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Hormonal contraceptive use among adolescent girls in Germany in relation to health behaviour and biological cardiovascular risk factors

Yong Du, Ph.D.[1*], Bettina M. Rosner, Ph.D.[2*], Hildtraud Knopf, M.D.[1], Sabine Schwarz[3], Martina Dören, M.D:[3], Christa Scheidt-Nave, M.D.[1]

[1] Robert Koch Institute, Department of Epidemiology and Health Monitoring, General-Pape-Str. 64-66, 12101 Berlin, Germany
[2] Robert Koch Institute, Department of Infectious Disease Epidemiology, DGZ-Ring 1, 13086 Berlin, Germany
[3] Charité-Universitätsmedizin Berlin, Clinical Research Center of Women´s Health, Hindenburgdamm 30, 12200 Berlin, Germany

*: Both YD and BMR contributed equally to the manuscript

Corresponding author:

Bettina M. Rosner
Robert Koch Institute
Department of Infectious Disease Epidemiology
DGZ-Ring 1
13086 Berlin
Germany

Email: RosnerB@rki.de

Keywords: hormonal contraceptives, adolescents, health-related behaviour, cardiovascular risk

Abstract

PURPOSE

To determine the association between hormonal contraceptive (HC) use, and behaviour-related and biological cardiovascular risk factors among teenage girls in Germany.

METHODS

HC use was assessed among 2285 girls aged 13-17 years who participated in the health survey for children and adolescents (German Health Interview and Examination Survey for Children and Adolescents, KiGGS), between years 2003 and 2006. Prevalence of HC use was determined according to sociodemographic variables, behavior-related health risks, and overweight status. We compared HC users and nonusers with respect to biological cardiovascular risk factors, including systolic and diastolic blood pressure, and serum concentrations of lipids, lipoproteins, high sensitivity C-reactive protein (hs-CRP), and homocysteine.

RESULTS

HC users were more likely than nonusers to combine several behavior-related health risks, independent of sociodemographic factors. In particular, HC use was strongly associated with current smoking (odds ratio: 3.4, 95% confidence interval: 2.7-4.3). HC use and behavioral factors showed an additive effect on biological cardiovascular risk factors, explaining between 6% and 30% of the population variance. Relative contributions of HC use ranged from <1% for systolic and diastolic blood pressure to 12% for hs-CRP.

CONCLUSIONS

HC use among 13-17-year old girls in Germany is significantly correlated with a more unfavorable cardiovascular risk profile, which is partly explained by a clustering of behavioral risk factors among HC users. When prescribing HC to teenagers, physicians should

systematically assess avoidable behavioral cardiovascular risk factors and provide counseling tailored to the risk profile of the individual patient.

Keywords: adolescents; cardiovascular risk; health-related behavior; hormonal contraceptives

Introduction

Hormonal contraceptives (HCs) have been recommended for the prevention of unintended pregnancies among adolescents in Germany because they are considered relatively safe as compared with other methods of contraception [1]. In addition, the use of HCs among adolescents may have positive effects on certain hormonal disorders such as dysmenorrhea, irregular menstrual cycles, and acne [2]. However, HCs have also been associated with adverse health effects. In epidemiological studies conducted among adult women, cardiovascular health risks, such as venous thrombosis, ischemic and hemorrhagic stroke, and myocardial infarction have been shown to be higher among users of HCs than among nonusers [3-8]. Consequently, the estrogen content of HCs has been gradually reduced from 150 µg to ≤35, and the progestin component has been modified. HCs available on the market currently are considered to have fewer adverse health effects because of this lower estrogen content and altered progestin; however, some studies with more recently introduced preparations do not support this view [9, 10].

Evidence on health risks of HC use among adolescents is scarce. Events such as venous thrombosis, stroke, and myocardial infarction occur rarely in adolescents, thus, hard endpoint studies would require extended follow-up far into adulthood. Previous epidemiological studies on HCs and cardiovascular risk in adolescents focused on behavioral risk factors relevant to cardiovascular risk or surrogate endpoints, such as blood pressure and serum lipids [11-16]. These studies were conducted in the 1980s or 1990s, and few studies were population-based.

