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Anthropometric measures during infancy and childhood and the risk of developing cardiovascular disease or diabetes mellitus type 2 in later life: A Systematic Review

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CONTENTS

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A Systematic Review

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2. EXECUTIVE SUMMARY:

Anthropometric measures during infancy and childhood and the risk of developing cardiovascular disease or diabetes mellitus type 2 in later life: A Systematic Review

Background: Concurrently, obesity and other related chronic diseases, in particular cardiovascular diseases (CVD) and diabetes mellitus (type-2: noninsulin-dependent), are increasing in most of the developing countries and in countries undergoing economic transition. The prevalence of these diseases has increased in the last two decades and researchers are involved in identifying the risk factors. Various birth cohorts have been established to identify the relevant risk factors of these diseases. This systematic review is one of the steps in achieving the conclusion of identifying risk factors for developing cardiovascular disease or diabetes mellitus type 2 in later life.

Objectives: The objective of this series of systematic reviews was to assess the associations between anthropometric measurements during infancy and childhood, and the risk of developing cardiovascular disease or diabetes mellitus type II in later life.

Search strategy: Two independent literature searches with predetermined search strategy were conducted at ICMR Advanced Centre for Evidence based child health, PGIMER, Chandigarh, India; comprising PubMed, Embase, Ovid Sp and manual searching of references from the relevant articles thus obtained.

Selection Criteria: We selected published cohort or longitudinal studies evaluating the associations between infancy & childhood anthropometric measures and the risk of developing cardiovascular disease or diabetes mellitus type II in later life. The studies where the outcomes were restricted to associations between anthropometric measurements at birth and adulthood were not included in the systematic review.

Data extraction and analysis: Five reviewers extracted the data independently and the discrepancies were resolved by consensus rating. Two reviewers independently evaluated the study quality using Newcastle-Ottawa scale and disagreements were resolved by discussion with the arbiter. Meta-analysis where-ever possible was done using Random effects inverse variance model using Stata MP 12 developed by Stata Corp Ltd. The data which were not meta-analyzed were described as narrative synthesis.

Cardiovascular Disease/Events: Eleven articles (including two consortia) from thirteen cohorts discussed the associations of various anthropometric measures during infancy or childhood and cardiovascular morbidity and mortality in later life.

Coronary Artery Diseases: Four cohort studies showed that higher BMI during childhood was associated with cardiovascular disease morbidity and mortality during adult life. One cohort study (Helsinki Birth Cohort) showed that lower BMI during early childhood was associated with higher risk of cardiovascular disease during adult life. Two cohort studies one each from the UK and the US did not find any association between childhood BMI and adult CVD. The pooled results from three British Cohorts found a significant relationship between being persistently overweight throughout childhood till adult life and coronary artery disease in later life. Pooled results from three historical British birth cohorts attributed minimal risk for ischemic heart disease when childhood BMI were high. One cohort study (Helsinki) showed that lower weight and/or shorter height at one year of age increased the morbidity and mortality due to CAD in adult life.

Stroke: Four studies assessed the risk of developing atherosclerotic cerebrovascular events and childhood BMI. One study found positive association between lower childhood BMI and mortality and morbidity due to stroke in adult life. One study showed positive relationship with males only. Two studies did not show any relationship between the two (childhood BMI and stroke in adults). One cohort study (Helsinki) showed that lower weight at 1-7 years of age increased the morbidity and mortality due to stroke in adult life but had no association with height during childhood.

Hypertension: Five articles (including 3 consortia) from 13 cohorts reported the association of anthropometric measures during infancy and childhood and risk of developing hypertension in later life. Pooled analysis of 3 British Birth cohorts (1946, 1958 and 1970) demonstrated that those who were persistently overweight from childhood to adulthood associated with increased odds of hypertension when compared to those who were never overweight (OR 2.56, 95% CI 1.46-4.68). Another pooled analysis from 5 low and middle income countries (LMIC) showed that higher conditional weights (CW) were associated with increased BP and odds of Pre-hypertension or hypertension, with coefficients proportional to the contribution of each CW to adult BMI. When adjusted for adult height and BMI, CW during childhood was not associated with adult BP. Pooled analysis from cohorts of 3 high income countries (HIC) showed that the relative risk (RR) of hypertension among the subjects who were overweight or obese in childhood, but non obese as adults was similar to the risks among the subjects who had a consistently normal BMI. In contrast, subjects who were obese as adults, irrespective of their childhood adiposity status showed increased risk with respect to hypertension in adulthood. Those who were overweight or obese in childhood showed significant association with hypertension in adulthood (RR 1.8, 95% CI 1.5-2.1).

Nine studies have observed positive associations between childhood and adolescence BMI levels and systolic (SBP) and diastolic blood pressure (DBP) in adulthood, where as two studies have shown inverse or no association. Six studies from 4 cohorts have shown a positive association between childhood and adolescence height and adulthood SBP. Three reports from three different cohorts also reported an association between infancy, childhood and adolescence weight with the adulthood DBP. There was no association seen between infant length and weight and adolescent SBP by the Peruvian Birth Cohort. Two studies from NHLBI and ALSPAC have found the rapid increase in waist circumference increased the odds of development of high SBP and DBP later in adolescence.

Two studies found a positive association between adolescence skin-fold thickness and increase in SBP and DBP in adulthood. One study reported a weak positive association between adolescent Triceps skin fold thickness and adulthood DBP and a strong positive correlation between sub-scapular skin fold thickness and adult DBP levels in females only.

Carotid Intima-Media Thickness (cIMT):

Fourteen reports (9 cohorts and one consortium) studied the relationship. Eight out of the nine cohorts were based in HIC. The remaining study was based in LMIC. Pooled analysis of 4 longitudinal studies from HIC showed that childhood overweight or obesity was positively associated with high risk cIMT (>90^{th} percentile) with RR 1.3 and 95% CI 1.1-1.16. Five studies showed a positive association between childhood and adolescent BMI and cIMT levels in adulthood. One study from LMIC showed no association when adjusted for adult waist circumference. The results from two studies established that the subjects who were obese in childhood and remained obese in adulthood had the highest cIMT levels and the subjects who were obese in childhood and became normal weight in adulthood did not have high levels of cIMT. One study from HIC showed that that being shorter at age 4 and gaining less height between ages 2-4 was associated with higher cIMT levels in adulthood. However, a study from LIMC established that being taller at age 2 and gaining more height between birth to 2 years of age was associated with higher cIMT levels, but this relationship was attenuated by adjusting for adulthood waist circumference. Two studies from HIC showed that weight gain during infancy was associated with higher cIMT levels in adulthood. One study established that there was a significant positive relationship between childhood triceps skinfold thickness and cIMT levels and another study found this relationship to be positive only in the girls.

Type 2 Diabetes Mellitus: Ten articles from eight cohorts and three consortia discussed the associations of various anthropometric measures during infancy or childhood and development of Diabetes Mellitus II in later life. Pooled analysis of 3 British Birth cohorts (1946, 1958 and 1970) demonstrated obesity in adulthood in combination with any pattern of overweight in earlier life was associated with increased odds of type 2 diabetes mellitus (type 2 DM). Another pooled analysis from cohorts of 3 high income countries reported that childhood overweight or obesity was a predictor of type 2 DM in adult life except for one cohort which showed no association. In a pooled analysis from five LMIC, weight at 2 years, 4 years and CW gain between birth and 4 years showed no association with imapaired fasting glucose (IFG) or DM. However, when adjusted for adult waist circumference, weight at 2 and 4 years and CW gain 0-4 years were inversely associated with IFG/DM.

Two studies found that higher BMI (age 4-18 years) was associated with increased risk of developing diabetes in adulthood. Two studies showed that individuals who were in highest two quartiles during childhood had a high risk of mortality due to type 2 DM. Another two studies showed that subjects with lower weight at 1 or 2 years was associated with high risk of type 2 DM in adulthood.

HOMA-IR: Six studies (four cohorts and one consortium) showed a relationship between childhood anthropometry and HOMA-IR levels in adulthood. In a pooled analysis from five LMIC, weight at 2 years, 4 years and CW gain between birth and 4 years were significantly associated with HOMA-IR, but the association becomes inversed and non significant after adjusting with adult waist circumference. Out of two cohorts, one cohort from HIC showed positive association of HOMA-IR with childhood BMI and another cohort from LMIC showed that an increase in BMI between 6 months to 11 years was positively associated with HOMA-IR at 11 years. However, out of two other cohorts from HIC, one showed no association and another showed an inverse association with HOMA-IR in later life. One cohort from LMIC showed that increase in weight and height between 6 months to 11 years was positively associated with HOMA-IR at 11 years.

Fasting glucose levels: Four studies reported positive association between childhood BMI and fasting glucose levels in adulthood. One study showed no association of childhood BMI with fasting glucose levels in adulthood and another study demonstrated no association of BMI during infancy with fasting glucose levels in childhood. Another study showed that childhood BMI was inversely related to 2 hour glucose levels in adulthood. In a pooled analysis from five LMIC, weight at 2 years, 4 years and CW gain between birth and 4 years showed no association with fasting glucose. However, when adjusted for adult waist circumference, weight at 2 and 4 years and CW gain 0-4 years were inversely associated with fasting glucose. Two studies reported no association of increased risk of development of high glucose levels in adolescent and adulthood with the increase weight at infancy. Height and waist circumference during infancy and childhood was not associated with increased risk of development of high glucose levels in adolescent and adulthood.

Insulin: Three studies from HIC attributed positive association of insulin levels in adulthood to childhood BMI levels. However, the association was inversed in one study after adjusting for adult BMI. One study showed that a rapid increase in BMI during childhood increased the risk of development of high insulin levels in adolescence. One study showed that increase in BMI between 6 months to 11 years was positively associated with higher levels of fasting insulin at 11 years. Another study showed a significant inverse relationship between adulthood insulin levels and childhood BMI. Increase in weight and height between 6 months to 11 years was positively associated with higher levels of fasting insulin at 11 years and adolescence also. One study showed a significant positive association between childhood weight, rate of increase in weight and height during childhood and adolescence and adulthood insulin levels, but not with rate of increase in height during childhood and adolescence. One study showed that rapid increase in waist circumference increased the odds of development of high insulin levels later in adolescence. One study showed that childhood triceps skin fold thickness positively correlated to adulthood insulin levels.

Overweight and obesity: We included 52 studies (36 cohorts or longitudinal studies) that provided information on the association of anthropometric measures during infancy and childhood and risk of developing obesity in later life (childhood, adolescence and adulthood). The meta-analysis using random-effects model showed a significant inverse association of correlation coefficients with an increase in follow-up time. The pooled analysis of BMI tracking showed decreasing trend when tracked from early childhood (3-6 years) to mid childhood (9-11 yrs) (r=0.79, 95% CI 0.71-0.87), adolescence (12-18 yrs) (r=0.66, 95% CI 0.53-0.78), adulthood (19-40 years) (r=0.39, 95% CI 0.29-0.50) and late adulthood (>40 years) (r=0.26, 95% CI 0.18-0.34); mid childhood (9-11) to adolescence (12-18 years) (r=0.81, 95% CI 0.73-0.88), adulthood (19-40 years) (r=0.58, 95% CI 0.50-0.66). BMI tracking showed similar trends in low and middle income countries (LMIC) and high income countries (HIC). Thirteen studies showed that high BMI in childhood or adolescence was associated with a high risk of overweight or obesity in later life. Majority of the studies predicted high risk of becoming overweight or obesity with weight status or rapid weight gain during the infancy and childhood. Similar results were found with height status.

Hyperlipidemia:

Total cholesterol: We included 9 studies (8 cohorts) that reported the association of childhood anthropometric measures with total cholesterol levels in later life. Three studies showed no association with total cholesterol in later life with childhood BMI status. One study showed an inverse association in females only. Two studies showed positive association with adulthood total cholesterol, however, one study showed no association after adjusted for adult BMI. Weight and height status attributed no association with total cholesterol.Only one study showed a significant association between waist circumference at 9 years and increase in total cholesterol levels between 12 to 14 years. Triceps skin fold thickness and sum of skin fold thickness showed positive correlation with adulthood total cholesterol levels.

Triglycerides: We included 12 studies (10 cohorts and one consortium) that reported the association of childhood anthropometric measures with triglyceride levels in later life. In a pooled analysis of 4 longitudinal cohorts showed those who were overweight or obese in childhood showed significant association with high risk triglycerides (>200mg/dL) in adulthood (RR 1.6, 95% CI 1.3-1.9). Eight studies reported positive association of childhood BMI with triglyceride levels in later life. One study showed an inverse association with adulthood triglyceride levels. Another study showed no association of childhood BMI with total cholesterol measured during mid childhood. Weight status during childhood showed positive association with adulthood triglyceride levels, however height status did not show any association. Rapid increase in waist circumference showed a positive relationship with adult triglyceride levels.

LDL: Eleven studies (six cohorts and one consortium) reported the relationship of childhood and adolescent anthropometric measures with adulthood LDL levels. In a pooled analysis of 4 longitudinal cohorts from 3 high income countries reported that childhood overweight or obesity was a predictor of high risk LDL cholesterol (>160 mg/dL) in adult life with RR of 1.4 and 95% CI 1.2-1.8. Seven studies attributed that BMI in childhood and adolescence was associated with the adulthood LDL levels. One study reported a weak inverse association with adulthood LD levels. Only one study showed that weight status during childhood is associated with adulthood LDL levels. Another study showed the rate of increase in height during childhood is associated with adulthood LDL levels. Two studies showed a rapid increase in waist circumference was positively associated with adult LDL levels. Two studies showed childhood Triceps skin fold thickness also positively correlated to adulthood LDL levels.

HDL: Fourteen studies (10 cohorts and one consortium) reported the association between childhood and adolescent anthropometric measures and HDL levels in adulthood. In a pooled analysis of 4 longitudinal cohorts from 3 high income countries reported that childhood overweight or obesity was a predictor of high risk HDL cholesterol (<40 mg/dL) in adult life with RR of 1.4 and 95% CI 1.2-1.6. Majority of the studies attributed negative association of childhood BMI status with adulthood HDL levels. Weight status also showed the negative association in majority of the included studies. Height status did not play any role in majority studies. Two studies also showed negative association of childhood waist circumference and triceps skin fold thickness with adulthood HDL levels.

3. BACKGROUND:

Overweight and obesity are associated with numerous co-morbidities, such as cardiovascular disease (CVD), type 2 diabetes and certain cancers (Reilly 2011). During last thirty years the prevalence of obesity and overweight has increased in the paediatric population (Wang 2006). The prevalence of obesity in children is increasing in all regions of the world, including countries suffering high levels of maternal and child under nutrition. The rising prevalence of obesity represents a global public health issue, with an estimated 30% of coronary heart disease (CHD) and ischemic stroke and almost 60% of hypertensive disease in developed countries attributable to excess body mass index (BMI) (WHO 2002). Globally, in 2011 an estimated 43 million children under-five years of age (7%) were overweight i.e. 54% increase from an estimated 28 million in 1990 (WHO 2012). Studies have shown that waist circumference may be a better predictor than BMI in the cardiovascular disease (Han 1998). However, several studies have shown a positive association between childhood obesity and adult CVD risk factors and it is unclear whether childhood obesity exerts an independent effect on adult cardiovascular health (Freedman 2004). Adiposity has been shown to track from childhood into adult life, potentially augmenting the risk associated with adult obesity (Singh 2008). From a public health perspective, it would be important to determine whether the childhood adiposity leads to adult's adiposity or there are adverse effects of childhood overweight or whether the childhood adiposity increases cardiovascular risk. And also to determine whether the anthropometric measures predict for later obesity, abnormal lipid profile, subsequent cardiovascular disease or diabetes mellitus type 2.

The aim of the current review was to systematically and critically appraise the available evidence regarding the predictive value of anthropometric measures in infants and children for developing cardiovascular disease or diabetes mellitus type 2 in later life.

4. **OBJECTIVE:** What is the predictive value of anthropometric measures in infants and children for developing cardiovascular disease or diabetes mellitus type 2 in later life?

5. METHODS:

a. <u>Criteria for considering studies for this review</u>

Selection criteria for studies

In this systematic review, we selected prospective, retrospective cohort studies and longitudinal studies demonstrating the anthropometric measures during infancy and childhood and the risk of developing cardiovascular disease or diabetes mellitus type 2 in later life.

Types of potential predictors evaluated

- Anthropometry at one time point- weight for age, height for age, weight for height or body mass index (BMI), Mid upper arm circumference, skin fold thickness, adiposity, waist circumference,
- Change in the anthropometric measures listed above

Time of measurement of the potential predictors

- 6 mths -2 yrs; 2-5 years; 5-9 yrs; 10-19 years

Types of outcome measures

According to the objective of present review, we looked for the cohort studies with the following outcome measures:

1. Cardiovascular events (CAD, Stroke) or diabetes mellitus type 2
2. Intermediate outcomes:
    - Hypertension , average blood pressure
    - Impaired glucose tolerance, average fasting glucose levels or glucose tolerance or HbA1C or insulin resistance
    - Hyperlipidemia or average lipid profile
    - obesity
    - Carotid artery elasticity or rigidity/intimal thickness

Time of measurement of outcomes of interest

- 2-5 years; 5-9 years; 10-19 years; 20-39 years; 40 and above (outcome measurement will be minimum of 2 years after the measurement of potential predictor)

Definition of outcomes:

Overweight/obesity:

- Classification of overweight <5years of age: BMI standard deviation score >2

- Classification of overweight 5-19 years of age: BMI z-score > 1.04-1.63, BMI percentile 85^{th}-94.9^{th} relative to suitable reference population
- Classification of overweight ≥ 19 years: BMI 25-30 kg/m^2
- Classification of obesity <5years of age: BMI standard deviation score >3
- Classification of obesity 5- 19 years of age: BMI z-score ≥1.64, BMI percentile ≥ 95^{th} relative to suitable reference population
- Classification of obesity ≥ 19 years: BMI ≥30 kg/m^2

b. Search strategy and selection criteria

In order to prevent the selection bias by acquiring as many relevant articles possible, two independent literature searches were carried out by two authors using the multiple electronic databases: PubMed, MEDLINE (Ovid SP) and EMBASE from their year of inception to August, 2014. The search strategy used a combination of medical subject headings, subject headings and keywords to identify publications. Medline was searched using the following terms: weight for age; height for age; weight for height; body mass index; mid upper arm circumference; skin fold thickness; adiposity; waist circumference; birth weight, newborn; infant; child; children; adolescence.

We combined the anthropometry measures, with the following terms for each of the studied outcomes:

Overweight or obesity: overweight; obesity; body mass index; or Metabolic syndrome

Hyperlipidemia: cholesterol; LDL; HDL; triglycerides; or blood lipids.

Type-2 diabetes: glucose tolerance; blood glucose; HbA1c; glycated haemoglobin; or insulin resistance

Blood pressure: blood pressure; hypertension; systolic or diastolic blood pressure.

Cardiovascular disease: cardiovascular disease; coronary artery disease; carotid artery elasticity or rigidity/intimal thickness; stroke; myocardial infarction; cardiomyopathy; heart failure; or ischemic heart disease

In addition to the electronic search, the reference lists of the articles initially identified were searched, and we also perused the Scientific Citation Index for papers citing the articles identified. Search strategy for MEDLINE (Ovid SP) is presented in **Annexure-II** and the same was translated for other databases.

6. DATA COLLECTION AND ANALYSIS

a. Selection of studies

Published original quantitative studies were included if they fulfilled the following selection criteria:

i. ***Inclusion*** Criteria:

- Prospective/retrospective cohort studies
- Type of predictor/exposure (measurements following WHO Child Growth Standards and definitions; measurements taken at/ between 6 months -2 years, 2-5 years, 5-9 years and 10-19 years of age) :
    - Weight for age
    - Height for age
    - Weight for height
    - Body mass index (BMI)
    - Mid upper arm circumference
    - Skin fold thickness
    - Adiposity
    - Waist circumference
- Outcome measures:
    - Cardiovascular events (Coronary artery disease, ischemic heart disease)
    - Cerebrovascular diseases (stroke)
- Outcome measurement was minimum of 2 years after the measurement of potential predictor
- All measurements taken by health professionals or trained investigators
- Low, middle and high income countries
- Articles published in English

ii. Exclusion Criteria:

1. Study participants on intervention/ health promotion programme
2. Review articles
3. Study cohort reporting selective groups eg. preterm babies, asthmatics, twin studies etc

Four authors independently reviewed the titles with abstracts of the studies identified by the literature searches and identified them as included or excluded based on the above mention criteria. After title and abstract screening, full text articles were retrieved and four authors independently screened the full texts of the studies based on the inclusion criteria. Third author acted as arbiter and discrepancies in selection of inclusion/exclusion of studies were resolved after discussion with him. The results of the search were presented as flow diagram (Figure 1) in accordance with PRISMA guidelines.

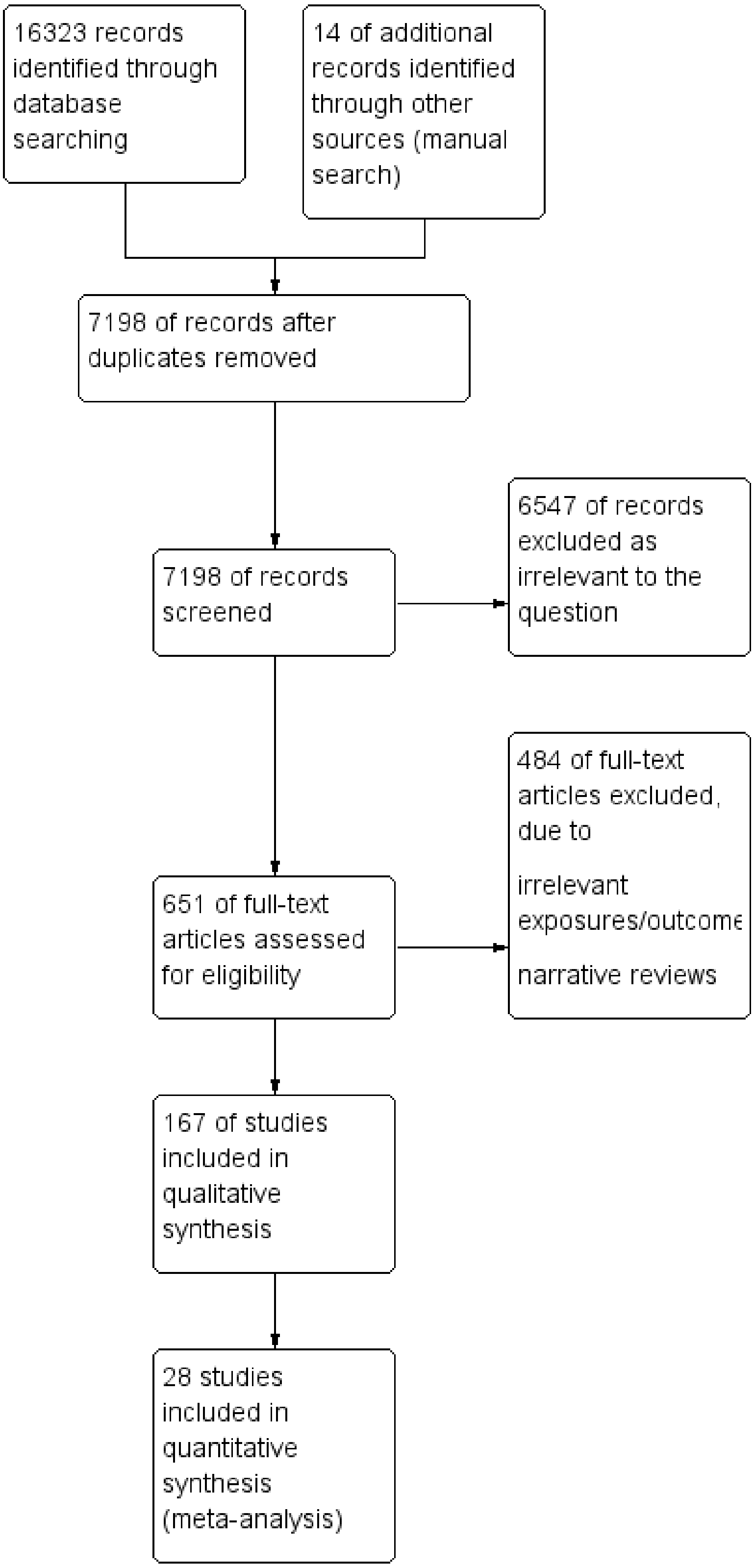

Figure 1: Flow diagram of the review of citations identified by the search

iii. *Data extraction and management*

Three authors independently extracted data from each article to minimum the risk of bias. In the beginning, pilot data collection sessions were held, in which each person assisted and articles were revised again and again for checking if all the criteria were consistently applied. Any disagreements were resolved through detailed discussions. The information extracted from the articles was as follows:

- Author's name, year
- Name of the cohort
- If the cohort is a birth cohort or not?
- Age at measurement/assessment of exposure and outcome
- Length of follow-up
- Exposures
- Outcomes
- Event risk/effect size

Data were extracted and in short, regression or correlation coefficients, or hazard ratios or relative risks and confidence intervals were extracted, together with the statistical significance of the associations (where provided). An independent reviewer confirmed all data entries and checked at least twice for completeness and accuracy. Disagreements were resolved through discussion.

iv. *Quality characterization of included studies:*

After the data extraction of included studies, The Newcastle-Ottawa Scale (NOS) was used to assess the quality of studies (Wells GA, 2009). This scale is designed to assess cohort or case-control studies on the basis of: (1) Selection of cohort or cases/controls; (2) comparability of cohorts or cases/controls; (3) Assessment of exposure and outcome. The NOS contains eight items, categorized into three dimensions including selection, comparability, and -depending on the study type- outcome (cohort studies) or exposure (case-control studies). For each item a series of response options is provided. A 'star system' has been developed in which a study is judged on three broad perspectives: the selection of the study groups; the comparability of the groups; and the ascertainment of either the exposure or outcome of interest for case-control or cohort studies respectively. This tool also avoids reporting of pooled scores, which have been shown to be unreliable and difficult to interpret, and this tool is specially designed for non randomized studies.

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8. RESULTS:

The literature search in the various databases (PubMed, MEDLINE (Ovid SP) and EMBASE) yielded 651 potentially relevant publications. After the titles and abstract of these publications were screened, 167 references were identified as potentially relevant and retrieved in full text. Reference checking revealed another 14 potentially relevant publications; all were retrieved in full text. We identified approximately 40 cohort groups and out of which 15 were well established. Therefore, evidence was available from approximately thirtee one studies conducted in high income countries and nine studies from low-and middle-income countries. The following are the cohorts identified from worldwide and have been found to eligible for the present systematic review:

High Income Countries (HIC):

1. Helsinki Birth cohort (1934-44), Finland
2. Aberdeen Children of the 1950s Prospective Cohort Study, United Kingdom
3. Norwegian cohort (1963-75), Norway
4. Danish birth cohort (1930-76), Denmark
5. NHLBI lipid research clinics (LRC) Princeton prevalence study and Princeton follow up study, United States
6. Harvard Growth Study of 1922 to 1935, United States
7. Boyd Orr Cohort, United Kingdom
8. Bogalusa Heart Study, United States
9. Muscatine Heart Study, United States
10. Young Finns Study, Finland
11. Northern Finland Birth Cohort of 1966
12. 1946 British Birth cohort
13. 1958 British Birth Cohort
14. Western Australian Pregnancy Cohort (Raine)
15. Avon Longitudinal Study of Parents and Children (ALSPAC)
16. Terneuzen Birth Cohort, Netherlands
17. National Heart, Lung and Blood Institute (NHLBI) Growth and Health Study (NGHS)
18. Longitudinal Study of Juvenile Hypertension, Lithuania
19. NHLBI Lipid research clinics (LRC) Princeton prevalence and follow up study, United States

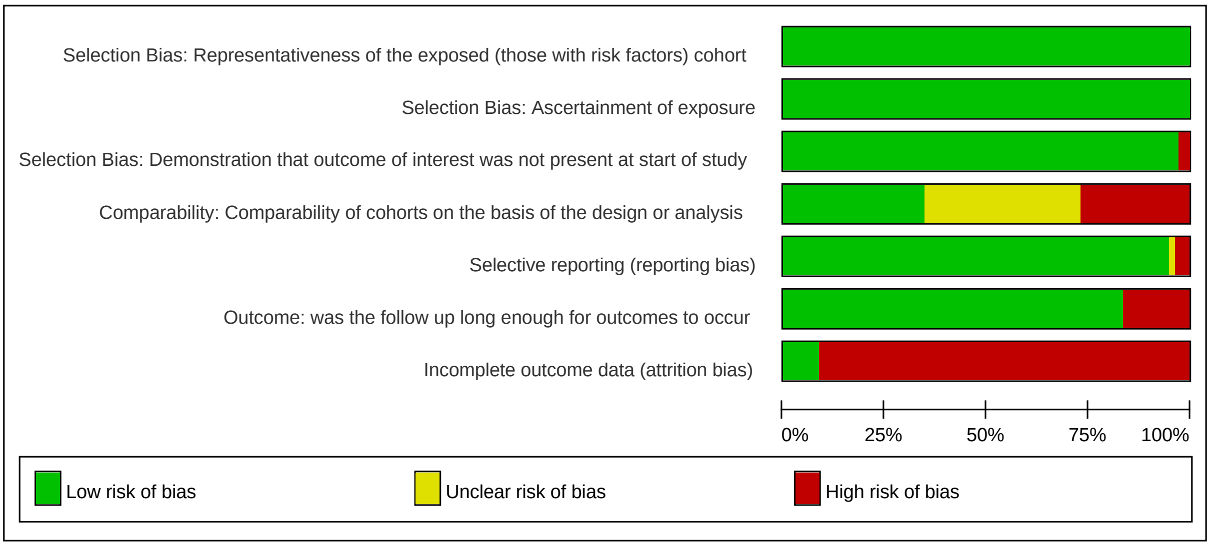
20. Child and Adolescent Trail for Cardiovascular Health (CATCH) study, United States
21. East Boston Blood Pressure Study, United States
22. Newcastle Thousand Families Cohort Study, United Kingdom
23. Minneapolis Children's Blood Pressure Study, United States
24. Old Helsinki Birth Cohort (1924-33), Finland
25. Dunedin Multidisciplinary Health and Development Study, New Zealand
26. National Longitudinal study of Youth, United States
27. Stockholm Weight Development Study, Sweden
28. German Birth Cohort (LISAplus and GINIplus)
29. Fels Longitudinal Study, United States
30. Hertfordshire Cohort Study, United Kingdom
31. Group Health Initiative (GHC) of Puget Sound, United states

Low and Middle Income Counties:

32. New Delhi Birth Cohort, India
33. Pelotas Birth Cohort of 1993, Brazil
34. Cebu Longitudinal Health and Nutrition Survey, Philippines
35. Birth to twenty cohort, South Africa
36. Institute of Nutrition of Central America ana Panama Nutritional Trial (Guatemela)
37. Hong Kong Children of 1997 Birth cohort, China
38. Vulnerable windows cohort, Jamaica
39. Peruvian Birth cohort, Peru
40. Pune Children's Study, India

Quality Assessment:

The quality assessment of the included studies was given after each outcome. The quality scores assessed according to the Newcastle Ottawa Scale varied among studies. For selection of sample population, the studies score very high, with majority of the studies scoring three points. For comparability, the results were more variable. Overall risk of bias summary was mentioned as below



Heterogeneity of included studies

Studies or cohorts showed a considerable level of heterogeneity in terms of study design, length of follow-up, geographical location, number of children included, definition of the exposure and outcomes assessed, measurement of effect size as assumed from characteristics of included studies.

Main Finding:

The exposure in early life and outcomes in later life are presented in **Annexure-I**.

Association of childhood and adolescent anthropometric measures with adolescence or adulthood obesity

Overall 52 studies (36 cohorts or longitudinal studies; 2,12,191 individuals) that provided information on the association of anthropometric measures during infancy and childhood and risk of developing obesity in later life (childhood, adolescence and adulthood) were included. **Table-1** gives a detailed description of the sample sizes, age at baseline and follow-up measurements, exposures, outcomes and main findings of the study included in this systematic review. The exposures included weight, height and BMI measured during infancy and childhood. The spectrum of results includes BMI tracking (Spearman's or Pearson's correlation coefficient) and risk (Odds ratio, Relative risk and regression coefficients).

Twenty-eight studies provided BMI tracking data on 40219 individuals for further analysis. Follow-up time ranged from 6 months to 65 years. The meta-analysis using random-effects model showed a significant inverse association of correlation coefficients with increase in follow-up time. The pooled analysis of BMI tracking showed decreasing trend when tracked from early childhood (3-6 years) to mid childhood (9-11 yrs) (r=0.79, 95% CI

0.71-0.87), adolescence (12-18 yrs) (r=0.66, 95% CI 0.53-0.78), adulthood (19-40 years) (r=0.39, 95% CI 0.29-0.50) and adulthood (>40 years) (r=0.26, 95% CI 0.18-0.34); mid childhood (9-11) to adolescence (12-18 years) (r=0.81, 95% CI 0.73-0.88), adulthood (19-40 years) (r=0.58, 95% CI 0.50-0.66) (Figure 2 and Figure 3). BMI tracking showed similar trends in Low and middle income countries (LMIC) and high income countries (HIC).

Thirteen studies showed that high BMI in childhood or adolescence was associated with a high risk of overweight or obesity in later life. Majority of the studies predicted high risk of becoming overweight or obesity with weight status or rapid weight gain during the infancy and childhood. Similar results were found with height status. A study from LMIC showed that BMI at the age of 2 years is positively correlated both in males and females.Another study reported that childhood BMI values were both more sensitive and more specific in predicting adolescent obesity than they were in predicting adolescent overweight.

