The importance of neighborhood crime, household assets, and sanitation facilities for systolic blood pressure among South African adolescents

Paula L Griffiths, PhD[1,2]
Zoë A Sheppard, PhD[1]
Noël Cameron, PhD[1,2]
John M Pettifor, MBBCh, PhD[2]
Shane A Norris, PhD[2]

[1] School of Sport, Exercise and Health Sciences, Loughborough University.
[2] MRC Mineral Metabolism Research Unit, Department of Paediatrics, University of the Witwatersrand, Johannesburg, South Africa.

Corresponding author: Paula L Griffiths, School of Sport, Exercise and Health Sciences, Loughborough University, Loughborough, Leicestershire, LE11 3TU, UK.
Tel: +44-(0)1509-228486
Fax: +44-(0)1509-223940

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Abstract

Purpose

This paper studies associations between household socio-economic status (SES) in infancy and at 16 years, neighborhood SES at 16 years, and systolic blood pressure (SBP) as well as systolic prehypertension (SPH) in 16 year old South Africans from the Birth to Twenty (Bt20) cohort.

Methods

Data from the Bt20 bone health sub-sample (n= 429, 75% Black, 52% male) were used to model associations between infancy household SES, household and community SES at 16 years, and SBP (multiple linear regression) or risk for SPH defined by the National Institutes of Health Heart Blood and Lung Institute's 90th percentile sex/age/height standardised SBP value (logistic regression) at 16 years. Models controlled for sex, ethnicity, maternal age, birthweight, parity, smoking, term birth, height/weight and BMI at 16 years.

Results

Male SBP was higher for those without a household phone during infancy and lower in neighborhoods with less crime at 16 years. Female SBP was higher for those without a household video/DVD at 16 years. SPH prevalence was 11%, with White males having the highest prevalence (17%). In neighborhoods with higher crime prevention SPH risk was lower. Those with outdoor water/toilet facilities during infancy and shared outside toilets at 16 years had higher SPH risk.

Conclusions

Where associations between SES and SBP were observed, low SES households/communities consistently had increased SBP/SPH risk. Targeting crime reduction, helping communities to feel protected from crime, ensuring good indoor sanitation facilities, and optimal wealth of individuals from infancy to adolescence could improve adolescent SBP in similar environments.

Key words: Household socioeconomic status; neighborhood socioeconomic status; pre-hypertension; South Africa; adolescents.

Abbreviations

BP = blood pressure

SBP = systolic blood pressure

SPH = systolic prehypertension

BMI = body mass index

SES = socio-economic status

CVD = cardiovascular disease

Bt20 = Birth to Twenty

PCA = principal components analysis

Introduction

Annually there are approximately 17 million cardiovascular disease (CVD) deaths [1] and 75% of this mortality occurs in low/middle income countries [2]. High blood pressure (BP) contributes significantly to this mortality [3]. Socio-economic status (SES) is known to be associated with many poor health outcomes globally [4,5] including adult BP. A 1998 review of adult studies linking SES and BP found lower SES was associated with higher mean BP in most developed country studies with low SES groups having on average 2-3 mm HG higher BP than high groups [6]. Consistent associations between adult SES and BP were not observed in developing countries [6].

The majority of child/adolescent studies also find no SES differences in BP [6], including the limited studies in developing countries e.g. for Peru [7], and South Africa [8]. Some developing country studies do show an association in children/adolescents such that low SES is correlated with increased BP e.g. The Congo [9] and Nigeria [10]. There are fewer child/adolescent studies, especially in developing countries, and these have often had methodological limitations. For instance failing to take account of height [9], a critically important variable in assessing BP in children/adolescents or not using appropriate age and sex adjusted standards [10] for assessing BP [11]. It is important to understand the association between SES and BP before adulthood using appropriate methods, because evidence shows that BP tends to track into adulthood [12].

Childhood SES has been shown to be important for adult health outcomes as well as contemporary SES [13]. Colhoun et al. conclude in their review that there is a need for future research to consider the potentially changing role of SES in its association with BP across ages [6]. However, eleven years after this review, a further literature review identified no studies that had subsequently investigated this association in developing countries.

The association between BP and individual/household SES has been more researched than community SES. Households with similar SES profiles can have different health outcomes when living in contrasting areas [14] meaning that community features could modify individual health influences. In reviews, Pickett and Pearl [15] and Riva et al. [16] found that contextual (neighborhood) effects existed in most studies. Associations between neighborhood SES and BP have been less studied than other health outcomes [17]. Nevertheless it is plausible that neighborhood SES could be linked to BP through its known influence on health behaviours like physical activity [18]. Community SES could also influence BP through psycho-social pathways as poor environments could result in elevated psychosocial stress, leading to an abnormal neuroendocrine secretory pattern [19]. Adult studies examining neighborhood SES and BP have occurred in developed countries.

In the USA, results show significant associations between state level inequalities and history of high BP in females but not males and between lower level neighborhood occupation level and high BP, but not between neighborhood educational levels/median household income and BP [20] or lower community SES and poor BP control [21]. In the Netherlands, high neighborhood SES has been associated with higher BP for ethnic minorities but not for native Dutch residents [17].

This paper aims to study the associations between household SES in infancy and at 16 years, neighborhood SES at 16 years, and systolic blood pressure (SBP) as well as systolic prehypertension (SPH) in 16 year old South Africans. Thus this study addresses gaps in the literature relating to understanding of the potential varying association between diverse household SES measures at different ages as well as neighborhood SES and SBP in adolescents. The South African context is ideal for examining BP inequalities because of the wide range of incomes observed [22].

Methods

Participants

Birth to Twenty (Bt20) is a longitudinal cohort study of 3273 singleton births occurring between April-June 1990 to permanently resident mothers in Johannesburg-Soweto, South Africa and is described in detail elsewhere [23,24]. At ages 9/10 years, a sub-sample from the cohort (n=429), stratified by ethnic group (Black/White) and sex, were enrolled into a longitudinal study assessing factors influencing bone health (Bone Health). This sub-sample was composed of children who had data at birth, ages 2, 4/5, and 7/8 years. Additional children were enrolled at 9/10 years by sending letters to parents of 9/10 year old predominantly White children attending the same schools as the Bt20 children (n= 160). This allows for ethnic comparisons, because the original study under recruited White participants. Bone Health participants had more detailed health assessments than the whole Bt20 cohort. Those with data on household/neighborhood SES, weight, height, and SBP measurements at 16 years were included in current analyses (n = 479, 52% male, 75% Black).

Ethical approval was granted by the ethics committees of the University of the Witwatersrand, South Africa for primary data collection and Loughborough University, UK for secondary data analyses. The primary caregiver gave written informed consent for their adolescent to participate in each assessment and the adolescent provided written ascent at 16 years.

