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**ORAL CONTRACEPTIVE USE IN GIRLS AND ALCOHOL CONSUMPTION
IN BOYS ASSOCIATE WITH INCREASED BLOOD PRESSURE IN LATE
ADOLESCENCE**

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ABSTRACT

Aims: Lifestyle behaviours established during adolescence may adversely affect blood pressure (BP) and contribute to gender differences in cardiovascular risk in adulthood. We aimed to assess the association of health behaviours with BP in adolescents in the Western Australian Pregnancy (Raine) Study. **Methods and Results:** Cross-sectional analysis on 1248 adolescents aged 17 years examined the association between lifestyle factors and BP. Boys had 8.97 mmHg higher systolic BP compared with girls. The 30% of girls using oral contraceptives (OC) had 3.27 and 1.74 mmHg higher systolic and diastolic BP, respectively, compared with non-users. Alcohol consumption in boys, increasing body mass index (BMI) and sodium-potassium ratio were associated with systolic BP. There was a continuous relationship between BMI and systolic BP in both genders, however the gradient of this relationship was significantly steeper in boys compared with girls not taking OC. In boys, systolic BP was 5.7 mmHg greater in alcohol consumers in the upper quartile of BMI and the urinary sodium-potassium ratio compared with teetotallers in the lowest quartile. In girls, systolic BP was 5.5 mmHg higher in those taking OC, in the highest BMI and urinary sodium-potassium ratio quartile compared to those not taking the pill and in the lowest quartile. **Conclusion:** In addition to gender-related differences in effects of adiposity on BP, health behaviours such as salt intake, consuming alcohol in boys, and OC use in girls are important factors associated with BP in late adolescence. This suggests that gender-specific behavioural modification in adolescence may prevent adult hypertension.

Key words: Oral contraceptive use; Alcohol consumption; Blood pressure; Adolescence; Gender differences; Lifestyle; BMI

INTRODUCTION

Adolescence is accompanied by adoption of a range of lifestyle habits that may profoundly influence blood pressure (BP) and adult cardiovascular risk ¹. Obesity, an emerging public health problem in childhood and adolescence worldwide, is associated with multiple cardiovascular risk factors including raised BP ² and a higher risk of adult cardiovascular diseases ³. In adults lifestyle factors such as dietary patterns, cigarette smoking, alcohol consumption, physical activity, and oral contraceptive (OC) use are also known to influence BP. However, their effects independent of obesity in adolescents are less clear.

Gender differences in BP levels ^{4,5} and risk of high BP ⁴ in adolescence have been documented, but little is known about the influence of gender on effects of lifestyle factors on BP in this age group. OC use has been suggested to raise BP in adolescent girls and increase the risk of hypertension in adult women ⁶. Women taking OC have a greater body mass index (BMI) ⁷, but to our knowledge no one has examined the relationship between OC use and BMI, and whether this affects BP in adolescent girls.

The aim of this study was therefore to examine the relationship of lifestyle factors with BP in a population-based adolescent cohort in Western Australia, with particular reference to possible gender differences and their potential interaction with adiposity.

METHODS

Participants

The Western Pregnancy Cohort (Raine) Study ⁸, with 2900 pregnant women enrolled from 1989 to 1992, is a longitudinal study of mothers and their children recruited from King Edward Memorial Hospital and nearby clinics in Perth, Western Australia, as described previously ⁹. Ninety percent of the eligible women participated in the study. The 2868 live-

births were evaluated and followed up at 1, 2, 3, 5, 8, 10, 14 and 17 years of age. The Human Ethics Committees of King Edward Memorial Hospital and Princess Margaret Hospital in Perth approved the study protocol. Informed parental and adolescent consent were obtained for participation in the study.

The present study was a cross-sectional analysis of data from the 17 year follow-up of the cohort, which was conducted between July 2006 and June 2009.