Table 1: Table showing the association of childhood and adolescent anthropometric measures with adolescence or adulthood overweight or obesity

S.No	AUTHOR	COHORT	SETTING	NO. OF SUBJECTS/ LENGTH OF FOLLOW-UP/ CHILDHOOD AGE/ ADULTHOOD AGE	EXPOSURES	OUTCOMES MEASURED	EFFECT SIZE
1	Laurer et al., 1988	Muscatine Heart study (1970-1981)	Males and females, Iowa, USA, born 1950–1960s; MS	2446 (1167 M; 1279 F) were followed up for 12 years from 8-18 (School children) to 20-30 yrs (1981-1985)	BMI (childhood BMI assessed as per the 2000 CDC Growth Charts; Adulthood overweight defined as BMI between 25-29 kg/m^2 and obese as ≥30 kg/m^2)	BMI	BMI tracking: r=0.53-0.84* 7-8 to 20-25 yrs: r=0.60*(M); r=0.53* (F) 9-10 to 20-25 yrs: r=0.68*(M); r=0.60* (F) 11-12 to 20-25 yrs: r=0.69*(M); r=0.66* (F) 13-14 to 20-25 yrs: r=0.71*(M); r=0.69* (F) 15-16 to 20-25 yrs: r=0.77*(M); r=0.74* (F) 17-18 to 20-25 yrs: r=0.81*(M); r=0.72* (F) 13-14 to 26-30 yrs: r=0.84*(M); r=0.71* (F) 15-16 to 26-30 yrs: r=0.70*(M); r=0.68* (F) 17-18 to 26-30 yrs: r=0.78*(M); r=0.67* (F)
2	Power et al.,1997	British Birth Cohort (1958)	All children born in England, Wales and Scotland between 3rd -9th March 1958	11212 were followed up for 33 yeras from 7,11,16 to 33 years	BMI	BMI (<20:Underweight 20-24.9: Normalweight 25-30:Overweight >30:Obese)	BMI tracking: 0.33-0.74* 7yrs -11yrs: r=0.63* (M); r=0.68* (F) 7yrs -16yrs: r=0.51* (M); r=0.56* (F) 7yrs -23yrs: r=0.36* (M); r=0.42* (F) 7yrs -33yrs: r=0.33* (M); r=0.37* (F) 11yrs-16yrs: r=0.75* (M); r=0.72* (F) 11yrs-23yrs: r=0.52* (M); r=0.55* (F) 11yrs-33yrs: r=0.45* (M); r=0.49* (F) 16yrs-23yrs: r=0.64* (M); r=0.67* (F) 16yrs-33yrs: r=0.54* (M); r=0.57* (F)
3	Sachdev et al., 2005	New Delhi birth cohort (1969-present)	South Delhi, India	1526 (886 males; 640 females) followed upfor 21 years from 6 months to 21 years of age	BMI (WHO growth charts)	BMI, overweight (BMI≥25 kg/m^2 for overweight) WHO standard definition	**Correlations between adult BMI and BMI measured during infancy, childhood, and adolescence were positive and strengthened** 6 mo:r= 0.19; 1 y: r=0.21; 2 y:r=0.24; 5 y: r=0.32; 8 y: r=0.47; 11 y: r=0.58; 14 y: r=0.65. **adjusted for age, education, occupation, number of household possessions, tobacco use, alcohol consumption, physical activity**

4	Juonala et al 2006	Young Finn study	Finland,	2260 males and females followed up for 19 yrs from the ages of 3, 6, 9, 12, 15, 18 to 24-39 yrs of age	BMI (Lean BMI: <50th Overweight: 80-90th Obese:>90th)	BMI	**BMI tracking**: r=0.30–0.65 (P<0.001)
5	Deshmukh-Taskar et al., 2006	Bogalusa Heart Study (1972-2016)	United States	841 (68.3% white; 63.5% women)were followed up for 10 yrs from the age of 9 to 11 years to 1995-1996 (19-35 years)	BMI	BMI, overweight (overweight: BMI≥85th percentile or BMI between 25-29 kg/m^2 and obese as ≥30 kg/m^2)	**Tracking of childhood BMI to adulthood (<u>Pearson correlation coefficient</u>:** r= 0.66 P<0.0005 RR for being overweight in adulthood (overweight children vs. normal weight children) = 1.9
6	Burke et al, 2004	Western Australian Cohort	Australia	600 subjects were followed up for 16 years from the age of 9 years to 25 years	BMI	BMI	**BMI tracking:** <u>9 to 25 years:</u> r= 0.575 <u>12 to 25 years:</u> r= 0.656 <u>15 to 25 years:</u> r= 0.704 <u>18 to 25 years:</u> r= 0.824 (Adjusted for sex) All coefficients were statistically significant (*p* <0.001) Of children who were overweight or obese at the age of 9 years, 16% remained in that category at the age of 25 years. Respective proportions were 24% for 12-year-olds, 34% for 15- year-olds and 35% for 18-year-olds
7	Joshi et al, 2014	Pune Children's Study	Pune, India	477 children were followed up for 13 years from 8 years of age to 21 years	BMI	BMI [Overweight: BMI ≥ 25 kg/m2 and <30 kg/m2, obesity: BMI ≥ 30 kg/ m2 (WHO criteria)]	**<u>BMI tracking (pearson correlation coefficient)</u>** r=0.53 (p<0.001) **<u>Relative risk of adiposiry measures of BMI from 8 who remained there at 21 y</u>** **<u>BMI ≥ 30 kg/ m^2 (highest fourth of the distribution)</u>** RR=2.87 (95%CI, 2.05-4.01) **<u>BMI < 25 kg/ m^2 (lowest fourth of the distribution)</u>** RR=2.86 (95%CI, 2.02- 4.05)
8	Sinaiko et al, 1999	The Minneapolis Children's Blood Pressure Study	Minneapolis, USA	679 males and females followed up for 5-16 yrs from 7-18 yrs to 23 yrs of age	BMI	BMI	**BMI tracking**: r=0.612 (P<0.001)

9	Oren et al, 2003	-	Netherlands, born	750 males and females followed upfor 14 yrs from12-16 yrs of age to 27-30 yrs of age	BMI	BMI	**BMI tracking**: r=0.62 (M) r=0.65 (F)
10	Hulens et al, 2001	Leuvin Growth Study	Belgium	161 males followed from 13 to 18 years, 18 to 30 years.	BMI (Overweight/obesity: BMI≥85th percentile/BMI≥95th percentile)	BMI (overweight: BMI≥27.8 kg/m^2)	**Pearson correlation coefficient** 13-18 yrs: r=0.77 18-30 yrs: r=0.69 **OR (95% CI for being overweight in adulthood** Overweight adolescents vs normal weight adolescents 13 years: 6.9 (2.3-18.1) 15 years: 5.0 (1.9-13.0) 17 years: 6.8 (2.5-18.6)
11	Frohnert et al, 2013	-	United States	207 subjects were followed up for 7 years from the age of 15 years to 22 years	BMI	BMI	**Tracking:** r= 0.86 *P value* <0.001 (adjusted for age at baseline, sex, and race)
12	Craigie et al, 2009	ASH30 Study	United Kingdom	295 subjects were followed up for 21 years from the age of 12 years to 33 years	BMI	BMI	**Association between BMI at age 12 and adulthood BMI (Pearson correlation coefficient)** Males: r= 0.58 *P value* <0.01 Females: r= 0.53 *P value* <0.01
13	Freedman et al, 2001	Bogalusa Heart Study	United States	2617 subjects were followed up for 17 years from the age of 2-17 years to 18-37 years	BMI* (85th-95th percentile are at risk of being overweight; >95th percentile are overweight)	BMI (>30 were obese)	**BMI tracking:** r= 0.58 (adjusted by age, race or sex did not change the effect) **Association between BMIin childhoodand adulthood** Childhood BMI — Adult BMI (kg/m^2): 25-29.9 (overweight) / ≥30 (obese) <50th (normal weight) 21% 7% 85th-94th (risk of being overweight) 33% 51% ≥95th (overweight) 16% 77%
14	Freedman et al, 2001	Bogalusa Heart Study	United States	105 subjects were followed up for 14-18 years from the age of 5 years to 19-23 years	BMI	BMI	**Association BMI at age 19-23 years and BMI at:** Age 5: r= 0.60 *P value* <0.001 Age 7: r= 0.70 *P value* <0.001 (adjusted for race, sex and follow up age at follow up examination)

15	Freedman et al, 2002	Bogalusa Heart Study	United States	1055 subjects were followed up for 18 years from age 2-8 years	BMI (childhood BMI assessed as per the 2000 CDC Growth Charts;	BMI (Adulthood overweight defined as BMI between 25-29 kg/m2 and obese as ≥30 kg/m2)	**Association between childhood BMI and adulthood BMI:** r= 0.54 *P value* <0.001 (adjusted for sex, age and race)
16	Freedman et al, 2005	Bogalusa Heart Study (1972-2016)	United States	2610 (1115 boys; 1495 girls) were followed up for 17.6 years from 2 to 17 years to 18-37 years	BMI	BMI	<u>**Correlation (spearman correlation coefficient) between Childhood BMI and adulthood BMI:**</u> <u>**MALES:**</u> r= 0.64 P<0.001 <u>**FEMALES:**</u> **r=** 0.58 P<0.001
17	Wright et al, 2001	New castle thousand family cohort	Newcastle, UK	412 males and females followed upfor 41yrs from 9-13 yrs to 50 yrs of age	BMI	BMI	**BMI tracking**: r=0.24–0.39 (P<0.001)
18	Gunnell et al, 2000	Boyd Orr Cohort	United Kingdom	287 subjects were followed up for 61 years (mean) from the age of 4 years to 65 years (56-78 years)	BMI	BMI	**BMI tracking:** <u>Males:</u> r= 0.19 <u>Females:</u> r= 0.21
19	Casey et al, 1992	Harward Longitudinal studies of Child health and development	United states	134 subjects were followed up for 50 years from the age of 1 to 50 years of age	BMI	BMI	**BMI tracking (Pearson correlation coefficient) r=-0.03 to 0.87**
20	Julia et al, 2008	-	Indonesia	308 urban children followed from age 6–8 to 11– 13 years	BMI	BMI	**BMI tracking (Pearson correlation coefficient)** r=0.65-0.78 (No change after adjustment with age and sex)
21	Palti et al, 1988	-	Jerusalem	558 children were followed up for 8 years from the age of 6 years to 14 years of age	BMI	BMI	**BMI tracking (Pearson correlation coefficient) r=0.50-0.57**
22	Wang et al, 2000	China Health and Nutritional survey	China	975 children were followed upfor 6 years from the age of 6 to 13 years of age	BMI	BMI	**BMI tracking (Pearson correlation coefficient) r=0.38-0.42**
23	Inokuchi et al, 2011		Japan	669 subjects were followed up for 11 years from the age of 6 years to 17 years	BMI	BMI	**BMI correlations for a 1-year interval between measurements at all ages tested in both sexes:** r= 0.89-0.95
24	Kelder et al, 2002	Child and Adolescent Trial for	United States	2212 subjects were followed up for 5-6 years from the age of 7-8 years to 13-14 years	BMI	BMI	**BMI tracking:** r= 0.80

		Cardiovascular Health (CATCH) cohort study					
25	Tan et al, 2000	Cohort Study on Hyperlipidemia In Rural Schoolchildren	Japan	507 subjects were followed up for 4 years from age 8 years to 12 years	BMI	BMI	**Tracking of BMI:** <u>All subjects:</u> r= 0.7975 *P value* <0.001 <u>Boys:</u> r= 0.8363 *P value* <0.001 <u>Girls:</u> r= 0.7665 *P value* <0.001
26	Nishimura et al, 2009	Japanese children cohort	Ina, Saitama , Japan	586 (304 boys 282 girls) subjectives were followed up for 3 years from 9-10 yrs To 12-13 yrs of age	BMI	BMI	**<u>BMI tracking (Spearman correlation coefficient)</u>** **<u>Boys</u>** **r=0.86 (p<0.001)** **<u>Girls</u>** **r=0.87 (p<0.001)**
27	Wardle et al, 2006	Health and Behaviour in Teenagers Study (HABITS)	United Kingdom	2672 subjects were followed up for 5 years from the age of 11 years to 16 years	BMI	BMI	**Tracking of BMI:** r= 0.82 *P value* <0.001
28	Wright et al., 2010	ALSPAC study(1991 - 1992)	Males and females, South west England (1991-1992)	6066 Children were followed upfor 4 years from 7 yrs to 11 yrs of age	BMI	BMI (categorized into normal, overweight and obese using International Obesity Task Force (IOTF) for gender andexact age)	BMI tracking (all): r= 0.83; p<0.002 Norml weght: r=0.75 Overweight: r=0.47 Obese: r=0.59
29	De Kroon et al, 2010	Terneuzen Birth Cohort Study (1977-1986)	Males and females, Terneuzen, Netherlands, born 1977-1986	762 (307 M, 455 F) were followed up to 18 years from 0-18 years	BMI	BMI, Overweight (BMI SDS≥1.3 or BMI≥25)	**<u>Pearson correlation coefficient</u>** BMI SDS tracking (1-18 yrs)=0.35-0.84
30	Patton et al, 2010	Prospective 8-wave cohort study	Australia	1,520 subjects were followed up for 14 years from the age of 10 years till the age of 24 years	BMI (childhood overweight and obese defined according to IOTF definitions*)	BMI (adulthood overweight defined as BMI≥ 25 and obese as BMI≥ 30)	**Predicting BMI≥25 (overweight) at 24 years:** Persistence of overweight or obese: <u>Overweight 1 or 2 waves</u> %= 45 95% CI= 34-56 <u>Overweight 3+ waves</u> %= 70 **Predicting BMI≥30 (obese) at 2 years:** Persistent of overweight or obes <u>Overweight 1 or 2 waves</u> %= 5 95% CI= 1-9 <u>Overweight 3+ waves</u> %= 14 95% CI= 9-18

							95% CI= 64-77 Obese 1 or 2 wave %= 87 95% CI= 74-100 Obese 3+ waves %= 93 95% CI=87-100 | Obese 1 or 2 wave %= 34 95% CI= 20-48 Obese 3+ waves %= 62 95% CI=48-77 Gender difference: Under half of females who had been overweight during the adolescent waves had a BMI≥25 by 24 years compared to over 70% males (OR=0.44, 0.30-0.66)
31	Juonala et al, 2005	Young Finns study	Finland	2,206 subjects were followed up for 21 years from the age of 3-18 years to 24-39 years	BMI (childhood overweight was defined as BMI between 80th and 90th percentile and obesity as >90th percentile)	BMI (Adulthood overweight was defined as BMI between 25 and 30 kg/m^2 and obesity as >30 kg/m^2)	**Prevalence (%) of obesity in adulthood according to BMI at baseline** **BMI measured in childhood:** Lean (BMI<50th) 3.6%; Overweight (80-90th) 20.5%; Obese (BMI>90th) 34.3% **BMI measured in adolescence:** Lean (BMI<50th) 5.2%; Overweight (80-90th) 27.2%; Obese (BMI>90th) 64.2%
32	Engeland et al, 2004	Norwegian Health survey (Retrospective)	Norway	128121 subjects (61522 malesand 66599 femalws) were followed 10 years from 14-19 years of age to 24-34 years	BMI (low-25th, medium-25th -74th , high-75th -84th , ver high-≥85th) based on CDC/NCHS growth percetiles	BMI≥30 kg/m^2 (obesity)	**Odds raio(OD) (95%CI) of being obese as an adult by adolescence BMI** **Men** 75th -84thpercentile 5.1 (4.7-5.55) (≥85th percentile) 15 (14-17) **Women** 75th -84thpercentile 4 (3.7-4.3) (≥85th percentile) 15 (11-13) (adjusted for age at adolescence and adult measurement)
33	Adair, 2007	Community-based Longitudinal Health and Nutrition Survey	Cebu, Philippines	1901 subjects (1012 males and 889 females) were followed for 19 yrs from 2 yrs of age to 21 yrs of age	Residual BMI (BMI at age 2 regressed on birth length)	BMI	**Linear regression analysis of BMI at 2 yrs on adult BMI** **r=0.64(p<01) males** **r=0.48 (p<01) females** **(Age adjusted)**
34	Graversen et al, 2014	Northern Finland Birth Cohort 1966 Study	Finland	2120 subjects were followed up for 31 years from the age of 1 year to 31 years	BMI	BMI (30>BMI>25= overweight)	**Risk of being overweight [relative risk (95% CI)] by BMI percentiles at age 2 years:** <5th percentile: 0.7 (0.5 to 1.1) | **Risk of being overweight [relative risk (95% CI)] by BMI percentiles at age 3 years:** <5th percentile: 0.7 (0.5 to 1.1)

							≥5th to <50th percentile: 1.0 ≥50th to <75th percentile: 1.2 (1.1 to 1.4) ≥75th to <90th percentile: 1.5 (1.3 to 1.7) ≥90th to <95th percentile: 1.6 (1.3 to 1.9) ≥95th percentile: 1.7 (1.4 to 2.1)	≥5th to <50th percentile: 1.0 ≥50th to <75th percentile: 1.4 (1.2 to 1.6) ≥75th to <90th percentile: 1.5 (1.3 to 1.8) ≥90th to <95th percentile: 1.8 (1.4 to 2.1) ≥95th percentile: 2.0 (1.7 to 2.3)
							Risk of being overweight [relative risk (95% CI)] by BMI percentiles at age 4 years:	**Risk of being overweight [relative risk (95% CI)] by BMI percentiles at age 5 years:**
							<5th percentile: 0.5 (0.3 to 0.8) ≥5th to <50th percentile: 1.0 ≥50th to <75th percentile: 1.3 (1.2 to 1.5) ≥75th to <90th percentile: 1.7 (1.5 to 1.9) ≥90th to <95th percentile: 2.0 (1.7 to 2.4) ≥95th percentile: 2.2 (1.9 to 2.6)	<5th percentile: 0.5 (0.3 to 0.8) ≥5th to <50th percentile: 1.0 ≥50th to <75th percentile: 1.3 (1.1 to 1.5) ≥75th to <90th percentile: 1.6 (1.4 to 1.8) ≥90th to <95th percentile: 2.1 (1.8 to 2.5) ≥95th percentile: 2.3 (2.0 to 2.6)
							(values adjusted for gender) (linear associations were adjusted for birth weight, gestational age, maternal smoking during pregnancy, maternal age at birth, maternal pre-pregnancy BMI, maternal education level, and parity)	
35	Graversen et al, 2014	Northern Finland Birth Cohort 1966 Study	Finland	2120 subjects were followed up for 31 years from the age of 1 year to 31 years	BMI	BMI (BMI>30= obese)	**Risk of being obese [relative risk (95% CI)] by BMI percentiles at age 2 years:**	**Risk of being obese [relative risk (95% CI)] by BMI percentiles at age 3 years:**
							<5th percentile: 0.5 (0.2 to 1.4) ≥5th to <50th percentile: 1.0 ≥50th to <75th percentile: 1.2 (0.8 to 1.7) ≥75th to <90th percentile: 1.8 (1.2 to 2.6) ≥90th to <95th percentile: 1.6 (0.9 to 2.9) ≥95th percentile: 2.2 (1.3 to 3.7)	<5th percentile: 0.0 (0.0 to 0.0) ≥5th to <50th percentile: 1.0 ≥50th to <75th percentile: 1.8 (1.2 to 2.5) ≥75th to <90th percentile: 1.7 (1.1 to 2.5) ≥90th to <95th percentile: 3.1 (1.9 to 5.0) ≥95th percentile: 3.6 (2.3 to 5.7)
							Risk of being obese [relative risk (95% CI)] by BMI percentiles at age 4 years:	**Risk of being obese [relative risk (95% CI)] by BMI percentiles at age 5 years:**
							<5th percentile: 0.2 (0.0 to 1.4) ≥5th to <50th percentile: 1.0 ≥50th to <75th percentile:	<5th percentile: 0.2 (0.0 to 1.4) ≥5th to <50th percentile: 1.0 ≥50th to <75th percentile:

							1.9 (1.3 to 2.7) ≥75th to <90th percentile: 2.3 (1.5 to 3.5) ≥90th to <95th percentile: 3.3 (2.0 to 5.6) ≥95th percentile: 6.4 (4.3 to 9.5) 1.5 (1.0 to 2.3) ≥75th to <90th percentile: 2.7 (1.8 to 4.0) ≥90th to <95th percentile: 4.1 (2.5 to 6.5) ≥95th percentile: 6.2 (4.2 to 9.3) (values adjusted for gender) (linear associations were adjusted for birth weight, gestational age, maternal smoking during pregnancy, maternal age at birth, maternal pre-pregnancy BMI, maternal education level, and parity)
36	Field et al, 2005	East Boston Blood Pressure study	United States	314 subjects were followed up for 8-12 years from the age of 8-15 years to 18-26 years	BMI	BMI	**Association [β (SE)] between adulthood BMI and childhood BMI according to age and gender-specific percentile of BMI:** **Males** <50th percentile: REFERENCE 50th to 75th percentile: 2.2 (0.7) 75th to 84th percentile: 2.6 (0.9) ≥85th percentile: 5.6 (0.7) **Females** <50th percentile: REFERENCE 50th to 75th percentile: 2.0 (0.8) 75th to 84th percentile: 3.3 (1.1) ≥85th percentile: 6.2 (0.7) Analyses adjusted for age and length of follow-up **Risk [OR (95% CI)] of being overweight in adulthood according to a gender-specific percentile of childhood BMI:** **Males** <50th percentile: REFERENCE 50th to 75th percentile: 5.3 (1.9 to 14.9) 75th to 84th percentile: 4.3 (1.2 to 15.1) ≥85th percentile: 13.2 (3.9 to 45.0) **Females** <50th percentile: REFERENCE 50th to 75th percentile: 4.8 (0.9 to 26.6) 75th to 84th percentile: 20.2 (3.4 to 121.6) ≥85th percentile: 48.2 (9.4 to 247.7) Analyses adjusted for age and length of follow-up
37	Whitaker et al, 1997	Group Health Cooperative (GHC) of Puget Sound (birth cohort)	United States	854 subjects were followed up for 21-29 years from birth till age 21-29 years	BMI (obese defined as BMI>85th percentile and very obese as BMI>95th percentile)	BMI (obesity defined as BMI≥27.8 for men and BMI≥27.3 for women)	**Risk [OR (95% CI)] of developing obesity in adulthood by childhood BMI status:** 1-2 years: Not obese: 1.0 Obese or very obese: 1.3 (0.7 to 2.5) Very obese: 2.0 (0,7 to 5.7) 3-5 years: Not obese: 1.0 Obese or very obese: 4.1 (2.5 to 6.7) Very obese: 7.9 (3.6 to 17.3) 6-9 years: Not obese: 1.0 Obese or very obese: 10.3 (6.2 to 17.3)

							Very obese: 18.5 (8.8 to 38.8) 10-14 years: Not obese: 1.0 Obese or very obese: 28.3 (15.0 to 53.5) Very obese: 44.3 (16.3 to 120) 15-17 years: Not obese: 1.0 Obese or very obese: 20.3 (10.4 to 39.6) Very obese: 32.5 (13.1 to 80.6)
38	Monyeki et al, 2008	Ellisras Longitudinal Growth and Health study	Men and women, of the rural population of Ellisras, South Africa	1771 (489 preschool and 1282 primary school students) followed up for 8 yrs from 3-10 years to 10-17 yrs of age	BMI	BMI	**Linear regression (Adjusted for age and maturation)** **Both preschool and primary students showed a significant association between first and subsequent measurements of BMI** which ranged from B=0.2 (95% CI 0.1-0.4) to B=0.8 (95% CI 0.6-0.9) for preschool and B=0.2 (95% CI 0.1-0.3) to B=0.7 (95% CI 0.6-0.8) for primary children. significant tracking of BMI during 4-12 years of life was more consistent for preschool children (B=0.6 (95% CI 0.6-0.7) and for primary school children (B=0.6 (95% CI 0.5-0.6)
39	Huerta et al,2010	Israel cohort study	Brazilai Medical Centre, Israel	3163 (1629 M and 1534 F) with a mean followe up of 6 ± 1.6 yrs from 8-15 yrs to 17-19 yrs of age	BMI (overweight >85th percentile and obese >95th obese according to Israeli Public Health Service references, which are based on current US National Center for Health Statistics)	Overweight and obesity (BMI>25 and >30)	**Relative risks (95% CI) of adolescent overweight and obesity by childhood BMI category:** Risk of adolescent overweight: Childhood BMI≤85th centile REFERENCE Childhood BMI>85th centile 7.03 (6.15 to 8.04) Childhood BMI>95th centile 7.20 (6.22 to 8.33) Risk of adolescent obesity: Childhood BMI≤85th centile REFERENCE Childhood BMI>85th centile 24.34 (16.48 to 35.96) Childhood BMI>95th centile 28.41 (19.74 to 40.90) (adjusted for age and sex)
40	Eriksson J, 2001	Helsinki birth cohort	Finland	3659 (1552 men and 2107 women) subjects followed up for 7 yrs from 7 years of age to 15 years	BMI	BMI (Obese:BMI≥ 30kg/ m^2)	**Age-adjusted Odds Ratio (OR) for adult obesity according BMI at age7 yrs (p<0.0001)** **BMI at age7 yrs** / **Men** / **Women** <14.5 kg/m^2 1.0 1.0 15.25 kg/m^2 1.4 (1.0-1.9) 1.4 (1.1-1.8) 16 kg/m^2 1.8 (1.3-2.5) 1.9 (1.5-2.5) >16 kg/m^2 3.0 (2.2-4.2) 3.0 (2.3-3.9)

41	Giles et al, 2013	Generation 1 Study	Australia	392 subjects were followed up for 9 years from birth till age 9	BMI (age- and sex- specific s.d. scores based on a 1990 UK reference population)	BMI (age- and sex- specific s.d. scores based on a 1990 UK reference population)	**Association [β (s.e.)] between z-BMI at age 9 years and z-BMI changes from:** <u>6 to 9 months:</u> 0.65 (0.07) *P value* <0.001 <u>9 to 12 months:</u> 0.83 (0.08) *P value* <0.001 <u>12 months to 2 years:</u> 0.81 (0.07) *P value* <0.001 <u>2 to 3.5 years:</u> 0.80 (0.06) *P value* <0.001 (values adjusted for birth z-BMI, z-BMI change from birth to 6 months, 6 to 9 months, 9 to 12 months, 12 months to 2 years, 2 to 3.5 years, maternal age at birth of study child, maternal BMI in early pregnancy, gestational age when maternal BMI measured, parity, maternal education and number of house moves before 3.5 years)
42	Hughes et al.,2011	ALSPAC study(1991 - 1992)	Males and females, South west England (1991-1992)	7759 (3946M; 3813 F) were followed up for 7 yrs from Children 7-11 years of age to 15 years`	BMI	Overweight or Obesity (BMI Normal weight: <85th percentile Overweight: 85-94th percentile Obese: >95th percentile)	**<u>Risk ratios (RR) for overweight and obesity at 15 yrs from overweight and obesity at 7 and 11 years (relative to healthy weight status at 7 and 11 years)</u>** **<u>N</u>** **<u>RR (95%CI)</u>** 7-15 yrs 4572 5.1 (4.7-5.6) 11-15 yrs 4667 8.6 (7.6-9.7)
43	Reilly et al., 2011	ALSPAC study(1991 - 1992)	Males and females, South west England (1991-1992)	5175 children (2615F, 2560M) were followed up for 6 yrs from 7 yrs to 13 yrs	BMI	Obesity (BMI Normal: <85th percentile Overweight: 85-94th percentile Obese: >95th percentile) also used IOTF definition for obesity (BMI>30 as obese)	Change in BMI z score boys- 0.10- 0.33* (7-13 yrs) Change in BMI z score girls- 0.09-0.32*(7-13 yrs) **<u>According to UK definitions:</u>** **<u>Overweight to Obesity</u>** **Unajusted OR (N=5175)** All: 19.4 (14.8-25.3) Boys: 20.2 (13.8-29.6) Girls: 18.5 (12.7-27.1) **<u>OR adjusted (N=3357</u>**) All: 18.1 (12.8-25.6) Boys: 20.5 (12.6-33.6) Girls: 16.4 (10.0-27.0) (Adjusted for socioeconomic status and parentalobesity) **<u>According to IOTF definitions:</u>** **<u>OR adjusted (N=3357</u>**) 55.7 (29.0-106.8)
44	Adair, 2013	Five birth cohorts from Low and	Brazil, Guatemala, New Delhi (India), Philippines and	8362 participants followed up from 2 years, 4-8 years to adulthood (15-31 years of age)	Conditional relative weight	Overweight (BMI >25 kg/m^2)	**Association between conditional weight gain during infancy and BMI>25 kg/m^2 at adulthood (OR, 95% CI)** 2 yrs: 1.51 (1.43-1.60) 4-8 yrs: 1.76 (1.66-1.86)

		middle income countries	South Africa				(Adjusted for adult age)
45	Ekelund et al, 2006	Stockholm Weight Development Study (SWEDES)	Sweden	248 males were followed up for 17 years from birth till age 17	Weight	BMI	**Association between weight gain during infancy and BMI at 17 years:** β= 0.92 (0.534 to 1.306) *P value* <0.0001 **Association between weight gain during early childhood and waist circumference at 17 years:** β= 1.507 (0.909 to 2.106) *P value* <0.0001 (adjusted for sex, birth weight, gestational age, current height, maternal socioeconomic status, and maternal fat mass)
46	Graversen et al, 2014	Northern Finland Birth Cohort 1966 Study	Finland	2120 subjects were followed up for 31 years from the age of 1 year to 31 years	Weight	BMI (30>BMI>25)	**Risk of being overweight [relative risk (95% CI)] by weight percentiles at age 1 year:** $<5^{th}$ percentile: 1.3 (1.0 to 1.6) $\geq5^{th}$ to $<50^{th}$ percentile: 1.0 $\geq50^{th}$ to $<75^{th}$ percentile: 1.2 (1.0 to 1.3) $\geq75^{th}$ to $<90^{th}$ percentile: 1.2 (1.0 to 1.4) $\geq90^{th}$ to $<95^{th}$ percentile: 1.4 (1.2 to 1.7) $\geq95^{th}$ percentile: 1.6 (1.3 to 1.9) (values adjusted for gender) (linear associations were adjusted for birth weight, gestational age, maternal smoking during pregnancy, maternal age at birth, maternal pre-pregnancy BMI, maternal education level, and parity)
47	Graversen et al, 2014	Northern Finland Birth Cohort 1966 Study	Finland	2120 subjects were followed up for 31 years from the age of 1 year to 31 years	Weight	BMI (BMI>30)	**Risk of being obese [relative risk (95% CI)] by weight percentiles at age 1 year:** $<5^{th}$ percentile: 1.5 (0.8 to 2.6) $\geq5^{th}$ to $<50^{th}$ percentile: 1.0 $\geq50^{th}$ to $<75^{th}$ percentile: 1.0 (0.7 to 1.5) $\geq75^{th}$ to $<90^{th}$ percentile: 1.5 (1.0 to 2.2) $\geq90^{th}$ to $<95^{th}$ percentile: 1.3 (0.8 to 2.5) $\geq95^{th}$ percentile:

							1.9 (1.1 to 3.3) (values adjusted for gender) (linear associations were adjusted for birth weight, gestational age, maternal smoking during pregnancy, maternal age at birth, maternal pre-pregnancy BMI, maternal education level, and parity)
48	McCarthy et al, 2007	Barry Caerphilly Growth Study	United Kingdom	679 subjects were followed up for 25 years from birth till ≈age 25	Weight	BMI	**Association [regression coefficient (95% CI)] of adult BMI with weight at age:** 1.5 years: MODEL 1: -0.07 (-0.63 to 0.48) *P value*= 0.80 MODEL 2: 0.27 (-0.28 to 0.81) *P value*= 0.34 MODEL 3: 0.38 (-0.17 to 0.92) *P value*= 0.18 MODEL 4: 0.41 (-0.14 to 0.96) *P value*= 0.14 MODEL 5: 0.38 (-0.18 to 0.93) *P value*= 0.18 5 years: MODEL 1: 1.34 (0.82 to 1.86 *P value* <0.001 MODEL 2: 1.05 (0.51 to 1.59) *P value* <0.001 MODEL 3: 1.02 (0.48 to 1.55) *P value* <0.001 MODEL 4: 1.02 (0.48 to 1.55) *P value* <0.001 MODEL 5: 1.01 (0.48 to 1.55) *P value* <0.001 **Association [regression coefficient (95% CI)] of adult BMI with weight velocities:** Infant (5 months to 1 year and 9 months): MODEL 1: 0.21 (-0.20 to 0.62) *P value*= 0.25 MODEL 2: 0.32 (-0.03 to 0.76) *P value*= 0.07 MODEL 3: 0.35 (-0.05 to 0.75) *P value*= 0.08 MODEL 4: 0.36 (-0.03 to 0.75) *P value*= 0.07 MODEL 5: 0.38 (-0.01 to 0.77) *P value*= 0.06 Child (1 years and 9 months to 5 years): MODEL 1: 1.13 (0.69 to 1.57) *P value* <0.001 MODEL 2: 0.95 (0.51 to 1.37) *P value* <0.001 MODEL 3: 0.96 (0.54 to 1.39) *P value* <0.001 MODEL 4: 0.99 (0.56 to 1.41) *P value* <0.001 MODEL 5: 1.01 (0.48 to 1.55) *P value* <0.001 Model 1: adjusted for adult age, sex and gestational age Model 2: adjusted as was model 1, with the addition of maternal and paternal weight and height Model 3: adjusted as was model 2, with the addition of parental socioeconomic status in childhood Model 4: adjusted as was model 3, with addition of maternal smoking in

							pregnancy Model 5: adjusted as was model 4, with the addition of current smoking status	
49	Gunnarsdottir et al, 2010	Copenhagen Cohort Study on Infant Nutrition and Growth and Icelandic infant nutrition study	Denmark and Iceland	64 subjects from the Danish cohort and 100 subjects from the Icelandic cohort were followed up for 10 years from birth till age 10	Weight	BMI (defined according to British 1990 growth references)	**BMI quartiles at age 10 according to weight at:** Age 6 months: Q1: 7568 Q2: 7984 Q3: 7918 Q4: 8259 *P value*= 0.043 Age 12 months: Q1: 9724 Q2: 9929 Q3: 9996 Q4: 10400 *P value*= 0.062	**BMI quartiles at age 10 according to weight gain between:** 6 to 12 months: Q1: 2115 Q2: 1999 Q3: 2068 Q4: 2205 *P value*= 0.383
50	Kinra et al, 2005	Historical Birth Cohort Study	United Kingdom	1335 subjects were followed up for 7 years from birth to age 7	Weight	BMI (z scores standardized to the 1990 UK reference population*)	**Association [regression coefficient (95% CI)] between 18 month weight z score and BMI z score at age 7:** Univariate model: 0.29 (0.26 to 0.33) R^2= 0.16 Bivariate models: MODEL 1 0.28 (0.24 to 0.32) R^2= 0.16 MODEL 2 0.29 (0.25 to 0.32) R^2= 0.16 Multivariate model: 0.28 (0.23 to 0.32) R^2= 0.16 Model 1: includes 6 week weight and 18 month weight z scores Model 2: birth weight and 18 month weight z scores Multivariate model: includes birth weight, 6 week weight and 18 month weight z scores	**Association [regression coefficient (95% CI)] between late weight gain (6 weeks to 18 months) z score and BMI z score at age 7:** Univariate model: 0.16 (0.12 to 0.20) R^2= 0.04 Bivariate models: MODEL 1 0.21 (0.17 to 0.25) R^2= 0.08 MODEL 2 0.18 (0.14 to 0.22) R^2= 0.08 Multivariate model: 0.28 (0.23 to 0.32) R^2= 0.16 Model 1: includes early (birth to 6 weeks) and late weight gain z scores z scores Model 2: birth weight and last weight gain z scores Multivariate model: includes birth weight, early and late weight gain z scores

51	Reilly et al, 2005	Avon Longitudinal Study of Parents and Children (ALSPAC)	United Kingdom	857 subjects were followed up for 7 years from birth till age 7	Weight	BMI (according to 1990 UK reference data)	**Association [OR (95% CI)] between development of obesity at age 7 and weight gain in the first 12 months:** <u>UNADJUSTED (UNIVARIATE)</u> 1.07 (1.05 to 1.10) *P value* <0.001 <u>FULL ADJUSTED</u> 1.06 (1.02 to 1.10) *P value*= 0.003 (adjusted for birth weight, maternal smoking, parental obesity, hours of sleep at age 30 months, time spent watching television at age 30 months, food groups, maternal education, sex and daily energy intake)
52	Adair L	community-based Longitudinal Health and Nutrition Survey	Cebu, Philippines	1901 subjects (1012 males and 889 females) were followed for 19 yrs from 2 yrs of age to 21 yrs of age	Residual weight (BMI at age 2 regressed on birth weight)	BMI	**Linear regression analysis of BMI at 2 yrs on adult BMI** **R=0.98(p<01) males** **R=0.48 (p<01) females** **(Age adjusted)**
53	Ong et al, 2000	Avon Longitudinal Study of Pregnancy and Childhood (ALSPAC)	United Kingdom	848 subjects were followed up for 5 years from birth till age 5	Weight	BMI	**Association [mean (SD)] between change in weight from 0-2 years and body mass index at 5 years:** <u>Catch-up growth vs. BMI at age 5:</u> 0.82 (1.01) *P value* <0.0005 <u>Catch-down growth vs. BMI at age 5:</u> -0.07 (0.86) <u>No growth change vs. BMI at age 5:</u> 0.19 (0.87) (Catch-up growth: a gain in SD score for weight between 0-2 years that was greater than 0.67 SD scores Catch-down growth: a decrease in SD scores for weight more than 0.67 SD scores)
54	Ioanna Tzulaki et al, 2010 112	Northern Finland Birth Cohort 1966 Study	Finland	3,778 subjects followed up for 31 years from birth to the age of 31 years	Weight	BMI	**Association between BMI in adulthood [β (95% CI)] and peak height velocity (cm/year) in infancy:** <u>Model 1:</u> 0.83 (0.55 to 1.10) *P value*= 0.0001 <u>Model 2:</u> 0.69 (0.40 to 0.99) *P value* <0.0001 <u>Model 3:</u> 0.68 (0.39 to 0.97) *P value* <0.0001 <u>Model 1:</u> adjusted for sex <u>Model 2:</u> adjusted for sex, socioeconomic status at birth, maternal age,

							maternal height and weight before pregnancy, maternal smoking after the second month of pregnancy, and gestational age at birth Model 3: adjusted for all variables in model 2 plus birth weight
55	Sayer et al, 2004	Hertfordshire Cohort Study (Birth Cohort)	United Kingdom	737 subjects were followed up for ≈65 years from birth till age 65 (mean)	Weight	BMI	**Association between weight at 1 year and BMI in adulthood:** r= 0.08 *p value* NS (adjusted for age at clinic visit, social class at birth, current social class, smoking status, alcohol consumption, and physical activity)
56	Freedman et al, 2002	Bogalusa Heart Study	United States	1055 subjects were followed up for 18 years from age 2-8 years	Weight	BMI	**Association between childhood weight and adulthood BMI:** r= 0.49 *P value* <0.001 (adjusted for sex, age and race)
57	Stettler et al, 2002	National Collaborative Perinatal Project (CPP)	United States	19397 subjects were followed up for 7 years from birth to age 7	Weight	BMI (overweight status defined as BMI>95th percentile according to CDC reference data)	**Association between weight at 1 year and BMI at age 7:** OR= 1.05 95% CI= 1.04 to 1.05 *P value* <0.001 (adjusted for early weight gain, childhood overweight status and initiation of breastfeeding)
58	Hui et al, 2008	Hong Kong's Children of 1997 Birth Cohort	China	6075 subjects were followed up for 7 years from birth till age 7	Weight	BMI (as per Centers for Disease Control and Prevention growth charts*)	**Association [regression coefficient (95% CI)] between body mass index z score at age 7 with per unit increase in weight z score at ages 3 to 12 months:** All subjects: 0.33 (0.28 to 0.37) *P for interaction**= 0.24 *P for interaction***= 0.07 *P for interaction****= 0.007 Boys: 0.30 (0.24 to 0.36) *P for interaction**= 0.38 Girls: 0.38 (0.31 to 0.45) *P for interaction**= 0.39 Models were adjusted for infant's sex, gestational age, z score for weight at baseline, and growth rate in the other period (0-3 months) *Growth rate (indicates the change in the weight z score during the relevant period, i.e., ages 3 to 12 months) and weight z score at baseline **Growth rate and sex ***Growth, weight z score at baseline, and sex
59	Adair, 2013	Five birth cohorts from Low and middle income	Brazil, Guatemala, New Delhi (India), Philippines and South Africa	8362 participants followed up from 2 years, 4-8 years to adulthood (15-31 years of age)	Conditional relative height	Overweight (BMI >25 kg/m^2)	**Association between conditional height gain during infancy and BMI>25 kg/m^2 at adulthood (OR, 95% CI)** 2 yrs: 1.24 (1.17-1.31) 4-8 yrs: 1.12 (1.06-1.18)

		countries					(Adjusted for adult age)
60	Freedman et al, 2000	Bogalusa Heart Study	United States	105 subjects were followed up for 14-18 years from the age of 5 years to 19-23 years	Height	BMI	**Association SSF at age 19-23 years and height at:** Age 5: r= -0.41 *P value* <0.001 Age 7: r= -0.41 *P value* <0.001 (adjusted for race, sex and follow up age at follow up examination)
61	Ioanna Tzulaki et al, 2010	Northern Finland Birth Cohort 1966 Study	Finland	3,778 subjects followed up for 31 years from birth to the age of 31 years	Height	BMI	**Association between BMI in adulthood [β (95% CI)] and peak height velocity (cm/year) in infancy:** Model 1: -0.07 (-0.04 to 0.02) *P value*= 0.63 Model 2: -0.02 (-0.34 to 0.30) *P value*= 0.91 Model 3: 0.01 (-0.31 to 0.33) *P value*= 0.96 Model 1: adjusted for sex Model 2: adjusted for sex, socioeconomic status at birth, maternal age, maternal height and weight before pregnancy, maternal smoking after the second month of pregnancy, and gestational age at birth Model 3: adjusted for all variables in model 2 plus birth weight
62	Freedman et al, 2002	Bogalusa Heart Study	United States	1055 subjects were followed up for 18 years from age 2-8 years	Height	BMI	**Association between childhood height and adulthood BMI:** r= 0.25 *P value* <0.001 (adjusted for sex, age and race)
63	Adair, 2007	community-based Longitudinal Health and Nutrition Survey	Cebu, Philippines	1901 subjects (1012 males and 889 females) were followed for 19 yrs from 2 yrs of age to 21 yrs of age	Residual length (BMI at age 2 regressed on birth length)	BMI	**Linear regression analysis of BMI at 2 yrs on adult BMI** R=0.19(p<01) males R=0.05 (NS) females (Age adjusted)

