**Article:**

Lichtenauer, M., Wheatley, S.D., Martyn-St James, M. orcid.org/0000-0002-4679-7831 et al. (13 more authors) (2018) Efficacy of anthropometric measures for identifying cardiovascular disease risk in adolescents: review and meta-analysis. Minerva Pediatrica, 70 (4). pp. 371-382. ISSN 0026-4946

10.23736/S0026-4946.18.05175-7

**Table 1:**

Table 1 Legend: Summary of studies included in the meta-analysis (n = 13 data sets representing 14 identified records).

| Study | Number of participants | Age range | Parameters of interest measured | Adiposity classifications of interest data available for |
|---|---|---|---|---|
| **Alvarez et al. (2006) [10]** | 388 | 12-19 years | TC, TG, HDL-c, LDL-c, glucose, insulin. | BMI, UW/NW, OW/Ob (females only) |
| **Burke et al. (2004) [11]** | 1,310 | 12 years | SBP, DBP. | BMI, UW/NW, OW/Ob (separated by sex) |
| **Chiolero et al. (2006) [12]** | 7,804 | 11-18 years | SBP, DBP. | BMI. All classifications for both sexes (raw data provided) |
| **Cobayashi et al. 2010) [13]** | 321 | 14-19 years | SBP, DBP, TC, TG, HDL-c, LDL-c, insulin. | BMI. All classifications for both sexes (raw data provided) |
| **Duncan et al. (2011) [14]** | 622 | 11-14 years | SBP, DBP. | BMI. All classifications for both sexes (raw data provided) |
| **Jung et al. (2010) (also represents Jung et al. (2009)) [15]** | 77 | 13-17 years | TC, TG, HDL-c, LDL-c. | BMI, WC, WHtR. All classifications, males only (raw data provided) |
| **Klein-Platat et al. (2005) [16]** | 120 | 12 years | SBP, DBP, TG, HDL-c, glucose, insulin. | BMI, UW/NW, OW/Ob (sexes combined) |
| **Kollias et al. (2009) [17]** | 558 | 12-17 years | SBP, DBP. | BMI. All classifications for both sexes (raw data provided) |
| **Lurbe et al. (2006) [18]** | 465 | 11-18 years | SBP, DBP. | BMI, UW/NW, OW (sexes combined) |
| **Manios et al. (2005) [19]** | 510 | 12-13 years | TC, TG, HDL-c, LDL-c. | BMI, NW, OW/Ob (separated by sex) |
| **Martinez-Gomez et al.** | 425 | 13-18.5 years | TC, TG, HDL-c, LDL-c, glucose. | BMI, UW/NW, OW/Ob (sexes combined) |

| | | | | |
|---|---|---|---|---|
| **(2010) [20]** | | | | |
| **Musso et al. (2011) [21]** | 966 | 11-19 years | SBP, DBP, TC, TG, HDL-c, LDL-c, glucose, insulin. | BMI, WC, WHtR. All classifications for both sexes (raw data provided) |
| **Sur et al. (2005) [22]** | 1,044 | 12-13 years | TC, TG, HDL-c, LDL-c. | BMI, UW/NW, OW/Ob (separated by sex) |

N.B. Manios et al. 2005 and Sur et al. 2005 include data from the same population. However, as the method for subdividing the data within each study was different these two studies were never included in the same analysis and so both studies were retained.

BMI = Body mass index; WC = Waist circumference; WHtR = Waist to height ratio; SBP = Systolic blood pressure; DBP = Diastolic blood pressure; TC = Total cholesterol; TG = Triglycerides; HDL-c = High density lipoprotein cholesterol; LDL-c = Low density lipoprotein cholesterol.

**Table 2:**

Table 3 Legend: Quality assessment of studies included in the meta-analysis (n = 13).

| Study | Quality assessment item (low, medium or high risk) | | | | | Overall assessment (High, medium or low risk) |
|---|---|---|---|---|---|---|
| | Study sample selection | Outcome assessment | Attrition Bias | Reporting Bias | Suitability of methods | |
| **Alvarez et al. 2006 [10]** | LOW | HIGH | LOW | LOW | LOW | **HIGH** |
| **Burke et al. 2004 [11]** | LOW | MEDIUM | LOW | LOW | LOW | **MEDIUM** |
| **Chiolero et al. 2006 [12]** | LOW | MEDIUM | LOW | LOW | LOW | **MEDIUM** |
| **Cobayashi et al. 2010 [13]** | MEDIUM | MEDIUM | LOW | LOW | MEDIUM | **MEDIUM** |
| **Duncan et al. 2011 [14]** | MEDIUM | MEDIUM | LOW | LOW | LOW | **MEDIUM** |
| **Jung et al. 2010 [15]** | MEDIUM | MEDIUM | LOW | LOW | MEDIUM | **MEDIUM** |
| **Klein Platat et al. 2005 [17]** | MEDIUM | MEDIUM | LOW | LOW | LOW | **MEDIUM** |
| **Kollias et al. 2009 [17]** | MEDIUM | MEDIUM | LOW | LOW | LOW | **MEDIUM** |
| **Lurbe et al. 2006 [18]** | MEDIUM | MEDIUM | LOW | LOW | MEDIUM | **MEDIUM** |
| **Manios et al. 2005 [19]** | MEDIUM | HIGH | LOW | LOW | LOW | **HIGH** |
| **Martinez-Gomez et al. 2010 [20]** | HIGH | HIGH | LOW | LOW | LOW | **HIGH** |
| **Musso et al. 2011 [21]** | MEDIUM | MEDIUM | LOW | LOW | MEDIUM | **MEDIUM** |
| **Sur et al. 2005 [22]** | MEDIUM | HIGH | LOW | LOW | LOW | **HIGH** |

**Supplementary Table 1:** Mean differences in triglyceride levels between normal weight and overweight/obese groups when waist circumference was used as an adiposity index.

| | No studies (No participants) | Mean difference, $mmol \cdot L^{-1}$ (95% CI) | Heterogeneity, $I^2$ | Test for overall effect |
|---|---|---|---|---|
| All | 2 (1,027) | -0.16 (-0.28 to -0.04) | 68% | Z = 2.60 P = 0.009 |
| Males | 2 (597) | -0.22 (-0.30 to -0.14) | 0% | Z = 5.41 P < 0.00001 |
| Females | 1 (430) | -0.07 (-0.16 to 0.02) | n/a | Z = 1.54 P = 0.12 |

**Supplementary Table 2:** Mean differences in triglyceride levels between normal weight (<0.5) and overweight (≥0.5) groups defined using waist to height ratio.

| | No studies (No participants) | Mean difference, $mmol \cdot L^{-1}$ (95% CI) | Heterogeneity, $I^2$ | Test for overall effect |
|---|---|---|---|---|
| All | 2 (1,035) | -0.42 (-0.59 to -0.24) | 0% | Z = 4.65 P < 0.00001 |
| Males | 2 (600) | -0.41 (-0.65 to -0.17) | 39% | Z = 3.34 P = 0.0008 |
| Females | 1 (435) | -0.32 (-1.02 to 0.38) | n/a | Z = 0.89 P = 0.37 |