Socio-economic status measures

During infancy and at 16 years, caregivers were asked to assess their household SES using a questionnaire based on standard measures used by the Demographic and Health Surveys routinely administered in low income settings (see www.measuredhs.com). The Bt20 SES questionnaire was piloted with 30 non-cohort caregivers to ensure understanding of concepts, an optimal layout, and to test translation. Measures included caregiver's education, private medical insurance coverage, home ownership, housing type, water/toilet facilities, marital status, and consumer durable ownership.

At 16 years of age neighborhood SES, including school SES, was assessed using a culturally relevant tool administered to Bt20 adolescents. This was developed by consulting community leaders and Bt20 adolescents/caregivers using focus group discussions and in-depth interviews in 2005/2006. Neighborhood was the term understood by most participants referring to community and this was defined for all participants as an area approximately 20 minutes walk/2 kilometres from home in any direction. The neighborhood SES questionnaire asked questions relating to; 1) economic aspects of neighborhoods including neighborhood wealth, perceived inequalities in wealth, type, condition, and spacing of housing, fences/walls around properties, infrastructure and service provision (e.g. street lighting, water supply), type and condition of roads, and neighborhood problems (e.g. traffic congestion, illegal dumping) 2) social aspects of neighborhoods including safety, crime, security measures to prevent crime, activities for young people, neighborhood friends/peer pressure, noise, community spirit/liveliness, feelings about the neighborhood, and religious involvement, 3) school SES environment with questions on school type, facilities, safety, class sizes, out of school activities, community activities, and problems (e.g. poor academic standards, alcohol/drug consumption, weapons).

Anthropometric measures

Birthweight, weight, and height at 16 years were assessed using standard techniques [25]. Weight was measured using a digital scale and height using a stadiometer (Holtain, UK). Two trained observers (one male and one female) recorded the anthropometric data at 16 years using the same equipment. Measures of reliability were undertaken and were within expected norms. Weight and height data were used to calculate body mass index (BMI = weight (Kg)/height $(m)^2$). Using Cole et al.'s [26] international age specific reference values for BMI for overweight/obesity, adolescents were classified as normal, overweight or obese.

Blood Pressure Measures

BP was measured three times using a digital device (Omron M6; Omron, Kyoto, Japan). Appropriate cuff sizes were used, and participants were measured seated and resting with several minute breaks between measurements. The first measurement was discarded and the second and third averaged. The SBP average measure was used to define SPH by using an average SBP at or above the National Heart Blood Lung Institute's [11] 90th percentile sex, age and height standardised value for SBP. Stage 1 hypertension was defined if the adolescent was above the 95th percentile. SPH was included because few adolescents have stage 1 hypertension. SPH helps to identify later risk for hypertension, given the propensity of BP to track into adulthood. In this paper SBP is the main outcome variable as there is growing evidence that this component of BP is the greater risk factor for CVD in older adults [27]. In studying adolescents here the intention is to use SBP as a marker for later risk of CVD as few adolescents show signs of hypertension.

Other variables used in the analysis

Those born before 37 weeks gestation were classified as preterm and after 41 weeks as post term. Adolescent's parity and smoking status (current or previous smoker or never smoked), mother's smoking status (not included in analyses as only 15 reported smoking), marital status and mother's age were self reported during infancy.

Statistical analyses

Because SBP is known to vary by sex and height, in all analyses where SBP was the outcome, sex stratified analyses were undertaken and height controlled for. Linear regression was used where the continuous SBP variable was the outcome and logistic regression for the dichotomous SPH outcome. Initial regression analyses explored relationships between each SES measure and the BP outcomes adjusting for height in the SBP models but not other factors. Subsequently multiple regression analyses controlled for other variables with a significant relationship with SBP in the initial analyses ($P<0.05$). Multiple regression models were built in steps; 1) significant infancy variables from the initial analysis entered, 2) added significant year 16 household/community SES variables from the initial analysis, and 3) added other significant year 16 variables. This approach allows for any mediating effect of the year 16 variables on the association between the infancy variables and the SBP outcomes as well as any mediating effects of the 16 year body composition measures on the association between 16 year SES measures and SBP to be investigated. Additionally, analyses were repeated separately for White and Black adolescents. Due to space constraints, separate results tables from these models are not presented, although differences emerging in the ethnic group analyses are highlighted in the results section. All analyses were conducted using SPSS 16.0 (Chicago, Illinois). When modelling neighborhood health effects it is common for researchers to use multi-level modelling [15]. However, the definition of neighborhood used here (within 20 minutes of home) means that no two households exactly share a neighborhood, rendering a multilevel approach inappropriate.

There were over 100 questions asked relating to neighborhood SES. To enable a more parsimonious analysis of these measures to be undertaken and to avoid problems of multicolinearity, principal components analysis (PCA) was used to extract indices grouping similar neighborhood SES variables together. A theory based approach was used to develop nine neighborhood indices and PCA confirmed the appropriateness of grouping these variables together. This data reduction approach has been undertaken by other researchers constructing SES measures [28]. In each case the first component scores were extracted and the statistical assumption that all Eigenvalues be greater than 1 was met. Three indices measured neighborhood economics; 1) Neighborhood economic index, 2) Neighborhood need for more services/facilities index, and 3) Neighborhood problem index. Two indices measured neighborhood social aspects; 1) Neighborhood crime prevention index and 2) Neighborhood social support/happiness index. In addition there were two variables (How safe do you feel in the neighborhood and How much crime is there in the neighborhood?) that did not load well onto any indices including the crime prevention index when tested using PCA. These two measures were retained as individual variables. There were also two school neighborhood indices identified; 1) School environment index and 2) School problems index. All indices were incorporated into analyses as regression factor scores.

Results

Descriptive statistics revealed a SPH prevalence at 16 years of approximately 11% (Table 1). White males had the highest prevalence (17%) and this was significantly higher (t=6.40, df=119, P<0.001) than White females (2%). Birthweights were similar across ethnic groups, although males were significantly heavier than females. The highest prevalence of overweight/obesity at age 16 years was observed in Black girls (39%) and the lowest in Black boys (14%) and the difference was statistically significant (χ^2 = 24.0, df = 1, P<0.001).

Initial linear regression models of male SBP at 16 years controlling only for height showed that infancy variables resulting in significantly higher SBP were being born post term, household not owning a phone, having a mother aged 35+ compared to 15-19 years, and having outside only water/toilet facilities (Table 2). At 16 years, one SES variable was significant; living in a neighborhood with a lot of crime (Table 3). In step one of the male SBP multiple regression model, those who were born post term and who did not own a household phone had significantly higher SBP (Table 4). These variables remained significant in step two and additionally, males living in areas with relatively less crime had lower SBP (Table 4). In step three these variables remained significant. Taller males also had significantly higher SBP in all steps (Table 4). The final model accounted for 14% of SBP variance. No ethnic differences were observed in findings in separate models for males (results not shown).