We present recent and nationally representative data on the association between current HC use, health-related behaviors, and main biological cardiovascular risk factors among teenage girls in Germany. We specifically asked: (1) Is there a significant association between HC use and behavioral as well as biological cardiovascular risk factors among adolescent girls in

Germany? (2) What is the relative contribution of HC use in models of biological risk factors independent of behavioral cardiovascular risk factors and other covariates?

Methods

Data source and study population

The German Health Interview and Examination Survey for Children and Adolescents (KiGGS) was conducted by the Robert Koch Institute between May 2003 and May 2006. The target population of the survey consisted of all noninstitutionalized children and adolescents aged 0-17 years living in Germany. The design, sampling strategy, and study protocol have been described elsewhere in detail [17]. Briefly, a two-stage random clustered sample of the target population was drawn on the basis of a representative sample of German communities [17]. The study was conducted according to a highly standardized protocol encompassing a medical computer-assisted interview, self-administered questionnaires, and standardized physical examinations including blood pressure measurements and casual venous blood sampling for biochemical tests. The final sample included 17,641 children and adolescents (8,985 boys, 8,656 girls). The overall response rate was 66.6% (69% in age group 11-13 years; 63% in age group 14-17 years). Nonresponse analysis showed little variation between the age groups and sexes, and no difference was found with respect to health-related variables [17]. The survey was approved by federal data protection officials and by the Charité Universitätsmedizin Berlin medical ethics committee. Written informed consent was obtained before the interview and examination from the children's parents and the children themselves if they were over 14 years of age. This study was restricted to the 2,307 girls aged 13-17 years who participated in the KiGGS. Of them, 22 girls who did not take part in the drug use survey were excluded, resulting in a study population of 2,285 girls available for the present analysis.

Assessment of hormonal contraceptive use

Survey participants were asked in advance to bring prescriptions or original medicine containers to the examination sites. Use of any medication, including prescription drugs and over-the-counter medications, within seven days before the medical examination was

assessed using a computer-assisted standardized drug use questionnaire. Details of medication use were documented, such as brand name, condition(s) treated, daily dosage, route of application, and duration of use. Specific ATC (Anatomical Therapeutic Chemical) codes were assigned to all reported medications and WHO ICD-10 codes to the conditions for which the medications were taken. For each medication recorded, a maximum of two conditions could be provided. We identified a total of 445 participants who took medications with ATC-codes G03A (HCs for systemic use, n=428), G03HB01 (combinations of cyproterone acetate (antiandrogen) and estrogens, for treatment of acne and hirsutism, n=15), and G02B (contraceptives for topical use, n=2).

Definition of behavioral cardiovascular risk factors, biological cardiovascular risk factors, and sociodemographic covariates

Behavioral cardiovascular risk factors included cigarette smoking, regular alcohol consumption, physical activity assessed as engagement in sports activities, and overweight status measured as body mass index (BMI) class. Standardized, self-administered questionnaires were used to collect information regarding behavior-related health risks and sociodemographic characteristics. Questionnaires were tailored to specific age groups (e. g., 11-13 years; 14-17 years) to capture health-related information of particular relevance to important developmental stages. Separate questionnaires were offered to the parents and to the children aged ≥11 years [17]. We used information provided by the girls themselves to define health-related behavior. Girls were classified as current smokers if they answered the question “Do you currently smoke?” with “daily”, “several times a week”, “once a week”, or “occasionally”. Regular alcohol consumption was defined as drinking a minimum of one glass of beer, wine, or hard liquor per week. The frequency of physical activity was assessed with the question, “In your leisure time, how often do you engage in physical activity (e.g., when doing sports or riding bicycle) that leads to heavy sweating or being out of breath?” with the answer choices “about every day”, “three to five times a week”, “about once or twice a week”, “about once or twice a month”, or “never”. For the present analysis, the frequency of physical

activity was defined as “often” (three to five times a week or more), “sometimes” (about once or twice a week, or about once or twice a month), and “never”. BMI was computed from standardized measures of children’s weight and height. Relative body weight was classified as normal, overweight, or underweight according to Kromeyer-Hauschild (overweight: BMI above the age- and sex-specific 90^{th} percentile; underweight: BMI below the age- and sex-specific 10^{th} percentile) [18]. In some regression models, we included pubertal stage as self-reported Tanner stage of pubic hair (stage 1: Tanner 1; stage 2: Tanner 2-3; stage 3: Tanner 4-6) and menarche status (yes/no) as additional factors [19].

