FEDERAL HEALTH REPORTING
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Journal of Health Monitoring

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Sports and dietary behaviour among children and adolescents in Germany. Results of the cross-sectional KiGGS Wave 2 study and trends

Abstract
This article focuses on selected indicators related to sports and dietary behaviour – two important factors that influence the development of obesity. The analyses are based on data collected for the second wave of the German Health Interview and Examination Survey for Children and Adolescents (KiGGS Wave 2), which was conducted between 2014 and 2017. These data were collected, using a questionnaire, from 6,810 girls and 6,758 boys aged between 3 and 17. The analyses also compare the data collected for wave 2 with those from the KiGGS baseline study (2003-2006).

More than 70% of 3- to 17-year-olds state that they participated in sports. However, boys do so significantly more often than girls, and 11- to 17-year-olds do so more frequently than 3- to 10-year-olds. In addition, there is a correlation between children’s and adolescents’ sports participation and those of their parents, and with an activity-friendly living environment.

Younger children and girls have healthier diets than older children and boys. However, although the consumption of confectionery and sugary drinks by 3- to 17-year-olds has declined significantly since the KiGGS baseline study was conducted, 11- to 17-year-olds, in particular, eat significantly smaller amounts of vegetables than they did about ten years ago. Significantly more 3- to 10-year-olds currently eat at least five servings of fruit and vegetables per day than ten years ago, although the proportion of the children who reach this recommendation continues to remain very low at 14% overall.

It is important to set an example by following a healthy lifestyle within families and other settings in early life. Furthermore, the living environments also need to be made more health-oriented to support children and adolescents in reaching the national recommendations on physical activity and healthy eating.
1. Introduction

The prevalence (frequency) of obesity has increased significantly throughout the world over the last few decades, and it is now a key issue in health promotion and disease prevention [1]. Current results from the second wave of the German Health Interview and Examination Survey for Children and Adolescents (KiGGS Wave 2), which was conducted between 2014 and 2017, show that 15.4% of 3- to 17-year-old children and adolescents in Germany are overweight, and that almost 6% are obese [2]. Although a comparison with data from the KiGGS baseline study (2003-2006) shows that the prevalence of overweight and obesity among children and adolescents has not increased over the last ten years, these conditions have continued to stagnate at a high level [2]. Childhood obesity is associated with a risk of long-lasting obesity that can continue into adulthood [3]. Moreover, the progression of obesity in adulthood is often even more severe in cases where the condition developed in childhood or adolescence [4]. Obesity is also associated with conditions such as cardiovascular diseases, type 2 diabetes as well as the metabolic syndrome, which reflects the co-occurrence of multiple cardiovascular risk factors.

Alongside genetics [5], the main cause of obesity is a permanent imbalance between energy intake and energy use [6]. Unhealthy eating habits, sedentary activities and a lack of physical activity, therefore, are important factors that influence obesity [7, 8]. It is important to note that even children and adolescents currently spend most of their day doing sedentary activities in school, as part of training or in the workplace. Furthermore, media-related activities during leisure time can contribute towards further periods of physical inactivity. Sedentary behaviour has established itself in recent years as an independent risk factor for obesity. In 2010, the World Health Organization (WHO) defined minimum recommendations for physical activity in childhood and adolescence [9], and according to this, children and adolescents should undertake at least 60 minutes of moderate to vigorous physical activity every day. Currently, only 25.9% of children and adolescents meet these recommendations [10], and these only represent the minimum recommended levels. Current national guidelines for Germany go even further, and recommend at least 180 minutes for children aged between four and six, and at least 90 minutes daily for children between six and eleven to achieve greater health benefits [11].

At the same time, food tends to be constantly available almost everywhere. Access to energy-rich foods is often particularly easy, and this causes them to be consumed in large amounts, resulting in increased energy intake. A further risk factor for obesity in childhood and adolescence are the food products that particularly appeal to children, as these are often potentially unhealthy [12]. Further risk factors are the consumption of large amounts of sugary drinks [13, 14] and a low dietary intake of fruit and vegetables [15]. During the Eating Study as a KiGGS Module (EsKiMo), which was a module of the KiGGS baseline study, the results showed that children and adolescents often did not meet the recommendations for a healthy diet [16].

An individual’s understanding of health and health-related behaviour are influenced by various obesity-
promoting (obesogenic) environmental factors [17-19]. The living environments of children and adolescents need to be made more health-oriented. The lack of safe cycle lanes and paths for pedestrians as well as poor accessibility to activity-friendly places foster a predominantly physical inactive lifestyle and consequently less energy expenditure [20]. On the other hand, the abundance of food stores and the supply of unhealthy products lead to increased energy intake.

For children and adolescents in Germany, current representative data from KiGGS Wave 2 are available on sport- and dietary behaviour as well as on obesity-promoting environmental factors. This article analyses the current sports and dietary behaviour of 3- to 17-year-old children and adolescents in Germany using selected indicators as well as environmental factors that favour obesogenic behaviour. In addition, in order to determine developments over time, these data from children and adolescents are compared to data from children of the same age that were collected about ten years ago.

2. Methodology

2.1 Study design

KiGGS is part of the health monitoring system at the Robert Koch Institute. The KiGGS study involves repeatedly performed representative cross-sectional surveys of children and adolescents aged between 0 and 17 in Germany (KiGGS cross-sectional component). The KiGGS baseline study was carried out as an examination and interview survey (2003-2006) while KiGGS Wave 1 was an interview-based survey (2009-2012). KiGGS Wave 2 (2014-2017) took place as a combined examination and interview survey. The KiGGS data were collected within a complex two-step sampling design that resulted in a clustered, stratified sample. Sample points were first randomly drawn from the various German federal states in accordance with the distribution of the BIK classes on community size. The study subjects were then randomly selected (stratified according to age) from the population registers held in local registry offices. In total, 15,023 children and adolescents (7,538 girls, 7,485 boys) participated in the cross-sectional survey of KiGGS Wave 2; 13,568 of the participants were aged between 3 and 17. The concept and design of KiGGS have been described in detail elsewhere [21-23].

2.2 Variables

Sports behaviour
This article focuses on sports behaviour, because sports represents a specific type of physical activity that is usually more intense and, therefore, more beneficial to health than general physical activity [24]. Moreover, current data on physical activity from KiGGS Wave 2 has been published in Physical Activity of Children and Adolescents in Germany. Results of the cross-sectional KiGGS Wave 2 study and trends in issue 1/2018 of the Journal of Health Monitoring [10].