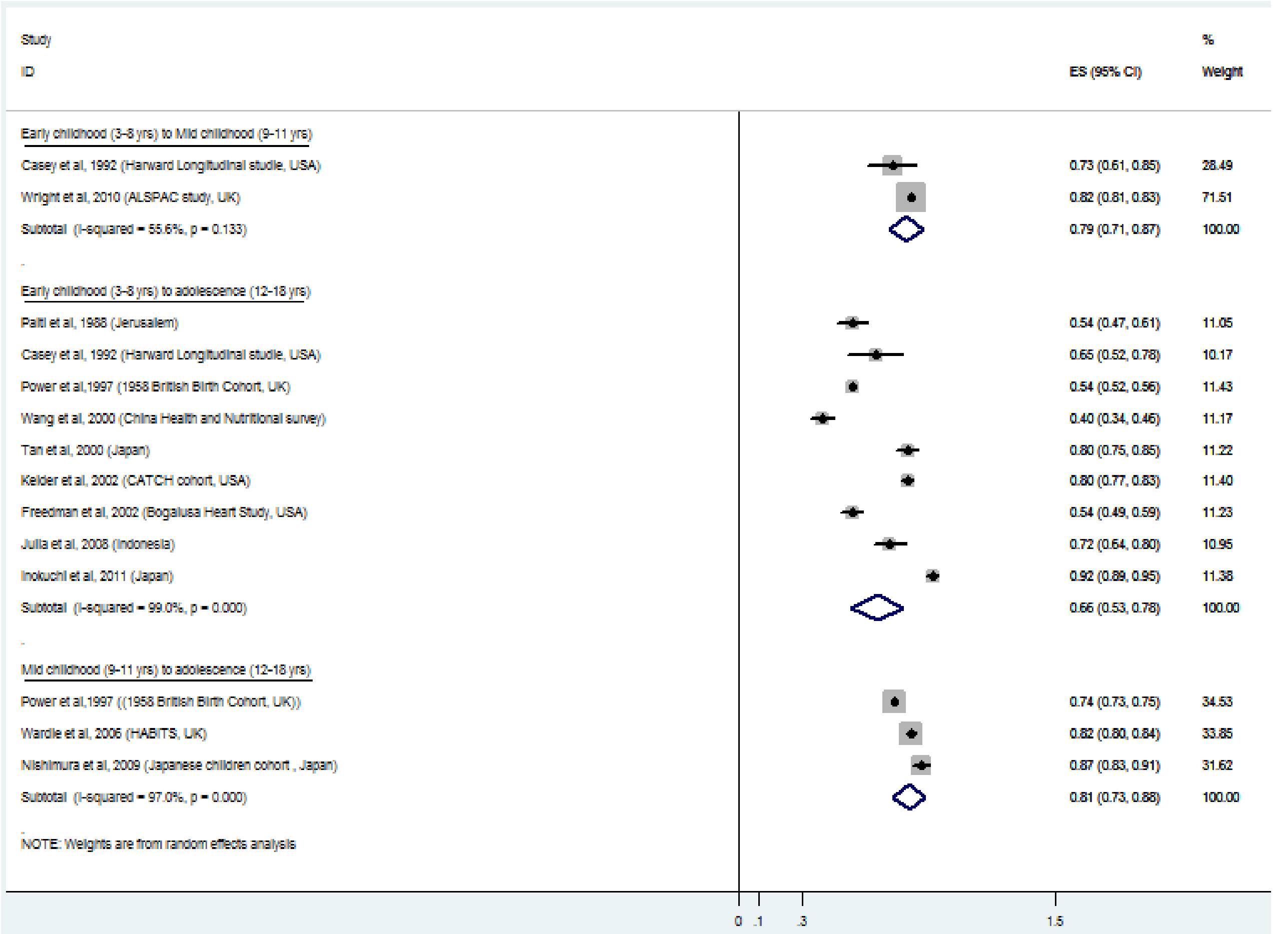


Figure 2: Forest plot showing the pooled analysis of correraltion coefficients of BMI tracking from early childhood to adolescence

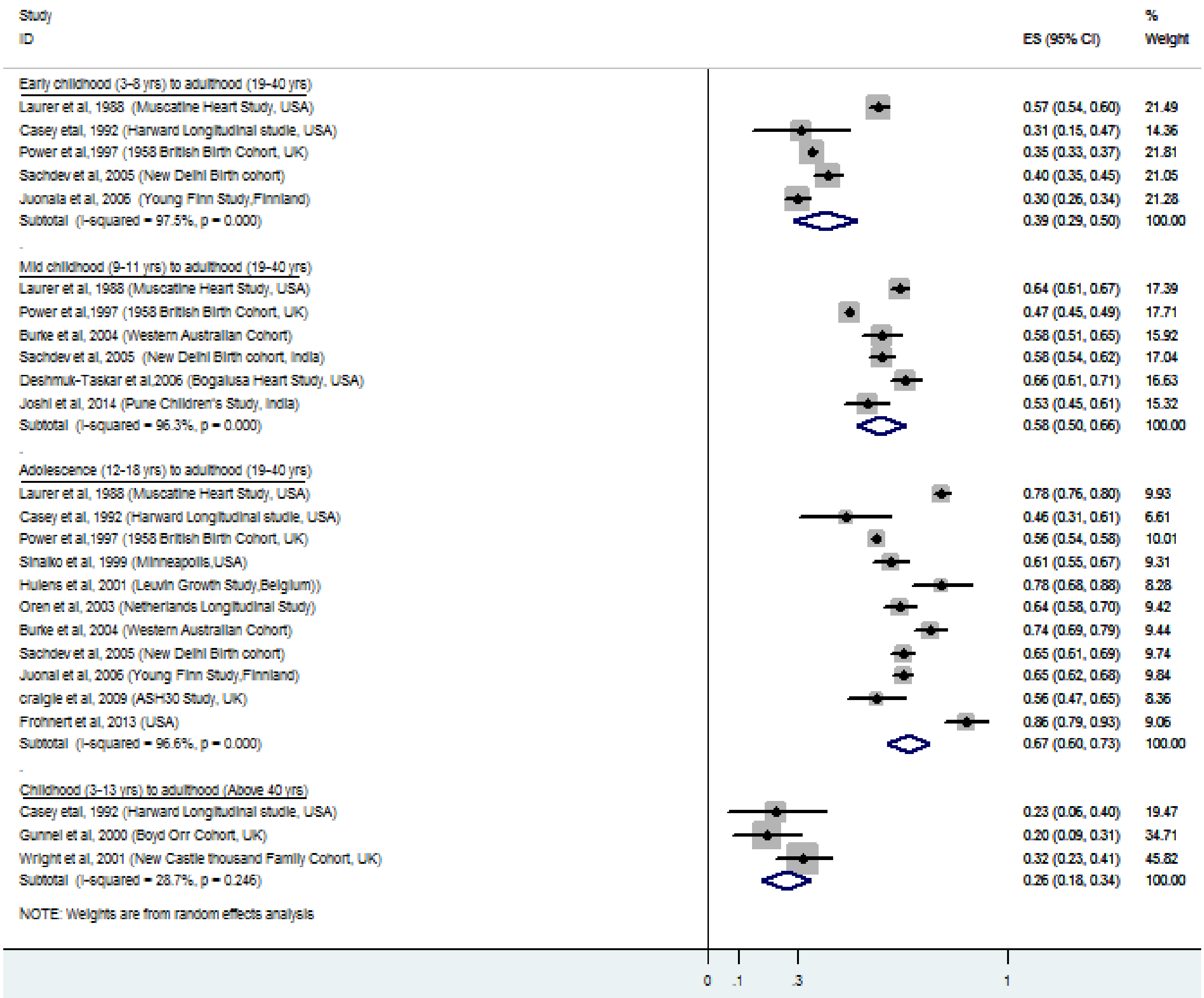


Figure 3: Forest plot showing the pooled analysis of correraltion coefficients of BMI tracking from early childhood to adulthood

Table 3: Assesment of quality of studies included for the above outcome

AUTHOR/COHORT	ASSESSMENT OF QUALITY OF INCLUDED COHORTS (NEW CASTLE OTTAWA SCALE)							
	SELECTION (Max. 4 stars)				COMPARABILITY Max. 2 stars	OUTCOME Max. 3 stars		
	Representativeness of the exposed (i.e. those wilh risk factors) cohort	Selection of non-exposed (i.e. those without risk factors) cohort	Ascertainment of exposure	Demonstration that outcome of interest was not present at start of study	Comparability of cohorts on the basis of the design or analysis	Assessment of outcome	Was follow up long enough for outcomes to occur	Adequacy of follow up of cohorts
Laurer et al., 1988 Muscatine Heart study	*		*	*	*	*	*	
Power et al.,1997 British Birth Cohort (1958)	*		*	*	* *	*	*	
Sachdev et al., 2005 New Delhi birth cohort	*		*	*	**	*	*	
Juonala et al 2006 Young Fin Study	*		*	*	*	*	*	
Deshmukh-Taskar et al., 2006 Bogalusa Heart Study	*		*	*		*	*	
Burke et al 2004 Cohort of Perth children	*		*	*		*	*	
Joshi et al, 2014 Pune Children's Study	*		*	*	*	*	*	
Sinaiko et al, 1999 The Minneapolis Children's Blood Pressure Study	*		*	*	*	*	*	
Oren et al, 2003	*		*	*		*	*	
Hulens et al, 2001 Leuvin Growth Study	*		*	*		*	*	
Frohnert et al, 2013	*		*	*	*	*	*	
Craigie et al, 2009 ASH30 Study	*		*	*		*	*	
Freedman et al.2001 Bogalusa Heart Study	*		*	*	*	*	*	
Freedman et al, 2002 Bogalusa Heart Study	*		*	*	**	*	*	
Freedman et al, 2005 Bogalusa Heart Study	*		*	*	* *	*	*	
Wright et al, 2001 Thousand families cohort study	*		*	*	*	*	*	
Gunnell et al, 2000 Boyd Orr Cohort	*		*	*		*	*	
Casey et al, 1992 Harward Longitudinal studies of Child health and development	*		*	*	*	*	*	
Julia et al, 2008	*		*	*	*	*		*
Palti et al, 1988	*		*	*	*	*		
Wang et al, 2000	*		*	*		*		
Inokuchi et al, 2011	*		*	*		*	*	*
Kelder et al, 2002 Child And Adolescent Trial For	*		*	*	*	*		

Cardiovascular Health (CATCH) Cohort Study								
Tan et al, 2000 Cohort Study on Hyperlipidemia In Rural Schoolchildren	*		*	*		*		
Nishimura et al, 2009 Japanese children cohort	*		*	*		*		*
Wardle et al, 2006 Health and Behaviour in Teenagers Study (HABITS)	*		*	*	*	*		
Wright et al., 2010 ALSPAC study	*		*	*		*		
De Kroon et al, 2010 Terneuzen Birth Cohort Study (1977-1986)	*		*	*	*	*	*	
Patton et al, 2011 Prospective 8-Wave Cohort Study	*		*	*		*	*	
Engeland et al, 2004 Norwegian Health survey	*		*	*	**	*	*	
Adair, 2007 Community-based Longitudinal Health and Nutrition Survey	*		*	*	*	*	*	
Graversen et al, 2014 The Northern Finland Birth Cohort	*		*	*	**	*	*	
Field et al, 2005 East Boston Blood Pressure study	*		*	*	**	*	*	
Whitaker et al, 1997 Group Health Cooperative (GHC) of Puget Sound	*		*	*	*	*	*	
Monyeki et al, 2008 Ellisras Longitudinal Growth and Health study	*		*	*	*	*		*
Huerta et al,2010 Israel cohort study	*		*	*	*	*	*	
Eriksson et al, 2001 Helsinki birth cohort	*		*	*	*	*		
Giles et al, 2013 Generation 1 Study	*		*	*	**	*		
Hughes et al.,2011 ALSPAC study	*		*	*		*		
Reilly et al., 2011 ALSPAC study	*		*	*	*	*	*	
Ekelund et al, 2006 Stockholm Weight Development Study (SWEDES)	*		*	*	**	*	*	
McCarthy et al, 2007 Barry Caerphilly Growth Study	*		*	*	* *	*	*	
Gunnarsdottir et al, 2010 Copenhagen Cohort Study On Infant Nutrition And Growth And Icelandic Infant Nutrition Study	*		*	*		*	*	
Kinra et al, 2005 Historical Birth Cohort Study	*		*	*	*	*	*	
Sayer et al, 2004 Hertfordshire Cohort Study	*		*	*	**	*	*	
Stettler et al, 2002 National Collaborative Perinatal Project (CPP)	*		*	*	*	*	*	
Hui et al, 2008 Hong Kong's Children Of 1997 Birth Cohort	*		*	*	*	*	*	

Association of childhood and adolescent anthropometric measures with adolescence or adulthood cardiovascular disease or events/stroke/deaths

Cardiovascular disease or events/stroke/deaths: Pooled analysis of 3 British Birth cohorts (1946, 1958 and 1970) (Park, 2013) demonstrated that overweight in adolescence and adulthood, and persistent overweight in childhood, adolescence and adulthood were associated with increased odds of coronary heart disease (CHD), when compared to those who were never overweight (OR 3.74, 95% CI 1.35-10.35; OR 6.62, 95% CI 1.94-22.65). The pooled analysis also showed that the OR for persistent overweight (OR 6.62, 95% CI 1.94-22.65) was higher than that for obesity in adulthood only (OR 3.83, 95% CI 1.98-7.42).

Ten articles (eight studies) examined the relationship of anthropometric measures during childhood and risk of cardiovascular disease or events in later life. Our spectrum of cardiovascular diseases included coronary heart disease, ischemic heart disease and stroke. Nine studies [44, 50, 69, 124, 132, 175, 206, 207, 208] examined the relationship between childhood and adolescent BMI and cardiac diseases like coronary heart disease and ischemic heart disease. Three[44, 50, 206] out of these studies also assessed the relationship with stroke. The remaining study[126] examined the relationship between childhood and adolescent BMI and stroke only. All the studies were done in cohorts from developed countries. Three[124, 126, 175] of the articles were from the Helsinki Birth Cohort based in Finland, three[44, 207, 208] from cohorts based in the United Kingdom, two[132, 206] from cohorts based in the United States, and one each from Norway[50] and Denmark[69].

The two articles[124, 175] from the Helsinki Birth Cohort found that a lower BMI in early childhood was associated with an increased risk of morbidity and mortality due to coronary heart disease in adulthood. This relationship was explained by the rapid gain in weight thereafter. Two[50, 207] out of three studies [44, 50, 207] which had divided the BMI into quartiles of percentiles found that the subjects with the BMI in the highest two quartiles had a significantly higher risk of suffering from a CHD than the subjects in the lower two quartiles. The third study[44] did not find any significant association. Another study[132] did not find any association between childhood and adolescent BMI and the development of CHD in adulthood. The Danish study[69] showed a positive association between the two. The Caerphilly Prospective Study[206] based in UK divided BMI at 18 years into five categories of lowest to highest and found that subjects with the BMI in the highest category had a significantly higher risk of having a coronary event in adulthood as compared to the subjects in the lowest category. The Third Harvard growth study of 1922 to 1935[206] showed a positive relationship between BMI and CHD in males only.

One study[126] showed a positive relationship between lower BMI in childhood (1-7 years) and morbidity and mortality due to stroke in adulthood. This relationship was explained by the rapid weight gain after childhood. Another study[50] showed a positive relationship between the two in the male subjects, but an inverse relationship was seen in the females. The remaining two studies[44, 207] did not show any significant relationship.

Carotid artery intima thickness (cIMT): Fourteen articles (9 cohorts and 1 consortium) studied the relationship of childhood and adolescent BMI vs. carotid intima media thickness in adulthood. The exposures included height, weight, BMI, and triceps skinfold thickness. Eight out of the nine studies were based in developing countries. The remaining study was based in India (New Delhi Birth Cohort).

Pooled analysis of 4 longitudinal studies from HIC showed that childhood overweight or obesity was positively associated with high risk cIMT (>90th percentile) with RR 1.3 and 95% CI 1.1-1.16. Five articles[11, 28, 120, 128, 172] showed a positive association between childhood and adolescent BMI and cIMT levels in adulthood. An article[43] based on the Muscatine Heart Study found that this association was present only in the females. An article[40] based on the 1946 British Birth Cohort had divided BMI into quartiles and only the male subjects in the highest quartile at age 4 had significantly higher cIMT levels. Increase in BMI from 11 years of age to adulthood lead to significant increase in adulthood cIMT levels, but this relationship was inversed by adjusting for adulthood waist circumference in an article[26] based on the New Delhi Birth Cohort. Two articles[12, 181] established that the positive relationship between childhood/adolescent BMI with adulthood cIMT levels was attenuated by adjusting for adult BMI. An article based on the Newcastle Thousand Families Cohort Study established that there was only a weak inverse relationship between childhood BMI and adulthood cIMT levels, after adjusting for adult BMI. Two articles[26, 203] found no relationship between childhood BMI and adulthood cIMT levels. Two articles[128, 203] found a positive association between cumulative BMI from childhood to adulthood and adulthood cIMT levels. The results from two articles established that the subjects who were obese in childhood and remained obese in adulthood had the highest cIMT levels and the subjects who were obese in childhood and became normal weight in adulthood did not have high levels of cIMT.

An article[40] based on the 1946 British Birth cohort found that being shorter at age 4 and gaining less height between ages 2-4 was associated with higher cIMT levels in adulthood. In the New Delhi Birth Cohort[26], a result conflicting with the above was seen. They established that being taller at age 2 and gaining more height between birth to 2 years of age was associated with higher cIMT levels, but this relationship was attenuated by adjusting for adulthood waist circumference.

The Childhood Asthma Prevention Study[146] ascertained that weight gain during infancy was associated with higher cIMT levels in adulthood. The Muscatine Heart Study[43] found that the relationship between childhood weight and adulthood cIMT levels was positive only in girls.

An article based on the Bogalusa Heart Study[172] established that there was a significant positive relationship between childhood triceps skinfold thickness and cIMT levels. The Muscatine Heart Study[43] found this relationship to be positive only in the girls.

Table 4: Table showing the association of childhood and adolescent anthropometric measures with adulthood cardiovascular disease morbidity and mortality

AUTHOR	COHORT	SETTING	NO. OF SUBJECTS/LENGTH OF FOLLOW-UP/CHILDHOOD AGE/ADULTHOOD AGE	EXPOSURES	OUTCOMES MEASURED	EVENT RISK
Park 2013	Three British cohort (1946, 1958 and 1970)	England, Wales and Scotland (1946) United kingdom (1958 and 1970)	11,447 subjectswere followed-up from 7,15 and 43 years of age to 53 years of age (1946) 7,16 and 42 years of age to 46 (1958) 10,16 and 34 years of age to 34 years of age (1970)	BMI (International age- and sex-specific BMI centiles, cut-off points corresponding to overweight (≥25 kg/m²) and obesity (≥30 kg/m²) in adulthood	Coronary heart disease (CHD)	**Association between patterns of overweight in childhood,adolescence and adulthood and CHD outcome (logistic regression analysis)** Overweight — CHD (OR, 95% CI) Never overweight — 1 Childhood only — 0.44 (0.20-1.89) Adolescence only — 1.63 (0.37-7.19) Adulthood only — 3.83 (1.98-7.42) Childhood + Adolescence — 3.43 (0.60-19.64) Childhood + Adulthood — 1.10 (0.14-8.48) Adolescence + Adulthood — 3.74(1.35-10.35) Persistant overweight — 6.62 (1.94-22.65)
JG Eriksson et al, 2001 **175**	Helsinki Birth Cohort (1934-44) (Retrospective cohort)	Helsinki, Finland	4630 men followed up for 27-63 years from the age of 1 year to 27-63 years	BMI	Morbidity and mortality due to coronary heart disease	**Hazard ratios (95% CI) for coronary heart disease according to:** Body mass index at 1 year ≤16 = 1.83 (1.28 to 2.60) 17 = 1.61 (1.15 to 2.25) 18 = 1.29 (0.91 to 1.81) 19 = 1.12 (0.77 to 1.62) >19 = 1.00 *P for trend*= 0.0004
Debbie A. Et al, 2005 **44**	Aberdeen Children of the 1950s Prospective Cohort Study (Birth cohort)	Aberdeen, United Kingdom	11,106 subjects followed up for 22 years from the age of 4-6 year to 31-53 years	BMI	Morbidity and mortality due to coronary heart disease	**Hazard ratio (95% CI) of CHD risk by early childhood Body Mass Index Quarters:** — BMI z score category: **<25th percentile:** Gender adjusted **Hazard ratio (95% CI) of CHD risk by overweight and obese status in early childhood:** — **Normal:** Gender adjusted 1 Fully adjusted

						0.82 (0.57 to 1.18) Fully adjusted 0.82 (0.57 to 1.18) **25th-49th percentile:** Gender adjusted 1.00 Fully adjusted 1.00 **50th-74th percentile:** Gender adjusted 1.33 (0.96 to 1.85) Fully adjusted 1.35 (0.97 to 1.88) **≥75th percentile:** Gender adjusted 0.79 (0.54 to 1.14) Fully adjusted 0.81 (0.55 to 1.17) *P linear* (assessment of a linear increase per 1 z score) Gender adjusted = 0.6 Fully adjusted = 0.7 *P nonlinear* (with inclusion of a quadratic term in the model) Gender adjusted = 0.4 Fully adjusted = 0.4	1 **Overweight:** Gender adjusted 0.97 (0.72 to 1.35) Fully adjusted 0.98 (0.72 to 1.36) **Obese:** Gender adjusted 0.71 (0.36 to 1.39) Fully adjusted 0.78 (0.39 to 1.52) (fully adjusted= adjusted for gender, father's social class at birth, no. of siblings, and birth weight for gestational age z score)
Debbie A. Et al, 2005 **44**	Aberdeen Children of the 1950s Prospective Cohort Study (Birth cohort)	Aberdeen, United Kingdom	11,106 subjects followed up for 22 years from the age of 4-6 year to 31-53 years	BMI	Morbidity and mortality due to coronary heart disease or stroke	**Hazard ratio (95% CI) of CHD or stroke risk by early childhood Body Mass Index Quarters:** BMI z score category: **<25th percentile:** Gender adjusted	**Hazard ratio (95% CI) of CHD or stroke risk by overweight and obese status in early childhood:** **Normal:** Gender adjusted 1 Fully adjusted

						0.86 (0.62 to 1.18) <u>Fully adjusted</u> 0.85 (0.62 to 1.18) **25^{th}-49^{th} percentile:** <u>Gender adjusted</u> 1.00 <u>Fully adjusted</u> 1.00 **50^{th}-74^{th} percentile:** <u>Gender adjusted</u> 1.33 (1.00 to 1.79) <u>Fully adjusted</u> 1.36 (1.01 to 1.82) **$\geq 75^{th}$ percentile:** <u>Gender adjusted</u> 0.93 (0.68 to 1.28) <u>Fully adjusted</u> 0.97 (0.70 to 1.33) *P linear* (assessment of a linear increase per 1 z score) <u>Gender adjusted</u> = 0.6 <u>Fully adjusted</u> = 0.5 *P nonlinear* (with inclusion of a quadratic term in the model) <u>Gender adjusted</u> = 0.4 <u>Fully adjusted</u> = 0.3	1 **Overweight:** <u>Gender adjusted</u> 0.96 (0.73 to 1.27) <u>Fully adjusted</u> 0.97 (0.73 to 1.29) **Obese:** <u>Gender adjusted</u> 1.08 (0.56 to 2.08) <u>Fully adjusted</u> 1.25 (0.65 to 2.40) (fully adjusted= adjusted for gender, father's social class at birth, no. of siblings, and birth weight for gestational age z score)	

Tone Bjørge et al, 2008 **50**	Norwegian population	Norway	226,678 subjects (114,977 males and 111,701 females) followed up for 34.9 years (average) from the age of 14-19 years to 49-54 years	BMI	Mortality due to ischemic heart disease	**Relative risk (95% CI) of mortality due to ischemic heart disease, adjusted for age and birth year, by body mass index in adolescence:** **<25th percentile:** <u>Males</u> 1.0 (0.8 to 1.2) <u>Females</u> 1.0 (0.5 to 1.7) **25th-74th percentile:** <u>Males</u> 1.0 <u>Females</u> 1.0 **75th-84th percentile:** <u>Males</u> 1.8 (1.5 to 2.3) <u>Females</u> 2.1 (1.3 to 3.4) **≥85th percentile:** <u>Males</u> 2.9 (2.3 to 3.6) <u>Females</u> 3.7 (2.3 to 5.7) *P value* <u>Males</u> = <0.001 <u>Females</u> = <0.001

Jennifer l. Baker et al, 2007 **69**	Danish birth cohort (1930-76)	Copenhagen, Denmark	276, 835 subjects followed up for 18 to 53 years from the age of 7-13 years to 25-60 years	BMI	Morbidity and mortality due to coronary heart diseases	**Hazard ratio [OR (95% CI)] for the risk of a fatal or a nonfatal CHD even in adulthood in relation to a 1-Unit increase in BMI z score:** **Age of boys:** <u>7 years</u> 1.06 (1.04 to 1.08) <u>13 years</u> 1.17 (1.15 to 1.20) **Age of girls:** <u>7 years</u> 1.02 (0.99 to 1.06) <u>13 years</u> 1.12 (1.09 to 1.16)
John A. Morrison et al, 2007 **132**	NHLBI lipid research clinics (LRC) Princeton prevalence study and Princeton follow up study	United States	771 subjects followed up for 25-30 years from the age of 6-19 years to 30-48 years	BMI	Risk of cardiovascular diseases (CVD)	**Risk of development of CVD by change in BMI percentile:** *P value* >0.5
JG Eriksson, 2006 **124**	Helsinki Birth Cohort (1934-44) (Retrospective cohort)	Helsinki, Born 1934-1944	4630 Men and 4130 women followed up for 37-64 years from the age of 0-12 to 37-64 years	BMI	Hospital admission or death from coronary heart disease	**Hazard ratios [OR (95% CI)] for CHD according to BMI at 2 and 11 years:** **BMI at 2 years: 16** <u>BMI at 11 years:</u> <u>16</u> 1.6 (0.8 to 3.3) <u>17.5</u> 2.4 (1.2 to 4.9) <u>>17.5</u> 3.0 (1.4 to 6.3) **BMI at 2 years: 17** <u>BMI at 11 years:</u> <u>16</u> 1.4 (0.7 to 3.1) <u>17</u> 1.6 (0.8 to 3.3) <u>>17.5</u> 1.9 (0.9 to 3.9)

						BMI at 2 years: **>17** BMI at 11 years: 16 1.0 17 1.3 (0.6 to 2.7) ≥17.5 1.1 (0.5 to 2.3)
David J Gunnell et al, 1998 **207**	Boyd Orr Cohort	United Kingdom	1165 men and 1234 women followed up for 57 years from the age of 2 years-14.9 years to 59-71 years	BMI	Mortality due to cardiovascular disease	**Hazard ratios (95% CI) for cardiovascular disease by percentile category of BMI:** **<25th percentile:** 1.1 (0.7 to 1.6) **25th-49th percentile:** 1.0 **50th-75th percentile:** 1.6 (1.1 to 2.5) **>75th percentile:** 1.6 (0.9 to 2.7) *P for linear term*= 0.05 *P for quadratic term*= 0.12 (values adjusted for age, height, and childhood and adulthood socioeconomic factors)

Hazard ratios (95% CI) for cardiovascular disease by percentile category of BMI for persons aged <8 years:	**Hazard ratios (95% CI) for cardiovascular disease by percentile category of BMI for persons aged ≥8 years:**
<25th percentile: 1.6 (0.7 to 3.3) **25th-49th percentile:** 1.0 **50th-75th percentile:** 1.2 (0.6 to 2.4) **≥75th percentile:** 1.6 (0.8 to 3.6) *P for linear term*= 0.83 *P for quadratic term*= 0.03	**<25th percentile:** 0.9 (0.5 to 1.4) **25th-49th percentile:** 1.0 **50th-75th percentile:** 1.8 (1.1 to 3.0) **≥75th percentile:** 1.1 (0.4 to 3.1) *P for linear term*= 0.03 *P for quadratic term*= 0.31

David J Gunnell et al, 1998 **207**	Boyd Orr Cohort	United Kingdom	1165 men and 1234 women followed up for 57 years from the age of 2 years-14.9 years to 59-71 years	BMI	Mortality due to ischemic heart disease	**Hazard ratios (95% CI) for ischemic heart disease by percentile category of BMI:** **<25th percentile:** 1.2 (0.7 to 2.0) **25th-49th percentile:** 1.0 **50th-75th percentile:** 2.1 (1.3 to 3.6) **>75th percentile:** 2.0 (1.0 to 3.9) *P for linear term*= 0.02 *P for quadratic term*= 0.014 (values adjusted for age, height, and childhood and adulthood socioeconomic factors) **Hazard ratios (95% CI) for cardiovascular disease by percentile category of BMI for persons aged <8 years:** **<25th percentile:** 1.5 (0.6 to 4.1) **25th-49th percentile:** 1.0 **50th-75th percentile:** 1.3 (0.5 to 3.3) **≥75th percentile:** 1.9 (0.7 to 5.0) *P for linear term*= 0.50 *P for quadratic term*= 0.03 **Hazard ratios (95% CI) for cardiovascular disease by percentile category of BMI for persons aged ≥8 years:** **<25th percentile:** 1.0 (0.5 to 1.8) **25th-49th percentile:** 1.0 **50th-75th percentile:** 2.4 (1.3 to 4.5) **≥75th percentile:** 1.7 (0.6 to 5.3) *P for linear term*= 0.01 *P for quadratic term*= 0.31

David J Gunnell et al, 1998 **207**	Boyd Orr Cohort	United Kingdom	1165 men and 1234 women followed up for 57 years from the age of 2 years-14.9 years to 59-71 years	BMI	Mortality due to stroke	**Hazard ratios (95% CI) for stroke by percentile category of BMI:** **<25th percentile:** 0.9 (0.3 to 2.4) **25th-49th percentile:** 1.0 **50th-75th percentile:** 0.5 (0.1 to 1.7) **>75th percentile:** 1.3 (0.3 to 5.0) *P for linear term*= 0.35 *P for quadratic term*= 0.41 (values adjusted for age, height, and childhood and adulthood socioeconomic factors) **Hazard ratios (95% CI) for cardiovascular disease by percentile category of BMI for persons aged <8 years:** **<25th percentile:** 0.4 (0.0 to 4.1) **25th-49th percentile:** 1.0 **50th-75th percentile:** 0.3 (0.0 to 3.1) **≥75th percentile:** 0.9 (0.1 to 6.1) *P for linear term*= 0.56 *P for quadratic term*= 0.38 **Hazard ratios (95% CI) for cardiovascular disease by percentile category of BMI for persons aged ≥8 years:** **<25th percentile:** 1.0 (0.3 to 3.1) **25th-49th percentile:** 1.0 **50th-75th percentile:** 0.5 (0.1 to 2.4) **≥75th percentile:** 1.0 (0.1 to 9.8) *P for linear term*= 0.37 *P for quadratic term*= 0.39

Aviva Must et al, 1992 **206**	Third Harvard growth study of 1922 to 1935	United States	508 subjects followed up for 55 years from the age of 13-18 years to 68-73 years	BMI	Mortality due to coronary heart disease	**Relative risk (95% CI) of CHD mortality associated with overweight in adolescence:** **Men:** 2.3 (1.4 to 4.1) *P for trend*= 0.002 **Women:** 0.8 (0.3 to 2.1)
John WG Yarnell et al, 2000 **208**	Caerphilly Prospective Study	United Kingdom	2335 men aged 45 to 59 years were asked to recall their weight at age 18 years and were then followed up for 14 years	BMI	Morbidity or mortality due to coronary events	**Relative odds of mortality due to coronary events in the 14 years after screening in fifths of the distribution of BMI at 18 years:** BMI<20.1: 1.00 BMI 20.1 to 21.5: 0.94 (0.67 to 1.32) BMI 21.6 to 22.7: 0.89 (0.63 to 1.25) BMI 22.8 to 24.1: 1.03 (0.74 to 1.45) BMI ≥24.2: 1.29 (0.93 to 1.79) **Relative odds of morbidity due to coronary events in the 14 years after screening in fifths of the distribution of BMI at 18 years:** BMI<20.1: 1.00 BMI 20.1 to 21.5: 1.41 (0.97 to 2.04) BMI 21.6 to 22.7: 1.12 (0.76 to 1.63) BMI 22.8 to 24.1: 1.43 (0.99 to 2.06) BMI ≥24.2: 1.73 (1.21 to 2.48) (relative odds adjusted for age, smoking habit and social class)
Tone Bjørge et al, 2008 **50**	Norwegian population	Norway	226,678 subjects (114,977 males and 111,701 females) followed up for 34.9 years (average) from the age of 14-19 years to 49-54 years	BMI	Mortality due to cerebrovascular disease	**Relative risk (95% CI) of mortality due to cerebrovascular disease, adjusted for age and birth year, by body mass index in adolescence:** **<25th percentile:** Males 1.2 (0.9 to 1.7) Females 1.7 (1.2 to 2.5) **25th-74th percentile:** Males 1.0 Females 1.0 **75th-84th percentile:**

						Males 1.2 (0.7 to 2.0) Females 1.1 (0.6 to 1.8) **≥85th percentile:** Males 1.9 (1.2 to 3.2) Females 1.5 (0.9 to 2.6) *P value* Males = 1.0 Females = 0.2
Debbie A. Et al, 2005 **44**	Aberdeen Children of the 1950s Prospective Cohort Study (Birth cohort)	Aberdeen, United Kingdom	11,106 subjects followed up for 22 years from the age of 4-6 year to 31-53 years	BMI	Morbidity and mortality due to stroke	<table><tr><td>**Hazard ratio (95% CI) of stroke risk by early childhood Body Mass Index Quarters:**</td><td>**Hazard ratio (95% CI) of stroke risk by overweight and obese status in early childhood:**</td></tr></table>

						BMI z score category: **<25th percentile:** <u>Gender adjusted</u> 1.04 (0.56 to 1.93) <u>Fully adjusted</u> 1.03 (0.56 to 1.90) **25th-49th percentile:** <u>Gender adjusted</u> 1.00 <u>Fully adjusted</u> 1.00 **50th-74th percentile:** <u>Gender adjusted</u> 1.33 (0.75 to 2.38) <u>Fully adjusted</u> 1.37 (0.75 to 2.38) **≥75th percentile:** <u>Gender adjusted</u> 1.27 (0.70 to 2.27) <u>Fully adjusted</u> 1.34 (0.74 to 2.46) *P linear* (assessment of a linear increase per 1 z score) <u>Gender adjusted</u> = 0.2 <u>Fully adjusted</u> = 0.08 *P nonlinear* (with inclusion of a quadratic term in the model) <u>Gender adjusted</u> = 0.4 <u>Fully adjusted</u> = 0.3	**Normal:** <u>Gender adjusted</u> 1 <u>Fully adjusted</u> 1 **Overweight:** <u>Gender adjusted</u> 0.80 (0.46 to 1.42) <u>Fully adjusted</u> 0.82 (0.47 to 1.44) **Obese:** <u>Gender adjusted</u> 2.38 (0.98 to 5.78) <u>Fully adjusted</u> 2.41 (1.00 to 5.86) (fully adjusted= adjusted for gender, father's social class at birth, no. of siblings, and birth weight for gestational age z score)	

Osmond C et al., 2007 **126**	Helsinki Birth Cohort (1934-44) (Retrospective cohort)	Helsinki, Finland	12439 subjects (6489 men and 5950 women) followed up for 27-60 years from the age of 0-11 years to 27-60 years	BMI	Morbidity or mortality due to Stroke	**Hazard ratios [OR (95% CI)] for stroke according to SD increase in BMI at:** <u>Age 1 year:</u> 0.88 (0.81 to 0.96) <u>Age 2 years:</u> 0.84 (0.77 to 0.92) <u>Age 7 years:</u> 0.85 (0.76 to 0.94) <u>Age 11 years:</u> 0.95 (0.85 to 1.05)
Aviva Must et al, 1992 **206**	Third Harvard growth study of 1922 to 1935	United States	508 subjects followed up for 55 years from the age of 13-18 years to 68-73 years	BMI	Mortality due to atherosclerotic cerebrovascular disease	**Relative risk (95% CI) of CHD mortality associated with overweight in adolescence:** **Men:** 13.2 (1.6 to 108.0) *P for trend*= 0.002 **Women:** 0.4 (0.1 to 1.8)
Laurel et al,2006	Three historical cohorts	Boyd orr cohort (BO), Christs hospital school(CH), Glasgow university(GA)	14,831 subjects were followed up from2-15 years(BO), 15-18yrs(CH), 16-18yrs (GA) of age to 50 yrs of age	BMI	Stroke, Ischemic heart disease(IHD)	When studies were pooled No significant for stroke mortality For IHD, HR of 1.09(95%CI 1.01 -1.19) per BMI Z – score But comparing overweight/ obese to normal weight the HRs were non significant (Not adjusted for adult BMI)
JG Eriksson et al, 2001 **175**	Helsinki Birth Cohort (1934-44) (Retrospective cohort)	Helsinki, Finland	4630 men followed up for 27-63 years from the age of 1 year to 27-63 years	Weight	Morbidity and mortality due to coronary heart disease	**Hazard ratios (95% CI) for coronary heart disease according to:** <u>Weight at 1 year</u> ≤9 = 1.82 (1.25 to 2.64) 10 = 1.17 (0.80 to 1.71) 11 = 1.12 (0.77 to 1.64) 12 = 0.94 (0.62 to 1.44) >12 = 1.00 *P for trend*= <0.0001