Biological cardiovascular risk factors included blood pressure and serum concentrations of total cholesterol, low density lipoprotein cholesterol (LDL-C), high density lipoprotein cholesterol (HDL-C), triglycerides, high sensitivity C-reactive protein (hs-CRP), and homocysteine. Analytical methods have been previously described in detail [20]. Standardized measurements of systolic, diastolic, and mean arterial pressure were obtained using an automated oscillometric blood pressure device. The means of two independent readings for systolic blood pressure (SBP) and diastolic blood pressure (DBP) were used in the present analysis.

Because associations between HC use and certain sociodemographic factors, such as residence in East or West Germany, family social status, and family immigration background, were conceivable, these covariates were included in regression models. The 10 federal states of the Federal Republic of Germany before reunification were defined as West Germany, the five new federal states covering the region of the former German Democratic Republic and the federal state of Berlin were defined as East Germany. Family social status score was computed integrating information obtained from the parents’ questionnaire on both parents’ educational level and professional status as well as total family income [17, 21]. Family immigration status was assessed on the basis of the information collected on nationality, country of birth, and year of immigration of both parents [17]. Girls were classified

as having an immigration background if either they themselves had immigrated from another country and at least one parent was not born in Germany, or if both parents were immigrants or not of German nationality.

Statistical analysis

Multivariable logistic regression was applied to identify independent determinants of HC use; results are expressed as adjusted odds ratios and 95% confidence intervals. Analysis of covariance was applied to compare mean levels of biological cardiovascular risk factors between HC users and nonusers, accounting for the effect of modifiable behavioral cardiovascular risk factors (smoking, alcohol consumption, physical activity), overweight status, pubertal stage, and sociodemographic covariates. As serum CRP and triglyceride measures showed a highly skewed distribution, values were logarithmically transformed for statistical analyses. Comparisons of adjusted means were extended to subgroups of HC users defined by duration of HC use (≥ 1 year vs. <1 year), estrogen dose (<20, 20-30, >30 μg), and progestin component (levonorgestre l= second generation; desogestrel and norgestimat = third generation; drospirenone and dienogest = fourth generation). Multiple linear regression models were fitted to assess the relative contribution of HC use in explaining the population variance of biological cardiovascular risk factors as dependent variables. A total of 130 (5.7%) study participants had missing observations in one or more variables. Missing values were excluded in multivariable regression modeling. All statistical analyses were performed using SPSS statistical software (release 17.0; SPSS Inc., Chicago, IL). A probability level of p <0.05 based on two-sided tests or 95% confidence intervals that did not overlap was considered statistically significant. To ensure that survey results are representative at the population level, all results were weighted by a survey weighting factor, considering deviations between survey responders and the actual German population structure (as of December 31, 2004) with respect to demographic characteristics (age, sex, residence in West or East Germany, nationality) [17]. The complex sample method was used to account for clustering due to the two-stage sampling procedure [17].

Results

Overall prevalence, indications, and patterns of current hormonal contraceptive use

Overall, 19.6% among girls aged 13-17 years were currently using HCs (Table 1). About 98% of HC users reported oral contraceptive preparations. Nonoral application routes included transdermal patches, hormonal implants, or injections. Overall, 11% of HC users took HC preparations exclusively for the treatment of medical disorders, mainly dysmenorrhoea, irregular menstrual cycles, or acne (data not shown). Nearly one-half (49.1%) of HC users reportedly had been using HCs for a minimum of 1 year (data not shown). The most frequently used oral HCs (91.5%) were single-phase combined preparations with a fixed amount of ethinyl estradiol and progestin. About two-thirds of users of oral HCs used preparations that contained 30 µg of ethinyl estradiol, 12% used HCs with more than 30 µg ethinyl estradiol, and 23% used HCs with 20 µg ethinyl estradiol (data not shown). About 35% of combined oral contraceptives that were used by the study participants contained levonorgestrel as progestin component. Combined oral contraceptives with desogestrel, chlormadinone acetate, or dienogest were used by approximately 16% of HC users each (data not shown).