Assessments

Clinical and biochemical

Resting BP and heart rate were obtained using an oscillometric sphygmomanometer (Dinamap ProCare 100, Soma Technology, USA). After five minutes quiet rest six automatic recordings were taken every 2 minutes with subjects supine and with an appropriate cuff size. The averages of the last 5 readings of systolic blood pressure (SBP) and diastolic blood pressure (DBP) were calculated. Body weight was measured using a Wedderburn Chair Scale (nearest 100g) and height with a Holtain Stadiometer (nearest 0.1 cm).

Fasting blood samples were analysed in the PathWest laboratory at Royal Perth Hospital for serum lipids. Spot urine samples were analysed for urinary sodium and potassium excretion.

Weight status was determined based on age (17 years) and gender-specific cut-off points from the recommendation for international comparisons of prevalence of overweight and obesity ¹⁰. Overweight was defined as BMI $\geq 24.46 \text{ kg/m}^2$ and $< 29.41 \text{ kg/m}^2$ for boys, and $\geq 24.70 \text{ kg/m}^2$ and $< 29.69 \text{ kg/m}^2$ for girls; obese as BMI $\geq 29.41 \text{ kg/m}^2$ for boys and $\geq 29.69 \text{ kg/m}^2$ for girls. Prehypertension was defined as gender-specific BP that was ≥ 90 th percentile for SBP or DBP but below the threshold for hypertension (≥ 95 th percentile), and hypertension as gender-specific SBP or DBP ≥ 95 th percentile ¹¹. Hypertensive status was also defined employing adult JNC-7 (www.nhlbi.nih.gov/guidelines/hypertension) criteria:

prehypertension as SBP 120-139 mmHg or DBP 80-89 mmHg, and hypertension as SBP $\geq$ 140 mmHg or DBP $\geq$ 90 mmHg.

Sociobehavioural

Socioeconomic status was assessed from annual family income (Australian dollars) and the SEIFA (Socio-Economic Indexes for Areas) score ¹², which is based on the adolescent's geographic postal area (a low score indicates an area of social disadvantage). Family income was used as an interpretable descriptor; however, SEIFA, a more robust measure of SES, was employed in the analysis.

Alcohol consumption information was obtained from an online questionnaire that asked the types (beer, wine or spirits) and amount (can, glass, stubby, nip or standard drink) of alcoholic beverages consumed daily during the past week. Alcohol consumption was defined as the average number of standard drinks consumed per day during the last 7 days where 1 standard drink is 10 g alcohol. Alcohol drinker was defined as consumer of alcohol at any level during the last 7 days.

Adolescents were asked to report the number of cigarettes smoked each day in the last 7 days. Physical activity was assessed from the question "How many hours do you usually exercise in your free time in a week, so much that you get out of breath or sweat?", and a dichotomous variable with cut-point at $\geq$ 4 hours per week was created ¹³. Oral contraceptive use in girls was defined as answering yes or no to the question "In the last 6 months, have you taken any prescription medication(s) e.g. the Pill?" (if yes, "which medication(s), and are you still taking it?").

From a 212-item food frequency questionnaire, two dietary patterns ("Western" and "Healthy") were identified using factor analysis ¹⁴.

Statistical analysis

SBP and DBP were examined as continuous outcome variables. Candidate factors investigated included age, gender, SEIFA score, BMI, alcohol consumption, smoking, physical activity, dietary patterns, OC use, urinary sodium, potassium, and Na/K ratio. BMI, alcohol consumption and smoking were analysed as continuous variables to avoid the loss of power and the bias of arbitrary choice of categorization of cut-points. Associations between factors and SBP and DBP were assessed with robust linear regression to reduce the influence of potential outliers. To examine linearity in the relationship between BMI and BP, fractional polynomial regression plots were used. Patterns observed in these plots suggested that for alcohol consumption a dichotomous arrangement represented the relationship with BP more closely than the continuous variable. In this instance both the dichotomous and continuous variables were analysed in the initial models. Gender and BMI interactions with other covariates were investigated. Initial models were adjusted for sex, and extended models adjusted for sex and BMI.

