exp *Obesity/ or *Body Weight/ or *body fat distribution/ or exp *Body Composition/ or exp *Adipose Tissue/ (0)

2 (obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*).ti. (2813)

3 ((obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (984)

4 (body adj1 (fat or composit* or weight*)).ti. (433)

5 (body adj1 (fat or composit* or weight*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (318)

6 ((visceral or subcutaneous) adj1 (fat or fatty or tissue*)).ti. (48)

7 ((visceral or subcutaneous) adj1 (fat or fatty or tissue*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (35)

8 or/1-7 (3890)

9 *body mass index/ (0)

10 ("body mass ind*" or "body fat ind*" or BMI or BFI).ti. (488)

11 ("body mass ind*" or "body fat ind*" or BMI or BFI).ab. /freq=2 (2867)

12 *waist-hip ratio/ or *"body weights and measures"/ (0)

13 (waist adj3 (height* or hip*)).ti. (12)

14 (waist adj3 (height* or hip*) adj1 (ratio* or measur* or mark* or cut-off* or identify* or identifi* or indicat*)).ab. /freq=2 (44)

15 (WHR or WHtR).ti. (0)

16 (WHR or WHtR).ab. /freq=2 (80)

17 (waist adj1 circumference*).ti. (21)

18 (waist adj1 circumference*).ab. /freq=2 (114)

19 or/9-18 (3024)

20 8 and 19 (951)

21 or/9-11 (2929)

22 or/13-18 (222)

23 21 and 22 (127)

24 20 or 23 (984)

25 exp Cardiovascular Diseases/ or exp Stroke/ or Hypertension/ or Dyslipidemias/ (0)

26 ((cardiovascular or cardio* or coronary* or vascular or peripheral or heart* or cardiac* or myocardia*) adj3 (disease* or disorder* or syndrome* or failure* or event* or attack* or arrest* or infarct* or condition* or dysfunct*)).ti,ab. (15357)

27 (CVD or CHD or IHD or MI).ti,ab. (2394)

28 (circulatory adj3 (disease* or disorder*)).ti,ab. (55)

29 (angina* or hypertensi* or atrial-fibrillat* or stroke* or poststroke* or cerebrovascular* or cerebro-vascular*).ti,ab. (13038)

30 ((brain* or cereb* or lacunar) adj2 (accident* or infarc*)).ti,ab. (497)

31 ((high or raised or elevated or increas*) adj2 (blood pressure or bp)).ti,ab. (658)

32 high cholesterol.ti,ab. (86)

33 (hypercholesterol?emi* or hypercholester?emi* or hyperlipid?emi* or Dyslipid?emi*).ti,ab. (1331)

34 cardiometabolic-risk*.ti,ab. (206)

35 or/25-34 (26245)

36 *Diabetes Mellitus, Type 2/ (0)

37 *Metabolic Syndrome/ (0)

38 (diabetes adj2 type 2).ti,ab. (2763)

39 (diabetes adj2 type II).ti,ab. (100)

40 (diabetes adj2 (non insulin or noninsulin)).ti,ab. (34)

41 (NIDDM or T2DM or T2D).ti,ab. (1092)

42 ((metabolic or dysmetabolic or reaven or insulin resistance) adj2 syndrome$).ti,ab. (824)

43 or/36-42 (3630)

44 exp *Neoplasms/ (0)

45 (cancer* or neoplas* or oncolog* or malignan$ or tumo?r* or carcinoma* or adenocarcinoma*).ti,ab. (48473)

46 or/44-45 (48473)

47 35 or 43 or 46 (74718)

48 sensitiv:.mp. (18627)

49 predictive value:.mp. (2290)

50 accurac:.tw. (10029)

51 or/48-50 (27042)

52 24 and 47 and 51 (37)

53 Observational Studies as Topic/ (0)

54 Observational Study/ (4)

55 Epidemiologic Studies/ (0)

56 exp Cohort Studies/ (0)

57 Comparative Study.pt. (0)

58 (cohort adj (study or studies)).tw. (9566)

59 cohort analy$.tw. (355)

60 (follow up adj (study or studies)).tw. (642)

61 (observational adj (study or studies)).tw. (4624)

62 longitudinal.tw. (7378)

63 prospective.tw. (13597)

64 retrospective.tw. (19743)

65 Cross-Sectional Studies/ (0)

66 cross sectional.tw. (11732)

67 or/53-66 (52757)

68 (MEDLINE or pubmed).tw. (9545)

69 systematic review.tw. (9608)

70 systematic review.pt. (126)

71 meta-analysis.pt. (104)

72 intervention$.ti. (4158)

73 or/68-72 (17317)

74 67 or 73 (66889)

75 52 and 74 (14)

76 limit 75 to dt=19900101-20211231 (14)

77 animals/ not humans/ (0)

78 76 not 77 (14)

79 limit 78 to yr="1990-Current" (14)

80 limit 79 to english language (14)

81 limit 80 to (letter or historical article or comment or editorial or news or case reports) (0)

82 80 not 81 (14)

Database name: Embase [Diagnostic]

1 exp *obese patient/ or exp *obesity/ or *body weight/ or exp *body composition/ or exp *adipose tissue/ (343970)

2 (obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*).ti. (248280)

3 ((obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (82099)

4 (body adj1 (fat or composit* or weight*)).ti. (38434)

5 (body adj1 (fat or composit* or weight*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (29749)

6 ((visceral or subcutaneous) adj1 (fat or fatty or tissue*)).ti. (4879)

7 ((visceral or subcutaneous) adj1 (fat or fatty or tissue*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (2948)

8 or/1-7 (456102)

9 *body mass/ (35086)

10 ("body mass ind*" or "body fat ind*" or BMI or BFI).ti. (34182)

11 ("body mass ind*" or "body fat ind*" or BMI or BFI).ab. /freq=2 (232692)

12 *waist hip ratio/ or *morphometry/ (3591)

13 (waist adj3 (height* or hip*)).ti. (1390)

14 (waist adj3 (height* or hip*) adj1 (ratio* or measur* or mark* or cut-off* or identify* or identifi* or indicat*)).ab. /freq=2 (4172)

15 (WHR or WHtR).ti. (105)

16 (WHR or WHtR).ab. /freq=2 (6406)

17 (waist adj1 circumference*).ti. (2945)

18 (waist adj1 circumference*).ab. /freq=2 (13709)

19 or/9-18 (252381)

20 8 and 19 (99959)

21 or/9-11 (240433)

22 or/12-18 (26137)

23 21 and 22 (14189)

24 20 or 23 (103619)

25 exp cardiovascular disease/ or exp cerebrovascular accident/ or hypertension/ or dyslipidemia/ (4307322)

26 ((cardiovascular or cardio* or coronary* or vascular or peripheral or heart* or cardiac* or myocardia*) adj3 (disease* or disorder* or syndrome* or failure* or event* or attack* or arrest* or infarct* or condition* or dysfunct*)).ti,ab. (1433748)

27 (CVD or CHD or IHD or MI).ti,ab. (198181)

28 (circulatory adj3 (disease* or disorder*)).ti,ab. (5660)

29 (angina* or hypertensi* or atrial-fibrillat* or stroke* or poststroke* or cerebrovascular* or cerebro-vascular*).ti,ab. (1247242)

30 ((brain* or cereb* or lacunar) adj2 (accident* or infarc*)).ti,ab. (55651)

31 ((high or raised or elevated or increas*) adj2 (blood pressure or bp)).ti,ab. (74728)

32 high cholesterol.ti,ab. (10688)

33 (hypercholesterol?emi* or hypercholester?emi* or hyperlipid?emi* or Dyslipid?emi*).ti,ab. (159260)

34 cardiometabolic-risk*.ti,ab. (9153)

35 or/25-34 (4758959)

36 *non insulin dependent diabetes mellitus/ (152844)

37 *metabolic syndrome X/ (42695)

38 (diabetes adj2 type 2).ti,ab. (214820)

39 (diabetes adj2 type II).ti,ab. (15630)

40 (diabetes adj2 (non insulin or noninsulin)).ti,ab. (11490)

41 (NIDDM or T2DM or T2D).ti,ab. (72312)

42 ((metabolic or dysmetabolic or reaven or insulin resistance) adj2 syndrome$).ti,ab. (88930)

43 or/36-42 (349825)

44 exp *neoplasm/ (3513091)

45 (cancer* or neoplas* or oncolog* or malignan$ or tumo?r* or carcinoma* or adenocarcinoma*).ti,ab. (4707753)

46 or/44-45 (5396085)

47 35 or 43 or 46 (9779627)

48 sensitiv:.tw. (1839818)

49 diagnostic accuracy.sh. (267004)

50 diagnostic.tw. (1061007)

51 or/48-50 (2822373)

52 24 and 47 and 51 (5709)

53 (MEDLINE or pubmed).tw. (304215)

54 exp systematic review/ or systematic review.tw. (362151)

55 meta-analysis/ (219105)

56 intervention$.ti. (220125)

57 or/53-56 (750317)

58 Clinical study/ (155798)

59 Family study/ (25315)

60 Longitudinal study/ (157525)

61 Retrospective study/ (1096542)

62 comparative study/ (905917)

63 Prospective study/ (694714)

64 Randomized controlled trials/ (206139)

65 63 not 64 (686826)

66 Cohort analysis/ (723590)

67 cohort analy$.tw. (14813)

68 (Cohort adj (study or studies)).tw. (348402)

69 (follow up adj (study or studies)).tw. (66443)

70 (observational adj (study or studies)).tw. (193528)

71 (epidemiologic$ adj (study or studies)).tw. (111603)

72 (cross sectional adj (study or studies)).tw. (255683)

73 case series.tw. (117588)

74 prospective.tw. (933248)

75 retrospective.tw. (994773)

76 or/58-62,65-75 (4311206)

77 57 or 76 (4902007)

78 52 and 77 (2014)

79 limit 78 to english language (1955)

80 79 not (letter or editorial).pt. (1955)

81 nonhuman/ not (human/ and nonhuman/) (4817226)

82 80 not 81 (1952)

83 limit 82 to yr="1990-Current" (1947)

84 limit 83 to dc=19900101-20211231 (1947)

85 (conference abstract or conference paper or conference proceeding or "conference review").pt. (4892778)

86 84 not 85 (1322)

Cost-Utility searches

Main search – Databases

Database	Date searched	Database Platform	Database segment or version	No. of results downloaded
EconLit (Ovid)	06/07/2021	OVID	1886 to June 24, 2021	7
Embase (Ovid)	06/07/2021	OVID	1974 to 2021 July 02	44
CRD NHS EED	06/07/2021	CRD	N/A	52
International HTA database (INAHTA)	07/07/2021	INAHTA	N/A	45
MEDLINE (Ovid) (Cost utility)	06/07/2021	OVID	1946 to July 02, 2021	54
MEDLINE In-Process (Ovid)	06/07/2021	OVID	1946 to July 02, 2021	2

MEDLINE Epub Ahead of Print	06/07/2021	OVID	July 02, 2021	1

Database name: Medline

1 exp *Obesity/ or *Body Weight/ or *body fat distribution/ or exp *Body Composition/ or exp *Adipose Tissue/ (255863)

2 (obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*).ti. (161823)

3 ((obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (47515)

4 (body adj1 (fat or composit* or weight*)).ti. (27783)

5 (body adj1 (fat or composit* or weight*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (18068)

6 ((visceral or subcutaneous) adj1 (fat or fatty or tissue*)).ti. (3524)

7 ((visceral or subcutaneous) adj1 (fat or fatty or tissue*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (1605)

8 or/1-7 (313457)

9 *body mass index/ (22403)

10 ("body mass ind*" or "body fat ind*" or BMI or BFI).ti. (19123)

11 ("body mass ind*" or "body fat ind*" or BMI or BFI).ab. /freq=2 (111508)

12 *waist-hip ratio/ or *"body weights and measures"/ (3117)

13 (waist adj3 (height* or hip*)).ti. (842)

14 (waist adj3 (height* or hip*) adj1 (ratio* or measur* or mark* or cut-off* or identify* or identifi* or indicat*)).ab. /freq=2 (2500)

15 (WHR or WHtR).ti. (47)

16 (WHR or WHtR).ab. /freq=2 (3765)

17 (waist adj1 circumference*).ti. (1808)

18 (waist adj1 circumference*).ab. /freq=2 (7255)

19 or/9-18 (124530)

20 8 and 19 (58896)

21 or/9-11 (117305)

22 or/12-18 (15378)

23 21 and 22 (8153)

24 20 or 23 (60872)

25 exp Cardiovascular Diseases/ or exp Stroke/ or Hypertension/ or Dyslipidemias/ (2507987)

26 ((cardiovascular or cardio* or coronary* or vascular or peripheral or heart* or cardiac* or myocardia*) adj3 (disease* or disorder* or syndrome* or failure* or event* or attack* or arrest* or infarct* or condition* or dysfunct*)).ti,ab. (870724)

27 (CVD or CHD or IHD or MI).ti,ab. (99281)

28 (circulatory adj3 (disease* or disorder*)).ti,ab. (5434)

29 (angina* or hypertensi* or atrial-fibrillat* or stroke* or poststroke* or cerebrovascular* or cerebro-vascular*).ti,ab. (729583)

30 ((brain* or cereb* or lacunar) adj2 (accident* or infarc*)).ti,ab. (33801)

31 ((high or raised or elevated or increas*) adj2 (blood pressure or bp)).ti,ab. (46855)

32 high cholesterol.ti,ab. (6679)

33 (hypercholesterol?emi* or hypercholester?emi* or hyperlipid?emi* or Dyslipid?emi*).ti,ab. (87349)

34 cardiometabolic-risk*.ti,ab. (5044)

35 or/25-34 (2910858)

36 *Diabetes Mellitus, Type 2/ (117022)

37 *Metabolic Syndrome/ (26728)

38 (diabetes adj2 type 2).ti,ab. (114709)

39 (diabetes adj2 type II).ti,ab. (8250)

40 (diabetes adj2 (non insulin or noninsulin)).ti,ab. (9634)

41 (NIDDM or T2DM or T2D).ti,ab. (33597)

42 ((metabolic or dysmetabolic or reaven or insulin resistance) adj2 syndrome$).ti,ab. (47862)

43 or/36-42 (204638)

44 exp *Neoplasms/ (3073109)

45 (cancer* or neoplas* or oncolog* or malignan$ or tumo?r* or carcinoma* or adenocarcinoma*).ti,ab. (3083040)

46 or/44-45 (3881287)

47 35 or 43 or 46 (6651029)

48 24 and 47 (23848)

49 Cost-Benefit Analysis/ (85302)

50 (cost* and ((qualit* adj2 adjust* adj2 life*) or qaly*)).tw. (12096)

51 ((incremental* adj2 cost*) or ICER).tw. (12474)

52 (cost adj2 utilit*).tw. (4794)

53 (cost* and ((net adj benefit*) or (net adj monetary adj benefit*) or (net adj health adj benefit*))).tw. (1550)

54 ((cost adj2 (effect* or utilit*)) and (quality adj of adj life)).tw. (16650)

55 (cost and (effect* or utilit*)).ti. (28607)

56 or/49-55 (96340)

57 48 and 56 (59)

58 limit 57 to ed=19900101-20211231 (58)

59 animals/ not humans/ (4822395)

60 58 not 59 (58)

61 limit 60 to yr="1990-Current" (58)

62 limit 61 to english language (55)

63 limit 62 to (letter or historical article or comment or editorial or news or case reports) (1)

64 62 not 63 (54)

Database name: Medline in process

1 exp *Obesity/ or *Body Weight/ or *body fat distribution/ or exp *Body Composition/ or exp *Adipose Tissue/ (0)

2 (obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*).ti. (4793)

3 ((obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (1562)

4 (body adj1 (fat or composit* or weight*)).ti. (685)

5 (body adj1 (fat or composit* or weight*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (505)

6 ((visceral or subcutaneous) adj1 (fat or fatty or tissue*)).ti. (85)

7 ((visceral or subcutaneous) adj1 (fat or fatty or tissue*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (38)

8 or/1-7 (6448)

9 *body mass index/ (0)

10 ("body mass ind*" or "body fat ind*" or BMI or BFI).ti. (663)

11 ("body mass ind*" or "body fat ind*" or BMI or BFI).ab. /freq=2 (4061)

12 *waist-hip ratio/ or *"body weights and measures"/ (0)

13 (waist adj3 (height* or hip*)).ti. (22)

14 (waist adj3 (height* or hip*) adj1 (ratio* or measur* or mark* or cut-off* or identify* or identifi* or indicat*)).ab. /freq=2 (70)

15 (WHR or WHtR).ti. (1)

16 (WHR or WHtR).ab. /freq=2 (108)

17 (waist adj1 circumference*).ti. (62)

18 (waist adj1 circumference*).ab. /freq=2 (222)

19 or/9-18 (4309)

20 8 and 19 (1471)

21 or/9-11 (4132)

22 or/12-18 (394)

23 21 and 22 (217)

24 20 or 23 (1536)

25 exp Cardiovascular Diseases/ or exp Stroke/ or Hypertension/ or Dyslipidemias/ (0)

26 ((cardiovascular or cardio* or coronary* or vascular or peripheral or heart* or cardiac* or myocardia*) adj3 (disease* or disorder* or syndrome* or failure* or event* or attack* or arrest* or infarct* or condition* or dysfunct*)).ti,ab. (20472)

27 (CVD or CHD or IHD or MI).ti,ab. (3203)

28 (circulatory adj3 (disease* or disorder*)).ti,ab. (53)

29 (angina* or hypertensi* or atrial-fibrillat* or stroke* or poststroke* or cerebrovascular* or cerebro-vascular*).ti,ab. (16288)

30 ((brain* or cereb* or lacunar) adj2 (accident* or infarc*)).ti,ab. (579)

31 ((high or raised or elevated or increas*) adj2 (blood pressure or bp)).ti,ab. (887)

32 high cholesterol.ti,ab. (122)

33 (hypercholesterol?emi* or hypercholester?emi* or hyperlipid?emi* or Dyslipid?emi*).ti,ab. (2118)

34 cardiometabolic-risk*.ti,ab. (341)

35 or/25-34 (34164)

36 *Diabetes Mellitus, Type 2/ (0)

37 *Metabolic Syndrome/ (0)

38 (diabetes adj2 type 2).ti,ab. (4844)

39 (diabetes adj2 type II).ti,ab. (170)

40 (diabetes adj2 (non insulin or noninsulin)).ti,ab. (22)

41 (NIDDM or T2DM or T2D).ti,ab. (2029)

42 ((metabolic or dysmetabolic or reaven or insulin resistance) adj2 syndrome$).ti,ab. (1530)

43 or/36-42 (6401)

44 exp *Neoplasms/ (0)

45 (cancer* or neoplas* or oncolog* or malignan$ or tumo?r* or carcinoma* or adenocarcinoma*).ti,ab. (73189)

46 or/44-45 (73189)

47 35 or 43 or 46 (108411)

48 24 and 47 (541)

49 Cost-Benefit Analysis/ (0)

50 (cost* and ((qualit* adj2 adjust* adj2 life*) or qaly*)).tw. (564)

51 ((incremental* adj2 cost*) or ICER).tw. (576)

52 (cost adj2 utilit*).tw. (182)

53 (cost* and ((net adj benefit*) or (net adj monetary adj benefit*) or (net adj health adj benefit*))).tw. (69)

54 ((cost adj2 (effect* or utilit*)) and (quality adj of adj life)).tw. (664)

55 (cost and (effect* or utilit*)).ti. (753)

56 or/49-55 (1217)

57 48 and 56 (2)

58 limit 57 to dt=19900101-20211231 (2)

59 animals/ not humans/ (0)

60 58 not 59 (2)

61 limit 60 to yr="1990-Current" (2)

62 limit 61 to english language (2)

63 limit 62 to (letter or historical article or comment or editorial or news or case reports) (0)

64 62 not 63 (2)

Database name: Medline epub ahead

1 exp *Obesity/ or *Body Weight/ or *body fat distribution/ or exp *Body Composition/ or exp *Adipose Tissue/ (0)

2 (obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*).ti. (2813)

3 ((obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (984)

4 (body adj1 (fat or composit* or weight*)).ti. (433)

5 (body adj1 (fat or composit* or weight*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (318)

6 ((visceral or subcutaneous) adj1 (fat or fatty or tissue*)).ti. (48)

7 ((visceral or subcutaneous) adj1 (fat or fatty or tissue*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (35)

8 or/1-7 (3890)

9 *body mass index/ (0)

10 ("body mass ind*" or "body fat ind*" or BMI or BFI).ti. (488)

11 ("body mass ind*" or "body fat ind*" or BMI or BFI).ab. /freq=2 (2867)

12 *waist-hip ratio/ or *"body weights and measures"/ (0)

13 (waist adj3 (height* or hip*)).ti. (12)

14 (waist adj3 (height* or hip*) adj1 (ratio* or measur* or mark* or cut-off* or identify* or identifi* or indicat*)).ab. /freq=2 (44)

15 (WHR or WHtR).ti. (0)

16 (WHR or WHtR).ab. /freq=2 (80)

17 (waist adj1 circumference*).ti. (21)

18 (waist adj1 circumference*).ab. /freq=2 (114)

19 or/9-18 (3024)

20 8 and 19 (951)

21 or/9-11 (2929)

22 or/12-18 (222)

23 21 and 22 (127)

24 20 or 23 (984)

25 exp Cardiovascular Diseases/ or exp Stroke/ or Hypertension/ or Dyslipidemias/ (0)

26 ((cardiovascular or cardio* or coronary* or vascular or peripheral or heart* or cardiac* or myocardia*) adj3 (disease* or disorder* or syndrome* or failure* or event* or attack* or arrest* or infarct* or condition* or dysfunct*)).ti,ab. (15357)

27 (CVD or CHD or IHD or MI).ti,ab. (2394)

28 (circulatory adj3 (disease* or disorder*)).ti,ab. (55)

29 (angina* or hypertensi* or atrial-fibrillat* or stroke* or poststroke* or cerebrovascular* or cerebro-vascular*).ti,ab. (13038)

30 ((brain* or cereb* or lacunar) adj2 (accident* or infarc*)).ti,ab. (497)

31 ((high or raised or elevated or increas*) adj2 (blood pressure or bp)).ti,ab. (658)

32 high cholesterol.ti,ab. (86)

33 (hypercholesterol?emi* or hypercholester?emi* or hyperlipid?emi* or Dyslipid?emi*).ti,ab. (1331)

34 cardiometabolic-risk*.ti,ab. (206)

35 or/25-34 (26245)

36 *Diabetes Mellitus, Type 2/ (0)

37 *Metabolic Syndrome/ (0)

38 (diabetes adj2 type 2).ti,ab. (2763)

39 (diabetes adj2 type II).ti,ab. (100)

40 (diabetes adj2 (non insulin or noninsulin)).ti,ab. (34)

41 (NIDDM or T2DM or T2D).ti,ab. (1092)

42 ((metabolic or dysmetabolic or reaven or insulin resistance) adj2 syndrome$).ti,ab. (824)

43 or/36-42 (3630)

44 exp *Neoplasms/ (0)

45 (cancer* or neoplas* or oncolog* or malignan$ or tumo?r* or carcinoma* or adenocarcinoma*).ti,ab. (48473)

46 or/44-45 (48473)

47 35 or 43 or 46 (74718)

48 24 and 47 (330)

49 Cost-Benefit Analysis/ (0)

50 (cost* and ((qualit* adj2 adjust* adj2 life*) or qaly*)).tw. (461)

51 ((incremental* adj2 cost*) or ICER).tw. (388)

52 (cost adj2 utilit*).tw. (212)

53 (cost* and ((net adj benefit*) or (net adj monetary adj benefit*) or (net adj health adj benefit*))).tw. (58)

54 ((cost adj2 (effect* or utilit*)) and (quality adj of adj life)).tw. (620)

55 (cost and (effect* or utilit*)).ti. (621)

56 or/49-55 (1193)

57 48 and 56 (1)

58 limit 57 to dt=19900101-20211231 (1)

59 animals/ not humans/ (0)

60 58 not 59 (1)

61 limit 60 to yr="1990-Current" (1)

62 limit 61 to english language (1)

63 limit 62 to (letter or historical article or comment or editorial or news or case reports) (0)

64 62 not 63 (1)

Database name: Embase

1 exp *obese patient/ or exp *obesity/ or *body weight/ or exp *body composition/ or exp *adipose tissue/ (343970)

2 (obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*).ti. (248280)

3 ((obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (82099)

4 (body adj1 (fat or composit* or weight*)).ti. (38434)

5 (body adj1 (fat or composit* or weight*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (29749)

6 ((visceral or subcutaneous) adj1 (fat or fatty or tissue*)).ti. (4879)

7 ((visceral or subcutaneous) adj1 (fat or fatty or tissue*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (2948)

8 or/1-7 (456102)

9 *body mass/ (35086)

10 ("body mass ind*" or "body fat ind*" or BMI or BFI).ti. (34182)

11 ("body mass ind*" or "body fat ind*" or BMI or BFI).ab. /freq=2 (232692)

12 *waist hip ratio/ or *morphometry/ (3591)

13 (waist adj3 (height* or hip*)).ti. (1390)

14 (waist adj3 (height* or hip*) adj1 (ratio* or measur* or mark* or cut-off* or identify* or identifi* or indicat*)).ab. /freq=2 (4172)

15 (WHR or WHtR).ti. (105)

16 (WHR or WHtR).ab. /freq=2 (6406)

17 (waist adj1 circumference*).ti. (2945)

18 (waist adj1 circumference*).ab. /freq=2 (13709)

19 or/9-18 (252381)

20 8 and 19 (99959)

21 or/9-11 (240433)

22 or/12-18 (26137)

23 21 and 22 (14189)

24 20 or 23 (103619)

25 exp cardiovascular disease/ or exp cerebrovascular accident/ or hypertension/ or dyslipidemia/ (4307322)

26 ((cardiovascular or cardio* or coronary* or vascular or peripheral or heart* or cardiac* or myocardia*) adj3 (disease* or disorder* or syndrome* or failure* or event* or attack* or arrest* or infarct* or condition* or dysfunct*)).ti,ab. (1433748)

27 (CVD or CHD or IHD or MI).ti,ab. (198181)

28 (circulatory adj3 (disease* or disorder*)).ti,ab. (5660)

29 (angina* or hypertensi* or atrial-fibrillat* or stroke* or poststroke* or cerebrovascular* or cerebro-vascular*).ti,ab. (1247242)

30 ((brain* or cereb* or lacunar) adj2 (accident* or infarc*)).ti,ab. (55651)

31 ((high or raised or elevated or increas*) adj2 (blood pressure or bp)).ti,ab. (74728)

32 high cholesterol.ti,ab. (10688)

33 (hypercholesterol?emi* or hypercholester?emi* or hyperlipid?emi* or Dyslipid?emi*).ti,ab. (159260)

34 cardiometabolic-risk*.ti,ab. (9153)

35 or/25-34 (4758959)

36 *non insulin dependent diabetes mellitus/ (152844)

37 *metabolic syndrome X/ (42695)

38 (diabetes adj2 type 2).ti,ab. (214820)

39 (diabetes adj2 type II).ti,ab. (15630)

40 (diabetes adj2 (non insulin or noninsulin)).ti,ab. (11490)

41 (NIDDM or T2DM or T2D).ti,ab. (72312)

42 ((metabolic or dysmetabolic or reaven or insulin resistance) adj2 syndrome$).ti,ab. (88930)

43 or/36-42 (349825)

44 exp *neoplasm/ (3513091)

45 (cancer* or neoplas* or oncolog* or malignan$ or tumo?r* or carcinoma* or adenocarcinoma*).ti,ab. (4707753)

46 or/44-45 (5396085)

47 35 or 43 or 46 (9779627)

48 cost utility analysis/ (10469)

49 (cost* and ((qualit* adj2 adjust* adj2 life*) or qaly*)).tw. (24820)

50 ((incremental* adj2 cost*) or ICER).tw. (25414)

51 (cost adj2 utilit*).tw. (9197)

52 (cost* and ((net adj benefit*) or (net adj monetary adj benefit*) or (net adj health adj benefit*))).tw. (2562)

53 ((cost adj2 (effect* or utilit*)) and (quality adj of adj life)).tw. (30312)

54 (cost and (effect* or utilit*)).ti. (49377)

55 or/48-54 (77885)

56 24 and 47 and 55 (81)

57 limit 56 to english language (77)

58 57 not (letter or editorial).pt. (77)

59 nonhuman/ not (human/ and nonhuman/) (4817226)

60 58 not 59 (76)

61 limit 60 to yr="1990-Current" (76)

62 limit 61 to dc=19900101-20211231 (76)

63 (conference abstract or conference paper or conference proceeding or "conference review").pt. (4892778)

64 62 not 63 (44)

Database name: Econlit

1 [exp *Obesity/ or *Body Weight/ or *body fat distribution/ or exp *Body Composition/ or exp *Adipose Tissue/] (0)

2 (obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*).ti. (1126)

3 ((obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (337)

4 (body adj1 (fat or composit* or weight*)).ti. (119)

5 (body adj1 (fat or composit* or weight*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (38)

6 ((visceral or subcutaneous) adj1 (fat or fatty or tissue*)).ti. (0)

7 ((visceral or subcutaneous) adj1 (fat or fatty or tissue*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*)).ab. (0)

8 or/1-7 (1416)

9 [*body mass index/] (0)

10 ("body mass ind*" or "body fat ind*" or BMI or BFI).ti. (182)

11 ("body mass ind*" or "body fat ind*" or BMI or BFI).ab. /freq=2 (593)

12 [*waist-hip ratio/ or *"body weights and measures"/] (0)

13 (waist adj3 (height* or hip*)).ti. (0)

14 (waist adj3 (height* or hip*) adj1 (ratio* or measur* or mark* or cut-off* or identify* or identifi* or indicat*)).ab. /freq=2 (1)

15 (WHR or WHtR).ti. (1)

16 (WHR or WHtR).ab. /freq=2 (5)

17 (waist adj1 circumference*).ti. (2)

18 (waist adj1 circumference*).ab. /freq=2 (3)

19 or/9-18 (632)

20 8 and 19 (281)

21 or/9-11 (625)

22 or/12-18 (11)

23 21 and 22 (4)

24 20 or 23 (281)

25 [exp Cardiovascular Diseases/ or exp Stroke/ or Hypertension/ or Dyslipidemias/] (0)

26 ((cardiovascular or cardio* or coronary* or vascular or peripheral or heart* or cardiac* or myocardia*) adj3 (disease* or disorder* or syndrome* or failure* or event* or attack* or arrest* or infarct* or condition* or dysfunct*)).ti,ab. (1090)

27 (CVD or CHD or IHD or MI).ti,ab. (381)

28 (circulatory adj3 (disease* or disorder*)).ti,ab. (44)

29 (angina* or hypertensi* or atrial-fibrillat* or stroke* or poststroke* or cerebrovascular* or cerebro-vascular*).ti,ab. (637)

30 ((brain* or cereb* or lacunar) adj2 (accident* or infarc*)).ti,ab. (7)

31 ((high or raised or elevated or increas*) adj2 (blood pressure or bp)).ti,ab. (68)

32 high cholesterol.ti,ab. (28)

33 (hypercholesterol?emi* or hypercholester?emi* or hyperlipid?emi* or Dyslipid?emi*).ti,ab. (34)