**Supplementary Table 3: Summary of included studies.**

| Study | Number of participants (in eligible subgroups) | Age | Key findings of study in relation to the current review |
|---|---|---|---|
| Adams et al. (2008) {1} | 4,263 | 14-18 years | Participants who were Ob by BMI were 6.9 times more likely to have elevated blood pressure than NW participants. There was a significant association between degree of OW (by BMI) and blood pressure. |
| Agyemang et al. (2009) {2} | 855 | 12-17 years | BMI significantly related to SBP and DBP in all ethnic groups tested (except Maroon participants). |
| Al-Sendi et al. (2007) {3} | 504 | 12-17 years | Significant relationships for both BMI and WC with SBP and DBP in males and females. Both SBP and DBP significantly higher in individuals with BMI ≥ 85$^{th}$ percentile compared to those with BMI < 85$^{th}$ percentile. Those in highest tertile for WC 7.33 times more likely to have hypertension compared to those in lowest tertile. Relationships similar when BMI or WC used. |
| Alvarez et al. (2006) {4} | 388 | 12-19 years | No significant differences between OW and non-OW groups (classified by BMI) for TC, TG, LDL-c or HDL-c (study included females only). |
| Baba et al. (2007) {5} | 39,848 | 15-16 years | BMI significantly related to SBP and DBP in males and females. BMI quintile had a significant effect on SBP and DBP with all quintiles significantly different to lowest quintile in males and quintiles 3-5 significantly different to lowest for SBP and highest quintile significantly different to lowest for DBP in females. |
| Barath et al. (2010) {6} | 14,290 | 11-16 years | BMI significantly related to SBP and DBP in males and females. OW and Ob adolescents had BP levels on |

| | | | |
|---|---|---|---|
| | | | average 11-6 mmHg (P < 0.001) greater than non-OW adolescents. |
| Benmohammed et al. (2011) {7} | 305 | 12-19 years | Rates of hypertension and pre-hypertension significantly different between Ob and OW adolescents (classified by BMI). SBP significantly different between OW and Ob participants. DBP no different between these groups. |
| Bergstrom et al. (1996) {8} | 1,032 | 14 or 17 years | All relationships (in males and females for both age groups) for BMI and WC with Insulin, TG, TC, HDL-c, LDL-c and SBP significant (except between both BMI and WC with SBP in 14 year old and 17 year old females). Relationship sizes similar when BMI or WC used. |
| Bermingham et al. (1995) {9} | 144 | 15-18 years | No significant differences between adiposity groups (classified by BMI) for TC or HDL-c. |
| Bindler and Daratha (2012) {10} | 151 | 11-14 years | SBP, DBP, TG and HDL-c significantly different between Ob and non-Ob groups (classified by BMI). TC and LDL-c no different between these groups. Odds ratios for elevated levels of these risk factors in Ob v non-Ob were 0.98 for TC, 2.56 for HDL-c, 1.41 for LDL-c, 2.48 for TG, 6.02 for SBP and 2.85 for DBP. |
| Bindler et al. (2012) {11} | 150 | 11-14 years | HDL-c, TG, SBP and DBP significantly different between Ob and non-Ob groups (classified by BMI). TC and LDL-c no different between these groups. |
| Blackett et al. (2005) {12} | 313 | 15-19 years | HDL-c significantly related to both BMI z-score and WC. Relationship slightly stronger with WC than BMI in Males though very similar magnitude for each in females. |
| Blackett et al. (1996) {13} | 29 | 15-19 years | TC and LDL-c significantly different in highest BMI quartile compared to lowest BMI quartile. |
| Brasileiro et al. (2005) {14} | 1,420 | 15-19 years | TG, HDL-c, LDL-c and insulin significantly different in non-OW participants compared to OW (classified by |

| | | | |
|---|---|---|---|
| | | | BMI). Glucose no different between groups. |
| Brophy et al. (2012) {15} | 1,147 | 11-13 years | Ob participants significantly more likely to have high BP, high TC, high fasting glucose and high fasting insulin than non-Ob participants (classified by BMI). |
| Burke et al. (2004) {16} | 1,310 | 12 years | DBP inversely associated with BMI with DBP lower in OW/Ob group than non-OW group. No association between BMI and SBP. |
| Cao et al. (2012) {17} | 88,974 | 12-17 years | SBP and DBP significantly different between all adiposity classification groups (NW, OW and Ob; classified by BMI) in males and females. OR (in males and females respectively) for hypertension using SBP in OW v NW 3.7 and 4.5, and in Ob v NW 14.2 and 19.4. For hypertension using DBP in OW v NW OR 2.1 and 2.3 and in Ob v NW 6.2 and 11.8. |
| Caserta et al. (2010) {18} | 646 | 11-13 years | Ob males significantly more likely to have low HDL-c, High LDL-c, High TG and high insulin than NW males. OW males significantly more likely to have low HDL, high TG and high insulin than NW males. Ob and OW females significantly more likely to have low HDL, high TG and high insulin than NW females. All adiposity classifications using BMI. |
| Centres for Disease Control and Prevention (2010) {19} | 3,125 | 12-19 years | OW v NW (classified by BMI) 1.4 times more likely to have high LDL-c, 1.9 times more likely to have low HDL-c and 2.4 times more likely to have high TG; rising to 2.5, 4.8 and 4.1 respectively for OB v NW. |
| Chiolero et al. (2006) {20} | 7,804 | 11-12 or 17-18 years | OR for high BP versus NW 4.5 (2.8-7.3) and 10.2 (6.0-17.2) for OW and Ob (classified by BMI) respectively in 11-12 year old males. OR for same comparisons in 17-18 year old males 4.0 (2.7-6.0) and 4.4 (2.4-7.9); in 11-12 year old females 3.00 (2.0-4.4) and 10.1 (6.6-15.5); and in 17-18 year old females 3.8 (2.6-5.5) and 9.3 (5.9-14.5) |
| Chu et al. (1998) {21} | 1,366 | 12-16 | SBP, DBP, TC, TG, HDL-c, LDL-c and glucose |

| | | | |
|---|---|---|---|
| | | years | significantly different between non-Ob and Ob groups (classified by BMI) in both males and females (except LDL-c and glucose in females). |
| Chu et al. (2000) {22} | 1,264 | 12-16 years | BMI significantly associated with SBP, TC, TG, HDL-c, LDL-c and insulin in males and females. |
| Chu et al. (2003) {23} | 1,032 | 12-16 years | SBP, DBP, TG, HDL-c, glucose and insulin significantly different between NW and OW groups (classified by BMI) in males and females. TC significantly different between same groups only in Males. |
| Chu et al. (2002) {24} | 1,184 | 12-16 years | Insulin significantly different between NW and OW groups (classified by BMI) in both males and females. |
| Chu et al. (2001) {25} | 1,265 | 12-16 years | BMI strongly associated with both SBP and DBP in males and females. |
| Cobayashi et al. (2010) {26} | 321 | 14-19 years | Crude OR in OW versus NW (classified by BMI) significant for abnormal SBP (OR not reported), abnormal DBP (OR not reported), pre-hypertension or hypertension (OR = 4.15, 2.09-8.24), high TG (3.62, 1.31-10.01), HDL-c (4.17, 1.65-10.51) and insulin (9.94, 4.72-20.91). OR non-significant for TC and LDL-c between the same groups. |
| Cook et al. (2003) {27} | 2,430 | 12-19 years | The prevalence of high TG, low HDL-c and elevated BP was higher in OW than NW participants (classified by BMI) and higher still in Ob participants than OW participants. High glucose was more prevalent in OW than both NW and Ob groups. The only groups where the 95% confidence interval did not overlap were in OW and Ob compared to NW for both TG and HDL-c, and for Ob v NW for BP (though no statistical analysis was performed between these groups). |
| de Oliveira et al. (2001) {28} | 80 | 12-18 years | BMI and WC related to HDL-c in males. BMI related to SBP, DBP and TC whilst WC related to SBP, DBP, TC, HDL-c and LDL-c in females. TG not related to BMI or |

| | | | |
|---|---|---|---|
| | | | WC in either sex. Relationships were stronger with WC than BMI for most variables. |
| Denney-Wilson et al. (2008) {29} | 496 | 15-16 years | OW and Ob groups classified by either BMI or WC had higher BP, TG, LDL-c and insulin levels and lower HDL-c than NW participants. There was little difference in the ability of BMI or WC to predict this. |
| Dhuper et al. (2009) {30} | 353 | 12-19 years | WC and WHtR significantly correlated with HDL-c (inversely) and TG but not TC or LDL-c. BMI z-score significantly correlated with HDL-c (inversely), TG and LDL-c but not TC. No clear difference in ability of BMI, WC or WHtR to predict CVD. |
| Dinç et al. (2009) {31} | 1,346 | 15-18 years | OR for hypertension from different models between 1.48 and 10.07 in OW group v NW and between 1.18 and 19.89 for Ob group v "NW" participants (classified using BMI). |
| Duncan et al. (2011) {32} | 622 | 11-14 years | BMI significantly related to, and a significant predictor of, SBP and DBP. SBP significantly different across all weight status groups (classified by BMI). DBP significantly different between all weight classification groups except between OW and Ob groups. |
| Ford et al. (2006) {33} | 1,791 | 12-19 years | BMI was associated with insulin concentration in males, females and in all participants combined. |
| Freedman et al. (1999) {34} | 5,568 | 11-17 years | SBP, DBP, TC, TG, HDL-c, LDL-c and insulin all significantly related to BMI. OR for OW compared to not OW in 11-12 year olds for elevated CVD risk factors were: SBP = 2.8, DBP = 2.0, TC = 2.0, TG = 7.3, HDL-c = 3.6, LDL-c = 2.6 and insulin = 16.1. In 13-14 year olds: SBP = 2.5, DBP = 2.3, TC = 3.4, TG = 8.7, HDL-c = 4.9, LDL-c = 6.6 and insulin = 10.7. In 15-17 year olds: SBP = 2.9, DBP = 0.8, TC = 2.8, TG = 6.5, HDL-c = 1.8, LDL-c = 2.5 and insulin = 11.1. |
| Freedman et al. (1997) {35} | 160 | 12-19 years | BMI significantly related to SBP, DBP, TC, TG, HDL-c and LDL-c in males and females (except for TC and |