KiGGS Wave 2 collected data on sports behaviour of children and adolescents by interviewing 11- to 17-year-old adolescents and the parents of 3- to 10-year-old children. Respondents were asked whether they participated in sports and were told that this referred to all kinds of
Apart from a number of exceptions in terms of certain foods, this questionnaire is largely comparable with the one used for the KiGGS baseline study. The respondents were asked which foods they had eaten ‘during the last four weeks’. The 3- to 10-year-olds were asked about a total of 48 food groups, and 11- to 17-year-olds were asked about 53 food groups (these also included alcoholic drinks). Whereas the parents of the 3- to 10-year-olds answered the questionnaire, the 11- to 17-year-olds answered the questions themselves. The questions on consumption frequency followed the pattern: ‘How often did your child/did you eat/drink food/drink X?’ Examples were given in most cases. Each question could be answered with: ‘never’, ‘once per month’, ‘2-3 times per month’, ‘1-2 times per week’, ‘3-4 times per week’, ‘5-6 times per week’, ‘daily’, ‘2 times per day’, ‘3 times per day’, ‘4-5 times per day’, ‘more than five times per day’. ‘More than five times a day’. Data on portion sizes were gathered using questions following the pattern: ‘When your child/you eat/drink food X, how much does your child/do you usually eat/drink?’ Five answer categories were provided in each case, but these varied depending on the type of food in question. They included for instance ‘½ a glass (or less)’, ‘1 glass’, ‘2 glasses’, ‘3 glasses’, ‘4 glasses (or more)’. For some foods, an additional question was asked about the specific way in which the food was consumed (such as to find out the degree to which juices were diluted). For the analysis, data on consumption frequencies were converted into the number of occasions a particular food was consumed over a four-week period (28 days). The portions were converted into grams or millilitres.
clustered, stratified sample. In order to improve the study's representativeness, the analyses were undertaken using weighting. Clustering within the sample was accounted for using statistical procedures for complex samples to provide more valid estimates of variance (including confidence intervals). Prevalence (sports participation) and averages (in the case of nutrition) are provided with 95% confidence intervals for complex samples. Significant differences were assumed in cases where confidence intervals do not overlap.

For the regression analysis (sports participation), individual (age and socioeconomic status; Model 1), interpersonal (parental sports behaviour; Model 2) and environmental factors (sports fields/swimming pools/parks and green spaces; Model 3) were gradually included in the complete case analysis once bivariate relationships had been considered. The models are adjusted for age and socioeconomic status. The way in which socioeconomic status was measured for KiGGS Wave 2 is described in more detail in Socioeconomic status and subjective social status measurement in KiGGS Wave 2, which was published in issue 1/2018 of the Journal of Health Monitoring [28].

3. Results
3.1 Sports behaviour

This section describes the prevalence of sports behaviour among 3- to 17-year-old girls and boys and its potential influencing factors; these details are also presented in Table 1. 70.9% of 3- to 17-year-old girls and 75.1% of boys of the same age report that they do sports.
Sports and dietary behaviour among children and adolescents in Germany

In this respect, a significant difference was identified between girls and boys. Girls and boys aged between 3 and 17 also differ significantly in the duration of sports participation: 53.9% of girls, but 62.8% of boys, participated in sports for at least 90 minutes per week. Moreover, 31.4% of girls, but 45.0% of boys (aged between 3 and 17), participated in sports for at least 180 minutes per week. No significant gender differences with regard to the factors that could potentially influence sports behaviour were observed: slightly more than half of the mothers and just under half of the fathers of the girls and boys interviewed participated in sports for at least one hour per week. According to their parents, 80% of girls and boys have an easily accessible sports field, park/green space, and about 55% have an easily accessible swimming pool.

The differences linked to gender persist within both age groups (3 to 10 years of age, and 11 to 17 years of age). In both age groups, boys are more likely to report that they participated in sports; however, the difference was

Parents’ sports participation and an activity-friendly living environment are associated with children’s and adolescents’ sports participation.

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Table 1  
Prevalences of sports participation and potential influencing factors for 3- to 17-year-olds according to gender and age (n=6,565 girls, n=6,413 boys)  

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>3-10 years</th>
<th>11-17 years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% (95% CI)</td>
<td>% (95% CI)</td>
<td>% (95% CI)</td>
</tr>
<tr>
<td><strong>Girls</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sports participation (yes or no)</td>
<td>70.9 (69.3-72.5)</td>
<td>69.9 (67.5-72.2)</td>
<td>72.1 (69.7-74.4)</td>
</tr>
<tr>
<td>Sports ≥ 90 minutes per week</td>
<td>53.9 (52.2-55.7)</td>
<td>48.2 (45.9-50.5)</td>
<td>60.3 (57.6-62.8)</td>
</tr>
<tr>
<td>Sports ≥ 180 minutes per week</td>
<td>31.4 (29.9-33.0)</td>
<td>25.4 (23.3-27.5)</td>
<td>38.1 (35.8-40.5)</td>
</tr>
<tr>
<td><strong>Potential influencing factors</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Mother: ≥1 hour of sport per week</td>
<td>50.6 (48.9-52.4)</td>
<td>46.8 (44.4-49.2)</td>
<td>54.8 (52.2-57.3)</td>
</tr>
<tr>
<td>Father: ≥1 hour of sport per week</td>
<td>47.3 (45.5-49.1)</td>
<td>46.6 (44.1-49.2)</td>
<td>48.1 (45.6-50.7)</td>
</tr>
<tr>
<td>Sports ground nearby</td>
<td>80.4 (78.4-82.3)</td>
<td>75.6 (73.1-77.9)</td>
<td>85.3 (82.9-87.4)</td>
</tr>
<tr>
<td>Swimming pool nearby</td>
<td>55.1 (51.2-58.9)</td>
<td>47.6 (43.5-51.8)</td>
<td>62.9 (58.7-67.0)</td>
</tr>
<tr>
<td>Park/green space nearby</td>
<td>80.9 (78.7-83.0)</td>
<td>77.5 (74.7-80.0)</td>
<td>84.6 (82.2-86.8)</td>
</tr>
<tr>
<td><strong>Boys</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sports participation (yes or no)</td>
<td>75.1 (73.5-76.6)</td>
<td>70.4 (68.0-72.7)</td>
<td>80.3 (78.2-82.3)</td>
</tr>
<tr>
<td>Sports ≥ 90 minutes per week</td>
<td>62.8 (61.0-64.6)</td>
<td>53.7 (51.4-55.9)</td>
<td>73.1 (70.8-75.3)</td>
</tr>
<tr>
<td>Sports ≥ 180 minutes per week</td>
<td>45.0 (43.2-46.7)</td>
<td>34.5 (32.5-36.6)</td>
<td>56.7 (54.2-59.2)</td>
</tr>
<tr>
<td><strong>Potential influencing factors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother: ≥1 hour of sport per week</td>
<td>50.3 (48.4-52.1)</td>
<td>47.3 (44.7-49.8)</td>
<td>53.4 (50.6-56.3)</td>
</tr>
<tr>
<td>Father: ≥1 hour of sport per week</td>
<td>49.2 (47.3-51.1)</td>
<td>48.1 (45.8-50.5)</td>
<td>50.4 (47.7-53.0)</td>
</tr>
<tr>
<td>Sports ground nearby</td>
<td>83.8 (81.9-85.5)</td>
<td>79.3 (77.0-81.6)</td>
<td>88.3 (86.2-90.1)</td>
</tr>
<tr>
<td>Swimming pool nearby</td>
<td>56.3 (52.2-60.2)</td>
<td>49.8 (45.5-54.1)</td>
<td>62.9 (58.5-67.2)</td>
</tr>
<tr>
<td>Park/green space nearby</td>
<td>79.7 (77.5-81.8)</td>
<td>77.0 (74.3-79.5)</td>
<td>82.6 (80.1-84.8)</td>
</tr>
</tbody>
</table>