34 cardiometabolic-risk*.ti,ab. (2)

35 or/25-34 (1948)

36 [*Diabetes Mellitus, Type 2/] (0)

37 [*Metabolic Syndrome/] (0)

38 (diabetes adj2 type 2).ti,ab. (96)

39 (diabetes adj2 type II).ti,ab. (13)

40 (diabetes adj2 (non insulin or noninsulin)).ti,ab. (2)

41 (NIDDM or T2DM or T2D).ti,ab. (18)

42 ((metabolic or dysmetabolic or reaven or insulin resistance) adj2 syndrome$).ti,ab. (13)

43 or/36-42 (123)

44 [exp *Neoplasms/] (0)

45 (cancer* or neoplas* or oncolog* or malignan$ or tumo?r* or carcinoma* or adenocarcinoma*).ti,ab. (1766)

46 or/44-45 (1766)

47 35 or 43 or 46 (3600)

48 24 and 47 (7)

49 limit 48 to yr="1990 -Current" (7)

Database name: NHS EED

1 MeSH DESCRIPTOR Obesity EXPLODE ALL TREES 1025

2 MeSH DESCRIPTOR body weight 218

3 MeSH DESCRIPTOR body fat distribution 3

4 MeSH DESCRIPTOR body composition 86

5 MeSH DESCRIPTOR adipose tissue EXPLODE ALL TREES 42

6 ((obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*)):TI 651

7 (((obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*))) 97

8 ((body adj1 (fat or composit* or weight*))):TI 73

9 ((body adj1 (fat or composit* or weight*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*))) 37

10 (((visceral or subcutaneous) adj1 (fat or fatty or tissue*))):TI 5

11 (((visceral or subcutaneous) adj1 (fat or fatty or tissue*) adj4 (central* or measur* or mark* or identify* or identifi* or indicat* or categor* or threshold*))) 1

12 (#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11) 1373

13 MeSH DESCRIPTOR body mass index 363

14 (("body mass ind*" or "body fat ind*" or BMI or BFI)) 1164

15 MeSH DESCRIPTOR waist-hip ratio 6

16 MeSH DESCRIPTOR body weights and measures 7

17 ((waist adj3 (height* or hip*))) 36

18 ((waist adj3 (height* or hip*) adj1 (ratio* or measur* or mark* or cut-off* or identify* or identifi* or indicat*))) 30

19 (WHR or WHtR) 1

20 ((waist adj1 circumference*)) 91

21 (#13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20) 1190

22 (#12 AND #21) 526

23 (#13 OR #14) 1164

24 (#15 OR #16 OR #17 OR #18 OR #19 OR #20) 113

25 (#23 AND #24) 87

26 (#22 OR #25) 549

27 MeSH DESCRIPTOR Cardiovascular Diseases EXPLODE ALL TREES 10752

28 MeSH DESCRIPTOR Stroke EXPLODE ALL TREES 1356

29 MeSH DESCRIPTOR Hypertension 846

30 MeSH DESCRIPTOR Dyslipidemias 57

31 (((cardiovascular or cardio* or coronary* or vascular or peripheral or heart* or cardiac* or myocardia*) adj3 (disease* or disorder* or syndrome* or failure* or event* or attack* or arrest* or infarct* or condition* or dysfunct*))) 7710

32 (CVD or CHD or IHD or MI) 1151

33 ((circulatory adj3 (disease* or disorder*))) 3

34 ((angina* or hypertensi* or atrial-fibrillat* or stroke* or poststroke* or cerebrovascular* or cerebro-vascular*)) 6157

35 ((brain* or cereb* or lacunar) adj2 (accident* or infarc*)) 188

36 ((high or raised or elevated or increas*) adj2 (blood pressure or bp)) 224

37 (high cholesterol) 35

38 (((hypercholesterol?emi* or hypercholester?emi* or hyperlipid?emi* or Dyslipid?emi*))) 634

39 (cardiometabolic-risk*) 10

40 (#27 OR #28 OR #29 OR #30 OR #31 OR #32 OR #33 OR #34 OR #35 OR #36 OR #37 OR #38 OR #39) 14573

41 MeSH DESCRIPTOR Diabetes Mellitus, Type 2 1216

42 MeSH DESCRIPTOR Metabolic Syndrome 0

43 ((diabetes adj2 type 2)) 1236

44 ((diabetes adj2 type II)) 6

45 ((diabetes adj2 (non insulin or noninsulin))) 6

46 (NIDDM or T2DM or T2D) 50

47 (((metabolic or dysmetabolic or reaven or insulin resistance) adj2 syndrome*)) 120

48 (#41 OR #42 OR #43 OR #44 OR #45 OR #46 OR #47) 1345

49 MeSH DESCRIPTOR Neoplasms EXPLODE ALL TREES 12016

50 ((cancer* or neoplas* or oncolog* or malignan* or tumo?r* or carcinoma* or adenocarcinoma*)) 14922

51 (#49 OR #50) 15703

52 (#40 OR #48 OR #51)29840

53 (#26 and #52) IN NHSEED FROM 1990 TO 2021 52

Database name: INAHTA

1. (obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*)[Title] OR (obes* or overweight or adipos* or anthropometr* or nonobese* or nonoverweight*)[abs] 278

2. (body)[Title] AND (fat or composit* or weight*)[Title] 2

3. (body)[abs] AND (fat or composit* or weight*)[abs] 116

4. (visceral OR subcutaneous)[Title] AND (fat OR fatty OR tissue*)[Title] 0

5. (visceral OR subcutaneous)[abs] AND (fat OR fatty OR tissue*)[abs] 11

6. "Obesity"[mhe] 216

7. "Body Weight"[mh] 11

8. "Body Fat Distribution"[mh] 0

9. "Body Composition"[mh] 4

10. "Adipose Tissue"[mh] 5

11. #10 OR #9 OR #8 OR #7 OR #6 OR #5 OR #4 OR #3 OR #2 OR #1 386

12. "Body Mass Index"[mh] 20

13. ("body mass index" or "body mass indexes" or "body mass indices" or "body fat index" or "body fat indexes" or "body fat indices" or BMI or BFI)[Title] OR ("body mass index" or "body mass indexes" or "body mass indices" or "body fat index" or "body fat indexes" or "body fat indices" or BMI or BFI)[abs] 77

14. "Waist-Hip Ratio"[mh] 1

15. "body weights and measures" 0

16. "Body Weights and Measures"[mh] 1

17. (waist)[Title] AND (height* OR hip*)[Title] 0

18. (waist AND (height* OR hip*))[abs] AND (ratio* or measur* or mark* or cut-off* or identify* or identifi* or indicat*)[abs] 2

19. (WHR or WHtR)[Title] OR (WHR or WHtR)[abs] 1

20. (waist AND circumference*)[Title] OR (waist AND circumference*)[abs] 9

21. #20 OR #19 OR #18 OR #17 OR #16 OR #15 OR #14 OR #13 OR #12 91

22. #21 AND #11 72

23. #13 OR #12 87

24. #20 OR #19 OR #18 OR #17 OR #16 OR #15 OR #14 10

25. #24 AND #23 6

26. #25 OR #22 72

27. "Cardiovascular Diseases"[mhe] 2031

28. "Stroke"[mhe] 205

29. "Hypertension"[mh] 143

30. "Dyslipidemias"[mh] 5

31. (cardiovascular or cardio* or coronary* or vascular or peripheral or heart* or cardiac* or myocardia*)[Title] AND (disease* or disorder* or syndrome* or failure* or event* or attack* or arrest* or infarct* or condition* or dysfunct*)[Title] 617

32. (cardiovascular or cardio* or coronary* or vascular or peripheral or heart* or cardiac* or myocardia*)[abs] AND (disease* or disorder* or syndrome* or failure* or event* or attack* or arrest* or infarct* or condition* or dysfunct*)[abs] 1158

33. (CVD or CHD or IHD or MI)[Title] OR (CVD or CHD or IHD or MI)[abs] 89

34. (circulatory)[Title] AND (disease* or disorder*)[Title] 0

35. (circulatory)[abs] AND (disease* OR disorder*)[abs] 5

36. (angina* or hypertensi* or atrial-fibrillat* or stroke* or poststroke* or cerebrovascular* or cerebro-vascular*)[Title] OR (angina* or hypertensi* or atrial-fibrillat* or stroke* or poststroke* or cerebrovascular* or cerebro-vascular*)[abs] 959

37. (brain* or cereb* or lacunar)[Title] AND (accident* or infarc*)[Title] 5

38. (brain* or cereb* or lacunar)[abs] AND (accident* or infarc*)[abs] 36

39. (high or raised or elevated or increas*)[Title] AND (blood pressure OR bp)[Title] 12

40. (high or raised or elevated or increas*)[abs] AND (blood pressure OR bp)[abs] 117

41. (high cholesterol)[Title] OR (high cholesterol)[abs] 32

42. (hypercholesterolaemi* or hypercholesterolemi* or hypercholesteraemi* or hypercholesteremi* or hyperlipidaemi* or hyperlipidemi* or Dyslipidaemi* or Dyslipidemi)[Title] OR (hypercholesterolaemi* or hypercholesterolemi* or hypercholesteraemi* or hypercholesteremi* or hyperlipidaemi* or hyperlipidemi* or Dyslipidaemi* or Dyslipidemi)[abs] 48

43. (cardiometabolic-risk*)[Title] OR (cardiometabolic-risk*)[abs] 2843

44. #43 OR #42 OR #41 OR #40 OR #39 OR #38 OR #37 OR #36 OR #35 OR #34 OR #33 OR #32 OR #31 OR #30 OR #29 OR #28 OR #27 4855

45. "Diabetes Mellitus Type 2"[mh] 146

46. "Metabolic Syndrome"[mh] 0

47. (diabetes AND type 2)[Title] OR (diabetes AND type 2)[abs] 311

48. ((diabetes AND type II)[Title] OR (diabetes AND type II)[abs]) 311

49. (Diabetes)[Title] AND (non insulin OR noninsulin)[Title] 2

50. (Diabetes)[abs] AND (non insulin OR noninsulin)[abs] 23

51. (NIDDM OR T2DM OR T2D)[Title] OR (NIDDM OR T2DM OR T2D)[abs] 12

52. (metabolic or dysmetabolic or reaven or insulin resistance)[Title] AND (syndrome*)[Title] 5

53. (metabolic or dysmetabolic or reaven or insulin resistance)[abs] AND (syndrome*)[abs] 30

54. #53 OR #52 OR #51 OR #50 OR #49 OR #48 OR #47 OR #46 OR #45 371

55. "Neoplasms"[mh] 2298

56. (cancer* or neoplas* or oncolog* or malignan* or tumour* or tumor* or carcinoma* or adenocarcinoma*)[Title] OR (cancer* or neoplas* or oncolog* or malignan* or tumour* or tumor* or carcinoma* or adenocarcinoma*)[abs] 3088

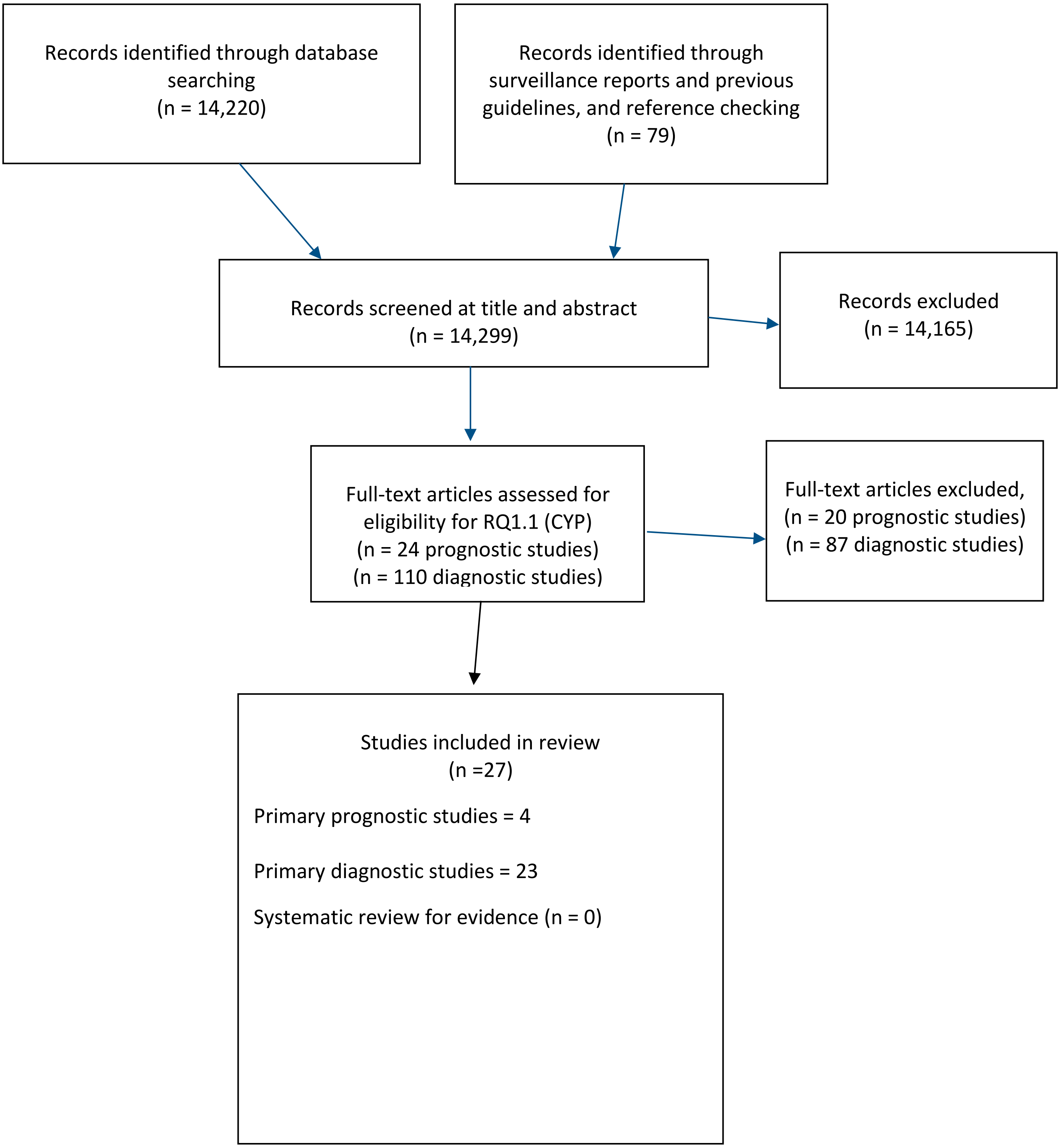
57. #56 OR #55 3357

58. #57 OR #54 OR #44 7635

59. #58 AND #26 45

Appendix D- Prognostic and diagnostic evidence study selection

A joint search was conducted for RQ1.1 which covers the adult population and RQ1.2 which covers children and young people.



Appendix E– Prognostic and Diagnostic evidence tables

Prognostic accuracy studies

Cheung, 2004

Bibliographic Reference	Cheung, Yin Bun; Machin, David; Karlberg, Johan; Khoo, Kei Siong; A longitudinal study of pediatric body mass index values predicted health in middle age.; Journal of clinical epidemiology; 2004; vol. 57 (no. 12); 1316-22

Study Characteristics

Study type	Prospective cohort study
Study details	Study location National Child Development Study (NCDS) included people born in England, Wales, and Scotland during a week in 1958 Study dates Recruitment in 1958 and medical examinations after 7 years, 11 years, 16 years, 33 years, and 42 years. Sources of funding Not detailed Ethnicity The population included were assumed to be >80% of white ethnicity for this analysis

Inclusion criteria	People born in England, Scotland, or Wales during a single week in 1958
Number of participants	Unclear how many people were recruited at age 7 but 12327 people were followed for 35 years.
Length of follow-up	35 years
Loss to follow-up	The loss to follow up was stated to be 30%
Index test(s)	BMI
Reference standard (s)	A person develops Type II diabetes during follow-up A person develops hypertension during follow-up A person develops cancer during follow-up

Critical appraisal - GUT QUIPS checklist - PROGNOSIS CHILDREN

Section	**Question**	**Answer**
Study participation	Summary Study participation	Low risk of bias
Study Attrition	Study Attrition Summary	Low risk of bias
Prognostic factor measurement	Prognostic factor Measurement Summary	Low risk of bias
Outcome Measurement	Outcome Measurement Summary	Low risk of bias
Study Confounding	Study Confounding Summary	Low risk of bias
Statistical Analysis and Reporting	Statistical Analysis and Presentation Summary	Low risk of bias

Section	Question	Answer
Overall risk of bias and directness	Risk of Bias	Low
Overall risk of bias and directness	Directness	Directly applicable

Fan, 2019

Bibliographic Reference	Fan, Hui; Zhu, Qi; Medrano-Gracia, Pau; Zhang, Xingyu; Comparison of child adiposity indices in prediction of hypertension in early adulthood.; Journal of clinical hypertension (Greenwich, Conn.); 2019; vol. 21 (no. 12); 1858-1862

Study Characteristics

Study type	Prospective cohort study
Study details	Study location China Setting The cohort from the China Health and Nutrition Survey 1993-2011 Study dates 1993-2011 Sources of funding

	This study was supported by the PhD Funding Program of North Sichuan Medical College (CBY18-QD02) and the Key Subject Development Program of North Sichuan Medical College (NSMC-M-18-19) Ethnicity The population in the study is assumed to be at least 80% of Chinese ethnicity Recruitment A multistage, random cluster process was used to select participants from 15 provinces and municipal cities in China.
Exclusion criteria	participants with incomplete data about their demographic characteristics (sex, age, and living area), adult blood pressure (BP), smoking and drinking, and childhood measurements (BP, weight, height, WC, hip circumference, and TSF)
Number of participants	2180 participants 1444 participants from CHNS 1993-2011 were included in the current study
Length of follow-up	The mean follow-up length was 10.1 years (median, 11.0 years; range, 2-18 years).
Loss to follow-up	736 participants with incomplete data about their demographic characteristics (sex, age, and living area), adult blood pressure (BP), smoking and drinking, and childhood measurements (BP, weight, height, WC, hip circumference, and TSF),were excluded
Index test(s)	BMI WC WHtR WHR
Reference standard (s)	A person develops hypertension during follow-up

Population characteristics

Study-level characteristics

Characteristic	Study (N =)
Mean age (SD) Range	4 to 17

Critical appraisal - GUT QUIPS checklist - PROGNOSIS CHILDREN

Section	Question	Answer
Study participation	Summary Study participation	Low risk of bias
Study Attrition	Study Attrition Summary	High risk of bias *(Loss to follow up data (n = 676))*
Prognostic factor measurement	Prognostic factor Measurement Summary	Low risk of bias
Outcome Measurement	Outcome Measurement Summary	Moderate risk of bias *(unclear how measurements were taken)*
Study Confounding	Study Confounding Summary	Low risk of bias
Statistical Analysis and Reporting	Statistical Analysis and Presentation Summary	Moderate risk of bias *(Partial reporting (only AUC data))*
Overall risk of bias and directness	Risk of Bias	High
Overall risk of bias and directness	Directness	Directly applicable

Koskinen, 2010

Bibliographic Reference	Koskinen, Juha; Viikari, Jorma; Juonala, Markus; Mattsson, Noora; Ronnemaa, Tapani; Raitakari, Olli T.; Thomson, Russell; Magnussen, Costan G.; Chen, Wei; Srinivasan, Sathanur R.; Berenson, Gerald S.; Schmidt, Michael D.; Kivimaki, Mika; Kahonen, Mika; Laitinen, Tomi; Taittonen, Leena; Pediatric metabolic syndrome predicts adulthood metabolic syndrome, subclinical atherosclerosis, and type 2 diabetes mellitus but is no better than body mass index alone: The Bogalusa Heart Study and the Cardiovascular Risk in Young Finns Study; Circulation; 2010; vol. 122 (no. 16); 1604-1611

Study Characteristics

Study type	Prospective cohort study
Study details	Study location USA and Finland Setting Two prospective cohorts, the Bogalusa Heart Study (BHS) and the Cardiovascular Risk in Young Finns Study Study dates For the BHS, youth aged 9–18 years who participated in either the 1984–85 or 1987–88 surveys and attended either the 2001–02 or 2003–07 adult surveys (then aged 25–41 years) were included in the analyses Young Finns study those who participated in the 1986 survey when aged 9, 12, 15, or 18 years and in either the 2001 or 2007 adult follow-ups (then aged 24–39 years Sources of funding The Bogalusa Heart Study was financially supported by NIH Grants AG-16592 from the National Institute of Aging, HL-38844 from the National Heart, Lung, and Blood Institute. The Cardiovascular Risk in Young Finns study was financially

	supported by the Academy of Finland (grants 117797, 126925, and 121584), the Social Insurance Institution of Finland, the Turku University Foundation, Special Federal Grants for the Turku University Central Hospital, the Juho Vainio Foundation, the Finnish Foundation of Cardiovascular Research, the Finnish Cultural Foundation, and the Orion Farmos Research Foundation. CGM's contribution to this paper was supported in part by the Emil and Blida Maunulan fund. MKiv is supported by the National Heart, Lung, and Blood Institute (R01HL036310-20A2), NIH, USA and the BUPA Foundation Specialist Research Grant. MKäh is supported by the Tampere University Hospital Medical Fund. Ethnicity 7% of participants were known to be Black but the study is assessed to be >80% White ethnicity for this review.
Inclusion criteria	Children 9-18 years old
Number of participants	For the BHS, (N=374). Young Finns N=1407).
Length of follow-up	Mean (SD) length of follow-up between baseline and follow-up was 24.4 (3.7) years and ranged from 14–27 years
Index test(s)	BMI
Reference standard (s)	A person develops Type II diabetes during follow-up A person develops hypertension during follow-up

Critical appraisal - GUT QUIPS checklist - PROGNOSIS CHILDREN

Section	**Question**	**Answer**
Study participation	Summary Study participation	Low risk of bias

Section	Question	Answer
Study Attrition	Study Attrition Summary	High risk of bias (*The proportion of subjects excluded due to missing values (30%))*
Prognostic factor measurement	Prognostic factor Measurement Summary	Low risk of bias
Outcome Measurement	Outcome Measurement Summary	Low risk of bias
Study Confounding	Study Confounding Summary	Low risk of bias
Statistical Analysis and Reporting	Statistical Analysis and Presentation Summary	Low risk of bias
Overall risk of bias and directness	Risk of Bias	Moderate *(Due to people excluded due to missing data)*
Overall risk of bias and directness	Directness	Directly applicable

Li, 2011

Bibliographic Reference	Li, Leah; Pinot de Moira, Angela; Power, Chris; Predicting cardiovascular disease risk factors in mid-adulthood from childhood body mass index: utility of different cut-offs for childhood body mass index.; The American journal of clinical nutrition; 2011; vol. 93 (no. 6); 1204-11

Study Characteristics

Study type	Retrospective cohort study

Study details	Study location UK Setting The 1958 British birth cohort, consists of all births in England, Wales, and Scotland in 1 week in March 1958 UCL Institute of Child Health, London, United Kingdom Study dates Not clear Sources of funding The UCL Institute of Child Health received a portion of its funding under the United Kingdom Department of Health's NIHR Biomedical Research Centres funding scheme. The Centre for Paediatric Epidemiology and Biostatistics also was supported by the United Kingdom MRC in its capacity as the MRC Centre of Epidemiology for Child Health. Data collection at age 45 y was funded by the MRC (grant G0000934) Ethnicity Immigrants to Britain born during the week were incorporated into the childhood follow-ups (n = 920). At age 45 y, 11,971 cohort members (including 467 immigrants) still living in Britain and in contact

	We assumed that 80% of the population are of white ethnicity
Inclusion criteria	Children born in England, Wales, and Scotland in 1 week in March 1958
Exclusion criteria	Not detailed
Number of participants	Approximately 17,000 live births were followed-up at ages 7, 11, 16, 23, 33, 42, 45, and 50 y
Length of follow-up	from 1958 - followed up at ages 7, 11, 16, 23, 33, 42, 45, and 50 y
Loss to follow-up	Information was collected on 9377 (78%) respondents
Index test(s)	BMI
Reference standard (s)	A person develops hypertension during follow-up

Population characteristics

Study-level characteristics

Characteristic	
Sample size Sample size	n = 9377 ; % = 78

Critical appraisal - GUT QUIPS checklist - PROGNOSIS CHILDREN

Section	**Question**	**Answer**
Study participation	Summary Study participation	Low risk of bias

Section	Question	Answer
Study Attrition	Study Attrition Summary	Moderate risk of bias *(moderate loss of data to follow-up (78% completed the study))*
Prognostic factor measurement	Prognostic factor Measurement Summary	Moderate risk of bias *(Cut-offs were not pre-specified)*
Outcome Measurement	Outcome Measurement Summary	Low risk of bias
Study Confounding	Study Confounding Summary	Low risk of bias
Statistical Analysis and Reporting	Statistical Analysis and Presentation Summary	Low risk of bias
Overall risk of bias and directness	Risk of Bias	High *(Cut-offs were not pre-specified and study attrition)*
Overall risk of bias and directness	Directness	Directly applicable

Diagnostic accuracy studies

Arellano-Ruiz, 2020

Bibliographic Reference	Arellano-Ruiz, Paola; Garcia-Hermoso, Antonio; Garcia-Prieto, Jorge C; Sanchez-Lopez, Mairena; Vizcaino, Vicente Martinez; Solera-Martinez, Montserrat; Predictive Ability of Waist Circumference and Waist-to-Height Ratio for Cardiometabolic Risk Screening among Spanish Children.; Nutrients; 2020; vol. 12 (no. 2)

Study Characteristics

Study type	Cross-sectional study

Study details	Study location Province of Cuenca in Spain Setting Survey conducted in 2010 among schoolchildren aged 8–11 years in 20 state schools Sources of funding Ministry of Education and Science- Junta de Comunidades de Castilla-La Mancha (grant numbers PII1I09-0259-9898, POII10-0208-5325); Ministry of Health (grant number FIS PI081297); and the Research Network on Preventative Activities and Health Promotion (grant number RD06/0018/0038) Ethnicity Ethnicity was not stated but was assumed to be >80% white for this analysis Recruitment Linked to a large cluster RCT across 10 schools. Consecutive children were included.
Inclusion criteria	Children Aged 8-11 years old.
Exclusion criteria	Children with serious learning difficulties or physical or mental disorders
Number of participants	848
Length of follow-up	NA
Loss to follow-up	NA

Index test(s)	Waist-to-height ratio (WHtR) Waist circumference (WC) WC was measured as the narrowest point between the lower costal border and the iliac crest using a metal tape measure, during shallow apnoea with the children standing erect with abdomen relaxed in accordance with the guidelines of the International Society for the Advancement of Kinanthropometry
Reference standard (s)	Hypertension >95th percentile for blood pressure
Additional comments	The receiver operating characteristic (ROC) curve was used to identify the best WtHR and WC cut-off

Population characteristics

Study-level characteristics

Characteristic	Study (N = 848)
% Female Custom value	51.9%
Mean age (SD) Mean (SD)	9.5 (0.7)

Critical appraisal - GUT QUADAS-2: DIAGNOSIS CHILDREN

Section	Question	Answer

Patient selection: risk of bias	Could the selection of patients have introduced bias?	Low
Patient selection: applicability	Are there concerns that included patients do not match the review question?	Low
Index tests: risk of bias	Could the conduct or interpretation of the index test have introduced bias?	High (Optimal thresholds were generated during the study)
Index tests: applicability	Are there concerns that the index test, its conduct, or interpretation differ from the review question?	Low
Reference standard: risk of bias	Could the reference standard, its conduct, or its interpretation have introduced bias?	Low
Reference standard: applicability	Is there concern that the target condition as defined by the reference standard does not match the review question?	Low
Flow and timing: risk of bias	Could the patient flow have introduced bias?	Low
Overall risk of bias and directness	Risk of Bias	Moderate
Overall risk of bias and directness	Directness	Directly applicable

Brar, 2013

Bibliographic Reference	Brar, Sandeep Kaur; Badaruddoza; Better anthropometric indicators to predict elevated blood pressure in North Indian Punjabi Adolescents; Journal of Biological Sciences; 2013; vol. 13 (no. 3); 139-145

Study Characteristics

Study type	Cross-sectional study
Study details	Study location Punjab region of India. Ethnicity Ethnicity not stated in the paper but participants were assumed to >80% South Asian for this analysis Recruitment Children were from state and private schools in 10 urban areas. Selection was randomised though it's not clear how this occurred.
Inclusion criteria	Children 10-18 years old
Exclusion criteria	Not reported
Number of participants	1225
Length of follow-up	NA
Loss to follow-up	NA

Index test(s)	Body mass index (BMI) Height measured using an anthropometric rod. Weighing was undertaken with "minimal clothing". Waist-to-height ratio (WHtR) Waist circumference (WC) Measured using a steel tape
Reference standard (s)	Hypertension Not defined in the paper
Subgroup analyses	Gender
Additional comments	No cut-offs presented

Population characteristics

Study-level characteristics

Characteristic	Study (N = 1225)
% Female Custom value	48.24%
Boys Mean (SD)	13.6 (2.3)
Girls	13.9 (2.5)

Characteristic	Study (N = 1225)
Mean (SD)	

Critical appraisal - GUT QUADAS-2: DIAGNOSIS CHILDREN

Section	Question	Answer
Patient selection: risk of bias	Could the selection of patients have introduced bias?	Low
Patient selection: applicability	Are there concerns that included patients do not match the review question?	Low
Index tests: risk of bias	Could the conduct or interpretation of the index test have introduced bias?	High (No threshold stated for accuracy outcomes)
Index tests: applicability	Are there concerns that the index test, its conduct, or interpretation differ from the review question?	Low
Reference standard: risk of bias	Could the reference standard, its conduct, or its interpretation have introduced bias?	High (Hypertension undefined)
Reference standard: applicability	Is there concern that the target condition as defined by the reference standard does not match the review question?	Low
Flow and timing: risk of bias	Could the patient flow have introduced bias?	Low

Overall risk of bias and directness	Risk of Bias	High (Due to thresholds not being pre-specified and outcome not fully defined.)
Overall risk of bias and directness	Directness	Directly applicable

Cheah, 2018

Bibliographic Reference	Cheah WL; Chang CT; Hazmi H; Kho GWF; Using Anthropometric Indicator to Identify Hypertension in Adolescents: A Study in Sarawak, Malaysia.; International journal of hypertension; 2018; vol. 2018

Study Characteristics

Study type	Cross-sectional study
Study details	Study location Sarawak, Malaysia. Study dates 2014-2015 Sources of funding Funded by the Fundamental Research Grant Scheme, Ministry of Higher Education Malaysia.