Multiple imputation was performed using Royston's Ice program¹⁵ to estimate the urinary Na/K ratio, missing in approximately one third of the sample. The imputation process, based on iterative multivariable regression, generated 20 new datasets, each containing an estimated value for the missing ratio. These datasets were then analysed separately and estimates combined to obtain the final single solution. Our analysis of complete cases and imputed data produced the same estimates of the association between Na/K and SBP. However, independently of Na/K itself, the reduced sample of complete cases created bias in the estimated effects of other covariates. Hence imputation maintained the whole sample in the analysis to reduce sample bias.

A 3-level gender variable incorporating oral contraceptive use (girls not using OC, OC using girls, and boys) was created to assess the effect of OC in the final multivariable models.

Variables significantly associated with BP in the initial models, as well as the relevant interaction terms were included in the multivariable regression models. Non-significant variables were removed in a backward process that included examination of the effect on coefficients and p values of all remaining variables, at each step.

Stata MP version 11 (Stata Corp, College Station, Texas) was used for statistical analysis, and significance was set at $p < 0.05$.

RESULTS

At 17 year 1771 adolescents from the original 2868 live-born children participated. There were 13.2% who deferred from participation, 16.6% had withdrawn from the study, 1.2% were deceased and 7.2% were lost to follow up. Of the 1771 participants, 1257 had anthropometric, cardiovascular, and biochemical assessment and detailed health questionnaires. Nine cases with major congenital malformations were excluded, resulting in a sample of 1248. Apart from having a higher percentage with higher family income, the participants were comparable to non participants at the 17-year survey (Table S1, Online Supplement). The sample comprised 88% Caucasians and is representative of the Western Australian population.

Demographic, anthropometric and socio-behavioural characteristics of the adolescents are shown in Table 1. Boys were heavier and had a larger waist than girls ($p < 0.001$). Fifty one percent of the adolescents consumed alcohol at any level in the previous week. More boys than girls exercised ≥ 4 hours in free time per week (42.6 vs 21.3, $p < 0.001$), and 30% of the girls used OC.

Mean SBP was higher in boys compared with girls (117.9 vs 108.6 mmHg, $p < 0.0001$) (Table 2), whereas mean DBP was lower in boys compared with girls (58.2 vs 59.5 mmHg,

$p=0.0007$). Employing gender-specific criteria, 8% were prehypertensive, and 7.8% were hypertensive, with similar proportions in boys and girls. However, using hypertensive status defined according to adult (JNC-7) criteria, there was a significantly higher prevalence of prehypertension and hypertension in boys compared with girls (36% vs 8.9%, and 2.2% vs 0.3%, respectively; $p<0.001$). Overall, 34% of overweight and 38% of obese adolescents had BP defined as prehypertensive or hypertensive (Table 3).

In univariate models examining lifestyle and sociodemographic factors (Table S2, Online Supplement), SBP was significantly associated with male gender, BMI, urinary sodium, the urinary Na/K ratio, alcohol drinker, and OC use in girls. Adjusted for BMI (Table S3, Online Supplement), male gender, alcohol drinker, OC use in girls, urinary sodium and the Na/K ratio, remained significantly associated with SBP. Dietary patterns were not related to SBP or DBP. In girls, DBP was positively associated with OC use and negatively with BMI (Table S2). This BMI-DBP negative association in girls became non-significant when four subjects with $BMI \geq 40$ were excluded ($\beta=-0.08$; $p=0.221$).

In multivariable models, male gender, alcohol drinking in boys, OC use in girls, BMI, and urinary Na/K ratio were positively associated with SBP (Table 4). SBP in boys was 8.97 mmHg higher compared with girls. Girls using OC had 3.27 mmHg higher in SBP compared with non OC users. There was a significant interaction between BMI, gender and OC use in girls. The relationship between BMI and SBP for boys differed when compared to girls not on OC (Figure 1). For an increase in BMI of 1 kg/m^2 , SBP increased by 0.65 mmHg in boys compared to 0.38 mmHg in non OC using girls ($p=0.028$). However, the interaction term indicated no difference between boys and girls on OC ($p=0.522$) or OC using and non OC using girls ($p=0.482$). DBP was negatively associated with physical activity and positively with OC use.