| | | | |
|---|---|---|---|
| | | | LDL-c in females). |
| Frontini et al. (2001) {36} | 4,917 | 12-13 years | BMI significantly related to SBP, DBP, TC, TG, HDL-c, LDL-c, glucose and insulin in white and black males and females, with the exceptions of glucose in white females and black females and TC in black males and black females. |
| Galhotra et al. (2009) {37} | 866 | 11-16 years | BMI associated with DBP in males and females combined. |
| Ghannem et al. (2003) {38} | 1,569 | 13-19 years | SBP, TC, TG and HDL-c significantly different in OW and OB groups compared to NW groups (classified using BMI) in males and females, with the exception of TC in Ob females. |
| Gillum (1989) {39} | 6,768 | 12-14 & 15-17 years | BMI and WC only significantly correlated to TC in white, 15-17 year old males and white 15-17 year old females. No association in 12-14 year olds of any sex or ethnicity or in black 15-17 year old males or females. |
| Gillum (1999) {40} | 7,987 | 12-19 years | Strength of relation with HDL-c and TC similar for both BMI and WC, a finding consistent in both sexes and across racial groups. |
| Goel et al. (2010) {41} | 1,022 | 14-19 years | WC superior indicator of diastolic hypertension and overall hypertension with OR for diastolic hypertension in highest quartile versus lowest quartile 7.38 (2.25 – 24.47) compared to 2.75 (1.08 – 7.03) for the same comparison using BMI. OR for systolic hypertension very similar for both methods. |
| Goodman et al. (2005) {42} | 1,578 | 12-18 years | BMI and WC both significantly correlated with TC, TG, HDL-c, LDL-c, glucose and insulin with little difference in the strength of the relationship for any of the variables. |
| Guimaraes et al. (2008) {43} | 536 | 11-18 years | Prevalence ratios for high SBP and high DBP higher for BMI (OW v non-OW) than WC (OW v non-OW). 85$^{th}$ percentile used as cut-off for BMI however and 75$^{th}$ percentile for WC which will have contributed to this. |

| | | | |
|---|---|---|---|
| Gungor et al. (2005) {44} | 62 | 13-16 years* | SBP, DBP, TC, HDL-c and LDL-c significantly different between NW and Ob groups (classified using BMI). No difference between groups for TG. |
| Gutin et al. (2007) {45} | 464 | 14-18 years | BMI and WC both related to SBP, TG and insulin. Strength of association comparable for both measures. |
| Gutin et al. (2005) {46} | 398 | 15-18 years | BMI and WC both significantly related to TG. Strength of relationship identical ($r^2 = 0.14$ for both). |
| Hakim et al. (1997) {47} | 102 | 11-16 years | BMI significantly related to both TC and TG. |
| Harding et al. (2006) {48} | 6,365 | 11-13 years | DBP in upper tertile for both BMI and WC significantly different to lower tertile in all ethnic groups for both males and females. No clear difference when using BMI compared to when using WC. |
| Harding et al. (2008) {49} | 6,644 | 11-13 years | OR of having high SBP in OW v non-OW participants (classified by BMI) 2.50 and 3.39 for males and females respectively and in OB v non-OW OR were 4.31 and 5.68 respectively. For high DBP OR (for males and females respectively) were 2.50 and 1.66 for OW and 5.74 and 5.05 for Ob v non-OW. |
| Hsieh et al. (2003) {50} | 852 | 12-16 years | BMI significantly related to fasting plasma insulin levels in both males and females. |
| Huang et al. (2011) {51} | 1149 | 14 years | Relationships with SBP, TC, TG, HDL-c, LDL-c and insulin very similar magnitudes for BMI, WC and WHtR. |
| Israeli et al. (2006) {52} | 560,588 | 16.5-19 years | Prevalence of hypertension significantly greater in those who were OW or Ob (classified by BMI) compared to those who were of “ideal weight”. |
| Jago (2006) {53} | 1,717 | 13-14 years | Odds of prehypertension, low HDL-c and high TG significantly different across adiposity groups (NW, OW and OB; classified by BMI) with all participants combined and when split by sex. Odds of hypertension only significant across groups for female participants, odds of high TC only significant across groups for male participants and odds of high LDL-c only significant |

| | | | |
|---|---|---|---|
| | | | when all participants combined. |
| Jung et al. (2009) {54} | 77 | 13-17 years | WC significantly associated with SBP, TG and HDL-c. BMI significantly associated with SBP and HDL-c but not TG. WC more strongly associated with HDL-c (as well as TG), though BMI slightly more strongly associated with SBP. Only used male participants. |
| Jung et al. (2010) {54} | 77 | 13-17 years | SBP and HDL-c significantly different between NW and OW groups (classified by BMI), though no difference between these groups for TC, TG or LDL-c. Only used male participants. |
| Klein-Platat et al. (2005) {55} | 120 | 12 years | TG, glucose and insulin significantly difference between NW and OW groups (classified by BMI), though no difference between these groups for SBP, DBP or HDL-c. |
| Kollias et al. (2009) {56} | 558 | 12-17 years | BMI significantly associated with SBP in males and females, but only associated with DBP in females. |
| Kuzawa et al. (2003) {57} | 608 | 14-16 years | BMI significantly correlated with TC, TG and LDL-c (but not HDL-c) in males and with TG, HDL-c and LDL-c (but not TC) in females. |
| Lavrador et al. (2011) {58} | 80 | 14-19 years | SBP, DBP, TG, HDL-c, glucose and insulin significantly different in participants with BMI z-score <2.5 compared to those ≥2.5. No difference between these groups for TC and LDL-c. OR between these groups significant for BP (OR = 3.6), TG (3.5), HDL-c (4.3) and glucose (3.6) but not for LDL-c or insulin and not reported for TC. |
| Lee et al. (2006) {59} | 1,791 | 12-19 years | Insulin significantly different in both OW and Ob groups compared to NW (classified by BMI). |
| Li et al. (2005) {60} | 3,026 | 7-17.9 years | Prevalence of hypertension, glycemia and hypertriglyceridemia significantly different between NW, OW and Ob groups (classified by BMI). No difference in prevalence of low HDL-c between groups. OR for hypertension (overall, systolic or diastolic) in OW and Ob groups compared to NW participants significant in |

| | | | |
|---|---|---|---|
| | | | all cases. |
| Lindsay et al. (2001) {61} | 985 | 15-19 years | HDL-c, glucose and insulin significantly related to BMI in males and females. TG significantly related to BMI in males only. |
| Lu et al. (2008) {62} | 291 | 15 or 18 years | SBP, DBP, TG and HDL-c all significantly related to BMI. SBP, DBP and HDL-c levels significantly different in OW/Ob group versus non-OW group. TG no different between groups. |
| Lu et al. (2010) {63} | 3,937 | 13-18 years | WC statistically significant predictor of fasting plasma glucose. |
| Lurbe et al. (2006) {64} | 465 | 11-18 years | BP correlated with BMI in both males and females. SBP and DBP significantly different between all adiposity classification groups (non-Ob, OW, moderately-Ob and severely-Ob). |
| Lusky et al. (1996) {65} | 110,000 | 17 years | BMI and hypertension positively associated (though specific details not reported). OR for prevalence of hypertension (versus NW) 2.8 (1.7 – 3.9) in mild OW and 13.1 (9.2 – 17.1) in severe OW participants. |
| Manios et al. (2005) {66} | 510 | 12-13 years | BMI positively related to TG in both males and females. TC, TG and LDL-c significantly different in OW group compared to NW group in males with HDL-c no different. Only HDL-c was different between adiposity classification groups in females. |
| Marti and Vartiainen (1989) {67} | 1,142 | 15 years | BMI significantly related to SBP and HDL-c in males and females. |
| Martinez-Gomez et al. (2010a) {68} | 192 | 13-17 years | BMI and WC significantly associated with insulin levels but not with glucose. Magnitude of relationship similar for both methods. |
| Martinez-Gomez et al. (2010b) {69} | 425 | 13-18.5 years | TG, HDL-c and LDL-c significantly different between non-OW and OW groups (classified by BMI). TC and glucose no different between these two groups. |
| Matsui et al. (1998) | 418 | 12-13 | BMI significantly associated with insulin. |