	Ethnicity The six major ethnic groups were stated to be Iban, Chinese, Malay, Bidayuh, Melanau, and Orang Ulu. The Chinese ethnicity were a little under 20%. For this analysis the other participants of the study are assumed to be Asian (other). Recruitment A quota of 18 schools were decided for each state and systematic sampling was employed in the selection of schools based on the size of enrolment as well as stratification by urban-rural location. In each selected school, one class was randomly selected for each level of schooling from secondary one to secondary six
Inclusion criteria	Children 13-17 years old
Exclusion criteria	Children with serious learning difficulties or physical or mental disorders
Number of participants	2461
Length of follow-up	NA
Loss to follow-up	NA
Index test(s)	Body mass index (BMI) Data collection was carried out by a team of trained field personnel. Anthropometric measurement was done using SECA body meter and portable weighing scale. Participants were weighed with light clothing without footwear. Waist-to-height ratio (WHtR)

	Waist circumference (WC) Measured using plastic non-elastic tape at the midpoint between the last rib and top of hip bone (iliac crest). The respondents were asked to relax their abdomen and stand upright
Reference standard (s)	Hypertension Blood pressure was taken using a digital blood pressure monitor, calibrated with auscultation (a mercury sphygmomanometer) with the correct cuff size for arm circumference. Participants were asked to rest for 5 minutes and check for no intake of caffeine or medication or no exercise before measurement. Classification of hypertension: BP 95th percentile or above. BP less than the 90th percentile for age, gender, and height is normal. BP within 90th to just below 95th percentile is categorized as prehypertension or high-normal.
Subgroup analyses	Gender
Additional comments	Using the Youden Index (J) method, the optimal cut-off was determined based on the difference between true positive rate and false positive rate over all possible cut-off values

Population characteristics

Study-level characteristics

Characteristic	**Study (N = 2461)**
% Female Custom value	58%
Mean age (SD)	14.5 (1.5)

Characteristic	Study (N = 2461)
Mean (SD)	

Critical appraisal - GUT QUADAS-2: DIAGNOSIS CHILDREN

Section	Question	Answer
Patient selection: risk of bias	Could the selection of patients have introduced bias?	Low
Patient selection: applicability	Are there concerns that included patients do not match the review question?	Low
Index tests: risk of bias	Could the conduct or interpretation of the index test have introduced bias?	High *(Due to calculating optimal thresholds for the data)*
Index tests: applicability	Are there concerns that the index test, its conduct, or interpretation differ from the review question?	Low
Reference standard: risk of bias	Could the reference standard, its conduct, or its interpretation have introduced bias?	Low

Section	Question	Answer
Reference standard: applicability	Is there concern that the target condition as defined by the reference standard does not match the review question?	Low
Flow and timing: risk of bias	Could the patient flow have introduced bias?	Low
Overall risk of bias and directness	Risk of Bias	Moderate
Overall risk of bias and directness	Directness	Directly applicable

Section	Question	Answer
Patient selection: risk of bias	Could the selection of patients have introduced bias?	Low
Patient selection: applicability	Are there concerns that included patients do not match the review question?	Low
Index tests: risk of bias	Could the conduct or interpretation of the index test have introduced bias?	High (Due to calculating optimal thresholds for the data)

Section	Question	Answer
Index tests: applicability	Are there concerns that the index test, its conduct, or interpretation differ from the review question?	Low
Reference standard: risk of bias	Could the reference standard, its conduct, or its interpretation have introduced bias?	Low
Reference standard: applicability	Is there concern that the target condition as defined by the reference standard does not match the review question?	Low
Flow and timing: risk of bias	Could the patient flow have introduced bias?	Low
Overall risk of bias and directness	Risk of Bias	Moderate
Overall risk of bias and directness	Directness	Directly applicable

Chiolero, 2013

Bibliographic Reference	Chiolero A; Paradis G; Maximova K; Burnier M; Bovet P; No use for waist-for-height ratio in addition to body mass index to identify children with elevated blood pressure.; Blood pressure; 2013; vol. 22 (no. 1)

Study Characteristics

Study type	Cross-sectional study

Study details	Setting Weight, height, waist circumference and BP were measured in all sixth-grade schoolchildren of the canton de Vaud (Switzerland) in 2005/06 Ethnicity Ethnicity not stated but assumed to be >80% White for this analysis
Inclusion criteria	Sixth grade school children (11-12 years old)
Exclusion criteria	Not reported
Number of participants	5207
Length of follow-up	NA
Loss to follow-up	76% response rate
Index test(s)	Waist-to-height ratio (WHtR) Waist circumference was measured at mid-distance between the last floating rib and the iliac crest at the end of normal expiration with a standard tape measure (at 0.1 cm). Body mass index (BMI) z-score Weight and height were measured with precision electronic scales (at 0.1 kg) and fixed stadiometers (at 0.1 cm).
Reference standard (s)	Hypertension BP was measured on the right arm. The mid-arm circumference was measured and the cuff width adapted accordingly. Three measurements of BP were taken at 1-min intervals after a rest of at least 3 minutes, in a seated position, using a clinically validated oscillometric device.

	Elevated BP was defined as systolic BP and/or diastolic BP equal to or above the US reference sex-, age- and height specific 95th percentile

Population characteristics

Study-level characteristics

Characteristic	Study (N = 5207)
% Female Sample size	n = 2586 ; % = 50
Mean age (SD) Mean (SD)	12.3 (0.5)

Critical appraisal - GUT QUADAS-2: DIAGNOSIS CHILDREN

Section	Question	Answer
Patient selection: risk of bias	Could the selection of patients have introduced bias?	Low
Patient selection: applicability	Are there concerns that included patients do not match the review question?	Low
Index tests: risk of bias	Could the conduct or interpretation of the index test have introduced bias?	Low

Index tests: applicability	Are there concerns that the index test, its conduct, or interpretation differ from the review question?	Low
Reference standard: risk of bias	Could the reference standard, its conduct, or its interpretation have introduced bias?	Low
Reference standard: applicability	Is there concern that the target condition as defined by the reference standard does not match the review question?	Low
Flow and timing: risk of bias	Could the patient flow have introduced bias?	Low
Overall risk of bias and directness	Risk of Bias	Low
Overall risk of bias and directness	Directness	Directly applicable

Christofaro, 2018

Bibliographic Reference	Christofaro, Diego G D; Farah, Breno Q; Vanderlei, Luiz Carlos M; Delfino, Leandro D; Tebar, William R; Barros, Mauro Virgilio G de; Ritti-Dias, Raphael M; Analysis of different anthropometric indicators in the detection of high blood pressure in school adolescents: a cross-sectional study with 8295 adolescents.; Brazilian journal of physical therapy; 2018; vol. 22 (no. 1); 49-54

Study Characteristics

Study type	Cross-sectional study

Study details	Study location States of Paraná (Southern Brazil) and Pernam-buco (Northeastern Brazil). Setting The databases from two school based studies involving adolescents (aged 10-17 years old) Study dates not reported Sources of funding Not reported. Though the authors declare no conflicts of interest. Ethnicity Ethnicity of participants not stated. For this analysis the participants have been classed in the Other ethnicity category.
Inclusion criteria	Children 10-17 years old
Exclusion criteria	Not reported
Number of participants	8295
Length of follow-up	NA
Loss to follow-up	NA
Index test(s)	Body mass index (BMI)

	Participants wore light clothing during all measurements. Body mass was measured using a digital scale with a precision of 0.1 kg and a maximum capacity of 150 kg. Height was measured using a portable stadiometer with an accuracy to 0.1 cm. Waist-to-height ratio (WHtR) Waist circumference (WC) WC was obtained using a tape measure to the nearest 0.1 cm (the average of two measures was used).
Reference standard (s)	Hypertension To assess blood pressure, an oscillometric equipment was used (Omron, model HEM 742). This equipment was previously validated for use in adolescents. The table used for the classification of blood pressure in the sample was subject to the National High Blood Pres-sure Education Program. High blood pressure was defined as systolic and/or diastolic blood pressure equal to or higher than the reference for the sex, age, and height-specific 95th percentile.
Additional comments	Published cut-offs used. BMI: 95.3 percentile for males and 84.8 for females WC: 80th percentile WHtR: 0.5

Population characteristics

Study-level characteristics

Characteristic	Study (N = 8295)
% Female Sample size	n = 4877

Critical appraisal - GUT QUADAS-2: DIAGNOSIS CHILDREN

Section	Question	Answer
Patient selection: risk of bias	Could the selection of patients have introduced bias?	Low
Patient selection: applicability	Are there concerns that included patients do not match the review question?	Low
Index tests: risk of bias	Could the conduct or interpretation of the index test have introduced bias?	Low
Index tests: applicability	Are there concerns that the index test, its conduct, or interpretation differ from the review question?	Low
Reference standard: risk of bias	Could the reference standard, its conduct, or its interpretation have introduced bias?	Low
Reference standard: applicability	Is there concern that the target condition as defined by the reference standard does not match the review question?	Low
Flow and timing: risk of bias	Could the patient flow have introduced bias?	Low
Overall risk of bias and directness	Risk of Bias	Low

Overall risk of bias and directness	Directness	Directly applicable

Dong, 2015

Bibliographic Reference	Dong, B; Wang, Z; Wang, H-J; Ma, J; Associations between adiposity indicators and elevated blood pressure among Chinese children and adolescents.; Journal of human hypertension; 2015; vol. 29 (no. 4); 236-40

Study Characteristics

Study type	Cross-sectional study
Study details	Study location China Setting The sampling procedures of 2010 Chinese National Survey on Students' Constitution and Health Study dates not reported Sources of funding This work was supported by the grant from the National Health and Medical Research Council of Australia

	Ethnicity Ethnicity of participants stated to be Han nationality. Recruitment Children recruited from primary and secondary schools
Inclusion criteria	Children 7-17 years old
Exclusion criteria	Participants with extreme height, weight, BP, BMI, waist circumference, hip circumference or skinfold thickness
Number of participants	99 583 Han nationality children and adolescents aged 7–17 years
Length of follow-up	NA
Loss to follow-up	NA
Index test(s)	Body mass index (BMI) z-score Measurements were performed according to the same protocol at all survey sites. Participants were asked to wear light clothes only and to stand straight without shoes. Height was measured using a wall-mounted stadiometer to the nearest 0.1 cm, and weight was measured with a scale to the nearest 0.1 kg. Waist-to-hip ratio (WHR) z-score Waist-to-height ratio (WHtR) z-score Waist circumference (WC) z-score Measured horizontally 1 cm above the navel at the end of normal expiration and hip circumference was measured at maximal protrusion of the buttocks, by a nonelastic flexible tape to the nearest 0.1 cm.

Reference standard (s)	Hypertension BP was measured according to the recommendation of the National High Blood Pressure Education Program (NHBPEP) Working Group in Children and Adolescents, using an auscultation mercury sphygmomanometer with an appropriate cuff size for children. BP measurements were taken 5 min after resting. Systolic blood pressure was defined as the onset of 'tapping' Korotkoff sounds, and diastolic blood pressure was defined as the fifth Korotkoff sounds. An average of three BP measurements at a single visit was calculated for each child.
Subgroup analyses	Gender

Population characteristics

Study-level characteristics

Characteristic	**Study (N = 99366)**
% Female Sample size	n = 9852
Mean age (SD) Mean (SD)	12 (3.2)

Critical appraisal - GUT QUADAS-2: DIAGNOSIS CHILDREN

Section	Question	Answer
Patient selection: risk of bias	Could the selection of patients have introduced bias?	Low

Patient selection: applicability	Are there concerns that included patients do not match the review question?	Low
Index tests: risk of bias	Could the conduct or interpretation of the index test have introduced bias?	Low
Index tests: applicability	Are there concerns that the index test, its conduct, or interpretation differ from the review question?	Low
Reference standard: risk of bias	Could the reference standard, its conduct, or its interpretation have introduced bias?	Low
Reference standard: applicability	Is there concern that the target condition as defined by the reference standard does not match the review question?	Low
Flow and timing: risk of bias	Could the patient flow have introduced bias?	Low
Overall risk of bias and directness	Risk of Bias	Low
Overall risk of bias and directness	Directness	Directly applicable

Fowokan, 2019

Bibliographic Reference	Fowokan, Adeleke O; Punthakee, Zubin; Waddell, Charlotte; Rosin, Miriam; Morrison, Katherine M; Gupta, Milan; Teo, Koon; Rangarajan, Sumathy; Lear, Scott A; Adiposity measures and their validity in estimating risk of hypertension in South Asian children: a cross-sectional study.; BMJ open; 2019; vol. 9 (no. 2); e024087

Study Characteristics

Study type	Cross-sectional study
Study details	Study location Canada Setting Community-based recruitment in two Canadian cities (Hamilton and Surrey). Study dates Between 2012 and 2016 Sources of funding This study was funded by the Canadian Institutes of Health Research (FRN: 109206). Ethnicity Children of South Asian ethnicity were recruited for this study
Inclusion criteria	Children In elementary or high school who have at least three grandparents of South Asian origin
Exclusion criteria	Not reported
Number of participants	360 boys and 402 girls (n=762)
Length of follow-up	NA
Loss to follow-up	NA

Index test(s)	Body mass index (BMI) z-score Measured by trained researchers. Height was measured to the nearest 0.1 cm using a right angle triangle and a calibrated wall-mounted scale. Weight was measured to the nearest 0.1 kg using the Tanita Ironman Innerscan BC-554 scale with participants dressed in light clothing. Following anthropometric assessment, BMI was transformed to z-scores using WHO growth references for young people aged 5–19 years. Waist-to-height ratio (WHtR) z-score WC and WHtR were both transformed to z-scores using recently published values for age and sex using the Third US National Health and Nutrition Examination Survey (NHANES III) Waist circumference (WC) z-score WC was recorded in centimetres as the average of two measures taken using a non-stretching tape, against the skin after a normal expiration, halfway between the lower rib margin and the iliac crest
Reference standard (s)	Hypertension Systolic and diastolic hypertension were diagnosed using the NHBPEP recommendations as average systolic blood pressure or diastolic blood pressure that is greater than or equal to the 95th percentile for sex, age and height
Subgroup analyses	Gender
Additional comments	Using the highest Youden’s index (J) the study determined cut-off values for the adiposity indices that optimise both the sensitivity and specificity for identifying hypertension

Population characteristics

Study-level characteristics

Characteristic	Study (N = 762)
% Female Sample size	n = 402
Mean age (SD) Mean (SD)	9.5 (3)

Critical appraisal - GUT QUADAS-2: DIAGNOSIS CHILDREN

Section	Question	Answer
Patient selection: risk of bias	Could the selection of patients have introduced bias?	Low
Patient selection: applicability	Are there concerns that included patients do not match the review question?	High (The ethnicity was determined by grandparents ethnicity rather than the child's or parents.)
Index tests: risk of bias	Could the conduct or interpretation of the index test have introduced bias?	High (Prespecified thresholds were not used.)
Index tests: applicability	Are there concerns that the index test, its conduct, or interpretation differ from the review question?	Low
Reference standard: risk of bias	Could the reference standard, its conduct, or its interpretation have introduced bias?	Low

Reference standard: applicability	Is there concern that the target condition as defined by the reference standard does not match the review question?	Low
Flow and timing: risk of bias	Could the patient flow have introduced bias?	Low
Overall risk of bias and directness	Risk of Bias	Moderate (Due to not using pre-specified thresholds.)
Overall risk of bias and directness	Directness	Partially applicable (Due to uncertainty about the ethnicity of the participants.)

Hirschler, 2011

Bibliographic Reference	Hirschler, Valeria; Molinari, Claudia; Maccallini, Gustavo; Aranda, Claudio; Oestreicher, Karin; Comparison of different anthropometric indices for identifying dyslipidemia in school children; Clinical Biochemistry; 2011; vol. 44 (no. 89); 659-664

Study Characteristics

Study type	Cross-sectional study
Study details	Study location Argentina Setting

	10 schools were randomly selected from 51 schools from the west side of Buenos Aires Study dates 2007-2008 Sources of funding Not stated Ethnicity The study states about 85% of the Argentine's population is of European descent (largely Spanish and Italian), with the remainder of mixed European and American Indian (12%) or American Indian descent (3%). For this analysis the study participants were assigned as Other ethnicity. Recruitment Custer sampling utilised.
Inclusion criteria	Children 5-15 years old
Exclusion criteria	Not fasting for at least 12 hours The presence of diabetes or other chronic diseases; Use of medication that would affect blood pressure (BP), glucose, or lipid metabolism Missing BMI or blood pressure information

Number of participants	1261
Length of follow-up	NA
Loss to follow-up	NA
Index test(s)	Waist-to-height ratio (WHtR) Waist circumference (WC) Body mass index (BMI) z-score BMI was converted to age- and sex-standardized z-scores and percentiles based on the CDC 2000 growth charts
Reference standard (s)	Dyslipidaemia The National Cholesterol Education Program (NCEP) guidelines are ≥5.18 mmol/L for total cholesterol and ≥3.37 mmol/L for low-density lipoprotein cholesterol (LDL-C).
Additional comments	The optimal threshold was determined representing the point on the ROC curve that optimizes specificity and sensitivity.

Population characteristics

Study-level characteristics

Characteristic	Study (N = 1261)
% Female Custom value	49%
Mean age (SD) Mean (SD)	9.5 (2.1)

Critical appraisal - GUT QUADAS-2: DIAGNOSIS CHILDREN

Section	Question	Answer
Patient selection: risk of bias	Could the selection of patients have introduced bias?	Low
Patient selection: applicability	Are there concerns that included patients do not match the review question?	Low
Index tests: risk of bias	Could the conduct or interpretation of the index test have introduced bias?	High (Optimal thresholds generated from the accuracy data)
Index tests: applicability	Are there concerns that the index test, its conduct, or interpretation differ from the review question?	Low
Reference standard: risk of bias	Could the reference standard, its conduct, or its interpretation have introduced bias?	Low
Reference standard: applicability	Is there concern that the target condition as defined by the reference standard does not match the review question?	Low
Flow and timing: risk of bias	Could the patient flow have introduced bias?	Low
Overall risk of bias and directness	Risk of Bias	Moderate (Optimal thresholds generated from the accuracy data)

Overall risk of bias and directness	Directness	Directly applicable

Hsu, 2020

Bibliographic Reference	Hsu, Chih-Yu; Lin, Rong-Ho; Lin, Yu-Ching; Chen, Jau-Yuan; Li, Wen-Cheng; Lee, Li-Ang; Liu, Keng-Hao; Chuang, Hai-Hua; Are Body Composition Parameters Better than Conventional Anthropometric Measures in Predicting Pediatric Hypertension?.; International journal of environmental research and public health; 2020; vol. 17 (no. 16)

Study Characteristics

Study type	Cross-sectional study
Study details	Study location Taiwan Setting Anonymous data from the database of a school-based health promotion project conducted by a single institution (Chang Gung Memorial Hospital, Linkou Main Branch, Taoyuan) i Study dates from 2013 to 2016. Sources of funding

	The study was funded by Chang Gung Medical Foundation, Grant number CORPG3C0011, 3C0012, 3C0013; CMRPG3F0491, 3F0492; CMRPG1H0061, CMRPG1H0062 and CORPG1I0021 (H. H. C.). Ethnicity Most participants were Han ethnicity and therefore were assumed to be >80% Chinese for this analysis
Inclusion criteria	Children aged 7–12 years
Exclusion criteria	Not reported
Number of participants	In total, 340 children (177; 52.1% girls and 163; 47.9% boys) with a mean age of 8.8 ± 1.7 years (range, 7–12 years)
Length of follow-up	not reported
Loss to follow-up	not reported
Index test(s)	Body mass index (BMI) The weight (in kg) and height (in cm) of all participants were measured according to standard protocols without shoes Waist-to-height ratio (WHtR) Waist circumference (in cm) was determined by measuring the circumference in the horizontal plane midway between the lowest ribs and the iliac crest Body mass index (BMI) z-score BMI z-scores and percentiles were calculated based on sex and age in months according to the United States Centers for Disease Control and Prevention 2000 growth charts
Reference standard (s)	Hypertension

	BP was recorded using an automated sphygmomanometer after placing the participant in a seated position for at least 10 minutes. Paediatric hypertension was defined as average clinic SBP and/or DBP ≥95th percentile on the basis of age, sex and height percentiles
Additional comments	Using receiver operator characteristic curves, the optimal cut-off values of anthropometric and BC measures were determined to predict paediatric hypertension using the maximal Youden index

Population characteristics

Study-level characteristics

Characteristic	**Study (N = 340)**
% Female Sample size	n = 177 ; % = 52.1
Mean age (SD) Mean (SD)	8.8 (1.7)

Critical appraisal - GUT QUADAS-2: DIAGNOSIS CHILDREN

Section	Question	Answer
Patient selection: risk of bias	Could the selection of patients have introduced bias?	Low
Patient selection: applicability	Are there concerns that included patients do not match the review question?	Low

Index tests: risk of bias	Could the conduct or interpretation of the index test have introduced bias?	High (Optimal threshold calculated from the accuracy data)
Index tests: applicability	Are there concerns that the index test, its conduct, or interpretation differ from the review question?	Low
Reference standard: risk of bias	Could the reference standard, its conduct, or its interpretation have introduced bias?	Low
Reference standard: applicability	Is there concern that the target condition as defined by the reference standard does not match the review question?	Low
Flow and timing: risk of bias	Could the patient flow have introduced bias?	Low
Overall risk of bias and directness	Risk of Bias	Moderate (Optimal threshold calculated from the accuracy data)
Overall risk of bias and directness	Directness	Directly applicable

Kromeyer-Hauschild, 2013

Bibliographic Reference	Kromeyer-Hauschild, Katrin; Neuhauser, Hannelore; Schaffrath Rosario, Angelika; Schienkiewitz, Anja; Abdominal obesity in German adolescents defined by waist-to-height ratio and its association to elevated blood pressure: the KiGGS study.; Obesity facts; 2013; vol. 6 (no. 2); 165-75

Study Characteristics

Study type	Cross-sectional study
Study details	Study location Germany Setting Data from the German Health Interview and Examination Survey for Children and Adolescents (KiGGS) Study dates May 2003 to May 2006 Sources of funding The KiGGS survey was funded by the German Ministry of Health, the Ministry of Education and Research, and the Robert Koch Institute Ethnicity Ethnicity not stated but for this analysis the participants were assumed to be >80% white ethnicity.
Inclusion criteria	Children 0-17 years old
Exclusion criteria	Participants with incomplete or invalid measurements as well as participants with chronic conditions or intake of medication that can influence growth and weight development had been excluded from the reference population.
Number of participants	17,641 participants (8,985 boys, 8,656 girls) aged 0–17 years
Length of follow-up	NA

Loss to follow-up	Response rate 67%
Index test(s)	Waist-to-height ratio (WHtR) Anthropometric measurements were performed by trained staff. A non-elastic tape was used to measure waist circumference (WC) at the level of the natural waist, which is the narrowest part of the torso, as seen from the anterior aspect, to the nearest 0.1 cm Body mass index (BMI) z-score Height was measured to the nearest 0.1 cm with a portable Harpenden stadiometer and body weight to the nearest 0.1 kg using a calibrated electronic scale. Waist-to-height ratio (WHtR) z-score
Reference standard (s)	Hypertension BP was classified as hypertensive when the systolic and/or diastolic BP was at or above the 95th age-, sex- and height-specific percentile according to the KiGGS reference data or if the adult threshold for hypertension of 140/90 mm Hg was exceeded
Additional comments	ROC analysis by sex was carried out to find the WHtR cut-offs with the best trade-off between sensitivity and specificity to identify subjects with hypertensive BP values.

Population characteristics

Study-level characteristics

Characteristic	Study (N = 6813)
% Female Sample size	n = 3321

Critical appraisal - GUT QUADAS-2: DIAGNOSIS CHILDREN

Section	Question	Answer
Patient selection: risk of bias	Could the selection of patients have introduced bias?	High (The response rate was 73% so not entirely consecutive.)
Patient selection: applicability	Are there concerns that included patients do not match the review question?	Low
Index tests: risk of bias	Could the conduct or interpretation of the index test have introduced bias?	Low
Index tests: applicability	Are there concerns that the index test, its conduct, or interpretation differ from the review question?	Low
Reference standard: risk of bias	Could the reference standard, its conduct, or its interpretation have introduced bias?	Low
Reference standard: applicability	Is there concern that the target condition as defined by the reference standard does not match the review question?	Low
Flow and timing: risk of bias	Could the patient flow have introduced bias?	Low
Overall risk of bias and directness	Risk of Bias	Moderate
Overall risk of bias and directness	Directness	Directly applicable

Li, 2014

Bibliographic Reference	Li, Tai-shun; Sun, Wen-jie; Wei, Ming-wei; Chen, Shi-hong; Wang, Peng; Wang, Xu-lin; He, Lian-ping; Wen, Yu-feng; Roc curves of obesity indicators have a predictive value for children hypertension aged 7-17 years.; Nutricion hospitalaria; 2014; vol. 30 (no. 2); 275-80

Study Characteristics

Study type	Cross-sectional study
Study details	Study location China Setting 2 cities were randomly selected from 22 cities. 5 primary schools were then randomly selected from the cities. Study dates 2013 Sources of funding This research was supported by Wannan Medical College key scientific research projects Engagement Fund (WK2014Z05). Ethnicity Ethnicity of participants not stated but assumed to be >80% Chinese for this analysis

Inclusion criteria	Children 7-17 years old
Exclusion criteria	Not reported
Number of participants	A total of 2,828 subjects (1,588 male and 1,240 female) aged 7-17 years
Length of follow-up	NA
Loss to follow-up	Response rate was 94.4%
Index test(s)	Body mass index (BMI) All measurements were conducted by a team of trained technicians in each of the selected districts and finished by the same type of apparatus and followed standard procedures. Height, weight, hipline and waistline of children were measured by using a calibrated stationmaster Waist-to-hip ratio (WHR) Hipline was measured at the widest level over the great trochanters using a plastic flexible tape to the nearest 0.1 cm. Waist-to-height ratio (WHtR) Height without shoes was measured by Metal column height-measuring by stands to the nearest 0.1 cm Waist circumference (WC) Measured midway between the lowest rib and the superior border of the iliac crest with a non-elastic measuring tape at the end of normal expiration to the nearest 0.1cm.
Reference standard (s)	Hypertension

	All BP measurements were recorded using an aneroid sphygmomanometer with the participants in a comfortable seated position and the right arm fully exposed and resting on a supportive surface at heart level. Children hypertension was defined by China national reference standard: systolic blood pressure or diastolic blood pressure equal or greater than the 95th percentile of the SBP or DBP with the same age and gender.
Subgroup analyses	Gender

Population characteristics

Study-level characteristics

Characteristic	**Study (N = 2828)**
% Female Sample size	n = 1240

Critical appraisal - GUT QUADAS-2: DIAGNOSIS CHILDREN

Section	Question	Answer
Patient selection: risk of bias	Could the selection of patients have introduced bias?	Low
Patient selection: applicability	Are there concerns that included patients do not match the review question?	Low
Index tests: risk of bias	Could the conduct or interpretation of the index test have introduced bias?	Low

Index tests: applicability	Are there concerns that the index test, its conduct, or interpretation differ from the review question?	Low
Reference standard: risk of bias	Could the reference standard, its conduct, or its interpretation have introduced bias?	Low
Reference standard: applicability	Is there concern that the target condition as defined by the reference standard does not match the review question?	Low
Flow and timing: risk of bias	Could the patient flow have introduced bias?	Low
Overall risk of bias and directness	Risk of Bias	Low
Overall risk of bias and directness	Directness	Directly applicable

Li, 2020

Bibliographic Reference	Li, Yamei; Zou, Zhiyong; Luo, Jiayou; Ma, Jun; Ma, Yinghua; Jing, Jin; Zhang, Xin; Luo, Chunyan; Wang, Hong; Zhao, Haiping; Pan, Dehong; Jia, Peng; The predictive value of anthropometric indices for cardiometabolic risk factors in Chinese children and adolescents: A national multicenter school-based study.; PloS one; 2020; vol. 15 (no. 1); e0227954

Study Characteristics

Study type	Cross-sectional study
Study details	Study location

	China Setting Survey conducted during September and December 2013 in seven provinces in China. Study dates 2013-2014 Ethnicity Participants ethnicity was not stated but assumed to be >80% Chinese for this analysis Recruitment Multi-stage stratified cluster sampling method was used to recruit primary and secondary students: 4–10 primary schools, 2–6 junior high schools, and 2–6 senior high schools were randomly selected in each province; 15–25 classes were randomly chosen from each of Grades 1–12 in the selected schools, except Grades 6, 9, and 12 to avoid influences on their preparation for graduation examination.
Inclusion criteria	Children 6-17 years old
Exclusion criteria	Use of medication that would affect blood pressure (BP), glucose, or lipid metabolism People with missing anthropometric measurements
Number of participants	65347
Length of follow-up	NA
Loss to follow-up	NA

Index test(s)	Waist-to-hip ratio (WHR) Measured by experienced technicians in accordance with standard procedures. Waist-to-height ratio (WHtR) Body mass index (BMI) z-score Waist circumference (WC) z-score
Reference standard (s)	Hypertension Blood pressures were measured by trained medical staff with mercury sphygmomanometers (model XJ11D, China), stethoscopes (model TZ-1, China), and appropriate cuffs. Hypertension was either/both SBP and DBP at or above the 95th percentile based on age and sex respectively Dyslipidaemia TC and TG levels were measured by enzymatic methods; and LDL and HDL levels were measured by clearance method. Dyslipidemia was defined as the presence of one or more of: TC ≥5.18 mmol/L; nHDL ≥3.76 mmol/L; LDL ≥3.37 mmol/L; TG ≥1.13 mmol/L for 0–9 years and ≥1.47 mmol/L for 10–19 years; HDL <1.04 mmol/L.
Subgroup analyses	Gender
Additional comments	

Population characteristics

Study-level characteristics

Characteristic	Study (N = 15698)
% Female Custom value	49%
Mean age (SD) Mean (SD)	11.08 (3.29)

Critical appraisal - GUT QUADAS-2: DIAGNOSIS CHILDREN

Section	Question	Answer
Patient selection: risk of bias	Could the selection of patients have introduced bias?	Low
Patient selection: applicability	Are there concerns that included patients do not match the review question?	Low
Index tests: risk of bias	Could the conduct or interpretation of the index test have introduced bias?	Low
Index tests: applicability	Are there concerns that the index test, its conduct, or interpretation differ from the review question?	Low
Reference standard: risk of bias	Could the reference standard, its conduct, or its interpretation have introduced bias?	Low

Reference standard: applicability	Is there concern that the target condition as defined by the reference standard does not match the review question?	Low
Flow and timing: risk of bias	Could the patient flow have introduced bias?	Low
Overall risk of bias and directness	Risk of Bias	Low
Overall risk of bias and directness	Directness	Directly applicable

Liang, 2015

Bibliographic Reference	Liang, J-j; Chen, Y-j; Jin, Y; Yang, W-h; Mai, J-c; Ma, J; Jing, J; Comparison of adiposity measures in the identification of children with elevated blood pressure in Guangzhou, China.; Journal of human hypertension; 2015; vol. 29 (no. 12); 732-6

Study Characteristics

Study type	Cross-sectional study
Study details	Study location Guangzhou, China Setting Pupils from seven primary schools in Guangzhou, China, between September and October in 2013.