Using the final multivariable model we compared boys and girls in the upper and lower quartiles for those factors that were significantly associated with SBP. In boys who were drinkers and were in the 75th percentiles for BMI and urinary Na/K ratio, SBP was 119.9 mmHg SBP compared to 114.1 mmHg of those who were not drinkers and in the 25th percentiles for BMI and urinary Na/K ratio. In girls using OC and were in the 75th percentiles for BMI and urinary Na/K ratio, SBP was 114.5 mmHg SBP compared to 105.9 mmHg of those not using OC and in the 25th percentiles for BMI and urinary Na/K ratio.

DISCUSSION

In this adolescent population we have shown significant association of a range of lifestyle factors with BP, some gender specific. Use of OC in girls and alcohol consumption in boys significantly associated with higher SBP. Boys had significantly higher SBP than girls. Furthermore, OC use associated with higher DBP in girls that took the pill than those that did not. There were significant gender differences in the relationship between obesity and BP, with boys showing a steeper gradient for the effect of BMI on SBP than girls not taking OC.

In our study SBP was 8.97 mmHg higher in boys compared with girls, consistent with previous reports on adolescent SBP². Using gender-specific percentiles to define hypertensive status, not surprisingly there was no difference between the sexes. However in 17-years-olds it is perhaps more logical to employ adult criteria cut-offs. Using JNC-7 criteria, approximately 24% of the adolescents were prehypertensive or hypertensive. We also found marked gender differences in the prevalence of prehypertension (36% in boys vs 9% in girls) and hypertension (2% in boys vs 0.3% in girls). Gender differences in prehypertension prevalence were also reported in an adolescent population aged 16-19 years¹⁶. In our study, the proportion of obese girls and boys that were prehypertensive was 15% and 51%, respectively. As a measure of adiposity BMI is a strong predictor of SBP in children and

adolescents ¹⁷, and has been shown to have a similar relation to BP compared with other anthropometric measurements when this population was studied at age 14 ¹⁸.

The 30% of our female adolescents who reported taking OC had significantly increased SBP and DBP compared with non OC users. These data agree with results from a study of 17-year-old girls that showed a 4.6 mmHg higher SBP in low dose OC users ¹⁹ and suggests a marked pressor effect of OC in adolescence. OC use even at low dose has been shown to raise BP and prevalence of hypertension in adult women ⁶.

We observed a significant and positive association between SBP and drinking alcohol at any consumption level within the last 7 days in boys, but not in girls. In a cohort of 365 students aged 13-18 years, there was a weak, albeit significant relationship, between frequency and quantity of alcohol consumption and DBP and a greater prevalence of hypertension in male heavy drinkers ²⁰. Similarly higher BP were observed in 18-year-old Australians with binge drinking alcohol behaviours ²¹. A stronger alcohol-SBP association has also been reported in older compared with younger men but not in women ²².

The association between sodium consumption and BP has been extensively documented in adults, children and adolescents ²³. We observed a significant relationship between urinary Na/K ratio and SBP in both boys and girls. The urinary Na/K ratio has been shown to correlate strongly with age-related BP increase in adults ²⁴. Our data reinforce evidence for a diet balanced for lower intake of salt containing foods and higher potassium rich foods and vegetables ²⁵.

With regards to the gender difference in the continuous relationship between BMI and SBP, a novel finding in our study was that in boys there was a significantly greater increase in SBP with increasing BMI compared with girls that were not taking OC. Gender differences in BP most likely relate to different effects of testosterone and oestrogens on BP regulation ²⁶ as well as to some of the lifestyle factors demonstrated here.

We confirm the continuous BP-weight status association and hypertension risk, rather than a threshold effect. In adults, linearity or a threshold in the BMI-BP relationship has been equivocal ²⁷, with some suggesting a threshold for BMI at 21 kg/m² ²⁸. Others have adopted this arbitrary figure for the interpretation of BP data in children ²⁹. Our observation of a continuous positive linear relationship between BMI and SBP across the entire range of BMI in both boys and girls is important in this context, suggesting that a BMI threshold in adolescence is not appropriate.