Osmond C et al., 2007 **126**	Helsinki Birth Cohort (1934-44) (Retrospective cohort)	Helsinki, Finland	12439 subjects (6489 men and 5950 women) followed up for 27-60 years from the age of 0-11 years to 27-60 years	Weight	Morbidity or mortality due to Stroke	**Hazard ratios (95% CI) for stroke according to SD increase in weight at:** Age 1 year: 0.87 (0.79 to 0.95) Age 2 years: 0.83 (0.76 to 0.91) Age 7 years: 0.88 (0.79 to 0.91) Age 11 years: 0.96 (0.86 to 1.06)
JG Eriksson et al, 2001 **175**	Helsinki Birth Cohort (1934-44) (Retrospective cohort)	Helsinki, Finland	4630 men followed up for 27-63 years from the age of 1 year to 27-63 years	Height	Morbidity and mortality due to coronary heart disease	**Hazard ratios (95% CI) for coronary heart disease according to:** Height at 1 year ≤73 = 1.55 (1.11 to 2.18) 75 = 0.90 (0.63 to 1.27) 77 = 0.94 (0.68 to 1.18) 79 = 0.83 (0.58 to 1.18) >79 = 1.00 *P for trend*= 0.007
Osmond C et al., 2007 **126**	Helsinki Birth Cohort (1934-44) (Retrospective cohort)	Helsinki, Finland	12439 subjects (6489 men and 5950 women) followed up for 27-60 years from the age of 0-11 years to 27-60 years	Height	Morbidity or mortality due to Stroke	**Hazard ratios (95% CI) for stroke according to SD increase in height at:** Age 1 year: 0.93 (0.85 to 1.01) Age 2 years: 0.92 (0.85 to 1.01) Age 7 years: 0.95 (0.86 to 1.05) Age 11 years: 0.97 (0.88 to 1.07)

Table 5: Table showing the association of childhood and adolescent anthropometric measures with adulthood cardiovascular disease morbidity and mortality

AUTHOR	COHORT	SETTING	NO. OF SUBJECTS/ LENGTH OF FOLLOW-UP/ CHILDHOOD AGE/ ADULTHOOD AGE	EXPOSURES	OUTCOMES MEASURED	EFFECT SIZE
Markus Juonala et al, 2010 **11**	Young Finns study	Finland	1,809 subjects were followed up for 27 years from the age of 3-18 years to 24-39 years	BMI (childhood overweight was defined as BMI between 80^{th} and 90^{th} percentile and obesity as $>90^{th}$ percentile; Adulthood overweight was defined as BMI between 25 and 30 kg/m^2 and obesity as >30 kg/m^2)	Progression of cIMT over 6 years in adulthood [measurement taken from posterior (far) wall of each common carotid artery]	**Relationship between childhood BMI and 6-year change in carotid IMT:** Multivariate model for associations between childhood BMI and IMT progression β= 5 95% CI= 1 to 9 *P value*= 0.047 Multivariate model for associations between childhood BMI and IMT progression, taking also into account the effects of adulthood BMI β= 0.6 95% CI= -5 to 5 *P value*= 0.82
Markus Juonala et al, 2005 **12**	Young Finns study	Finland	2,206 subjects were followed up for 21 years from the age of 3-18 years to 24-39 years	BMI (childhood overweight was defined as BMI between 80^{th} and 90^{th} percentile and obesity as $>90^{th}$ percentile; Adulthood overweight was defined as BMI between 25 and 30 kg/m^2 and obesity as >30 kg/m^2)	cIMT [measurement taken from posterior (far) wall of each common carotid artery]	**Adult IMT (mm) according to obesity status from youth to adulthood (adjusted for age and sex):** Obesity status Youth: lean ($BMI<50^{th}$) Adulthood: normal weight (BMI<25) 0.610 (0.603-0.616) Youth: lean ($BMI<50^{th}$) Adulthood: overweight or obese (BMI≥25) 0.634* (0.624-0.644) Youth: overweight or obese ($BMI>80^{th}$) Adulthood: normal weight (BMI<25) 0.627 (0.610-0.644) Youth: overweight or obese ($BMI>80^{th}$) Adulthood: overweight or obese (BMI≥25) 0.642* (0.632-0.652) *groups differ significantly from the first group (lean in youth and normal weight in adulthood) *Overall P value* <0.0001

Markus Juonala et al, 2005 **12**	Young Finns study	Finland	2,206 subjects were followed up for 21 years from the age of 3-18 years to 24-39 years	BMI (childhood overweight was defined as BMI between 80th and 90th percentile and obesity as >90th percentile; Adulthood overweight was defined as BMI between 25 and 30 kg/m² and obesity as >30 kg/m²)	cIMT [measurement taken from posterior (far) wall of each common carotid artery]	**Association (correlation coefficient) between childhood and adolescent BMI and adulthood cIMT according to age in childhood, adolescence and adulthood (unadjusted):** 3 years to 24 years: 0.06 6 years to 27 years: 0.06 9 years to 30 years: 0.05 12 years to 33 years: 0.18 *P value* <0.001 15 years to 36 years: 0.09 18 years to 39 years: 0.12 *P value* <0.05	**Association (correlation coefficient) between childhood and adolescent BMI and adulthood cIMT according to age in childhood, adolescence and adulthood (adjusted for adulthood BMI):** 3 years to 24 years: -0.01 6 years to 27 years: -0.02 9 years to 30 years: -0.08 12 years to 33 years: 0.05 15 years to 36 years: 0.02 18 years to 39 years: 0.03
Anita Khalil et al, 2013 **26**	New Delhi birth cohort (retrospective birth cohort)	New Delhi, India	600 subjects were followed up for 34 years from the age of 2 years to 36 years	BMI	cIMT [measurement taken from posterior (far) wall of each common carotid artery]	**Association [regression coefficient (95% CI)] between childhood BMI and mean cIMT (adjusted for age and sex):** 2 years: 0.06 (-0.04 to 0.16) *P value*= 0.2 After additional adjustment for adult waist circumference 0.00 (-0.10 to 0.10) *P value*= 1.0 11 years: 0.06 (-0.04 to 0.16) *P value*= 0.2 After additional adjustment	**Association [regression coefficient (95% CI)] between change in childhood conditional BMI and mean cIMT (adjusted for age and sex):** 0-2 years: 0.06 (-0.04 to 0.16) *P value*= 0.3 After additional adjustment for adult waist circumference 0.00 (-0.10 to 0.11) *P value*= 0.9 2-11 years: -0.02 (-0.12 to 0.08) *P value*= 0.4 After additional adjustment

						for adult waist circumference -0.10 (-0.22 to 0.01) *P value*= 0.08	for adult waist circumference -0.11 (-0.23 to 0.00) *P value*= 0.05 <u>11 years-adulthood:</u> 0.22 (0.11 to 0.32) *P value* <0.001 After additional adjustment for adult waist circumference 0.03 (-0.12 to 0.18) *P value*= 0.7
DS Freedman et al, 2008 **28**	Bogalusa Heart Study	United States	1,142 subjects were followed up for 7-28 years from the age of 2-19 years to 23-43 years	BMI (childhood BMI assessed as per the 2000 CDC Growth Charts; Adulthood overweight defined as BMI between 25-29 kg/m^2 and obese as ≥30 kg/m^2)	cIMT (measurements taken from far and near walls of each internal carotid artery, common carotid artery and bifurcation of carotid artery)	**Correlation (Pearson correlation coefficient) between mean carotid IMT and initial childhood BMI:** 0.13 *P value* <0.0001 **Correlation (Pearson correlation coefficient) between mean carotid IMT and cumulative level of BMI throughout childhood:** 0.15 *P value* <0.0001 (values have been adjusted for sex, race and final adult age)	
William Johnson et al, 2014 **40**	1946 British Birth Cohort	United Kingdom	604 men and 669 women were followed up for 58 to 62 years from the age of 2 years to 60-64 years	BMI (childhood overweight and obesity defined as per the guidelines of the International Obesity Taskforce; Adulthood overweight was defined as BMI between 25-29 kg/m^2 and obesity as BMI ≥30 kg/m^2)	cIMT (measurement taken from each common carotid artery)	**Odds ratios (95% CI) of BMI for cIMT at 60 to 64 years in the Upper Quartile vs. Lower 3 Quartiles for males:** <u>BMI z score at 2 years:</u> 1.137 (0.918 to 1.408) *P value*= 0.2 <u>BMI z score at 4 years:</u> 1.256 (1.026 to 1.538) *P value*= 0.03 <u>BMI z score at 6 years:</u> 1.189 (0.956 to 1.479) *P value*= 0.1 <u>BMI z score at 7 years:</u> 0.989 (0.787 to 1.245) *P value*= 0.9 <u>BMI z score at 11 years:</u> 1.058 (0.863 to 1.245)	**Odds ratios (95% CI) of BMI for cIMT at 60 to 64 years in the Upper Quartile vs. Lower 3 Quartiles for females:** <u>BMI z score at 2 years:</u> 1.106 (0.901 to 1.357) *P value*= 0.3 <u>BMI z score at 4 years:</u> 0.992 (0.818 to 1.204) *P value*= 0.9 <u>BMI z score at 6 years:</u> 0.954 (0.774 to 1.176) *P value*= 0.7 <u>BMI z score at 7 years:</u> 0.881 (0.720 to 1.078) *P value*= 0.2 <u>BMI z score at 11 years:</u> 0.941 (0.772 to 1.147)

						P value= 0.6 BMI z score at 15 years: 1.204 (0.958 to 1.512) *P value*= 0.1	*P value*= 0.5 BMI z score at 15 years: 0.947 (0.762 to 1.176) *P value*= 0.6
						Odds ratios (95% CI) of BMI change for cIMT at 60 to 64 years in the Upper Quartile vs. Lower 3 Quartiles for males:	**Odds ratios (95% CI) of BMI change for cIMT at 60 to 64 years in the Upper Quartile vs. Lower 3 Quartiles for females:**
						BMI z score changes 2-4 y: 1.173 (0.933 to 1.476) *P value*= 0.2 BMI z score changes 4-7 y: 0.856 (0.660 to 1.109) *P value*= 0.2 BMI z score changes 7-15 y: 1.267 (0.950 to 1.689) *P value*= 0.1 BMI z score changes 15-20 y: 1.283 (0.910 to 1.808) *P value*= 0.2	BMI z score changes 2-4 y: 1.017 (0.810 to 1.275) *P value*= 0.9 BMI z score changes 4-7 y: 0.842 (0.661 to 1.074) *P value*= 0.2 BMI z score changes 7-15 y: 0.972 (0.732 to 1.290) *P value*= 0.8 BMI z score changes 15-20 y: 1.174 (0.854 to 1.615) *P value*= 0.3
William Johnson et al, 2014 **40**	1946 British Birth Cohort	United Kingdom	604 men and 669 women were followed up for 58 to 62 years from the age of 2 years to 60-64 years	Height	cIMT (measurement taken from each common carotid artery)	**Odds ratios (95% CI) of height for cIMT at 60 to 64 years in the Upper Quartile vs. Lower 3 Quartiles for males:**	**Odds ratios (95% CI) of height for cIMT at 60 to 64 years in the Upper Quartile vs. Lower 3 Quartiles for females:**
						Height z score at 2 years: 0.890 (0.718 to 1.102) *P value*= 0.3 Height z score at 4 years: 0.780 (0.631 to 0.964) *P value*= 0.02 Height z score at 6 years: 0.874 (0.706 to 1.082) *P value*= 0.2 Height z score at 7 years: 0.950 (0.766 to 1.178) *P value*= 0.6 Height z score at 11 years: 1.039 (0.841 to 1.283) *P value*= 0.7	Height z score at 2 years: 0.998 (0.815 to 1.222) *P value* >0.9 Height z score at 4 years: 0.982 (0.805 to 1.198) *P value*= 0.9 Height z score at 6 years: 1.072 (0.870 to 1.320) *P value*= 0.5 Height z score at 7 years: 1.061 (0.864 to 1.301) *P value* >0.6 Height z score at 11 years: 0.941 (0.772 to 1.147) *P value* >0.9

						<table><tr><td><u>Height z score at 15 years:</u> 1.022 (0.826 to 1.265) *P value*= 0.8</td><td><u>Height z score at 15 years:</u> 1.087 (0.893 to 1.324) *P value*= 0.4</td></tr><tr><td>**Odds ratios (95% CI) of height change for cIMT at 60 to 64 years in the Upper Quartile vs. Lower 3 Quartiles for males:**</td><td>**Odds ratios (95% CI) of height change for cIMT at 60 to 64 years in the Upper Quartile vs. Lower 3 Quartiles for females:**</td></tr><tr><td><u>Height z score changes 2-4 y:</u> 0.698 (0.534 to 0.913) *P value*= 0.009 <u>Height z score changes 4-7 y:</u> 1.280 (0.934 to 1.752) *P value*= 0.1 <u>Height z score changes 7-15 y:</u> 1.192 (0.842 to 1.690) *P value*= 0.3 <u>Height z score changes 15-20 y:</u> 0.798 (0.588 to 1.082) *P value*= 0.1</td><td><u>Height z score changes 2-4 y:</u> 1.036 (0.813 to 1.322) *P value*= 0.8 <u>Height z score changes 4-7 y:</u> 1.099 (0.810 to 1.490) *P value*= 0.5 <u>Height z score changes 7-15 y:</u> 0.851 (0.603 to 1.201) *P value*= 0.4 <u>Height z score changes 15-20 y:</u> 1.341 (0.854 to 2.107) *P value*= 0.2</td></tr></table>
Patricia H Davis et al, 2001 **43**	Muscatine Heart study	United States	346 men and 379 women were followed up for 25 years (average) from the age of 8-18 years to 33-42 years	BMI (childhood BMI assessed as per the 2000 CDC Growth Charts; Adulthood overweight defined as BMI between 25-29 kg/m² and obese as ≥30 kg/m²)	cIMT (measurements taken from far and near walls of each internal carotid artery, common carotid artery and bifurcation of carotid artery)	**Univariate spearman rank correlation coefficients for cIMT with childhood BMI:** <u>Males:</u> 0.09 <u>Females:</u> 0.18 *P value* <0.001 **Multivariate Odds ratio of BMI for cIMT in the Upper Quartile vs. Lower Three Quartiles in women:** **Childhood BMI** OR= 1.47 95% CI= 1.14 to 1.89 SD= 3.4 **BMI tracking from childhood to adulthood:** OR= 1.41 95% CI= 1.06 to 1.89 SD= 0.83

Patricia H Davis et al, 2001 **43**	Muscatine Heart study	United States	346 men and 379 women were followed up for 25 years (average) from the age of 8-18 years to 33-42 years	Weight	cIMT (measurements taken from far and near walls of each internal carotid artery, common carotid artery and bifurcation of carotid artery)	**Univariate spearman rank correlation coefficients for cIMT with childhood weight:** Males: 0.06 Females: 0.17 *P value* <0.001
Anita Khalil et al, 2013 **26**	New Delhi birth cohort (retrospective birth cohort)	New Delhi, India	600 subjects were followed up for 34 years from the age of 2 years to 36 years	Height	cIMT [measurement taken from posterior (far) wall of each common carotid artery]	<table><tr><th>Association [regression coefficient (95% CI)] between childhood height and mean cIMT (adjusted for age and sex):</th><th>Association [regression coefficient (95% CI)] between change in childhood conditional height and mean cIMT (adjusted for age and sex):</th></tr><tr><td>2 years: 0.12 (0.02 to 0.22) P value= 0.02 After additional adjustment for adult waist circumference 0.05 (-0.05 to 0.15) P value= 0.3 11 years: 0.06 (-0.04 to 0.16) P value= 0.2 After additional adjustment for adult waist circumference -0.02 (-0.13 to 0.08) P value= 0.7</td><td>0-2 years: 0.13 (0.03 to 0.23) P value= 0.01 After additional adjustment for adult waist circumference 0.06 (-0.04 to 0.16) P value- 0.3 2-11 years: -0.02 (-0.12 to 0.08) P value= 0.7 After additional adjustment for adult waist circumference -0.08 (-0.18 to 0.03) P value= 0.2 11 years-adulthood: -0.05 (-0.15 to 0.06) P value= 0.4 After additional adjustment for adult waist circumference -0.05 (-0.15 to 0.06) P value= 0.4</td></tr></table>
Patricia H Davis et al,	Muscatine Heart study	United States	346 men and 379 women were followed up for 25	Triceps skinfold thickness	cIMT (measurements	**Univariate spearman rank correlation coefficients for cIMT with childhood triceps skinfold thickness:**

2001 **43**			years (average) from the age of 8-18 years to 33-42 years		taken from far and near walls of each internal carotid artery, common carotid artery and bifurcation of carotid artery)	Males: 0.04 Females: 0.09 *P value* <0.05
Charlotte M Wright et al, 2001 **46**	Newcastle thousand families cohort study (birth cohort)	United Kingdom	412 subjects were followed for 41 years from the age of 9 years to 50 years	BMI (childhood BMI assessed as per body mass index reference curves for UK, 1990; Adulthood overweight defined as BMI between 24-29 kg/m^2 and obese as BMI≥30 kg/m^2)	cIMT (measurements taken from each internal and common carotid artery)	**Association (standardized regression coefficients) between BMI at ages 9 and 13 years in childhood and cIMT at age 50:** Males: BMI age 9 -0.11 BMI age 13 -0.07 Females: BMI age 9 -0.02 BMI age 13 0.10 (values adjusted for body mass index at age 50)
OT Raitakari et al, 2003 **120**	Young Finns Study	Finland	2,229 subjects were followed up for 12 years from the age of 12-18 years to 24-39 years	BMI (childhood overweight was defined as BMI between 80th and 90th percentile and obesity as >90th percentile; Adulthood overweight was defined as BMI between 25 and 30 kg/m^2 and obesity as >30 kg/m^2)	Progression of cIMT over 6 years in adulthood [measurement taken from posterior (far) wall of each common carotid artery]	**Multivariate analysis of relationship between adolescent BMI and cIMT measured in adulthood:** Regression coefficient: 0.009 SE: 0.003 *P value*= 0.007 (adjusted for age and sex)
Shengxu Li et al, 2003 **128**	Bogalusa Heart Study	United States	486 subjects were followed up for 14.0-23.3 years from the age 4-17 years to 25-37 years	BMI (childhood BMI assessed as per the 2000 CDC Growth Charts; Adulthood overweight defined as BMI between 25-	cIMT (measurements taken from far and near walls of each internal carotid artery, common carotid artery and bifurcation of	**Pearson correlation coefficients of cIMT in young adults with childhood BMI:** 0.162 *P value* <0.001 **Pearson correlation coefficients of cIMT in young adults with cumulative (childhood to adulthood) BMI:** 0.180 *P value* <0.001

				29 kg/m² and obese as ≥30 kg/m²)	carotid artery]	**Odds ratios (95% CI) of childhood BMI for cIMT in young adults in the Upper Quartile vs. Lower 3 Quartiles:** 1.25 (1.01 to 1.54) **Odds ratios (95% CI) of cumulative (childhood to adulthood) BMI for cIMT in young adults in the Upper Quartile vs. Lower 3 Quartiles:** 1.16 (0.92 to 1.46)
Ta-Chen Su et al, 2014 **145**	Young Taiwanese Cohort (YOTA) Study	Taiwan	789 subjects were followed up for 6-14 years from the age of 6-18 years to ~30 years	BMI (childhood overweight was defined as BMI between 85th and 94th percentile and obesity as ≥95th percentile; Adulthood overweight was defined as BMI between 24 and 26.99 kg/m² and obesity as >27 kg/m² as per the Taiwan Department of Health)	cIMT (measurements taken from far wall of each internal carotid artery, common carotid artery and bifurcation of carotid artery)	**Multivariate logistic regression analysis of determinants of cIMT≥75th percentile:** <u>Childhood overweight/obesity & adulthood obesity:</u> OR (95% CI)= 4.17 (2.21 to 7.85) *P value* <0.001 <u>Childhood overweight/obesity & adulthood overweight:</u> OR (95% CI)= 2.82 (1.26 to 6.28) *P value*= 0.011 <u>Childhood overweight/obesity & adulthood normal weight:</u> OR (95% CI)= 2.07 (0.91 to 4.71) *P value*= 0.083 <u>Childhood normal weight & adulthood obesity:</u> OR (95% CI)= 1.32 (0.51 to 3.44) *P value*= 0.567 <u>Childhood normal weight & adulthood overweight:</u> OR (95% CI)= 1.67 (0.94 to 2.99) *P value*= 0.083 <u>Childhood normal weight & adulthood normal weight:</u> 1.0
Michael R. Skilton et al, 2013 **146**	Childhood Asthma Prevention Study (birth cohort)	Australia	395 subjects were followed up for 8 years from birth to 8 years	Weight	cIMT (measurement taken from each common carotid artery)	**Association between height-adjusted weight gain from 0-18 months to cIMT:** <u>Unstandardized β-regression coefficient (95% CI)</u> 0.012 (0.004 to 0.019) *P value*= 0.002
DS Freedman et al, 2004 **172**	Bogalusa Heart Study	United States	513 subjects were followed up for 24 years (average) from the age of 4-18 years to 20-37 years	BMI (childhood BMI assessed as per the 2000 CDC Growth Charts; Adulthood overweight defined as BMI between 25-29 kg/m² and obese as ≥30 kg/m²)	cIMT (measurements taken from far and near walls of each internal carotid artery, common carotid artery and bifurcation of carotid artery)	see nested table below

Mean levels of BMI (adjusted for age, sex and race) by age and IMT group:	Mean levels of BMI z score (adjusted for age, sex and race) by age and IMT group:
IMT group: low <u>Age <11:</u> 16.6 <u>Age 11-14:</u> 18.7 <u>Age 15-18:</u> 20.9 **IMT group: intermediate** <u>Age <11:</u> 16.8 <u>Age 11-14:</u> 19.6	**IMT group: low** <u>Age <11:</u> -0.1 <u>Age 11-14:</u> -0.3 <u>Age 15-18:</u> -0.2 **IMT group: intermediate** <u>Age <11:</u> -0.1 <u>Age 11-14:</u> 0

						Age 15-18: 21.7 **IMT group: high** Age <11: 17.3 Age 11-14: 22.0 (r= 0.15) *P value* <0.01 Age 15-18: 24.7 (r=0.22) *P value* <0.001 — Age 15-18: 0 **IMT group: high** Age <11: +0.4 (r= 0.10) *P value* <0.05 Age 11-14: +0.6 (r= 0.15) *P value* <0.01 Age 15-18: +0.6 (r=0.22) *P value* <0.001
DS Freedman et al, 2004 **172**	Bogalusa Heart Study	United States	513 subjects were followed up for 24 years (average) from the age of 4-18 years to 20-37 years	Triceps skinfold thickness	cIMT (measurements taken from far and near walls of each internal carotid artery, common carotid artery and bifurcation of carotid artery)	**Mean levels of TSF (adjusted for age, sex and race) by age and IMT group:** **IMT group: low** Age <11: 11 Age 11-14: 12 Age 15-18: 13 **IMT group: intermediate** Age <11: 11 Age 11-14: 14 Age 15-18: 14 **IMT group: high** Age <11: 13 (r= 0.12) *P value* <0.05 Age 11-14: 22.0 (r= 0.10) *P value* <0.05 Age 15-18: 24.7 (r=0.17) *P value* <0.01
A Oren et al, 2003 **181**	Atherosclerosis Risk in Young Adults (ARYA) study (The Utrecht cohort)	Netherlands	750 subjects were followed up for 15 years from the age of 12-16 years to 27-30 years	BMI (childhood overweight was defined as BMI between 85th and 95th percentile and obesity as >95th percentile; Adulthood overweight was defined as BMI between 25 and 30 kg/m^2 and obesity as >30 kg/m^2)	cIMT (measurements taken from each common carotid artery)	**Association [linear regression coefficients (95% CI)] between adolescent BMI and adulthood common cIMT:** Model 1: Adjusted for reader, adolescent age and gender 3.1 (2.1 to 4.0) Model 2: Model 1+lumen diameter 2.6 (1.6 to 3.6) Model 3: Model 2+adolescent blood pressure and puberty stage 2.3 (1.3 to 3.3) Model 4: Model 3+adulthood blood pressure and adult LDL cholesterol 2.1 (1.0 to 3.1) Model 5: Model 4+adult BMI 0.9 (-0.3 to 2.2)

Marietta Charakida et al, 2014 **203**	1946 British Birth Cohort	United Kingdom	604 men and 669 women were followed up for 58 to 62 years from the age of 2 years to 60-64 years	BMI (childhood overweight and obesity defined as per the guidelines of the International Obesity Taskforce; Adulthood overweight was defined as BMI between 25-29 kg/m^2 and obesity as BMI ≥30 kg/m^2)	cIMT (measurement taken from each common carotid artery)	**Association between childhood overweight/obesity and adulthood cIMT:** Regression coefficient= -0.005 95% CI= -0.02 to 0.01 *P value*= 0.45 (adjusted for sex) (values adjusted for sex, LDL cholesterol, heart rate, systolic blood pressure at 60-64 years, and socioeconomic class at 53 years) **Association [regression coefficient (95% CI)] between childhood and adulthood overweight/obesity (O/O) and adulthood cIMT:** <u>NW child NW adult:</u> REFERENCE <u>NW child O/O adult:</u> 0.042 (0.015 to 0.069) *P value*= 0.002 (adjusted for sex) <u>O/O child NW adult:</u> -0.019 to 0.031 *P value*= 0.62 (adjusted for sex) <u>O/O child O/O adult:</u> 0.031 (0.007 to 0.054) *P value*= 0.011 (adjusted for sex)

Table 6: Assesment of quality of studies included for the above outcome

AUTHOR/COHORT	ASSESSMENT OF QUALITY OF INCLUDED COHORTS (NEW CASTLE OTTAWA SCALE)							
	SELECTION				COMPARABILITY	OUTCOME		
	Representativeness of the intervention cohort	Selection of non intervention cohort	Ascertainment of intervention	Demonstration that outcome of interest was not present at start of study	Comparability of cohorts on the basis of the design or analysis	Assessment of outcome	Was follow up long enough for outcomes to occur	Adequacy of follow up of cohorts
Park et al,2013	*		*	*	**	*	*	
Debbie A. et al, 2005 Aberdeen Children Of 1950s Prospective Cohort Study	*		*	*	* *	*	*	*
Tone Bjørge et al, 2008 Norwegian Cohort	*		*	*	* *	*	*	*
Jennifer L. Baker et al, 2007 Danish Cohort	*		*	*	*	*	*	*
JG Eriksson, 2006 Helsinki Birth Cohort	*		*	*	* *	*	*	
Clive Osmond et al, 2007 Helsinki Birth Cohort	*		*	*	* *	*	*	*
John A. Morrison et al, 2006 Nhlbi Lipid Research Clinics (Lrc) Princeton Prevalence Study And Princeton Follow Up Study	*		*	*	* *		*	
JG Eriksson et al, 2001 Helsinki Birth Cohort	*		*	*	*	*	*	
Aviva Must et al, 1992 Harvard Growth Study Of 1922 To 1935	*		*	*	*		*	
David J Gunnell, 1998 Boyd Orr Cohort	*		*	*	*	*	*	

Childhood and adolescent anthropometric measures Vs adulthood Type 2 Diabetes Mellitus (Type 2 DM):

Pooled analysis of 3 British Birth cohorts (1946, 1958 and 1970) demonstrated obesity in adulthood in combination with any pattern of overweight in earlier life was associated with increased odds of type 2 diabetes mellitus (type 2 DM), compared to never overweight subjects. The pooled analysis also showed that the odds ratio (OR) for type 2 DM was higher for persistent overweight (OR 12.6, 95% CI 6.6-24.0) than for obesity in adulthood only (OR 5.5, 95% CI 3.4-8.8). Compared to those who were never overweight, overweight during childhood only or adolescence only did not have increased odd of type 2 DM. Another pooled analysis from cohorts of 4 high income countries (Bogalusa, Muscatine, Young Finn and CDAH study) (n=6328) reported that childhood overweight or obesity was a predictor of type 2 DM in all the cohorts except CDAH study. The individuals with consistent overweight or obese status from childhood to adulthood (group-III) had increased risk of type 2 DM (RR 5.4, 95% CI 3.4-8.5) as compared to children who were never overweight. Further, the relative risk (RR) of type 2 DM among the subjects who were overweight or obese in childhood, but non obese as adults (group-II) was similar to the risks among the subjects who had a consistently normal BMI. The relative risk was significantly lower among individuals who were overweight or obesity during childhood and non obese as adults (group-II) compared to subjects who were consistently obese or who became obese as adults (group III and IV).

Ten articles (eight cohorts) analyzed the relationship between anthropometric measures during childhood and type-2 diabetes mellitus in later life. The exposures included body mass index, weight and height. The spectrum of results included prevalence, risk (odds ratio) and mortality. Six of the seven studies were based in high income countries. The remaining study was based in low and middle income country, India (New Delhi Birth Cohort). Two studies[61, 141] found that higher BMI (age 4-18 years) was associated with increased risk of developing diabetes in adulthood. But one[61] of these studies did not follow up the subjects for an adequate length of time. Study[64] from the New Delhi Birth Cohort established that lower BMI at age 2 and higher BMI at age 14 were associated with the increased risk of diabetes in adulthood. Another study[72] from the same cohort found the prevalence of diabetes was higher in the subjects with the lowest BMI at age 2 and highest BMI at age 12. In the 1958 British Birth Cohort[39], the gain in BMI was divided into tertiles and the risk of diabetes was increased considerably in the upper vs. the lower tertile. Two articles[64, 77] from the New Delhi Birth Cohort found that rapid increase in BMI in childhood and adolescence increased the risk of diabetes later in life. One of the studies [50] on the Norwegian population had made quartiles of the lowest to highest percentiles of adolescent BMI and found that the subjects who were in highest two quartiles had the highest risk of mortality due to diabetes mellitus in adulthood.

Study [122] based on the Hertfordshire Cohort Study found that the highest prevalence of diabetes was seen in the subjects with the lowest weight at age 1 year. A similar finding was seen in study based on the 1946 British Birth Cohort[117] demonstrating lower weight at age 2 was associated with increased risk of developing type 2 diabetes in adulthood. Another study[77] based on the New Delhi Birth Cohort found that greater weight gain between early childhood and adulthood increased the risk of developing diabetes.

Table 7: Table showing the association of childhood and adolescent anthropometric measures with Type 2 DM in later life

AUTHOR	COHORT	SETTING	NO. OF SUBJECTS/LENGTH OF FOLLOW-UP/CHILDHOOD AGE/ADULTHOOD AGE	EXPOSURES	OUTCOMES MEASURED	EFFECT SIZE
Park 2013	Three British cohort (1946, 1958 and 1970)	England, Wales and Scotland (1946) United kingdom (1958 and 1970)	11,447 subjectswere followed-up from 7,15 and 43 years of age to 53 years of age (1946) 7,16 and 42 years of age to 46 (1958) 10,16 and 34 years of age to 34 years of age (1970)	BMI (International age- and sex-specific BMI centiles, cut-off points corresponding to overweight ($\geq$25 kg/m^2) and obesity ($\geq$30 kg/m^2) in adulthood	Type 2 DM	**Association between patterns of overweight in childhood,adolescence and adulthood and Type 2 DM outcome (logistic regression analysis)** Overweight — Type 2 DM (OR, 95% CI) Never overweight — 1 Childhood only — 0.99 (0.35-2.80) Adolescence only — 0.88 (0.31-2.50) Adulthood only — 5.47 (3.39-8.82) Childhood + Adolescence — 1.24 (0.29-5.25) Childhood + Adulthood — 4.70 (1.89-11.67) Adolescence + Adulthood — 6.61 (3.61-12.09) Persistant overweight — 12.60 (6.61-23.98)
Tone Bjørge et al, 2008 **50**	Norwegian population	Norway	226, 678 subjects were followed up for 34.9 years (average) from the age of 14-19 years	BMI	Mortality due to diabetes mellitus	**Relative risk (95% CI) of mortality due to diabetes mellitus, adjusted for age and birth year, by body mass index in adolescence:** **<25th percentile:** Males 1.7 (1.1 to 2.6) **25th-74th percentile:** Males 1.0 **75th-84th percentile:** Males 2.1 (1.1 to 4.0) **≥85th percentile:** Males 1.9 (0.8 to 4.1) *P value* Males = 0.1 **Number of deaths due to diabetes mellitus, by body mass composition in adolescence:** **<25th percentile:** Females 0 **25th-74th percentile:** Females 16 RR= 1.0 **75th-84th percentile:** Females 13 RR (95% CI)= 2.6 (1.4 to 4.7) **≥85th percentile:** Females 14 RR (95% CI)= 5.6 (3.3 to 9.6)

Elina Hyppönen et al, 2003 **39**	1958 British Birth Cohort	United Kingdom	10, 683 subjects were followed up for 34 years from the age of 7 years to 41 years	BMI	Risk of type 2 diabetes mellitus	<table><tr><th>Risk of type 2 diabetes mellitus by thirds of BMI [OR (95% CI)]:</th><th>Risk of type 2 diabetes by the rate of BMI gain (per 1-SD change in BMI score) [OR (95% CI)]</th></tr><tr><td>BMI at 7 years: <u>Lowest third</u> 2.84 (1.2 to 6.9) <u>Middle third</u> REFERENCE <u>Upper third</u> 3.97 (1.7 to 9.1) P for trend <0.001 BMI at 11 years: <u>Lowest third</u> 1.73 (0.8 to 4.0) <u>Middle third</u> REFERNCE <u>Upper third</u> 3.59 (1.7 to 7.5) P for trend <0.001 BMI at 16 years: <u>Lowest third</u> 0.62 (0.2 to 1.7) <u>Middle third</u> REFERNCE <u>Upper third</u> 4.18 (2.1 to 8.4) P for trend <0.001 (values adjusted for sex)</td><td>Increase from birth to 7 years: 1.65 (1.3 to 2.2) P for trend <0.001 Increase from 7 to 11 years: 1.62 (1.3 to 1.9) P for trend <0.001 Increase from 11 to 16 years: 2.01 (1.5 to 2.8) P for trend <0.001 (values adjusted for sex)</td></tr></table>

<table>
<tr>
<td>Abdullah Al Mamun et al, 2009

61</td>
<td>Mater-University study of pregnancy</td>
<td>Australia</td>
<td>2639 subjects were followed up for 16 years from the age of 5 years to 21 years</td>
<td>BMI</td>
<td>Risk of type 2 diabetes mellitus</td>
<td>
<table>
<tr><th>Risk of being diabetic [OR (95% CI)] at age 21 years by BMI z-score at age 5 years, adjusting for potential confounders and mediators:</th><th>Risk of being diabetic at age 21 years by overweight status at age 5, adjusting for potential confounders and mediators:</th></tr>
<tr>
<td>Model 1
Nondiabetes
1.00
Diabetes
1.61 (1.24 to 2.09)
Model 2
Nondiabetes
1.00
Diabetes
1.60 (1.23 to 2.08)
Model 3
Nondiabetes
1.00
Diabetes
1.50 (1.13 to 1.99)
Model 4
Nondiabetes
1.00
Diabetes
1.59 (1.23 to 2.07)
Model 5
Nondiabetes
1.00
Diabetes
1.48 (1.11 to 1.96)</td>
<td>Model 1
Nondiabetes
1.00
Diabetes
2.60 (1.29 to 5.22)
Model 2
Nondiabetes
1.00
Diabetes
2.54 (1.25 to 5.15)
Model 3
Nondiabetes
1.00
Diabetes
2.24 (1.09 to 4.60)
Model 4
Nondiabetes
1.00
Diabetes
2.51 (1.2 to 5.09)
Model 5
Nondiabetes
1.00
Diabetes
2.23 (1.08 to 4.60)</td>
</tr>
<tr><td colspan="2">Model 1: adjusted by exact age at 5 and sex
Model 2: adjusted by exact age at 5, sex, maternal age at birth, gestational age, birth weight, and weight gain during pregnancy
Model 3: adjusted by exact age at 5, sex, maternal age at birth, and maternal prepregnancy BMI
Model 4: adjusted by exact age at age , sex, maternal age at birth, and maternal tobacco consumption during pregnancy
Model 5: adjusted by all factors mentioned above</td></tr>
</table>
</td>
</tr>
</table>