For females no infancy variables were significant in initial models (Table 2). Of the year 16 SES variables, ownership of a DVD/video and living in neighborhoods with a higher crime prevention index were significantly associated with lower SBP (Table 3). In step two of the female SBP multiple regression model only non ownership of a DVD/ video was statistically significantly associated with higher SBP (Table 4). This association remained in step three, where overweight, obese, and taller girls were also significantly more likely to have higher SBP, explaining 9% of SBP variation. In separate models by ethnicity the results were the same for Black females, although no statistically significant effects were observed for White females (results not shown). However, the White female sample size (n=62) was small and thus would have lacked sufficient statistical power to detect a small or medium effect size with this number of parameters [29].

Infancy variables that were significantly associated with reduced risk of SPH in the initial model were being parity 2 and maternal age 25-29 years (Table

2). Increased risk of SPH was observed for outside only access to water/toilet facilities. In initial models for year 16 SES variables, shared use of an outdoor flush toilet was significantly associated with increased risk of SPH, whilst a higher score on the neighborhood crime prevention index resulted in reduced risk of SPH (Table 3). In step one of the modelling process all of the significant infancy variables from the initial models retained significance and direction of association (Table 5). This was not changed in step two. However, the neighborhood crime prevention index was not significant in step two, although having a shared outside toilet facility was. Step three did not change the significance of the other variables, apart from the neighborhood crime prevention index, which became significant. Additionally, obese individuals had a higher risk of SPH. Findings were the same for Black children as the overall sample. It was not possible to estimate SPH models for White children separately because of the small number of cases of SPH in this group.

Discussion

Findings show SPH prevalence of approximately 11%, with prevalence highest among White males (17%). A mixed ethnicity UK study of 11-13 year olds found SPH prevalence of approximately 7% for boys and 10% for girls, with highest prevalence amongst White boys (12%) [30]. Thus, a larger percent of South African compared to UK adolescents had SPH. White boys show the highest risk in both studies and this group have higher SES than other ethnic groups. Given that results from this and other studies show lower SES is normally associated with increased risk, the higher risk for White boys is more likely to be driven by biological than social factors.

Some household/community SES variables were significantly associated with SBP/SPH. At the household level not owning a phone in infancy significantly increased male SBP at 16 years and owning a DVD/video player at 16 yrs reduced female SBP. Outdoor toilet facilities during infancy and shared use of an outdoor flush toilet at 16 years were associated with increased SPH risk at 16 years. A high community crime prevention index was associated with reduced SPH risk. Males in communities without much crime had significantly lower SBP. No other element of neighborhood/school SES was significantly associated with SBP/SPH.

Results show community/household SES to be related to SBP/SPH in a consistent direction, with participants in the most deprived households/communities having higher SBP/SPH risk. This direction of association confirms findings from most adult studies in developed countries [6]. It is also consistent with findings from some studies in developing country children [9,10]. However, current associations were observed taking into account height, age and sex. Previous child/adolescent developing country studies where height, age and sex were accounted for showed no association between SES and BP [7,8]. However, these studies had fewer SES measures. Adair et al [8] used parental education and a household consumer durable index and Miranda et al [7] used mother's education and number of persons per room. While this study finds evidence of a relationship between ownership of some consumer durables and SBP, the majority of consumer durables were not significantly associated with BP and there was no association between education and SBP.

Most adult studies of SES and BP have shown BMI to mediate the association [6]. This mediation did not occur in all models in this cohort, potentially because some of the significant SES associations work through different mechanisms besides BMI to affect BP. For instance in the case of observed associations with toilet facilities, it is possible that poor sanitation facilities result in a high risk environment for infections with a faecal-oral route of transmission e.g. diarrhoea. Other researchers suggest that high diarrhoea prevalence in infancy could result in repeated exposure to dehydration, which could 'programme' the body for increased water and therefore salt retention to cope with a risky dehydration environment, leading to hypertension risk [31,32]. However, most studies investigating the association between diarrhoea episodes/sanitation and BP in cohorts in the UK, Brazil and Peru show no association [7,33-35]. Hospital admissions for diarrhoea have been associated with increased BP, although these studies have a common limitation of having few hospital admissions to study [7,31].

The association between neighborhood crime and SBP/SPH could also work through other mechanisms besides BMI. Although high crime levels or a lack of neighborhood crime prevention could make healthy lifestyle behaviours (e.g. physical activity) more difficult, it is also plausible that the effect of such neighborhoods on BP could be mediated through stress, for example through increased cortisol secretion, which increases risk of higher BP [36]. The findings here related to crime are not unique. In the Netherlands, Turkish adult immigrants living in high crime neighborhoods had a higher diastolic BP [17].

In this cohort household SES measured during infancy remained significantly associated with SBP/SPH at 16 years even after controlling for contemporary household/community SES. This study's findings are similar to those observed in adults for other health and mortality outcomes in developed countries. For example adverse childhood SES has been associated with adult mortality [13], CVD [37], and adult BMI [38], after accounting for adult SES. These findings further highlight the importance of the early life SES environment as well as the contemporary one for later health.

Limitations

The sub-sample used for this analysis represents a small proportion of the original Bt20 cohort, which is not completely socio-economically representative of Bt20. The sub-sample has a significantly higher SES on some measures compared to the original Bt20 children, thus under-representing the poor. Nevertheless, results show that SBP consistently decreases with SES. It is unlikely that the direction of this association would have altered with a more representative sample, although a greater magnitude of difference could have been observed if the low SES group were more disadvantaged. This study also lacks neighborhood SES measures during infancy, which means that we are only able to study neighborhood SES in adolescence. Finally the study has a smaller number of White than Black participants, which means that it is difficult to detect ethnic specific SES effects, especially in the White sample. Findings therefore more likely reflect the effect of SES on BP in the Black sample.

Conclusions

Although SBP differences observed between SES groups only account for a small amount of the variance in SBP, they have clinical relevance. In the multiple linear regression models for males, SES effects varied from an increase of 3.5 mm Hg SBP for households without a telephone in infancy to a reduction of 4.8 mm Hg for those in lower crime neighborhoods at 16 years. DVD/Video ownership at 16 years resulted in a 3.0 mm Hg lower female SBP. Others have suggested that reducing SBP by 2 mm Hg at the population level can result in a decline in stroke (8%), CVD (5%), and all cause mortality (4%) [39]. Therefore the current findings suggest that these urban South African adolescents have an increased SBP and higher risk for later disease if they live in more deprived households or communities with crime problems.

However, other elements of community SES do not appear to be important. Targeting crime reduction, helping communities to feel protected from crime, ensuring good indoor sanitation facilities, and improving household wealth from infancy to adolescence could improve adolescent SBP in similar environments.

References

[1] WHO: The World Health Report 2002 - Reducing Risks, Promoting Healthy Life. Geneva: WHO, 2002.