In adolescents of both sexes, moderate to vigorous physical activity has been reported to be inversely related to higher SBP levels ³⁰. Our data showed twice as many boys engaged in more regular physical activity compared with girls. This finding is consistent with other studies ³¹. Self-reported habitual exercise was negatively associated with DBP in both boys and girls. These results are in agreements with other reports ^{32, 33} in children and adolescents.

Applying our model that best described the association between SBP and lifestyle factors, our findings showed that boys that drank alcohol and were in the 75th percentiles for BMI and the Na/K ratio had 5.7 mmHg higher SBP, compared to non-drinkers and in the 25th percentiles for BMI and urinary Na/K ratio. Similarly, in girls taking OC and in the 75th percentiles for BMI and the Na/K, SBP was 5.5 mmHg higher compared to those not using OC and in the 25th percentiles for BMI and urinary Na/K ratio.

Interpretation of our findings as regards causality requires caution in view of the cross-sectional design of the study. However, strengths of the study include a population-based sample, a study large enough to detect gender effects and to analyse for the multiplicative effects of several lifestyle factors, and the collection of comprehensive and standardised phenotypic, lifestyle and socio-behavioural data by trained personnel.

In conclusion, in this study of 17-years-old adolescents, increased BP was associated with OC use in girls and alcohol consumption in boys, as well as increasing BMI and Na/K

ratio, and lower physical activity. There were marked gender differences in SBP and its relation to increasing BMI. By adult criteria boys had four times the prevalence of prehypertension compared with girls. These substantial differences in SBP in boys and girls between those with a healthier versus a less favourable lifestyle pattern, are likely to significantly affect their risk of ischemic heart disease and stroke in adulthood. Adolescence is a time of life when unhealthy lifestyle behaviours impacting on BP and related metabolic disorders tend to become entrenched. Our findings suggest that significant public health benefits may be achieved from a range of lifestyle modifications appropriate to gender in this age group of adolescents.

SUPPLEMENTARY MATERIAL

Supplementary material is available at *European Journal of Preventive Cardiology* online.

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CONFLICT OF INTEREST

None declared.

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Figure legends

Figure 1. Relationship of BMI and systolic BP (A, with $p=0.028$, boys vs girls not using OC [Girls - OC]; $p=0.482$, girls using OC [Girls + OC] vs girls not using OC) and diastolic BP (B) between boys, girls using and not using OC.

**TABLE 1 Demographic, Anthropometric and Socio-Behavioural Characteristics
of the Study Population**

	Girls n = 620 (49.7%)	Boys n = 628 (50.3%)	Whole sample n = 1,248
	<i>mean (95%CI)</i>	<i>mean (95%CI)</i>	<i>mean (95%CI)</i>
Age, y	17.05 (17.03, 17.07)	17.02 (17, 17.04)	17.04 (17.02, 17.05)
Height, m	1.659 (1.653, 1.664)	1.783 (1.777, 1.789)	
Weight, kg	62.5 (61.5, 63.4)	71.0 (69.9, 72)	
Waist circumference, mm	768 (759, 776)	799 (790, 807)	
BMI, kg/m ²	22.7 (22.4, 23)	22.3 (22.0, 22.6)	
Socio-behavioural			
SEIFA score*	1041.4 (1035.8, 1046.9)	1045.1 (1039.6, 1050.5)	1043.2 (1039.4, 1047.1)
Alcohol consumption†	0.97 (0.88, 1.08)	1.29 (1.15, 1.46)	1.12 (1.04, 1.22)
	<i>% (95% CI)</i>	<i>% (95% CI)</i>	<i>n (%)</i>
Alcohol drinker‡	50.2 (46.3, 54.2)	51 (47.1, 55)	628 (50.7)
Smoker§	18.2 (15.2, 21.3)	15.1 (12.3, 17.9)	208 (16.7)
Oral contraceptives user	30 (26.3, 33.6)		
Physically active	21.3 (17.9, 24.8)	42.6 (38.3, 46.9)	334 (31.5)
User of at least one recreational drug type¶	13.2 (10.6, 15.9)	15.4 (12.6, 18.3)	179 (14.3)
Annual family income			
≤ A\$ 35,000	13.8 (10.9, 16.8)	12.8 (10.1, 15.6)	145 (13.3)
A\$ 35,001 - ≤ 78,000	33.3 (29.3, 37.4)	33 (29.1, 36.9)	361 (33.2)
> A\$ 78,000	52.8 (48.6, 57.1)	54.2 (50.1, 58.3)	583 (53.5)