CI=confidence interval
Older children report more frequently that they participated in sports than younger children. The reported frequency of sports participation for at least 90 minutes and at least 180 minutes per week is higher in older children than in younger ones. Boys between the ages of 11 and 17 report more frequently than boys between 3 and 10 that only significant among 11- to 17-year-olds. 3- to 10-year-old and 11- to 17-year-old boys participated in sports for at least 90 minutes respectively at least 180 minutes per week more frequently than girls of the same age. No significant gender-related differences were identified in terms of possible influencing factors in either of the age groups.

### Table 2a
Step-by-step analysis of the relationships between individual, interpersonal, and environmental influencing factors and sports participation among 3- to 17-year-old girls (n=5,431)


<table>
<thead>
<tr>
<th></th>
<th>Bivariate relationships</th>
<th>Model 1 (age, social status)</th>
<th>Model 2 (Model 1 + parental sports)</th>
<th>Model 3 (Model 2 + environmental factors)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age group</strong></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>3-6 years</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>7-10 years</td>
<td>2.62 (2.09-3.29)</td>
<td>2.71 (2.14-3.43)</td>
<td>2.64 (2.08-3.36)</td>
<td>2.72 (2.13-3.47)</td>
</tr>
<tr>
<td>11-13 years</td>
<td>2.55 (1.98-3.29)</td>
<td>2.70 (2.08-3.49)</td>
<td>2.56 (1.97-3.34)</td>
<td>2.58 (1.95-3.40)</td>
</tr>
<tr>
<td>14-17 years</td>
<td>1.33 (1.08-1.63)</td>
<td>1.50 (1.22-1.86)</td>
<td>1.37 (1.09-1.72)</td>
<td>1.39 (1.11-1.75)</td>
</tr>
<tr>
<td><strong>Socioeconomic status</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Medium</td>
<td>2.25 (1.76-2.87)</td>
<td>2.29 (1.79-2.91)</td>
<td>1.96 (1.51-2.54)</td>
<td>1.91 (1.46-2.49)</td>
</tr>
<tr>
<td>High</td>
<td>4.13 (3.06-5.58)</td>
<td>4.26 (3.14-5.78)</td>
<td>3.08 (2.23-4.26)</td>
<td>3.11 (2.24-4.31)</td>
</tr>
<tr>
<td><strong>Sports participation of the mother</strong></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>&lt;1 hour per week</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>≥1 hour per week</td>
<td>2.48 (2.10-2.93)</td>
<td>1.92 (1.60-2.31)</td>
<td>1.89 (1.57-2.28)</td>
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<tr>
<td><strong>Sports participation of the father</strong></td>
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<td></td>
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</tr>
<tr>
<td>&lt;1 hour per week</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
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<tr>
<td>≥1 hour per week</td>
<td>2.01 (1.70-2.37)</td>
<td>1.42 (1.16-1.73)</td>
<td>1.41 (1.14-1.74)</td>
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<tr>
<td><strong>Sports ground nearby</strong></td>
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<td>No</td>
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<tr>
<td>Yes</td>
<td>1.47 (1.20-1.80)</td>
<td></td>
<td>1.36 (1.08-1.70)</td>
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<tr>
<td><strong>Swimming pool nearby</strong></td>
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<tr>
<td>No</td>
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<tr>
<td>Yes</td>
<td>1.14 (0.96-1.35)</td>
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<td>0.97 (0.80-1.18)</td>
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<tr>
<td><strong>Park/green space nearby</strong></td>
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<tr>
<td>Yes</td>
<td>0.97 (0.79-1.20)</td>
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<td>0.79 (0.62-1.00)</td>
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</tbody>
</table>

OR = odds ratio, CI = confidence interval
The results of the logistic regression analysis described below are presented in Table 2a and Table 2b where they are arranged according to gender due to the significant differences that were identified between girls and boys. The odds ratios (OR) in the tables indicate the factor by which the odds of sports participation for they participated in sports. Mothers of 11- to 17-year-old girls and boys report more frequently that they participated in sports than mothers of 3- to 10-year-olds. In addition, parents of 11- to 17-year-olds indicate more often than parents of 3- to 10-year-olds that their child has easy access to a sports field, swimming pool or park/green space.