HPS Sachdev et al, 2009 **64**	New Delhi Birth Cohort	India	1492 subjects were followed up for 24-30 years from the age of 2 years to 26-32 years	BMI	IGT/Diabetes	<table><tr><th>Risk of developing IGT/Diabetes [OR (95% CI)] in adulthood by BMI SD-score at:</th><th>Risk of developing IGT/Diabetes [OR (95% CI)] in adulthood by change in BMI SD-score between:</th></tr><tr><td>**2 years:** 0.84 (0.71 to 1.00) *P value*= 0.04 **5 years:** 0.89 (0.76 to 1.04) *P value*= 0.14 **8 years:** 1.00 (0.86 to 1.16) *P value*= 1.00 **11 years:** 1.13 (0.97 to 1.31) *P value*= 0.11 **14 years:** 1.22 (1.06 to 1.41) *P value*= 0.0005</td><td>**2-5 years:** 1.02 (0.86 to 1.20) *P value*= 0.83 **5-8 years:** 1.25 (1.02 to 1.52) *P value*= 0.03 **8-11 years:** 1.74 (1.30 to 2.32) *P value* <0.001 **11-14 years:** 1.33 (0.97 to 1.82) *P value*= 0.08</td></tr></table>
Quoc Manh Nguyen et al, 2008 **141**	Bogalusa heart study	United States	1988 subjects were followed up for 21 years from the age of 4-18 years to 19-44 years	BMI	Pre-diabetes Diabetes	**Association between BMI (SD) and the development of pre-diabetes and diabetes:** <u>Normoglycemia</u> 18.3±0.1 <u>Pre-diabetes</u> 19.5±0.4 *P value* >0.05 <u>Normoglycemia</u> 18.3±0.1 <u>Diabetes</u> 22.2±0.8 β= 0.09 (NORMOGLYCEMIA VS. DIEABTES) (adjusted for age, age², race, sec, and the race × sex interaction) 95% CI= 0.06 to 0.12 *P value* <0.0001 <u>Pre-diabetes</u> 19.5±0.4 <u>Diabetes</u>

						22.2±0.8 *P value* <0.0001
Caroline HD Fall et al, 2008 **77**	New Delhi birth cohort	India	1492 subjects were followed up for 26-32 years from birth to 26-32 years	BMI	Risk of IGT/Diabetes	**Risk [OR (95% CI)] of adulthood IGT/Diabetes by conditional BMI SD scores:** **Birth to 2 years:** 0.86 (0.82 to 1.09) *P value*= 0.1 **2-11 years:** 1.25 (1.05 to 1.47) *P value*= 0.01 **11 years-adulthood:** 1.40 (1.18 to 1.67) *P value* <0.001 Analysis is adjusted for age, sex, and lifestyle factors: alcohol consumption, physical activity, tobacco use, socioeconomic status in childhood based on father's occupation, socioeconomic status in adult life derived from education level, household possessions and occupation, and family history of any high blood pressure, angina, myocardial infarction, stroke, or diabetes in a first-degree relative
Caroline HD Fall et al, 2008 **77**	New Delhi birth cohort	India	1492 subjects were followed up for 26-32 years from birth to 26-32 years	Weight	Risk of IGT/Diabetes	**Risk [OR (95% CI)] of adulthood IGT/Diabetes by conditional weight SD scores:** **Birth to 2 years:** 0.94 (0.79 to 1.13) *P value*= 0.5 **2-11 years:** 1.26 (1.06 to 1.49) *P value*= 0.008 **11 years-adulthood:** 1.31 (1.11 to 1.56) *P value*= 0.002 Analysis is adjusted for age, sex, and lifestyle factors: alcohol consumption, physical activity, tobacco use, socioeconomic status in childhood based on father's occupation, socioeconomic status in adult life derived from education level, household possessions and occupation, and family history of any high blood pressure, angina, myocardial infarction, stroke, or diabetes in a first-degree relative
M. Wadsworth, 2005	1946 British birth cohort	United Kingdom	1833 subjects were followed up for 30-50 years from the age of 2 years to 31-53 years	Age at adiposity rebound	Risk of type 2 diabetes	**Hazard ratio (95% CI) for type 2 diabetes in relation to age at adiposity rebound:**

117						**2 years:** 4.83 (1.08 to 21.59) **4 years:** 2.06 (0.47 to 8.95) **7 years:** 1.51 (0.35 to 6.55) **11 years:** 1.00 *P for trend*= 0.002 (Each variable adjusted for sex only) After adjusting separately for birthweight, weight at 2 years, father's social status, own social class, adult height, maternal and paternal diabetes, the effect of early adiposity rebound remained significant. Adjustment for BMI considerably reduced the effect of age at adiposity rebound, and the trend was no longer statistically significant (*P value*= 0.1)
M. Wadsworth, 2005 **117**	1946 British birth cohort	United Kingdom	1833 subjects were followed up for 30-50 years from the age of 2 years to 31-53 years	Weight at 2 years	Risk of type 2 diabetes	**Hazard ratio (95% CI) for type 2 diabetes in relation to weight at 2 years:** 0.77 (0.60 to 0.99) *P value*= 0.04 Adjusted for birthweight, weight at 2 years, father's social status, own social class, adult height, adult BMI, maternal and paternal diabetes
Santosh K. Bhargava et al, 2004 **72**	New Delhi birth cohort	India	1492 subjects were followed up for 24-30 years from the age of 2 years to 26-32 years	Age at adiposity rebound	Prevalence of IGT/Diabetes	**Prevalence (%) of IGT/Diabetes in relation to age at adiposity rebound:** **2-5 years:** 21.0 **6 years:** 13.9 **7 years:** 14.6 **8-9 years:** 12.2 **All subjects:** 14.9 *P value*= 0.006 (after adjustment for age, sex and adult body mass index)

Santosh K. Bhargava et al, 2004 **72**	New Delhi birth cohort	India	1492 subjects were followed up for 24-30 years from the age of 2 years to 26-32 years	BMI	Prevalence of IGT/Diabetes	**Risk [OR (95% CI)] for development of IGT/Diabetes according to BMI at 2 years and 12 years BMI:** **BMI at 2 years:** <15.0 BMI at 12 years <22.7 2.2 (0.8 to 5.9) BMI at 12 years= 22.7-26.5 2.0 (0.7 to 5.7) BMI at 12 years >26.5 4.5 (1.6 to 12.8) **BMI at 2 years:** 15.0-16.1 BMI at 12 years <22.7 1.8 (0.6 to 5.0) BMI at 12 years= 22.7-26.5 1.4 (0.5 to 4.1) BMI at 12 years >26.5 2.4 (0.9 to 6.8) **BMI at 2 years:** >16.1 BMI at 12 years <22.7 1.0 (REFERENCE GROUP) BMI at 12 years= 22.7-26.5 1.5 (0.5 to 4.3) BMI at 12 years>26.5 2.1 (0.8 to 5.6) (Values adjusted for sex and current age)
David I.W. Phillips et al , 2005 **122**	Hertfordshire Cohort Study	United Kingdom	724 males and 658 females were followed up for more than 60 years from the age of 1 year	Weight	Prevalence of Diabetes type 2	**Prevalence of type 2 diabetes according to weight (lbs) at 1 year** Men: ≤18.5: 18% -20: 12% -22: 14% -24: 13% -26: 10% >26: 13% Women: ≤18.5: 15% -20: 10% -22: 13% -24: 9% -26: 9% >26: 8%

Table 8: Assesment of quality of studies included for the above outcome

AUTHOR/COHORT	ASSESSMENT OF QUALITY OF INCLUDED COHORTS (NEW CASTLE OTTAWA SCALE)							
	SELECTION				COMPARABILITY	OUTCOME		
	Representativeness of the intervention cohort	Selection of non intervention cohort	Ascertainment of intervention	Demonstration that outcome of interest was not present at start of study	Comparability of cohorts on the basis of the design or analysis	Assessment of outcome	Was follow up long enough for outcomes to occur	Adequacy of follow up of cohorts
Park et al,2013	*		*	*	**	*	*	
Elina Hyppönen et al, 2003 1958 British Birth Cohort	*		*	*	*		*	
Tone Bjørge et al, 2008 Norwegian Cohort	*		*	*	* *	*	*	*
Abdullah Al Mamun et al, 2009 Mater-University Study Of Pregnancy Cohort, Australia	*		*	*	*			
HPS Sachdev et al, 2008 New Delhi Birth Cohort	*		*	*	* *	*	*	
Santosh K. Bhargava et al, 2004 New Delhi Birth Cohort	*		*	*	* *	*	*	
Caroline HD Fall et al, 2008 New Delhi Birth Cohort	*		*	*	* *	*	*	
M. Wadsworth et al, 2005 1946 British Birth Cohort	*		*	*	* *		*	
David IW Phillips et al, 2005 Hertfordshire Cohort	*		*	*	* *	*	*	
JG Eriksson, 2006 Helsinki Birth Cohort	*		*	*		*	*	
Quon Manh Nguyen et al, 2008 Bogalusa Heart Study	*		*	*	* *	*	*	

Childhood and adolescent anthropometric measures Vs adulthood Homa- IR, Impaired Glucose Tolerance

Five studies (four cohorts) observed relationship between childhood BMI, height, weight, with the HOMA-IR levels in adulthood [1,68, 23, 29,77]. Three cohorts included were from developed countries and one cohort from the Low & middle income country.

Two studies from the Vulnerable windows birth cohort has found a positive association between an increase in height, weight and BMI with the HOMA-IR in adoloscence[2, 68]. Where as study from the same cohort did not find any significant association between childhood and adolescence BMI and development of insulin resistance in adulthood. New Delhi birth cohort study reported that change of conditional BMI and weight from 2 years to adulthood was significantly associated with the development of insulin resistance in adulthood[77]. There was a positive correlation between childhood BMI and development of insulin resistance in a study by NHLBI[23]. However, childhood BMI was inversely related to HOMA-IR in adulthood as reported by Boyd Orr cohort[29].

There is only one study from NHLBI which has reported that development of impaired glucose tolerance was associated with BMI at baseline in black girls and rate of BMI increase in white girls [23.]

Table 9: Showing the association of childhood and adolescent anthropometric measures with HOMA-IR and impaired glucose tolerance in later life

AUTHOR	COHORT	SETTING	NO. OF SUBJECTS/ LENGTH OF FOLLOW-UP/ CHILDHOOD AGE/ ADULTHOOD AGE	EXPOSURES	OUTCOMES MEASURED	EFFECT SIZE
Wei Chan et al, 2007 **68**	Bogalusa Heart Study	United States	389 black and 631 white subjects were followed up for 16 years (mean) from age 4-17 years till 18-38 years	BMI	HOMA-IR	**Association between the development of insulin resistance and BMI in childhood:** Whites: r= 0.331 Blacks: r= 0.364 (values adjusted for sex and age)
Michael s. Boyne et al, 2010 **1**	Vulnerable Windows Cohort Study (Birth Cohort)	Kingston, Jamaica	296 subjects (134 boys and 162 girls) were followed up for 11 years from birth till age 11	BMI	HOMA-IR	**Association (regression coefficient) between HOMA-IR at 11 years and increase in BMI between:** 6 months to 2 years: 0.209 *P value* <0.001 2 years to 11 years: 0.421 *P value* <0.001 (values adjusted for age and sex)
David J Klein et al, 2004 **23**	National Heart, Lung and Blood Institute (NHLBI) Growth and Health study (NGHS)	United States	1,296 girls were followed up for 10 years from the age of 9-10 years till the age of 19-20 years	BMI (as per 2000 CDC growth charts)	HOMA-IR	**Association between BMI at baseline and HOMA-IR levels after the 10-year follow up:** r= 0.16 *P value* <0.001
Richard M Martin et al, 2006 **29**	Boyd Orr Cohort	United Kingdom	214 subjects were followed up for 65 years from the age of 2 years and 14 years 9 months till a mean age of 71 years	BMI	HOMA-IR	**Change in measure of HOMA-IR in adulthood per SD change in childhood BMI:** Basic model: -5.5% (-12.3% to 1.9%) *P* linear trend= 0.14 *P* nonlinearity= 0.8 Fully adjusted model: -8.0% (-2.0% to -15.1%) *P* linear trend= 0.045

						P nonlinearity= 0.7 All values are standardized for age, sex, and sample type. Fully adjusted models control additionally for social class of head of household in childhood, social class in adulthood, smoking, alcohol consumption, and exercise.
Caroline HD Fall et al, 2008 **77**	New Delhi birth cohort	India	1492 subjects were followed up for 26-32 years from birth till age 26-32	BMI	HOMA-IR	**Association [β (95% CI)] of adulthood insulin resistance with conditional BMI SD scores:** **Birth to 2 years:** 0.04 (-0.02 to 0.09) *P value*= 0.2 **2-11 years:** 0.15 (0.09 to 0.20) *P value* <0.001 **11 years-adulthood:** 0.45 (0.40 to 0.51) *P value* <0.001 Analysis is adjusted for age, sex, and lifestyle factors: alcohol consumption, physical activity, tobacco use, socioeconomic status in childhood based on father's occupation, socioeconomic status in adult life derived from education level, household possessions and occupation, and family history of any high blood pressure, angina, myocardial infarction, stroke, or diabetes in a first-degree relative
Michael s. Boyne et al, 2010 **1**	Vulnerable Windows Cohort Study (Birth Cohort)	Kingston, Jamaica	296 subjects (134 boys and 162 girls) were followed up for 11 years from birth till age 11	Weight	HOMA-IR	**Association (regression coefficient) between HOMA-IR at 11 years and increase in weight between:** <u>6 months to 2 years:</u> 0.207 *P value* <0.001 <u>2 years to 11 years:</u> 0.459 *P value* <0.001 (values adjusted for age and sex)
Caroline HD Fall et al, 2008 **77**	New Delhi birth cohort	India	1492 subjects were followed up for 26-32 years from birth till age 26-32	Weight	HOMA-IR	**Association [β (95% CI)] of adulthood insulin resistance with conditional weight SD scores:** **Birth to 2 years:** 0.08 (0.02 to 0.13) *P value*= 0.005 **2-11 years:** 0.15 (0.10 to 0.20) *P value* <0.001 **11 years-adulthood:**

						0.44 (0.39 to 0.49) *P value* <0.001 Analysis is adjusted for age, sex, and lifestyle factors: alcohol consumption, physical activity, tobacco use, socioeconomic status in childhood based on father's occupation, socioeconomic status in adult life derived from education level, household possessions and occupation, and family history of any high blood pressure, angina, myocardial infarction, stroke, or diabetes in a first-degree relative
Michael s. Boyne et al, 2010 **1**	Vulnerable Windows Cohort Study (Birth Cohort)	Kingston, Jamaica	296 subjects (134 boys and 162 girls) were followed up for 11 years from birth till age 11	Height	HOMA-IR	**Association (regression coefficient) between HOMA-IR at 11 years and increase in height between:** <u>6 months to 2 years:</u> 0.095 <u>2 years to 11 years:</u> 0.266 *P value* <0.001 (values adjusted for age and sex)

Table 10 Showing the association of childhood and adolescent anthropometric measures with impaired glucose tolerance in later life

AUTHOR	COHORT	SETTING	NO. OF SUBJECTS/ LENGTH OF FOLLOW-UP/ CHILDHOOD AGE/ ADULTHOOD AGE	EXPOSURES	OUTCOMES MEASURED	EFFECT SIZE
David J Klein et al, 2004 **23**	National Heart, Lung and Blood Institute (NHLBI) Growth and Health study (NGHS)	United States	1,296 girls were followed up for 10 years from the age of 9-10 years till the age of 19-20 years	BMI (as per 2000 CDC growth charts)	Impaired glucose tolerance	**Association between BMI at baseline and development of impaired glucose tolerance after the 10-year follow up for black girls:** OR= 1.12 *P value*= 0.02 **Association between rate of BMI increase and development of impaired glucose tolerance after the 10-year follow up for white girls:** OR= 7.6 *P value*= 0.002

Table 11: Assesment of quality of studies included for the above outcome

AUTHOR/COHORT	ASSESSMENT OF QUALITY OF INCLUDED COHORTS (NEW CASTLE OTTAWA SCALE)							
	SELECTION				COMPARABILITY	OUTCOME		
	Representativeness of the intervention cohort	Selection of non intervention cohort	Ascertainment of intervention	Demonstration that outcome of interest was not present at start of study	Comparability of cohorts on the basis of the design or analysis	Assessment of outcome	Was follow up long enough for outcomes to occur	Adequacy of follow up of cohorts
Michael S. Boyne et al, 2010 Vulnerable Windows Cohort Study	*		*	*		*	*	
David J Klein et al, 2004 National Heart, Lung And Blood Institute (Nhlbi) Growth And Health Study (Nghs)	*		*	*		*	*	*
Richard M Martin et al, 2006 Boyd Orr Cohort	*		*	*	*	*	*	
Caroline HD Fall et al, 2008 New Delhi Birth Cohort	*		*	*	* *	*	*	
Wei Chan et al, 2007 Bogalusa Heart Study	*		*	*		*	*	

Childhood and adolescent anthropometric measures Vs adulthood fasting glucose levels

Nine studies were included from different cohorts to analyze the relationship of childhood anthropometric measures versus adolescent and adulthood glucose levels. The exposures included in infancy and childhood were height, weight, BMI and age at adiposity rebound. The spectrum of results included regression co-efficient, odds ratio. Eight of the nine studies were based in developed countries. The remaining study was based in India (New Delhi Birth Cohort).

There is one study found from the Vulnerable Windows Cohort Study[1] showing no association between BMI at infancy and glucose levels at childhood. A study from Terneuzen Birth Cohort[13] also reported the finding showing no association between BMI at infancy and glucose levels in adulthood. However there are two studies from National Heart, Lung and Blood Institute (NHLBI) Growth and Health study[23] and Avon Longitudinal Study of Parents and Children[102] which shows positive correlation with BMI at infancy and childhood with glucose levels in adulthood. There is only one study from Newcastle thousand family cohort[46] showing inverse relationship of childhood BMI with adulthood 2 hour glucose levels. The risk of having high fasting glucose levels in adulthood was significant only in the highest BMI percentile in infancy in Northern Finland Birth Cohort 1966 Study[42]. Study from Bogalusa Heart Study[127] found significant association between adolescent weight status and change in BMI and adulthood glucose levels. Whereas, study from New Delhi birth cohort[77] demonstrated that the change of conditional BMI from age 11 to adulthood were significantly associated with high glucose levels in adulthood.

There are two studies from Northern Finland Birth Cohort 1966 Study [112] and Vulnerable Windows Cohort Study[1] showing no association of increased risk of development of high glucose levels in adolescent and adulthood with the increase weight at infancy. However one study from New Delhi birth cohort [77] has shown that change of conditional weight from age 11 years to adulthood were significantly associated with the development of higher glucose levels in adulthood.

In the anthropometric measures height was also seen as an exposure for its association with glucose levels. Studies from Vulnerable Windows Cohort Study[1] and Northern Finland Birth Cohort 1966 Study [112] found no association of increased risk of development of high glucose levels in adolescent and adulthood with the height at birth.

There is only one study from Avon Longitudinal Study of Parents and Children[102] which has reported no increase in the odds of development of high glucose levels later in adolescence with increase in waist circumference in childhood.

The association of age at adiposity rebound and adulthood glucose levels were studied by Northern Finland Birth Cohort of the 1966 Study[111] and found no association between the variables.

Table 12 Showing the association of childhood and adolescent anthropometric measures with fasting glucose levels

AUTHOR	COHORT	SETTING	NO. OF SUBJECTS/ LENGTH OF FOLLOW-UP/ CHILDHOOD AGE/ ADULTHOOD AGE	EXPOSURES	OUTCOMES MEASURED	EFFECT SIZE
Michael S. Boyne et al, 2010 **1**	Vulnerable Windows Cohort Study (Birth Cohort)	Kingston, Jamaica	296 subjects (134 boys and 162 girls) were followed up for 11 years from birth till age 11	BMI	Fasting glucose	**Association (regression coefficient) between fasting glucose at 11 years and increase in BMI between:** <u>6 months to 2 years:</u> -0.012 <u>2 years to 11 years:</u> 0.057 (values adjusted for age and sex)
Marlou LA de Kroon et al, 2010 **13**	Terneuzen Birth Cohort (1977-86)	Netherlands	642 subjects were followed for 18-28 years from birth to the age of 18-28 years	BMI (overweight and obese defined according to the Dutch reference data)	Fasting glucose	**Association between fasting glucose levels in adulthood [Regression coefficient (95% CI)] and change in conditional measures of BMI:** <u>Change in score from birth to 1 year:</u> 0.02 (-0.06 to 0.10) <u>Change in score from 1-2 years:</u> -0.06 (-0.14 to 0.02) <u>Change in score from 2-6 years:</u> 0.06 (-0.02 to 0.14) <u>Change in score from 6-10 years:</u> 0.00 (-0.08 to 0.08) <u>Change in score from 10-18 years:</u> 0.05 (-0.01 to 0.11) (all analyses are adjusted for age and gender) (Change score: the expected value of BMI SDS at a break age is called the *status score.* The change between the status score at the start and the end of the various age intervals is called the *change score*)
David J Klein et al, 2004 **23**	National Heart, Lung and Blood Institute (NHLBI) Growth and Health study (NGHS)	United States	1,296 girls were followed up for 10 years from the age of 9-10 years till the age of 19-20 years	BMI (as per 2000 CDC growth charts)	Glucose	**Association between BMI at baseline and glucose levels after the 10-year follow up:** r= 0.16 *P value* <0.001
Lise Graversen et al, 2014 **42**	Northern Finland Birth Cohort 1966 Study	Finland	2120 subjects were followed up for 31 years from the age of 1 year to 31 years	BMI	Fasting glucose	**Risk of having high fasting glucose levels in adulthood [relative risk (95% CI)] by weight percentiles at age 1 year:** <u><5th percentile:</u> 1.4 (0.8 to 2.2) <u>≥5th to <50th percentile:</u>

						1.0 <u>≥50th to <75th percentile:</u> 1.1 (0.8 to 1.4) <u>≥75th to <90th percentile:</u> 0.9 (0.6 to 1.3) <u>≥90th to <95th percentile:</u> 1.3 (0.8 to 2.2) <u>≥95th percentile:</u> 1.4 (0.9 to 2.3) (values adjusted for gender) (linear associations were adjusted for birth weight, gestational age, maternal smoking during pregnancy, maternal age at birth, maternal pre-pregnancy BMI, maternal education level, and parity)
Charlotte M Wright et al, 2001 **46**	Newcastle thousand families cohort study (birth cohort)	United Kingdom	412 subjects were followed for 41 years from the age of 9 years to 50 years	BMI (childhood BMI assessed as per body mass index reference curves for UK, 1990; Adulthood overweight defined as BMI between 24-29 kg/m² and obese as BMI≥30 kg/m²)	2 hour glucose	**Association (standardized regression coefficients) between BMI at ages 9 and 13 years in childhood and glucose levels at age 50:** <u>Males:</u> BMI age 9 -0.22 *P value* <0.01 BMI age 13 -0.03 <u>Females:</u> BMI age 9 -0.17 *P value* <0.05 BMI age 13 -0.20 *P value* <0.05 (values adjusted for body mass index at age 50)
Caroline HD Fall et al, 2008 **77**	New Delhi birth cohort	India	1492 subjects were followed up for 26-32 years from birth till age 26-32	BMI	Glucose	**Association [β (95% CI)] of adulthood glucose levels with conditional BMI SD scores:** **Birth to 2 years:** -0.02 (-0.08 to 0.03) *P value*= 0.4 **2-11 years:** 0.03 (-0.03 to 0.09) *P value*= 0.3 **11 years-adulthood:** 0.08 (0.02 to 0.14) *P value*= 0.006

						Analysis is adjusted for age, sex, and lifestyle factors: alcohol consumption, physical activity, tobacco use, socioeconomic status in childhood based on father's occupation, socioeconomic status in adult life derived from education level, household possessions and occupation, and family history of any high blood pressure, angina, myocardial infarction, stroke, or diabetes in a first-degree relative
Debbie A Lawlor et al, 2010 **102**	Avon Longitudinal Study of Parents and Children	United Kingdom	5235 subjects were followed for 5-6 years from age 9-12 years to 15-16 years	BMI	Glucose	**Association [OR (95% CI)] between change (1 SD z score) in BMI and development of high glucose levels:** **Males:** <u>MODEL 1:</u> 1.22 (1.07 to 1.38); <u>MODEL 2:</u> 1.18 (1.03 to 1.36) **Females:** <u>MODEL 1:</u> 1.06 (0.87 to 1.29); <u>MODEL 2:</u> 1.03 (0.84 to 1.27) *P value for sex interaction*= 0.03 Model 1: adjusted for age, height and height^2 Model 2: additional adjusted for maternal age, parity, family social class, maternal education, paternal education, birth weight, gestational age, maternal and parental BMI, and puberty
Santhur R Srinivasan et al, 1996 **127**	Bogalusa Heart Study	United States	783 subjects were followed up for 14 years from age 13-17 to age 27-31 years	BMI	Glucose	**Association between adolescent weight status and glucose levels in adulthood:** β= 5.3 *P value* <0.05 **Association between change in BMI during follow up and glucose levels in adulthood:** β= 0.8 *P value* <0.01 *P value*: overweight vs. lean
Ioanna Tzulaki et al, 2010 **112**	Northern Finland Birth Cohort 1966 Study	Finland	3,778 subjects followed up for 31 years from birth to the age of 31 years	Weight	Glucose	**Association between glucose levels in adulthood [β (95% CI)] and peak height velocity (cm/year) in infancy:** <u>Model 1:</u> -0.69 (-1.37 to 0.23) *P value*= 0.07 <u>Model 2:</u> -1.64 (-8.04 to 12.34) *P value*= 0.75 <u>Model 3:</u> -2.55 (-7.30 to 13.45) *P value*= 0.62

						Model 4: -1.82 (-7.88 to -12.55) *P value*= 0.72 Model 1: adjusted for sex Model 2: adjusted for sex, socioeconomic status at birth, maternal age, maternal height and weight before pregnancy, maternal smoking after the second month of pregnancy, and gestational age at birth Model 3: adjusted for all variables in model 2 plus birth weight Model 4: adjusted for all variables in model 3 plus body mass index at age 31 years
Michael S. Boyne et al, 2010 **1**	Vulnerable Windows Cohort Study (Birth Cohort)	Kingston, Jamaica	296 subjects (134 boys and 162 girls) were followed up for 11 years from birth till age 11	Weight	Fasting glucose	**Association (regression coefficient) between fasting glucose at 11 years and increase in weight between:** 6 months to 2 years: 0.042 2 years to 11 years: 0.071 (values adjusted for age and sex)
Caroline HD Fall et al, 2008 **77**	New Delhi birth cohort	India	1492 subjects were followed up for 26-32 years from birth till age 26-32	Weight	Glucose	**Association [β (95% CI)] of adulthood glucose levels with conditional weight SD scores:** **Birth to 2 years:** 0.04 (-0.02 to 0.10) *P value*= 0.2 **2-11 years:** 0.04 (-0.01 to 0.10) *P value*= 0.1 **11 years-adulthood:** 0.07 (0.01 to 0.13) *P value*= 0.01 Analysis is adjusted for age, sex, and lifestyle factors: alcohol consumption, physical activity, tobacco use, socioeconomic status in childhood based on father's occupation, socioeconomic status in adult life derived from education level, household possessions and occupation, and family history of any high blood pressure, angina, myocardial infarction, stroke, or diabetes in a first-degree relative
Michael S. Boyne et al, 2010 **1**	Vulnerable Windows Cohort Study (Birth Cohort)	Kingston, Jamaica	296 subjects (134 boys and 162 girls) were followed up for 11 years from birth till age 11	Height	Fasting glucose	**Association (regression coefficient) between fasting glucose at 11 years and increase in height between:** 6 months to 2 years: 0.095

						<u>2 years to 11 years:</u> 0.082 (values adjusted for age and sex)
Ioanna Tzulaki et al, 2010 **112**	Northern Finland Birth Cohort 1966 Study	Finland	3,778 subjects followed up for 31 years from birth to the age of 31 years	Height	Glucose	**Association between glucose levels in adulthood [β (95% CI)] and peak height velocity (cm/year) in infancy:** <u>Model 1:</u> -0.23 (-1.14 to 0.46) *P value*= 0.54 <u>Model 2:</u> -0.38 (-0.94 to 0.54) *P value*= 0.59 <u>Model 3:</u> -0.38 (-1.02 to 0.47) *P value*= 0.47 <u>Model 4:</u> -0.37 (-0.99 to 0.47) *P value*= 0.45 <u>Model 1:</u> adjusted for sex <u>Model 2:</u> adjusted for sex, socioeconomic status at birth, maternal age, maternal height and weight before pregnancy, maternal smoking after the second month of pregnancy, and gestational age at birth <u>Model 3:</u> adjusted for all variables in model 2 plus birth weight <u>Model 4:</u> adjusted for all variables in model 3 plus body mass index at age 31 years
U Sovio et al, 2014 **111**	Northern Finland Birth Cohort of 1966 Study	Finland	4228 subjects were followed up for 31 years from birth till age 31	BMI at adiposity rebound	Glucose	**Association between adulthood glucose levels and BMI at adiposity rebound:** % change= 0.76 95% CI= -0.35 to 1.89 *P value*= 0.18 (adjusted for father's socioeconomic status, mother's age, height, weight, smoking at 2 months of pregnancy, gestational age, child's birth weight, sex, PHV1, BMI at BMIP and age at BMIR)

<table>
<tr>
<td>Debbie A Lawlor et al, 2010

102</td>
<td>Avon Longitudinal Study of Parents and Children</td>
<td>United Kingdom</td>
<td>5235 subjects were followed for 5-6 years from age 9-12 years to 15-16 years</td>
<td>Waist circumference</td>
<td>Glucose</td>
<td>
<table>
<tr><th colspan="2">Association [OR (95% CI)] between change (1 SD z score) in waist circumference and development of high glucose levels:</th></tr>
<tr><th>Males</th><th>Females</th></tr>
<tr><td><u>MODEL 1:</u>
1.18 (1.03 to 1.35)
<u>MODEL 2:</u>
1.14 (0.99 to 1.32)</td><td><u>MODEL 1:</u>
1.09 (0.87 to 1.33)
<u>MODEL 2:</u>
1.06 (0.84 to 1.32)</td></tr>
<tr><td colspan="2">P value for sex interaction= 0.003</td></tr>
<tr><td colspan="2">Model 1: adjusted for age, height and height^2
Model 2: additional adjusted for maternal age, parity, family social class, maternal education, paternal education, birth weight, gestational age, maternal and parental BMI, and puberty</td></tr>
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Table 13: Assesment of quality of studies included for the above outcome

AUTHOR/COHORT	ASSESSMENT OF QUALITY OF INCLUDED COHORTS (NEW CASTLE OTTAWA SCALE)							
	SELECTION				COMPARABILITY	OUTCOME		
	Representativeness of the intervention cohort	Selection of non intervention cohort	Ascertainment of intervention	Demonstration that outcome of interest was not present at start of study	Comparability of cohorts on the basis of the design or analysis	Assessment of outcome	Was follow up long enough for outcomes to occur	Adequacy of follow up of cohorts
Michael S. Boyne et al, 2010 Vulnerable Windows Cohort Study	*		*	*		*	*	
Marlou LA de Kroon et al, 2010 Terneuzen Birth Cohort	*		*	*		*	*	
David J Klein et al, 2004 National Heart, Lung And Blood Institute (Nhlbi) Growth And Health Study (Nghs)	*		*	*		*	*	*
Lise Graversen et al, 2014 Northern Finland Birth Cohort 1966 Study	*		*	*	*	*	*	
Charlotte M Wright et al, 2001 Thousand Families Cohort Study	*		*	*	*	*	*	
U Sovio et al, 2014 Northern Finland Birth Cohort Of 1966 Study	*		*	*	*	*	*	
Caroline HD Fall et al, 2008 New Delhi Birth Cohort	*		*	*	* *	*	*	
Ioanna Tzaoulaki et al, 2010 Northern Finland Birth Cohort 1966 Study	*		*	*	* *	*	*	
Santhur R Srinivasan et al, 1996 Bogalusa Heart Study	*	*	*	*	* *	*	*	

Childhood and adolescent anthropometric measures vs Hypertension in later life

Hypertension: Pooled analysis of 3 British Birth cohorts (1946, 1958 and 1970) demonstrated that those who were persistently overweight in childhood, adolescence and adulthood associated with increased odds of hypertension when compared to those who were never overweight (OR 2.56, 95% CI 1.46-4.68). The pooled analysis also showed that the OR for persistent overweight (OR 2.56, 95% CI 1.40-4.68) was similar that for obesity in adulthood only (OR 2.28, 95% CI 1.76-2.95). Pooled analysis from 5 low and middle income countries [Brazil, Guatemala, New Delhi (India), Philippines and South Africa] showed that higher conditional weights (CW) were associated with increased BP and odds of P/HTN, with coefficients proportional to the contribution of each CW to adult BMI. When adjusted for adult height and BMI, no child CW was associated with adult BP. Another pooled analysis from cohorts of 4 high income countries (Bogalusa, Muscatine, Young Finn and CDAH study) showed that the relative risk (RR) of hypertension among the subjects who were overweight or obese in childhood, but non obese as adults (group-II) was similar to the risks among the subjects who had a consistently normal BMI. In contrast, subjects who were obese as adults, irrespective of their childhood adiposity status (group-III and IV) showed increased risk with respect to hypertension in adulthood. Those who were overweight or obese in childhood showed significant association with hypertension in adulthood (RR 1.8, 95% CI 1.5-2.1).

Two studies considered the impact of childhood BMI on the adulthood hypertension. East Boston Blood Pressure Study has shown the increase risk of hypertension in adulthood with the increase in childhood BMI percentile. A report from the 1958 British Cohort, also analyzed for the association of childhood BMI with adulthood hypertension. The data from the study shows the association of significant increase in hypertension with the BMI at 16 yrs and change in BMI between 7yrs to 16yrs.

Systolic blood pressure: 14 studies (12 cohorts) have shown an association of anthropometric measures in childhood and adolescence with systolic blood pressure (SBP) in later life. The spectrum of exposures varied from height, weight, BMI, ponderal index, waist circumference and skin fold thickness. Ten cohorts showed the relationship of BMI with systolic blood pressure, seven cohorts defined relationship of weight with hypertension, seven cohorts showed the relationship of height with SBP, Longitudinal study of Juvenile Hypertension discussed skin fold thickness with SBP and one cohort addressed age at adiposity rebound and SBP.

The study from vulnerable window cohort [1] has shown a positive association of BMI in (6 months-2 yrs) childhood with systolic blood pressure (2-11 yrs.) childhood. Another study from 1958 British Birth Cohort [49] has shown a significant association at 16 yrs. Adulthood SBP levels were significantly associated with BMI at 16 years and change in BMI between 7-16 years. Significant association was observed for thinnest 10% of the population at 11 & 16 yrs age with the adulthood SBP[49].

The study from Northern Finland Birth Cohort [42] has observed a significant association of BMI at infancy with adulthood SBP in >90th to <95th percentile. Whereas another study from the New Delhi Birth Cohort[77] has observed significant association in the change of conditional BMI in infancy with adulthood SBP. There are five studies from different Cohorts [127,17,30,32,53] which has observed a significant association between childhood BMI and adulthood increase in SBP. However, there is only one study from New Castle Thousand Families Cohort Study[46] which shows an inverse relationship between childhood BMI and adulthood SBP. Study from Nothern Finland Birth Cohort[111] has measured BMI at adiposity rebound at birth and found no association with SBP in adulthood.

Two studies from vulnerable windows Cohort[1] and Avon Longitudinal Study Of Parents And Children[8] demonstrating positive association of weight at infancy with the SBP in childhood (10 and 11 yrs.). Study from the Peruvian Birth Cohort[144] has shown no association between infancy weight and adolescence SBP, but after adjustment for adolescent weight there was an inverse relationship. Another study from Northern Finland Birth Cohort 1966 Study[112] observed that subjects with peak weight velocity > 3.9 Kg /yr from infancy had increased risk of development of SBP in adulthood. There are two studies from different cohorts which shows a positive association of weight in childhood with the adulthood SBP[32,53]. Study from New Delhi Birth Cohort shows a positive association of conditional weight at infancy with the adulthood weight.

There were two studies from ALSPAC[8] and Vulnerable Windows Cohort Study[1] showing a positive association of height at infancy with the higher SBP at mid childhood (10 & 11yrs). A Study from the 1946 British Birth Cohort [17]had observed positive association of height at two years and SBP in adulthood. There was a weak positive association in males and weak negative association in females by a study of longitudinal study of juvenile hypertension between childhood height and adulthood SBP[32]. Study from Minneapolis Children Blood Pressure Study has shown a positive association of childhood height with the adulthood SBP. Peak height velocity > 8cm /yr at infancy was positively associated with the increase in risk of SBP in adulthood in study from Northern Finland Birth Cohort 1966 Study[112]. However, there was no association seen in infancy height and adulthood SBP by the study in Peruvian Birth Cohort[144].

There are two studies from Bogulosa heart study [30] and Longitudinal study in juvenile hypertension[32], which had found a positive association between adolescence skinfold thickness and an increase in SBP in adulthood. However, NHLBI study found no association of sum of skin fold at 9 yrs age and SBP in adoloscence [87]. Two studies from NHLBI[87] and ALSPAC[102] has found a significant association between waist circumference at 9 years and SBP at adolescence. The rapid increase in waist circumference increased the odds of development of high SBP later in adolescence.

Diastolic blood pressure: 14 articles (10 cohorts) analyzed the association between childhood and adolescent anthropometric measures vs diastolic blood pressure(DBP) levels in adulthood. The spectrum of exposures varied from height, weight, BMI, waist circumference, skinfold thickness and age at adiposity rebound. Eight out of the ten cohorts were based in developed countries. The remaining two cohort was based in low and middle income countries (Peru and China).

The Bogalusa Heart Study[30] found that childhood BMI was positively associated with adulthood DBP levels. Three articles[32,49,127] found a positive relationship between adolescent BMI and adulthood DBP levels. In the Northern Finland Birth Cohort Study of 1966, childhood BMI was categorized by percentiles and it was found that subjects in the highest percentile (>95th) had a higher risk of developing higher DBP levels in adulthood. 1958 British Birth Cohort, the BMI in adulthood was stratified (%) according to the childhood and adolescent BMI and they established that adults who were in the leanest 10% of the population during childhood and adolescence had the highest DBP levels in adulthood. Two articles[13,49] found that greater increase in BMI during childhood (2-10 years) and adolescence (11-16 years) was positively associated with adulthood DBP levels. The ALSPAC Study[102] did not find any association between increase in BMI from late childhood to adolescence. The Hong Kong Birth Cohort of 1967 also did not find any association between increase in BMI during and after infancy (6-18 months) and adulthood DBP levels. Two studies demonstrated that the positive association between childhood BMI and adulthood DBP levels was inversed by adjusting for adulthood BMI levels[30, 46]. Another two studies[30, 127] from the Bogalusa Heart Study found the adulthood DBP levels correlated with the tracking of childhood obesity into adulthood.