	Sources of funding This work was supported by special research grant for non-profit public service of the Ministry of Health of China (Grant no. 201202010). Ethnicity Participants assumed to be >80% Chinese ethnicity for this analysis
Inclusion criteria	Children 6-10 years old
Exclusion criteria	Children with missing or invalid BP or anthropometric data,
Number of participants	A total of 5601 pupils (2731 girls, 2870 boys) aged 6–10 years
Length of follow-up	NA
Loss to follow-up	NA
Index test(s)	Body mass index (BMI) Trained physicians collected anthropometric data. Body height was measured according to a standardised protocol to the nearest 0.1 cm. Body weight was measured with the child wearing only underwear to the nearest 0.1 kg. Waist-to-hip ratio (WHR) Hip circumference was measured using the point of maximum girth around the buttocks Waist-to-height ratio (WHtR) Waist circumference (WC)

	Measured to the nearest 1 mm at the midway between the lowest rib and the superior border of the iliac crest with a flexible tape
Reference standard (s)	Hypertension BP was obtained by using a mercury sphygmomanometer after each subject had rested for at least 15 min in a sitting position. Elevated BP was defined as systolic BP (SBP) and/or DBP ⩾ 95th percentile for age and gender according to the BP reference standards for Chinese children and adolescents established in 2010.11
Subgroup analyses	Gender
Additional comments	

Population characteristics

Study-level characteristics

Characteristic	**Study (N = 5601)**
% Female Sample size	n = 2672 ; % = 48

Critical appraisal - GUT QUADAS-2: DIAGNOSIS CHILDREN

Section	Question	Answer

Patient selection: risk of bias	Could the selection of patients have introduced bias?	Low
Patient selection: applicability	Are there concerns that included patients do not match the review question?	Low
Index tests: risk of bias	Could the conduct or interpretation of the index test have introduced bias?	Low
Index tests: applicability	Are there concerns that the index test, its conduct, or interpretation differ from the review question?	Low
Reference standard: risk of bias	Could the reference standard, its conduct, or its interpretation have introduced bias?	Low
Reference standard: applicability	Is there concern that the target condition as defined by the reference standard does not match the review question?	Low
Flow and timing: risk of bias	Could the patient flow have introduced bias?	Low
Overall risk of bias and directness	Risk of Bias	Low
Overall risk of bias and directness	Directness	Directly applicable

Lopez-Gonzalez, 2016

Bibliographic Reference	Lopez-Gonzalez, D.; Miranda-Lora, A.; Klunder-Klunder, M.; Queipo-Garcia, G.; Bustos-Esquivel, M.; Paez-Villa, M.; Chavez-Requena, I.; Garibay-Nieto, N.; Villanueva-Ortega, E.; Laresgoiti-Servitje, E.; Diagnostic performance of waist circumference measurments for predicting cardiometabolic risk in mexican children; Endocrine Practice; 2016; vol. 22 (no. 10); 1170-1176

Study Characteristics

Study type	Cross-sectional study
Study details	Study location Mexico Setting Obesity clinic in a hospital in Mexico city. Study dates 2011 - 2015 Sources of funding Work funded by a grant from CONACyT SALUD-2012-01-181786 Ethnicity Ethnicity of participants was not stated but analysed as Other in this review. Recruitment Children with overweight or obesity who attended hospital were recruited. Normal weight children were recruited from schools.
Inclusion criteria	Children 10-18 years old
Exclusion criteria	The presence of diabetes or other chronic diseases;

	Use of medication that would affect blood pressure (BP), glucose, or lipid metabolism
Number of participants	366
Length of follow-up	NA
Loss to follow-up	NA
Index test(s)	Waist circumference Measurements taken by paediatric obesity specialists and paediatric endocrinologists. Two methods were used. WHO: midpoint between the lowest rib and immediately above the iliac crest. NCHS: point immediately above the iliac crest. Waist-to-height ratio (WHtR)
Reference standard (s)	Hypertension Not defined.

Population characteristics

Study-level characteristics

Characteristic	**Study (N = 366)**
% Female Sample size	n = 179 ; % = 49

Critical appraisal - GUT QUADAS-2: DIAGNOSIS CHILDREN

Section	Question	Answer

Patient selection: risk of bias	Could the selection of patients have introduced bias?	High (Opportunity sampling used.)
Patient selection: applicability	Are there concerns that included patients do not match the review question?	Low
Index tests: risk of bias	Could the conduct or interpretation of the index test have introduced bias?	Low
Index tests: applicability	Are there concerns that the index test, its conduct, or interpretation differ from the review question?	Low
Reference standard: risk of bias	Could the reference standard, its conduct, or its interpretation have introduced bias?	High (Hypertension was not defined)
Reference standard: applicability	Is there concern that the target condition as defined by the reference standard does not match the review question?	Low
Flow and timing: risk of bias	Could the patient flow have introduced bias?	Low
Overall risk of bias and directness	Risk of Bias	High (Due to opportunity sampling and hypertension definition used in analysis not provided.)
Overall risk of bias and directness	Directness	Directly applicable

Ma, 2015

Bibliographic Reference	Ma, Chun-ming; Li, Yang; Gao, Guo-qin; Yin, Fu-Zai; Wang, Rui; Liu, Xiao-li; Lu, Qiang; Mid-upper arm circumference as a screening measure for identifying children with hypertension.; Blood pressure monitoring; 2015; vol. 20 (no. 4); 189-93

Study Characteristics

Study type	Cross-sectional study
Study details	Study location China Setting Samples of primary schools in Qinhuangdao, China, were obtained randomly; in the second stage, children aged 7–12 years in these schools were invited to participate. Study dates In 2011 Sources of funding not reported Ethnicity All children were Chinese ethnicity

	Recruitment The study population was determined according to two-stage cluster sampling.
Inclusion criteria	Children aged 7–12 years
Exclusion criteria	Children with a diagnosis of secondary hypertension, acute or chronic illnesses, infections, renal or hepatic diseases, or neoplasia or who were under medical treatment were excluded.
Number of participants	A total of 1352 Han children (679 boys and 673 girls) were included in the study population
Length of follow-up	NA
Loss to follow-up	NA
Index test(s)	Body mass index (BMI) Anthropometric measurements, including height, weight, WC, and MUAC, were obtained while the participants were in light clothing and barefoot. Waist circumference (WC) WC was accurately measured at the level of the midway point between the lowest rib and the top of the iliac crest.
Reference standard (s)	Hypertension Hypertension was determined by blood pressure–mean SBP or DBP of at least 95th percentile for all three screenings
Subgroup analyses	Gender
Additional comments	

Population characteristics

Study-level characteristics

Characteristic	Study (N = 1352)
% Female Sample size	n = 673 ; % = 50

Critical appraisal - GUT QUADAS-2: DIAGNOSIS CHILDREN

Section	Question	Answer
Patient selection: risk of bias	Could the selection of patients have introduced bias?	Low
Patient selection: applicability	Are there concerns that included patients do not match the review question?	Low
Index tests: risk of bias	Could the conduct or interpretation of the index test have introduced bias?	Low
Index tests: applicability	Are there concerns that the index test, its conduct, or interpretation differ from the review question?	Low
Reference standard: risk of bias	Could the reference standard, its conduct, or its interpretation have introduced bias?	Low
Reference standard: applicability	Is there concern that the target condition as defined by the reference standard does not match the review question?	Low
Flow and timing: risk of bias	Could the patient flow have introduced bias?	Low

Overall risk of bias and directness	Risk of Bias	Low
Overall risk of bias and directness	Directness	Directly applicable

Mai, 2020

Bibliographic Reference	Mai TMT; Gallegos D; Jones L; Tran QC; Tran TMH; van der Pols JC; The utility of anthopometric indicators to identify cardiovascular risk factors in Vietnamese children.; The British journal of nutrition; vol. 123 (no. 9)

Study Characteristics

Study type	Cross-sectional study
Study details	Study location Vietnam Setting Data from the Survey of Nutritional Status Among School-aged Children conducted by the HCMC Study dates Between October 2014 and January 2015

	Sources of funding This work was supported by the Australian Government Research Training Program, and QUT HDR Tuition Fee Scholarship to T. M. T. M. for the programme Doctor of Philosophy at Queensland University of Technology, Brisbane, Australia. Ethnicity Ethnicity was not stated but was assessed to be >80% Asian (other) for this analysis Recruitment The largest sample size of 10 900 students was from the estimation of mean height for each age group from 6 to 18 years in school-aged children in HCMC. This estimation was calculated from the standard deviation of height for age from the nutritional survey in school-aged children in HCMC in 2009. All schools in HCMC were categorised by school level (primary, secondary and high school) and location (urban and rural). Probability-proportion-to-size sampling was used to select schools from these school categories
Inclusion criteria	Children 6-18 years old
Exclusion criteria	Children with disorders affecting their ability to be accurately weighed and measured such as severe scoliosis, and urgent medical conditions such as high fever or diarrhoea
Number of participants	In total, 10 949 subjects were included in the analyses, 50·6 % were male and mean age was 10·7 (SD 3·4) years (range 6– 18 years).
Length of follow-up	NA
Loss to follow-up	NA
Index test(s)	Waist-to-height ratio (WHtR) Height, weight and WC were measured by trained health officers using standardised WHO guidelines.

	Body mass index (BMI) z-score Children wore light clothes and no shoes during measurement. Weight was measured to the nearest 0·1kg using electronic scales. Height was measured using a wooden stadiometer Waist circumference (WC) z-score Measured using non-elastic tape-measures against the skin at the midpoint between the lower costal border and the top of the iliac crest at the end of expiration, to the nearest 0·1 cm. The circumference at the umbilicus was used if the anatomical landmarks could not be identified.
Reference standard (s)	Dyslipidaemia Dyslipidaemia was identified as having one of following: high cholesterol (total cholesterol≥ 5·18 mmol/l); hypertriacylglycerolaemia (TAG ≥ 1·13 mmol/l (6–9 year) or ≥1·47 mmol/l (10–18 years); low HDL (HDL < 0·91 mmol/l) or high LDL (LDL ≥ 3·37 mmol/l)
Additional comments	The optimal cut-off for anthropometric indicators was defined based on the maximum Youden index

Critical appraisal - GUT QUADAS-2: DIAGNOSIS CHILDREN

Section	Question	Answer
Patient selection: risk of bias	Could the selection of patients have introduced bias?	Low
Patient selection: applicability	Are there concerns that included patients do not match the review question?	Low

Index tests: risk of bias	Could the conduct or interpretation of the index test have introduced bias?	High (Optimal thresholds generated from the accuracy data)
Index tests: applicability	Are there concerns that the index test, its conduct, or interpretation differ from the review question?	Low
Reference standard: risk of bias	Could the reference standard, its conduct, or its interpretation have introduced bias?	Low
Reference standard: applicability	Is there concern that the target condition as defined by the reference standard does not match the review question?	Low
Flow and timing: risk of bias	Could the patient flow have introduced bias?	Low
Overall risk of bias and directness	Risk of Bias	Moderate
Overall risk of bias and directness	Directness	Directly applicable

Quadros, 2019

Bibliographic Reference	Quadros, Teresa Maria Bianchini de; Gordia, Alex Pinheiro; Andaki, Alynne Christian Ribeiro; Mendes, Edmar Lacerda; Mota, Jorge; Silva, Luciana Rodrigues; High blood pressure screening in children and adolescents from Amargosa, Bahia: usefulness of anthropometric indices of obesity.; Revista brasileira de epidemiologia = Brazilian journal of epidemiology; 2019; vol. 22; e190017

Study Characteristics

Study type	Cross-sectional study
Study details	Study location Amargosa, Bahia, Northeast region of Brazil Study dates Data were collected from August 2011 to May 2012. Ethnicity Ethnicity not stated but for this study we have analysed them under the Other ethnicity category. Recruitment Cluster sample of schools proportionally stratified by type of school (“urban public,” “rural public,” and “private”). Five urban public, five rural public, and one private school were selected, with the estimated sample size for each stratum being proportional to the study population. Students were randomly sampled with consideration given to the number of individuals required in each school to compose a sample equivalent to its size.
Inclusion criteria	Children 6-17 years old
Exclusion criteria	Not reported
Number of participants	1139
Length of follow-up	NA
Loss to follow-up	NA
Index test(s)	Body mass index (BMI)

	A Plenna digital scale, with capacity for 150 kg and resolution of 100 g measured body weight. The scale underwent a calibration test. Height was measured using a Seca portable stadiometer, model Bodymeter 208 fixed to the wall, graduated from 0 to 220 cm, with an accuracy of 0.1 cm. BMI was classified according to four criteria: International Obesity Task Force (IOTF)19, World Health Organization (WHO), Centers for Disease Control and Prevention (CDC), and Conde and Monteiro. Waist-to-height ratio (WHtR) Defined according to a cut-off point designed for adults (≥ 0.5) and the specific cut-off points for children and adolescents suggested by Kelishadi et al. and Zhou et al. Waist circumference (WC) Measured with an inelastic anthropometric tape with a resolution of 0.1 cm, based on procedures described by WHO, Evaluation was based on procedures described by WHO, and classified as normal or high according to criteria proposed by Taylor et al, Katzmarzyk et al, Fernández et al, and CDC. Body mass index (BMI) z-score Waist-to-height ratio (WHtR) z-score Waist circumference (WC) z-score
Reference standard (s)	Hypertension High BP was classified as systolic or diastolic ≥ 95th percentile, and adjusted for gender, age, and height.
Subgroup analyses	Age groups Broken up into children (6-9) and adolescents (10-17).

Population characteristics

Study-level characteristics

Characteristic	Study (N = 1139)
% Female Sample size	n = 633 ; % = 56

Critical appraisal - GUT QUADAS-2: DIAGNOSIS CHILDREN

Section	Question	Answer
Patient selection: risk of bias	Could the selection of patients have introduced bias?	Low
Patient selection: applicability	Are there concerns that included patients do not match the review question?	Low
Index tests: risk of bias	Could the conduct or interpretation of the index test have introduced bias?	Low
Index tests: applicability	Are there concerns that the index test, its conduct, or interpretation differ from the review question?	Low
Reference standard: risk of bias	Could the reference standard, its conduct, or its interpretation have introduced bias?	High (Blood pressure only measured once.)
Reference standard: applicability	Is there concern that the target condition as defined by the reference standard does not match the review question?	Low

Flow and timing: risk of bias	Could the patient flow have introduced bias?	Low
Overall risk of bias and directness	Risk of Bias	Moderate (Due to blood pressure being measured only once)
Overall risk of bias and directness	Directness	Directly applicable

Rosa, 2007

Bibliographic Reference	Rosa, Maria Luiza Garcia; Mesquita, Evandro Tinoco; da Rocha, Emanuel Ribeiro Romeiro; Fonseca, Vania de Matos; Body mass index and waist circumference as markers of arterial hypertension in adolescents.; Arquivos brasileiros de cardiologia; 2007; vol. 88 (no. 5); 573-8

Study Characteristics

Study type	Cross-sectional study
Study details	Study location Brazil Setting schools of the Fonseca neighbourhood, in Niterói, Rio de Janeiro, . The sample investigated was proportional to the number of students enrolled by age in all public and private schools of this neighbourhood

	Study dates October 2003 to June 2004. Sources of funding not reported Ethnicity Ethnicity not stated but for this analysis categorised as Other ethnicity. Recruitment in schools of the Fonseca neighbourhood, in Niterói, Rio de Janeiro,
Inclusion criteria	Children 12-17 years old
Exclusion criteria	Not reported
Number of participants	456 pupils participated in the study.
Length of follow-up	NA
Loss to follow-up	456 pupils participated in the study. The 24 losses resulted from absences or refusals (three cases).
Index test(s)	Body mass index (BMI) Waist circumference (WC) Measured at the level of the iliac crest rim with a non-extensible tape measure with the subject in expiratory phase

Reference standard (s)	Hypertension Measured at two visits: intervals between the two visits varied from 15 days to 3 months. BP taken three times on each clinical visit, with minimal intervals of one minute between one reading and another. Systolic arterial pressure (SAP) and diastolic arterial pressure (DAP) means greater than the 95th percentile for sex, age, and height,
Additional comments	

Critical appraisal - GUT QUADAS-2: DIAGNOSIS CHILDREN

Section	Question	Answer
Patient selection: risk of bias	Could the selection of patients have introduced bias?	Low
Patient selection: applicability	Are there concerns that included patients do not match the review question?	Low
Index tests: risk of bias	Could the conduct or interpretation of the index test have introduced bias?	Low
Index tests: applicability	Are there concerns that the index test, its conduct, or interpretation differ from the review question?	Low

Reference standard: risk of bias	Could the reference standard, its conduct, or its interpretation have introduced bias?	Low
Reference standard: applicability	Is there concern that the target condition as defined by the reference standard does not match the review question?	Low
Flow and timing: risk of bias	Could the patient flow have introduced bias?	High (Unclear which patients were included in the final analysis as there was some distinction by ethnicity.)
Overall risk of bias and directness	Risk of Bias	Moderate (Unclear which patients were included in the final analysis as there was some distinction by ethnicity.)
Overall risk of bias and directness	Directness	Directly applicable

Tee, 2020

Bibliographic Reference	Tee, Joyce Ying Hui; Gan, Wan Ying; Lim, Poh Ying; Comparisons of body mass index, waist circumference, waist-to-height ratio and a body shape index (ABSI) in predicting high blood pressure among Malaysian adolescents: a cross-sectional study.; BMJ open; 2020; vol. 10 (no. 1); e032874

Study Characteristics

Study type	Cross-sectional study
Study details	Study location

	Malaysia Setting two government secondary schools in Selangor state were randomly selected. Sources of funding This study was supported by Putra Grant—Postgraduate Initiative (GPIPS) from the Universiti Putra Malaysia, grant number GP/IPS/2017/9519900 Ethnicity For this analysis this study was placed in the Asian (other) ethnicity category Recruitment A total of 513 adolescents (58.9% women and 41.1% men) aged 12–16 years were recruited.
Inclusion criteria	Children 12-16 years old
Exclusion criteria	Adolescents who had medical conditions (eg, sleep disorders, diabetes, thyroid disease and CVDs), neurological or psychiatric disorders (eg, autism spectrum disorders, anxiety and depression), learning disabilities or developmental delays were excluded from the study (n=5).
Number of participants	A total of 513 adolescents
Length of follow-up	NA
Loss to follow-up	NA
Index test(s)	Waist-to-height ratio (WHtR)

	Body mass index (BMI) z-score Adolescents' body weight and height were taken in light clothing and without shoes using a TANITA weighing scale. The WHO AnthroPlus software V.1.0.4 BMI-for-age z-score of the adolescents Waist circumference (WC) z-score Participants folded their arms in front of their chest in a relaxed standing position while the measurements were taken using a Lufkin executive diameter pocket tape. According to the WC percentile chart for Malaysian childhood population, a WC of >90th percentile was used as the cut-off point to define abdominal obesity
Reference standard (s)	Hypertension BP was measured using a digital sphygmomanometer. Stage 1 hypertension (95th to 99th percentile) and stage 2 hypertension (>99th percentile) using the normative tables of BP based on age and sex adjusted for height percentiles.
Subgroup analyses	Gender
Additional comments	The optimal cut-off values of the anthropometric indices to predict high BP were estimated based on the largest value of the Youden index

Population characteristics

Study-level characteristics

Characteristic	Study (N = 513)
% Female Sample size	n = 302 ; % = 59

Critical appraisal - GUT QUADAS-2: DIAGNOSIS CHILDREN

Section	Question	Answer
Patient selection: risk of bias	Could the selection of patients have introduced bias?	Low
Patient selection: applicability	Are there concerns that included patients do not match the review question?	Low
Index tests: risk of bias	Could the conduct or interpretation of the index test have introduced bias?	High (Optimal cut-offs calculated and presented.)
Index tests: applicability	Are there concerns that the index test, its conduct, or interpretation differ from the review question?	Low
Reference standard: risk of bias	Could the reference standard, its conduct, or its interpretation have introduced bias?	Low
Reference standard: applicability	Is there concern that the target condition as defined by the reference standard does not match the review question?	Low
Flow and timing: risk of bias	Could the patient flow have introduced bias?	Low
Overall risk of bias and directness	Risk of Bias	Moderate (Due to optimal cut-offs being calculated from the accuracy data)
Overall risk of bias and directness	Directness	Directly applicable

Vaquero-Álvarez, 2020

Bibliographic Reference	Vaquero-Álvarez M; Molina-Luque R; Fonseca-Pozo FJ; Molina-Recio G; López-Miranda J; Romero-Saldaña M; Diagnostic Precision of Anthropometric Variables for the Detection of Hypertension in Children and Adolescents.; International journal of environmental research and public health; vol. 17 (no. 12)

Study Characteristics

Study type	Cross-sectional study
Study details	Study location Spain Setting children and adolescents who were studying in primary and secondary schools in Pedro Abad (Córdoba) Study dates 2018 Sources of funding This research received no external funding Ethnicity Ethnicity of the participants not stated but assumed to be >80% White for this analysis

	Recruitment The final sample was composed of 265 children and adolescents, selected at random and stratified by age and sex.
Inclusion criteria	Children 6 to 17 years old
Exclusion criteria	Children with rare diseases or cardiac pathology were excluded
Number of participants	The final sample was composed of 265 children and adolescents
Length of follow-up	NA
Loss to follow-up	NA
Index test(s)	Body mass index (BMI) Anthropometric variables were measured following the recommendations of the Reference Manual for the Standardization of Anthropometric Measurements. Waist-to-height ratio (WHtR) Waist circumference (WC) Measured at the midpoint between the lower edge of the last rib and the highest point of the iliac crest at the end of inspiration and using a flexible stainless-steel tape measure
Reference standard (s)	Elevated BP / hypertension Blood pressure (outcome variable) was determined through systolic blood pressure (SBP) and diastolic blood pressure (DBP) readings in mmHg. The measurement was made three times, with a

	five-minute interval between measurements, using the average of the last two. The procedure was carried out following the recommendations of the European Society for Hypertension in Children and Adolescents. High blood pressure: ≥95th percentile.
Additional comments	The optimal cut-offs were calculated through the Youden index

Population characteristics

Study-level characteristics

Characteristic	**Study (N = 265)**
% Female Sample size	n = 121 ; % = 46
Mean age (SD) Mean (SD)	11.2 (*empty data*)

Critical appraisal - GUT QUADAS-2: DIAGNOSIS CHILDREN

Section	Question	Answer

Patient selection: risk of bias	Could the selection of patients have introduced bias?	High (Unclear if selection was consecutive)
Patient selection: applicability	Are there concerns that included patients do not match the review question?	Low
Index tests: risk of bias	Could the conduct or interpretation of the index test have introduced bias?	High (Due to optimal thresholds being utilised.)
Index tests: applicability	Are there concerns that the index test, its conduct, or interpretation differ from the review question?	Low
Reference standard: risk of bias	Could the reference standard, its conduct, or its interpretation have introduced bias?	Low
Reference standard: applicability	Is there concern that the target condition as defined by the reference standard does not match the review question?	Low
Flow and timing: risk of bias	Could the patient flow have introduced bias?	Low
Overall risk of bias and directness	Risk of Bias	High (Due to patient selection and generating optimal cut-offs)
Overall risk of bias and directness	Directness	Directly applicable

Wariri, 2018

Bibliographic Reference	Wariri, Oghenebrume; Jalo, Iliya; Bode-Thomas, Fidelia; Discriminative ability of adiposity measures for elevated blood pressure among adolescents in a resource-constrained setting in northeast Nigeria: a cross-sectional analysis; BMC Obesity; 2018; vol. 5 (no. 1); 35

Study Characteristics

Study type	Cross-sectional study
Study details	Study location Nigeria Setting A multi-stage sampling technique and involved 367 secondary school adolescent (10–18 years) boys and girls in Gombe Local Government Area, Gombe State, northeast Nigeria Study dates From January to September 2015. Sources of funding Not reported Ethnicity

	Among study participants, five ethnic groups accounted for more than 70% of study participants: Fulani 90 (24.5%), Hausa 75 (20.4%), Tangalle 61 (16.6%), Waja 20 (5.5%), and Yoruba 15 (4.1%). For this analysis this is categorised as an Black African / Caribbean population. Recruitment A multistage random sampling technique was used in this study to recruit 377 adolescents aged 10–18 years from 12 secondary schools including six public and six private schools respectively in Gombe LGA. The number recruited was based on an estimation that used a prevalence of hypertension of 5.4% from a previous Nigerian study
Inclusion criteria	Children 10-18 years old
Exclusion criteria	Participants excluded from the study include; those with any form of chronic disease based on participant volunteered information, available school records, or evidence from physical examination. Other exclusion criteria were presence of haematuria and glucosuria on urinalysis, participants who actively consumed alcohol or cigarette within the past 3 months to the date of the study and participants who were on any medication known to affect blood pressure such as steroids, and diuretics.
Number of participants	377 adolescents aged 10–18 years
Length of follow-up	NA
Loss to follow-up	Of these, 370 participants who fulfilled the study criteria eventually completed the study. Data for 367 participants were analysed, because three participants were excluded due to incomplete or missing data at the time of data analysis.
Index test(s)	Body mass index (BMI) All participants removed their outer clothing, accessories, shoes, belts, wrist watches and emptied their pockets before measurements were taken. Body weight was measured to the nearest 0.1 kg using a digital scale. Height was measured to the nearest 0.1 cm using a potable, collapsible stadiometer. Waist-to-height ratio (WHtR)

	Waist circumference (WC) Waist circumference were measured according to standard procedures with a non-stretch tape rule placed horizontally, once, midway between the lower border of the 10th rib and the top of the iliac crest, at normal expiration
Reference standard (s)	Hypertension Blood pressure measurements were done per the recommendations of the 4th report criteria of the National High Blood Pressure Education Programme. Measurements were taken at the level of the heart with participants in seated position, using a standard mercury sphygmomanometer with systolic and diastolic blood pressure read off at the 1st and 5th Korotkoff respectively. Systolic and diastolic blood pressures were calculated as the mean of three readings taken 1 week apart.
Subgroup analyses	Gender
Additional comments	

Population characteristics

Study-level characteristics

Characteristic	Study (N = 370)
% Female Sample size	n = 176 ; % = 48

Critical appraisal - GUT QUADAS-2: DIAGNOSIS CHILDREN

Section	Question	Answer
Patient selection: risk of bias	Could the selection of patients have introduced bias?	Low
Patient selection: applicability	Are there concerns that included patients do not match the review question?	Low
Index tests: risk of bias	Could the conduct or interpretation of the index test have introduced bias?	Low
Index tests: applicability	Are there concerns that the index test, its conduct, or interpretation differ from the review question?	Low
Reference standard: risk of bias	Could the reference standard, its conduct, or its interpretation have introduced bias?	Low
Reference standard: applicability	Is there concern that the target condition as defined by the reference standard does not match the review question?	Low
Flow and timing: risk of bias	Could the patient flow have introduced bias?	Low
Overall risk of bias and directness	Risk of Bias	Low
Overall risk of bias and directness	Directness	Directly applicable

Yazdi, 2020

Bibliographic Reference	Yazdi M; Assadi F; Qorbani M; Daniali SS; Heshmat R; Esmaeil Motlagh M; Kelishadi R; Validity of anthropometric indices in predicting high blood pressure risk factors in Iranian children and adolescents: CASPIAN-V study.; Journal of clinical hypertension (Greenwich, Conn.); 2020; vol. 22 (no. 6)

Study Characteristics

Study type	Cross-sectional study
Study details	Study location Conducted in 2015 in Iran Setting National school-based project entitled Childhood and Adolescence Surveillance and Prevention of Adult Non-Communicable Disease (CASPIAN-IV). Sources of funding Funding not stated but the authors indicate no financial conflicts of interest Ethnicity Ethnicity not specified but participants assumed to be >80% Iranian ethnicity for this analysis Recruitment Multi-stage, stratified sampling approach. Random sampling within each province was carried out in proportion to the size of the population in urban or rural areas and the school level (elementary, middle, and secondary).
Inclusion criteria	Children 7-18 years old
Exclusion criteria	Not reported

Number of participants	14008
Length of follow-up	NA
Loss to follow-up	NA
Index test(s)	Body mass index (BMI) z-score Weight and height were measured to the nearest 0.1 kg and 0.5 cm, respectively, with participant in light clothing and without shoes. Childhood overweight and obesity were defined as BMIs between the 85th and 95th percentile and ≥95th percentile by age and sex groups, respectively Waist-to-height ratio (WHtR) z-score Waist circumference (WC) centile Measured at a level midway between the lower rib margin and the iliac crest to the nearest 0.5 cm with a flexible measuring tape and the participants in a standing position. A WC >90th percentile was used as the cut-off point to define abdominal obesity.
Reference standard (s)	Hypertension Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured in the right arm with a standardized mercury sphygmomanometers using a stethoscope placed over the brachial artery pulse on the cubital fossa at heart level and appropriate sized cuff with an inflammable bladder width of at least 40 percent of the arm circumference at a point midway between the olecranon and the acromion with the child in a sitting position for at least 5 minutes rest. Hypertension as SBP and/or DBP 95th percentile or ≥ 130/89 mm Hg (whichever was lower).
Subgroup analyses	Gender

Additional comments	Cut-off values of anthropometric indices to predict HTN were estimated on the highest value of the Youden Index

Population characteristics

Study-level characteristics

Characteristic	Study (N = 14003)
% Female No of events	n = 6913 ; % = 49

Critical appraisal - GUT QUADAS-2: DIAGNOSIS CHILDREN

Section	Question	Answer
Patient selection: risk of bias	Could the selection of patients have introduced bias?	Low
Patient selection: applicability	Are there concerns that included patients do not match the review question?	Low
Index tests: risk of bias	Could the conduct or interpretation of the index test have introduced bias?	High (Optimal threshold generated from the accuracy data)
Index tests: applicability	Are there concerns that the index test, its conduct, or interpretation differ from the review question?	Low

Reference standard: risk of bias	Could the reference standard, its conduct, or its interpretation have introduced bias?	Low
Reference standard: applicability	Is there concern that the target condition as defined by the reference standard does not match the review question?	Low
Flow and timing: risk of bias	Could the patient flow have introduced bias?	Low
Overall risk of bias and directness	Risk of Bias	Moderate (Due to optimal threshold generated from the accuracy data)
Overall risk of bias and directness	Directness	Directly applicable

Zheng, 2016

Bibliographic Reference	Zheng, Wei; Zhao, Ai; Xue, Yong; Zheng, Yingdong; Chen, Yun; Mu, Zhishen; Wang, Peiyu; Zhang, Yumei; Gender and urban-rural difference in anthropometric indices predicting dyslipidemia in Chinese primary school children: a cross-sectional study.; Lipids in health and disease; 2016; vol. 15; 87

Study Characteristics

Study type	Cross-sectional study
Study details	Study location

	China Setting Data were from a health and nutrition survey conducted in seven urban areas and two rural areas in China Study dates between 2011 and 2012. Sources of funding The investigation was supported by Mengniu Dairy Co. Ltd (Inner Mongolia, China), Key Projects of Beijing Science & Technology (Z1411000048140), Ethnicity Ethnicity not stated but for this analysis the participants were assumed to be >80% Chinese ethnicity Recruitment The participants were selected by a multistage cluster sampling strategy. In the first stage, seven urban areas (Beijing, Guangzhou, Chengdu, Shenyang, Suzhou, Lanzhou, and Zhengzhou city) and two rural areas
Inclusion criteria	Children attending primary school
Exclusion criteria	Children with reported birth defects (including congenital heart disease, hydrocephalus, and deformity at birth), infantile paralysis and thalassemia, or acute health problems (including common cold and diarrhoea) at the time of survey were excluded from the study.
Number of participants	A total of 932 school-age children participated in the health and nutrition survey. Of these participants, 773 with both anthropometric and blood lipid profile data were included in the analysis.
Length of follow-up	NA