**Table 2b**

<table>
<thead>
<tr>
<th></th>
<th>Boys' sports participation</th>
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<td></td>
<td>Bivariate relationships</td>
<td>Model 1 (age, social status)</td>
<td>Model 2 (Model 1 + parental sports)</td>
<td>Model 3 (Model 2 + environmental factors)</td>
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<td></td>
<td>OR (95% CI)</td>
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<td>OR (95% CI)</td>
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<tr>
<td><strong>Age group</strong></td>
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<tr>
<td>3-6 years</td>
<td>1.00 (1.00)</td>
<td>1.00 (1.00)</td>
<td>1.00 (1.00)</td>
<td>1.00 (1.00)</td>
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<tr>
<td>7-10 years</td>
<td>3.37 (2.67-4.24)</td>
<td>3.62 (2.88-4.56)</td>
<td>3.61 (2.86-4.56)</td>
<td>3.49 (2.76-4.41)</td>
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<tr>
<td>11-13 years</td>
<td>3.47 (2.62-4.61)</td>
<td>3.66 (2.74-4.89)</td>
<td>3.59 (2.67-4.82)</td>
<td>3.28 (2.43-4.44)</td>
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<tr>
<td>14-17 years</td>
<td>2.40 (1.89-3.05)</td>
<td>2.64 (2.07-3.36)</td>
<td>2.47 (1.95-3.14)</td>
<td>2.22 (1.74-2.84)</td>
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<tr>
<td><strong>Socioeconomic status</strong></td>
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<tr>
<td>Low</td>
<td>1.00 (1.00)</td>
<td>1.00 (1.00)</td>
<td>1.00 (1.00)</td>
<td>1.00 (1.00)</td>
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</tr>
<tr>
<td>Medium</td>
<td>1.77 (1.39-2.26)</td>
<td>1.94 (1.50-2.52)</td>
<td>1.69 (1.31-2.19)</td>
<td>1.65 (1.26-2.15)</td>
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<tr>
<td>High</td>
<td>2.87 (2.10-3.91)</td>
<td>3.33 (2.44-4.55)</td>
<td>2.49 (1.82-3.41)</td>
<td>2.44 (1.79-3.32)</td>
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</tr>
<tr>
<td><strong>Sports participation of the mother</strong></td>
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<tr>
<td>&lt;1 hour per week</td>
<td>1.00 (1.00)</td>
<td>1.00 (1.00)</td>
<td>1.00 (1.00)</td>
<td>1.00 (1.00)</td>
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<td></td>
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<tr>
<td>≥1 hour per week</td>
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<td>1.55 (1.28-1.87)</td>
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<td><strong>Sports participation of the father</strong></td>
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<tr>
<td>&lt;1 hour per week</td>
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<tr>
<td>≥1 hour per week</td>
<td>2.15 (1.79-2.57)</td>
<td>1.70 (1.39-2.08)</td>
<td>1.69 (1.39-2.06)</td>
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<td><strong>Sports ground nearby</strong></td>
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<tr>
<td>No</td>
<td>1.00 (1.00)</td>
<td>1.00 (1.00)</td>
<td>1.00 (1.00)</td>
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<tr>
<td><strong>Swimming pool nearby</strong></td>
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</tr>
<tr>
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<td>1.00 (1.00)</td>
<td>1.00 (1.00)</td>
<td>1.00 (1.00)</td>
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</tr>
<tr>
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<td>1.40 (1.17-1.68)</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Park/green space nearby</strong></td>
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<tr>
<td>No</td>
<td>1.00 (1.00)</td>
<td>1.00 (1.00)</td>
<td>1.00 (1.00)</td>
<td>1.00 (1.00)</td>
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</tr>
</tbody>
</table>

OR = odds ratio; CI = confidence interval
a selected group is higher or lower compared to the reference category (no sports).

Individual factors
There is a positive relationship between sports participation and age as well as between sports participation and socioeconomic status among girls and boys. There is a stronger correlation between sports participation and age among boys than among girls. In contrast, among girls the relationship with an intermediate or high socioeconomic status and sports participation was stronger than among boys. The relationship between individual factors and sports participation remains significant in the multivariate models, but these are weaker than found for the bivariate models.

Interpersonal factors
Parental sports participation is associated with children’s sports participation. Girls and boys whose mothers or fathers participated in sports for at least one hour per week are twice as likely to participate in sports than girls and boys whose mothers or fathers participated in sports for less than one hour per week. The relationship remains significant even in the multivariate analyses (Models 2 and 3), but the relationship is weaker in these cases.

Environmental factors
There is a positive correlation between an easily accessible sports field and sports participation among girls and boys. The correlation remains significant in the multivariate model even after adjusting for age, socioeconomic status and parental sports participation (Model 3); however, it is weaker in this case. An easily accessible swimming pool as well as an easily accessible park/green space are only associated with sports participation among boys. However, no significant relationship was found when the models were applied in this case.

3.2 Nutrition
Table 3 sets out exemplary data about nutrition for the daily intake of certain food groups that contain high levels of sugar (sugary drinks, confectionery and sweet spreads) as well as for other food groups that are indicative of a more healthier lifestyle (water, fruit and vegetables).

Sugary drinks
On average, 3- to 17-year-olds drink more than half a litre of sugary drinks per day. However, the figures are significantly lower for girls aged between 3 and 10 (454ml per day) compared to 11- to 17-year-old girls (569ml per day). Nevertheless, the corresponding estimates for boys aged between 3 and 10-years-of-age (568ml per day), and for those aged between 11 and 17 (708ml per day) are significantly higher than for girls. In comparison to the results from the KiGGS baseline study, the average daily consumption of these drinks has fallen by about one quarter; these changes are statistically significant for all of the age and gender groups shown in Table 3.

Confectionery
On average, 3- to 17-year-olds consume 68.9 grams of Confectionery per day. 3- to 10-year-old girls are...
### Table 3
Mean values for daily amounts of foods with 95% confidence intervals for 3- to 17-year-olds according to gender and age (KiGGS baseline study n=6,918 girls, n=7,186 boys; KiGGS Wave 2 n=6,568 girls, n=6,466 boys)