[2] WHO: Cardiovascular Disease Prevention and Control: Translating Evidence into Action. Geneva: WHO, 2005.

[3] Kearney PM, Whelton M, Reynolds K, et al. Global Burden of Hypertension: Analysis of Worldwide Data. The Lancet 2005;365:217-223.

[4] Alder NE, Ostrove JM. Socioeconomic Status and Health: What We Know and What We Don't. Annals of the New York Academy of Sciences 2002;896:3-15.

[5] Barker DJP, Forsen T, Uutela A, et al. Size at Birth and Resilience to Effects of Poor Living Conditions in Adult Life: Longitudinal Study. British Medical Journal 2001;323:1273-1276.

[6] Colhoun HM, Hemingway H, Poulter NR. Socio-Economic Status and Blood Pressure: An Overview Analysis. Journal of Human Hypertension 1998;12:91-110.

[7] Miranda JJ, Davies AR, Davey Smith G, et al. Frequency of Diarrhoea as a Predictor of Elevated Blood Pressure in Children. Journal of Hypertension 2009;27:259-265.

[8] Adair LS, Martorell R, Stein AD, et al. Size at Birth, Weight Gain in Infancy and Childhood, and Adult Blood Pressure in 5 Low and Middle-Income-Country Cohorts: When Does Weight Gain Matter? American Journal of Clinical Nutrition 2009;89:1383-1392.

[9] Longo-Mbenza B, Luila EL, M'Buyamba-Kabangu JR. Nutritional Status, Socio-Economic Status, Heart Rate, and Blood Pressure in African School Children and Adolescents. International Journal of Cardiology 2007;121:171-177.

[10] Akinkugbe FM, Akinwolere AOA, Kayode CM. Blood Pressure Patterns in Nigerian Adolescents. West African Journal of Medicine 1999;18:196-202.

[11] US Department of Health and Human Services, National Institutes of Health Heart Blood and Lung Institute: The Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents. NIH Publication No. 05-5267, 2005.

[12] Bao W, Threefootm SA, Srinivasan SR, et al. Essential Hypertension Predicted by Tracking of Elevated Blood Pressure from Childhood to Adulthood: the Bogolusa Heart Study. American Journal of Hypertension 1995;8:657-665.

[13] Davey-Smith G, Hart C, Blane D, et al. Adverse Socioeconomic Conditions in Childhood and Cause Specific Adult Mortality: Prospective Observational Study. British Medical Journal 1998;316:1631-1635.

[14] Macintyre S, Ellaway A. Biological Approaches: Rediscovering the Role of the Physical and Social Environment. In: Berkman L, Kawachi I, eds. Social Epidemiology, New York: Oxford University Press, 2000:174-190.

[15] Pickett KE, Pearl M. Multilevel Analyses of Neighborhood Socioeconomic Context and Health Outcomes: A Critical Review. Journal of Epidemiology and Community Health 2001;55:111-122.

[16] Riva M, Gauvin L, Barnett TA. Toward the Next Generation of Research into Small Area Effects on Health: a Synthesis of Multilevel Investigations Published Since July 1998. Journal of Epidemiology and Community Health 2007;61:853-861.

[17] Agyemang C, van Hooijdonk C, Wendel-Vos W, et al. Ethnic Differences in the Effect of Environmental Stressors on Blood Pressure and Hypertension in the Netherlands. BMC Public Health 2007;7:electronic pages 1-10.

[18] Duncan MJ, Spence JC, Mummery WK. Perceived Environment and Physical Activity: A Meta Analysis of Selected Environmental Characteristics. International Journal of Behavior Nutrition and Physical Activity 2005;2:electronic pages 1-9.

[19] Galea S, Ahern J, Rudenstine S, et al. Urban Built Environment and Depression: A Multilevel Analysis. Journal of Epidemiology and Community Health 2005;59:822-827.

[20] Diez-Roux AV, Nieto FJ, Muntaner C, et al. Neighborhood Environments and Coronary Heart Disease: A Multilevel Analysis. American Journal of Epidemiology 1997;146:48-63.

[21] Gary TL, Safford MM, Gerzoff RB, et al. Perceptions of Neighborhood Problems, Health Behaviours, and Diabetes Outcomes Among Adults with Diabetes in Managed Care. Diabetes Care 2008;31:273-278.

[22] May J, ed. Poverty and Inequality in South Africa: Meeting the Challenge. Cape Town, David Philip Publishers, 2000.

[23] Richter LM, Norris SA, De Wet T. Transition from Birth to Ten to Birth to Twenty: the South African Cohort Reaches 13 Years of Age. Paediatric and Perinatal Epidemiology 2004;18:290-301.

[24] Richter L, Norris S, Pettifor J, et al. Mandela's Children: The 1990 Birth to Twenty Study in South Africa. International Journal of Epidemiology 2007;36:electronic pages 1-8.

[25] Lohman TG, Roche AF, Martorell R. Anthropometric Standardization Reference Manual. Champaign, Human Kinetics Books, 1991.

[26] Cole TJ, Bellizzi MC, Flegal KM, et al. Establishing a Standard Definition for Child Overweight and Obesity Worldwide: International Survey. British Medical Journal 2000;320:1240-1243.

[27] Williams B, Lindholm LH, Sever P. Systolic Blood Pressure is All That Matters. The Lancet 2008;371:2219-2221.

[28] Filmer D, Pritchett LH. Estimating Wealth Effects Without Expenditure Data - Or Tears: An Application to Educational Enrollments in States of India. Demography 2001;38:115-132.

[29] Cohen J. A Power Primer. Psychological Bulletin 1992;112:155-159.

[30] Harding S, Maynard MJ, Cruickshank K, et al. 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 2008;32:82-90.

[31] Davey Smith G, Leary S, Ness S, et al. Could Dehydration in Infancy Lead to High Blood Pressure? Journal of Epidemiology and Community Health 2006;60:142-143.

[32] Lawlor DA, Davey Smith G, Mitchell R, et al. Adult Blood Pressure and Climate Conditions in Infancy: A Test of the Hypothesis that Dehydration in Infancy is Associated with Higher Adult Blood Pressure. American Journal of Epidemiology 2006;163:608-614.

[33] Batty GD, Davey Smith G, Fall CHD, et al. Association of Diarrhoea in Childhood with Blood Pressure and Coronary Heart Disease in Older Age: Analyses of Two UK Cohort Studies. International Journal of Epidemiology 2007;36:1349-1355.

[34] Batty GD, Horta BL, Davey Smith G, et al. Early Life Diarrhoea and Later Blood Pressure in a Developing Country: the 1982 Pelotas (Brazil) Birth Cohort Study. Journal of Epidemiology and Community Health 2009;63:163-165.