| | | | |
|---|---|---|---|
| {70} | | years | |
| May et al. (2012) {71} | 3,383 | 12-19 years | The prevalence of pre-hypertension or hypertension, borderline high/high LDL-c and low HDL-c was higher in OW than NW and in OB than OW and NW participants (classified by BMI). No statistical analyses relevant to these data were performed. |
| Mazicioglu et al. (2010) {72} | 2,860 | 11-17 years | BMI, WC and WHtR significantly related to SBP and DBP in males and females. Strength of relationship similar for all methods. |
| McCarthy et al. (2008) {73} | 199 | 11-12 years | TC significantly different between Ob and NW groups (classified by BMI). SBP and DBP significantly different between Ob and both NW and OW. OR in OB group compared to NW group for high SBP 3.42 (1.50-7.80), for high DBP 8.01 (3.11-20.63) and for hypertension 7.04 (3.00-16.50) |
| McCrindle et al. (2010) {74} | 20,719 | 14-15 years | BMI significantly related to BP and TC; relationship stronger with BP. |
| McFarlin et al. (2007) {75} | 109 | 13 years | BMI z-score significantly and inversely associated with HDL-c (no other relevant association reported). TG, HDL-c and insulin significantly different between adiposity classification groups (using BMI). TC, LDL-c and glucose no different between groups. |
| McNiece et al. (2007) {76} | 6,790 | 11-17 years | Adjusted OR for pre-hypertension versus NW (classified by BMI) 1.35 and 2.26 for OW and Ob respectively; OR for hypertension 1.39 and 4.26 for OW and Ob respectively. |
| Messiah et al. (2008) {77} | 631 | 12-14 years | For SBP and TG prevalence increased in a dose respondent manner from NW through OW and Ob groups (classified by BMI). For DBP, HDL-c and glucose prevalence in NW participants was higher than in OW participants, though prevalence was still higher |

| | | | |
|---|---|---|---|
| | | | in the Ob group than both. The only groups for which 95%CI did not cross were between OB and both NW and OW groups for HDL-c and TG. No statistical comparison was made between groups. |
| Misra et al. (2006) {78} | 1,214 | 14-18 years | Receiver operating characteristics area under the curve similar for BMI and WC when assessing ability to correctly identify participants with high fasting serum insulin; indicating greater than chance prediction for both. OR for high fasting serum insulin 5.2 and 4.9 in OW groups (versus NW) for BMI and WC respectively in males; and 3.2 and 2.2 for same comparisons in females. |
| Misra et al. (2004) {79} | 250 | 14-18 years | BMI and WC both significantly related to fasting serum insulin (correlations adjusted for age). Magnitude of relationship very similar between methods in males though relationship stronger with BMI in females. OR for hyperinsulinemia in OW v NW 4.7 and 6.4 for BMI and WC respectively (sexes combined). |
| Moon et al. (2004) {80} | 71 | 15-16 years | DBP significantly related to WC only. TG significantly related to BMI and WC with similar magnitude associations. No relationship between either method and SBP, TC, HDL-c or glucose (LDL-c correlations not reported). TG was significantly different between Ob and non-Ob groups (classified using BMI); no difference for SBP, DBP, TC, HDL-c, LDL-c or glucose. |
| Movahed et al. (2011) {81} | 2,072 | 13-19 years | OR for high SBP 2.24 (1.46 – 3.45) in Ob v non-Ob participants (classified using BMI). OR for high DBP 2.10 (1.06 – 4.17) between same groups. |
| Musso et al. (2011) {82} | 966 | 11-19 years | SBP, DBP, TG and HDL-c significantly different in OW/Ob group compared to non-OW/Ob group (classified by BMI). Glucose no different between groups. |
| Nichols and Cadogan | 3,749 | 12-16 | Significant positive relationship between BMI and both |

| | | | |
|---|---|---|---|
| (2006) {83} | | years | SBP and DBP (magnitude not reported). OR for high SBP in OW v non-OW 5.22 (3.96 – 6.88) and OR for high DBP between same groups 2.63 (1.06 – 4.17). |
| Paradis et al. (2004) {84} | 1,827 | 13 or 16 years | BMI and SBP significantly associated in 13 and 16 year old males and females. BMI only associated significantly with DBP in 16 year old males and 13 year old females (P = 0.06 in 13 year old males and 16 year old females). |
| Paterno (2003) {85} | 2,599 | 12-19 years | TC and BP both correlated with BMI (magnitudes not reported). OR for high TC 1.26 (0.87 – 1.82) in OW v NW and 2.00 (1.10 – 3.66) in Ob v NW. OR for hypertension 2.9 (2.2 – 3.6) in OW v NW and 4.9 (3.1 – 4.9) in Ob v NW. |
| Perez Gomez and Huffman (2008) {86} | 100 | 12-16 years | BP, TC, TG and LDL-c significantly different in OW v non-OW (classified by BMI) though no difference in HDL-c or glucose between these groups. Unable to calculate OR for high BP as no non-OW participants had high BP. OR for high TG and high LDL-c significant in OW v non-OW but non-significant for low HDL-c and impaired fasting glucose between same groups. OR for high TC not reported. |
| Petridou et al. (1995) {87} | 307 | 12-18 years | BMI significantly associated with TC, TG, HDL-c and LDL-c. |
| Plachta-Danielzik et al. (2008) {88} | 3,196 | 13-16 years | Non-adjusted BMI and WC were associated with all CVD risk factors in both sexes with very similar magnitudes of association for both adiposity indexes. |
| Rabbone et al. (2009) {89} | 28 | 12-13 years* | SBP, TG, HDL-c and insulin levels significantly different between Ob and NW groups (classified by BMI). No difference between these groups for DBP, TC, LDL-c or glucose. |
| Rafraf et al. (2010) {90} | 985 | 14-17 years | SBP and DBP both significantly associated with BMI (with age controlled for as a confounding factor). |

| | | | |
|---|---|---|---|
| Raftopoulos et al. (1999) {91} | 110 | 15-18 years | BMI and WC both significantly associated with TC and HDL-c, though association for both CVD risk factors stronger with BMI. |
| Reich et al. (2003) {92} | 1,651 | 11-12 or 15-16 years | OR for HTN with 1 $kg \cdot m^{-2}$ increase in BMI was 1.23 (1.14 – 1.34). |
| Riva et al. (2001) {93} | 37 | 10-17 years* | BP, TG, HDL-c, glucose and insulin all significantly different in Ob groups versus NW group (classified by BMI). TC no different between these groups. |
| Roh et al. (2007) {94} | 83 | 14-16 years | SBP, DBP, TG, HDL-c and LDL-c significantly different between Ob and non-Ob groups. TC no different between groups. |
| Rosa et al. (2007) {95} | 456 | 12-17 years | Prevalence ratios for hypertension 2.38 (1.03 – 5.47), 2.94 (1.27 – 2.82) and 4.22 (1.85 – 9.65) using three different BMI classification criteria (point of increased likelihood of >3 CVD risk factors in white people and black people respectively and 90$^{th}$ percentile for a Brazilian population). Prevalence ratio for WC (with 75$^{th}$ percentile as cut-off point between groups) 2.66 (1.13 – 6.25). |
| Rosenbaum et al. (2004) {96} | 72 | 13-14 years | Fasting insulin significantly different between OW and non-OW group (classified by BMI). Glucose no different between these groups. |
| Salvadori et al. (2008) {97} | 252 | 13-17 years | OR for prehypertension 2.0 (0.8-5.0) in OW v NW and 3.2 (1.1 – 9.0) in Ob v NW classified by BMI. OR for hypertension 5.9 (1.8 – 19.8) and 5.9 (1.5 – 24.3) in OW and Ob versus NW respectively. |
| Sangi and Mueller (1991) {98} | 6,768 | 12-17 years | SBP and DBP significantly related to BMI and WC in black and white participants of both sexes whether sexually mature or immature. TC only related to BMI in white boys (whether sexually mature or not) and with WC in sexually mature white boys; not related to BMI or WC in any other group. Magnitude of relationship within |