Loss to follow-up	Of 932 participants, 773 with both anthropometric and blood lipid profile data were included in the analysis.
Index test(s)	Waist-to-hip ratio (WHR) HC was measured at maximal protrusion of the buttocks. Waist-to-height ratio (WHtR) WC was measured at 2 cm above the umbilicus. Body mass index (BMI) z-score Anthropometric characteristics were measured by trained researchers in a comfortable examination area with the children wearing minimal clothing. Height was measured accurate to 0.1 cm, and weight was measured accurate to 0.1 kg. The BMI z-score was calculated according to the criteria of the World Health Organization.
Reference standard (s)	Dyslipidaemia The definition of dyslipidaemia was taken from the National Cholesterol Education Program (NCEP) and "Experts Consensus for Prevention and Treatment of Dyslipidaemia in Children and Adolescents" in China. The cut-off of each type of dyslipidaemia was defined as follows: TC ≥ 200 mg/dL (5.172 mmol/L), LDL-C ≥ 130 mg/dL (3.3618 mmol/L), TG ≥ 150 mg/dL (1.6935 mmol/L), and HDL-C ≤ 35 mg/dL (0.9051 mmol/L).
Additional comments	Optimal cut-off points for each anthropometric index were determined using the maximum value of Youden's index

Population characteristics

Study-level characteristics

Characteristic	Study (N = 773)
Mean age (SD)	9.3 (1.7)

Characteristic	**Study (N = 773)**
Mean (SD)	

Critical appraisal - GUT QUADAS-2: DIAGNOSIS CHILDREN

Section	Question	Answer
Patient selection: risk of bias	Could the selection of patients have introduced bias?	Low
Patient selection: applicability	Are there concerns that included patients do not match the review question?	Low
Index tests: risk of bias	Could the conduct or interpretation of the index test have introduced bias?	High (Cut-off generated from the accuracy data)
Index tests: applicability	Are there concerns that the index test, its conduct, or interpretation differ from the review question?	Low
Reference standard: risk of bias	Could the reference standard, its conduct, or its interpretation have introduced bias?	Low
Reference standard: applicability	Is there concern that the target condition as defined by the reference standard does not match the review question?	Low
Flow and timing: risk of bias	Could the patient flow have introduced bias?	High (Due to accuracy data not being presented for female participants)

Overall risk of bias and directness	Risk of Bias	High (Due to ideal cur-offs being utilised based on accuracy data and not presenting the accuracy data for female children.)
Overall risk of bias and directness	Directness	Directly applicable

Appendix F – Forest plots

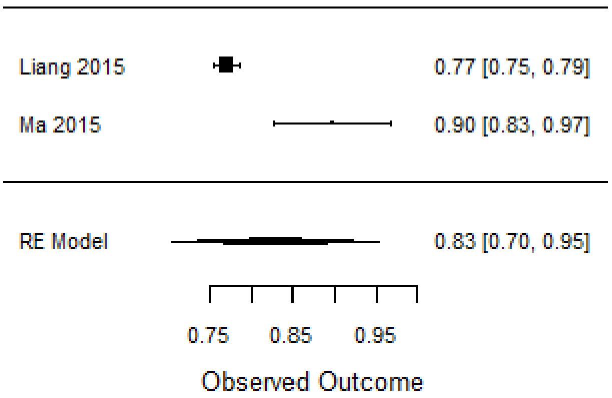
Area under the curve (C-statistics)

Diagnostic accuracy

Chinese population

Hypertension

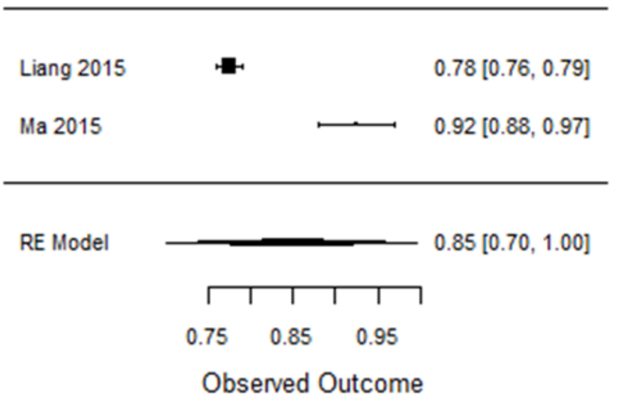
BMI in male children 6-10 years old



0.7 ≤ c-statistic <0.8 Good	*0.8 ≤ c-statistic <0.9 Excellent*	*0.9 ≤ c-statistic < 1.0 Outstanding*

I^2 (total heterogeneity / total variability): 91.72%

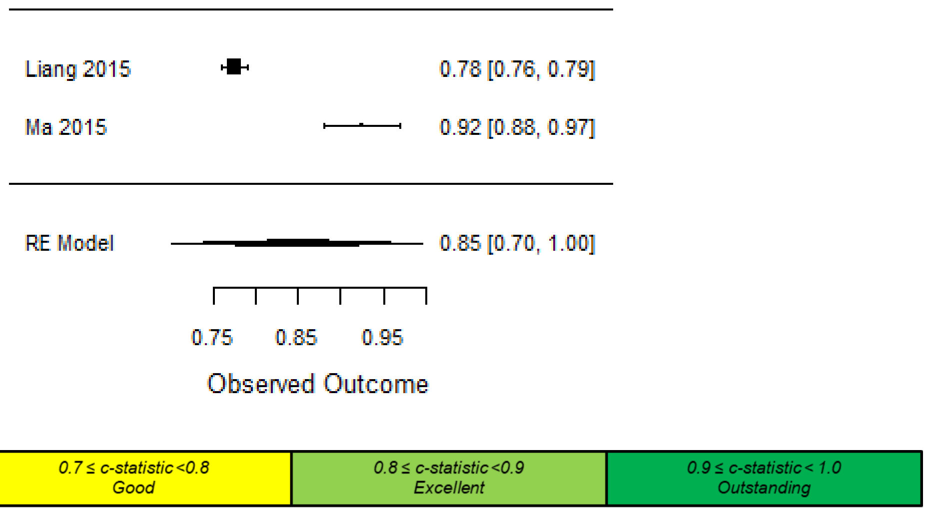
BMI in female children 6-10 years old



0.7 ≤ c-statistic <0.8 Good	*0.8 ≤ c-statistic <0.9 Excellent*	*0.9 ≤ c-statistic < 1.0 Outstanding*

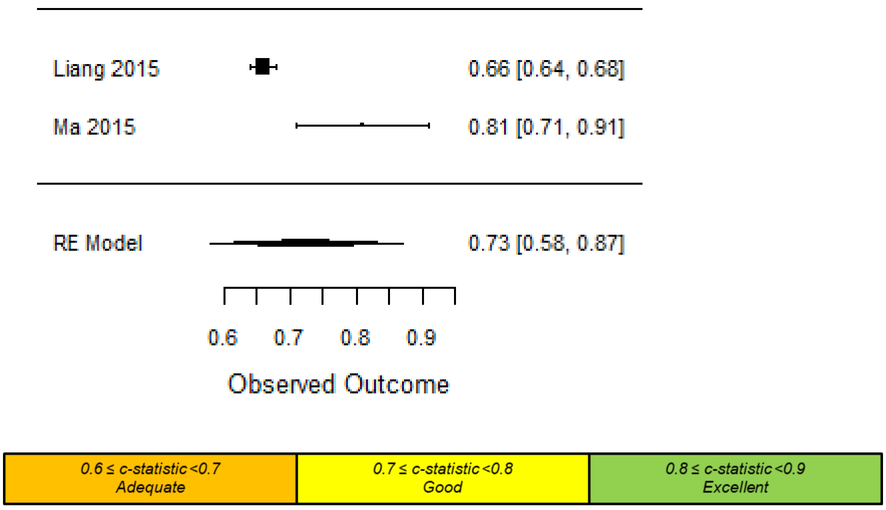
I^2 (total heterogeneity / total variability): 91.72%

Waist circumference in male children 6-10 years old



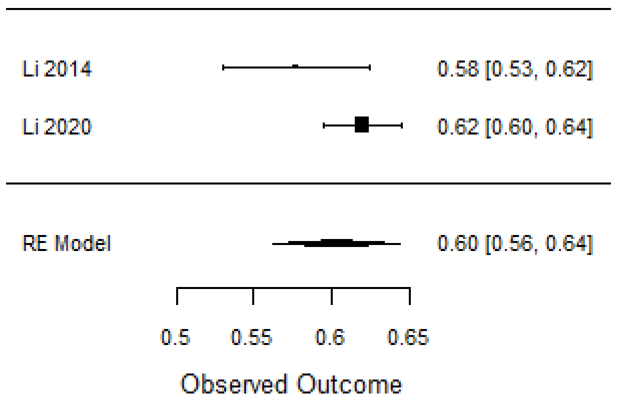
I^2 (total heterogeneity / total variability): 98.7%

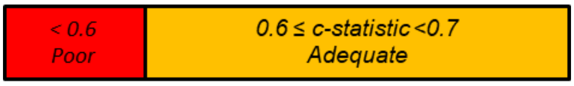
Waist circumference in female children 6-10 years old



I^2 (total heterogeneity / total variability): 97.43%

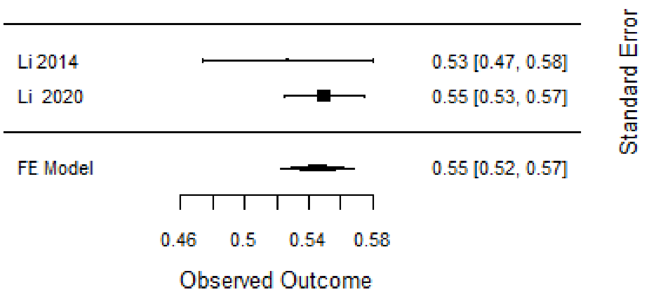
Waist-to-hip ratio in male children 7-17 years old

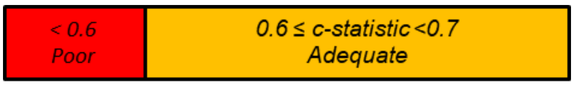




I^2 (total heterogeneity / total variability): 59.44%

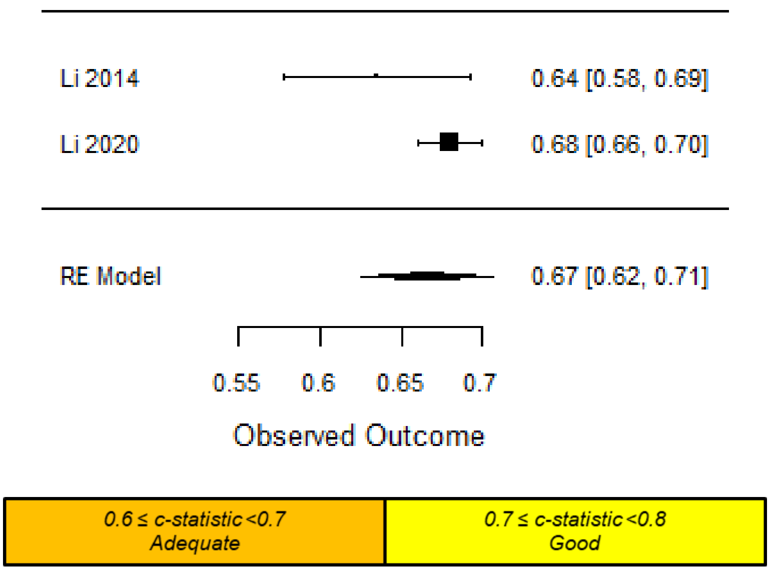
Waist-to-hip ratio in female children 7-17 years old





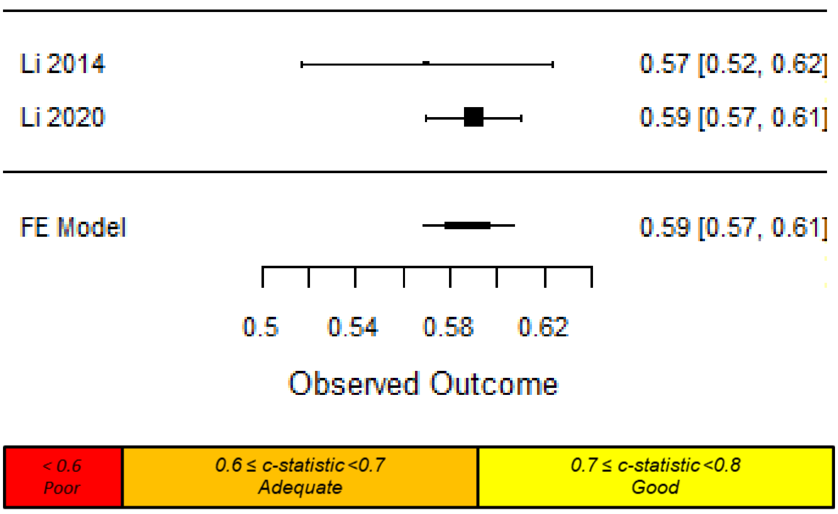
I^2 (total heterogeneity / total variability): 0%

Waist-to-height ratio male children 7-17 years old



I^2 (total heterogeneity / total variability): 52.36 %

Waist-to-height ratio in female children 7-17 years old

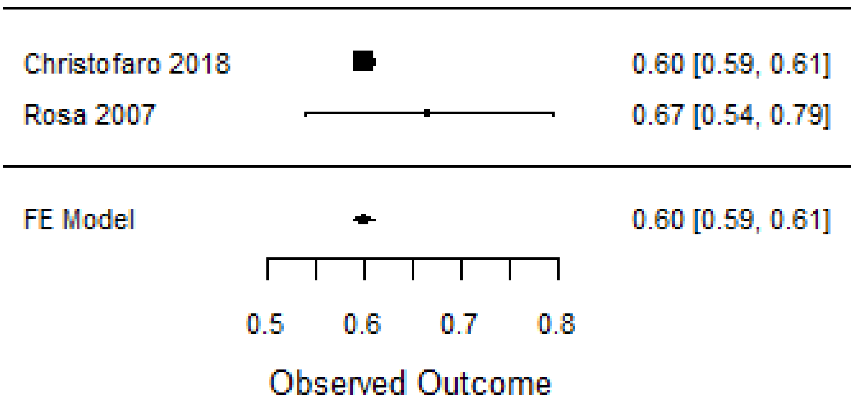


I^2 (total heterogeneity / total variability): 0%

Other ethnicity population

Hypertension

BMI in 10-17 year olds from Brazil



0.6 ≤ c-statistic <0.7 Adequate	*0.7 ≤ c-statistic <0.8 Good*	*0.8 ≤ c-statistic <0.9 Excellent*

I^2 (total heterogeneity / total variability): 3.02%

Appendix G – GRADE tables

Sensitivity, specificity, likelihood ratios

Prognostic accuracy

White population

Type 2 diabetes

BMI

No. of studies	Study design	Sample size	Sensitivity (95%CI)	Specificity (95%CI)	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
BMI assessed when 9 to 18 years of age. Mean follow-up: 24.4 years (range 14 to 27 years). Cut-off (standard) ≥75th percentile										
Koskinen 2010	Prospective	1767	0.528 (0.368,0.683)	0.751 (0.730,0.771)	LR+ 2.120 (1.541,2.919)	Serious[5]	Not serious	NA[4]	Serious[2]	Low
					LR- 0.628 (0.444,0.889)				Serious[2]	Low
BMI at 7 years of age. Outcome assessed when 45 years old. Cut-off (via ROC curve: 0.58) male: 16.2 kg/m², female: 17.6 kg/m²										
Li 2011	Prospective	7142 to 8979[3]	0.419 (0.359,0.482)	0.766 (0.756,0.775)	LR+ 1.791 (1.536,2.088)	Very Serious[1]	Not serious	NA[4]	Serious[2]	Very low
					LR- 0.758 (0.681,0.845)				Not serious	Low
BMI at 11 years of age. Outcome assessed when 42 years old. Cut-off (via ROC curve: 0.6 male: 17.9 kg/m², female: 18.4 kg/m²										
Li 2011	Prospective	7142 to 8979[3]	0.495 (0.433,0.558)	0.730 (0.720,0.740)	LR+ 1.833 (1.606,2.092)	Very Serious[1]	Not serious	NA[4]	Serious[2]	Very low
					LR- 0.692 (0.610,0.784)				Not serious	Low
BMI at 16 years of age. Outcome assessed when 42 years old. Cut-off (via ROC curve: 0.61) male: 20.4 kg/m², female: 23.1 kg/m²										
Li 2011	Prospective	7142 to 8979[3]	0.602 (0.539,0.662)	0.716 (0.706,0.726)	LR+ 2.120 (1.902,2.362)	Very Serious[1]	Not serious	NA[4]	Serious[2]	Very low
					LR- 0.556 (0.476,0.649)				Not serious	Low

[1] Downgraded by 2 increments because the majority of the evidence was at very high risk of bias.
[2] Downgraded 1 increment as 95% confidence interval of likelihood ratio crosses one end of a defined MID interval (0.5, 2)
[3] The paper stated that data was available for between 7142 to 8979 participants depending on the measure.

[4] Inconsistency not applicable as evidence from a single study
[5]Downgraded by 1 increments because the majority of the evidence was at high risk of bias.
ROC: receiver operating characteristic

Hypertension

BMI

No. of studies	Study design	Sample size	Sensitivity (95%CI)	Specificity (95%CI)	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
BMI at 7 years of age. Outcome assessed when 45 years old. Cut-off (via ROC curve: 0.51) male: 16.1 kg/m², female: 16.6.6 kg/m²										
Li 2011	Prospective	7142 to 89792[2]	0.390 (0.371,0.410)	0.697 (0.686,0.708)	LR+ 1.287 (1.210,1.369)	Very Serious[1]	Not serious	NA[3]	Not serious	Low
					LR- 0.875 (0.844,0.907)				Not serious	Low
BMI at 11 years of age. Outcome assessed when 42 years old. Cut-off (via ROC curve: 0.56) male: 15.9 kg/m², female: 17.7 kg/m²										
Li 2011	Prospective	7142 to 89792[2]	0.557 (0.537,0.577)	0.561 (0.549,0.573)	LR+ 1.269 (1.213,1.327)	Very Serious[1]	Not serious	NA[3]	Not serious	Low
					LR- 0.790 (0.751,0.830)				Not serious	Low
BMI at 16 years of age. Outcome assessed when 42 years old. Cut-off (via ROC curve: 0.6) male: 19.8 kg/m², female: 24.3 kg/m²										
Li 2011	Prospective	7142 to 89792[2]	0.448 (0.428,0.468)	0.739 (0.729,0.749)	LR+ 1.716 (1.617,1.822)	Very Serious[1]	Not serious	NA[3]	Not serious	Low
					LR- 0.747 (0.718,0.777)				Not serious	Low

[1] Downgraded by 2 increments because the majority of the evidence was at very high risk of bias.
[2] The paper stated that data was available for between 7142 to 8979 participants depending on the measure.
[3] Inconsistency not applicable as evidence from a single study.
ROC: receiver operating characteristic

Diagnostic accuracy

Chinese population

Dyslipidaemia

BMI z-score

No. of studies	Study design	Sample size	Sensitivity (95%CI)	Specificity (95%CI)	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 7-12 years old at cut off (via ROC curve: 0.66) 0.973										
Zheng 2016	Cross-sectional	399	0.596 (0.453,0.724)	0.732 (0.683,0.776)	LR+ 2.224 (1.664,2.972)	Very serious[1]	Not serious	NA[3]	Serious[2]	Very low
					LR- 0.552 (0.389,0.783)				Serious[2]	Very low
[1] Downgraded by 2 increments because the majority of the evidence was at very high risk of bias. [2] Downgraded 1 increment as 95% confidence interval of likelihood ratio crosses one end of a defined MID interval (0.5, 2) [3] Inconsistency not applicable as evidence from a single study ROC: receiver operating characteristic										

Waist-to-hip ratio

No. of studies	Study design	Sample size	Sensitivity (95%CI)	Specificity (95%CI)	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 7-12 years old at cut off (via ROC curve: 0.73) 0.862										
Zheng 2016	Cross-sectional	399	0.702 (0.559,0.814)	0.703 (0.653,0.748)	LR+ 2.364 (1.851,3.019)	Very serious[1]	Not serious	NA[3]	Serious[2]	Very low
					LR- 0.424 (0.273,0.658)				Serious[2]	Very low
[1] Downgraded by 2 increments because the majority of the evidence was at very high risk of bias. [2] Downgraded 1 increment as 95% confidence interval of likelihood ratio crosses one end of a defined MID interval (0.5, 2) [3] Inconsistency not applicable as evidence from a single study ROC: receiver operating characteristic										

Waist-to-height ratio

No. of studies	Study design	Sample size	Sensitivity (95%CI)	Specificity (95%CI)	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 7-12 years old at cut off (via ROC curve: 0.72) 0.473										
Zheng 2016	Cross-sectional	399	0.596 (0.453,0.724)	0.766 (0.719,0.807)	LR+ 2.547 (1.887,3.439)	Very serious[1]	Not serious	NA[3]	Serious[2]	Very low
					LR- 0.527 (0.372,0.747)				Serious[2]	Very low

[1] Downgraded by 2 increments because the majority of the evidence was at very high risk of bias.
[2] Downgraded 1 increment as 95% confidence interval of likelihood ratio crosses one end of a defined MID interval (0.5, 2)
[3] Inconsistency not applicable as evidence from a single study
ROC: receiver operating characteristic

South Asian population

Hypertension

BMI z-score

No. of studies	Study design	Sample size	Sensitivity (95%CI)	Specificity (95%CI)	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 6-17 years old at cut off (via Youden's Index: 0.48) 0.92										
Fowokan 2019	Cross-sectional	360	0.830 (0.688,0.915)	0.650 (0.596,0.701)	LR+ 2.371 (1.938,2.902)	Serious[3]	Serious[4]	NA[2]	Serious[1]	Very low
					LR- 0.262 (0.134,0.509)				Serious[1]	Very low
Female children 6-17 years old at cut off (via Youden's Index: 0.54) 1.41										
Fowokan 2019	Cross-sectional	402	0.720 (0.578,0.828)	0.810 (0.766,0.848)	LR+ 3.789 (2.869,5.005)	Serious[3]	Serious[4]	NA[2]	Not serious	Low
					LR- 0.346 (0.219,0.546)				Serious[1]	Very low

[1] Downgraded 1 increment as 95% confidence interval of likelihood ratio crosses one end of a defined MID interval (0.5, 2)
[2] Inconsistency not applicable as evidence from a single study
[3] Downgraded by 1 increments because the majority of the evidence was at high risk of bias.
[4] Downgrade 1 increment for partially applicable evidence due to uncertainty about the ethnicity in the participants.

BMI

No. of studies	Study design	Sample size	Sensitivity (95%CI)	Specificity (95%CI)	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 10-18 years old (no cut-off presented)										
Brar 2013	Cross-sectional	634	0.754 (0.701,0.800)	0.582 (0.529,0.633)	LR+ 1.804 (1.567,2.076)	Very serious[1]	Not serious	NA[3]	Serious[2]	Very low
					LR- 0.423 (0.339,0.527)				Serious[2]	Very low
Female children 10-18 years old (no cut-off presented)										
Brar 2013	Cross-sectional	591	0.581 (0.517,0.642)	0.609 (0.557,0.659)	LR+ 1.486 (1.255,1.760)	Very serious[1]	Not serious	NA[3]	Not serious	Low
					LR- 0.688 (0.580,0.816)				Not serious	Low

[1] Downgraded by 2 increments because the majority of the evidence was at very high risk of bias.
[2] Downgraded 1 increment as 95% confidence interval of likelihood ratio crosses one end of a defined MID interval (0.5, 2)
[3] Inconsistency not applicable as evidence from a single study

Waist circumference z-score

No. of studies	Study design	Sample size	Sensitivity (95%CI)	Specificity (95%CI)	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 6-17 years old at cut off (via Youden's Index: 0.51) 0.85										
Fowokan 2019	Cross-sectional	360	0.740 (0.590,0.849)	0.770 (0.720,0.813)	LR+ 3.217 (2.460,4.207)	Serious[3]	Serious[4]	NA[2]	Not serious	Low
					LR- 0.338 (0.203,0.561)				Serious[1]	Very low
Female children 6-17 years old at cut off (via Youden's Index: 0.42) 0.39										
Fowokan 2019	Cross-sectional	402	0.750 (0.610,0.852)	0.670 (0.619,0.717)	LR+ 2.273 (1.823,2.834)	Serious[3]	Serious[4]	NA[2]	Serious[1]	Very low
					LR- 0.373 (0.227,0.612)				Serious[1]	Very low

[1] Downgraded 1 increment as 95% confidence interval of likelihood ratio crosses one end of a defined MID interval (0.5, 2)
[2] Inconsistency not applicable as evidence from a single study
[3] Downgraded by 1 increment because the majority of the evidence was at high risk of bias.
[4] Downgrade 1 increment for partially applicable evidence due to uncertainty about the ethnicity in the participants.

Waist circumference

No. of studies	Study design	Sample size	Sensitivity (95%CI)	Specificity (95%CI)	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 10-18 years old (no cut-off presented)										
Brar 2013	Cross-sectional	634	0.754 (0.701,0.800)	0.582 (0.529,0.633)	LR+ 1.804 (1.567,2.076)	Very serious[1]	Not serious	NA[3]	Serious[2]	Very low
					LR- 0.423 (0.339,0.527)				Serious[2]	Very low
Female children 10-18 years old (no cut-off presented) NA[2]										
Brar 2013	Cross-sectional	591	0.581 (0.517,0.642)	0.609 (0.557,0.659)	LR+ 1.486 (1.255,1.760)	Very serious[1]	Not serious	NA[3]	Not serious	Low
					LR- 0.688 (0.580,0.816)				Not serious	Low

[1] Downgraded by 2 increments because the majority of the evidence was at very high risk of bias.
[2] Downgraded 1 increment as 95% confidence interval of likelihood ratio crosses one end of a defined MID interval (0.5, 2)
[3] Inconsistency not applicable as evidence from a single study

Waist-to-height ratio z-score

No. of studies	Study design	Sample size	Sensitivity (95%CI)	Specificity (95%CI)	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 6-17 years old at cut off (via Youden's Index: 0.52) 0.43										
Fowokan 2019	Cross-sectional	360	0.760 (0.611,0.864)	0.760 (0.710,0.804)	LR+ 3.167 (2.446,4.099)	Serious[3]	Serious[4]	NA[2]	Not serious	Low
					LR- 0.316 (0.185,0.539)				Serious[1]	Very low
Female children 6-17 years old at cut off (via Youden's Index: 0.38) 0.32										
Fowokan 2019	Cross-sectional	402	0.640 (0.496,0.762)	0.740 (0.692,0.783)	LR+ 2.462 (1.869,3.242)	Serious[3]	Serious[4]	NA[2]	Serious[1]	Very low
					LR- 0.486 (0.332,0.713)				Serious[1]	Very low

[1] Downgraded 1 increment as 95% confidence interval of likelihood ratio crosses one end of a defined MID interval (0.5, 2)
[2] Inconsistency not applicable as evidence from a single study
[3] Downgraded by 1 increment because the majority of the evidence was at high risk of bias.
[4] Downgrade 1 increment for partially applicable evidence due to uncertainty about the ethnicity in the participants.