Data are presented as mean (95% confidence interval), or for categorical variable as percentage (95% confidence interval) or n (%) as indicated.

BMI indicates Body Mass Index; SEIFA, Socio-Economic Indexes for Areas

* Index of advantage/disadvantage, Australian Bureau of Statistics Socio-economic Indexes for Areas.

† Average number of standard drinks consumed during the last 7 days.

‡ Consumer of alcohol at any level over the last 7 days.

§ Smoking ≥ 1 cigarettes in a week.

|| Having ≥ 4 hours of exercise in free time per week.

¶ Drug types included amphetamine, marijuana, and party drugs.

**TABLE 2 Clinical and Biochemical Characteristics, and Comorbidities
of the Study Population**

	Girls n = 620 (49.7%)	Boys n = 628 (50.3%)	Whole sample n = 1,248
	<i>mean (95%CI)</i>	<i>mean (95%CI)</i>	<i>mean (95%CI)</i>
SBP, mmHg	108.6 (107.9, 109.4)	117.9 (117.1, 118.6)	113.3 (112.7, 113.9)
DBP, mmHg	59.5 (59, 60)	58.2 (57.7, 58.7)	58.8 (58.5, 59.2)
HR, bpm	67.2 (66.5, 67.9)	62.9 (62.2, 63.6)	65.0 (64.5, 65.5)
Fasting			
Glucose, mmol/L	4.63 (4.59, 4.66)	4.82 (4.78, 4.87)	4.73 (4.70, 4.76)
Insulin, mU/L	7.64 (7.21, 8.1)	6.86 (6.49, 7.25)	7.22 (6.94, 7.52)
Total cholesterol, mmol/L	4.30 (4.24, 4.37)	3.93 (3.87, 3.99)	4.11 (4.06, 4.15)
Triglycerides, mmol/L	0.95 (0.91, 0.98)	0.95 (0.92, 0.99)	0.95 (0.93, 0.97)
HDL-C, mmol/L	1.39 (1.36, 1.42)	1.20 (1.18, 1.22)	1.29 (1.28, 1.31)
LDL-C, mmol/L	2.43 (2.38, 2.49)	2.24 (2.19, 2.29)	2.33 (2.29, 2.37)
Urine			
Sodium, mmol/L	132.84 (127.2, 138.47)	122.93 (118.07, 127.78)	127.59 (123.89, 131.29)
Potassium, mmol/L	41.45 (39.23, 43.8)	41.24 (39.37, 43.2)	41.34 (39.89, 42.84)
Sodium/Potassium ratio	2.85 (2.67, 3.04)	2.69 (2.54, 2.84)	2.76 (2.65, 2.88)
Hypertensive status	% (95% CI)	% (95% CI)	n (%)
Adolescent gender-defined*			
Prehypertension	7.8 (5.7, 9.9)	8.3 (6.1, 10.5)	100 (8)
Hypertension	7.8 (5.7, 9.9)	7.8 (5.7, 10)	97 (7.8)
Adult criteria†			
Prehypertension	8.9 (6.7, 11.4)	36 (32.2, 39.9)	280 (22.5)
Hypertension	0.3 (0.03, 1)	2.2 (1.2, 3.7)	16 (1.3)

Data are presented as mean (95% confidence interval), or for categorical variable as percentage (95% confidence interval) or n (%) as indicated.