| | | | |
|---|---|---|---|
| | | | each group similar for both BMI and WC with all variables. |
| Schuster et al. (1998) {99} | 60 | 11-15 years* | Study population divided into NW black, Ob black, NW white and Ob white (classified by BMI). TC significantly different in NW black compared to all groups, TG between Ob black and all groups and insulin between OB black and both NW groups and between Ob white and both NW groups. HDL-c and glucose showed no significant differences between any groups. |
| Schwandt et al. (2010) {100} | 3,038 | 12-18 years | BMI (<90th percentile v ≥ 90th percentile) significant predictor of hypertension (OR = 4.9 (2.8 – 8.4)) and elevated glucose (1.8 (1.2 – 2.7). WC (<90th percentile v ≥ 90th percentile) significantly predicted low HDL-c (OR = 1.7, 1.1 – 2.8) and WHtR (<0.5 v ≥ 0.5) significantly predicted high LDL-c (OR = 3.0, 1.7 – 5.3). None of the adiposity indexes predicted TG. |
| Sharp et al. (2003) {101} | 115 | 13-18 years | BMI and WC both significantly associated with SBP, DBP, TC, TG, HDL-c, glucose and insulin. For TG, HDL-c and insulin the magnitude of association was stronger with WC. SBP and DBP had a stronger association with BMI whilst there was not much difference between the two adiposity indexes for TC and glucose. |
| Sinaiko et al. (2001) {102} | 357 | 10-14 years | BMI significantly associated with SBP, TC, TG, HDL-c and LDL-c in males but only SBP and HDL-c in females. |
| Sinaiko et al. (2002) {103} | 357 | 10-14 years | SBP significantly associated with both BMI and WC in black and white, males and females. Relationship slightly stronger with BMI in males but stronger with WC in females. DBP not significantly associated with either |

| | | | |
|---|---|---|---|
| | | | adiposity index in any groups. |
| Steffen et al. (2008) {104} | 264 | 10-14 years | SBP, TC, TG, HDL-c, LDL-c and insulin significantly different between NW and OW groups (classified by BMI). Glucose not significantly different between groups (P = 0.05). |
| Steinberger et al. (2005) {105} | 130 | 10-14 years | BMI significantly associated with SBP, TG, HDL-c and insulin. |
| Stray-Pedersen et al. (2009) {106} | 2,825 | 15-18 years | OR for systolic hypertension 3.3 (0.5 -21.5) and 11.4 (1.6-82.0) in OW and Ob versus NW (classified by BMI) Argentinian participants. OR for diastolic hypertension 4.5 (1.2–17.3) and 2.2 (0.4-10.8) in same cohort. In the Norwegian sample OR for systolic hypertension in OW and Ob versus NW were 3.8 (2.7-5.4) and 28.3 (11.3-67.7) respectively and for diastolic hypertension were 1.0 (0.1-8.2) and 5.1 (0.6-42.4) between the same groups. |
| Stringer et al. (2009) {107} | 77 | 12-15 years | LDL-c significantly different in Ob group compared to non-Ob group (classified by BMI). SBP, DBP, TC, TG, HDL-c, glucose and insulin no different between groups. |
| Sugiyama et al. (2007) {108} | 4,508 | 12-19 years | BMI z-score significantly associated with SBP (positively) and DBP (negatively) when diet and physical activity are controlled for. |
| Sur et al. (2005) {109} | 1,044 | 12-13 years | BMI significantly associated with TG in males and females, but not with TC, HDL-c or LDL-c. TC, TG and LDL-c significantly different in OW v NW males (classified by BMI) though HDL-c no different between these groups. TG and HDL-c significantly different between OW and NW females, though no difference between these groups for TC or LDL-c. |
| Turconi et al. (2007) {110} | 532 | 14-17 years | SBP and DBP significantly associated with BMI and WC in males and females. BMI strongest predictor of SBP in both sexes. Neither BMI nor WC reported as |

| | | | |
|---|---|---|---|
| | | | stronger predictor of DBP in either sex. |
| Ullrich-French et al. (2010) {111} | 153 | 11-15 years | BMI percentile and WHtR both significantly associated with SBP and DBP. Magnitude of association very similar for both. |
| Vikram et al. (2004) {112} | 62 | 14-18 years | SBP, TG and insulin significantly different between NW and OW groups (classified by BMI). DBP, TC, HDL-c, LDL-c and glucose no different between these groups. |
| Wang et al. (2008) {113} | 1,022 | 12-18 years | BMI significantly related to SBP in both sexes but only to DBP in female participants. OR for high SBP, based on BMI classification, 1.30 (1.13-1.51) in males and 1.25 (1.11-1.41) in females. OR for high DBP 1.08 (0.97-1.21; non-significant) in males and 1.34 (1.17-1.54) in females. |
| Williams et al. (2005) {114} | 915 | 12-19 years | Prevalence of impaired fasting glucose significantly different in NW v Ob and OW v Ob but not in NW v OW groups (classified by BMI). Prevalence between those with WHtR < 95$^{th}$ percentile compared to those ≥ 95$^{th}$ percentile was also significantly different, with a greater magnitude than the between group differences when classified by BMI. |
| Yamamoto-Kimura et al. (2006) {115} | 3,121 | 12-16 years | With the exception of TC and LDL-c in males and females in urban, private schools BMI and WC were significantly associated with all CVD risk factors (SBP, DBP, TC, TG, HDL-c and LDL-c) in all groups. In most groups for most CVD risk factors the magnitude of relationships was comparable for BMI and WC. |
| Zhou et al. (2010) {116} | 269 | 13-19 years | DBP significantly related to BMI in male participants and SBP significantly associated with BMI in female participants. All other relationships (TC, TG, HDL-c. LDL-c and glucose in both sexes plus SBP in males and DBP in females with BMI) were non-significant. |

Supplementary References:

{1} Adams MH, Carter TM, Lammon CAB, Judd AH, Leeper J, et al. (2008) Obesity and blood pressure trends in rural adolescents over a decade. Pediatric Nursing 34: 381-394.

{2} Agyemang C, Oudeman E, Zijlmans W, Wendte J, Stronks K (2009) Blood pressure and body mass index in an ethnically diverse sample of adolescents in Paramaribo, Suriname. BMC Cardiovascular Disorders 9: 19.

{3} Al-Sendi AM, Shetty P, Musaiger AO, Myatt M (2007) Relationship between body composition and blood pressure in Bahraini adolescents. British Journal of Nutrition 90: 837.

{4} Alvarez MM, Vieira ACRe, Moura AS, da Veiga GV (2006) Insulin resistance in Brazilian adolescent girls: Association with overweight and metabolic disorders. Diabetes Research & Clinical Practice 74: 183-188.

{5} Baba R, Koketsu M, Nagashima M, Inasaka H, Yoshinaga M, et al. (2007) Adolescent obesity adversely affects blood pressure and resting heart rate. Circulation Journal 71: 722-726.

{6} Barath A, Boda K, Tichy M, Karoly E, Turi S (2010) International comparison of blood pressure and BMI values in schoolchildren aged 11-16 years. Acta Paediatrica 99: 251-255.

{7} Benmohammed K, Nguyen MT, Khensal S, Valensi P, Lezzar A (2011) Arterial hypertension in overweight and obese Algerian adolescents: Role of abdominal adiposity. Diabetes & Metabolism 37: 291-297.

{8} Bergstrom E, Hernell O, Persson LA, Vessby B (1996) Insulin resistance syndrome in adolescents. Metabolism 45: 908-914.

{9} Bermingham MA, Jones E, Steinbeck K, Brock K (1995) Plasma cholesterol and other cardiac risk factors in adolescent girls. Archives of Disease in Childhood 73: 392-397.

{10} Bindler RC and Daratha KB (2012) Relationship of weight status and cardiometabolic outcomes for adolescents in the TEAMS study. Biological Research for Nursing 14: 65-70.