Waist-to-height ratio

No. of studies	Study design	Sample size	Sensitivity (95%CI)	Specificity (95%CI)	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 10-18 years old (no cut-off presented)										
Brar 2013	Cross-sectional	634	0.640 (0.583,0.693)	0.571 (0.518,0.622)	LR+ 1.492 (1.285,1.732)	Very serious[1]	Not serious	NA[2]	Not serious	Low
					LR- 0.630 (0.527,0.754)				Not serious	Low
Female children 10-18 years old (no cut-off presented)										
Brar 2013	Cross-sectional	591	0.621 (0.558,0.680)	0.607 (0.555,0.657)	LR+ 1.580 (1.342,1.860)	Very serious[1]	Not serious	NA[2]	Not serious	Low
					LR- 0.624 (0.520,0.750)				Not serious	Low

[1] Downgraded by 2 increments because the majority of the evidence was at very high risk of bias.
[2] Inconsistency not applicable as evidence from a single study

Asian (other) population

Hypertension

BMI z-score

No. of studies	Study design	Sample size	Sensitivity (95%CI)	Specificity (95%CI)	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 12-16 years old at cut off (via Youden's Index: 0.536) 1.87										
Tee 2020	Cross-sectional	211	0.692 (0.494,0.838)	0.843 (0.783,0.889)	LR+ 4.408 (2.893,6.715)	Serious[1]	Not serious	NA[3]	Not serious	Moderate
					LR- 0.365 (0.205,0.652)				Serious[2]	Low
Female children 12-16 years old at cut off (via Youden's Index: 0.549) 1.18										
Tee 2020	Cross-sectional	302	0.714 (0.545,0.839)	0.835 (0.786,0.875)	LR+ 4.327 (3.075,6.090)	Serious[1]	Not serious	NA[3]	Not serious	Moderate
					LR- 0.343 (0.202,0.580)				Serious[2]	Low

[1] Downgraded by 1 increment because the majority of the evidence was at high risk of bias
[2] Downgraded 1 increment as 95% confidence interval of likelihood ratio crosses one end of a defined MID interval (0.5, 2)
[3] Inconsistency not applicable as evidence from a single study

BMI

No. of studies	Study design	Sample size	Sensitivity (95%CI)	Specificity (95%CI)	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 13-17 years old at cut off (via Youden's Index[4]) 20										
Cheah 2018	Cross-sectional	1033	0.754 (0.695,0.805)	0.603 (0.569,0.636)	LR+ 1.899 (1.697,2.126)	Serious[1]	Not serious	NA[3]	Serious[2]	Low
					LR- 0.408 (0.323,0.515)				Serious[2]	Low
Female children 13-17 years old at cut off (via Youden's Index[4]) 20.7										
Cheah 2018	Cross-sectional	1428	0.729 (0.660,0.788)	0.600 (0.572,0.627)	LR+ 1.823 (1.631,2.037)	Serious[1]	Not serious	NA[3]	Serious[2]	Low
					LR- 0.452 (0.355,0.575)				Serious[2]	Low

[1] Downgraded by 1 increment because the majority of the evidence was at high risk of bias
[2] Downgraded 1 increment as 95% confidence interval of likelihood ratio crosses one end of a defined MID interval (0.5, 2)
[3] Inconsistency not applicable as evidence from a single study
[4] Specific Youden Index not stated

Waist circumference percentile

No. of studies	Study design	Sample size	Sensitivity (95%CI)	Specificity (95%CI)	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 12-16 years old at cut off (via Youden's Index: 0.485) 78th										
Tee 2020	Cross-sectional	211	0.577 (0.385,0.748)	0.908 (0.857,0.942)	LR+ 6.272 (3.584,10.98)	Serious[1]	Not serious	NA[3]	Not serious	Moderate
					LR- 0.466 (0.297,0.732)				Serious[2]	Low
Female children 12-16 years old at cut off (via Youden's Index: 0.599) 73rd										
Tee 2020	Cross-sectional	302	0.857 (0.699,0.939)	0.742 (0.686,0.791)	LR+ 3.322 (2.602,4.241)	Serious[1]	Not serious	NA[3]	Not serious	Moderate
					LR- 0.193 (0.085,0.435)				Not serious	Moderate

[1] Downgraded by 1 increment because the majority of the evidence was at high risk of bias
[2] Downgraded 1 increment as 95% confidence interval of likelihood ratio crosses one end of a defined MID interval (0.5, 2)
[3] Inconsistency not applicable as evidence from a single study

Waist circumference (WC)

No. of studies	Study design	Sample size	Sensitivity (95%CI)	Specificity (95%CI)	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 13-17 years old at cut off (via Youden's Index[4]) 60.7 cm										
Cheah 2018	Cross-sectional	1033	0.773 (0.715,0.822)	0.618 (0.584,0.651)	LR+ 2.024 (1.809,2.264)	Serious[1]	Not serious	NA[3]	Serious[2]	Low
					LR- 0.367 (0.288,0.469)				Not serious	Moderate
Female children 13-17 years old at cut off (via Youden's Index[4]) 68.2 cm										
Cheah 2018	Cross-sectional	1428	0.713 (0.644,0.774)	0.616 (0.589,0.643)	LR+ 1.857 (1.654,2.084)	Serious[1]	Not serious	NA[3]	Serious[2]	Low
					LR- 0.466 (0.370,0.587)				Serious[2]	Low

[1] Downgraded by 1 increment because the majority of the evidence was at high risk of bias

[2] Downgraded 1 increment as 95% confidence interval of likelihood ratio crosses one end of a defined MID interval (0.5, 2)

[3] Inconsistency not applicable as evidence from a single study

[4] Specific Youden Index not stated

Waist-to-height ratio (WHtR)

No. of studies	Study design	Sample size	Sensitivity (95%CI)	Specificity (95%CI)	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 12-16 years old at cut off (via Youden's Index: 0.53) 0.52										
Tee 2020	Cross-sectional	211	0.654 (0.457,0.809)	0.876 (0.820,0.916)	LR+ 5.274 (3.283,8.474)	Serious[1]	Not serious	NA[3]	Not serious	Moderate
					LR- 0.395 (0.232,0.672)				Serious[2]	Low
Male children 13-17 years old at cut off (via Youden's Index[4]) 0.42										
Cheah 2018	Cross-sectional	1033	0.712 (0.650,0.767)	0.605 (0.571,0.638)	LR+ 1.803 (1.601,2.029)	Serious[1]	Not serious	NA[3]	Serious[2]	Low
					LR- 0.476 (0.386,0.587)				Serious[2]	Low
Female children 12-16 years old at cut off (via Youden's Index: 0.602) 0.45										
Tee 2020	Cross-sectional	302	0.943 (0.799,0.986)	0.659 (0.600,0.713)	LR+ 2.765 (2.297,3.329)	Serious[1]	Not serious	NA[3]	Not serious	Moderate
					LR- 0.086 (0.022,0.334)				Not serious	Moderate
Female children 13-17 years old at cut off (via Youden's Index[4]) 0.44										
		1428			LR+ 1.798 (1.606,2.012)	Serious[1]	Not serious	NA[3]	Serious[2]	Low

Cheah 2018	Cross-sectional		0.719 (0.650,0.779)	0.600 (0.572,0.627)	LR- 0.468 (0.370,0.592)				Serious[2]	Low
[1] Downgraded by 1 increment because the majority of the evidence was at high risk of bias [2] Downgraded 1 increment as 95% confidence interval of likelihood ratio crosses one end of a defined MID interval (0.5, 2) [3] Inconsistency not applicable as evidence from a single study [4] Specific Youden Index not stated										

Dyslipidaemia

BMI z-score

No. of studies	Study design	Sample size	Sensitivity (95%CI)	Specificity (95%CI)	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 6-18 years old at cut off (via Youden's Index: 0.213) 1.39										
Mai 2020	Cross-sectional	5540	0.455 (0.411,0.500)	0.758 (0.746,0.770)	LR+ 1.880 (1.686,2.096)	Serious[1]	Not serious	NA[3]	Serious[2]	Low
					LR- 0.719 (0.662,0.781)				Not serious	Moderate
Female children 6-18 years old at cut off (via Youden's Index: 0.279) 1										
Mai 2020	Cross-sectional	5540	0.411 (0.370,0.454)	0.868 (0.858,0.877)	LR+ 3.114 (2.747,3.529)	Serious[1]	Not serious	NA[3]	Not serious	Moderate
					LR- 0.679 (0.631,0.730)				Not serious	Moderate
[1] Downgraded by 1 increment because the majority of the evidence was at high risk of bias [2] Downgraded 1 increment as 95% confidence interval of likelihood ratio crosses one end of a defined MID interval (0.5, 2) [3] Inconsistency not applicable as evidence from a single study										

Waist circumference z-score

No. of studies	Study design	Sample size	Sensitivity (95%CI)	Specificity (95%CI)	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 6-18 years old at cut off (via Youden's Index: 0.179) 0.47										
Mai 2020	Cross-sectional	5540	0.712 (0.670,0.751)	0.468 (0.454,0.482)	LR+ 1.338 (1.258,1.424)	Serious[1]	Not serious	NA[3]	Not serious	Moderate
					LR- 0.615 (0.533,0.710)				Not serious	Moderate
Female children 6-18 years old at cut off (via Youden's Index: 0.239) 0.26										

Mai 2020	Cross-sectional	5540	0.462 (0.420,0.505)	0.777 (0.765,0.788)	LR+ 2.072 (1.863,2.304)	Serious[1]	Not serious	NA[3]	Serious[2]	Low
					LR- 0.692 (0.639,0.751)				Not serious	Moderate
[1] Downgraded by 1 increment because the majority of the evidence was at high risk of bias [2] Downgraded 1 increment as 95% confidence interval of likelihood ratio crosses one end of a defined MID interval (0.5, 2) [3] Inconsistency not applicable as evidence from a single study										

Waist-to-height ratio (WHtR)

No. of studies	Study design	Sample size	Sensitivity (95%CI)	Specificity (95%CI)	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 6-18 years old at cut off (via Youden's Index: 0.218) 0.44										
Mai 2020	Cross-sectional	5540	0.766 (0.726,0.802)	0.453 (0.439,0.467)	LR+ 1.400 (1.325,1.480)	Serious[1]	Not serious	NA[3]	Not serious	Moderate
					LR- 0.517 (0.439,0.608)				Serious[2]	Low
Female children 6-18 years old at cut off (via Youden's Index: 0.276) 0.47										
Mai 2020	Cross-sectional	5540	0.475 (0.432,0.518)	0.801 (0.790,0.812)	LR+ 2.387 (2.146,2.654)	Serious[1]	Not serious	NA[3]	Not serious	Moderate
					LR- 0.655 (0.603,0.712)				Not serious	Moderate
[1] Downgraded by 1 increment because the majority of the evidence was at high risk of bias [2] Downgraded 1 increment as 95% confidence interval of likelihood ratio crosses one end of a defined MID interval (0.5, 2) [3] Inconsistency not applicable as evidence from a single study										

White population

Hypertension

BMI z-score

No. of studies	Study design	Sample size	Sensitivity (95%CI)	Specificity (95%CI)	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 11-17 years old at Extended International (IOTF) Body Mass Index Cut-Offs for Thinness, Overweight and Obesity in Children										
Kromeyer-Hauschild 2013	Cross-sectional	3492	0.192 (0.156,0.234)	0.955 (0.947,0.962)	LR+ 4.267 (3.285,5.541)	Serious[2]	Not serious	NA[1]	Not serious	Moderate
					LR- 0.846 (0.805,0.889)				Not serious	Moderate
Female children 11-17 years old at IOTF cut off										
Kromeyer-Hauschild 2013	Cross-sectional	3321	0.153 (0.118,0.197)	0.958 (0.950,0.965)	LR+ 3.643 (2.675,4.960)	Serious[2]	Not serious	NA[1]	Not serious	Moderate
					LR- 0.884 (0.844,0.927)				Not serious	Moderate

[1] Inconsistency not applicable as evidence from a single study
[2] Downgraded by 1 increment because the majority of the evidence was at high risk of bias

BMI

No. of studies	Study design	Sample size	Sensitivity (95%CI)	Specificity (95%CI)	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Children 6-16 years old at cut off (via Youden's Index: 0.46) 23 kg/m²										
Vaquero-Álvarez 2020	Cross-sectional	265	0.667 (0.429,0.842)	0.789 (0.734,0.835)	LR+ 3.161 (2.107,4.743)	Very serious[1]	Not serious	NA[3]	Not serious	Low
					LR- 0.422 (0.219,0.814)				Serious[2]	Very low

[1] Downgraded by 2 increments because the majority of the evidence was at very high risk of bias
[2] Downgraded 1 increment as 95% confidence interval of likelihood ratio crosses one end of a defined MID interval (0.5, 2)
[3] Inconsistency not applicable as evidence from a single study.

Waist circumference percentile

No. of studies	Study design	Sample size	Sensitivity (95%CI)	Specificity (95%CI)	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Children 8-11 years old at cut off (via ROC curve) of 90th centile										
Arellano -Ruiz 2020	Cross-sectional	848	0.296 (0.156,0.490)	0.905 (0.883,0.923)	LR+ 3.119 (1.680,5.788)	Serious[1]	Not serious	NA[3]	Serious[2]	Low
					LR- 0.778 (0.608,0.994)				Not serious	Moderate
[1] Downgraded by 1 increment because the majority of the evidence was at high risk of bias [2] Downgraded 1 increment as 95% confidence interval of likelihood ratio crosses one end of a defined MID interval (0.5, 2) [3] Inconsistency not applicable as evidence from a single study. ROC: receiver operating characteristic										

Waist circumference

No. of studies	Study design	Sample size	Sensitivity (95%CI)	Specificity (95%CI)	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Children 6-16 years old at cut off (via Youden's Index: 0.48) 73.5 cm										
Vaquero -Álvarez 2020	Cross-sectional	265	0.722 (0.481,0.879)	0.760 (0.703,0.809)	LR+ 3.008 (2.094,4.323)	Very serious[1]	Not serious	NA[3]	Not serious	Low
					LR- 0.366 (0.173,0.773)				Serious[2]	Very low
[1] Downgraded by 2 increment because the majority of the evidence was at very high risk of bias [2] Downgraded 1 increment as 95% confidence interval of likelihood ratio crosses one end of a defined MID interval (0.5, 2) [3] Inconsistency not applicable as evidence from a single study.										

Waist-to-height ratio percentile

No. of studies	Study design	Sample size	Sensitivity (95%CI)	Specificity (95%CI)	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 11-17 years old at a cut-off of 90th percentile										
Kromeyer-Hauschild 2013	Cross-sectional	3492	0.321 (0.276,0.369)	0.906 (0.895,0.916)	LR+ 3.415 (2.847,4.096)	Serious[2]	Not serious	NA[1]	Not serious	High
					LR- 0.749 (0.699,0.804)				Not serious	High
Female children 11-17 years old at a cut-off of 90th percentile										
Kromeyer-Hauschild 2013	Cross-sectional	3221	0.269 (0.223,0.320)	0.903 (0.892,0.913)	LR+ 2.773 (2.247,3.423)	Serious[2]	Not serious	NA[1]	Not serious	High
					LR- 0.810 (0.757,0.866)				Not serious	High

[1] Inconsistency not applicable as evidence from a single study.
[2] Downgraded by 1 increment because the majority of the evidence was at high risk of bias

Waist-to-height ratio

No. of studies	Study design	Sample size	Sensitivity (95%CI)	Specificity (95%CI)	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 11-17 years old at a cut-off of 0.5										
Kromeyer-Hauschild 2013	Cross-sectional	3492	0.296 (0.252,0.344)	0.918 (0.908,0.927)	LR+ 3.610 (2.973,4.383)	Serious[1]	Not serious	NA[3]	Not serious	Moderate
					LR- 0.767 (0.718,0.819)				Not serious	Moderate
Female children 11-17 years old at a cut-off of 0.5										
Kromeyer-Hauschild 2013	Cross-sectional	3221	0.226 (0.184,0.275)	0.936 (0.927,0.944)	LR+ 3.531 (2.766,4.508)	Serious[1]	Not serious	NA[3]	Not serious	Moderate
					LR- 0.827 (0.779,0.878)				Not serious	Moderate
Children 8-11 years old at cut off (via ROC curve: 0.63) of 0.57										
Arellano-Ruiz 2020	Cross-sectional	848	0.333 (0.183,0.527)	0.918 (0.898,0.935)	LR+ 4.085 (2.285,7.300)	Very serious[4]	Not serious	NA[3]	Not serious	Low
					LR- 0.726 (0.556,0.949)				Not serious	Low
Children 6-16 years old at cut off (via Youden's Index: 0.37) 0.455										
Vaquero-Álvarez 2020	Cross-sectional	265	0.722 (0.481,0.879)	0.646 (0.584,0.703)	LR+ 2.040 (1.463,2.844)	Very serious[4]	Not serious	NA[3]	Serious[2]	Very low
					LR- 0.430 (0.203,0.911)				Serious[2]	Very low

[1] Downgraded by 1 increment because the majority of the evidence was at high risk of bias
[2] Downgraded 1 increment as 95% confidence interval of likelihood ratio crosses one end of a defined MID interval (0.5, 2)
[3] Inconsistency not applicable as evidence from a single study.
[4] Downgraded by 2 increments because the majority of the evidence was at very high risk of bias
ROC: receiver operating characteristic

Other ethnicity populations

Hypertension

BMI z-score

No. of studies	Study design	Sample size	Sensitivity (95%CI)	Specificity (95%CI)	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
(Iran) Male children 7-18 years old at cut off (via Youden's Index: 0.137) 0.075										
Yazdi 2020	Cross-sectional	7091	0.541 (0.505,0.577)	0.596 (0.584,0.608)	LR+ 1.339 (1.245,1.440)	Serious[1]	Not serious	NA[2]	Not serious	Moderate
					LR- 0.770 (0.710,0.835)				Not serious	Moderate
(Iran) Female children 7-18 years old at cut off 0(via Youden's Index: 0.149) 0.245										
Yazdi 2020	Cross-sectional	6817	0.521 (0.486,0.556)	0.628 (0.616,0.640)	LR+ 1.401 (1.300,1.509)	Serious[1]	Not serious	NA[2]	Not serious	Moderate
					LR- 0.763 (0.707,0.823)				Not serious	Moderate

[1] Downgraded by 1 increment because the majority of the evidence was at high risk of bias
[2] Inconsistency not applicable as evidence from a single study

BMI percentile

No. of studies	Study design	Sample size	Sensitivity (95%CI)	Specificity (95%CI)	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
(Brazil) Children 12-17 years old at cut off specified in Assessment of the nutritional status of Brazilian adolescents by body mass index by Sichieri at al. (1996)										
Rosa 2007	Cross-sectional	456	0.524 (0.319,0.722)	0.801 (0.761,0.836)	LR+ 2.633 (1.680,4.126)	Not serious	Not serious	NA[2]	Serious[1]	Moderate
					LR- 0.594 (0.378,0.933)				Serious[1]	Moderate
(Brazil) Female children 7-18 years old at cut off 95.3 percentile for males and 84.8 for females										
Christofaro 2018	Cross-sectional	8295	0.350 (0.324,0.377)	0.860 (0.852,0.868)	LR+ 2.500 (2.272,2.751)	Not serious	Not serious	NA[2]	Not serious	High
					LR- 0.756 (0.725,0.788)				Not serious	High

[1] Downgraded 1 increment as 95% confidence interval of likelihood ratio crosses one end of a defined MID interval (0.5, 2)
[2] Inconsistency not applicable as evidence from a single study.

Waist circumference percentile

No. of studies	Study design	Sample size	Sensitivity (95%CI)	Specificity (95%CI)	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
(Brazil) Children 12-17 years old at cut off specified in Waist circumference percentiles in nationally representative samples of African-American, European-American, and Mexican-American children and adolescents by Fernandez et al. (2004)										
Rosa 2007	Cross-sectional	456	0.450 (0.257,0.659)	0.775 (0.733,0.812)	LR+ 2.000 (1.208,3.311)	Serious[1]	Not serious	NA[3]	Serious[2]	Low
					LR- 0.710 (0.480,1.048)				Very serious[4]	Very low
(Brazil) Female children 7-18 years old at cut off 80th percentile										
Christofaro 2018	Cross-sectional	8295	0.370 (0.343,0.397)	0.820 (0.811,0.829)	LR+ 2.056 (1.882,2.245)	Not serious	Not serious	NA[3]	Serious[2]	Moderate
					LR- 0.768 (0.735,0.803)				Not serious	High

[1] Downgraded by 1 increment because the majority of the evidence was at high risk of bias
[2] Downgraded 1 increment as 95% confidence interval of likelihood ratio crosses one end of a defined MID interval (0.5, 2)
[3] Inconsistency not applicable as evidence from a single study.
[4] Downgraded 2 increments as 95% confidence interval of likelihood ratio crosses one end of a defined MID interval (0.5, 2) and the line of no effect

Waist circumference

No. of studies	Study design	Sample size	Sensitivity (95%CI)	Specificity (95%CI)	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
(Iran) Male children 7-18 years old at cut off (via Youden's Index: 0.126) 60.5 cm										
Yazdi 2020	Cross-sectional	7091	0.501 (0.465,0.537)	0.625 (0.613,0.637)	LR+ 1.336 (1.235,1.445)	Serious[1]	Not serious	NA[2]	Not serious	Moderate
					LR- 0.798 (0.741,0.860)				Not serious	Moderate
(Iran) Female children 7-18 years old at cut off (via Youden's Index: 0.144) 68.5 cm										
Yazdi 2020	Cross-sectional	6817	0.457 (0.422,0.492)	0.687 (0.675,0.698)	LR+ 1.460 (1.341,1.589)	Serious[1]	Not serious	NA[2]	Not serious	Moderate
					LR- 0.790 (0.740,0.845)				Not serious	Moderate

[1] Downgraded by 1 increment because the majority of the evidence was at high risk of bias
[2] Inconsistency not applicable as evidence from a single study

Waist-to-height ratio

No. of studies	Study design	Sample size	Sensitivity (95%CI)	Specificity (95%CI)	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
(Brazil) Female children 7-18 years old at cut off 0.5										
Christofaro 2018	Cross-sectional	8295	0.310 (0.285,0.336)	0.830 (0.821,0.839)	LR+ 1.824 (1.653,2.011)	Not serious	Not serious	NA[2]	Serious[1]	Moderate
					LR- 0.831 (0.800,0.864)				Not serious	High
(Iran) Male children 7-18 years old at cut off (cut off (via Youden's Index: 0.514) 0.469										
Yazdi 2020	Cross-sectional	7091	0.495 (0.459,0.531)	0.659 (0.647,0.671)	LR+ 1.452 (1.339,1.573)	Serious[3]	Not serious	NA[2]	Not serious	Moderate
					LR- 0.766 (0.712,0.825)				Not serious	Moderate
(Iran) Female children 7-18 years old at cut off (via Youden's Index: 0.128) 0.477										
Yazdi 2020	Cross-sectional	6817	0.417 (0.383,0.452)	0.711 (0.700,0.722)	LR+ 1.443 (1.317,1.581)	Serious[3]	Not serious	NA[2]	Not serious	Moderate
					LR- 0.820 (0.771,0.872)				Not serious	Moderate

[1] Downgraded 1 increment as 95% confidence interval of likelihood ratio crosses one end of a defined MID interval (0.5, 2)
[2] Inconsistency not applicable as evidence from a single study.
[3] Downgraded by 1 increment because the majority of the evidence was at high risk of bias

Area under the curve (c-statistics)

Prognostic accuracy

Chinese population

Hypertension

BMI

No. of studies	Study design	Sample size	C-statistic (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
BMI at Age <18y (Hypertension; mean follow-up 10.1 years, range 2 to 18 years)								
Fan, 2019	Prospective	1444	0.56 (0.53-0.59)	Very serious[1]	Not serious	NA[2]	Not serious	Low
[1] Downgraded by 2 increments because the majority of the evidence was at very high risk of bias. [2] Inconsistency not applicable as evidence from a single study.								

Waist circumference

No. of studies	Study design	Sample size	C-statistic (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
WC at Age <18y (Hypertension, mean follow-up was 10.1 years, range 2 to 18 years)								
Fan, 2019	Prospective	1444	0.54 (0.51-0.57)	Very serious[1]	Not serious	NA[2]	Not serious	Low
[1] Downgraded by 2 increments because the majority of the evidence was at very high risk of bias [2] Inconsistency not applicable as evidence from a single study.								

Waist-to-hip ratio

No. of studies	Study design	Sample size	C-statistic (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
WHR at Age <18y (Hypertension, mean follow-up was 10.1 years, range 2 to 18 years)								

Fan, 2019	Prospective	1444	0.50 (0.47-0.53)	Very serious[1]	Not serious	NA[2]	Not serious	Low
[1] Downgraded by 2 increments because the majority of the evidence was at very high risk of bias [2] Inconsistency not applicable as evidence from a single study.								

Waist-to-height ratio

No. of studies	Study design	Sample size	C-statistic (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
WHtR at Age <18y (Hypertension, mean follow-up was 10.1 years, range 2 to 18 years)								
Fan 2019	Prospective	1444	0.51 (0.48-0.54)	Very serious[1]	Not serious	NA[2]	Not serious	Low
[1] Downgraded by 2 increments because the majority of the evidence was at very high risk of bias [2] Inconsistency not applicable as evidence from a single study.								

White population

Type 2 diabetes

BMI

No. of studies	Study design	Sample size	C-statistic (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
BMI at Age 7y (Type 2 Diabetes at age 42y, follow-up 35y)								
Cheung 2004	Prospective	4592	0.58 (0.51 - 0.66)	Not serious	Not serious	NA[1]	Serious[2]	Moderate
BMI at Age 11y (Type 2 Diabetes at age 42y, follow-up 31y)								
Cheung 2004	Prospective	4427	0.6 (0.52 - 0.67)	Not serious	Not serious	NA[1]	Serious[2]	Moderate
BMI at Age 16y (Type 2 Diabetes at age 42y, follow-up 19y)								
Cheung 2004	Prospective	4047	0.61 (0.54 - 0.68)	Not serious	Not serious	NA[1]	Serious[2]	Moderate
BMI at 9 to 18 years (Type 2 Diabetes, mean follow-up 24.4 years, range 14 to 27 years)								

Koskinen 2010	Prospective	1767	0.63 (0.55–0.72)	Serious [3]	Not serious	NA[1]	Very serious[4]	Very low
BMI at 7 years of age. Outcome (Type 2 diabetes or Hb A1c ≥7%) assessed when 45 years old								
Li 2011	Prospective	7142 to 8979[6]	0.59 (0.54- 0.63)	Very Serious[5]	Not serious	NA[1]	Serious[2]	Very low
BMI at 11 years of age. Outcome (Type 2 diabetes or Hb A1c ≥7%) assessed when 42 years old.								
Li 2011	Prospective	7142 to 8979[6]	0.65 (0.60-0.69)	Very Serious[5]	Not serious	NA[1]	Not serious	Low
BMI at 16 years of age. Outcome (Type 2 diabetes or Hb A1c ≥7%) assessed when 42 years old								
Li 2011	Prospective	7142 to 8979[6]	0.68 (0.63-0.72)	Very Serious[5]	Not serious	NA[1]	Serious[2]	Very low

[1] Inconsistency not applicable as evidence from a single study.
[2] Downgraded by 1 increment because the confidence interval crossed into 2 classification categories
[3] Downgraded by 1 increment because the majority of the evidence was at high risk of bias
[4] Downgraded by 2 increments because the confidence interval crossed into 3 classification categories
[5] Downgraded by 2 increments because the majority of the evidence was at very high risk of bias
[6] The paper stated that data was available for between 7142 to 8979 participants depending on the measure.

Hypertension

BMI

No. of studies	Study design	Sample size	C-statistic (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
BMI at Age 7y (Hypertension at age 42y, follow-up 35y)								
Cheung 2004	Prospective	4592	0.51 (0.48 - 0.53)	Not serious	Not serious	NA[1]	Not serious	High
BMI at Age 11y (Hypertension at age 42y, follow-up 31y)								
Cheung, 2004	Prospective	4427	0.56 (0.53 - 0.59)	Not serious	Not serious	NA[1]	Not serious	High
BMI at Age 16y (Hypertension at age 42y, follow-up 19y)								
Cheung 2004	Prospective	4047	0.6 (0.57 - 0.63)	Not serious	Not serious	NA[1]	Serious[2]	Moderate

BMI at 7 years of age. Outcome assessed when 45 years old								
Li 2011	Prospective	7142 to 8979[3]	0.53 (0.52 - 0.55)	Very Serious[4]	Not serious	NA[1]	Not serious	Low
BMI at 11 years of age. Outcome assessed when 42 years old.								
Li 2011	Prospective	7142 to 8979[3]	0.54 (0.52 - 0.55)	Very Serious[4]	Not serious	NA[1]	Not serious	Low
BMI at 16 years of age. Outcome assessed when 42 years old								
Li 2011	Prospective	7142 to 8979[3]	0.54 (0.52 - 0.55)	Very Serious[4]	Not serious	NA[1]	Not serious	Low

[1] Inconsistency not applicable as evidence from a single study.
[2] Downgraded by 1 increment because the confidence interval crossed into 2 classification categories
[3] The paper stated that data was available for between 7142 to 8979 participants depending on the measure.
[4] Downgraded by 2 increments because the majority of the evidence was at very high risk of bias

Cancer

BMI

No. of studies	Study design	Sample size	C-statistic (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
BMI at Age 7y (Cancer at age 42y, follow-up 35y)								
Cheung, 2004	Prospective	4592	0.46 (0.41 - 0.51)	Not serious	Not serious	NA[1]	Not serious	High
BMI at Age 11y (Cancer at age 42y, follow-up 31y)								
Cheung, 2004	Prospective	4427	0.47 (0.42 - 0.53)	Not serious	Not serious	NA[1]	Not serious	High
BMI at Age 16y (Cancer at age 42y, follow-up 19y)								
Cheung, 2004	Prospective	4047	0.53 (0.47 - 0.58)	Not serious	Not serious	NA[1]	Not serious	High

[1] Inconsistency not applicable as evidence from a single study.

Diagnostic accuracy

Black African/ Caribbean population

Hypertension

BMI

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 10-18 years old								
Wariri 2018	Cross-sectional	191	0.770 (95% CI not reported)	Not serious	Not serious	NA[2]	Very serious[1]	Low
Female children 10-18 years old								
Wariri 2018	Cross-sectional	176	0.790 (95% CI not reported)	Not serious	Not serious	NA[2]	Very serious[1]	Low
[1] Downgraded 2 increments as the confidence interval was not reported and there were 250 or fewer individuals in the study [2] Inconsistency not applicable as evidence from a single study.								

Waist circumference

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 10-18 years old								
Wariri 2018	Cross-sectional	191	0.760 (95% CI not reported)	Not serious	Not serious	NA[2]	Very serious[1]	Low
Female children 10-18 years old								
Wariri 2018	Cross-sectional	176	0.780 (95% CI not reported)	Not serious	Not serious	NA[2]	Very serious[1]	Low
[1] Downgraded 2 increments as the confidence interval was not reported and there were 250 or fewer individuals in the study [2] Inconsistency not applicable as evidence from a single study.								

Waist-to-height ratio

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 10-18 years old								
Wariri 2018	Cross-sectional	191	0.750 (95% CI not reported)	Not serious	Not serious	NA[2]	Very serious[1]	Low
Female children 10-18 years old								
Wariri 2018	Cross-sectional	176	0.770 (95% CI not reported)	Not serious	Not serious	NA[2]	Very serious[1]	Low
[1] Downgraded 2 increments as the confidence interval was not reported and there were 250 or fewer individuals in the study [2] Inconsistency not applicable as evidence from a single study.								

Chinese population

Hypertension

BMI

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Children 7-12 years old								
Hsu 2020	Cross-sectional	340	0.649 (0.584–0.715)	Serious[1]	Not serious	NA[2]	Very serious[4]	Very low
Male children 7-17 years old								
Dong 2015	Cross-sectional	49514	0.656 (95% CI not reported)	Not serious	Not serious	NA[2]	Not serious	High
Li 2014	Cross-sectional	1588	0.679 (0.635-0.723)	Not serious	Not serious	NA[2]	Serious[3]	Moderate
Male children 6-10 years old								
2 studies (Liang 2015, Ma 2015)	Cross-sectional	3549	0.83 (0.7-0.95)	Not serious	Not serious	Very serious[5]	Very serious[4]	Very low
Female children 7-17 years old								

Dong 2015	Cross-sectional	49852	0.644 (95% CI not reported)	Not serious	Not serious	NA[2]	Not serious	High
Li 2014	Cross-sectional	1240	0.629 (0.58-0.628)	Not serious	Not serious	NA[2]	Serious[3]	Moderate
Female children 6-10 years old								
2 studies (Liang 2015, Ma 2015)	Cross-sectional	3345	0.85 (0.7-1)	Not serious	Not serious	Very serious[5]	Very serious[4]	Very low

[1] Downgraded by 1 increment because the majority of the evidence was at high risk of bias
[2] Inconsistency not applicable as evidence from a single study.
[3] Downgraded by 1 increment because the confidence interval crossed into 2 classification categories
[4] Downgraded by 2 increments because the confidence interval crossed into 3 classification categories
[5] Downgraded 1 increment because the I^2 was over 66%

BMI z-score / percentile

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
BMI percentile								
Children 7-12 years old								
Hsu 2020	Cross-sectional	340	0.63 (0.565–0.694)	Serious[1]	Not serious	NA[3]	Serious[2]	Low
BMI z-score								
Children 7-12 years old								
Hsu 2020	Cross-sectional	340	0.627 (0.562–0.692)	Serious[1]	Not serious	NA[3]	Serious[2]	Low
Male children 7-17 years old								
Li 2020	Cross-sectional	8004	0.7 (0.68 - 0.72)	Not serious	Not serious	NA[3]	Serious[2]	Moderate
Female children 7-17 years old								
Li 2020	Cross-sectional	7694	0.65 (0.63 - 0.68)	Not serious	Not serious	NA[3]	Not serious	High

[1] Downgraded by 1 increment because the majority of the evidence was at high risk of bias
[2] Downgraded by 1 increment because the confidence interval crossed into 2 classification categories
[3] Inconsistency not applicable as evidence from a single study.