[35] Pearce MS, Relton CL, Unwin NC, et al. The Relation Between Diarrhoeal Episodes in Infancy and Blood Pressure and Sodium Intake

in Later Life: The Newcastle Thousand Families Study. Journal of Human Hypertension 2008;22:582-584.

[36] Kapuku GK, Treiber FA, Davis HC. Relationships Among Socioeconomic Status, Stress Induced Changes in Cortisol and Blood Pressure in African American Males. Annals of Behavioral Medicine 2002;24:320-325.

[37] Blane D, Hart CL, Davey Smith G, et al. Association of Cardiovascular Disease Risk Factors with Socioeconomic Position During Childhood and During Adulthood. British Medical Journal 1996;313:1434-1438.

[38] Hardy R, Wadsworth M, Kuh D. The Influence of Childhood Weight and Socioeconomic Status on Change in Adult Body Mass Index in a British National Birth Cohort. International Journal of Obesity 2000;24:725-734.

[39] Van Hooijdonk C, Droomers M, van Loon JA, et al. Exceptions to the Rule: Healthy Deprived Areas and Unhealthy Wealthy Areas. Social Science and Medicine 2007;64:1326-1342.

Table 1 Mean (SD) systolic blood pressure (mm Hg), birthweight (g), height, body mass index, percent with prehypertension, stage 1 hypertension, overweight, and obese by sex and ethnicity for the South African bone health sample aged 16 years

Ethnic group	Black		White		Total
Sex (n)	Male (191)	Female (167)	Male (58)	Female (63)	Total (479)
Mean (SD) systolic blood pressure (mm Hg)	116.3 (10.4)	110.4 (9.4) [a]	120.3 (9.6)	110 (7.8)[a]	114.0 (10.3)
Percent (n) systolic prehypertension[1]	12.0 (23)	10.2 (17)	17.2 (10)	1.6 (1)[2]	10.6 (51)
Percent (n) systolic stage 1 hypertension[1]	1.6 (3)	2.4 (4)	5.2 (3)	0.0 (0)	2.1 (10)
Mean (SD) Birthweight (g)[2]	3167.9 (513.6)	3010.0[a] (487.1)	3264.1 (528.5)	3072.9[a] (488.8)	3111.1 (509.1)
Age 16 mean (SD) height (cm)[b]	169.0 (7.5)	158.1 (5.8)[a]	177.0 (8.2)	164.5 (6.9)[a]	165.6 (9.4)
Age 16 mean (SD) BMI	20.6 (3.9)	23.1 (4.3)[a]	21.9 (3.0)	21.9 (4.0)	21.8 (4.1)
Percent (n) Overweight[3]	9.9 (19)	30.5 (51)[a]	19.0 (11)	23.8 (15)	20.0 (96)
Percent (n) Obese[3]	3.7 (7)	8.4 (14)	3.4 (2)	3.2 (2)	5.2 (25)

Table 1 Notes

[1] Prehypertension is defined using a systolic blood pressure at or above the National Heart Blood Lung Institute's 90th percentile sex age and height standardised value [11]. Stage 1 hypertension is defined using a systolic blood pressure at or above the National Heart Blood Lung Institute's 95th percentile sex age and height standardised value.

[2] 10 cases did not have birthweight recorded.

[3] Overweight and obesity are defined using Cole et al.'s age appropriate international cut-offs for children and adolescents [26].

[a] Indicates a significant ($P<0.05$) sex difference in this variable was observed within the ethnic group indicated in the column of the table. Continuous variables were tested using an independent samples t-test and categorical variables using a multidimensional Chi-square test.

[b] Indicates a significant ($P<0.05$) ethnic difference in this variable was observed. Continuous variables were tested using an independent samples t-test and categorical variables using a multidimensional Chi-square test.

Table 2 Infancy predictors of systolic blood pressure from an initial regression analysis controlling for height for males and females and unadjusted odds ratios for prehypertension

Total n = 479	Percent or mean (SD)	Linear regression coefficient (se) systolic blood pressure males[1]	Linear regression systolic blood pressure females[1]	Unadjusted Odds (95% CI) of prehypertension
Birthweight (g)	3111.1 (509.1)	-0.002 (0.001)[NS]	0.001 (0.001)[NS]	1.00 (0.99-1.00)[NS]
Low birthweight(ref[2] normal)	10.0	2.466 (2.478) [NS]	-1.739 (1.791)[NS]	1.54 (0.33, 1.54)[NS]
Preterm (ref term)	12.3	1.290 (2.134)[NS]	-2.721 (1.657)[NS]	1.00(0.41, 2.48)[NS]
Postterm	1.7	10.619 (5.068)[*]	6.662 (4.495)[NS]	2.95 (0.58, 15.10)[NS]
Missing	1.7	5.809 (4.531)[NS]	2.458 (5.218)[NS]	2.95 (0.58, 15.10)[NS]
Parity 2(ref 1)	30.1	-0.286 (1.537)[NS]	-0.739 (1.399)[NS]	0.42 (0.18, 0.96)[*]
Parity 3	15.7	0.101 (1.831)[NS]	-0.493 (1.827)[NS]	0.98 (0.43, 2.20)[NS]
Parity 4 plus	10.2	2.639 (2.210)[NS]	-0.320 (2.084)[NS]	1.19 (0.48, 2.94)[NS]
Parity missing	1.5	7.149 (5.170)[NS]	1.008 (5.291)[NS]	2.86 (0.53, 15.56)[NS]
Owns a TV (ref does not own)	61.2	1.405 (1.715)[NS]	0.414 (1.738)[NS]	0.71 (0.33, 1.53)[NS]
Missing data for owns a TV	22.8	3.080 (1.665)[NS]	0.017 (2.007)[NS]	0.91 (0.38, 2.19)[NS]
Does not own a car (ref owns)	24.0	1.405 (1.715)[NS]	2.101 (1.432)[NS]	1.17 (0.58, 2.38)[NS]
Missing data for owns a car	22.8	3.080 (1.665)[NS]	0.393 (1.520)[NS]	1.25 (0.61, 2.54)[NS]
Does not own a fridge (ref owns a fridge)	59.3	1.775 (1.702)[NS]	1.974 (1.614)[NS]	0.61 (0.30, 1.27)[NS]
Missing data for owns a fridge	23.0	3.210 (1.657)[NS]	1.185 (1.893)[NS]	0.82 (0.35, 1.89)[NS]
Does not own a washing machine (ref owns a washing machine)	12.3	3.577 (1.982)[NS]	0.212 (1.843)[NS]	0.27 (0.06, 1.14)[NS]
Missing data for owns a washing machine	23.0	5.727 (1.982)[*]	-0.009 (1.478)[NS]	1.02 (0.52, 2.00)[NS]
Does not own a phone (ref owns a phone)	47.4	3.618 (1.437)[*]	-0.626 (1.421)[NS]	0.76 (0.38, 1.49)[NS]
Missing data for owns a phone	22.8	4.216 (1.701)[*]	-0.719 (1.714)[NS]	1.00 (0.47, 2.17)[NS]
Maternal age 15-19 years (ref 35 plus)	15.4	-5.338(2.683)[*]	-0.167 (2.435)[NS]	0.50 (0.17, 1.48)[NS]
Mat age 20-24 years	25.1	-3.817 (2.449)[NS]	-1.114 (2.281)[NS]	0.68 (0.27, 1.73)[NS]
Mat age 25-29 years	29.9	-4.609 (2.416)[NS]	-2.410 (2.157)[NS]	0.32 (0.12, 0.88)[*]
Mat age 30-34 years	18.8	-3.211 (2.549)[NS]	-0.416 (2.334)[NS]	0.59 (0.22, 1.63)[NS]
Mat age missing	1.3	7.001 (5.108)[NS]	2.462 (6.632)[NS]	2.38 (0.37, 15.27)[NS]
Widowed/ divorced/ separated (ref married/ living together)	1.5	3.074 (5.135)[NS]	-7.920 (5.277)[NS]	1.40 (0.16, 12.23)[NS]
Single	57.6	-1.440 (1.370)[NS]	-0.010 (1.276)[NS]	0.99 (0.54, 1.80)[NS]
Missing birth marital data	1.7	2.482 (4.253)[NS]	3.561 (6.408)[NS]	1.20 (0.14,10.26)[NS]
Maternal education grades 11-12 (ref up to grade 10)	33.2	-1.925 (1.448)[NS]	0.020 (1.431)[NS]	1.10 (0.55, 2.17)[NS]
Maternal education post school	19.2	0.835 (1.890)[NS]	0.696 (1.611)[NS]	1.37 (0.64, 2.94)[NS]
Maternal education missing	5.2	0.133 (2.997)[NS]	-0.671 (2.761)[NS]	0.80 (0.18, 3.63)[NS]