Sociodemographic determinants of current hormonal contraceptive use

The prevalence of HC use increased continuously with age, ranging from 0.2% among 13-year-olds to 45.6% among 17-year-olds (Table 1). HC use was significantly and inversely related to residence in West versus East Germany and to immigration background (Table 1). No significant association was found between HC use and family social status (Table 1). Results persisted in multivariable logistic regression of HC use on sociodemographic factors (data not shown). Considering individual components of social status, for example, parental education levels or household income, in separate models also did not change the results (data not shown).

Association between hormonal contraceptive use and modifiable health-related behavioral risk factors

As compared with nonusers, HC users were significantly more likely to be current smokers (56% vs. 20%), to consume alcohol on a regular basis (38% vs. 14%), and to report not to be involved in any sports activity (24% vs. 15%) (Table 1). Age-stratified analysis showed that group differences between HC users and nonusers declined with increasing age (Figure 1). Among girls aged <16 years, current HC use was significantly related to all three behavior-related cardiovascular risk factors. Significant differences between HC users and nonusers were reduced to current smoking and alcohol use among 16-year-old girls and to current smoking alone among 17-year-old girls (Figure 1). Consistently, HC users and nonusers did not significantly differ with respect to overweight status (Figure 1). HC users were more likely than nonusers to have combinations of behavioral cardiovascular risk factors (cigarette smoking, alcohol consumption, inactivity, and being overweight). Overall, 80% of HC users had at least one out of the four selected risk factors as opposed to 47% of nonusers. A total of 25.2% of HC users had two, and 14.5% had three or four of the risk factors considered, in contrast to 13.5% and 3.1%, respectively, among non-users (data not shown in Figure 1). Associations between individual behavioral cardiovascular risk factors and HC use were reduced but not fully explained in multivariable logistic regression analyses, adjusting for sociodemographic variables (Table 2). Results did not materially change when 13- and 14-year-old girls were excluded from the regression model (e.g., OR for smoking was then 3.10 (2.45-3.93)).

Independent associations between current HC use and biological cardiovascular risk factors

Adjusting for behavioral cardiovascular risk factors, sociodemographic covariates, and pubertal stage, HC users had significantly higher mean SBP and DBP, and higher mean serum concentrations of total cholesterol, HDL-C, LDL-C, triglycerides, and hs-CRP as compared with nonusers (Table 3). No statistically significant association was observed between HC use and serum homocysteine. Absolute differences between HC users and

nonusers increased with extended duration of HC use (≥ 1 year vs. < 1 year), although group mean differences between short term (<1 year) and longer term (≥ 1 year) users did not reach statistical significance (*p* values not shown in Table 3). Mean levels of biological cardiovascular risk factors did not consistently differ in relation to estrogen content or progestin generation with the exception of mean serum HDL-C concentrations. These were significantly higher among HC users of preparations with higher estrogen content (30 or >30 μg vs. 20 μg) as well as among users of preparations containing third- and fourth-generation progestins compared with users of preparations containing second-generation progestins (data not shown).

In general linear models including sociodemographic variables, behavioral cardiovascular risk factors, and pubertal stage, HC use explained a small to moderate additional proportion of the population variance of biological cardiovascular risk factors (Table 4). Relative contributions of HC use ranged between <1% in models with SBP or DBP as dependent variables and 12.3% in models with hs-CRP as the dependent variable (Table 4). We observed no interaction between HC use and smoking or other behavioral cardiovascular risk factors (data not shown).

Discussion

Overall, 19.6% of 13-17-year-old girls in Germany were currently using HCs. This prevalence estimate is consistent with results obtained from a previous interview survey conducted among 14-17-year-old girls in Germany, despite methodological differences in study design [22]. Our results are also similar to prevalence estimates reported by other western European countries [11, 23, 24].

In contrast to a previous study among Finnish teenagers [25] but in agreement with study results obtained among adult women in Germany [26], we did not find an association of HC use with family social status or individual components of this construct, that is, educational or professional status or household income. As observed in the present study, differences in social status and educational background might in part be captured by regional and cultural differences in HC use. As expected, HC use among teenage girls was strongly and inversely correlated with a family immigration background. Most of the families immigrating to Germany have an Islamic background, thus, cultural and religious influences are likely to restrict the proportion of sexually active girls and the demand for HCs. As observed among teenagers in the present study, HC use among adult women was previously reported to be significantly higher in eastern German federal states than in western federal states [26, 27], possibly because of easier access to this contraceptive method in the former German Democratic Republic [27]. Although differences in health and health-related behavior between children and adolescents living in former East and West Germany have almost disappeared within the 20 years since reunification [28], the mother's preference may conceivably affect the daughter's choice of contraception method.