<table>
<thead>
<tr>
<th>Gender/age group</th>
<th>Indicator (unit of measure)</th>
<th>KiGGS baseline study</th>
<th>KiGGS Wave 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AV</td>
<td>95% CI</td>
<td>AV</td>
</tr>
<tr>
<td><strong>Girls</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sugary drinks (ml)</td>
<td>704.8</td>
<td>(670.4-739.1)</td>
</tr>
<tr>
<td></td>
<td>Confectionery (g)</td>
<td>85.2</td>
<td>(80.7-89.7)</td>
</tr>
<tr>
<td></td>
<td>Sweet spreads (g)</td>
<td>10.3</td>
<td>(9.9-10.8)</td>
</tr>
<tr>
<td></td>
<td>Drinking water (ml)</td>
<td>874.5</td>
<td>(830.0-918.9)</td>
</tr>
<tr>
<td></td>
<td>Fruit (g)</td>
<td>242.4</td>
<td>(231.2-253.5)</td>
</tr>
<tr>
<td></td>
<td>Vegetables (g)</td>
<td>129.8</td>
<td>(125.3-134.2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Boys</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sugary drinks (ml)</td>
<td>843.4</td>
<td>(804.1-882.7)</td>
</tr>
<tr>
<td></td>
<td>Confectionery (g)</td>
<td>95.2</td>
<td>(91.2-99.2)</td>
</tr>
<tr>
<td></td>
<td>Sweet spreads (g)</td>
<td>12.3</td>
<td>(11.8-12.9)</td>
</tr>
<tr>
<td></td>
<td>Drinking water (ml)</td>
<td>816.1</td>
<td>(776.0-856.3)</td>
</tr>
<tr>
<td></td>
<td>Fruit (g)</td>
<td>203.9</td>
<td>(195.2-212.6)</td>
</tr>
<tr>
<td></td>
<td>Vegetables (g)</td>
<td>119.7</td>
<td>(116.1-123.4)</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sugary drinks (ml)</td>
<td>775.7</td>
<td>(746.4-805.1)</td>
</tr>
<tr>
<td></td>
<td>Confectionery (g)</td>
<td>90.3</td>
<td>(86.7-93.9)</td>
</tr>
<tr>
<td></td>
<td>Sweet spreads (g)</td>
<td>11.3</td>
<td>(10.9-11.7)</td>
</tr>
<tr>
<td></td>
<td>Drinking water (ml)</td>
<td>844.6</td>
<td>(810.4-878.7)</td>
</tr>
<tr>
<td></td>
<td>Fruit (g)</td>
<td>222.7</td>
<td>(214.9-230.4)</td>
</tr>
<tr>
<td></td>
<td>Vegetables (g)</td>
<td>124.6</td>
<td>(121.7-127.6)</td>
</tr>
<tr>
<td></td>
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<td></td>
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</tr>
<tr>
<td><strong>Girls, 3-10 years</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sugary drinks (ml)</td>
<td>626.1</td>
<td>(585.6-666.7)</td>
</tr>
<tr>
<td></td>
<td>Confectionery (g)</td>
<td>75.4</td>
<td>(70.7-80.1)</td>
</tr>
<tr>
<td></td>
<td>Sweet spreads (g)</td>
<td>9.9</td>
<td>(9.3-10.5)</td>
</tr>
<tr>
<td></td>
<td>Drinking water (ml)</td>
<td>649.2</td>
<td>(601.0-697.3)</td>
</tr>
<tr>
<td></td>
<td>Fruit (g)</td>
<td>234.7</td>
<td>(223.0-246.4)</td>
</tr>
<tr>
<td></td>
<td>Vegetables (g)</td>
<td>115.0</td>
<td>(110.0-120.0)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Girls, 11-17 years</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sugary drinks (ml)</td>
<td>780.1</td>
<td>(731.0-829.2)</td>
</tr>
<tr>
<td></td>
<td>Confectionery (g)</td>
<td>94.6</td>
<td>(88.3-100.8)</td>
</tr>
<tr>
<td></td>
<td>Sweet spreads (g)</td>
<td>10.7</td>
<td>(10.1-11.3)</td>
</tr>
<tr>
<td></td>
<td>Drinking water (ml)</td>
<td>1,089.8</td>
<td>(1,025.5-1,154.2)</td>
</tr>
<tr>
<td></td>
<td>Fruit (g)</td>
<td>249.7</td>
<td>(233.4-266.1)</td>
</tr>
<tr>
<td></td>
<td>Vegetables (g)</td>
<td>143.9</td>
<td>(137.1-150.7)</td>
</tr>
</tbody>
</table>

Continued on next page
Girls have healthier diets than boys, and 3- to 10-year-olds eat healthier than 11- to 17-year-olds.

Table 3 Continued
Mean values for daily amounts of foods with 95% confidence intervals for 3- to 17-year-olds according to gender and age (KiGGS baseline study n=6,918 girls, n=7,186 boys; KiGGS Wave 2 n=6,568 girls, n=6,466 boys)

Girls have healthier diets than boys, and 3- to 10-year-olds eat healthier than 11- to 17-year-olds.

Estimated to eat a significantly lower amount (60.6g per day) compared to 11- to 17-year-old girls (73.1g per day). Boys aged between 3 and 10 years of age consume significantly more confectionery (68.4g per day) than girls of the same age. 11- to 17-year-old boys eat 74.1 grams per day, which is almost the same as the amount consumed by girls of this age. The reports from young people demonstrate that they are consuming significantly lower amounts of confectionery compared to the period during which the KiGGS baseline study was conducted. Depending on gender and age group, this rate has fallen as much as 20% to 30% and is statistically significant.

Sweet spreads
On average, 3- to 17-year-olds eat 12.2 grams of sweet spreads per day. 3- to 10-year-old girls are estimated to consume significantly less at 10.6 grams per day compared to 11- to 17-year-old girls (12.3g per day). 3- to 10-year-old boys eat about the same amount as girls of the same age (11.3g per day), whereas boys aged between 11 and 17 consume 14.8g per day, which is significantly more than girls of the same age and younger boys. The mean values are similar to those identified by the KiGGS baseline study.

Water
3- to 17-year-olds tend to drink an average of almost one and a half litres of water per day. However, girls aged between 3 and 10 drink significantly less (1.246ml per day) than 11- to 17-year-old girls (1.665ml per day). Boys drink a similar amount of water as girls, with boys aged between 3 and 10 drinking 1.273 millilitres per day and...
11- to 17-year-olds drinking 1,527 millilitres per day. Compared to the KiGGS baseline study, mean daily water consumption has increased greatly. Depending on age and gender, water consumption has increased significantly by between 50% and 90%.

**Fruit**

On average, 3- to 17-year-olds eat 252 grams of fruit per day. 3- to 10-year-old girls eat a significantly greater amount (286g per day) than 11- to 17-year-old girls (252g per day). 3- to 10-year-old boys consume slightly less than girls of the same age at 267 grams per day. However, 11- to 17-year-old boys eat much less fruit at 199 grams per day than girls of the same age and younger boys; this constitutes a significant difference. Young people aged between 3 and 10 currently eat significantly greater levels of fruit compared to the figures identified by the KiGGS baseline study. Nevertheless, the quantities eaten by older girls and boys have hardly changed.

**Vegetables**

On average, 3- to 17-year-olds consume 125 grams of vegetables per day. 3- to 10-year-old girls eat slightly more (142g per day) than 11- to 17-year-old girls (129g per day), although this difference is not significant. Boys aged