Rented private (ref = own property)	14.6	2.496 (2.082)^{NS}	-2.747 (1.941)^{NS}	0.74 (0.29,1.89)^{NS}
Rented local authority	36.7	0.997 (1.619)^{NS}	-2.265 (1.549)^{NS}	0.66 (0.32, 1.38)^{NS}
Provided by employer	1.7	-2.787 (4.674)^{NS}	-4.411 (5.305)^{NS}	No cases of at risk
Missing data for home ownership	21.5	4.278 (1.965)*	-2.327 (1.746)^{NS}	0.87 (0.39, 1.94)^{NS}
Mixture or inside/ outside water and toilet facilities (ref all indoor facilities)	18.2	3.341 (2.009)^{NS}	-1.334 (1.889)^{NS}	2.83 (0.84, 9.53)^{NS}
Outside only water and toilet facilities (ref all indoor facilities)	36.1	3.876 (1.732)*	0.306 (1.605)^{NS}	4.14 (1.40, 12.26)*
Missing data on birth water and toilet facilities	24.4	6.508 (1.963)**	-1.142 (1.750)^{NS}	3.06 (0.97, 9.71)^{NS}
Both sole and shared use of toilet and water facilities (ref Sole use of water/toilet facilities)	2.9	-0.969 (3.248)^{NS}	-6.844 (4.549)^{NS}	0.74 (0.09, 5.88)^{NS}
Shared use of toilet and water facilities (ref sole use of water/ toilet facilities)	10.4	3.301 (2.179)^{NS}	-0.300 (1.910)^{NS}	2.12 (0.93, 4.81)^{NS}
Missing birth water/ toilet source information	24.4	4.181 (1.603)*	-1.228 (1.456)^{NS}	1.21 (0.60, 2.42)^{NS}
Ethnicity Black (ref White)	74.7	-1.865 (1.645)^{NS}	1.296 (1.457)^{NS}	1.26 (0.62, 2.54)^{NS}

[1] Adjusted for height at age 16 years
[2] Ref = reference category
^{NS} = not significant, * P<0.05, ** P<0.01, *** P<0.001, two tailed

Table 3 Year 16 predictors of systolic blood pressure from an initial regression analysis controlling for height for males and females and unadjusted odds ratios for prehypertension

Total n = 479	Percent	Linear regression coefficient (se) systolic blood pressure males[1]	Linear regression systolic blood pressure females[1]	Unadjusted Odds (95% CI) of prehypertension
Owns a TV (ref[2] does not own)	94.4	-4.842 (5.862)[NS]	1.743 (3.447)[NS]	0.45 (0.09, 2.20)[NS]
Missing data for owns a TV	3.5	-3.591 (6.639)[NS]	3.242 (4.821)[NS]	0.86 (0.12, 6.26)[NS]
Owns a radio (ref does not own)	88.7	0.734 (2.474)[NS]	1.014 (2.153)[NS]	1.34 (0.40, 4.55)[NS]
Missing data for owns a radio	3.5	1.869 (3.979)[NS]	2.475 (3.987)[NS]	2.43 (0.44, 13.52) [NS]
Owns a DVD/video (ref does not own)	71.8	-0.605 (1.543)[NS]	-3.728 (1.360)[**]	0.59 (0.31, 1.11)[NS]
Missing data for owns a DVD/video	3.5	0.730 (3.460)[NS]	-1.400 (3.578)[NS]	1.27 (0.33, 4.90)[NS]
Has MNet (ref does not have)	20.5	1.364 (1.725)[NS]	-1.310 (1.493)[NS]	0.84 (0.39, 1.80)[NS]
Missing data for MNet	3.8	1.456 (3.269)[NS]	1.492 (3.296)[NS]	1.66 (0.46, 6.00)[NS]
Has DSTV (ref does not have)	18.4	1.414 (1.731)[NS]	0.309 (1.606)[NS]	0.83 (0.38, 1.85)[NS]
Missing data for DSTV	3.8	1.465 (3.269)[NS]	2.001 (3.293)[NS]	1.67 (0.46, 6.00)[NS]
Owns a computer (ref does not own)	39.2	0.848 (1.347)[NS]	-1.866 (1.303)[NS]	0.95 (0.51,1.74)[NS]
Missing data for owns a computer	3.8	1.561 (3.306)[NS]	0.999 (3.314)[NS]	1.68 (0.46, 6.16)[NS]
Internet access (ref no access)	19.4	1.950 (1.736)[NS]	-0.504 (1.549)[NS]	0.93 (0.43, 1.99)[NS]
Missing data for owning internet	4.0	2.558 (3.121)[NS]	1.756 (3.303)[NS]	2.31 (0.73, 7.31)[NS]
Family but not adolescent covered by medical aid (ref family and adolescent covered by medical aid)	3.1	-1.063 (3.560)[NS]	-1.137 (3.821)[NS]	0.62 (0.08, 5.08)[NS]
No medical aid coverage	63.0	-0.830 (1.445)[NS]	-1.325 (1.371)[NS]	0.99 (0.52, 1.92)[NS]
Missing data for medical aid	3.3	1.808 (3.395)[NS]	2.730 (3.823) [NS]	2.91 (0.83, 10.18)[NS]
Indoor sole use running hot and cold water (ref other water source sole or shared outside the hhold)	40.5	-1.559 (1.889)[NS]	-2.037 (1.605)[NS]	0.56 (0.26, 1.21)[NS]
Indoor shared use running hot and cold water	10.9	-1.781 (2.477)[NS]	-3.621 (2.289)[NS]	0.49 (0.15, 1.58)[NS]
Indoor sole use cold running water	20.0	-0.380 (2.065)[NS]	-3.020 (1.899)[NS]	0.53 (0.21, 1.35)[NS]
Indoor shared use cold running water	6.7	-2.186 (2.955)[NS]	2.747 (2.588)[NS]	1.35 (0.47, 3.91)[NS]
Missing data for water	3.3	0.418 (3.553)[NS]	1.749 (3.891)[NS]	1.35 (0.34, 5.40)[NS]
Shared use indoor flush toilet (ref sole use of indoor flush toilet)	10.0	0.103 (2.346)[NS]	-0.409 (1.948)[NS]	1.01 (0.33, 3.13)[NS]
Sole use outdoor flush toilet	27.3	1.647 (1.561)[NS]	0.856 (1.430)[NS]	1.34 (0.65, 2,76)[NS]
Shared use outdoor flush toilet	9.2	1.263 (2.238)[NS]	3.686 (2.258)[NS]	3.72 (1.63, 8.51)[**]
Other toilet type/ missing toilet	5.2	-0.419 (2.782)[NS]	2.619 (2.956)[NS]	1.52 (0.42, 5.55) [NS]
Neighborhood has average	24.4	-2.757 (2.934)[NS]	0.266 (1.937)[NS]	0.65 (0.22, 1.91)[NS]