{11} Bindler RJ, Bindler RC, Daratha KB (2012) Biological correlates and predictors of insulin resistance among early adolescents. Journal of Pediatric Nursing 28: 20-27.

{12} Blackett PR, Blevins KS, Stoddart M, Wang W, Quintana E, et al. (2005) Body mass index and high-density lipoproteins in Cherokee Indian children and adolescents. Pediatric Research 58: 472-477.

{13} Blackett PR, Taylor T, Russell D, Lu M, Fesmire J, et al. (1996) Lipoprotein changes in relation to body mass index in native American adolescents. Pediatric Research 40: 77-81.

{14} Brasileiro RS, Escrivao MA, Taddei JA, D'Almeida V, Ancona-Lopez F, et al. (2005) Plasma total homocysteine in Brazilian overweight and non-overweight adolescents: a case-control study. Nutricion Hospitalaria

20: 313-319.

{15} Brophy S, Rees A, Knox G, Baker J, Thomas NE (2012) Child fitness and father's BMI are important factors in childhood obesity: A school based cross-sectional study. PLoS One 7: e36597.

{16} Burke V, Beilin L, Dunbar D, Kevan M (2004) Associations between blood pressure and overweight defined by new standards for body mass index in childhood. Preventive Medicine 38: 558-564.

{17} Cao Z-q, Zhu L, Zhang T, Wu L, Wang Y (2012) Blood pressure and obesity among adolescents: A school-based population study in China. American Journal of Hypertension 25: 576-582.

{18} Caserta CA, Pendino GM, Alicante S, Amante A, Amato F, et al. (2010) Body mass index, cardiovascular risk factors, and carotid intima-media thickness in a pediatric population in southern Italy. Journal of Pediatric Gastroenterology & Nutrition 51: 216-220.

{19} Centres for Disease Control and Prevention (2010) Prevalence of abnormal lipid levels among youths -- United States, 1999-2006. Morbidity & Mortality Weekly Report 59: 29-33.

{20} Chiolero A, Madeleine G, Gabriel A, Burnier M, Paccaud F, et al. (2006) Prevalence of elevated blood pressure and association with overweight in children of a rapidly developing country. Journal of Human Hypertension 21: 120-127.

{21} Chu N, Rimm EB, Wang D, Liou H, Shieh S (1998) Clustering of cardiovascular disease risk factors among obese schoolchildren: the Taipei Children Heart Study. American Journal of Clinical Nutrition 67: 1141-1146.

{22} Chu NF, Wang DJ, Shieh SM, Rimm EB (2000) Plasma leptin concentrations and obesity in relation to insulin resistance syndrome components among school children in Taiwan--The Taipei Children Heart Study. International Journal of Obesity 24: 1265-1271.

{23} Chu N-F, Chang J-B, Shieh S-M (2003) Plasma leptin, fatty acids, and tumor necrosis facor-receptor and insulin resistance in children. Obesity Research 11: 532-540.

{24} Chu N-F, shen M-H, Wu D-M, Shieh S-M (2002) Plasma TNF-R1 and insulin concentration in relation to leptin levels among normal and overweight children. Clinical Biochemistry 35: 287-292.

{25} Chu N-F, Wang D-J, Shieh S-M (2001) Obesity, leptin and blood pressure among children in Taiwan: the Taipei children's heart study. American Journal of Hypertension 14: 135-140.

{26} Cobayashi F, Oliveira FL, Escrivao MA, Daniela S, Taddei JA (2010) Obesity and cardiovascular risk factors in adolescents attending public schools. Arquivos Brasileiros de Cardiologia 95: 200-205.

{27} Cook S, Weitzman M, Auinger P, Nguyen M, Dietz WH (2003) Prevalence of a metabolic syndrome phenotype in adolescents. Findings from the third National

Health and Nutrition Examination Survey, 1988-1994. Archives of Pediatrics & Adolescent Medicine 157: 821-827.

{28} de Oliveira CL, da Veiga GV, Sichieri R (2001) Anthropometric markers for cardiovascular disease risk factors among overweight adolescents. Nutrition Research 21: 1335-1345.

{29} Denney-Wilson E, Hardy LL, Dobbins T, Okely AD, Baur LA (2008) Body mass index, waist circumference, and chronic disease risk factors in Australian adolescents. Archives of Pediatrics & Adolescent Medicine 162: 566-573.

{30} Dhuper S, Sakowitz S, Daniels J, Buddhe S, Cohen HW (2009) Association of lipid abnormalities with measures and severity of adiposity and insulin resistance among overweight children and adolescents. Journal of Clinical Hypertension 11: 594-600.

{31} Dinç G, Saatli G, Baydur H, Ozcan C (2009) Hypertension and overweight among Turkish adolescents in a city in Aegean region of Turkey: a strong relationship in a population with a relatively low prevalence of overweight. Anatolian Journal of Cardiology 9: 450-456.

{32} Duncan MJ, James L, Griffiths L (2011) The relationship between resting blood pressure, body mass index and lean body mass index in British children. Annals of Human Biology 38: 324-329.

{33} Ford ES, Li C, Imperatore G, Cook S (2006) Age, sex, and ethnic variations in serum insulin concentrations among U.S. youth: findings from the National Health and Nutrition Examination Survey 1999-2002. Diabetes Care 29: 2605-2611.

{34} Freedman DS, Dietz WH, Srinivasan SR, Berenson GS (1999) The relation of overweight to cardiovascular risk factors among children and adolescents: the Bogalusa Heart

{35} Freedman DS, Serdula MK, Percy CA, Ballew C, White L (1997) Obesity, levels of lipids and glucose, and smoking among Navajo adolescents. Journal of Nutrition 127: 2120s-

{36} Frontini MG, Bao W, Elkasabany A, Srinivasan SR, Berenson G (2001) Comparison of weight-for-height indices as a measure of adiposity and cardiovascular risk from childhood to young adulthood: the Bogalusa heart study. Journal of Clinical Epidemiology 54: 817-822.

{37} Galhotra A, Abrol A, Agarwal N, Goel NK, Gupta S (2009) Life style related risk factors for cardiovascular diseases in Indian adolescents. Internet Journal of Health 9: 9p.

{38} Ghannem H, Harrabi I, Abdelaziz AB, Gaha R, Mrizak N (2003) Clustering of cardiovascular risk factors among obese urban schoolchildren in Sousse, Tunisia. Eastern Mediterranean Health Journal 9: 70-77.

{39} Gillum RF (1989) Correlates and predictors of serum total cholesterol in adolescents aged 12-17 years: the National Health Examination Survey. Public Health Reports 104: 256-265.

{40} Gillum RF (1999) Distribution of waist-to-hip ratio, other indices of body fat distribution and obesity and associations with HDL cholesterol in children and young adults aged 4-19 years: The Third National Health and Nutrition Examination Survey. International Journal of Obesity 23: 556-563.

{41} Goel R, Misra A, Agarwal SK, Vikram N (2010) Correlates of hypertension among urban Asian Indian adolescents. Archives of Disease in Childhood 95: 992-997.

{42} Goodman E, Dolan LM, Morrison JA, Daniels SR (2005) Factor analysis of clustered cardiovascular risks in adolescence: Obesity is the predominant correlate of risk among youth. Circulation 111: 1970-1977.

{43} Guimaraes IC, de Almeida AM, Santos AS, Barbosa DBV, Guimaraes AC (2008) Blood pressure: effect of body mass index and of waist circumference on adolescents. Arquivos Brasileiros de Cardiologia 90: 393-399.

{44} Gungor N, Thompson T, Sutton-Tyrrell K, Janosky J, Arslanian S (2005) Early signs of cardiovascular disease in youth with obesity and type 2 diabetes. Diabetes Care 28: 1219-1221.

{45} Gutin B, Johnson MH, Humphries MC, Hatfield-Laube JL, Kapuku GK, et al. (2007) Relationship of visceral adiposity to cardiovascular disease risk factors in black and white teens. Obesity 15: 1029-1035.

{46} Gutin B, Yin Z, Humphries MC, Bassali R, Le N-A, et al. (2005) Relations of body fatness and cardiovascular fitness to lipid profile in Black and White adolescents. Pediatric Research 58: 78-82.

{47} Hakim IA, Awad AH, Mohamed NH, El-Husseiny S (1997) Blood cholesterol and triglycerides in adolescent Egyptian girls: Relation to anthropometric measurements. Food & Nutrition Bulletin 18.