An association between HC use and unhealthy lifestyle, in particular current cigarette smoking, was found in our study as well as in others [11-14, 29]. Clustering of behavioral cardiovascular risk factors among adolescents has been previously observed to be

associated with an adverse biological cardiovascular risk profile [13]. Previous studies conducted among adolescents reported an association of HC use and elevated SBP, DBP, serum total cholesterol and LDL-C [11, 13-16]. Studies that were conducted in the 1970s and 1980s found decreased HDL–C levels among HC users as compared with nonusers [16, 30]. In contrast, in the present study, HDL–C levels were higher among HC users than nonusers, most likely because of the differences in the progestin component between older and more recently developed oral contraceptives. Elevated levels of serum hs-CRP in association with HC use have been previously described in studies of adolescent girls [31] as well as adult women [32-34]. In agreement with other studies, we did not find evidence for an association between HC use and homocysteine levels [31].

In addition to previous investigations, the present study assessed the joint effect of HC use and main modifiable behavior-related health risks as well as the relative contribution of HC use on biological cardiovascular risk factors. We observed an additive effect of HC use and behavioral health risk factors. In particular, we found no interaction between HC use and smoking, although a synergistic effect of smoking and HC use on cardiovascular risk has been described by some studies [35, 36]. Relative contributions of HC use on biological cardiovascular risk factors were small (<1 -12%).

The clinical relevance of the association between HC use and established cardiovascular risk factors among adolescent HC users remains unclear. The risk of cardiovascular events, in particular stroke, or venous thromboembolism is considered low among adolescent HC users, unless a genetic predisposition for thrombosis exists [2, 37]. As risk considerably increases with age, heavy smoking is a contraindication of HC use for adult women, especially for those aged >35 years according to guidelines of the German Society of Gynaecology and Obstetrics. A small increase in SBP or DBP is probably not clinically relevant for healthy adolescent girls, but may be relevant for girls with established hypertension. Elevated levels of total serum cholesterol, LDL-C, and triglycerides are

associated with an increased cardiovascular disease risk, whereas elevated levels of HDL–C associated with HC use are considered beneficial with respect to cardiovascular disease risk. Elevated levels of serum hs-CRP, if not caused by an acute infection, have been associated with cardiovascular disease risk, in particular risk of atherosclerotic degenerative processes [38]. However, it is subject to debate whether hs-CRP is an indicator or an inducer of atherosclerotic processes [39]. To determine the clinical relevance of the observed associations of HC use and biological cardiovascular risk factors, tracking of risk factors and the development of subclinical disease in association with HC use need to be investigated prospectively in population-based cohorts of adolescent girls.

The main strength of the present study is that HC use could be investigated in a nationally representative sample of 13 - 17-year-old girls in Germany. Recall bias with respect to medication use was minimized because questions referred to the 7 days before the interview rather than a longer period. In addition, study participants were encouraged to bring their prescriptions or medication packages to the medical interview, which increased the quality of medication use data. There are limitations to our study. Because of the cross-sectional study design, neither the clinical relevance nor the causality of the observed association between HC use and biological cardiovascular risk factors can be established. Also, we cannot exclude misclassification bias caused by underreporting. Although some study participants may have chosen not to admit to HC use during the interview, the number is likely to be small. Ethnicity of the study participants could be a confounding factor because biological cardiovascular risk factors are well known to differ by ethnicity. The present study included a representative proportion of adolescents with immigration background. However, this group was largely dominated by study participants with a Turkish background, whereas the number of black or Asian children was very small. Thus, the present study did not permit to differentiate between ethnically distinct subgroups.

Among healthy girls, small increments in cardiovascular risk are likely to be outweighed by the benefits of HC use, mainly protection from teenage pregnancy. However, the strong correlation between HC use and avoidable risk behaviors, in particular cigarette smoking, is of public health concern. Because HCs are only available on prescription, physicians prescribing them should take the opportunity to systematically assess the occurrence of modifiable behavior-related risk factors and provide evidence-based counseling tailored to the needs of the individual teenage patient.