Waist circumference

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 7-17 years old								
Dong 2015	Cross-sectional	49514	0.639 (95% CI not reported)	Not serious	Not serious	NA[4]	Not serious	High
Li 2014	Cross-sectional	1588	0.676 (0.631-0.722)	Not serious	Not serious	NA[4]	Serious[1]	Moderate
Male children 6-10 years old								
2 studies (Liang 2015, Ma 2015)	Cross-sectional	3549	0.85 (0.7-1)	Not serious	Not serious	Very serious[3]	Very serious[2]	Very low
Female children 7-17 years old								
Dong 2015	Cross-sectional	49852	0.631 (95% CI not reported)	Not serious	Not serious	NA[4]	Not serious	High
Li 2014	Cross-sectional	1240	0.594 (0.543-0.646)	Not serious	Not serious	NA[4]	Serious[1]	Moderate
Female children 6-10 years old								
2 studies (Liang 2015, Ma 2015)	Cross-sectional	3345	0.73 (0.58-0.87)	Not serious	Not serious	Very serious[3]	Very serious[2]	Very low

[1] Downgraded by 1 increment because the confidence interval crossed into 2 classification categories
[2] Downgraded by 2 increments because the confidence interval crossed into 3 classification categories
[3] Downgraded 2 increments because the I^2 was over 66%
[4] Inconsistency not applicable as evidence from a single study.
[5]

Waist circumference z-score

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 7-17 years old								
Li 2020	Cross-sectional	8004	0.69 (0.67 - 0.71)	Not serious	Not serious	NA[2]	Serious[1]	Moderate
Female children 7-17 years old								
Li 2020	Cross-sectional	7694	0.62 (0.6 - 0.64)	Not serious	Not serious	NA[2]	Not serious	High
[1] Downgraded by 1 increment because the confidence interval crossed into 2 classification categories [2] Inconsistency not applicable as evidence from a single study.								

Waist-to-hip ratio

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 7-17 years old								
Dong 2015	Cross-sectional	49514	0.611 (95% CI not reported)	Not serious	Not serious	NA[3]	Not serious	High
2 studies (Li 2014, Li 2020)	Cross-sectional	9592	0.6 (0.56-0.64)	Not serious	Not serious	Serious[2]	Serious[1]	Low
Male children 6-10 years old								
Liang 2015	Cross-sectional	2870	0.683 (0.665–0.7)	Not serious	Not serious	NA[3]	Serious[1]	Moderate
Female children 7-17 years old								
Dong 2015	Cross-sectional	49852	0.584 (95% CI not reported)	Not serious	Not serious	NA[3]	Not serious	High
2 studies (Li 2014, Li 2020)	Cross-sectional	8934	0.55 (0.52-0.57)	Not serious	Not serious	Not serious	Not serious	High
Female children 6-10 years old								
Liang 2015	Cross-sectional	2672	0.652 (0.634–0.670)	Not serious	Not serious	NA[3]	Not serious	High

[1] Downgraded by 1 increment because the confidence interval crossed into 2 classification categories
[2] Downgraded 1 increment because the I^2 was over 33%
[3] Inconsistency not applicable as evidence from a single study.

Waist-to-height ratio

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Children 7-12 years old								
Hsu 2020	Cross-sectional	340	0.614 (0.547–0.681)	Serious[1]	Not serious	NA[4]	Serious[2]	Low
Male children 7-17 years old								
Dong 2015	Cross-sectional	49514	0.655 (95% CI not reported)	Not serious	Not serious	NA[4]	Not serious	High
2 studies (Li 2014, Li 2020)	Cross-sectional	9592	0.67 (0.62-0.71)	Not serious	Not serious	Serious[3]	Serious[2]	Low
Male children 6-10 years old								
Liang 2015	Cross-sectional	2870	0.754 (0.737–0.770)	Not serious	Not serious	NA[4]	Not serious	High
Female children 7-17 years old								
Dong 2015	Cross-sectional	49852	0.637 (95% CI not reported)	Not serious	Not serious	NA[4]	Not serious	High
2 studies (Li 2014, Li 2020)	Cross-sectional	8934	0.59 (0.57 - 0.61)	Not serious	Not serious	Not serious	Serious[2]	Moderate
Female children 6-10 years old								
Liang 2015	Cross-sectional	2672	0.591 (0.572–0.610)	Not serious	Not serious	NA[4]	Serious[2]	Moderate

[1] Downgraded by 1 increment because the majority of the evidence was at high risk of bias
[2] Downgraded by 1 increment because the confidence interval crossed into 2 classification categories
[3] Downgraded 1 increment because the I^2 was over 33%
[4] Inconsistency not applicable as evidence from a single study.

Dyslipidaemia

BMI z-score

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 7-17 years old								
Li 2020	Cross-sectional	8004	0.62 (0.61 - 0.64)	Not serious	Not serious	NA[3]	Not serious	High
Male children 7-12 years old								
Zheng 2016	Cross-sectional	399	0.66 (0.57–0.75)	Very serious[1]	Not serious	NA[3]	Very serious[2]	Very low
Female children 7-17 years old								
Li 2020	Cross-sectional	7694	0.59 (0.57 - 0.6)	Not serious	Not serious	NA[3]	Serious[4]	Moderate
Female children 7-12 years old								
Zheng 2016	Cross-sectional	374	Results not presented for this subgroup					

[1] Downgraded by 2 increments because the majority of the evidence was at very high risk of bias
[2] Downgraded by 2 increment because the confidence interval crossed into 3 classification categories
[3] Inconsistency not applicable as evidence from a single study.
[4] Downgraded by 1 increment because the confidence interval crossed into 2 classification categories

Waist circumference z-score

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 7-17 years old								
Li 2020	Cross-sectional	8004	0.63 (0.62 - 0.65)	Not serious	Not serious	NA[2]	Not serious	High
Female children 7-17 years old								
Li 2020	Cross-sectional	7694	0.59 (0.57 - 0.6)	Not serious	Not serious	NA[2]	Serious[1]	Moderate

[1] Downgraded by 1 increment because the confidence interval crossed into 2 classification categories [2] Inconsistency not applicable as evidence from a single study.

Waist-to-hip ratio

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 7-17 years old								
Li 2020	Cross-sectional	8004	0.59 (0.58 - 0.61)	Not serious	Not serious	NA[4]	Serious[1]	Moderate
Male children 7-12 years old								
Zheng 2016	Cross-sectional	399	0.73 (0.66–0.80)	Very serious[3]	Not serious	NA[4]	Very serious[2]	Very low
Female children 7-17 years old								
Li 2020	Cross-sectional	7694	0.56 (0.55 - 0.58)	Not serious	Not serious	NA[4]	Not serious	High
Female children 7-12 years old								
Zheng 2016	Cross-sectional	374	Results not presented for this subgroup					
[1] Downgraded by 1 increment because the confidence interval crossed into 2 classification categories [2] Downgraded by 2 increments because the confidence interval crossed into 3 classification categories [3] Downgraded by 2 increments because the majority of the evidence was at very high risk of bias [4] Inconsistency not applicable as evidence from a single study.								

Waist-to-height ratio

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 7-17 years old								
Li 2020	Cross-sectional	8004	0.62 (0.61 - 0.64)	Not serious	Not serious	NA[4]	Not serious	High
Male children 7-12 years old								

Zheng 2016	Cross-sectional	399	0.72 (0.65–0.80)	Very serious[1]	Not serious	NA[4]	Very serious[2]	Very low
Female children 7-17 years old								
Li 2020	Cross-sectional	7694	0.59 (0.57 - 0.6)	Not serious	Not serious	NA[4]	Serious[3]	Moderate
Female children 7-12 years old								
Zheng 2016	Cross-sectional	374	Results not presented for this subgroup					

[1] Downgraded by 2 increments because the majority of the evidence was at very high risk of bias
[2] Downgraded by 2 increments because the confidence interval crossed into 3 classification categories
[3] Downgraded by 1 increment because the confidence interval crossed into 2 classification categories
[4] Inconsistency not applicable as evidence from a single study.

South Asian population

Hypertension

BMI z-score

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 6-17 years old								
Fowokan 2019	Cross-sectional	360	0.79 (0.72–0.85)	Serious[1]	Not serious	NA[3]	Serious[2]	Low
Female children 6-17 years old								
Fowokan 2019	Cross-sectional	402	0.79 (0.70–0.88)	Serious[1]	Not serious	NA[3]	Serious[2]	Low

[1] Downgraded by 1 increments because the majority of the evidence was at high risk of bias
[2] Downgraded by 1 increment because the confidence interval crossed into 2 classification categories
[3] Inconsistency not applicable as evidence from a single study.

Waist circumference

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 6-17 years old								
Fowokan 2019	Cross-sectional	360	0.78 (0.71–0.85)	Serious[1]	Not serious	NA[4]	Serious[2]	Low
Female children 6-17 years old								
Fowokan 2019	Cross-sectional	402	0.74 (0.66–0.83)	Serious[1]	Not serious	NA[4]	Very serious[3]	Very low

[1] Downgraded by 1 increment because the majority of the evidence was at high risk of bias
[2] Downgraded by 1 increment because the confidence interval crossed into 2 classification categories
[3] Downgraded by 2 increments because the confidence interval crossed into 3 classification categories
[4] Inconsistency not applicable as evidence from a single study.

Waist-to-height ratio

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 6-17 years old								
Fowokan 2019	Cross-sectional	360	0.77 (0.70–0.84)	Serious[1]	Not serious	NA[4]	Serious[2]	Low
Female children 6-17 years old								
Fowokan 2019	Cross-sectional	402	0.74 (0.66–0.82)	Serious[1]	Not serious	NA[4]	Very serious[3]	Very low

[1] Downgraded by 1 increment because the majority of the evidence was at high risk of bias
[2] Downgraded by 1 increment because the confidence interval crossed into 2 classification categories
[3] Downgraded by 2 increments because the confidence interval crossed into 3 classification categories
[4] Inconsistency not applicable as evidence from a single study.

Asian (other) population

Hypertension

BMI z-score

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 12-16 years old								
Tee 2020	Cross-sectional	211	0.817 (0.723 - 0.912)	Serious[1]	Not serious	NA[3]	Very serious[2]	Very low
Female children 12-16 years old								
Tee 2020	Cross-sectional	302	0.854 (0.793 - 0.916)	Serious[1]	Not serious	NA[3]	Very serious[2]	Very low
[1] Downgraded by 1 increment because the majority of the evidence was at high risk of bias [2] Downgraded by 2 increments because the confidence interval crossed into 3 classification categories [3] Inconsistency not applicable as evidence from a single study.								

Waist circumference percentile

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 12-16 years old								
Tee 2020	Cross-sectional	211	0.781 (0.671 - 0.891)	Serious[1]	Not serious	NA[3]	Very serious[2]	Very low
Female children 12-16 years old								
Tee 2020	Cross-sectional	302	0.863 (0.798 - 0.927)	Serious[1]	Not serious	NA[3]	Very serious[2]	Very low
[1] Downgraded by 1 increment because the majority of the evidence was at high risk of bias [2] Downgraded by 2 increments because the confidence interval crossed into 3 classification categories [3] Inconsistency not applicable as evidence from a single study.								

Waist-to-height ratio

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 12-16 years old								
Tee 2020	Cross-sectional	211	0.789 (0.675 - 0. 903)	Serious[1]	Not serious	NA[3]	Very serious[2]	Very low
Female children 12-16 years old								
Tee 2020	Cross-sectional	302	0.854 (0.781 - 0.927)	Serious[1]	Not serious	NA[3]	Very serious[2]	Very low

[1] Downgraded by 1 increment because the majority of the evidence was at high risk of bias
[2] Downgraded by 2 increments because the confidence interval crossed into 3 classification categories
[3] Inconsistency not applicable as evidence from a single study.

Dyslipidaemia

BMI z-score

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 6-18 years old								
Mai 2020	Cross-sectional	5540	0.64 (95% CI not reported)	Serious[1]	Not serious	NA[2]	Not serious	Moderate
Female children 6-18 years old								
Mai 2020	Cross-sectional	5540	0.65 (95% CI not reported)	Serious[1]	Not serious	NA[2]	Not serious	Moderate

[1] Downgraded by 1 increment because the majority of the evidence was at high risk of bias
[2] Inconsistency not applicable as evidence from a single study.

Waist circumference z-score

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 6-18 years old								

Mai 2020	Cross-sectional	5540	0.61 (95% CI not reported)	Serious[1]	Not serious	NA[2]	Not serious	Moderate
Female children 6-18 years old								
Mai 2020	Cross-sectional	5540	0.62 (95% CI not reported)	Serious[1]	Not serious	NA[2]	Not serious	Moderate
[1] Downgraded by 1 increment because the majority of the evidence was at high risk of bias [2] Inconsistency not applicable as evidence from a single study.								

Waist-to-height ratio

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Male children 6-18 years old								
Mai 2020	Cross-sectional	5540	0.65 (95% CI not reported)	Serious[1]	Not serious	NA[2]	Not serious	Moderate
Female children 6-18 years old								
Mai 2020	Cross-sectional	5540	0.66 (95% CI not reported)	Serious[1]	Not serious	NA[2]	Not serious	Moderate
[1] Downgraded by 1 increment because the majority of the evidence was at high risk of bias [2] Inconsistency not applicable as evidence from a single study.								

White population

Hypertension

BMI z-score + waist-to-height ratio

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Children 10-14 years old								
Chiolero 2013	Cross-sectional	5207	0.62 (0.59-0.64)	Not serious	Not serious	NA[1]	Serious[2]	High

[1] Inconsistency not applicable as evidence from a single study. [2] Downgraded by 1 increment because the confidence interval crossed into 2 classification categories.

BMI / BMI z-score

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
BMI								
Children 6-17 years old								
Vaquero-Álvarez 2020	Cross-sectional	265	0.718 (0.583–0.853)	Very serious[1]	Not serious	NA[3]	Very serious[4]	Very low
BMI z-score								
Children 10-14 years old								
Chiolero 2013	Cross-sectional	5207	0.62 (0.6-0.65)	Not serious	Not serious	NA[3]	Not serious	High
Male children 11-17 years old								
Kromeyer-Hauschild 2013	Cross-sectional	3492	0.684 (0.655–0.712)	Serious[2]	Not serious	NA[3]	Serious[5]	Low
Female children 11-17 years old								
Kromeyer-Hauschild 2013	Cross-sectional	3321	0.607 (0.574–0.641)	Serious[2]	Not serious	NA[3]	Serious[5]	Low

[1] Downgraded by 2 increments because the majority of the evidence was at very high risk of bias
[2] Downgraded by 1 increment because the majority of the evidence was at high risk of bias
[3] Inconsistency not applicable as evidence from a single study.
[4] Downgraded by 2 increments because the confidence interval crossed into 3 or more classification categories
[5] Downgraded by 1 increment because the confidence interval crossed into 2 classification categories

Waist circumference

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Waist circumference								
Children 6-17 years old								

Vaquero-Álvarez 2020	Cross-sectional	265	0.729 (0.587–0.871)	Very serious[1]	Not serious	NA[3]	Very serious[4]	Very low
Children 8-11 years old								
Arellano-Ruiz 2020	Cross-sectional	848	0.61 (0.48-0.74)	Serious[2]	Not serious	NA[3]	Very serious[4]	Very low

[1] Downgraded by 2 increments because the majority of the evidence was at very high risk of bias
[2] Downgraded by 1 increment because the majority of the evidence was at high risk of bias
[3] Inconsistency not applicable as evidence from a single study.
[4] Downgraded by 2 increments because the confidence interval crossed into 3 or more classification categories

Waist-to-height ratio / waist-to-height ratio z-score

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
Waist-to-height ratio								
Children 10-14 years old								
Chiolero 2013	Cross-sectional	5207	0.62 (0.59-0.64)	Not serious	Not serious	NA[3]	Not serious	High
Children 6-17 years old								
Vaquero-Álvarez 2020	Cross-sectional	265	0.706 (0.593–0.819)	Very serious[1]	Not serious	NA[3]	Very serious[4]	Very low
Children 8-11 years old								
Arellano-Ruiz 2020	Cross-sectional	848	0.63 (0.51 - 0.76)	Serious[2]	Not serious	NA[3]	Very serious[4]	Very low
Male children 11-17 years old								
Kromeyer-Hauschild 2013	Cross-sectional	3492	0.664 (0.635–0.692)	Serious[2]	Not serious	NA[3]	No serious	Moderate
Female children 11-17 years old								
Kromeyer-Hauschild 2013	Cross-sectional	3321	0.605 (0.571–0.639)	Serious[2]	Not serious	NA[3]	Serious[5]	Low
Waist-to-height ratio z-score								
Male children 11-17 years old								

Kromeyer-Hauschild 2013	Cross-sectional	3492	0.667 (0.638–0.695)	Serious[2]	Not serious	NA[3]	Not serious	Moderate
Female children 11-17 years old								
Kromeyer-Hauschild 2013	Cross-sectional	3321	0.604 (0.570–0.638)	Serious[2]	Not serious	NA[3]	Serious[5]	Low

[1] Downgraded by 2 increments because the majority of the evidence was at very high risk of bias
[2] Downgraded by 1 increment because the majority of the evidence was at high risk of bias
[3] Inconsistency not applicable as evidence from a single study.
[4] Downgraded by 2 increments because the confidence interval crossed into 3 or more classification categories
[5] Downgraded by 1 increment because the confidence interval crossed into 2 classification categories

Other population

Hypertension

BMI z-score

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
(Iran) Male children 7-18 years old								
Yazdi 2020	Cross-sectional	7091	0.584 (0.562-0.606)	Serious[1]	Not serious	NA[3]	Serious[2]	Low
(Iran) Female children 7-18 years old								
Yazdi 2020	Cross-sectional	6817	0.6 (0.579-0.621)	Serious[1]	Not serious	NA[3]	Serious[2]	Low

[1] Downgraded by 1 increment because the majority of the evidence was at high risk of bias
[2] Downgraded by 1 increment because the confidence interval crossed into 2 classification categories
[3] Inconsistency not applicable as evidence from a single study.

BMI

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
(Brazil) Children 10-17 years old								

2 studies (Christofaro 2018, Rosa 2007)	Cross-sectional	8751	0.60 (0.59-0.61)	Not serious	Not serious	NA[3]	Serious[1]	Moderate
(Brazil) Male children 6-10 years old								
de Quadros 2019	Cross-sectional	160	0.81 (0.74-0.87)	Serious[2]	Not serious	NA[3]	Serious[1]	Low
(Brazil) Male children 11-17 years old								
de Quadros 2019	Cross-sectional	341	0.67 (0.62-0.72)	Serious[2]	Not serious	NA[3]	Serious[1]	Low
(Brazil) Female children 6-10 years old								
de Quadros 2019	Cross-sectional	203	0.78 (0.71-0.83)	Serious[2]	Not serious	NA[3]	Serious[1]	Low
(Brazil) Female children 11-17 years old								
de Quadros 2019	Cross-sectional	435	0.63 (0.59-0.68)	Serious[2]	Not serious	NA[3]	Serious[1]	Low
[1] Downgraded by 1 increment because the confidence interval crossed into 2 classification categories [2] Downgraded by 1 increment because the majority of the evidence was at high risk of bias [3] Inconsistency not applicable as evidence from a single study.								

Waist circumference centile

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
(Iran) Male children 7-18 years old								
Yazdi 2020	Cross-sectional	7091	0.578 (0.556-0.601)	Serious[1]	Not serious	NA[3]	Serious[2]	Low
(Iran) Female children 7-18 years old								
Yazdi 2020	Cross-sectional	6817	0.592 (0.571-0.613)	Serious[1]	Not serious	NA[3]	Serious[2]	Low
[1] Downgraded by 1 increment because the majority of the evidence was at high risk of bias [2] Downgraded by 1 increment because the confidence interval crossed into 2 classification categories [3] Inconsistency not applicable as evidence from a single study.								

Waist circumference

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
(Brazil) Children 10-17 years old								
Christofaro 2018	Cross-sectional	8295	0.59 (0.58-0.60)	Not serious	Not serious	NA[3]	Serious[1]	Moderate
(Brazil) Children 10-18 years old								
Lopez-Gonzalez 2016 (WHO measure)	Cross-sectional	366	0.691 (0.603-0.779)	Very serious[2]	Not serious	NA[3]	Serious[1]	Very low
Lopez-Gonzalez 2016 (NCHS measure)	Cross-sectional	366	0.59 (0.58-0.60)	Very serious[2]	Not serious	NA[3]	Serious[1]	Very low
(Brazil) Children 12-17 years old								
Rosa 2007	Cross-sectional	456	0.612 (0.485-0.746)	Serious[4]	Not serious	NA[3]	Very serious[5]	Very low
(Brazil) Male children 6-10 years old								
de Quadros 2019	Cross-sectional	160	0.78 (0.71-0.84)	Serious[4]	Not serious	NA[3]	Serious[1]	Low
(Brazil) Male children 11-17 years old								
de Quadros 2019	Cross-sectional	341	0.65 (0.6-0.7)	Serious[4]	Not serious	NA[3]	Serious[1]	Low
(Brazil) Female children 6-10 years old								
de Quadros 2019	Cross-sectional	203	0.71 (0.64-0.77)	Serious[4]	Not serious	NA[3]	Serious[1]	Low
(Brazil) Female children 11-17 years old								
de Quadros 2019	Cross-sectional	435	0.63 (0.58-0.68)	Serious[4]	Not serious	NA[3]	Serious[1]	Low

[1] Downgraded by 1 increment because the confidence interval crossed into 2 classification categories
[2] Downgraded by 2 increments because the majority of the evidence was at very high risk of bias
[3] Inconsistency not applicable as evidence from a single study.
[4] Downgraded by 1 increment because the majority of the evidence was at high risk of bias
[5] Downgraded by 2 increments because the confidence interval crossed into 3 classification categories

Waist-to-height ratio

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
(Brazil) Children 10-17 years old								
Christofaro 2018	Cross-sectional	8295	0.57 (0.56-0.58)	Not serious	Not serious	NA[3]	Not serious	High
(Brazil) Children 10-18 years old								
Lopez-Gonzalez 2016 (WHO measure)	Cross-sectional	366	0.628 (0.539 - 0.717)	Very serious[2]	Not serious	NA[3]	Very serious[5]	Very low
Lopez-Gonzalez 2016 (NCHS measure)	Cross-sectional	366	0.625 (0.533 - 0.715)	Very serious[2]	Not serious	NA[3]	Very serious[5]	Very low
(Brazil) Male children 6-10 years old								
de Quadros 2019	Cross-sectional	160	0.62 (0.54-0.69)	Serious[4]	Not serious	NA[3]	Serious[1]	Low
(Brazil) Male children 11-17 years old								
de Quadros 2019	Cross-sectional	341	0.51 (0.46-0.57)	Serious[4]	Not serious	NA[3]	Not serious	Low
(Iran) Male children 7-18 years old								
Yazdi 2020	Cross-sectional	7091	0.593 (0.571-0.615)	Serious[4]	Not serious	NA[3]	Serious[1]	Low
(Brazil) Female children 6-10 years old								
de Quadros 2019	Cross-sectional	203	0.62 (0.54-0.69)	Serious[4]	Not serious	NA[3]	Serious[1]	Low
(Brazil) Female children 11-17 years old								
de Quadros 2019	Cross-sectional	435	0.62 (0.57-0.63)	Serious[4]	Not serious	NA[3]	Serious[1]	Low
(Iran) Female children 7-18 years old								
Yazdi 2020	Cross-sectional	6817	0.584 (0.562-0.605)	Serious[4]	Not serious	NA[3]	Serious[1]	Low

[1] Downgraded by 1 increment because the confidence interval crossed into 2 classification categories
[2] Downgraded by 2 increments because the majority of the evidence was at very high risk of bias

[3] Inconsistency not applicable as evidence from a single study.
[4] Downgraded by 1 increment because the majority of the evidence was at high risk of bias
[5] Downgraded by 2 increments because the confidence interval crossed into 3 classification categories

Dyslipidaemia

BMI z-score

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
(Argentina) Children 5-15 years old								
Hirschler 2011	Cross-sectional	1261	0.87 (0.78-0.95)	Serious[1]	Not serious	NA[3]	Very serious[2]	Very low

[1] Downgraded by 1 increment because the majority of the evidence was at high risk of bias
[2] Downgraded by 2 increments because the confidence interval crossed into 3 classification categories
[3] Inconsistency not applicable as evidence from a single study.

Waist circumference

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
(Argentina) Children 5-15 years old								
Hirschler 2011	Cross-sectional	1261	0.87 (0.78-0.95)	Serious[1]	Not serious	NA[3]	Very serious[2]	Very low

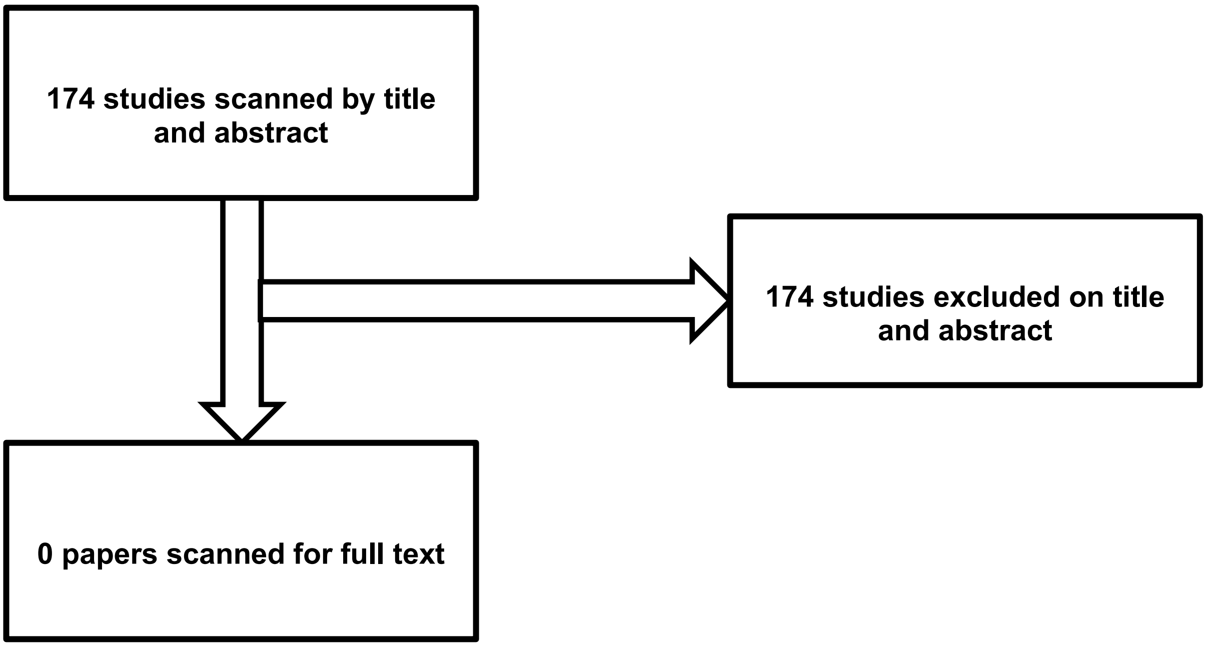
[1] Downgraded by 1 increment because the majority of the evidence was at high risk of bias
[2] Downgraded by 2 increments because the confidence interval crossed into 3 classification categories
[3] Inconsistency not applicable as evidence from a single study.

Waist-to-height ratio

No. of studies	Study design	Sample size	Effect size (95%CI)	Risk of bias	Indirectness	Inconsistency	Imprecision	Quality
(Argentina) Children 5-15 years old								
Hirschler 2011	Cross-sectional	1261	0.84 (0.72 - 0.95)	Serious[1]	Not serious	NA[3]	Very serious[2]	Very low

[1] Downgraded by 1 increment because the majority of the evidence was at high risk of bias
[2] Downgraded by 2 increments because the confidence interval crossed into 3 classification categories
[3] Inconsistency not applicable as evidence from a single study.

Appendix H- Economic evidence study selection



Appendix I– Economic evidence tables

No economic studies were identified which were applicable to this review question.

Appendix J – Health economic model

No economic analysis was conducted for this review question.