safety (ref very unsafe/ unsafe)				
Neighborhood is safe (ref very unsafe/ unsafe)	47.4	-2.065 (2.766)^{NS}	1.756 (1.797)^{NS}	0.79 (0.30, 2.06)^{NS}
Neighborhood is very safe (ref very unsafe/ unsafe)	18.2	-0.891 (2.992)^{NS}	3.176 (2.141)^{NS}	1.12 (0.39, 3.20)^{NS}
Neighborhood has some crime (ref a lot of crime)	31.3	-2.105 (1.991)^{NS}	-0.088 (1.704)^{NS}	1.01 (0.44, 2.30)^{NS}
Neighborhood has average crime (ref a lot of crime)	25.1	-2.515 (2.077)^{NS}	-0.214 (1.771)^{NS}	0.67 (0.27, 1.70)^{NS}
Neighborhood has not much crime (ref a lot of crime)	22.8	-4.551 (2.111)*	1.488 (1.826)^{NS}	0.83 (0.34, 2.06)^{NS}
Neighborhood has no crime (ref a lot of crime)	3.3	-1.354 (3.436)^{NS}	5.044 (4.224)^{NS}	1.06 (0.21, 5.35)^{NS}
Neighborhood economic index	0 (1)	-0.112 (0.641)^{NS}	0.660 (0.607)^{NS}	1.06 (0.80, 1.42)^{NS}
Neighborhood index of need for more services/ facilities	0 (1)	-0.700 (0.567)^{NS}	1.109 (0.635)^{NS}	1.10 (0.90, 1.35)^{NS}
Neighborhood index of problems	0 (1)	-0.090 (0.651)^{NS}	0.668 (0.619)^{NS}	0.84 (0.62, 1.13)^{NS}
Neighborhood index of crime prevention	0 (1)	-0.315 (0.685)^{NS}	-1.390 (0.590)*	0.74 (0.54, 0.99)*
Neighborhood index of social support and happiness.	0 (1)	-0.072 (0.701)^{NS}	0.630 (0.553)^{NS}	1.00 (0.75, 1.34)^{NS}
Index of school environment	0 (1)	0.984 (0.644)^{NS}	-0.613 (0.668)^{NS}	1.03 (0.77, 1.39)^{NS}
Index of school problems	0 (1)	0.473 (0.676)^{NS}	-0.546 (0.608)^{NS}	0.82 (0.60, 1.12)^{NS}
Height (cms)	165.6 (9.4)	0.303 (0.076)***	0.132 (0.088)^{NS}	1.00 (0.97, 1.04)^{NS}
BMI (wt(Kg)/ ht(m^2)	21.8 (4.1)	0.804 (0.165)***	0.543 (0.137)***	1.10 (1.04, 1.17)**
Overweight[3]	20.0	5.92 (1.92)***	4.212 (1.284)**	1.60 (0.83, 3.09)^{NS}
Obese[3]	5.2	10.35 (3.36)***	7.016 (2.277)**	3.62 (1.43, 9.16)**
Previously smoked (ref currently smoke)	31.1	0.670 (1.636)^{NS}	-0.985 (1.815)^{NS}	1.03 (0.44, 2.41)^{NS}
Never smoked	42.4	1.882 (1.617)^{NS}	0.732 (1.673)^{NS}	1.33 (0.61, 2.89)^{NS}
Missing smoking data	3.8	1.008 (3.409)^{NS}	6.282 (3.463)^{NS}	1.98 (0.49, 8.03)^{NS}

[1] Adjusted for height at age 16 years
[2] Ref = reference category
[2] Overweight and obesity are defined using Cole et al.'s age appropriate international cut-offs for children and adolescents [26].
^{NS} = not significant, * P < 0.05, ** P < 0.01, *** P <0.001, two tailed

Table 4 Adjusted parameter estimates for systolic blood pressure (sbp) taken from a multiple linear regression model for variables that had shown a previous significant association with systolic blood pressure at age 16 years in the initial analysis (adjusting for height only)