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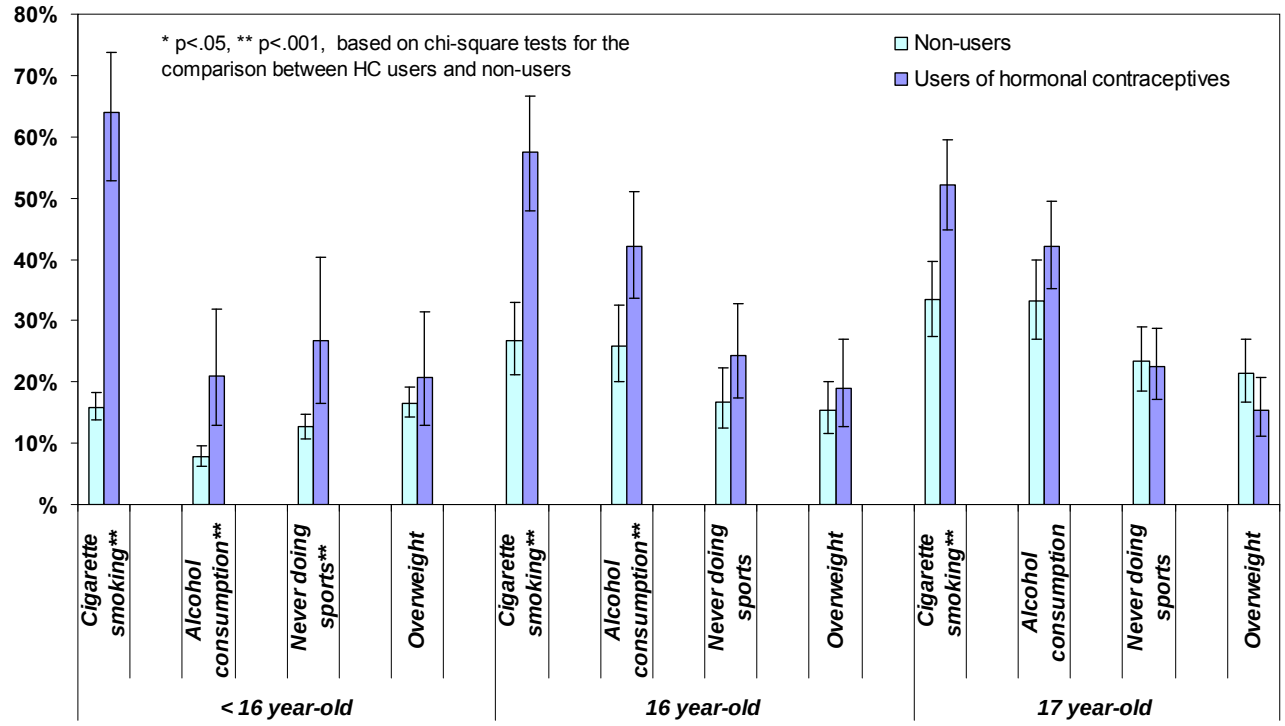
Figure 1.



Legend to Figure 1

Figure 1: Distribution of behavioral cardiovascular risk factors according to current hormonal contraceptive use among 13- to 17-year-old girls in Germany. German Health Interview and Examination Survey for Children and Adolescents (KiGGS), 2003-2006. * p<.05, ** p<.001, based on χ^2 tests for the comparison between HC users and nonusers

Table 1. Characteristics of the study population and prevalence of current hormonal contraceptive (HC) use among 13- to 17-year old girls in Germany. German Health Interview and Examination Survey for Children and Adolescents (KiGGS), 2003-2006