The ALSPAC study[8] established a strong positive relationship between post infancy weight and weight for height and childhood (10 years) DBP levels. The Longitudinal Study of Juvenile Hypertension[32] found weak positive association between adolescent weight and adult DBP levels. The Peruvian Birth Cohort[144] did not find any association between weight for length in infancy and early childhood and adolescent DBP levels. The Northern Finland Birth Cohort of 1966[112] demonstrated that greater gain in weight in infancy was associated with higher adulthood DBP levels, but this relationship was inversed by adjusting for adulthood BMI.

The Northern Finland Birth Cohort of 1966[112] found that a greater increase in height during infancy was associated with higher DBP in adulthood even after adjusting for adulthood BMI. The ALSPAC study did not find any association between postinfancy height and adolescent DBP levels. Similar results were found in the Peruvian Birth Cohort[144]. The Longitudinal Study of Juvenile Hypertension[32] found that there was a weak positive relationship between adolescent height and DBP levels in adults in males and a weak negative relationship in females.

The Bogalusa Heart Study[30] found a positive correlation between childhood TSF thickness and adulthood DBP levels. The National Heart, Lung and Blood Institute Growth and Health Study (NGHS)[87] demonstrated a positive relationship between sum of skinfold thickness at age 9 and the increase in DBP levels from 12 to 14 years. The Longitudinal Study of Juvenile Hypertension[32] established that there was a weak positive association between adolescent TSF and adulthood DBP. They also found a strong positive correlation between subscapular SF thickness and adult DBP levels in females only.

The ALSPAC study[102] established a positive relationship between rapid increase in waist circumference from late childhood (9-12 years) to adolescence (15-16 years) and DBP levels in adolescence. The National Heart, Lung and Blood Institute Growth and Health Study (NGHS)[87] demonstrated that waist circumference at age 9 was associated with increase in DBP levels from 12 to 14 years.

The Northern Finland Birth Cohort of 1966 Study[111] established that an earlier age at adiposity rebound was associated with higher DBP levels in adulthood. But they found no relationship between BMI at adiposity rebound and adult DBP levels.

Table 14 Showing the association of childhood and adolescent anthropometric measures with hypertension in later life

AUTHOR	COHORT	SETTING	NO. OF SUBJECTS/ LENGTH OF FOLLOW-UP/ CHILDHOOD AGE/ ADULTHOOD AGE	EXPOSURES	OUTCOMES MEASURED	EFFECT SIZE
Adair, 2009	Five birth cohorts from Low and middle income countries	Brazil, Guatemala, New Delhi (India), Philippines and South Africa	4335 participants followed up from 1, 2 and 4 years of age to adulthood (mean age 20-30 years)	Conditional relative weight (CW)	prehypertension and hypertension (P/HTN), defined as SBP≥ 130 mm Hg or DBP≥ 80 mm Hg for adults.	**Association of conditional weight (CW) at 12, 24, and 48 mo with adult prehypertension and hypertension** **OR (95% CI)** CW3 12 mo 1.20 (1.12, 1.29) p<0.01 CW 2 years 1.02 (0.95, 1.09) p= 0.54 CW 48 mo 1.18 (1.10, 1.26) p<,0.01 (Adjused for age, sex, site) **OR (95% CI)** CW3 12 mo 1.03 (0.94, 1.11) p=0.56 CW 2 years 0.93 (0.86, 1.00) p= 0.05 CW 48 mo 0.98 (0.90, 1.05) p= 0.53 (Adjused for age, sex, site, adult BMI and height)
Park 2013	Three British cohort (1946, 1958 and 1970)	England, Wales and Scotland (1946) United kingdom (1958 and 1970)	11,447 subjectswere followed-up from 7,15 and 43 years of age to 53 years of age (1946) 7,16 and 42 years of age to 46 (1958) 10,16 and 34 years of age to 34 years of age (1970)	BMI (International age- and sex-specific BMI centiles, cut-off points corresponding to overweight (≥25 kg/m²) and obesity (≥30 kg/m²) in adulthood	Hypertension	**Association between patterns of overweight in childhood,adolescence and adulthood and Hypertension outcome (logistic regression analysis)** **Overweight** — **Hypertension (OR, 95% CI)** Never overweight 1 Childhood only 0.87 (0.54-1.40) Adolescence only 0.97 (0.61-1.55) Adulthood only 2.28 (1.76-2.95) Childhood + Adolescence 1.01 (0.46-2.21) Childhood + Adulthood 2.91 (1.54-5.49) Adolescence + Adulthood 3.01 (2.11-4.29) Persistant overweight 2.56 (1.40-4.68)
Juonala et al, 2011	Bogalusa Heart study, Muscatine study, Young Finns Study, and Childhood Determinants of Adult Health (CDAH)	United states (2 nos), Finland Australia	6328 subjects were followed up from mean age of 11.4 ± 4.0 years to 23.1 ± 3.3 years of age	BMI (International age- and sex-specific BMI centiles, cut-off points corresponding to overweight (≥25 kg/m²) and obesity (≥30 kg/m²) in adulthood	Hypertension	**Relative risk of Hypertension in adulthood who were overweight or obese in childhood (pooled analysis)** **RR (95% CI)** 1.8 (1.5-2.1) (Adjusted for age, height, cohort and length of follow-up) **Relative risk of Hypertension in adulthood according to adiposity group in childhood and adulthood** **RR (95% CI)** *Group-I Reference * Group-II 1.3 (0.4-4.1) p=0.69 * Group III 5.4 (3.4-8.5) p<0.001

						* Group IV 4.5 (2.9-6.8) p<0.001
Alison E Field et al, 2005 **45**	East Boston Blood Pressure study	United States	314 subjects were followed up for 8-12 years from the age of 8-15 years to 18-26 years	BMI	Hypertension	**Risk of being hypertensive in adulthood according to age-specific childhood BMI:** OR= 2.2 95% CI= 1.2 to 3.9
Leah Li et al, 2007 **49**	1958 British Birth Cohort	United Kingdom	9297 subjects were followed up for 45 years from birth till age 45	BMI	Hypertension	**Association [OR (95% CI)] between BMI in childhood and adolescence and hypertension in adulthood:** <u>7 years:</u> 1.10 (1.04 to 1.17) <u>11 years:</u> 1.22 (1.15 to 1.28) <u>16 years:</u> 1.27 (1.20 to 1.34) (adjusted for room temperature and sex) **Association [OR (95% CI)] between hypertension in adulthood and BMI change between:** <u>Birth to 7 years:</u> 1.13 (1.07 to 1.20) <u>7-11 years:</u> 1.26 (1.16 to 1.36) <u>11-16 years:</u> 1.21 (1.10 to 1.32) [adjusted for room temperature, sex, and previous BMI (e.g. change in BMI between 7 and 11 years was adjusted for BMI at 7 years)]

Note: * Group-I, children with normal BMI in childhood and who were non obese as adults; Group II, those who were overweight or obese in child hood but non obese as adults; Group-III, those who were overweight or obese in child hood and obese as adults; Group-IV, those with a normal BMI in childhood who were obese as adults

Table 15 Showing the association of childhood and adolescent anthropometric measures with systolic blood pressure (SBP) in later life

AUTHOR	COHORT	SETTING	NO. OF SUBJECTS/ LENGTH OF FOLLOW-UP/ CHILDHOOD AGE/ ADULTHOOD AGE	EXPOSURES	OUTCOMES MEASURED	EFFECT SIZE
Michael s. Boyne et al, 2010 **1**	Vulnerable Windows Cohort Study (Birth Cohort)	Kingston, Jamaica	296 subjects (134 boys and 162 girls) were followed up for 11 years from birth till age 11	BMI	Systolic Blood Pressure	**Association (regression coefficient) between systolic blood pressure at 11 years and increase in BMI between:** <u>6 months to 2 years:</u> 0.256 *P value* <0.001 <u>2 years to 11 years:</u> 0.265 *P value* <0.001 (values adjusted for age and sex)
Marlou LA de Kroon et al, 2010 **13**	Terneuzen Birth Cohort (1977-86)	Netherlands	642 subjects were followed for 18-28 years from birth to the age of 18-28 years	BMI (overweight and obese defined according to the Dutch reference data)	Systolic blood pressure	**Association between systolic blood pressure in adulthood [Regression coefficient (95% CI)] and change in conditional measures of BMI:** <u>Change in score from birth to 1 year:</u> 0.01 (-0.05 to 0.07) <u>Change in score from 1-2 years:</u> 0.00 (-0.06 to 0.06) <u>Change in score from 2-6 years:</u> 0.19 (0.13 to 0.25) *P value* <0.002 <u>Change in score from 6-10 years:</u> 0.11 (0.05 to 0.17) *P value* <0.002 <u>Change in score from 10-18 years:</u> 0.11 (0.04 to 0.17) *P value* <0.002 (all analyses are adjusted for age and gender) (Change score: the expected value of BMI SDS at a break age is called the *status score.* The change between the status score at the start and the end of the various age intervals is called the *change score*)

Debbie A Lawlor et al, 2010 **102**	Avon Longitudinal Study of Parents and Children (ALSPAC)	United Kingdom	5235 subjects were followed for 5-6 years from age 9-12 years to 15-16 years	BMI	Systolic blood pressure	**Association [OR (95% CI)] between change (1 SD z score) in BMI and development of high SBP:** **Males**: MODEL 1: 1.26 (1.15 to 1.37); MODEL 2: 1.24 (1.13 to 1.37) **Females**: MODEL 1: 1.24 (1.13 to 1.37); MODEL 2: 1.23 (1.10 to 1.38) *P value for sex interaction*= 0.91 Model 1: adjusted for age, height and height^2 Model 2: additional adjusted for maternal age, parity, family social class, maternal education, paternal education, birth weight, gestational age, maternal and parental BMI, and puberty
Santhur R Srinivasan et al, 1996 **127**	Bogalusa Heart Study	United States	783 subjects were followed up for 14 years from age 13-17 to age 27-31 years	BMI	Systolic blood pressure	**Association between adolescent weight status and SBP levels in adulthood:** β= 4.1 *P value* <0.0001 **Association between change in BMI during follow up and SBP levels in adulthood:** β= 0.8 *P value* <0.0001 *P value*: overweight vs. lean
Leah Li et al, 2007 **49**	1958 British Birth Cohort	United Kingdom	9297 subjects were followed up for 45 years from birth till age 45	BMI	Systolic blood pressure	**Association [regression coefficient (95% CI)] between BMI in childhood and adolescence and SBP levels in adulthood:** <u>7 years:</u> 0.4 (0.0 to 0.7) <u>11 years:</u> 0.9 (0.6 to 1.3) <u>16 years:</u> 1.3 (0.9 to 1.6) (adjusted for room temperature and sex) **Association [regression coefficient (95% CI)] between adulthood SBP levels and BMI change between:** <u>Birth to 7 years:</u> 1.1 (-0.1 to 2.2)

						<u>7-11 years:</u> 2.1 (1.0 to 3.3) <u>11-16 years:</u> 3.1 (1.8 to 4.3) [adjusted for room temperature, sex, and previous BMI (e.g. change in BMI between 7 and 11 years was adjusted for BMI at 7 years)]
Leah Li et al, 2007 **49**	1958 British Birth Cohort	United Kingdom	9297 subjects were followed up for 45 years from birth till age 45	BMI	Systolic blood pressure	**Association [regression coefficient (95% CI)] of adulthood SBP levels and concurrent BMI, stratified childhood BMI:** **At 7 years:** <u>Bottom 10%:</u> 3.5 (2.2 to 4.7) <u>10-50%:</u> 4.3 (3.7 to 4.9) <u>50-90%:</u> 4.4 (3.9 to 5.0) <u>Top 90%:</u> 4.0 (3.1 to 4.9) **At 11 years:** <u>Bottom 10%:</u> 5.5 (4.0 to 7.0) <u>10-50%:</u> 4.3 (3.6 to 4.9) <u>50-90%:</u> 4.4 (3.8 to 5.0) <u>Top 90%:</u> 3.3 (2.4 to 4.2) **At 16 years:** <u>Bottom 10%:</u> 5.6 (3.8 to 7.4) <u>10-50%:</u> 5.1 (4.3 to 5.8) <u>50-90%:</u> 4.3 (3.6 to 4.9) <u>Top 90%:</u> 3.1 (2.2 to 4.1) (adjusted for room temperature and sex)
Rebecca Handy et al, 2004 **17**	1946 British Birth Cohort	United Kingdom	3157 subjects were followed up for 41 years from the age of 2 years to 43 years	BMI	Systolic blood pressure	<table><tr><th>Association [regression coefficient (95% CI)] between systolic blood pressure at age 43 and BMI at (men):</th><th>Association [regression coefficient (95% CI)] between systolic blood pressure at age 43 and BMI at (women):</th></tr><tr><td><u>2 years:</u> -0.68 (-1.86 to 0.50) P value= 0.3 <u>4 years:</u> -0.16 (-1.05 to 0.72) P value= 0.7 <u>7 years:</u> -0.51 (-1.40 to 0.37) P value= 0.3</td><td><u>2 years:</u> -1.29 (-2.47 to -0.10) P value= 0.03 <u>4 years:</u> -0.44 (-1.36 to 0.49) P value= 0.4 <u>7 years:</u> -0.64 (-1.58 to 0.30) P value= 0.2 <u>15 years:</u></td></tr></table>

						<u>15 years:</u> -0.22 (-1.16 to 0.71) *P value*= 0.6 0.40 (-0.59 to 1.39) *P value*= 0.4 (adjusted for birthweight and body size at 2, 4 and 7 years)
DS Freedman et al, 2001 **30**	Bogalusa Heart Study	United States	2617 subjects were followed up for 17 years from the age of 2-17 years to 18-37 years	BMI* (85^{th}-95^{th} percentile are at risk of being overweight; >95^{th} percentile are overweight)	Systolic blood pressure	**Association (spearman correlation coefficient) of adulthood systolic blood pressure with:** <u>Childhood BMI percentile:</u> 0.08 <u>Change in BMI during follow up:</u> 0.15 <u>Childhood BMI percentile adjusted for adult BMI:</u> -0.07 (values adjusted for race, sex, and age)
Lise Graversen et al, 2014 **42**	Northern Finland Birth Cohort 1966 Study	Finland	2120 subjects were followed up for 31 years from the age of 1 year to 31 years	BMI	Systolic blood pressure	**Risk of having high systolic blood pressure levels in adulthood [relative risk (95% CI)] by BMI percentiles at age 5 years:** <u><5^{th} percentile:</u> 1.0 (0.7 to 1.3) <u>≥5^{th} to <50^{th} percentile:</u> 1.0 <u>≥50^{th} to <75^{th} percentile:</u> 1.1 (0.9 to 1.2) <u>≥75^{th} to <90^{th} percentile:</u> 0.9 (0.8 to 1.1) <u>≥90^{th} to <95^{th} percentile:</u> 1.3 (1.1 to 1.6) <u>≥95^{th} percentile:</u> 1.1 (0.9 to 1.5) (values adjusted for gender) (linear associations were adjusted for birth weight, gestational age, maternal smoking during pregnancy, maternal age at birth, maternal pre-pregnancy BMI, maternal education level, and parity)
Jurate Klumbiene et al, 2000 **32**	Longitudinal study of Juvenile Hypertension	Lithuania	505 subjects were followed up for 20 years from the age of 12-13 years to 32-33 years	BMI	Systolic blood pressure	**Association between adulthood systolic blood pressure and childhood BMI:** <u>Males:</u> r= 0.18 *P value* <0.01 <u>Females:</u> r= 0.12

						P value <0.05
Alan R Sinaiko et al, 1999 **53**	Minneapolis Children's Blood Pressure Study	United States	679 subjects were followed up for 16 years from 7.7 years to 23.6 years	BMI	Systolic blood pressure	**Association between SBP levels in adulthood and BMI in childhood:** r= 0.27 *P value* <0.0001 **Association between SBP levels in adulthood and rate of increase in BMI in childhood:** r= 0.16 *P value*= 0.0001 **Association between SBP levels in adulthood and rate of increase in BMI in adolescence:** r= 0.18 *P value*= 0.0001
Caroline HD Fall et al, 2008 **77**	New Delhi birth cohort	India	1492 subjects were followed up for 26-32 years from birth till age 26-32	BMI	Systolic blood pressure	**Association [β (95% CI)] of adulthood systolic blood pressure with conditional BMI SD scores:** **Birth to 2 years:** 0.06 (0.01 to 0.12) *P value*= 0.02 **2-11 years:** 0.11 (0.06 to 0.17) *P value* <0.001 **11 years-adulthood:** 0.30 (0.24 to 0.35) *P value* <0.001 Analysis is adjusted for age, sex, and lifestyle factors: alcohol consumption, physical activity, tobacco use, socioeconomic status in childhood based on father's occupation, socioeconomic status in adult life derived from education level, household possessions and occupation, and family history of any high blood pressure, angina, myocardial infarction, stroke, or diabetes in a first-degree relative
Charlotte M Wright et al, 2001 **46**	Newcastle thousand families cohort study (birth cohort)	United Kingdom	412 subjects were followed for 41 years from the age of 9 years to 50 years	BMI (childhood BMI assessed as per body mass index reference curves for UK,	Systolic blood pressure	**Association (standardized regression coefficients) between BMI at ages 9 and 13 years in childhood and systolic blood pressure at age 50:** <u>Males:</u> BMI age 9 -0.09

				1990; Adulthood overweight defined as BMI between 24-29 kg/m² and obese as BMI≥30 kg/m²)		BMI age 13 0.01 <u>Females:</u> BMI age 9 -0.15 *P value* <0.05 BMI age 13 -0.10 (values adjusted for body mass index at age 50)
U Sovio et al, 2014 **111**	Northern Finland Birth Cohort of 1966 Study	Finland	4228 subjects were followed up for 31 years from birth till age 31	BMI at adiposity rebound	Systolic blood pressure	**Association between adulthood SBP and BMI at adiposity rebound:** % change=-0.35 95% CI= -1.47 to -0.78 *P value*= 0.54 (adjusted for father's socioeconomic status, mother's age, height, weight, smoking at 2 months of pregnancy, gestational age, child's birth weight, sex, PHV1, BMI at BMIP and age at BMIR)
Michael s. Boyne et al, 2010 **1**	Vulnerable Windows Cohort Study (Birth Cohort)	Kingston, Jamaica	296 subjects (134 boys and 162 girls) were followed up for 11 years from birth till age 11	Weight	Systolic Blood Pressure	**Association (regression coefficient) between systolic blood pressure at 11 years and increase in weight between:** <u>6 months to 2 years:</u> 0.317 *P value* <0.001 <u>2 years to 11 years:</u> 0.250 *P value* <0.001 (values adjusted for age and sex)
Alexander Jones et al, 2012 **8**	Avon Longitudinal Study of Parents and Children (Birth Cohort)	United Kingdom	3230 boys and 3346 girls were followed up for 10 years from birth till age 10	Weight	Systolic Blood Pressure	**Association between infancy weight gain between 0-17 months and systolic blood pressure at 10 years:** Regression coefficient= 0.90 95% CI= 0.68 to 1.12 *P value* <0.001 **Association between infancy weight for height gain between >17 months to 10 years and systolic blood pressure at 10 years:** Regression coefficient= 1.91 95% CI= 1.69 to 2.13 *P value* <0.001

						(values adjusted for sex)
Jurate Klumbiene et al, 2000 **32**	Longitudinal study of Juvenile Hypertension	Lithuania	505 subjects were followed up for 20 years from the age of 12-13 years to 32-33 years	Weight	Systolic blood pressure	**Association between adulthood systolic blood pressure and childhood weight:** <u>Males:</u> r= 0.17 *P value* <0.05 <u>Females:</u> r= 0.07
Robie Sterling et al, 2014 **144**	Peruvian Birth Cohort	Peru	147 subjects were followed up for 11-14 years from birth till 11-14 years	Weight	Systolic blood pressure	**Association [β (95% CI)] between rate of change of weight for length z score (1 SD/month) between 6-30 months and SBP in adolescence:** MODEL 1: -0.77 (-3.3 to 1.8) MODEL 2: -2.45 (-4.9 to -0.0) Model 1: adjusted for sex, age at the time of follow up, and socioeconomic deprivation Model 2: additionally adjusted for adolescent BMI for age z score and height
Alan R Sinaiko et al, 1999 **53**	Minneapolis Children's Blood Pressure Study	United States	679 subjects were followed up for 16 years from 7.7 years to 23.6 years	Weight	Systolic blood pressure	**Association between SBP levels in adulthood and weight in childhood:** r= 0.30 *P value*= 0.0001 **Association between SBP levels in adulthood and rate of increase in weight in childhood:** r= 0.21 *P value*= 0.0001 **Association between SBP levels in adulthood and rate of increase in weight in adolescence:** r= 0.28 *P value*= 0.0001
Ioanna Tzulaki et al, 2010 **112**	Northern Finland Birth Cohort 1966 Study	Finland	3,778 subjects followed up for 31 years from birth to the age of 31 years	Weight	Systolic blood pressure	**Association between systolic blood pressure in adulthood [β (95% CI)] and peak height velocity (cm/year) in infancy:** <u>Model 1:</u>

						1.21 (0.38 to 2.03) *P value*= 0.004 Model 2: 0.99 (0.09 to 1.89) *P value*= 0.03 Model 3: 1.01 (0.20 to 2.00) *P value*= 0.02 Model 4: 0.45 (-0.41 to 1.31) *P value*= 0.31 Model 1: adjusted for sex Model 2: adjusted for sex, socioeconomic status at birth, maternal age, maternal height and weight before pregnancy, maternal smoking after the second month of pregnancy, and gestational age at birth Model 3: adjusted for all variables in model 2 plus birth weight Model 4: adjusted for all variables in model 3 plus body mass index at age 31 years
Caroline HD Fall et al, 2008 **77**	New Delhi birth cohort	India	1492 subjects were followed up for 26-32 years from birth till age 26-32	Weight	Systolic blood pressure	**Association [β (95% CI)] of adulthood systolic blood pressure with conditional weight SD scores:** **Birth to 2 years:** 0.11 (0.05 to 0.17) *P value* <0.001 **2-11 years:** 0.11 (0.06 to 0.17) *P value* <0.001 **11 years-adulthood:** 0.30 (0.24 to 0.35) *P value* <0.001 Analysis is adjusted for age, sex, and lifestyle factors: alcohol consumption, physical activity, tobacco use, socioeconomic status in childhood based on father's occupation, socioeconomic status in adult life derived from education level, household possessions and occupation, and family history of any high blood pressure, angina, myocardial infarction, stroke, or diabetes in a first-degree relative
Alexander Jones et al, 2012 **8**	Avon Longitudinal Study of Parents and Children (Birth Cohort)	United Kingdom	3230 boys and 3346 girls were followed up for 10 years from birth till age 10	Height	Systolic Blood Pressure	**Association between infancy height gain between 0-17 months and systolic blood pressure at 10 years:** Regression coefficient= 0.82 95% CI= 0.58 to 1.07 *P value* <0.001

						Association between postinfancy height gain between >17 months to 10 years and systolic blood pressure at 10 years: Regression coefficient= 1.20 95% CI= 0.96 to 1.45 *P value* <0.001 (values adjusted for sex)
Alan R Sinaiko et al, 1999 **53**	Minneapolis Children's Blood Pressure Study	United States	679 subjects were followed up for 16 years from 7.7 years to 23.6 years	Height	Systolic blood pressure	**Association between SBP levels in adulthood and height in childhood:** r= 0.21 *P value*= 0.0001 **Association between SBP levels in adulthood and rate of increase in BMI in childhood:** r= -0.02 *P value*= 0.5289 **Association between SBP levels in adulthood and rate of increase in BMI in adolescence:** r= 0.16 *P value*= 0.0001
Rebecca Handy et al, 2004 **17**	1946 British Birth Cohort	United Kingdom	3157 subjects were followed up for 41 years from the age of 2 years to 43 years	Height	Systolic blood pressure	**Association [regression coefficient (95% CI)] between systolic blood pressure at age 43 and height at (men):** 2 years: -0.49 (-1.67 to 0.67) *P value*= 0.4 4 years: -1.15 (-2.05 to -0.25) *P value*= 0.01 7 years: -0.46 (-1.34 to 0.41) *P value*= 0.3 15 years: 0.092 (-0.83 to 1.02) *P value*= 0.9 **Association [regression coefficient (95% CI)] between systolic blood pressure at age 43 and height at (women):** 2 years: -0.95 (-2.12 to 0.23) *P value*= 0.1 4 years: -1.28 (-2.22 to -0.35) *P value*= 0.007 7 years: -1.05 (-1.97 to -0.13) *P value*= 0.03 15 years: -0.91 (-1.85 to 0.04) *P value*= 0.06

						(adjusted for birthweight and body size at 2,4 and 7 years)
Jurate Klumbiene et al, 2000 **32**	Longitudinal study of Juvenile Hypertension	Lithuania	505 subjects were followed up for 20 years from the age of 12-13 years to 32-33 years	Height	Systolic blood pressure	**Association between adulthood systolic blood pressure and childhood height:** Males: r= 0.08 Females: r= -0.08
Michael s. Boyne et al, 2010 **1**	Vulnerable Windows Cohort Study (Birth Cohort)	Kingston, Jamaica	296 subjects (134 boys and 162 girls) were followed up for 11 years from birth till age 11	Height	Systolic Blood Pressure	**Association (regression coefficient) between systolic blood pressure at 11 years and increase in height between:** 6 months to 2 years: 0.209 *P value* <0.001 2 years to 11 years: 0.161 (values adjusted for age and sex)
Ioanna Tzulaki et al, 2010 **112**	Northern Finland Birth Cohort 1966 Study	Finland	3,778 subjects followed up for 31 years from birth to the age of 31 years	Height	Systolic blood pressure	**Association between systolic blood pressure in adulthood [β (95% CI)] and peak height velocity (cm/year) in infancy:** Model 1: 1.41 (0.52 to 2.29) *P value*= 0.002 Model 2: 1.73 (0.75 to 2.72) *P value*= 0.001 Model 3: 1.58 (0.59 to 2.58) *P value*= 0.002 Model 4: 1.57 (0.62 to 2.51) *P value*= 0.001 Model 1: adjusted for sex Model 2: adjusted for sex, socioeconomic status at birth, maternal age, maternal height and weight before pregnancy, maternal smoking after the second month of pregnancy, and gestational age at birth Model 3: adjusted for all variables in model 2 plus birth weight Model 4: adjusted for all variables in model 3 plus body mass index at age 31 years
Robie Sterling et al, 2014	Peruvian Birth Cohort	Peru	152 subjects were followed up for 11-14 years from birth till 11-	Height	Systolic blood pressure	**Association [β (95% CI)] between rate of change of length for age z score (1 SD/month) between 0-30 months and SBP in**

144			14 years			**adolescence:** MODEL 1: 0.80 (-0.6 to 2.2) MODEL 2: -0.94 (-2.6 to 0.7) Model 1: adjusted for sex, age at the time of follow up, and socioeconomic deprivation Model 2: additionally adjusted for adolescent BMI for age z score and height
Jurate Klumbiene et al, 2000 **32**	Longitudinal study of Juvenile Hypertension	Lithuania	505 subjects were followed up for 20 years from the age of 12-13 years to 32-33 years	Triceps skinfold thickness	Systolic blood pressure	**Association between adulthood systolic blood pressure and childhood TSF:** <u>Males:</u> r= 0.17 *P value* <0.05 <u>Females:</u> r= 0.09
Jurate Klumbiene et al, 2000 **32**	Longitudinal study of Juvenile Hypertension	Lithuania	505 subjects were followed up for 20 years from the age of 12-13 years to 32-33 years	Subscapular skinfold thickness	Systolic blood pressure	**Association between adulthood systolic blood pressure and childhood SSF:** <u>Males:</u> r= 0.19 *P value* <0.01 <u>Females:</u> r= 0.12 *P value* <0.05
Yin Bun Cheung et al, 2000 **38**	Hong Kong Birth Cohort of 1967	China	122 subjects were followed up for 30 years from birth till the age of 30 years	Ponderal Index (PI)	Systolic blood pressure	**Association [regression coefficient (95% CI)] between rate of change of PI between 6-18 months and adulthood systolic blood pressure levels:** <u>Bivariate regression coefficient:</u> -0.7 (-1.8 to 0.3) *P value*= 0.18 (adjusted for gender, current BMI, mother's education, mother's health during pregnancy, and respondent's education) <u>Multivariate regression coefficient:</u> -2.2 (-4.1 to -0.4) *P value*= 0.02 (adjusted for PI at birth, change in PI between 0-6 months, birth length, change in birth length between 0-6 months and 6-18 months, gestational age, gender, mother's education, mother's health during pregnancy, respondent's education, and current BMI)

J White et al, 2011 **87**	National Heart, Lung and Blood Institute (NHLBI) Growth and Health Study (NGHS)	United States	617-904 subjects were followed up for 5 years from the age of 9 till 12-14 years	Sum of skinfolds	Systolic blood pressure	**Association between SSF at age 9 and change in SBP levels between 12 to 14 years:** β= 0.02 95% CI= -0.02 to 0.07 *P value* NS (adjusted for age at entry, race, parental education, household income, menstrual status at 12 and 14 years, and changes in: total calorific intake, key score, and height)
J White et al, 2011 **87**	National Heart, Lung and Blood Institute (NHLBI) Growth and Health Study (NGHS)	United States	904 subjects were followed up for 5 years from the age of 9 till 12-14 years	Waist circumference	Systolic blood pressure	**Association between waist circumference at age 9 and change in SBP levels between 12 to 14 years:** β= 0.24 95% CI= 0.11 to 0.37 *P value* <0.001 (adjusted for age at entry, race, parental education, household income, menstrual status at 12 and 14 years, and changes in: total calorific intake, key score, and height)
Debbie A Lawlor et al, 2010 **102**	Avon Longitudinal Study of Parents and Children (ALSPAC)	United Kingdom	5235 subjects were followed for 5-6 years from age 9-12 years to 15-16 years	Waist circumference	Systolic blood pressure	**Association [OR (95% CI)] between change (1 SD z score) in waist circumference and development of high SBP:** **Males:** MODEL 1: 1.24 (1.12 to 1.36); MODEL 2: 1.20 (1.08 to 1.33) **Females:** MODEL 1: 1.21 (1.09 to 1.35); MODEL 2: 1.18 (1.05 to 1.33) *P value for sex interaction*= 0.85 Model 1: adjusted for age, height and height^2 Model 2: additional adjusted for maternal age, parity, family social class, maternal education, paternal education, birth weight, gestational age, maternal and parental BMI, and puberty
DS Freedman et al, 2001 **30**	Bogalusa Heart Study	United States	2617 subjects were followed up for 17 years from the age of 2-17 years to 18-37 years	Triceps skinfold thickness	Systolic blood pressure	**Association between adulthood systolic blood pressure and childhood triceps skinfold thickness:** r= 0.07 (values adjusted for race, age, and sex)

Table 16 Showing the association of childhood and adolescent anthropometric measures with diastolic blood pressure (DBP) in later life

AUTHOR	COHORT	SETTING	NO. OF SUBJECTS/ LENGTH OF FOLLOW-UP/ CHILDHOOD AGE/ ADULTHOOD AGE	EXPOSURES	OUTCOMES MEASURED	EFFECT SIZE
Marlou LA de Kroon et al, 2010 **13**	Terneuzen Birth Cohort (1977-86)	Netherlands	642 subjects were followed for 18-28 years from birth to the age of 18-28 years	BMI (overweight and obese defined according to the Dutch reference data)	Diastolic blood pressure	**Association between diastolic blood pressure in adulthood [Regression coefficient (95% CI)] and change in conditional measures of BMI:** Change in score from birth to 1 year: 0.04 (-0.04 to 0.12) Change in score from 1-2 years: 0.01 (-0.07 to 0.09) Change in score from 2-6 years: 0.20 (0.12 to 0.28) *P value* <0.002 Change in score from 6-10 years: 0.10 (0.02 to 0.18) *P value* <0.05 Change in score from 10-18 years: 0.04 (-0.02 to 0.10) (all analyses are adjusted for age and gender) (Change score: the expected value of BMI SDS at a break age is called the *status score.* The change between the status score at the start and the end of the various age intervals is called the *change score*)
DS Freedman et al, 2001 **30**	Bogalusa Heart Study	United States	2617 subjects were followed up for 17 years from the age of 2-17 years to 18-37 years	BMI* (85^{th}-95^{th} percentile are at risk of being overweight; >95^{th} percentile are overweight)	Diastolic blood pressure	**Association (spearman correlation coefficient) of adulthood diastolic blood pressure with:** Childhood BMI percentile: 0.09 Change in BMI during follow up: 0.13 Childhood BMI percentile adjusted for adult BMI: -0.05 (values adjusted for race, sex, and age)
Jurate Klumbiene et al, 2000 **32**	Longitudinal study of Juvenile Hypertension	Lithuania	505 subjects were followed up for 20 years from the age of 12-13 years to 32-33 years	BMI	Diastolic blood pressure	**Association between adulthood diastolic blood pressure and childhood BMI:** Males: r= 0.14 *P value* <0.05 Females: r= 0.12

						P value <0.05
Lise Graversen et al, 2014 **42**	Northern Finland Birth Cohort 1966 Study	Finland	2120 subjects were followed up for 31 years from the age of 1 year to 31 years	BMI	Diastolic blood pressure	**Risk of having high diastolic blood pressure levels in adulthood [relative risk (95% CI)] by BMI percentiles at age 5 years:** <5th percentile: 0.8 (0.5 to 1.2) ≥5th to <50th percentile: 1.0 ≥50th to <75th percentile: 1.0 (0.9 to 1.2) ≥75th to <90th percentile: 0.9 (0.8 to 1.5) ≥90th to <95th percentile: 1.1 (0.8 to 1.5) ≥95th percentile: 1.3 (1.0 to 1.7) (values adjusted for gender) (linear associations were adjusted for birth weight, gestational age, maternal smoking during pregnancy, maternal age at birth, maternal pre-pregnancy BMI, maternal education level, and parity)
U Sovio et al, 2014 **111**	Northern Finland Birth Cohort of 1966 Study	Finland	4228 subjects were followed up for 31 years from birth till age 31	BMI at adiposity rebound	Diastolic blood pressure	**Association between adulthood DBP and BMI at adiposity rebound:** % change= 0.60 95% CI= -1.08 to 2.31 *P value*= 0.49 (adjusted for father's socioeconomic status, mother's age, height, weight, smoking at 2 months of pregnancy, gestational age, child's birth weight, sex, PHV1, BMI at BMIP and age at BMIR)
Charlotte M Wright et al, 2001 46	Newcastle thousand families cohort study (birth cohort)	United Kingdom	412 subjects were followed for 41 years from the age of 9 years to 50 years	BMI (childhood BMI assessed as per body mass index reference curves for UK, 1990; Adulthood overweight defined as BMI between 24-29 kg/m2 and obese as	Diastolic blood pressure	Association (standardized regression coefficients) between BMI at ages 9 and 13 years in childhood and diastolic blood pressure at age 50: Males: BMI age 9 -0.11 BMI age 13 -0.11 Females: BMI age 9 -0.16 P value <0.05

				BMI≥30 kg/m2)		BMI age 13 -0.06 P value <0.05 (values adjusted for body mass index at age 50)
Santhur R Srinivasan et al, 1996 **127**	Bogalusa Heart Study	United States	783 subjects were followed up for 14 years from age 13-17 to age 27-31 years	BMI	Diastolic blood pressure	**Association between adolescent weight status and DBP levels in adulthood:** β= 2.7 *P value* <0.001 **Association between change in BMI during follow up and DBP levels in adulthood:** β= 0.5 *P value* <0.0001 *P value*: overweight vs. lean
Leah Li et al, 2007 **49**	1958 British Birth Cohort	United Kingdom	9297 subjects were followed up for 45 years from birth till age 45	BMI	Diastolic blood pressure	**Association [regression coefficient (95% CI)] between BMI in childhood and adolescence and DBP levels in adulthood:** <u>7 years:</u> 0.3 (0.0 to 0.5) <u>11 years:</u> 0.7 (0.4 to 0.9) <u>16 years:</u> 0.9 (0.7 to 1.2) (adjusted for room temperature and sex) **Association [regression coefficient (95% CI)] between adulthood DBP levels and BMI change between:** <u>Birth to 7 years:</u> 0.4 (0.2 to 0.7) <u>7-11 years:</u> 0.8 (0.4 to 1.1) <u>11-16 years:</u> 1.0 (0.6 to 1.4) [adjusted for room temperature, sex, and previous BMI (e.g. change in BMI between 7 and 11 years was adjusted for BMI at 7 years)]
Leah Li et al, 2007	1958 British Birth Cohort	United Kingdom	9297 subjects were followed up for 45 years from birth till age 45	BMI	Diastolic blood pressure	**Association [regression coefficient (95% CI)] of adulthood DBP levels and concurrent BMI, stratified childhood BMI:**