{48} Harding S, Maynard M, Cruickshank JK, Gray L (2006) Anthropometry and blood pressure differences in black Caribbean, African, south Asian and white adolescents: the MRC DASH study. Journal of Hypertension 24: 1507-1514.

{49} Harding S, Maynard MJ, Cruickshank K, Teyhan A (2008) Overweight, obesity and high blood pressure in an ethnically diverse sample of adolescents in Britain: the Medical Research Council DASH study. International Journal of Obesity 32: 82-90.

{50} Hsieh A-T, Chu N-F, Shen M-H, Wu D-M, Wang D-J, et al. (2003) Insulin, proinsulin and insulin resistance status in relation to lipid profiles among school children in Taiwan—The Taipei Children Heart Study. Clinical Biochemistry 36: 367-372.

{51} Huang RC, de Klerk N, Mori TA, Newnham JP, Stanley FJ, et al. (2011) Differential relationships between anthropometry measures and cardiovascular risk factors in boys and girls. International Journal of Pediatric Obesity 6: e271-282.

{52} Israeli E, Schochat T, Korzets Ze, Tekes-Manova D, Bernheim J, et al. (2006) Prehypertension and obesity in adolescents - A population study. American Journal of Hypertension 19: 708-712.

{53} Jago R (2006) Prevalence of abnormal lipid and blood pressure values among an ethnically diverse population of eighth-grade adolescents and screening Iimplications. Pediatrics 117: 2065-2073.

{54} Jung C, Gerdes N, Fritzenwanger M, Figulla HR (2010) Circulating levels of interleukin-1 family cytokines in overweight adolescents. Mediators of Inflammation 2010: Article ID 958403.

{55} Jung C, Fischer N, Fritzenwanger M, Pernow J, Brehm BR, et al. (2009) Association of waist circumference, traditional cardiovascular risk factors, and stromal-derived factor-1 in adolescents. Pediatric Diabetes 10: 329-335.

{56} Klein-Platat C, Drai J, Oujaa M, Schlienger J-L, Simon C (2005) Plasma fatty acid composition is associated with the metabolic syndrome and low-grade inflammation in overweight adolescents. American Journal of Clinical Nutrition 82: 1178-1184.

{57} Kollias A, Antonodimitrakis P, Grammatikos E, Chatziantonakis N, Grammatikos EE, et al. (2009) Trends in high blood pressure prevalence in Greek adolescents. Journal of Human Hypertension 23: 385-390.

{58} Kuzawa CW, Adair LS, Avila JL, Cadungog JHC, Le N-A (2003) Atherogenic lipid profiles in Filipino adolescents with low body mass index and low dietary fat intake. American Journal of Human Biology 15: 688-696.

{59} Lavrador MS, Abbes PT, Escrivao MA, Taddei JA (2011) Cardiovascular risks in adolescents with different degrees of obesity. Arquivos Brasileiros de Cardiologia 96: 205-211.

{60} Lee JM, Okumura MJ, Davis MM, Herman WH, Gurney JG (2006) Prevalence and determinants of insulin resistance among U.S. adolescents: a population-based study. Diabetes Care 29: 2427-2432. Li Y-P, Yang X-G, Zhai F-Y, Piao R-H, Zhao W-H, et al. (2005) Disease risks of childhood obesity in China. Biomedical & Environmental Sciences 18: 401-410.

{61} Lindsay RS, Hanson RL, Roumain J, Ravussin E, Knowler WC, et al. (2001) Body mass index as a measure of adiposity in children and adolescents: relationship to adiposity by dual energy X-ray absorptiometry and to cardiovascular risk factors. Journal of Clinical Endocrinology & Metabolism 86: 4061-4067.

{62} Lu JJ, Jiang DD, Chou SM, Hor CB, Lay JD, et al. (2008) Prevalence of obesity and its association with cardiovascular disease risk factors in adolescent girls from a college in central Taiwan. Kaohsiung Journal of Medical Sciences 24: 144-151.

{63} Lu Q, Yin FZ, Ma CM, Liu BW, Lou DH, et al. (2010) Prevalence of impaired fasting glucose and analysis of risk factors in Han adolescents. Journal of Diabetes & its Complications 24: 320-324.

{64} Lurbe E, Invitti C, Torro I, Maronati A, Aguilar F, et al. (2006) The impact of the degree of obesity on the discrepancies between office and ambulatory blood pressure values in youth. Journal of Hypertension 24: 1557-1564.

{65} Lusky A, Barell V, Lubin F, Kaplan G, Layani V, et al. (1996) Relationship between morbidity and extreme values of body mass index in adolescents. International Journal of Epidemiology 25: 829-834.

{66} Manios Y, Kolotourou M, Moschonis G, Sur H, Keskin Y, et al. (2005) Macronutrient intake, physical activity, serum lipids and increased body weight in primary schoolchildren in Istanbul. Pediatrics International 47: 159-166.

{67} Marti B, Vartiainen E (1989) Relation between leisure time exercise and cardiovascular risk factors among 15-year-olds in eastern Finland. Journal of Epidemiology & Community Health 43: 228-233.

{68} Martinez-Gomez D, Rey-López JP, Chillón P, Gómez-Martínez S, Vicente-Rodríguez G, et al. (2010) Excessive TV viewing and cardiovascular disease risk factors in adolescents. The AVENA cross-sectional study. BMC Public Health 10: 274-274.

{69} Martinez-Gomez D, Eisenmann JC, Waernberg J, Gomez-Martinez S, Veses A, et al. (2010) Associations of physical activity, cardiorespiratory fitness and fatness with low-grade inflammation in adolescents: the AFINOS Study. International Journal of Obesity 34: 1501-1507.

{70} Matsui I, Nambu S, Baba S (1998) Evaluation of fasting serum insulin levels among Japanese school-age children. Journal of Nutritional Science & Vitaminology 44: 819-828.

{71} May AL, Kuklina EV, Yoon PW (2012) Prevalence of cardiovascular disease risk factors among US adolescents, 1999-2008. Pediatrics 129: 1035-1041.

{72} Mazicioglu MM, Yalcin BM, Ozturk A, Ustunbas HB, Kurtoglu S (2010) Anthropometric risk factors for elevated blood pressure in adolescents in Turkey aged 11–17. Pediatric Nephrology 25: 2327-2334.

{73} McCarthy WJ, Yancey AK, Siegel JM, Wong WK, Ward A, et al. (2008) Correlation of obesity with elevated blood pressure among racial/ethnic minority children in two Los Angeles middle schools. Preventing Chronic Disease 5: A46.

{74} McCrindle BW, Manlhiot C, Millar K, Gibson D, Stearne K, et al. (2010) Population trends toward increasing cardiovascular risk factors in Canadian adolescents. Journal of Pediatrics 157: 837-843.

{75} McFarlin BK, Johnston CA, Tyler C, Hutchison AT, Kueht ML, et al. (2007) Inflammatory markers are elevated in overweight Mexican-American children. International Journal of Pediatric Obesity 2: 235-241.

{76} McNiece KL, Poffenbarger TS, Turner JL, Franco KD, Sorof JM, et al. (2007) Prevalence of hypertension and pre-hypertension among adolescents. Journal of Pediatrics 150: 640-644.e641.

{77} Messiah SE, Arheart KL, Luke B, Lipshultz SE, Miller TL (2008) Relationship between body mass index and metabolic syndrome risk factors among US 8- to 14-year-olds, 1999 to 2002. Journal of Pediatrics 153: 215-221.

{78} Misra A, Vikram NK, Sharma R, Basit A (2006) High prevalence of obesity and associated risk factors in urban children in India and Pakistan highlights immediate need to initiate primary prevention program for diabetes and coronary heart disease in schools. Diabetes Research & Clinical Practice 71: 101-102.

{79} Misra A, Vikram NK, Arya S, Pandey RM, Dhingra V, et al. (2004) High prevalence of insulin resistance in postpubertal Asian Indian children is associated with adverse truncal body fat patterning, abdominal adiposity and excess body fat. International Journal of Obesity 28: 1217-1226.

{80} Moon Y-S, Kim D-H, Song D-K (2004) Serum tumor necrosis factor-alpha levels and components of the metabolic syndrome in obese adolescents. Metabolism 53: 863-867.