<table>
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<th>Gender/age group</th>
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<th>KiGGS Wave 2</th>
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<tbody>
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<td></td>
<td>% (95% CI)</td>
<td>% (95% CI)</td>
</tr>
<tr>
<td>Girls, 3-17 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;1 Portion</td>
<td>9.9 (8.9-10.9)</td>
<td>11.2 (10.2-12.3)</td>
</tr>
<tr>
<td>1-&lt;3 Portion</td>
<td>53.5 (51.7-55.4)</td>
<td>50.9 (49.3-52.5)</td>
</tr>
<tr>
<td>3-&lt;5 Portion</td>
<td>22.9 (21.6-24.2)</td>
<td>22.2 (21.0-23.6)</td>
</tr>
<tr>
<td>≥5 Portion</td>
<td>13.7 (12.7-14.9)</td>
<td>15.7 (14.6-16.8)</td>
</tr>
<tr>
<td>Boys, 3-17 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;1 Portion</td>
<td>12.8 (11.8-13.8)</td>
<td>15.1 (13.9-16.4)</td>
</tr>
<tr>
<td>1-&lt;3 Portion</td>
<td>55.1 (53.5-56.6)</td>
<td>51.7 (50.2-53.3)</td>
</tr>
<tr>
<td>3-&lt;5 Portion</td>
<td>21.3 (20.2-22.5)</td>
<td>20.6 (19.3-21.9)</td>
</tr>
<tr>
<td>≥5 Portion</td>
<td>10.9 (10.0-11.9)</td>
<td>12.6 (11.4-13.8)</td>
</tr>
<tr>
<td>Total, 3-17 years</td>
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</tr>
<tr>
<td>&lt;1 Portion</td>
<td>11.3 (10.6-12.1)</td>
<td>13.2 (12.4-14.0)</td>
</tr>
<tr>
<td>1-&lt;3 Portion</td>
<td>54.3 (53.1-55.6)</td>
<td>51.3 (50.3-52.4)</td>
</tr>
<tr>
<td>3-&lt;5 Portion</td>
<td>22.1 (21.2-23.0)</td>
<td>21.4 (20.4-22.4)</td>
</tr>
<tr>
<td>≥5 Portion</td>
<td>12.3 (11.5-13.1)</td>
<td>14.1 (13.3-15.0)</td>
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</table>

CI=confidence interval

<table>
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<th>KiGGS Wave 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% (95% CI)</td>
<td>% (95% CI)</td>
</tr>
<tr>
<td>Girls, 3-10 years</td>
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<td></td>
</tr>
<tr>
<td>&lt;1 Portion</td>
<td>8.4 (7.3-9.6)</td>
<td>7.3 (6.3-8.5)</td>
</tr>
<tr>
<td>1-&lt;3 Portion</td>
<td>57.0 (54.9-59.0)</td>
<td>50.7 (48.5-52.8)</td>
</tr>
<tr>
<td>3-&lt;5 Portion</td>
<td>22.8 (21.0-24.6)</td>
<td>24.9 (23.0-26.8)</td>
</tr>
<tr>
<td>≥5 Portion</td>
<td>11.9 (10.7-13.2)</td>
<td>17.2 (15.6-19.0)</td>
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<tr>
<td>Girls, 11-17 years</td>
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<td></td>
</tr>
<tr>
<td>&lt;1 Portion</td>
<td>11.3 (9.9-12.8)</td>
<td>15.5 (13.8-17.4)</td>
</tr>
<tr>
<td>1-&lt;3 Portion</td>
<td>50.3 (47.8-52.8)</td>
<td>51.2 (48.7-53.7)</td>
</tr>
<tr>
<td>3-&lt;5 Portion</td>
<td>23.0 (21.2-24.8)</td>
<td>19.3 (17.5-21.3)</td>
</tr>
<tr>
<td>≥5 Portion</td>
<td>15.5 (14.0-17.1)</td>
<td>14.0 (12.4-15.7)</td>
</tr>
<tr>
<td>Boys, 3-10 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;1 Portion</td>
<td>9.3 (8.1-10.6)</td>
<td>8.5 (7.3-10.0)</td>
</tr>
<tr>
<td>1-&lt;3 Portion</td>
<td>57.0 (55.0-58.9)</td>
<td>51.3 (49.1-53.5)</td>
</tr>
<tr>
<td>3-&lt;5 Portion</td>
<td>21.9 (20.3-23.6)</td>
<td>24.6 (22.7-26.7)</td>
</tr>
<tr>
<td>≥5 Portion</td>
<td>11.8 (10.6-13.2)</td>
<td>15.5 (14.0-17.2)</td>
</tr>
<tr>
<td>Boys, 11-17 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;1 Portion</td>
<td>16.2 (14.7-17.7)</td>
<td>22.5 (20.5-24.6)</td>
</tr>
<tr>
<td>1-&lt;3 Portion</td>
<td>53.2 (51.1-55.4)</td>
<td>52.2 (49.9-54.6)</td>
</tr>
<tr>
<td>3-&lt;5 Portion</td>
<td>20.7 (19.0-22.5)</td>
<td>16.0 (14.4-17.8)</td>
</tr>
<tr>
<td>≥5 Portion</td>
<td>9.9 (8.8-11.2)</td>
<td>9.3 (7.9-10.9)</td>
</tr>
</tbody>
</table>

CI=confidence interval
between 3 and 10 consume slightly less vegetables (127g per day) than girls of the same age; boys aged between 11 and 17 eat 102 grams per day of vegetables, which is significantly less than girls of the same age and younger boys. Compared with the KiGGS baseline study, the quantities of vegetables consumed by girls and boys aged between 3 and 10 years of age have increased significantly. In contrast, girls and boys aged between 11 and 17 currently eat significantly less vegetables.

The number of portions of fruit or vegetables eaten per day between 3 and 10: eat less than one portion of fruit or vegetables per day; 51.3% eat between one and three portions, 21.4% eat between three and five, and 14.1% meet the recommendations made by the '5 a day' campaign and eat five or more portions of fruit and vegetables per day (Table 4). The proportion of young people who eat five or more portions of fruit and vegetables per day is relatively similar across all age groups: 17.2% of 3- to 10-year-old girls, 14.0% of 11- to 17-year-old girls and 15.5% of 3- to 10 year-old boys meet the recommendations. The proportion is only significantly lower among 11- to 17-year-old boys at 9.3%. The proportion of 3- to 10-year-olds that eats five or more portions of fruit and vegetables per day has increased significantly compared to the figures from the KiGGS baseline study. Nevertheless, the proportion of 11- to 17-year-olds that does so has remained roughly the same.

4. Discussion

The results provide an overview of selected indicators that can influence the balance between energy intake and energy use, and, thus, can affect the onset or course of obesity.

The results for sports behaviour show that more than 70% of children and adolescents state that they participated in sports; boys do so more often than girls, and older children do so more often than younger children. Moreover, various individual, interpersonal and environmental factors are related to sports behaviour in children and adolescents. Younger age, male gender and a high socioeconomic status are associated with sports participation in childhood and adolescence. Parental sports participation is also positively associated with sports participation among children and adolescents. The living environment – particularly an easily accessible sports field – also seems to have a positive influence on sports participation, regardless of socioeconomic status.