SBP, systolic blood pressure; DBP, diastolic blood pressure; HR, heart rate; HDL-C, high density lipoprotein cholesterol; LDL-C, low density lipoprotein cholesterol.

* Gender-specific SBP or DBP $\geq$ 90th percentile but $<$ 95th percentile (prehypertension); $\geq$ 95th percentile (hypertension).

† SBP 120-139 mmHg or DBP 80-89 mmHg (prehypertension); $\geq$ 140 mmHg or DBP $\geq$ 90 mmHg (hypertension).

TABLE 3   Hypertensive Status by Weight Categories

	Adult criteria defined categories of BP		
	Normotensive	Prehypertensive	Hypertensive
Whole sample			
(n=1,243)			
Normal weight	79.6 (76.8, 82.1)	19.8 (17.3, 22.5)	0.63 (0.23, 1.36)
Overweight	66.1 (58.7, 73)	31.1 (24.4, 38.4)	2.8 (0.9, 6.4)
Obese	62.5 (52.5, 71.8)	32.7 (23.8, 42.6)	4.8 (1.6, 10.9)
Girls (n=618)			
Normal weight	92.6 (89.8, 94.8)	7.2 (5, 9.9)	0.2 (0.005, 1.2)
Overweight	86 (77.3, 92.3)	14 (7.7, 22.7)	0
Obese	83 (70.2, 91.9)	15.1 (6.7, 27.6)	1.9 (0.05, 10.1)
Boys (n=625)			
Normal weight	66.9 (62.6, 71.1)	32 (27.9, 36.4)	1 (0.3, 2.4)
Overweight	44.8 (34.1, 55.9)	49.4 (38.5, 60.4)	5.7 (1.9, 12.9)
Obese	41.2 (27.6, 55.8)	51 (36.6, 65.2)	7.8 (2.2, 18.9)

Data are presented as percentage (95% confidence interval).

Overweight as BMI ≥ 24.46 kg/m² and < 29.41 kg/m² (boys) and ≥ 24.70 kg/m² and < 29.69 kg/m² (girls); obese as BMI ≥ 29.41 kg/m² (boys) and ≥ 29.69 kg/m² (girls).

Prehypertension as SBP 120-139 mmHg or DBP 80-89 mmHg; hypertension as ≥ 140 mmHg or DBP ≥ 90 mmHg (hypertension).

TABLE 4   Multivariable Models for Adolescent Systolic and Diastolic Blood Pressure

	Regression coefficient	95% CI	p
SBP			
Male gender*	8.97	7.43, 10.5	<0.001
OC use	3.27	1, 5.54	0.005
Urinary Na/K ratio‡	0.27	0.02, 0.51	0.031
BMI§			
Boys	0.65	0.48, 0.81	<0.001
Girls using OC¶	0.52	0.17, 0.87	0.004
Girls not using OC	0.38	0.21, 0.55	<0.001
Alcohol drinker#			
Boys	2.48	1.09, 3.87	<0.001
Girls using OC	-0.12	-1.8, 1.56	0.89
Girls not using OC	0.28	-2.29, 2.85	0.83
<i>Constant</i>	<i>107.46</i>	<i>106.3, 108.6</i>	<i><0.001</i>
DBP			
Male gender*	-0.26	-1.15, 0.63	0.571
OC use	1.74	0.55, 2.93	0.004
Physical activity†	-1.22	-2.1, -0.34	0.007
<i>Constant</i>	<i>60.22</i>	<i>58.95, 61.49</i>	<i><0.001</i>

BMI indicates Body Mass Index; OC, oral contraceptive; Na/K ratio, sodium / potassium ratio.

* Reference group was girls not using OC.

‡ Na/K - mean Na/K.

§ BMI - mean BMI.

|| p=0.028, boys vs non-OC girls.

¶ p=0.482, OC using girls vs non-OC girls.

Consumer of alcohol at any level over the last 7 days.

† ≥ 4 hours vs < 4 hours of exercise outside study or work per week.

Figure 1**A** **B**