Appendix K – Excluded studies

Prognostic accuracy

Study	Code [Reason]
Ashley-Martin, Jillian, Ensenauer, Regina, Maguire, Bryan et al. (2019) Predicting cardiometabolic markers in children using tri-ponderal mass index: a cross-sectional study. Archives of disease in childhood 104(6): 577-582	- Cross-sectional study
Barzin, Maryam, Hosseinpanah, Farhad, Fekri, Sahba et al. (2011) Predictive value of body mass index and waist circumference for metabolic syndrome in 6-12-year-olds. Acta paediatrica (Oslo, Norway : 1992) 100(5): 722-7	- Outcome to be predicted do not match that specified in the protocol *Metabolic syndrome*
Choi, J R, Ahn, S V, Kim, J Y et al. (2018) Comparison of various anthropometric indices for the identification of a predictor of incident hypertension: the ARIRANG study. Journal of human hypertension 32(4): 294-300	- Study in adults
Gus, M, Cichelero, F Tremea, Moreira, C Medaglia et al. (2009) Waist circumference cut-off values to predict the incidence of hypertension: an estimation from a Brazilian population-based cohort. Nutrition, metabolism, and cardiovascular diseases : NMCD 19(1): 15-9	- Study in adults
Horesh, Adi, Bardugo, Aya, Tsur, Avishai M. et al. (2021) Adolescent and Childhood Obesity and Excess Morbidity and Mortality in Young Adulthood-a Systematic Review. Current Obesity Reports	- Systematic review used as source of primary studies
Kahn, Henry S, Divers, Jasmin, Fino, Nora F et al. (2019) Alternative waist-to-height ratios associated with risk biomarkers in youth with diabetes: comparative models in the SEARCH for Diabetes in Youth Study. International journal of obesity (2005) 43(10): 1940-1950	- Results not separated by ethnicity
Kasturi, K, Onuzuruike, AU, Kunnam, S et al. (2019) Two- vs one-hour glucose tolerance testing: predicting prediabetes in adolescent	- Assessment tool do not match that specified in the protocol

Study	Code [Reason]
girls with obesity. Pediatric diabetes 20(2): 154-159	
Lai, Chin-Chih, Sun, Dianjianyi, Cen, Ruiqi et al. (2014) Impact of long-term burden of excessive adiposity and elevated blood pressure from childhood on adulthood left ventricular remodeling patterns: the Bogalusa Heart Study. Journal of the American College of Cardiology 64(15): 1580-7	- Results not separated by ethnicity
Lloyd, L.J.; Langley-Evans, S.C.; McMullen, S. (2010) Childhood obesity and adult cardiovascular disease risk: A systematic review. International Journal of Obesity 34(1): 18-28	- Systematic review used as source of primary studies
Mousavi, S V, Mohebi, R, Mozaffary, A et al. (2015) Changes in body mass index, waist and hip circumferences, waist to hip ratio and risk of all-cause mortality in men. European journal of clinical nutrition 69(8): 927-32	- Study in adults
Ochoa Sangrador, C. and Ochoa-Brezmes, J. (2018) Waist-to-height ratio as a risk marker for metabolic syndrome in childhood. A meta-analysis. Pediatric Obesity 13(7): 421-432	- Systematic review used as source of primary studies
Park, M H, Falconer, C, Viner, R M et al. (2012) The impact of childhood obesity on morbidity and mortality in adulthood: a systematic review. Obesity reviews : an official journal of the International Association for the Study of Obesity 13(11): 985-1000	- Systematic review used as source of primary studies
Petkeviciene, Janina, Klumbiene, Jurate, Kriaucioniene, Vilma et al. (2015) Anthropometric measurements in childhood and prediction of cardiovascular risk factors in adulthood: Kaunas cardiovascular risk cohort study. BMC public health 15: 218	- Prognostic accuracy of relevant weight measures was not reported
Simmonds, Mark, Burch, Jane, Llewellyn, Alexis et al. (2015) The use of measures of obesity in childhood for predicting obesity and the development of obesity-related diseases in adulthood: a systematic review and meta-	- Systematic review used as source of primary studies

Study	Code [Reason]
analysis. Health technology assessment (Winchester, England) 19(43): 1-336	
Trandafir, Laura Mihaela, Russu, Georgiana, Moscalu, Mihaela et al. (2020) Waist circumference a clinical criterion for prediction of cardio-vascular complications in children and adolescences with overweight and obesity. Medicine 99(30): e20923	- Cross-sectional study
Umer, Amna, Kelley, George A, Cottrell, Lesley E et al. (2017) Childhood obesity and adult cardiovascular disease risk factors: a systematic review with meta-analysis. BMC public health 17(1): 683	- Systematic review used as source of primary studies
Wu, Feitong, Ho, Valentina, Fraser, Brooklyn J et al. (2018) Predictive utility of childhood anthropometric measures on adult glucose homeostasis measures: a 20-year cohort study. International journal of obesity (2005) 42(10): 1762-1770	- Outcome to be predicted do not match that specified in the protocol

Diagnostic accuracy

Study	Code [Reason]
Adegboye AR, Andersen LB, Froberg K et al. (2010) Linking definition of childhood and adolescent obesity to current health outcomes. International journal of pediatric obesity : IJPO : an official journal of the International Association for the Study of Obesity 5(2): 130-142	- Outcome to be predicted does not match that specified in the protocol *Cardiometabolic risk factors*
Aguirre P, F, Coca, A, Aguirre, M F et al. (2017) Waist-to-height ratio and sedentary lifestyle as predictors of metabolic syndrome in children in Ecuador. Hipertension y riesgo vascular	- Study does not compare anthropometric measures *Accuracy outcomes only provided for waist-to-height ratio and not for the other measures of interest.*
Al-Hussein, Fahad Abdullah, Tamimi, Waleed, Al Banyan, Esam et al. (2014) Cardiometabolic risk among Saudi children and adolescents: Saudi childrens overweight, obesity, and	- Not a diagnostic accuracy study

Study	Code [Reason]
lifestyles (S.Ch.O.O.Ls) study. Annals of Saudi medicine 34(1): 46-53	
Androutsos, O, Grammatikaki, E, Moschonis, G et al. (2012) Neck circumference: a useful screening tool of cardiovascular risk in children. Pediatric obesity 7(3): 187-95	- Not a diagnostic test accuracy study
Aristizabal, Juan C, Barona, Jacqueline, Hoyos, Marcela et al. (2015) Association between anthropometric indices and cardiometabolic risk factors in pre-school children. BMC pediatrics 15: 170	- Outcome to be predicted does not match that specified in the protocol *Insulin resistance*
Ashley-Martin, Jillian, Ensenauer, Regina, Maguire, Bryan et al. (2019) Predicting cardiometabolic markers in children using tri-ponderal mass index: a cross-sectional study. Archives of disease in childhood 104(6): 577-582	- Study does not compare anthropometric measures *Only evaluates BMI*
Bauer KW, Marcus MD, El ghormli L et al. (2015) Cardio-metabolic risk screening among adolescents: understanding the utility of body mass index, waist circumference and waist to height ratio. Pediatric obesity 10(5): 329-337	- Accuracy outcomes were not stratified by ethnicity
Beck, Carmem Cristina; Lopes, Adair da Silva; Pitanga, Francisco Jose Gondim (2011) Anthropometric indicators as predictors of high blood pressure in adolescents. Arquivos brasileiros de cardiologia 96(2): 126-33	- Study population stated to be 74% white and 26% non-white. Outcomes were not stratified by ethnicity
Benmohammed K, Valensi P, Benlatreche M et al. (2015) Anthropometric markers for detection of the metabolic syndrome in adolescents. Diabetes & metabolism 41(2): 138-144	- Outcome to be predicted does not match that specified in the protocol *Metabolic syndrome with obesity criteria*
Bohn, Barbara, Muller, Manfred James, Simic-Schleicher, Gunter et al. (2015) BMI or BIA: Is Body Mass Index or Body Fat Mass a Better Predictor of Cardiovascular Risk in Overweight or Obese Children and Adolescents? A German/Austrian/Swiss Multicenter APV Analysis of 3,327 Children and Adolescents. Obesity facts 8(2): 156-65	- No accuracy outcomes reported for a measure of interest

Study	Code [Reason]
Buchan, Duncan S and Baker, Julien S (2017) Utility of Body Mass Index, Waist-to-Height-Ratio and cardiorespiratory fitness thresholds for identifying cardiometabolic risk in 10.4-17.6-year-old children. Obesity research & clinical practice 11(5): 567-575	- Outcome to be predicted do not match that specified in the protocol
Buchan, Duncan S, Boddy, Lynne M, Grace, Fergal M et al. (2017) Utility of three anthropometric indices in assessing the cardiometabolic risk profile in children. American journal of human biology : the official journal of the Human Biology Council 29(3)	- Outcome to be predicted do not match that specified in the protocol
Campagnolo, Paula Dal Bo; Hoffman, Daniel J; Vitolo, Marcia Regina (2011) Waist-to-height ratio as a screening tool for children with risk factors for cardiovascular disease. Annals of human biology 38(3): 265-70	- Outcome to be predicted does not match that specified in the protocol *Risk factors for cardiovascular disease*
Choi, Dong-Hyun, Hur, Yang-Im, Kang, Jae-Heon et al. (2017) Usefulness of the Waist Circumference-to-Height Ratio in Screening for Obesity and Metabolic Syndrome among Korean Children and Adolescents: Korea National Health and Nutrition Examination Survey, 2010-2014. Nutrients 9(3)	- Study does not compare anthropometric measures *Evaluates waist-to-height ratio alone*
Chuang, Shao-Yuan and Pan, Wen-Harn (2009) Predictability and implications of anthropometric indices for metabolic abnormalities in children: nutrition and health survey in Taiwan elementary children, 2001-2002. Asia Pacific journal of clinical nutrition 18(2): 272-9	- Outcome to be predicted does not match that specified in the protocol *Metabolic abnormalities*
Chung IH, Park S, Park MJ et al. (2016) Waist-to-Height Ratio as an Index for Cardiometabolic Risk in Adolescents: Results from the 1998-2008 KNHANES. Yonsei medical journal 57(3): 658-663	- Outcome to be predicted does not match that specified in the protocol *Metabolic syndrome including obesity criteria*
Cristine Silva, Kellen, Santana Paiva, Natalia, Rocha de Faria, Franciane et al. (2020) Predictive Ability of Seven Anthropometric Indices for Cardiovascular Risk Markers and Metabolic Syndrome in Adolescents. The Journal of adolescent health : official publication	- Study population stated to be 74% non-white and 26% White. Outcomes were not stratified by ethnicity

Study	Code [Reason]
of the Society for Adolescent Medicine 66(4): 491-498	
de Quadros, Teresa Maria Bianchini, Gordia, Alex Pinheiro, Andaki, Alynne Christian Ribeiro et al. (2019) Utility of anthropometric indicators to screen for clustered cardiometabolic risk factors in children and adolescents. Journal of pediatric endocrinology & metabolism : JPEM 32(1): 49-55	- Outcome to be predicted does not match that specified in the protocol *Cardiometabolic risk factors*
Dou, Yalan, Jiang, Yuan, Yan, Yinkun et al. (2020) Waist-to-height ratio as a screening tool for cardiometabolic risk in children and adolescents: a nationwide cross-sectional study in China. BMJ open 10(6): e037040	- Outcome to be predicted does not match that specified in the protocol
Duncan, Michael J, Vale, Susana, Santos, Maria Paula et al. (2013) Cross validation of ROC generated thresholds for field assessed aerobic fitness related to weight status and cardiovascular disease risk in Portuguese young people. American journal of human biology : the official journal of the Human Biology Council 25(6): 751-5	- Study does not compare anthropometric measures *Evaluated only BMI*
Ekoru, K, Murphy, G A V, Young, E H et al. (2017) Deriving an optimal threshold of waist circumference for detecting cardiometabolic risk in sub-Saharan Africa. International journal of obesity (2005)	- Outcome to be predicted do not match that specified in the protocol *Metabolic syndrome*
Elizondo-Montemayor L, Serrano-González M, Ugalde-Casas PA et al. (2011) Waist-to-height: cutoff matters in predicting metabolic syndrome in Mexican children. Metabolic syndrome and related disorders 9(3): 183-190	- Outcome to be predicted does not match that specified in the protocol *Metabolic syndrome with obesity criteria*
Fazeli, Mostafa, Mohammad-Zadeh, Mohammad, Darroudi, Susan et al. (2019) New anthropometric indices in the definition of metabolic syndrome in pediatrics. Diabetes & metabolic syndrome 13(3): 1779-1784	- Outcome to be predicted does not match that specified in the protocol *Metabolic syndrome utilising the obesity criteria*
Freedman, David S, Kahn, Henry S, Mei, Zuguo et al. (2007) Relation of body mass index and waist-to-height ratio to cardiovascular disease	- Accuracy outcomes were not stratified by ethnicity

Study	Code [Reason]
risk factors in children and adolescents: the Bogalusa Heart Study. The American journal of clinical nutrition 86(1): 33-40	*Study included people of white and black ethnicity*
Gong, Chun-dan, Wu, Qiao-ling, Chen, Zheng et al. (2013) Glycolipid metabolic status of overweight/obese adolescents aged 9- to 15-year-old and the BMI-SDS/BMI cut-off value of predicting dyslipidemiain boys, Shanghai, China: a cross-sectional study. Lipids in health and disease 12: 129	- Study does not compare anthropometric measures *Evaluates BMI alone*
Graves, L, Garnett, S P, Cowell, C T et al. (2014) Waist-to-height ratio and cardiometabolic risk factors in adolescence: findings from a prospective birth cohort. Pediatric obesity 9(5): 327-38	- Outcome to be predicted does not match that specified in the protocol
Hannon, Tamara S, Bacha, Fida, Lee, So Jung et al. (2006) Use of markers of dyslipidemia to identify overweight youth with insulin resistance. Pediatric diabetes 7(5): 260-6	- Assessment tools do not match that specified in the protocol *This study is evaluating markers of dyslipidaemia to identify people with insulin resistance.*
Hirschler, V, Molinari, C, Beccaria, M et al. (2010) Comparison of various maternal anthropometric indices of obesity for identifying metabolic syndrome in offspring. Diabetes technology & therapeutics 12(4): 297-305	- Assessment tool do not match that specified in the protocol *Investigating the mother's obesity rather than the child's*
Hirschler, Valeria, Maccallini, Gustavo, Aranda, Claudio et al. (2012) Dyslipidemia without obesity in indigenous Argentinean children living at high altitude. The Journal of pediatrics 161(4): 646-51e1	- Outcome to be predicted does not match that specified in the protocol *The accuracy to find dyslipidaemia is split into its components rather than in combination*
Hirschler, Valeria, Maccallini, Gustavo, Calcagno, Maria et al. (2007) Waist circumference identifies primary school children with metabolic syndrome abnormalities. Diabetes technology & therapeutics 9(2): 149-57	- Outcome to be predicted do not match that specified in the protocol *metabolic syndrome*
Jafar, Tazeen H; Chaturvedi, Nish; Pappas, Gregory (2006) Prevalence of overweight and obesity and their association with hypertension and diabetes mellitus in an Indo-Asian	- Study does not compare anthropometric measures *Evaluates BMI alone*

Study	Code [Reason]
population. CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne 175(9): 1071-7	
Jiang Y, Dou Y, Chen H et al. (2021) Performance of waist-to-height ratio as a screening tool for identifying cardiometabolic risk in children: a meta-analysis. Diabetology & metabolic syndrome 13(1): 66	- Systematic review. Included stuidies were checked for inclusion in this review
Jung, Christian, Fischer, Nicole, Fritzenwanger, Michael et al. (2010) Anthropometric indices as predictors of the metabolic syndrome and its components in adolescents. Pediatrics international : official journal of the Japan Pediatric Society 52(3): 402-9	- Outcome to be predicted does not match that specified in the protocol *Metabolic syndrome utilising the obesity criteria*
Kajale, N A, Khadilkar, A V, Chiplonkar, S A et al. (2014) Body fat indices for identifying risk of hypertension in Indian children. Indian pediatrics 51(7): 555-60	- Accuracy outcomes were not reported in the full text paper
Kakinami, Lisa, Henderson, Melanie, Delvin, Edgard E et al. (2012) Association between different growth curve definitions of overweight and obesity and cardiometabolic risk in children. CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne 184(10): e539-50	- Study does not compare anthropometric measures *Evaluates BMI alone*
Katzmarzyk, Peter T, Srinivasan, Sathanur R, Chen, Wei et al. (2004) Body mass index, waist circumference, and clustering of cardiovascular disease risk factors in a biracial sample of children and adolescents. Pediatrics 114(2): e198-205	- Assessment tool do not match that specified in the protocol *Risk Factor Clustering*
Kelishadi, Roya, Gheiratmand, Riaz, Ardalan, Gelayol et al. (2007) Association of anthropometric indices with cardiovascular disease risk factors among children and adolescents: CASPIAN Study. International journal of cardiology 117(3): 340-8	- Outcome to be predicted does not match that specified in the protocol *Pre-hypertension*
Khadilkar, Anuradha, Ekbote, Veena, Chiplonkar, Shashi et al. (2014) Waist circumference percentiles in 2-18 year old	- Study does not compare anthropometric measures

Study	Code [Reason]
Indian children. The Journal of pediatrics 164(6): 1358-62e2	*Waist circumference alone*
Khoshhali, Mehri, Heidari-Beni, Motahar, Qorbani, Mostafa et al. (2020) Tri-ponderal mass index and body mass index in prediction of pediatric metabolic syndrome: the CASPIAN-V study. Archives of endocrinology and metabolism 64(2): 171-178	- Study does not compare anthropometric measures *Evaluated BMI alone*
Khoury M, Manlhiot C, Dobbin S et al. (2012) Role of waist measures in characterizing the lipid and blood pressure assessment of adolescents classified by body mass index. Archives of pediatrics & adolescent medicine 166(8): 719-724	- Not a diagnostic test accuracy study
Kruger HS, Faber M, Schutte AE et al. (2013) A proposed cutoff point of waist-to-height ratio for metabolic risk in African township adolescents. Nutrition (Burbank, Los Angeles County, Calif.) 29(3): 502-507	- Outcome to be predicted do not match that specified in the protocol *These were fasting plasma glucose, HOMA-IR, serum high-sensitivity C-reactive protein, and elevated blood pressure*
Kuba, Valesca Mansur; Leone, Claudio; Damiani, Durval (2013) Is waist-to-height ratio a useful indicator of cardio-metabolic risk in 6-10-year-old children?. BMC pediatrics 13: 91	- Outcome to be predicted does not match that specified in the protocol *Cardio-metabolic risk*
Laurson, Kelly R; Welk, Gregory J; Eisenmann, Joey C (2014) Diagnostic performance of BMI percentiles to identify adolescents with metabolic syndrome. Pediatrics 133(2): e330-8	- Study does not compare anthropometric measures *Evaluates BMI alone*
Li, Ping, Jiang, Ranhua, Li, Ling et al. (2014) Prevalence and risk factors of metabolic syndrome in school adolescents of northeast China. Journal of pediatric endocrinology & metabolism : JPEM 27(56): 525-32	- Study does not compare anthropometric measures *Evaluates BMI alone*
Lo K, Wong M, Khalechelvam P et al. (2016) Waist-to-height ratio, body mass index and waist circumference for screening paediatric cardio-metabolic risk factors: a meta-analysis. Obesity reviews : an official journal of the International Association for the Study of Obesity 17(12): 1258-1275	- Systematic review. Included stuidies were checked for inclusion in this review

Study	Code [Reason]
Lu, Xi, Shi, Peng, Luo, Chun-Yan et al. (2013) Prevalence of hypertension in overweight and obese children from a large school-based population in Shanghai, China. BMC public health 13: 24	- Not a diagnostic test accuracy study
Lu, Yali, Luo, Benmai, Xie, Juan et al. (2018) Prevalence of hypertension and prehypertension and its association with anthropometrics among children: a cross-sectional survey in Tianjin, China. Journal of human hypertension 32(11): 789-798	- Outcome to be predicted does not match that specified in the protocol *Pre-hypertension rather than hypertension*
Ma, Chunming, Wang, Rui, Liu, Yue et al. (2016) Performance of obesity indices for screening elevated blood pressure in pediatric population: Systematic review and meta-analysis. Medicine 95(39): e4811	- Systematic review. Included studies were checked for inclusion in this review
Ma, Lu, Cai, Li, Deng, Lu et al. (2016) Waist Circumference is Better Than Other Anthropometric Indices for Predicting Cardiovascular Disease Risk Factors in Chinese Children--a Cross-Sectional Study in Guangzhou. Journal of atherosclerosis and thrombosis 23(3): 320-9	- Outcome to be predicted does not match that specified in the protocol *Cardiovascular risk factors*
Maffeis C, Banzato C, Talamini G et al. (2008) Waist-to-height ratio, a useful index to identify high metabolic risk in overweight children. The Journal of pediatrics 152(2): 207-213	- Study does not compare anthropometric measures *Waist-to-height ratio evaluated alone*
Malavazos, Alexis E, Capitanio, Gloria, Milani, Valentina et al. (2021) Tri-Ponderal Mass Index vs body Mass Index in discriminating central obesity and hypertension in adolescents with overweight. Nutrition, metabolism, and cardiovascular diseases : NMCD 31(5): 1613-1621	- Study does not compare anthropometric measures *Evaluate BMI alone*
Mastroeni, Silmara Salete de Barros Silva, Mastroeni, Marco Fabio, Ekwaru, John Paul et al. (2019) Anthropometric measurements as a potential non-invasive alternative for the diagnosis of metabolic syndrome in adolescents. Archives of endocrinology and metabolism 63(1): 30-39	- Study does not compare anthropometric measures *Evaluates BMI alone*

Study	Code [Reason]
Matsha, Tandi E., Kengne, Andre-Pascal, Yako, Yandiswa Y. et al. (2013) Optimal Waist-to-Height Ratio Values for Cardiometabolic Risk Screening in an Ethnically Diverse Sample of South African Urban and Rural School Boys and Girls. PLOS ONE 8(8): e71133	- Accuracy outcomes were not stratified by ethnicity
Messiah, Sarah E, Arheart, Kristopher L, Lipshultz, Steven E et al. (2008) Body mass index, waist circumference, and cardiovascular risk factors in adolescents. The Journal of pediatrics 153(6): 845-50	- Outcome to be predicted does not match that specified in the protocol *Cardiovascular disease risk factors*
Motswagole BS, Kruger HS, Faber M et al. (2011) The sensitivity of waist-to-height ratio in identifying children with high blood pressure. Cardiovascular journal of Africa 22(4): 208-211	- Study does not compare anthropometric measures *Examines waist-to-height ratio only*
Mueller, Noel T, Pereira, Mark A, Buitrago-Lopez, Adriana et al. (2013) Adiposity indices in the prediction of insulin resistance in prepubertal Colombian children. Public health nutrition 16(2): 248-55	- Outcome to be predicted does not match that specified in the protocol *Insulin resistance*
Nawarycz, T, So, H-K, Choi, K-C et al. (2016) Waist-to-height ratio as a measure of abdominal obesity in southern Chinese and European children and adolescents. International journal of obesity (2005) 40(7): 1109-18	- Not a diagnostic test accuracy study
Ng, Vanessa W S, Kong, Alice P S, Choi, Kai Chow et al. (2007) BMI and waist circumference in predicting cardiovascular risk factor clustering in Chinese adolescents. Obesity (Silver Spring, Md.) 15(2): 494-503	- Outcome to be predicted do not match that specified in the protocol *Cardiovascular Risk Factor Clustering*
Okuda, Masayuki, Sugiyama, Shinichi, Kunitsugu, Ichiro et al. (2010) Use of body mass index and percentage overweight cutoffs to screen Japanese children and adolescents for obesity-related risk factors. Journal of epidemiology 20(1): 46-53	- Study does not compare anthropometric measures *Evaluates waist circumference only*
Oliveira, Raphael Goncalves de and Guedes, Dartagnan Pinto (2017) Performance of different diagnostic criteria of overweight and obesity as	- Study not reported in English

Study	Code [Reason]
predictors of metabolic syndrome in adolescents. Jornal de pediatria 93(5): 525-531	
Oliveira, Raphael Goncalves de and Guedes, Dartagnan Pinto (2018) Performance of anthropometric indicators as predictors of metabolic syndrome in Brazilian adolescents. BMC pediatrics 18(1): 33	- Outcome to be predicted does not match that specified in the protocol *metabolic syndrome*
Oliveira-Santos, Jose, Santos, Rute, Moreira, Carla et al. (2016) Ability of Measures of Adiposity in Identifying Adverse Levels of Inflammatory and Metabolic Markers in Adolescents. Childhood obesity (Print) 12(2): 135-43	- Outcome to be predicted do not match that specified in the protocol *Adverse levels of inflammatory and metabolic markers*
Ouerghi, N., Ben Khalifa, W., Boughalmi, A. et al. (2020) First reference curves of waist circumference and waist-to-height ratio for Tunisian children. Archives de Pediatrie 27(2): 87-94	- Unable to acquire
Paulmichl, Katharina, Hatunic, Mensud, Hojlund, Kurt et al. (2016) Modification and Validation of the Triglyceride-to-HDL Cholesterol Ratio as a Surrogate of Insulin Sensitivity in White Juveniles and Adults without Diabetes Mellitus: The Single Point Insulin Sensitivity Estimator (SPISE). Clinical chemistry 62(9): 1211-9	- Assessment tool do not match that specified in the protocol
Perona, Javier S., Schmidt-RioValle, Jacqueline, Fernandez-Aparicio, Angel et al. (2019) Waist Circumference and Abdominal Volume Index Can Predict Metabolic Syndrome in Adolescents, but only When the Criteria of the International Diabetes Federation are Employed for the Diagnosis. Nutrients 11(6): 1370	- Outcome to be predicted do not match that specified in the protocol *Metabolic syndrome with obesity criteria*
Perona, Javier S, Schmidt-RioValle, Jacqueline, Rueda-Medina, Blanca et al. (2017) Waist circumference shows the highest predictive value for metabolic syndrome, and waist-to-hip ratio for its components, in Spanish adolescents. Nutrition research (New York, N.Y.) 45: 38-45	- Outcome to be predicted do not match that specified in the protocol *Metabolic syndrome with obesity criteria*

Study	Code [Reason]
Quadros, Teresa Maria Bianchini, Gordia, Alex Pinheiro, Silva, Rosane Carla Rosendo et al. (2015) Predictive capacity of anthropometric indicators for dyslipidemia screening in children and adolescents. Jornal de pediatria 91(5): 455-63	- Study not reported in English
Redondo, Olga, Villamor, Eduardo, Valdes, Javiera et al. (2015) Validation of a BMI cut-off point to predict an adverse cardiometabolic profile with adiposity measurements by dual-energy X-ray absorptiometry in Guatemalan children. Public health nutrition 18(6): 951-8	- Study does not compare anthropometric measures *Evaluates BMI alone*
Rodea-Montero, Edel Rafael; Apolinar-Jimenez, Evelia; Evia-Viscarra, Maria Lola (2014) Waist-to-height ratio is a better anthropometric index than waist circumference and BMI in predicting metabolic syndrome among obese mexican adolescents. International Journal of Endocrinology 2014: 195407	- Incorrect population *Only obese people were recruited for this study*
Santoro N, Amato A, Grandone A et al. (2013) Predicting metabolic syndrome in obese children and adolescents: look, measure and ask. Obesity facts 6(1): 48-56	- Study does not compare anthropometric measures *Evaluated waist-to-height ratio alone*
Sardinha, Luis B, Santos, Diana A, Silva, Analiza M et al. (2016) A Comparison between BMI, Waist Circumference, and Waist-To-Height Ratio for Identifying Cardio-Metabolic Risk in Children and Adolescents. PloS one 11(2): e0149351	- Outcome to be predicted do not match that specified in the protocol *Clustered cardiometabolic risk factors*
Savva, S C, Tornaritis, M, Savva, M E et al. (2000) Waist circumference and waist-to-height ratio are better predictors of cardiovascular disease risk factors in children than body mass index. International journal of obesity and related metabolic disorders : journal of the International Association for the Study of Obesity 24(11): 1453-8	- Not a diagnostic test accuracy study
Saydah S, Bullard KM, Imperatore G et al. (2013) Cardiometabolic risk factors among US adolescents and young adults and risk of early mortality. Pediatrics 131(3): e679	- Not a diagnostic test accuracy study

Study	Code [Reason]
Sijtsma A, Bocca G, L'abée C et al. (2014) Waist-to-height ratio, waist circumference and BMI as indicators of percentage fat mass and cardiometabolic risk factors in children aged 3-7 years. Clinical nutrition (Edinburgh, Scotland) 33(2): 311-315	- Not a diagnostic test accuracy study
Simmonds, Mark, Burch, Jane, Llewellyn, Alexis et al. (2015) The use of measures of obesity in childhood for predicting obesity and the development of obesity-related diseases in adulthood: a systematic review and meta-analysis. Health technology assessment (Winchester, England) 19(43): 1-336	- Systematic review not relevant for this review
Singh, Yashpal, Garg, M K, Tandon, Nikhil et al. (2013) A study of insulin resistance by HOMA-IR and its cut-off value to identify metabolic syndrome in urban Indian adolescents. Journal of clinical research in pediatric endocrinology 5(4): 245-51	- Assessment tool do not match that specified in the protocol *HOMA-IR*
Taylor, Sharonda Alston and Hergenroeder, Albert C (2011) Waist circumference predicts increased cardiometabolic risk in normal weight adolescent males. International journal of pediatric obesity : IJPO : an official journal of the International Association for the Study of Obesity 6(22): e307-11	- Accuracy outcomes were not stratified by ethnicity *White, Black and Hispanic ethnicities were equally represented in the study participants*
Thomas, Nihal, Paul, T.V., Christopher, S. et al. (2011) Anthropometric measurements for the prediction of the metabolic syndrome: A cross-sectional study on adolescents and young adults from southern India. Heart Asia 3(1): 2-7	- Accuracy outcomes reported in supplementary tables that could not be acquired
Tompuri TT, Jääskeläinen J, Lindi V et al. (2019) Adiposity Criteria in Assessing Increased Cardiometabolic Risk in Prepubertal Children. Frontiers in endocrinology 10: 410	- Outcome to be predicted does not match that specified in the protocol *Cardiometabolic risk factors*
Trandafir, Laura Mihaela, Russu, Georgiana, Moscalu, Mihaela et al. (2020) Waist circumference a clinical criterion for prediction of cardio-vascular complications in children and adolescences with overweight and obesity. Medicine 99(30): e20923	- Incorrect population *Only includes overweight or obese people*

Study	Code [Reason]
Valerio, Giuliana, Maffeis, Claudio, Balsamo, Antonio et al. (2013) Severe obesity and cardiometabolic risk in children: comparison from two international classification systems. PloS one 8(12): e83793	- Comparison from two classification systems
Vasquez, F D, Corvalan, C L, Uauy, R E et al. (2017) Anthropometric indicators as predictors of total body fat and cardiometabolic risk factors in Chilean children at 4, 7 and 10 years of age. European journal of clinical nutrition 71(4): 536-543	- Not a diagnostic test accuracy study
Vasquez, Fabian, Correa-Burrows, Paulina, Blanco, Estela et al. (2019) A waist-to-height ratio of 0.54 is a good predictor of metabolic syndrome in 16-year-old male and female adolescents. Pediatric research 85(3): 269-274	- Outcome to be predicted do not match that specified in the protocol *Metabolic syndrome including the obesity criteria*
Wu, Xiao-Yan, Hu, Chuan-Lai, Wan, Yu-Hui et al. (2012) Higher waist-to-height ratio and waist circumference are predictive of metabolic syndrome and elevated serum alanine aminotransferase in adolescents and young adults in mainland China. Public health 126(2): 135-42	- Unable to acquire
Xu T, Liu J, Liu J et al. Relation between metabolic syndrome and body compositions among Chinese adolescents and adults from a large-scale population survey. BMC public health 17(1): 337	- Outcome to be predicted does not match that specified in the protocol *Metabolic syndrome with obesity criteria*
Yoo, Eun-Gyong (2016) Waist-to-height ratio as a screening tool for obesity and cardiometabolic risk. Korean Journal of Pediatrics 59(11): 425-431	- Systematic review. Included studies were checked for inclusion in this review
Zhou, Dan, Yang, Min, Yuan, Zhe-Ping et al. (2014) Waist-to-Height Ratio: a simple, effective and practical screening tool for childhood obesity and metabolic syndrome. Preventive medicine 67: 35-40	- Outcome to be predicted does not match that specified in the protocol *Metabolic syndrome with obesity criteria*

Appendix L– Research recommendations – full details

NICE's process and methods guide for research recommendations

Research recommendation

What are the most accurate and suitable measurements and boundary values to assess the health risk associated with overweight, obesity and central adiposity in children and young people of different ethnicities, particularly those from Black, Asian and minority ethnic family backgrounds?

Why this is important

A child or young person's future health is linked to their overweight, obesity and central adiposity, and this is thought to be linked to their ethnic background. However, there are very few prognostic accuracy data linking simple measures in children, stratified by ethnic background, to future health risks. It is uncertain what the most predictive simple measure is and also what the key boundary values are in children with different ethnic backgrounds. It would be useful to assess the accuracy of published of boundary values which can then be used to define overweight, obesity, severe obesity, and very severe obesity in children and young people.

Rationale for research recommendation

Importance to 'patients' or the population	Utilising the most accurate measure to assess the link between overweight, obesity and central adiposity to future health risks will support children/young people and their parents/careers to make more informed decisions linked to weight management. Stratifying the analysis by ethnic family background will address known variation in health risks linked to central adiposity.
Relevance to NICE guidance	This guideline found there was very limited ethnicity specific prognostic accuracy data linking simple measures to health outcomes in a UK population. This will inform future recommendations linking assessment of

	overweight, obesity and central adiposity to health risks in children and young people.
Relevance to the NHS	Utilising the most accurate methods and boundary values to assess children and young people will ideally reduce the number of people acquiring the health conditions of interest, for example type 2 diabetes, and requiring the associated care.
National priorities	High
Current evidence base	Minimal prognostic accuracy data stratified by ethnicity and utilising children and young people in the UK
Equality considerations	None known

Modified PICO table

Population	Children and young people aged under 18 years Population should be stratified by ethnicity: • White • Black African/ Caribbean • Asian (South Asian, Chinese, any other Asian background) • Other ethnic groups (Arab, any other ethnic group) • Multiple/mixed ethnic group
Test	Method of measurement (and associated boundary values): • BMI z-score /BMI-for-age percentile • Waist-to-height ratio • Waist-to-hip ratio • Waist circumference Combinations of methods of measurement.
Reference standard	Development of a condition of interest • Type 2 diabetes • Cardiovascular disease (including coronary heart disease) • Cancer • Dyslipidaemia • Hypertension • All-cause Mortality
Outcome	Prognostic accuracy: • Sensitivity • Specificity • Likelihood ratios • Predictive values The optimal/most appropriate cut-offs to predict the development of the relevant conditions.

Study design	Prognostic accuracy study
Timeframe	Mean follow-up should be 3 years at a minimum
Additional information	Subgroup analysis: • Children and young people with special educational needs and disabilities (SEND) • Children and young people with physical disabilities and physical conditions such as scoliosis