	Study population	Non-users of HC	Users of HC	Prevalence of HC use
	N (%)	N (%)	N (%)	% (95% CI)
Total	2,285 (100)	1,840 (100)	445 (100)	19.6 (17.9-21.4)
Age group*, *years*				
13	467 (18.6)	465 (23.1)	2 (0.2)	0.2 (0.0-0.7)
14	462 (20.4)	443 (24.5)	19 (3.3)	3.1 (1.9-5.1)
15	462 (20.2)	389 (21.3)	73 (15.5)	15.0 (11.7-19.0)
16	448 (20.5)	302 (17.4)	146 (33.6)	32.0 (27.8-36.6)
17	446 (20.4)	241 (13.8)	205 (47.5)	45.6 (40.6-50.6)
Region*				
East Germany	779 (20.3)	590 (18.5)	189 (28.0)	27.0 (23.4-30.9)
West Germany	1,506 (79.7)	1,250 (81.5)	256 (72.0)	17.7 (15.9-19.6)
Family immigration background*				
Yes	329 (16.8)	303 (19.3)	26 (6.5)	7.6 (5.1-11.2)
No	1,953 (83.1)	1,534 (80.6)	419 (93.5)	22.0 (20.1-24.0)
Missing	3 (0.1)	3 (0.1)	0	
Family social status				
Lower	584 (26.0)	473 (26.2)	111 (25.3)	19.0 (15.9-22.6)
Intermediate	1,067 (46.0)	847 (45.3)	220 (48.8)	20.7 (18.2-23.6)
Upper	563 (24.9)	458 (25.1)	105 (24.2)	19.0 (15.9-22.7)
Missing	71 (3.1)	62 (3.4)	9 (1.6)	10.5 (5.2-20.0)
Body mass index				
Underweight	152 (6.4)	128 (6.8)	24 (4.7)	14.5 (9.4-21.7)
Normal	1,728 (75.9)	1,383 (75.6)	345 (77.4)	19.9 (18.0-22.0)
Overweight	390 (17.0)	316 (16.9)	74 (17.4)	20.1 (16.1-24.7)
Missing	15 (0.7)	13 (0.8)	2 (0.4)	11.3 (2.7-37.0)
Physical activity*				
Often	880 (38.4)	750 (40.5)	130 (29.8)	15.2 (12.8-17.9)
Sometimes	996 (43.9)	791 (43.5)	205 (45.6)	20.3 (17.8-23.0)
Never	376 (16.4)	271 (14.6)	105 (23.6)	28.2 (23.5-33.5)
Missing	33 (1.4)	28 (1.4)	5 (1.1)	15.6 (6.5-33.0)
Current cigarette smoking*				
Yes	620 (27.0)	376 (20.1)	244 (55.7)	40.3 (36.3-44.4)
No	1,646 (72.2)	1,450 (79.2)	196 (43.5)	11.8 (10.2-13.6)
Missing	19 (0.8)	14 (0.7)	5 (0.9)	22.6 (8.8-47.0)
Regular alcohol consumption*				
Yes	409 (18.7)	250 (14.1)	159 (37.8)	39.5 (34.4-44.8)
No	1,837 (79.5)	1,555 (83.9)	282 (61.4)	15.1 (13.4-17.0)
Missing	39 (1.8)	35 (2.0)	4 (0.8)	8.7 (2.9-23.6)
Pubertal stage				
Stage 1 (Tanner 1)	4 (0.2)	4 (0.2)	0	
Stage 2 (Tanner 2-3)	121 (4.8)	112 (5.5)	9 (1.8)	7.3 (3.4-16.0)

Stage 3 (Tanner 4-6)	2,119 (93.6)	1,691 (92.8)	428 (96.9)	20.2 (18.5-22.1)
Missing	41 (1.5)	33 (1.5)	8 (1.4)	18.0 (7.7-36.5)
Menarche				
Yes	2,086 (91.8)	1,642 (89.9)	444 (99.9)	21.3 (19.4-23.2)
No	184 (7.6)	184 (9.4)	0	0
Missing	15 (0.6)	14 (0.7)	1 (0.1)	3.9 (0.5-24.1)

Percentages and prevalence data were weighted according to the national child population in Germany.