49						**At 7 years:** Bottom 10%: 2.2 (1.4 to 3.1) 10-50%: 3.2 (2.8 to 3.6) 50-90%: 3.4 (3.0 to 3.7) Top 90%: 2.5 (1.9 to 3.1) **At 11 years:** Bottom 10%: 4.0 (3.0 to 5.0) 10-50%: 3.5 (3.1 to 3.9) 50-90%: 3.3 (2.9 to 3.7) Top 90%: 2.1 (1.5 to 2.6) **At 16 years:** Bottom 10%: 3.8 (2.6 to 4.9) 10-50%: 3.9 (3.4 to 4.3) 50-90%: 3.4 (3.0 to 3.8) Top 90%: 1.8 (1.2 to 2.4) (adjusted for room temperature and sex)
Jurate Klumbiene et al, 2000 **32**	Longitudinal study of Juvenile Hypertension	Lithuania	505 subjects were followed up for 20 years from the age of 12-13 years to 32-33 years	Weight	Diastolic blood pressure	**Association between adulthood diastolic blood pressure and childhood weight:** Males: r= 0.13 Females: r= 0.09
Robie Sterling et al, 2014 **144**	Peruvian Birth Cohort	Peru	147 subjects were followed up for 11-14 years from birth till 11-14 years	Weight	Diastolic blood pressure	**Association [β (95% CI)] between rate of change of weight for length z score (1 SD/month) between 6-30 months and DBP in adolescence:** MODEL 1: -0.02 (-2.1 to 2.1) MODEL 2: -0.78 (-3.0 to 1.4) Model 1: adjusted for sex, age at the time of follow up, and socioeconomic deprivation Model 2: additionally adjusted for adolescent BMI for age z score and height
Ioanna Tzulaki et al, 2010 **112**	Northern Finland Birth Cohort 1966 Study	Finland	3,778 subjects followed up for 31 years from birth to the age of 31 years	Weight	Diastolic blood pressure	**Association between diastolic blood pressure in adulthood [β (95% CI)] and peak height velocity (cm/year) in infancy:** Model 1: 1.21 (0.38 to 2.03) *P value*= 0.004

						<u>Model 2:</u> 0.99 (0.09 to 1.89) *P value*= 0.03 <u>Model 3:</u> 1.01 (0.20 to 2.00) *P value*= 0.02 <u>Model 4:</u> 0.45 (-0.41 to 1.31) *P value*= 0.31 <u>Model 1:</u> adjusted for sex <u>Model 2:</u> adjusted for sex, socioeconomic status at birth, maternal age, maternal height and weight before pregnancy, maternal smoking after the second month of pregnancy, and gestational age at birth <u>Model 3:</u> adjusted for all variables in model 2 plus birth weight <u>Model 4:</u> adjusted for all variables in model 3 plus body mass index at age 31 years
Alexander Jones et al, 2012 **8**	Avon Longitudinal Study of Parents and Children (Birth Cohort)	United Kingdom	3230 boys and 3346 girls were followed up for 10 years from birth till age 10	Weight for height	Diastolic Blood Pressure	**Association between infancy weight for height gain between 0-17 months and diastolic blood pressure at 10 years:** Regression coefficient= 0.06 95% CI= -0.16 to 0.28 *P value*= 0.57 **Association between postinfancy weight for height gain between >17 months to 10 years and diastolic blood pressure at 10 years:** Regression coefficient= 1.14 95% CI= 0.92 to 1.35 *P value* <0.001 (values adjusted for sex)
Alexander Jones et al, 2012 **8**	Avon Longitudinal Study of Parents and Children (Birth Cohort)	United Kingdom	3230 boys and 3346 girls were followed up for 10 years from birth till age 10	Height	Diastolic Blood Pressure	**Association between infancy height gain between 0-17 months and diastolic blood pressure at 10 years:** Regression coefficient= 0.08 95% CI= -0.14 to 0.30 *P value*= 0.48 **Association between postinfancy height gain between >17 months to 10 years and diastolic blood pressure at 10 years:** Regression coefficient= 0.22 95% CI= -0.002 to 0.43

						P value= 0.052 (values adjusted for sex)
Robie Sterling et al, 2014 **144**	Peruvian Birth Cohort	Peru	152 subjects were followed up for 11-14 years from birth till 11-14 years	Height	Diastolic blood pressure	**Association [β (95% CI)] between rate of change of length for age z score (1 SD/month) between 0-30 months and DBP in adolescence:** MODEL 1: -0.26 (-1.4 to 0.9) MODEL 2: -0.71 (-2.1 to 0.7) Model 1: adjusted for sex, age at the time of follow up, and socioeconomic deprivation Model 2: additionally adjusted for adolescent BMI for age z score and height
Debbie A Lawlor et al, 2010 **102**	Avon Longitudinal Study of Parents and Children	United Kingdom	5235 subjects were followed for 5-6 years from age 9-12 years to 15-16 years	BMI	Diastolic blood pressure	**Association [OR (95% CI)] between change (1 SD z score) in BMI and development of high DBP:** **Males:** MODEL 1: 1.01 (0.82 to 1.25); MODEL 2: 1.06 (0.84 to 1.35) **Females:** MODEL 1: 1.05 (0.79 to 1.39); MODEL 2: 1.11 (0.81 to 1.52) *P value for sex interaction*= 0.37 Model 1: adjusted for age, height and height^2 Model 2: additional adjusted for maternal age, parity, family social class, maternal education, paternal education, birth weight, gestational age, maternal and parental BMI, and puberty
Ioanna Tzulaki et al, 2010 **112**	Northern Finland Birth Cohort 1966 Study	Finland	3,778 subjects followed up for 31 years from birth to the age of 31 years	Height	Diastolic blood pressure	**Association between diastolic blood pressure in adulthood [β (95% CI)] and peak height velocity (cm/year) in infancy:** Model 1: 0.85 (0.73 to 1.63) *P value*= 0.032 Model 2: 1.06 (0.19 to 1.93) *P value*= 0.017 Model 3: 1.03 (0.15 to 1.91) *P value*= 0.021 Model 4: 1.01 (0.18 to 1.84) *P value*= 0.017

						<u>Model 1:</u> adjusted for sex <u>Model 2:</u> adjusted for sex, socioeconomic status at birth, maternal age, maternal height and weight before pregnancy, maternal smoking after the second month of pregnancy, and gestational age at birth <u>Model 3:</u> adjusted for all variables in model 2 plus birth weight <u>Model 4:</u> adjusted for all variables in model 3 plus body mass index at age 31 years
Jurate Klumbiene et al, 2000 **32**	Longitudinal study of Juvenile Hypertension	Lithuania	505 subjects were followed up for 20 years from the age of 12-13 years to 32-33 years	Height	Diastolic blood pressure	**Association between adulthood diastolic blood pressure and childhood height:** <u>Males:</u> r= 0.04 <u>Females:</u> r= -0.03
DS Freedman et al, 2001 **30**	Bogalusa Heart Study	United States	2617 subjects were followed up for 17 years from the age of 2-17 years to 18-37 years	Triceps skinfold thickness	Diastolic blood pressure	**Association between adulthood diastolic blood pressure and childhood triceps skinfold thickness:** r= 0.07 (values adjusted for race, age, and sex)
Jurate Klumbiene et al, 2000 **32**	Longitudinal study of Juvenile Hypertension	Lithuania	505 subjects were followed up for 20 years from the age of 12-13 years to 32-33 years	Triceps skinfold thickness	Diastolic blood pressure	**Association between adulthood diastolic blood pressure and childhood TSF:** <u>Males:</u> r= 0.12 <u>Females:</u> r= 0.02
Jurate Klumbiene et al, 2000 **32**	Longitudinal study of Juvenile Hypertension	Lithuania	505 subjects were followed up for 20 years from the age of 12-13 years to 32-33 years	Subscapular skinfold thickness	Diastolic blood pressure	**Association between adulthood diastolic blood pressure and childhood SSF:** <u>Males:</u> r= 0.11 <u>Females:</u> r= 0.14 *P value* <0.05
Yin Bun Cheung et al, 2000 **38**	Hong Kong Birth Cohort of 1967	China	122 subjects were followed up for 30 years from birth till the age of 30 years	Ponderal Index (PI)	Diastolic blood pressure	**Association [regression coefficient (95% CI)] between rate of change of PI between 6-18 months and adulthood diastolic blood pressure levels:** <u>Bivariate regression coefficient:</u> -0.1 (-1.0 to 0.7) *P value*= 0.78 (adjusted for gender, current BMI, mother's education, mother's health during pregnancy, and respondent's education) <u>Multivariate regression coefficient:</u>

						-1.1 (-2.6 to 0.3) *P value*= 0.12 (adjusted for PI at birth, change in PI between 0-6 months, birth length, change in birth length between 0-6 months and 6-18 months, gestational age, gender, mother's education, mother's health during pregnancy, respondent's education, and current BMI)
U Sovio et al, 2014 **111**	Northern Finland Birth Cohort of 1966 Study	Finland	4228 subjects were followed up for 31 years from birth till age 31	Age at adiposity rebound	Diastolic blood pressure	**Association between adulthood DBP and age at adiposity rebound:** % change=-2.83 95% CI= -4.09 to -1.55 *P value* <0.0001 (adjusted for father's socioeconomic status, mother's age, height, weight, smoking at 2 months of pregnancy, gestational age, child's birth weight, sex, PHV1, BMI at BMIP and BMI at BMIR)
J White et al, 2011 **87**	National Heart, Lung and Blood Institute (NHLBI) Growth and Health Study (NGHS)	United States	617-904 subjects were followed up for 5 years from the age of 9 till 12-14 years	Waist circumference	Diastolic blood pressure	**Association between waist circumference at age 9 and change in DBP levels between 12 to 14 years:** β= 0.12 95% CI= -0.07 to 0.32 *P value* <0.001 (adjusted for age at entry, race, parental education, household income, menstrual status at 12 and 14 years, and changes in: total calorific intake, key score, and height)
J White et al, 2011 **87**	National Heart, Lung and Blood Institute (NHLBI) Growth and Health Study (NGHS)	United States	617-904 subjects were followed up for 5 years from the age of 9 till 12-14 years	Sum of skinfolds	Diastolic blood pressure	**Association between SSF at age 9 and change in DBP levels between 12 to 14 years:** β= -0.01 95% CI= -0.06 to 0.05 *P value* <0.001 (adjusted for age at entry, race, parental education, household income, menstrual status at 12 and 14 years, and changes in: total calorific intake, key score, and height)

Table 17: Assesment of quality of studies included for the above outcome

AUTHOR/COHORT	ASSESSMENT OF QUALITY OF INCLUDED COHORTS (NEW CASTLE OTTAWA SCALE)							
	SELECTION				COMPARABILITY	OUTCOME		
	Representativeness of the intervention cohort	Selection of non intervention cohort	Ascertainment of intervention	Demonstration that outcome of interest was not present at start of study	Comparability of cohorts on the basis of the design or analysis	Assessment of outcome	Was follow up long enough for outcomes to occur	Adequacy of follow up of cohorts
Boyne et al, 2010 Vulnerable Windows Cohort Study	*		*	*		*	*	
Jones et al, 2012 ALSPAC	*		*	*		*	*	
de Kroon et al, 2010 Terneuzen Birth Cohort	*		*	*		*	*	
Handy et al, 2004 1946 British Birth Cohort	*		*	*	*	*	*	
Freedman et al, 2001 Bogalusa Heart Study	*		*	*	* *	*	*	
Klumbiene et al, 2000 Longitudinal Study Of Juvenile Hypertension	*		*	*		*	*	
Cheung et al, 2000 Hong Kong Birth Cohort Of 1967	*		*	*	* *	*	*	
Graversen et al, 2014 Northern Finland Birth Cohort 1966 Study	*		*	*	*	*	*	
Wright et al, 2001 Thousand Families Cohort Study	*		*	*	*	*	*	
Sovio et al, 2014 Northern Finland Birth Cohort Of 1966 Study	*		*	*	*	*	*	
Fall et al, 2008 New Delhi Birth Cohort	*		*	*	* *	*	*	
Tzaoulaki et al, 2010 Northern Finland Birth Cohort 1966 Study	*		*	*	* *	*	*	
White et al, 2011 National Heart, Lung And Blood Institute (Nhlbi) Growth And Health Study (Nghs)	*		*	*	*	*	*	
Sterling et al, 2014 Peruvian Birth Cohort	*		*	*	* *	*	*	
Sinaiko et al, 1999 Minneapolis Children's Blood Pressure Study	*		*	*		*	*	
Lawlor et al, 2010 Avon Longitudinal Study Of Parents And Children (Alspac)	*		*	*	*	*	*	
Srinivasan et al, 1996 Bogalusa Heart Study	*		*	*	* *	*	*	
Li et al, 2007 1958 British Birth Cohort	*		*	*	* *	*	*	

Association between childhood anthropometric measures and hyperlipidemia in later life

Total Cholesterol: 9 studies analyzed the association from different cohorts. The spectrum of exposures varied from, height, weight, BMI, BMI at adiposity rebound, ponderal, waist circumference, sum of skinfold thickness, Triceps of skinfold thickness, age at adiposity rebound.

Study from Vulnerable Windows Cohort[1] shows no association between infancy BMI and increase in total cholesterol till 11 yrs of age. Bogalusa Heart Study [30] and Minneapolis Children Blood Pressure Study[53] have shown positive association between BMI and rate of increase in adulthood cholesterol level. One of the report from Bogalusa Heart Study has observed significant association between adolescent weight status and change in BMI with adulthood total cholesterol[127]. Inverse relationship has been observed in females for BMI at the age of 9 yrs with cholesterol levels in adulthood[46].

Study from Northern Finland Birth Cohort 1966 demostrated association between BMI at adiposity rebound in infancy and cholesterol level in adulthood[111]. No association was observed between change in BMI fron 7yrs to 16yrs and adulthood total cholesterol level in 1958 British Birth Cohort Study[107]. Study from New Delhi Birth Cohort observed significant association of change of conditional BMI from age 11 yrs till adulthood[77].

The relationship of weight in childhood and adolescence was observed with the total cholesterol levels in adulthood. Significant association was found between childhood BMI and cholesterol level in adulthood by the Minneapolis Children Blood Pressure Study[53]. However no association was observed in weight between 6 months to 11 yrs with higher total cholesterol levels by Vulnerable Windows Cohort Study[1]

New Delhi Birth Cohort found significant association between change of conditional weight from age 11 yrs to adulthood with the development of higher total cholesterol level. In reference to height there are two studies, one showing association and another no association between height during childhood and cholesterol levels in adulthood [1, 53].

There was significant association between waist circumference,sum of skin folds at 9 years and increase in total cholesterol levels at adulthood [87]. Childhood Triceps Skinfold thickness positively correlated to adulthood total cholesterol levels in Bogalusa heart study [30]. Age at adiposity rebound was not associated with higher total cholesterol levels in adulthood in Northern Finland Birth Cohort of 1966 Study[111].

Table 18 Showing the association of childhood and adolescent anthropometric measures with total cholesterol level in later life

AUTHOR	COHORT	SETTING	NO. OF SUBJECTS/ LENGTH OF FOLLOW-UP/ CHILDHOOD AGE/ ADULTHOOD AGE	EXPOSURES	OUTCOMES MEASURED	EFFECT SIZE
Michael s. Boyne et al, 2010 **1**	Vulnerable Windows Cohort Study (Birth Cohort)	Kingston, Jamaica	296 subjects (134 boys and 162 girls) were followed up for 11 years from birth till age 11	BMI	Total Cholesterol	**Association (regression coefficient) between total cholesterol levels at 11 years and increase in BMI between:** <u>6 months to 2 years:</u> -0.095 <u>2 years to 11 years:</u> 0.083 (values adjusted for age and sex)
DS Freedman et al, 2001 **30**	Bogalusa Heart Study	United States	2617 subjects were followed up for 17 years from the age of 2-17 years to 18-37 years	BMI* (85^{th}-95^{th} percentile are at risk of being overweight; >95^{th} percentile are overweight)	Total cholesterol	**Association (spearman correlation coefficient) of adulthood total cholesterol levels with:** <u>Childhood BMI percentile:</u> 0.10 <u>Change in BMI during follow up:</u> 0.17 <u>Childhood BMI percentile adjusted for adult BMI:</u> -0.08 (values adjusted for race, sex, and age)
Charlotte M Wright et al, 2001 **46**	Newcastle thousand families cohort study (birth cohort)	United Kingdom	412 subjects were followed for 41 years from the age of 9 years to 50 years	BMI (childhood BMI assessed as per body mass index reference curves for UK, 1990; Adulthood overweight defined as BMI between 24-29 kg/m^2 and obese as BMI≥30 kg/m^2)	Total cholesterol	**Association (standardized regression coefficients) between BMI at ages 9 and 13 years in childhood and total cholesterol levels at age 50:** <u>Males:</u> BMI age 9 -0.11 BMI age 13 -0.12 <u>Females:</u> BMI age 9 -0.17 *P value*<0.05 BMI age 13 0.16 (values adjusted for body mass index at age 50)
U Sovio et al, 2014	Northern Finland Birth Cohort of 1966	Finland	4228 subjects were followed up for 31 years from birth till age 31	BMI at adiposity rebound	Total cholesterol	**Association between adulthood total cholesterol levels and BMI at adiposity rebound:**

111	Study					% change= 0.01 95% CI= -2.24 to 2.26 *P value*= 0.99 (adjusted for father's socioeconomic status, mother's age, height, weight, smoking at 2 months of pregnancy, gestational age, child's birth weight, sex, PHV1, BMI at BMIP and age at BMIR)
Caroline HD Fall et al, 2008 **77**	New Delhi birth cohort	India	1492 subjects were followed up for 26-32 years from birth till age 26-32	BMI	Total cholesterol	**Association [β (95% CI)] of adulthood total cholesterol levels with conditional BMI SD scores:** **Birth to 2 years:** -0.03 (-0.09 to 0.02) *P value*= 0.2 **2-11 years:** 0.01 (-0.04 to 0.07) *P value*= 0.6 **11 years-adulthood:** 0.19 (0.13 to 0.25) *P value* <0.001 Analysis is adjusted for age, sex, and lifestyle factors: alcohol consumption, physical activity, tobacco use, socioeconomic status in childhood based on father's occupation, socioeconomic status in adult life derived from education level, household possessions and occupation, and family history of any high blood pressure, angina, myocardial infarction, stroke, or diabetes in a first-degree relative
Alan R Sinaiko et al, 1999 **53**	Minneapolis Children's Blood Pressure Study	United States	679 subjects were followed up for 16 years from 7.7 years to 23.6 years	BMI	Total cholesterol	**Association between total cholesterol levels in adulthood and BMI in childhood:** r= 0.04 *P value*= 0.29 **Association between total cholesterol levels in adulthood and rate of increase in BMI in childhood:** r= 0.09 *P value*= 0.0226 **Association between total cholesterol levels in adulthood and rate of increase in BMI in adolescence:** r= -0.02

						P value= 0.4549
Snehal M Pinto Pereira et al, 2012 **107**	1958 British Birth Cohort	United Kingdom	3927 men and 3897 women were followed up for 45 years from birth till age 45	BMI	Total cholesterol	**Association [mean% (95% CI)] between total cholesterol levels in adulthood and BMI change between:** **Males:** 7-11 years: 0.20 (-0.69 to 1.09); 11-16 years: -0.80 (-1.90 to 0.29) **Females:** 7-11 years: 0.85 (-0.02 to 1.71); 11-16 years: -0.77 (-1.94 to 0.34) Adjustment done for social class at birth, adult social class, smoking, education, alcohol consumption, hypertension and for women menopausal status
Santhur R Srinivasan et al, 1996 **127**	Bogalusa Heart Study	United States	783 subjects were followed up for 14 years from age 13-17 to age 27-31 years	BMI	Total cholesterol	**Association between adolescent weight status and total cholesterol levels in adulthood:** β= 14.3 *P value* <0.001 **Association between change in BMI during follow up and total cholesterol levels in adulthood:** β= 2.2 *P value* <0.0001 *P value*: overweight vs. lean
Alan R Sinaiko et al, 1999 **53**	Minneapolis Children's Blood Pressure Study	United States	679 subjects were followed up for 16 years from 7.7 years to 23.6 years	Weight	Total cholesterol	**Association between total cholesterol levels in adulthood and weight in childhood:** r= 0.04 *P value*= 0.24 **Association between total cholesterol levels in adulthood and rate of increase in weight in childhood:** r= 0.10 *P value*= 0.0141 **Association between total cholesterol levels in adulthood and rate of increase in weight in adolescence:** r= -0.06 *P value*= 0.1350

Michael s. Boyne et al, 2010 **1**	Vulnerable Windows Cohort Study (Birth Cohort)	Kingston, Jamaica	296 subjects (134 boys and 162 girls) were followed up for 11 years from birth till age 11	Weight	Total Cholesterol	**Association (regression coefficient) between total cholesterol levels at 11 years and increase in weight between:** 6 months to 2 years: -0.159 2 years to 11 years: 0.049 (values adjusted for age and sex)
Caroline HD Fall et al, 2008 **77**	New Delhi birth cohort	India	1492 subjects were followed up for 26-32 years from birth till age 26-32	Weight	Total cholesterol	**Association [β (95% CI)] of adulthood total cholesterol levels with conditional weight SD scores:** **Birth to 2 years:** 0.00 (-0.06 to 0.06) *P value*= 1.0 **2-11 years:** 0.01 (-0.05 to 0.07) *P value*= 0.7 **11 years-adulthood:** 0.16 (0.10 to 0.22) *P value* <0.001 Analysis is adjusted for age, sex, and lifestyle factors: alcohol consumption, physical activity, tobacco use, socioeconomic status in childhood based on father's occupation, socioeconomic status in adult life derived from education level, household possessions and occupation, and family history of any high blood pressure, angina, myocardial infarction, stroke, or diabetes in a first-degree relative
Michael s. Boyne et al, 2010 **1**	Vulnerable Windows Cohort Study (Birth Cohort)	Kingston, Jamaica	296 subjects (134 boys and 162 girls) were followed up for 11 years from birth till age 11	Height	Total Cholesterol	**Association (regression coefficient) between total cholesterol levels at 11 years and increase in height between:** 6 months to 2 years: -0.105 2 years to 11 years: -0.156 (values adjusted for age and sex)
Alan R Sinaiko et al, 1999 **53**	Minneapolis Children's Blood Pressure Study	United States	679 subjects were followed up for 16 years from 7.7 years to 23.6 years	Height	Total cholesterol	**Association between total cholesterol levels in adulthood and height in childhood:** r= 0.03 *P value*= 0.37 **Association between total cholesterol levels in adulthood and rate of increase in BMI in childhood:**

						r= 0.07 *P value*= 0.0746 **Association between total cholesterol levels in adulthood and rate of increase in BMI in adolescence:** r= -0.09 *P value*= 0.0735
J White et al, 2011 **87**	National Heart, Lung and Blood Institute (NHLBI) Growth and Health Study (NGHS)	United States	617 subjects were followed up for 5 years from the age of 9 till 12-14 years	Waist circumference	Total cholesterol	**Association between waist circumference at age 9 and change in total cholesterol levels between 12 to 14 years:** β= 0.62 95% CI= 0.25 to 1.00 *P value* <0.001 (adjusted for age at entry, race, parental education, household income, menstrual status at 12 and 14 years, and changes in: total calorific intake, key score, and height)
J White et al, 2011 **87**	National Heart, Lung and Blood Institute (NHLBI) Growth and Health Study (NGHS)	United States	617subjects were followed up for 5 years from the age of 9 till 12-14 years	Sum of skinfolds	Total cholesterol	**Association between SSF at age 9 and change in total cholesterol levels between 12 to 14 years:** β= 0.18 95% CI= 0.06 to 0.30 *P value* <0.01 (adjusted for age at entry, race, parental education, household income, menstrual status at 12 and 14 years, and changes in: total calorific intake, key score, and height)
DS Freedman et al, 2001 **30**	Bogalusa Heart Study	United States	2617 subjects were followed up for 17 years from the age of 2-17 years to 18-37 years	Triceps skinfold thickness	Total cholesterol	**Association between adulthood total cholesterol and childhood triceps skinfold thickness:** r= 0.10 (values adjusted for race, age, and sex)

Table 19: Assesment of quality of studies included for the above outcome

AUTHOR/COHORT	ASSESSMENT OF QUALITY OF INCLUDED COHORTS (NEW CASTLE OTTAWA SCALE)							
	SELECTION				COMPARABILITY	OUTCOME		
	Representativeness of the intervention cohort	Selection of non intervention cohort	Ascertainment of intervention	Demonstration that outcome of interest was not present at start of study	Comparability of cohorts on the basis of the design or analysis	Assessment of outcome	Was follow up long enough for outcomes to occur	Adequacy of follow up of cohorts
Boyne et al, 2010 Vulnerable Windows Cohort Study	*		*	*		*	*	
Freedman et al, 2001 Bogalusa Heart Study	*		*	*	* *	*	*	
Wright et al, 2001 Thousand Families Cohort Study	*		*	*	*	*	*	
Sovio et al, 2014 Northern Finland Birth Cohort Of 1966 Study	*		*	*	*	*	*	
Fall et al, 2008 New Delhi Birth Cohort	*		*	*	* *	*	*	
White et al, 2011 National Heart, Lung And Blood Institute (Nhlbi) Growth And Health Study (Nghs)	*		*	*	*	*	*	
Sinaiko et al, 1999 Minneapolis Children's Blood Pressure Study	*		*	*		*	*	
Pereira et al, 2012 1958 British Birth Cohort	*		*	*	*	*	*	
Srinivasan et al, 1996 Bogalusa Heart Study	*		*	*	* *	*	*	

Triglycerides: Thirteen studies analyzed the relationship between childhood and adolescent anthropometric measures vs adulthood triglyceride level. The exposures included body mass index, weight, height, waist circumference, skin fold thickness and age at adiposity rebound. The spectrum of results included regression co –efficient β, spearman's rank co-efficient r, % change, percentiles, and odds ratio.

The three studies from Ternuzian Birth Cohort[13], Bogalusa Heart Study [30], 1950 British Birth Cohort has found the positive association between BMI at childhood and adolescence and triglyceride levels in adulthood. But two studies from Vulnerable Windows Cohort Study [1] and Northern Finland Birth Cohort of 1966 Study[111] did not observe any association between BMI at infancy and triglyceride levels in adolescence and adulthood.

The study from New Castle Thousand Families Cohort Studies[46] found an inverse relationship between childhood BMI and adulthood triglyceride levels. Minneapolis Children Blood Pressure Study[53] and ALSPAC [102] observed a significant association of rapid increase in BMI in childhood with the odds of development of triglyceride level in adolescence and adulthood. One of the reports from Bogulosa Heart Study has shown a significant association between adolescence, weight status and change in BMI with the adulthood triglyceride levels. The risk of having triglyceride levels in adulthood was significant in the BMI percentile >90th to < 95th and change of conditional BMI from age 2 to adulthood was reported by Northern Finland Birth Cohort 1966 Study [42] and New Delhi Birth Cohort Study [77].

Weight was observed in infancy, childhood, adolescence for its association with triglyceride levels in adulthood. There was no association with weight at infancy and adulthood triglyceride levels as reported by the Vulnerable Windows Cohort Study[1]. Minneapolis Children Blood Pressure Study has shown a significant association between weight, rate of increase in weight during childhood with the adulthood triglyceride levels [53]. New Delhi Birth Cohort Study found significant association between conditional weight from birth to adulthood and triglyceride levels in adulthood [77]. Subjects with peak weight velocity >3.9Kg/yr had increased risk of high triglyceride levels in adulthood [112.]

There was no association in height at infancy and adulthood triglyceride levels as reported by the Vulnerable Windows Cohort Study[1]. Similarly, subjects with peak height velocity >8cm/yr from infancy have no increase risk of triglyceride levels in adulthood [112]. There was a significant positive association between childhood height and adulthood triglyceride levels in Minneapolis Children Blood Pressure Study [53].

There was a significant association with the rapid increase in waist circumference in childhood with the odds of development of high triglyceride levels in adolescence [87,102]. Sum of skin fold thickness in childhood was no significantly associated with the adolescence triglyceride levels as reported by NHLBI study [87]. Positive correlation was found between skin fold thickness in the age group 2yrs to 17 yrs and triglyceride levels in adolescence [30].

Table 20 Showing the association of childhood and adolescent anthropometric measures with triglyceride level in later life

AUTHOR	COHORT	SETTING	NO. OF SUBJECTS/ LENGTH OF FOLLOW-UP/ CHILDHOOD AGE/ ADULTHOOD AGE	EXPOSURES	OUTCOMES MEASURED	EFFECT SIZE
Michael s. Boyne et al, 2010 **1**	Vulnerable Windows Cohort Study (Birth Cohort)	Kingston, Jamaica	296 subjects (134 boys and 162 girls) were followed up for 11 years from birth till age 11	BMI	Triglycerides	**Association (regression coefficient) between triglyceride levels at 11 years and increase in BMI between:** 6 months to 2 years: 0.044 2 years to 11 years: 0.119 (values adjusted for age and sex)
Santhur R Srinivasan et al, 1996 **127**	Bogalusa Heart Study	United States	783 subjects were followed up for 14 years from age 13-17 to age 27-31 years	BMI	Triglycerides	**Association between adolescent weight status and triglyceride levels in adulthood:** β= 37.5 *P value* <0.001 **Association between change in BMI during follow up and triglyceride levels in adulthood:** β= 5.4 *P value* <0.001 *P value*: overweight vs. lean
U Sovio et al, 2014 **111**	Northern Finland Birth Cohort of 1966 Study	Finland	4228 subjects were followed up for 31 years from birth till age 31	BMI at adiposity rebound	Triglycerides	**Association between adulthood triglyceride levels and BMI at adiposity rebound:** % change= 1.85 95% CI= -3.81 to 7.85 *P value*= 0.53 (adjusted for father's socioeconomic status, mother's age, height, weight, smoking at 2 months of pregnancy, gestational age, child's birth weight, sex, PHV1, BMI at BMIP and age at BMIR)
Marlou LA de Kroon et al, 2010 **13**	Terneuzen Birth Cohort (1977-86)	Netherlands	642 subjects were followed for 18-28 years from birth to the age of 18-28 years	BMI (overweight and obese defined according to the Dutch reference data)	Triglycerides	**Association between triglycerides levels in adulthood [Regression coefficient (95% CI)] and change in conditional measures of BMI:** Change in score from birth to 1 year: 0.00 (-0.08 to 0.08) Change in score from 1-2 years: -0.06 (-0.14 to 0.02)

						Change in score from 2-6 years: 0.18 (0.10 to 0.26) *P value* <0.002 Change in score from 6-10 years: 0.08 (0.00 to 0.16) *P value* <0.05 Change in score from 10-18 years: 0.21 (0.15 to 0.27) *P value* <0.002 (all analyses are adjusted for age and gender) (Change score: the expected value of BMI SDS at a break age is called the *status score.* The change between the status score at the start and the end of the various age intervals is called the *change score*)
Caroline HD Fall et al, 2008 **77**	New Delhi birth cohort	India	1492 subjects were followed up for 26-32 years from birth till age 26-32	BMI	Triglycerides	**Association [β (95% CI)] of adulthood triglyceride levels with conditional BMI SD scores:** **Birth to 2 years:** -0.00 (-0.06 to 0.06) *P value*= 1.0 **2-11 years:** 0.06 (0.01 to 0.12) *P value*= 0.03 **11 years-adulthood:** 0.29 (0.23 to 0.35) *P value* <0.001 Analysis is adjusted for age, sex, and lifestyle factors: alcohol consumption, physical activity, tobacco use, socioeconomic status in childhood based on father's occupation, socioeconomic status in adult life derived from education level, household possessions and occupation, and family history of any high blood pressure, angina, myocardial infarction, stroke, or diabetes in a first-degree relative
Charlotte M Wright et al, 2001 **46**	Newcastle thousand families cohort study (birth cohort)	United Kingdom	412 subjects were followed for 41 years from the age of 9 years to 50 years	BMI (childhood BMI assessed as per body mass index reference curves for UK, 1990; Adulthood overweight defined as BMI between 24-29	Triglycerides	**Association (standardized regression coefficients) between BMI at ages 9 and 13 years in childhood and triglyceride levels at age 50:** Males: BMI age 9 -0.18 *P value* <0.05 BMI age 13 -0.12 Females:

				kg/m² and obese as BMI≥30 kg/m²)		BMI age 9 -0.27 *P value* <0.01 BMI age 13 -0.19 *P value* <0.05 (values adjusted for body mass index at age 50)
DS Freedman et al, 2001 **30**	Bogalusa Heart Study	United States	2617 subjects were followed up for 17 years from the age of 2-17 years to 18-37 years	BMI* (85^{th}-95^{th} percentile are at risk of being overweight; >95^{th} percentile are overweight)	Triglycerides	**Association (spearman correlation coefficient) of adulthood triglyceride levels with:** <u>Childhood BMI percentile:</u> 0.16 <u>Change in BMI during follow up:</u> 0.22 <u>Childhood BMI percentile adjusted for adult BMI:</u> -0.09 (values adjusted for race, sex, and age)
Lise Graversen et al, 2014 **42**	Northern Finland Birth Cohort 1966 Study	Finland	2120 subjects were followed up for 31 years from the age of 1 year to 31 years	BMI	Triglycerides	**Risk of having high triglyceride levels in adulthood [relative risk (95% CI)] by BMI percentiles at age 5 years:** <u><5^{th} percentile:</u> 0.7 (0.4 to 1.3) <u>≥5^{th} to <50^{th} percentile:</u> 1.0 <u>≥50^{th} to <75^{th} percentile:</u> 0.9 (0.7 to 1.2) <u>≥75^{th} to <90^{th} percentile:</u> 1.0 (0.7 to 1.3) <u>≥90^{th} to <95^{th} percentile:</u> 1.5 (1.1 to 2.2) <u>≥95^{th} percentile:</u> 1.2 (0.8 to 1.8) (values adjusted for gender) (linear associations were adjusted for birth weight, gestational age, maternal smoking during pregnancy, maternal age at birth, maternal pre-pregnancy BMI, maternal education level, and parity)
Alan R Sinaiko et al, 1999 **53**	Minneapolis Children's Blood Pressure Study	United States	679 subjects were followed up for 16 years from 7.7 years to 23.6 years	BMI	Triglycerides	**Association between triglyceride levels in adulthood and BMI in childhood:** r= 0.19 *P value* <0.0001

						Association between triglyceride levels in adulthood and rate of increase in BMI in childhood: r= 0.17 *P value*= 0.0001 **Association between triglyceride levels in adulthood and rate of increase in BMI in adolescence:** r= 0.07 *P value*= 0.0593
Debbie A Lawlor et al, 2010 **102**	Avon Longitudinal Study of Parents and Children	United Kingdom	5235 subjects were followed for 5-6 years from age 9-12 years to 15-16 years	BMI	Triglycerides	**Association [OR (95% CI)] between change (1 SD z score) in BMI and development of high triglyceride levels:** **Males:** MODEL 1: 1.93 (1.54 to 2.41); MODEL 2: 1.96 (1.51 to 2.55) **Females:** MODEL 1: 1.35 (1.02 to 1.78); MODEL 2: 1.43 (1.06 to 1.92) *P value for sex interaction*= 0.49 Model 1: adjusted for age, height and height^2 Model 2: additional adjusted for maternal age, parity, family social class, maternal education, paternal education, birth weight, gestational age, maternal and parental BMI, and puberty
Snehal M Pinto Pereira et al, 2012 **107**	1958 British Birth Cohort	United Kingdom	3927 men and 3897 women were followed up for 45 years from birth till age 45	BMI	Triglycerides	**Association [mean% (95% CI)] between triglyceride levels in adulthood and BMI change between:** **Males:** 7-11 years: 0.57 (-1.87 to 3.01); 11-16 years: 1.31 (-2.08 to 4.71) **Females:** 7-11 years: 5.22 (2.73 to 7.72), *P value* <0.05; 11-16 years: 3.40 (0.73 to 6.08), *P value* <0.05 Adjustment done for social class at birth, adult social class, smoking, education, alcohol consumption, hypertension and for women menopausal status
Michael s. Boyne et al, 2010 **1**	Vulnerable Windows Cohort Study (Birth Cohort)	Kingston, Jamaica	296 subjects (134 boys and 162 girls) were followed up for 11 years from birth till age 11	Weight	Triglycerides	**Association (regression coefficient) between triglyceride levels at 11 years and increase in weight between:** 6 months to 2 years: -0.004 2 years to 11 years: 0.140