		Males			Females		
	n	Step 1[1] Adjusted parameter estimate (SE)	Step 2 Adjusted parameter estimate (SE)	Step 3 Adjusted parameter estimate (SE)	n	Step 2 Adjusted parameter estimate (SE)	Step 3 Adjusted parameter estimate (SE)
Constant	249	77.305 (13.968)	76.226 (13.952)	73.359 (13.804)			
INFANCY VARIABLES					No infancy variables were significantly associated with SBP for females		
Maternal age at birth (ref[2] 35+ yrs/ missing)	27						
15-19 years	38	-4.672 (2.725)^{NS}	-4.557 (2.724)^{NS}	-4.062 (2.700)^{NS}	-	-	-
20-24 years	65	-2.968 (2.525)^{NS}	-2.516 (2.548)^{NS}	-2.204 (2.528)^{NS}	-	-	-
25-29 years	71	-4.423 (2.410)^{NS}	-4.414 (2.412)^{NS}	-4.546 (2.389)^{NS}	-	-	-
30-34 years	48	-2.716 (2.577)^{NS}	-2.391 (2.595)^{NS}	-2.581 (2.556)^{NS}	-	-	-
Term birth (ref Term)	215						
Preterm	25	0.756 (2.112)^{NS}	0.933 (2.115)^{NS}	1.445 (2.090)^{NS}	-	-	-
Post term	4	10.407 (5.010)*	11.348 (5.062)*	7.512 (5.240)^{NS}	-	-	-
Missing term data	5	0.560 (4.915)^{NS}	1.202 (4.958)^{NS}	-0.508 (4.921)^{NS}	-	-	-
Phone ownership (ref owns a phone/ missing)	168						
Does not own a phone	81	3.119 (1.440)*	3.102 (1.439)*	3.493 (1.428)*			
Toilet/ Water facility (ref indoor toilet & water facility)	50						
Mix of indoor and outdoor facilities	47	2.950 (2.024)^{NS}	2.496 (2.045)^{NS}	1.633 (2.036)^{NS}	-	-	-
Outdoor facilities only	94	3.327 (1.775)^{NS}	3.016 (1.807)^{NS}	2.452 (1.789)^{NS}	-	-	-
Missing data	58	6.414 (2.074)**	6.064 (2.081)**	5.352 (2.062)*	-	-	-
YR 16 SES							

VARIABLES							
Index of neighborhood crime prevention (High score = high level of crime prevention measures)					230	-1.014 (0.612)^{NS}	-1.074 (0.595)^{NS}
Ownership of a DVD/video (ref household owns a DVD/video)	-	-	-	-	162		
Does not own DVD/ video	-	-	-	-	61	3.059 (1.414)*	2.964 (1.381)*
Missing data	-	-	-	-	7	2.239 (3.412)^{NS}	3.392 (3.331)^{NS}
Level of crime in the neighborhood (ref: A lot)	38						
Some crime	80	-	-1.793 (1.953)^{NS}	-1.497 (1.928)^{NS}	-	-	-
Average level of crime	62	-	-2.453 (2.056)^{NS}	-2.399 (2.031)^{NS}	-	-	-
Not much crime	58	-	-4.570 (2.070)*	-4.800 (2.043)*	-	-	-
No crime	11	-	-1.396 (3.379)^{NS}	-1.055 (3.329)^{NS}	-	-	-
OTHER YR 16 VARIABLES							
Weight status (ref normal weight)	210						
Overweight	30	-	-	3.746 (2.293)^{NS}	66	-	2.824 (1.406)*
Obese	9	-	-	5.819 (4.069)^{NS}	16	-	5.298 (2.474)*
Height (cms)	249	0.226 (0.080)**	0.246 (0.080)**	0.261 (0.079)**	230	0.196 (0.089)*	0.187 (0.087)*
Adjusted R^2		0.11	0.11	0.14		0.04	0.09

^{NS} = not significant, * P<0.05, ** P<0.01, *** P<0.001, two tailed

[1] Multiple regression models were built in steps; 1) significant infancy variables from the initial analysis entered, 2) added significant year 16 household/community SES variables from the initial analysis, and 3) added other significant year 16 variables.

[2] ref = reference category

Table 5 Adjusted odds ratios for risk of prehypertension for variables that had a significant unadjusted odds of prehypertension at birth and 16 years

	n	Step 1[1] Adjusted odds (95% CI) of prehypertension	Step 2 Adjusted odds (95% CI) of prehypertension	Step 3 Adjusted Odds (95% CI) of prehypertension
INFANCY VARIABLES				
Maternal age at birth (ref[2] 35+ yrs/ missing)	52			
15-19 years	74	0.37 (0.10,1.43)^{NS}	0.32 (0.08,1.28)^{NS}	0.30 (0.07,1.22)^{NS}
20-24 years	120	0.64 (0.20,2.01)^{NS}	0.57 (0.17,1.84)^{NS}	0.48 (0.14,1.61)^{NS}
25-29 years	143	0.34 (0.12,0.96)*	0.30 (0.10,0.89)*	0.26 (0.09,0.79)*
30-34 years	90	0.68 (0.25,1.87)^{NS}	0.66 (0.23,1.88)^{NS}	0.60 (0.21,1.73)^{NS}
Parity (ref 1)	204			
2	144	0.38 (0.15,0.91)*	0.33 (0.13,0.82)*	0.34 (0.14,0.85)*
3	75	0.80 (0.30,2.12)^{NS}	0.70 (0.26,1.90)^{NS}	0.66 (0.24,1.85)^{NS}
4 plus	49	0.82 (0.25,2.63)^{NS}	0.67 (0.20,2.24)^{NS}	0.66 (0.19,2.22)^{NS}
Missing parity data	7	2.20 (0.33,14.51)^{NS}	2.05 (0.29,14.31)^{NS}	0.97 (0.11,8.40)^{NS}
Toilet/ Water facility (ref indoor toilet & water facility)	102			
Mix of indoor and outdoor facilities	87	2.77 (0.81,9.51)^{NS}	2.17 (0.60,7.92)^{NS}	2.09 (0.57,7.70)^{NS}
Outdoor facilities only	173	4.26 (1.42,12.80)*	3.29 (1.04,10.42)*	3.37 (1.06,10.70)*
Missing data	117	2.70 (0.79,9.24)^{NS}	3.70 (1.03,13.24)*	4.07 (1.11,14.93)*
YR 16 SES VARIABLES				
Index of neighborhood crime prevention (High score = high crime prevention measures)	479		0.70 (0.49,1.02)^{NS}	0.67 (0.46,0.98)*
Toilet facilities (ref sole use indoor flush toilet)	231	-		
Shared use indoor flush toilet	48	-	1.01 (0.32,3.27)^{NS}	0.96 (0.29,3.14)^{NS}
Sole use outdoor flush toilet	131	-	1.04 (0.43,2.50)^{NS}	1.04 (0.43,2.52)^{NS}
Shared use outdoor flush toilet	44	-	3.26 (1.23,8.67)*	3.45 (1.28,9.29)*
Missing/other toilet	24		1.05 (0.27,4.16)^{NS}	1.26 (0.32,1.92)^{NS}
OTHER YR 16 VARIABLES				
Weight status (ref normal/missing)	358			
Overweight	96	-	-	0.78 (0.32,1.92)^{NS}
Obese	25	-	-	5.71 (1.53,21.34)*

^{NS} = not significant, * P<0.05, ** P<0.01, *** P<0.001, two tailed

[1] Multiple regression models were built in steps; 1) significant infancy variables from the initial analysis entered, 2) added significant year 16 household/community SES variables from the initial analysis, and 3) added other significant year 16 variables.

[2] ref = reference category