* $p<.001$, based on χ^2 tests for the comparison between HC users and non-users

Table 2: Odds ratios (OR) and 95% confidence intervals (CI) of HC use according to behavioral cardiovascular risk factors among 13- to 17-year old girls in Germany. German Health Interview and Examination Survey for Children and Adolescents (KiGGS), 2003-2006

	Crude OR (95% CI)	Adjusted OR[a] (95% CI)
BMI		
Normal weight	1	
Underweight	0.68 (0.44-1.05)	0.64 (0.39-1.05)
Overweight	0.98 (0.76-1.27)	0.88 (0.66-1.19)
Physical activity		
Often	**1**	
Sometimes	**1.43 (1.15-1.78)**	1.21 (0.94-1.55)
Never	**2.19 (1.67-2.86)**	**1.63 (1.20-2.23)**
Current cigarette smoking		
No	**1**	
Yes	**5.04 (4.12-6.17)**	**3.44 (2.73-4.33)**
Regular alcohol consumption		
No	**1**	
Yes	**3.67 (2.96-4.54)**	**1.62 (1.27-2.07)**

[a] Results obtained from multivariable logistic regression models adjusted for age, region (East/West Germany), family immigration background, and family social status.

Table 3: Adjusted mean levels of biological cardiovascular risk factors according to hormonal contraceptive use among 13- to 17-year-old girls in Germany. German Health Interview and Examination Survey for Children and Adolescents (KiGGS), 2003-2006

Risk factor	Non-users (N=1840)	Hormonal contraceptive users		
		Total users (N=445)	Duration of use	
			<1 year (n=173)	>=1 year (n=167)
SBP, *mm Hg*	113.6±0.33	**115.2±0.66***	113.5±0.96	**115.9±0.83***
DBP, *mm Hg*	68.6±0.23	**69.9±0.42****	69.1±0.67	**70.2±0.61***
Total-C, *mg/dl*	161.6±0.92	**184.4±2.50*****	**179.9±2.99*****	**190.7±5.07*****
HDL-C, *mg/dl*	57.9±0.37	**61.7±1.00*****	60.3±1.18	**63.6±1.67****
LDL-C, *mg/dl*	91.3±0.82	**108.9±2.5*****	**106.2±3.01*****	**113.7±4.70*****
Triglycerides, *mg/dl*	87.4±1.02	**113.3±1.03*****	**111.4±1.03*****	**117.3±1.04*****
hs-CRP, *µg/dl*	43.3±1.03	**123.1±1.07*****	**113.8±1.11*****	**140.9±1.10*****
Homocysteine, *µmol/l*	7.97±0.07	7.69±0.14	7.58±0.25	7.85±0.23

Data are presented as mean ± SEM.

Values for triglycerides and hs-CRP are anti-logs from means of log-transformed values.

Results obtained from general linear models adjusted for age, region (East/West Germany), family immigration background, family social status, as well as overweight status, pubertal stage, physical activity, smoking, and alcohol consumption.

SBP = systolic blood pressure; DBP = diastolic blood pressure; total-C = total serum cholesterol; LDL-C = low density lipoprotein cholesterol; HDL-C = high density lipoprotein cholesterol; hs-CRP = high-sensitivity C-reactive protein.

* p<.05, ** p<.01, *** p<.001

Table 4: Relative contribution of HC use to explain the population variance in biological cardiovascular risk factors among 13- to 17-year old girls in Germany. German Health Interview and Examination Survey for Children and Adolescents (KiGGS), 2003-2006

Dependent variable		r^2	B	95% CI	p- value	η^2
SBP	Model 1	.056				-
	Model 2	.057	1.29	.28-2.30	.013	.002
DBP	Model 1	.055				
	Model 2	.058	1.18	.41-1.95	.003	.004
Total-C	Model 1	.063				
	Model 2	.124	22.76	19.28-26.25	<.001	.065
LDL-C	Model 1	.052				
	Model 2	.095	17.11	13.95-20.26	<.001	.046
HDL-C	Model 1	.054				
	Model 2	.066	4.20	2.72-5.67	<.001	.013
Triglycerides	Model 1	.065				
	Model 2	.098	1.29	1.23-1.37	<.001	.034
CRP	Model 1	.197				
	Model 2	.295	2.97	2.64-3.35	<.001	.123

Results obtained from general linear models.

Model 1: adjusted for age, region (East/West Germany), family immigration background, family social status, pubertal stage, overweight status, physical activity, current cigarette smoking, and alcohol consumption

Model: 2: Model 1+HC use

SBP = systolic blood pressure; DBP = diastolic blood pressure; total-C = total serum cholesterol; LDL-C = low density lipoprotein cholesterol; HDL-C = high density lipoprotein cholesterol; hs-CRP = high-sensitivity C-reactive protein.