						(values adjusted for age and sex)
Alan R Sinaiko et al, 1999 **53**	Minneapolis Children's Blood Pressure Study	United States	679 subjects were followed up for 16 years from 7.7 years to 23.6 years	Weight	Triglycerides	**Association between triglyceride levels in adulthood and weight in childhood:** r= 0.20 *P value*= 0.0001 **Association between triglyceride levels in adulthood and rate of increase in weight in childhood:** r= 0.18 *P value*= 0.0001 **Association between triglyceride in adulthood and rate of increase in weight in adolescence:** r= 0.10 *P value*= 0.0118
Caroline HD Fall et al, 2008 **77**	New Delhi birth cohort	India	1492 subjects were followed up for 26-32 years from birth till age 26-32	Weight	Triglycerides	**Association [β (95% CI)] of adulthood triglyceride levels with conditional weight SD scores:** **Birth to 2 years:** 0.09 (0.03 to 0.15) *P value*= 0.004 **2-11 years:** 0.07 (0.01 to 0.12) *P value*= 0.02 **11 years-adulthood:** 0.28 (0.22 to 0.34) *P value* <0.001 Analysis is adjusted for age, sex, and lifestyle factors: alcohol consumption, physical activity, tobacco use, socioeconomic status in childhood based on father's occupation, socioeconomic status in adult life derived from education level, household possessions and occupation, and family history of any high blood pressure, angina, myocardial infarction, stroke, or diabetes in a first-degree relative
Alan R Sinaiko et al, 1999 **53**	Minneapolis Children's Blood Pressure Study	United States	679 subjects were followed up for 16 years from 7.7 years to 23.6 years	Height	Triglycerides	**Association between triglyceride levels in adulthood and height in childhood:** r= 0.12 *P value*= 0.001 **Association between triglyceride levels in adulthood and rate of**

						increase in BMI in childhood: r= 0.006 *P value*= 0.8788 **Association between triglyceride levels in adulthood and rate of increase in BMI in adolescence:** r= 0.01 *P value*= 0.8171
Ioanna Tzulaki et al, 2010 **112**	Northern Finland Birth Cohort 1966 Study	Finland	3,778 subjects followed up for 31 years from birth to the age of 31 years	Height	Triglycerides	**Association between triglyceride levels in adulthood [β (95% CI)] and peak height velocity (cm/year) in infancy:** Model 1: -1.37 (-4.72 to 2.09) *P value*= 0.45 Model 2: -0.18 (-0.41 to 0.04) *P value*= 0.46 Model 3: -1.42 (-5.11 to 2.40) *P value*= 0.29 Model 4: -2.03 (-5.72 to 1.80) *P value*= 0.25 Model 1: adjusted for sex Model 2: adjusted for sex, socioeconomic status at birth, maternal age, maternal height and weight before pregnancy, maternal smoking after the second month of pregnancy, and gestational age at birth Model 3: adjusted for all variables in model 2 plus birth weight Model 4: adjusted for all variables in model 3 plus body mass index at age 31 years
Michael s. Boyne et al, 2010 **1**	Vulnerable Windows Cohort Study (Birth Cohort)	Kingston, Jamaica	296 subjects (134 boys and 162 girls) were followed up for 11 years from birth till age 11	Height	Triglycerides	**Association (regression coefficient) between triglyceride levels at 11 years and increase in height between:** 6 months to 2 years: -0.010 2 years to 11 years: -0.023 (values adjusted for age and sex)
J White et al, 2011	National Heart, Lung and Blood	United States	617subjects were followed up for 5 years from the age of 9 till 12-	Sum of skinfolds	Triglycerides	**Association between SSF at age 9 and change in total triglyceride levels between 12 to 14 years:**

87	Institute (NHLBI) Growth and Health Study (NGHS)		14 years			β= 0.27 95% CI= -0.05 to 0.59 *P value* NS (adjusted for age at entry, race, parental education, household income, menstrual status at 12 and 14 years, and changes in: total calorific intake, key score, and height)
DS Freedman et al, 2001 **30**	Bogalusa Heart Study	United States	2617 subjects were followed up for 17 years from the age of 2-17 years to 18-37 years	Triceps skinfold thickness	Triglycerides	**Association between adulthood triglyceride levels and childhood triceps skinfold thickness:** r= 0.12 (values adjusted for race, age, and sex)
Debbie A Lawlor et al, 2010 **102**	Avon Longitudinal Study of Parents and Children	United Kingdom	5235 subjects were followed for 5-6 years from age 9-12 years to 15-16 years	Waist circumference	Triglycerides	**Association [OR (95% CI)] between change (1 SD z score) in waist circumference and development of high triglyceride levels:** **Males:** <u>MODEL 1:</u> 1.96 (1.57 to 2.46); <u>MODEL 2:</u> 1.97 (1.50 to 2.59) **Females:** <u>MODEL 1:</u> 1.36 (1.00 to 1.87); <u>MODEL 2:</u> 1.42 (1.01 to 1.99) *P value for sex interaction*= 0.99 Model 1: adjusted for age, height and height^2 Model 2: additional adjusted for maternal age, parity, family social class, maternal education, paternal education, birth weight, gestational age, maternal and parental BMI, and puberty
J White et al, 2011 **87**	National Heart, Lung and Blood Institute (NHLBI) Growth and Health Study (NGHS)	United States	617-904 subjects were followed up for 5 years from the age of 9 till 12-14 years	Waist circumference	Triglycerides	**Association between waist circumference at age 9 and change in triglyceride levels between 12 to 14 years:** β= 1.6 95% CI= 0.86 to 2.68 *P value* <0.001 (adjusted for age at entry, race, parental education, household income, menstrual status at 12 and 14 years, and changes in: total calorific intake, key score, and height)

Table 21: Assesment of quality of studies included for the above outcome

AUTHOR/COHORT	ASSESSMENT OF QUALITY OF INCLUDED COHORTS (NEW CASTLE OTTAWA SCALE)							
	SELECTION				COMPARABILITY	OUTCOME		
	Representativeness of the intervention cohort	Selection of non intervention cohort	Ascertainment of intervention	Demonstration that outcome of interest was not present at start of study	Comparability of cohorts on the basis of the design or analysis	Assessment of outcome	Was follow up long enough for outcomes to occur	Adequacy of follow up of cohorts
Michael S. Boyne et al, 2010 Vulnerable Windows Cohort Study	*		*	*		*	*	
Marlou LA de Kroon et al, 2010 Terneuzen Birth Cohort	*		*	*		*	*	
DS Freedman et al, 2001 Bogalusa Heart Study	*		*	*	* *	*	*	
Lise Graversen et al, 2014 Northern Finland Birth Cohort 1966 Study	*		*	*	*	*	*	
Charlotte M Wright et al, 2001 Thousand Families Cohort Study	*		*	*	*	*	*	
U Sovio et al, 2014 Northern Finland Birth Cohort Of 1966 Study	*		*	*	*	*	*	
Caroline HD Fall et al, 2008 New Delhi Birth Cohort	*		*	*	* *	*	*	
Ioanna Tzaoulaki et al, 2010 Northern Finland Birth Cohort 1966 Study	*		*	*	* *	*	*	
J White et al, 2011 National Heart, Lung And Blood Institute (Nhlbi) Growth And Health Study (Nghs)	*		*	*	*	*	*	
Alan R Sinaiko et al, 1999 Minneapolis Children's Blood Pressure Study	*		*	*		*	*	
Snehal M Pinto Pereira et al, 2012 1958 British Birth Cohort	*		*	*	*	*	*	
Santhur R Srinivasan et al, 1996 Bogalusa Heart Study	*		*	*	* *	*	*	

LDL cholesterol: There are ten studies (six cohorts) which had considered the relationship of childhood and adolescent anthropometric measures vs adulthood LDL levels. The statistical measures used to analyze their relationship are Spearman's correlation co-efficient, standard regression co-efficient, percentage change and odds ratio. The studies from all the six cohorts are from developed countries.

BMI in childhood and adolescence was associated with the adulthood LDL levels by the seven studies from five cohorts[30, 46,111, 53, 102, 115, 127]. Three reports from the Bogalusa Heart Study and one report from the Minneapolis Children Blood Pressure Study has shown a significant positive relationship between childhood and adolescence BMI level and adulthood LDL levels [30,115,127,53]. There was an inverse relationship of childhood BMI with the adulthood LDL levels as reported by Newcastle Thousand Families Cohort Studies. BMI at adiposity rebound was not associated with the LDL levels in adulthood when values were adjusted for socioeconomic status, mother's age, height, weight, BMI, birth weight and gestational age[111]. Rapid increase in BMI increased the odds of development of high LDL levels later in adolescence were observed by the ALSPAC study, the values were adjusted for age, height, maternal age, parity, maternal and paternal education, puberty and gestational age [102].

There was a significant positive association between the rate of increase in weight and height during childhood with adulthood LDL levels in the Minneapolis Children Blood Pressure Study [53]. Two studies reported a significant association between waist circumference during childhood and rapid increase in waist circumference with the highest LDL levels during adulthood [87,102].

A significant positive association was found between skinfold thickness in childhood with the adolescence and adulthood LDL levels[30, 87].

Table 22 Showing the association of childhood and adolescent anthropometric measures with LDL cholesterol level in later life

AUTHOR	COHORT	SETTING	NO. OF SUBJECTS/ LENGTH OF FOLLOW-UP/ CHILDHOOD AGE/ ADULTHOOD AGE	EXPOSURES	OUTCOMES MEASURED	EFFECT SIZE
DS Freedman et al, 2001 **30**	Bogalusa Heart Study	United States	2617 subjects were followed up for 17 years from the age of 2-17 years to 18-37 years	BMI* (85^{th}-95^{th} percentile are at risk of being overweight; >95^{th} percentile are overweight)	LDL	**Association (spearman correlation coefficient) of adulthood low density cholesterol with:** <u>Childhood BMI percentile:</u> 0.11 <u>Change in BMI during follow up:</u> 0.20 <u>Childhood BMI percentile adjusted for adult BMI:</u> -0.09 (values adjusted for race, sex, and age)
Charlotte M Wright et al, 2001 **46**	Newcastle thousand families cohort study (birth cohort)	United Kingdom	412 subjects were followed for 41 years from the age of 9 years to 50 years	BMI (childhood BMI assessed as per body mass index reference curves for UK, 1990; Adulthood overweight defined as BMI between 24-29 kg/m^2 and obese as BMI≥30 kg/m^2)	LDL	**Association (standardized regression coefficients) between BMI at ages 9 and 13 years in childhood and LDL levels at age 50:** <u>Males:</u> BMI age 9 -0.13 BMI age 13 0.01 <u>Females:</u> BMI age 9 -0.15 BMI age 13 -0.03 (values adjusted for body mass index at age 50)
U Sovio et al, 2014 **111**	Northern Finland Birth Cohort of 1966 Study	Finland	4228 subjects were followed up for 31 years from birth till age 31	BMI at adiposity rebound	LDL	**Association between adulthood HDL levels and BMI at adiposity rebound:** % change= 1.12 95% CI= -2.21 to 4.57 *P value*= 0.51 (adjusted for father's socioeconomic status, mother's age, height, weight, smoking at 2 months of pregnancy, gestational age, child's birth weight, sex, PHV1, BMI at BMIP and age at BMIR)
Alan R Sinaiko et al, 1999	Minneapolis Children's Blood	United States	679 subjects were followed up for 16 years from 7.7 years to	BMI	LDL	**Association between LDL levels in adulthood and BMI in childhood:**

53	Pressure Study		23.6 years			r= 0.05 *P value*= 0.17 **Association between LDL levels in adulthood and rate of increase in BMI in childhood:** r= 0.10 *P value*= 0.0101 **Association between LDL levels in adulthood and rate of increase in BMI in adolescence:** r= -0.003 *P value*= 0.9749
Debbie A Lawlor et al, 2010 **102**	Avon Longitudinal Study of Parents and Children	United Kingdom	5235 subjects were followed for 5-6 years from age 9-12 years to 15-16 years	BMI	LDL	**Association [OR (95% CI)] between change (1 SD z score) in BMI and development of high LDL levels:** **Males:** MODEL 1: 1.33 (1.11 to 1.59); MODEL 2: 1.30 (1.07 to 1.59) **Females:** MODEL 1: 1.24 (1.09 to 1.40); MODEL 2: 1.19 (1.03 to 1.38) *P value for sex interaction*= 0.10 Model 1: adjusted for age, height and height^2 Model 2: additional adjusted for maternal age, parity, family social class, maternal education, paternal education, birth weight, gestational age, maternal and parental BMI, and puberty
Santhur R Srinivasan et al, 2005 **115**	Bogalusa Heart Study	United States	1163 subjects were followed up for 27 years from age 5-14 years	BMI	LDL	**Association between baseline BMI and LDL cholesterol levels in adulthood:** β= 0.58 Standardized regression coefficient= 0.40 *P value* <0.001 **Risk of having high LDL levels in adulthood by childhood BMI quartiles* (4th vs. 1st):** OR**= 3.46 95% CI= 2.02 to 6.07 *P value* <0.001 *specific for baseline age, race and gender **adjusted for baseline BMI and change after 27 years
Santhur R	Bogalusa Heart	United States	783 subjects were followed up	BMI	LDL	**Association between adolescent weight status and LDL levels in**

Srinivasan et al, 1996 **127**	Study		for 14 years from age 13-17 to age 27-31 years			**adulthood:** β= 12.4 *P value* <0.001 **Association between change in BMI during follow up and LDL levels in adulthood:** β= 2.3 *P value* <0.0001 *P value*: overweight vs. lean
Alan R Sinaiko et al, 1999 **53**	Minneapolis Children's Blood Pressure Study	United States	679 subjects were followed up for 16 years from 7.7 years to 23.6 years	Weight	LDL	**Association between LDL levels in adulthood and weight in childhood:** r= 0.05 *P value*= 0.13 **Association between LDL levels in adulthood and rate of increase in weight in childhood:** r= 0.12 *P value*= 0.0032 **Association between LDL levels in adulthood and rate of increase in weight in adolescence:** r= -0.02 *P value*= 0.5689
Alan R Sinaiko et al, 1999 **53**	Minneapolis Children's Blood Pressure Study	United States	679 subjects were followed up for 16 years from 7.7 years to 23.6 years	Height	LDL	**Association between LDL levels in adulthood and height in childhood:** r= 0.04 *P value*= 0.30 **Association between LDL levels in adulthood and rate of increase in BMI in childhood:** r= 0.08 *P value*= 0.0311 **Association between LDL levels in adulthood and rate of increase in BMI in adolescence:** r= -0.06

						P value= 0.1094
J White et al, 2011 **87**	National Heart, Lung and Blood Institute (NHLBI) Growth and Health Study (NGHS)	United States	617-904 subjects were followed up for 5 years from the age of 9 till 12-14 years	Waist circumference	LDL	**Association between waist circumference at age 9 and change in LDL levels between 12 to 14 years:** β= 0.70 95% CI= 0.38 to 1.01 *P value* <0.001 (adjusted for age at entry, race, parental education, household income, menstrual status at 12 and 14 years, and changes in: total calorific intake, key score, and height)
Debbie A Lawlor et al, 2010 **102**	Avon Longitudinal Study of Parents and Children	United Kingdom	5235 subjects were followed for 5-6 years from age 9-12 years to 15-16 years	Waist circumference	LDL	**Association [OR (95% CI)] between change (1 SD z score) in waist circumference and development of high LDL levels:** **Males:** MODEL 1: 1.29 (1.08 to 1.54); MODEL 2: 1.29 (1.03 to 1.54) **Females:** MODEL 1: 1.28 (1.11 to 1.47); MODEL 2: 1.23 (1.05 to 1.43) *P value for sex interaction*= 0.10 Model 1: adjusted for age, height and height^2 Model 2: additional adjusted for maternal age, parity, family social class, maternal education, paternal education, birth weight, gestational age, maternal and parental BMI, and puberty
J White et al, 2011 **87**	National Heart, Lung and Blood Institute (NHLBI) Growth and Health Study (NGHS)	United States	617 subjects were followed up for 5 years from the age of 9 till 12-14 years	Sum of skinfolds	LDL	**Association between SSF at age 9 and change in LDL levels between 12 to 14 years:** β= 0.24 95% CI= 0.14 to 0.34 *P value* <0.001 (adjusted for age at entry, race, parental education, household income, menstrual status at 12 and 14 years, and changes in: total calorific intake, key score, and height)
DS Freedman et al, 2001 **30**	Bogalusa Heart Study	United States	2617 subjects were followed up for 17 years from the age of 2-17 years to 18-37 years	Triceps skinfold thickness	LDL	**Association between adulthood LDL levels and childhood triceps skinfold thickness:** r= 0.08 (values adjusted for race, age, and sex)

Table 23: Assesment of quality of studies included for the above outcome

AUTHOR/COHORT	ASSESSMENT OF QUALITY OF INCLUDED COHORTS (NEW CASTLE OTTAWA SCALE)							
	SELECTION				COMPARABILITY	OUTCOME		
	Representativeness of the intervention cohort	Selection of non intervention cohort	Ascertainment of intervention	Demonstration that outcome of interest was not present at start of study	Comparability of cohorts on the basis of the design or analysis	Assessment of outcome	Was follow up long enough for outcomes to occur	Adequacy of follow up of cohorts
DS Freedman et al, 2001 Bogalusa Heart Study	*		*	*	* *	*	*	
Charlotte M Wright et al, 2001 Thousand Families Cohort Study	*		*	*	*	*	*	
U Sovio et al, 2014 Northern Finland Birth Cohort Of 1966 Study	*		*	*	*	*	*	
J White et al, 2011 National Heart, Lung And Blood Institute (Nhlbi) Growth And Health Study (Nghs)	*		*	*	*	*	*	
Alan R Sinaiko et al, 1999 Minneapolis Children's Blood Pressure Study	*		*	*		*	*	
Santhur R Srinivasan et al, 2005 Bogalusa Heart Study	*		*	*	* *	*	*	
Santhur R Srinivasan et al, 1996 Bogalusa Heart Study	*		*	*	* *	*	*	

HDL: Thirteen studies (10 cohorts) analyzed the association between childhood and adolescent anthropometric measures vs HDL levels in adulthood. The spectrum of exposures varied from, height, weight, BMI, ponderal index, waist circumference, skinfold thickness and BMI at adiposity rebound.

Studies from Ternuzian Birth Cohort, Minneapolis Children Blood Pressure Study and ALSPAC has shown a negative correlation between rapid increase in BMI from 2yrs to 18 yrs with the adult HDL levels [13,102,53]. Whereas, two reports from the Bogalusa Heart Study has shown an inverse association between childhood BMI levels with the adulthood HDL levels. The association was with the increase in BMI when adjusted for race,age and sex[30,127]. Northern Finland Birth Cohort Study has reported no significant association between BMI at childhood and HDL levels in adulthood [42]. Only weak inverse relationship in females and weak positive relationship with males was observed between childhood BMI and adulthood HDL levels, when adjusted for BMI at age 50 yrs [46]. Change in conditional BMI from age 11 to adulthood was significantly associated with lower adulthood HDL levels 77. Northern Finland Birth Cohort of 1966 Study has reported no association of adiposity rebound in childhood with HDL levels in adulthood [111]. There is only one study from 1958 British Birth Cohort which has reported a negative association between change in BMI from 7yrs to 16 yrs and HDL levels in adulthood[107].

Four studies consider the impact of childhood weight on adulthood HDL levels. New Delhi birth cohort has observed a significant association between change of conditional weight from age 11yrs to adulthood and lower HDL level in adulthood [77]. Significant negative association between childhood weight, rate of increase in weight and adulthood HDL levels was observed in the Minneapolis Children Blood Pressure Study [53]. There was increased risk of development of lower HDL levels in adulthood when correlated with subjects with peak weight velocity >3.9 Kg/yr in Northern Finland Birth Cohort [112]. Vulnerable Windows Cohort found association between increase in weight from 2-11yrs and lower HDL levels at 11 yrs of age [1].

Relationship of height with adulthood HDL levels was observed by three studies from three different cohorts. Vulnerable Windows Cohort found no association between the birth height and HDL levels at 11yrs of age[1]. However, Minneapolis Children Blood Pressure Study found a significant negative association between childhood height and adulthood HDL levels. But there was no association with the rate of increase in height during childhood and adolescence. Subjects with peak height velocity > 8cm/yr did not have any increased risk of development of lower HDL levels in adulthood [112].

The two studies looked at the impact of childhood waist circumference on adulthood HDL levels. These two studies (ALSPAC & NHLBI) reported that the rapid increase in waist circumference and waist circumference in the childhood have the increased odds of development of low HDL level in adolescence [81,102]. Childhood triceps skinfold was negatively correlated to adulthood HDL levels when adjusted for race, age and sex [30]. NHLBI has found a significant association between skinfold at childhood and decrease in HDL levels in adolescence [87].

Table 24 Showing the association of childhood and adolescent anthropometric measures with LDL cholesterol level in later life

AUTHOR	COHORT	SETTING	NO. OF SUBJECTS/ LENGTH OF FOLLOW-UP/ CHILDHOOD AGE/ ADULTHOOD AGE	EXPOSURES	OUTCOMES MEASURED	EFFECT SIZE
Snehal M Pinto Pereira et al, 2012 **107**	1958 British Birth Cohort	United Kingdom	3927 men and 3897 women were followed up for 45 years from birth till age 45	BMI	HDL	**Association [mean% (95% CI)] between HDL levels in adulthood and BMI change between:** **Males:** 7-11 years: -0.65 (-1.65 to 0.35) 11-16 years: -1.56 (-2.79 to -0.32) *P value* <0.05 **Females:** 7-11 years: -2.96 (-4.09 to -1.83) *P value* <0.05 11-16 years: -2.47 (-3.71 to -1.22) *P value* <0.05 Adjustment done for social class at birth, adult social class, smoking, education, alcohol consumption, hypertension and for women menopausal status
Santhur R Srinivasan et al, 1996 **127**	Bogalusa Heart Study	United States	783 subjects were followed up for 14 years from age 13-17 to age 27-31 years	BMI	HDL	**Association between adolescent weight status and HDL levels in adulthood:** β= -3.4 *P value* <0.05 **Association between change in BMI during follow up and HDL levels in adulthood:** β= -0.8 *P value* <0.0001 *P value*: overweight vs. lean
Michael s. Boyne et al, 2010 **1**	Vulnerable Windows Cohort Study (Birth Cohort)	Kingston, Jamaica	296 subjects (134 boys and 162 girls) were followed up for 11 years from birth till age 11	BMI	HDL	**Association (regression coefficient) between HDL levels at 11 years and increase in BMI between:** 6 months to 2 years: -0.237 *P value* <0.001 2 years to 11 years: -0.175 (values adjusted for age and sex)
Marlou LA de Kroon et al, 2010	Terneuzen Birth Cohort (1977-86)	Netherlands	642 subjects were followed for 18-28 years from birth to the age of 18-28 years	BMI (overweight and obese defined	HDL	**Association between HDL levels in adulthood [Regression coefficient (95% CI)] and change in conditional measures of BMI:**

13				according to the Dutch reference data)		<u>Change in score from birth to 1 year:</u> -0.07 (-0.15 to 0.01) <u>Change in score from 1-2 years:</u> -0.05 (-0.13 to 0.03) <u>Change in score from 2-6 years:</u> -0.08 (-0.16 to 0.00) *P value* <0.05 <u>Change in score from 6-10 years:</u> 0.09 (0.01 to 0.17) *P value* <0.05 <u>Change in score from 10-18 years:</u> -0.10 (-0.16 to -0.04) *P value* <0.002 (all analyses are adjusted for age and gender) (Change score: the expected value of BMI SDS at a break age is called the *status score.* The change between the status score at the start and the end of the various age intervals is called the *change score*)
DS Freedman et al, 2001 **30**	Bogalusa Heart Study	United States	2617 subjects were followed up for 17 years from the age of 2-17 years to 18-37 years	BMI* (85^{th}-95^{th} percentile are at risk of being overweight; >95^{th} percentile are overweight)	HDL	**Association (spearman correlation coefficient) of adulthood high density cholesterol with:** <u>Childhood BMI percentile:</u> -0.14 <u>Change in BMI during follow up:</u> -0.18 <u>Childhood BMI percentile adjusted for adult BMI:</u> 0.07 (values adjusted for race, sex, and age)
Lise Graversen et al, 2014 **42**	Northern Finland Birth Cohort 1966 Study	Finland	2120 subjects were followed up for 31 years from the age of 1 year to 31 years	BMI	HDL	**Risk of having lower HDL levels in adulthood [relative risk (95% CI)] by BMI percentiles at age 5 years:** <u><5^{th} percentile:</u> 0.6 (0.3 to 1.3) <u>≥5^{th} to <50^{th} percentile:</u> 1.0 <u>≥50^{th} to <75^{th} percentile:</u> 1.0 (0.7 to 1.4) <u>≥75^{th} to <90^{th} percentile:</u> 1.3 (0.9 to 1.7) <u>≥90^{th} to <95^{th} percentile:</u> 0.9 (0.5 to 1.6) <u>≥95^{th} percentile:</u> 1.3 (0.8 to 2.1)

						(values adjusted for gender) (linear associations were adjusted for birth weight, gestational age, maternal smoking during pregnancy, maternal age at birth, maternal pre-pregnancy BMI, maternal education level, and parity)
Alan R Sinaiko et al, 1999 **53**	Minneapolis Children's Blood Pressure Study	United States	679 subjects were followed up for 16 years from 7.7 years to 23.6 years	BMI	HDL	**Association between HDL levels in adulthood and BMI in childhood:** r= -0.18 *P value* <0.0001 **Association between HDL levels in adulthood and rate of increase in BMI in childhood:** r= -0.16 *P value*= 0.0001 **Association between HDL levels in adulthood and rate of increase in BMI in adolescence:** r= -0.18 *P value*= 0.0001
Charlotte M Wright et al, 2001 **46**	Newcastle thousand families cohort study (birth cohort)	United Kingdom	412 subjects were followed for 41 years from the age of 9 years to 50 years	BMI (childhood BMI assessed as per body mass index reference curves for UK, 1990; Adulthood overweight defined as BMI between 24-29 kg/m^2 and obese as BMI≥30 kg/m^2)	HDL	**Association (standardized regression coefficients) between BMI at ages 9 and 13 years in childhood and HDL levels at age 50:** <u>Males:</u> BMI age 9 0.07 BMI age 13 0.05 <u>Females:</u> BMI age 9 -0.04 BMI age 13 0.04 (values adjusted for body mass index at age 50)
U Sovio et al, 2014 **111**	Northern Finland Birth Cohort of 1966 Study	Finland	4228 subjects were followed up for 31 years from birth till age 31	BMI at adiposity rebound	HDL	**Association between adulthood HDL levels and BMI at adiposity rebound:** % change= -2.12 95% CI= -4.60 to 0.42 *P value*= 0.10

						(adjusted for father's socioeconomic status, mother's age, height, weight, smoking at 2 months of pregnancy, gestational age, child's birth weight, sex, PHV1, BMI at BMIP and age at BMIR)
Caroline HD Fall et al, 2008 **77**	New Delhi birth cohort	India	1492 subjects were followed up for 26-32 years from birth till age 26-32	BMI	HDL	**Association [β (95% CI)] of adulthood HDL levels with conditional BMI SD scores:** **Birth to 2 years:** -0.19 (-0.07 to 0.05) *P value*= 0.7 **2-11 years:** -0.01 (-0.07 to 0.05) *P value*= 0.7 **11 years-adulthood:** -0.14 (-0.20 to -0.08) *P value* <0.001 Analysis is adjusted for age, sex, and lifestyle factors: alcohol consumption, physical activity, tobacco use, socioeconomic status in childhood based on father's occupation, socioeconomic status in adult life derived from education level, household possessions and occupation, and family history of any high blood pressure, angina, myocardial infarction, stroke, or diabetes in a first-degree relative
Debbie A Lawlor et al, 2010 **102**	Avon Longitudinal Study of Parents and Children	United Kingdom	5235 subjects were followed for 5-6 years from age 9-12 years to 15-16 years	BMI	HDL	**Association [OR (95% CI)] between change (1 SD z score) in BMI and development of low HDL levels:** **Males:** <u>MODEL 1:</u> 1.43 (1.27 to 1.61); <u>MODEL 2:</u> 1.39 (1.22 to 1.57) **Females:** <u>MODEL 1:</u> 1.37 (1.20 to 1.57); <u>MODEL 2:</u> 1.25 (1.08 to 1.46) *P value for sex interaction*= 0.24 Model 1: adjusted for age, height and height^2 Model 2: additional adjusted for maternal age, parity, family social class, maternal education, paternal education, birth weight, gestational age, maternal and parental BMI, and puberty
Caroline HD Fall et al, 2008 **77**	New Delhi birth cohort	India	1492 subjects were followed up for 26-32 years from birth till age 26-32	Weight	HDL	**Association [β (95% CI)] of adulthood HDL levels with conditional weight SD scores:** **Birth to 2 years:** -0.03 (-0.09 to 0.03) *P value*= 0.3 **2-11 years:** -0.03 (-0.09 to 0.03)

						P value= 0.3 **11 years-adulthood:** -0.14 (-0.20 to -0.08) *P value* <0.001 Analysis is adjusted for age, sex, and lifestyle factors: alcohol consumption, physical activity, tobacco use, socioeconomic status in childhood based on father's occupation, socioeconomic status in adult life derived from education level, household possessions and occupation, and family history of any high blood pressure, angina, myocardial infarction, stroke, or diabetes in a first-degree relative
Ioanna Tzulaki et al, 2010 **112**	Northern Finland Birth Cohort 1966 Study	Finland	3,778 subjects followed up for 31 years from birth to the age of 31 years	Weight	HDL	**Association between HDL in adulthood [β (95% CI)] and peak height velocity (cm/year) in infancy:** Model 1: 0.005 (-0.02 to 0.02) *P value*= 0.89 Model 2: 0.012 (-0.013 to 0.037) *P value*= 0.33 Model 3: -0.97 (-4.35 to 2.54) *P value*= 0.58 Model 4: 0.030 (0.0006 to 0.053) *P value*= 0.01 Model 1: adjusted for sex Model 2: adjusted for sex, socioeconomic status at birth, maternal age, maternal height and weight before pregnancy, maternal smoking after the second month of pregnancy, and gestational age at birth Model 3: adjusted for all variables in model 2 plus birth weight Model 4: adjusted for all variables in model 3 plus body mass index at age 31 years
Michael s. Boyne et al, 2010 **1**	Vulnerable Windows Cohort Study (Birth Cohort)	Kingston, Jamaica	296 subjects (134 boys and 162 girls) were followed up for 11 years from birth till age 11	Weight	HDL	**Association (regression coefficient) between HDL levels at 11 years and increase in weight between:** 6 months to 2 years: -0.144 2 years to 11 years: -0.227 *P value* <0.001 (values adjusted for age and sex)
Alan R Sinaiko	Minneapolis	United States	679 subjects were followed up	Weight	HDL	**Association between HDL levels in adulthood and weight in**

et al, 1999 **53**	Children's Blood Pressure Study		for 16 years from 7.7 years to 23.6 years			**childhood:** r= -0.17 *P value*= 0.0001 **Association between HDL levels in adulthood and rate of increase in weight in childhood:** r= -0.18 *P value*= 0.0001 **Association between HDL levels in adulthood and rate of increase in weight in adolescence:** r= -0.23 *P value*= 0.0001
Alan R Sinaiko et al, 1999 **53**	Minneapolis Children's Blood Pressure Study	United States	679 subjects were followed up for 16 years from 7.7 years to 23.6 years	Height	HDL	**Association between HDL levels in adulthood and height in childhood:** r= -0.08 *P value*= 0.04 **Association between HDL levels in adulthood and rate of increase in BMI in childhood:** r= -0.002 *P value*= 0.5829 **Association between HDL levels in adulthood and rate of increase in BMI in adolescence:** r= -0.11 *P value*= 0.2292
Ioanna Tzulaki et al, 2010 **112**	Northern Finland Birth Cohort 1966 Study	Finland	3,778 subjects followed up for 31 years from birth to the age of 31 years	Height	HDL	**Association between HDL levels in adulthood [β (95% CI)] and peak height velocity (cm/year) in infancy:** <u>Model 1:</u> 0.01 (-0.01 to 0.002) *P value*= 0.31 <u>Model 2:</u> 0.02 (-0.004 to 0.05) *P value*= 0.09 <u>Model 3:</u>

						0.03 (-0.002 to 0.05) *P value*= 0.07 Model 4: 0.03 (-0.001 to 0.05) *P value*= 0.06 Model 1: adjusted for sex Model 2: adjusted for sex, socioeconomic status at birth, maternal age, maternal height and weight before pregnancy, maternal smoking after the second month of pregnancy, and gestational age at birth Model 3: adjusted for all variables in model 2 plus birth weight Model 4: adjusted for all variables in model 3 plus body mass index at age 31 years
Michael s. Boyne et al, 2010 **1**	Vulnerable Windows Cohort Study (Birth Cohort)	Kingston, Jamaica	296 subjects (134 boys and 162 girls) were followed up for 11 years from birth till age 11	Height	HDL	**Association (regression coefficient) between HDL levels at 11 years and increase in height between:** 6 months to 2 years: 0.034 2 years to 11 years: -0.132 (values adjusted for age and sex)
Debbie A Lawlor et al, 2010 **102**	Avon Longitudinal Study of Parents and Children	United Kingdom	5235 subjects were followed for 5-6 years from age 9-12 years to 15-16 years	Waist circumference	HDL	**Association [OR (95% CI)] between change (1 SD z score) in waist circumference and development of low HDL levels:** **Males:** MODEL 1: 1.45 (1.30 to 1.62); MODEL 2: 1.40 (1.25 to 1.57) **Females:** MODEL 1: 1.41 (1.23 to 1.62); MODEL 2: 1.29 (1.12 to 1.49) *P value for sex interaction*= 1.00 Model 1: adjusted for age, height and $height^2$ Model 2: additional adjusted for maternal age, parity, family social class, maternal education, paternal education, birth weight, gestational age, maternal and parental BMI, and puberty

J White et al, 2011 **87**	National Heart, Lung and Blood Institute (NHLBI) Growth and Health Study (NGHS)	United States	617subjects were followed up for 5 years from the age of 9 till 12-14 years	Waist circumference	HDL	**Association between waist circumference at age 9 and change in HDL levels between 12 to 14 years:** β= -0.28 95% CI= -0.45 to -0.12 *P value* <0.001 (adjusted for age at entry, race, parental education, household income, menstrual status at 12 and 14 years, and changes in: total calorific intake, key score, and height)
DS Freedman et al, 2001 **30**	Bogalusa Heart Study	United States	2617 subjects were followed up for 17 years from the age of 2-17 years to 18-37 years	Triceps skinfold thickness	HDL	**Association between adulthood HDL levels and childhood triceps skinfold thickness:** r= -0.12 (values adjusted for race, age, and sex)
U Sovio et al, 2014 **111**	Northern Finland Birth Cohort of 1966 Study	Finland	4228 subjects were followed up for 31 years from birth till age 31	Age at adiposity rebound	HDL	**Association between adulthood HDL levels and age at adiposity rebound:** % change= 4.60 95% CI= 2.54 to 6.70 *P value*< 0.0001 (adjusted for father's socioeconomic status, mother's age, height, weight, smoking at 2 months of pregnancy, gestational age, child's birth weight, sex, PHV1, BMI at BMIP and BMI at BMIR)
J White et al, 2011 **87**	National Heart, Lung and Blood Institute (NHLBI) Growth and Health Study (NGHS)	United States	617 subjects were followed up for 5 years from the age of 9 till 12-14 years	Sum of skinfolds	HDL	**Association between SSF at age 9 and change in HDL levels between 12 to 14 years:** β= -0.09 95% CI= -0.15 to -0.03 *P value* <0.001 (adjusted for age at entry, race, parental education, household income, menstrual status at 12 and 14 years, and changes in: total calorific intake, key score, and height)

Table 25: Assesment of quality of studies included for the above outcome

AUTHOR/COHORT	ASSESSMENT OF QUALITY OF INCLUDED COHORTS (NEW CASTLE OTTAWA SCALE)							
	SELECTION				COMPARABILITY	OUTCOME		
	Representativeness of the intervention cohort	Selection of non intervention cohort	Ascertainment of intervention	Demonstration that outcome of interest was not present at start of study	Comparability of cohorts on the basis of the design or analysis	Assessment of outcome	Was follow up long enough for outcomes to occur	Adequacy of follow up of cohorts
Michael S. Boyne et al, 2010 Vulnerable Windows Cohort Study	*		*	*		*	*	
Marlou LA de Kroon et al, 2010 Terneuzen Birth Cohort	*		*	*		*	*	
DS Freedman et al, 2001 Bogalusa Heart Study	*		*	*	* *	*	*	
Lise Graversen et al, 2014 Northern Finland Birth Cohort 1966 Study	*		*	*	*	*	*	
Charlotte M Wright et al, 2001 Thousand Families Cohort Study	*		*	*	*	*	*	
U Sovio et al, 2014 Northern Finland Birth Cohort Of 1966 Study	*		*	*	*	*	*	
Caroline HD Fall et al, 2008 New Delhi Birth Cohort	*		*	*	* *	*	*	
Ioanna Tzaoulaki et al, 2010 Northern Finland Birth Cohort 1966 Study	*		*	*	* *	*	*	
J White et al, 2011 National Heart, Lung And Blood Institute (Nhlbi) Growth And Health Study (Nghs)	*		*	*	*	*	*	
Alan R Sinaiko et al, 1999 Minneapolis Children's Blood Pressure Study	*		*	*		*	*	
Snehal M Pinto Pereira et al, 2012 1958 British Birth Cohort	*		*	*	*	*	*	
Santhur R Srinivasan et al, 1996 Bogalusa Heart Study	*		*	*	* *	*	*	

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ANNEXURE-I

MEDLINE (Ovid SP) Search strategy

1. weight for age.mp.
2. height for age.mp.
3. weight for height.mp.
4. body mass index.mp.
5. mid upper arm circumference.mp.
6. skin fold thickness.mp.
7. adiposity.mp.
8. waist circumference.mp.
9. birth weight.mp.
10. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9
11. newborn.mp.
12. infant.mp.
13. child.mp.
14. children.mp.
15. adolescence.mp.
16. 11 or 12 or 13 or 14 or 15
17. cardiovascular disease.mp.
18. coronary artery disease.mp.
19. stroke.mp.
20. myocardial infarction.mp.
21. cardiomyopathy.mp.
22. heart failure.mp.
23. ischemic heart disease.mp.
24. 17 or 18 or 19 or 20 or 21 or 22 or 23
25. diabetes mellitus type 2.mp.
26. hypertension.mp.
27. blood pressure.mp.
28. glucose tolerance.mp.
29. blood glucose.mp.
30. HbA1c.mp.
31. glycated hemoglobin.mp.
32. insulin resistance.mp.
33. hyperlipidemia.mp.
34. hypercholesterolemia.mp.
35. obesity.mp.
36. overweight.mp.
37. central obesity.mp.
38. peripheral obesity.mp.
39. metabolic syndrome.mp.
40. carotid artery elasticity.mp.
41. carotid intimal thickness.mp.
42. carotid artery intima thickness.mp.
43. systolic blood pressure.mp.
44. diastolic blood pressure.mp.

45. 25 or 26 or 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 or 40 or 41 or 42 or 43 or 44
46. 24 or 45
47. 10 and 16 and 46
48. cohort.mp.
49. case-control.mp.
50. 48 or 49
51. 47 and 50

1.