However, when interpreting the results it is important to remember that sports participation in KiGGS Wave 2 refer to all kinds of sports practiced by 3- to 17-year-olds in their leisure time, regardless of whether the participation was part of a sports club or not. Overall, the results presented here on sports behaviour are comparable with those from the Health Behaviour in School-aged Children (HBSC) study [29, 30] and are in line with the statistics collected by the German Olympic Sports Confederation [31]. However, the prevalence related to sport behaviour identified by the HBSC and KiGGS studies cannot be compared exactly as they used different indicators. For
KiGGS Wave 2 (2014-2017) is problematic as changes were made to the method used to query information. Within the concept of physical activity, a slight decline was identified among 3- to 10-year-old girls in terms of moderate to vigorous physical activity that lasted for at least 60 minutes per day between KiGGS Wave 1 (2009-2012) and KiGGS Wave 2 (2014-2017) [10]. Between 2002 and 2014, the results of the HBSC study of 11-, 13- and 15-year-olds show that physical activity has increased, and this includes at least 60 minutes of moderate to vigorous physical activity per day. However, the level is significantly lower among 15-year-old girls than for boys of this age and children in other age groups [39].

The HBSC study also shows an increase in very intense physical activity undertaken at least four times a week among both girls and boys [39]. The Motorik-Module (MoMo), which gathers data using in-depth questions about physical activity and sports from a sub-sample of the KiGGS study, also identified a decline in sports activity conducted outside a sports club and an increase in sports activity undertaken within sports clubs between the MoMo baseline study (2003-2006) and MoMo Wave 1 (2009-2012) [40].

Several food groups were selected for evaluation using the data collected on food consumption for KiGGS Wave 2. These foods are at the focus of health policy debates in terms of the prevention of obesity. On the one hand, they include sugary drinks, confectionery and sweet spreads, all of which are conducive to the development of obesity when consumed in high quantities; on the other, they include water, fruit and vegetables, which are associated with reduced obesity. The

example, the HBSC study focused on sports participation that lasted for at least two hours per week (the children were expected to be out of breath or begin to sweat), whereas KiGGS Wave 2 asked whether the children participated in sports (‘Yes’ or ‘No’) and focused on sports participation that lasted for at least 90 minutes per week as well as for at least 180 minutes per week.

Other studies have also demonstrated the relationships identified here between interpersonal factors in the form of parental sports participation [32-34] and between environmental factors and sports participation in children [8, 35]. In terms of environmental factors, the question remains as to whether parents or children who frequently use their local environment for activities may be more likely to answer affirmatively about accessible play and sports facilities (such as a sports field, park/green space and swimming pool) as parents who are rarely or never active (with their child) in the local area. A cross-sectional study of the relationship between subjective and objective data on the local environment and sports behaviour found that the subjective parental assessment of the local environment is more strongly associated with their sports participation than the objective results about the local area [36]. As such, the issue of the local environment also depends on whether the parks, green spaces, swimming pools and sports fields that are viewed as easily accessible are actually used for sports activities, as well as the distance to these facilities, and on the parents’ opinions on the quality of footpaths, cycle lanes and road safety [38].

A comparison of trends in terms of sports behaviour between the KiGGS baseline study (2003-2006) and KiGGS Wave 2 (2014-2017) is problematic as changes were made to the method used to query information. Within the concept of physical activity, a slight decline was identified among 3- to 10-year-old girls in terms of moderate to vigorous physical activity that lasted for at least 60 minutes per day between KiGGS Wave 1 (2009-2012) and KiGGS Wave 2 (2014-2017) [10]. Between 2002 and 2014, the results of the HBSC study of 11-, 13- and 15-year-olds show that physical activity has increased, and this includes at least 60 minutes of moderate to vigorous physical activity per day. However, the level is significantly lower among 15-year-old girls than for boys of this age and children in other age groups [39]. The HBSC study also shows an increase in very intense physical activity undertaken at least four times a week among both girls and boys [39]. The Motorik-Module (MoMo), which gathers data using in-depth questions about physical activity and sports from a sub-sample of the KiGGS study, also identified a decline in sports activity conducted outside a sports club and an increase in sports activity undertaken within sports clubs between the MoMo baseline study (2003-2006) and MoMo Wave 1 (2009-2012) [40].

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Since the ways in which data was collected about food by the KiGGS baseline study and KiGGS Wave 2 were very similar, results can be presented on developments over time. The presentation of the findings focuses on averages, as this simplifies comparison with other sets of results. However, this does not always do justice to the spread of the data. The average consumption of water in KiGGS Wave 2, for example, is relatively high, partly because a large group of children and adolescents reported very high values. The median amounts of water that the respondents drink are significantly lower, but this also applies to the KiGGS baseline study. The increase in water consumption coincides with an increase in per capita consumption of mineral water, which has increased from 138.1 litres in 2008 to 151.9 litres in 2015 [42]. The decrease in per capita consumption of fizzy drinks (82.9 litres in 2012, 78.2 litres in 2016 [41]) and fruit juices (37.4 litres in 2008, 33.0 litres in 2015 [42]) also fits well with the reduction in the consumption of sugary drinks observed in KiGGS. However, these figures refer to the entire population and may not necessarily match the trends in consumption among children and adolescents. Despite this, the HBSC study of 11-, 13- and 15-year-olds in Germany identified a reduction in the daily consumption of soft drinks between 2002 and 2014 [43]. The figures for chocolates, cocoa-containing spreads, confectionery and pastry products have hardly changed between 2007 and 2014. The per capita consumption of vegetables has increased from 86.4 kg per year in 2005/2006 to 98.6 kg per year in 2014/2015. However, it has fallen for fruit from 78.6 kg per year in 2005/2006 to 66.5 kg per year in 2014/2015 [42]. Therefore, the findings

results of the indicators on dietary behaviour suggest that younger children and girls drink fewer sugary drinks and eat less confectionery and sweet spreads, as well as greater amounts of fruit and vegetables than older children and boys. However, the results point to different trends. Whereas the consumption of confectionery and sugary drinks has declined significantly among 3- to 17-year-olds since the KiGGS baseline study was conducted, 11- to 17-year-olds, in particular, now eat significantly less vegetables compared to about ten years ago. The proportion of girls and boys who meet the recommendation of the German Nutrition Society to eat at least five portions of fruit and vegetables per day has increased significantly among 3- to 10-year-olds over the last ten years, but the proportion of those who reach this recommendation remains very low at 14%.