{81} Movahed MR, Bates S, Strootman D, Sattur S (2011) Obesity in adolescence is associated with left ventricular hypertrophy and hypertension. Echocardiography 28: 150-153.

{82} Musso C, Graffigna M, Soutelo J, Honfi M, Ledesma L, et al. (2011) Cardiometabolic risk factors as apolipoprotein B, triglyceride/HDL-cholesterol ratio and C-reactive protein, in adolescents with and without obesity: cross-sectional study in middle class suburban children. Pediatric Diabetes 12: 229-234.

{83} Nichols S, Cadogan F (2006) Blood pressure and its correlates in Tobagonian adolescents. West Indian Medical Journal 55: 305-312.

{84} Paradis G, Lambert M, O'Loughlin J, Lavallee C, Aubin J, et al. (2004) Blood pressure and adiposity in children and adolescents. Circulation 110: 1832-1838.

{85} Paterno CA (2003) Coronary risk factors in adolescence. The FRICELA study. Revista Espanola de Cardiologia

56: 452-458.

{86} Perez Gomez G, Huffman FG (2008) Risk factors for type 2 diabetes and cardiovascular diseases in Hispanic adolescents. Journal of Adolescent Health 43: 444-450.

{87} Petridou E, Malamou H, Doxiadis S, Pantelakis S, Kanellopoulou G, et al. (1995) Blood lipids in Greek adolescents and their relation to diet, obesity, and socioeconomic factors.

{88} Plachta-Danielzik S, Landsberg B, Johannsen M, Lange D, Mueller MJ (2008) Association of different obesity indices with blood pressure and blood lipids in children and adolescents. British Journal of Nutrition 100: 208-218.

{89} Rabbone I, Bobbio A, Rabbia F, Bertello MC, Ignaccoldo MG, et al. (2009) Early cardiovascular autonomic dysfunction, beta cell function and insulin resistance in obese adolescents. Acta Biomedica 80: 29-35.

{90} Rafraf M, Gargari BP, Safaiyan A (2010) Prevalence of prehypertension and hypertension among adolescent high school girls in Tabriz, Iran. Food & Nutrition Bulletin 31: 461-465.

{91} Raftopoulos C, Bermingham MA, Steinbeck KS (1999) Coronary heart disease risk factors in male adolescents, with particular reference to smoking and blood lipids. Journal of Adolescent Health 25: 68-74.

{92} Reich A, Müller G, Gelbrich G, Deutscher K, Godicke R, et al. (2003) Obesity and blood pressure--results from the examination of 2365 schoolchildren in Germany. International Journal of Obesity 27: 1459-1464.

{93} Riva P, Martini G, Rabbia F, Milan A, Paglieri C, et al. (2001) Obesity and autonomic function in adolescence. Clinical & Experimental Hypertension 23: 57-67.

{94} Roh EJ, Lim JW, Ko KO, Cheon EJ (2007) A useful predictor of early atherosclerosis in obese children: Serum high-sensitivity C-reactive protein. Journal of Korean Medical science 22: 192-197.

{95} Rosa ML, Mesquita ET, da Rocha ER, Fonseca Vde M (2007) Body mass index and waist circumference as markers of arterial hypertension in adolescents. Arquivos Brasileiros de Cardiologia 88: 573-578.

{96} Rosenbaum M, Nonas C, Horlick M, Fennoy I, Vargas I, et al. (2004) Beta-cell function and insulin sensitivity in early adolescence: association with body fatness and family history of type 2 diabetes mellitus. Journal of Clinical Endocrinology & Metabolism 89: 5469-5476.

{97} Salvadori M, Sontrop JM, Garg AX, Truong J, Suri RS, et al. (2008) Elevated blood pressure in relation to overweight and obesity among children in a rural Canadian community. Pediatrics 122: e821-827.

{98} Sangi H, Mueller WH (1991) Which measure of body fat distribution is best for epidemiologic research among adolescents? American Journal of Epidemiology 133: 870-883.

{99} Schuster DP, Kien CL, Osei K (1998) Differential impact of obesity on glucose metabolism in black and white American adolescents American Journal of the Medical Sciences 316: 361-367.

{100} Schwandt P, Bertsch T, Haas GM (2010) Anthropometric screening for silent cardiovascular risk factors in adolescents: The PEP Family Heart Study. Atherosclerosis 211: 667-671.

{101} Sharp TA, Grunwald GK, Giltinan KEK, King DL, Jatkauskas CJ, et al. (2003) Association of anthropometric measures with risk of diabetes and cardiovascular disease in Hispanic and Caucasian adolescents. Preventive Medicine 37: 611-616.

{102} Sinaiko AR, Jacobs DR, Jr., Steinberger J, Moran A, Luepker R, et al. (2001) Insulin resistance syndrome in childhood: associations of the euglycemic insulin clamp and fasting insulin with fatness and other risk factors. Journal of Pediatrics 139: 700-707.

{103} Sinaiko AR, Steinberger J, Moran A, Prineas RJ, Jacobs DR (2002) Relation of insulin resistance to blood pressure in childhood. Journal of Hypertension 20: 509-517.

{104} Steffen LM, Vessby B, Jacobs DR, Jr., Steinberger J, Moran A, et al. (2008) Serum phospholipid and cholesteryl ester fatty acids and estimated desaturase activities are related to overweight and cardiovascular risk factors in adolescents. International Journal of Obesity 32: 1297-1304.

{105} Steinberger J, Jacobs DR, Jr., Raatz S, Moran A, Hong CP, et al. (2005) Comparison of body fatness measurements by BMI and skinfolds vs dual energy X-ray absorptiometry and their relation to cardiovascular risk factors in adolescents. International Journal of Obesity 29: 1346-1352.

{106} Stray-Pedersen M, Helsing RM, Gibbons L, Cormick G, Holmen TL, et al. (2009) Weight status and hypertension among adolescent girls in Argentina and Norway: Data from the ENNyS and HUNT studies. BMC Public Health 9: 398.

{107} Stringer DM, Sellers EA, Burr LL, Taylor CG (2009) Altered plasma adipokines and markers of oxidative stress suggest increased risk of cardiovascular disease in First Nation youth with obesity or type 2 diabetes mellitus. Pediatric Diabetes 10: 269-277.

{108} Sugiyama T, Xie D, Graham-Maar RC, Inoue K, Kobayashi Y, et al. (2007) Dietary and Lifestyle Factors Associated with Blood Pressure among U.S. Adolescents. Journal of Adolescent Health 40: 166-172.

{109} Sur H, Kolotourou M, Dimitriou M, Kocaoglu B, Keskin Y, et al. (2005) Biochemical and behavioral indices related to BMI in schoolchildren in urban Turkey. Preventive Medicine 41: 614-621.

{110} Turconi G, Maccarini L, Bazzano R, Roggi C (2007) Overweight and blood pressure: results from the examination of a selected group of adolescents in northern Italy. Public Health Nutrition 11.

{111} Ullrich-French SC, Power TG, Daratha KB, Bindler RC, Steele MM (2010) Examination of adolescents' screen time and physical fitness as independent correlates of weight status and blood pressure. Journal of Sports Sciences 28: 1189-1196.

{112} Vikram NK, Misra A, Pandey RM, Dwivedi M, Luthra K (2004) Adiponectin, insulin resistance, and C-reactive protein in postpubertal Asian Indian adolescents. Metabolism 53: 1336-1341.

{113} Wang H, Necheles J, Carnethon M, Wang B, Li Z, et al. (2008) Adiposity measures and blood pressure in Chinese children and adolescents. Archives of Disease in Childhood 93: 738-744.

{114} Williams DE, Cadwell BL, Cheng YJ, Cowie CC, Gregg EW, et al. (2005) Prevalence of impaired fasting glucose and its relationship with cardiovascular disease risk factors in US adolescents, 1999-2000. Pediatrics 116: 1122-1126.

{115} Yamamoto-Kimura L, Posadas-Romero C, Posadas-Sánchez R, Zamora-González J, Cardoso-Saldaña G, et al. (2006) Prevalence and interrelations of cardiovascular risk factors in urban and rural Mexican adolescents. Journal of Adolescent Health 38: 591-598.

{116} Zhou P, Chaudhari RS, Antal Z (2010) Gender differences in cardiovascular risks of obese adolescents in the Bronx. Journal of Clinical Research in Pediatric Endocrinology 2: 67-71.