When interpreting the results, it is important to consider that the results from the food questionnaire can only provide rough descriptions of the foods that were eaten compared to data collected by more extensive surveys of nutrition, and, therefore, that the estimated quantities only represent rough indicators of patterns of consumption. For example, chocolate drinks and other mixed milk drinks also contain sugar, but questions about them were posed as part of the food group ‘milk’. As such, these drinks are not displayed separately in the tables and are not considered here. In addition, although the market share of flavoured water is currently relatively small [41], some of these products contain a substantial amount of sugar. The respondents probably also classified these drinks as water when answering the questionnaire.
Sports and dietary behaviour among children and adolescents in Germany

only coincide with the results of KiGGS Wave 2 with regard to vegetable consumption by 3- to 10-year-olds. The levels estimated for 3- to 10-year-olds are lower than those for 11- to 17-year-olds due to the lower energy and nutritional needs of younger children. It is striking however, that the estimated daily amount of fruit eaten by 3- to 10-year-olds is slightly higher than the level estimated for 11- to 17-year-olds. This could be due to the fact that the parents of 3- to 10-year-olds completed the questionnaire and may have been more likely to provide socially desirable responses. It could also be due to the fact that consumption actually decreases during adolescence.

Within the objective ‘Grow up healthy’ of the German national health targets (www.gesundheitsziele.de) there is a focus on life skills, exercise and nutrition [44]. Patterns of behaviour develop early in life and are difficult to change. As such, parents acting as role models, behaviour in the family and peer group as well as in the living environment (settings) in which children and adolescents grow up can have a very early positive effect on health-related behaviour. Physically active children often become physically active adults [45]. Dietary habits have also been observed to persist into adulthood [46-47]. In addition to individual behaviour, research is increasingly focusing on the importance and consideration of issues such as environmental factors on physical activity, diet and obesity [48]. They also need to be taken into account as an integral part of the implementation of policy measures. Legislative approaches, such as providing better access to healthy food (for example, through tax reforms) and designing settings which promote good health especially for socially disadvantaged children (such as through the physical activity friendly design of areas where socially disadvantaged people live), are also required [1]. As part of an early approach to intervention, healthy eating, physical activity and sports need to be anchored in school curricula and local environments, and opportunities need to be developed that encourage children to eat healthier foods and be active every day [49]. This means that teachers and educators also need to receive support when implementing activities that promote good health and parents also require help to motivate their children to become more active, less sedentary and to eat a balanced diet. A combination of measures, therefore, needs to be put in place if children and adolescents are to meet the national recommendations on physical activity and healthy eating.

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Please cite this publication as
Data protection and ethics
KiGGS Wave 2 is subject to strict compliance with the data protection provisions set out in the Federal Data Protection Act. Hannover Medical School's ethics committee assessed the ethics of the study and provided its approval (No. 2275-2014). Participation in the study was voluntary. The participants and/or their parents/legal guardians were also informed about the aims and contents of the study, and about data protection. Informed consent was obtained in writing.

Funding
KiGGS is funded by the Federal Ministry of Health and the Robert Koch Institute.

Conflicts of interest
The authors declared no conflicts of interest.

Acknowledgement
Foremost we would like to express our gratitude to both the participants and their parents. We would also like to thank everyone at the 167 study sites who provided us with space and active support on site.

KiGGS Wave 2 could not have been conducted without the dedication of numerous colleagues at the Robert Koch Institute. We would especially like to thank the study teams for their excellent work and their exceptional commitment during the three-year data collection phase.

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Sports and dietary behaviour among children and adolescents in Germany


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Sports and dietary behaviour among children and adolescents in Germany


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Imprint

Journal of Health Monitoring

Publisher
Robert Koch Institute
Nordufer 20
D-13353 Berlin, Germany

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ISSN 2511-2708

Note
External contributions do not necessarily reflect the opinions of the
Robert Koch Institute.

The Robert Koch Institute is a Federal Institute within
the portfolio of the German Federal Ministry of Health
Tobacco and alcohol use among 11- to 17-year-olds in Germany.
Results of the cross-sectional KiGGS Wave 2 study and trends

Abstract
Tobacco and alcohol use are among the leading preventable risk factors associated with premature mortality and a variety of diseases that have long-term effects. Although tobacco and alcohol use among adults is widespread in Germany, there is a trend towards lower levels of consumption. The foundations for health-related behaviour in adulthood are set at an early age: young people who use alcohol and tobacco also tend to do so regularly when they reach adulthood. With this in mind, health policies should focus on preventing young people from smoking, and encouraging them to adopt a responsible, low-risk approach to alcohol. This article analyses patterns of tobacco and alcohol use among children and adolescents (aged between 11 and 17 years). It describes the prevalences of tobacco and alcohol use, as well as trends and correlates. The data used in this article was sourced from the second follow-up to the German Health Interview and Examination Survey for Children and Adolescents (KiGGS Wave 2). The survey’s results show that 7.2% of 11- to 17-year-old children and adolescents smoke at least occasionally, with 3.7% doing so daily. The survey also demonstrates that a good half (51.0%) of 11- to 17-year-olds have ever drunk alcohol; at-risk drinking was prevalent among 12.1%, and heavy episodic drinking among 7.0%. The consumption of tobacco and alcohol increases considerably with age. Patterns of at-risk drinking and heavy episodic drinking show gender-associated differences: While more girls than boys practice at-risk drinking, more boys than girls practice heavy episodic drinking. Nevertheless, the KiGGS survey waves demonstrate a highly significant trend towards a decline in tobacco use (KiGGS baseline study 21.4%, KiGGS Wave 1 12.4%). The proportion of 11- to 17-year-olds who have ever drunk alcohol is also declining (KiGGS baseline study 63.9%, KiGGS Wave 1 55.6%). The proportions of at-risk drinking (KiGGS Wave 1 16.5%) and heavy episodic drinking (KiGGS Wave 1 12.0%) decreased as well. The results presented here are in line with findings from other studies that have surveyed adolescent tobacco and alcohol use in Germany, and they underscore the success of preventive measures.
1. Introduction

Tobacco and alcohol consumption are among the leading preventable risk factors associated with disease and premature death [1, 2]. It is a well-known fact that even low doses of tobacco smoke are harmful [3, 4]. Furthermore, nicotine found in tobacco is highly addictive [3]. A number of illnesses, including cardiovascular, respiratory diseases and cancer, are linked to smoking and exposure to passive smoking. In 2013, around 121,000 people died in Germany as a result of smoking; this corresponds to 13.5% of all deaths or one in every seven deaths [5].

Alcohol plays a role in the development of over 200 diseases [6]. Every year, around 14,000 deaths in Germany are entirely attributable to alcohol. Alcohol-related deaths are mainly recorded as ‘alcoholic liver disease’ and ‘mental and behavioural disorders due to use of alcohol’ [7]. Alcohol produces physical and mental reactions that occur during and after consumption [6]. Depending on the concentration of alcohol in the blood, these can lead to short- or long-term physical, mental and societal damage. As such, alcohol affects not only those who consume it, but also other people due to psychological stress, alcohol-related accidents, aggressive behaviour and harm to unborn children. Alcohol can also damage society by placing burdens on the health system and by causing loss of productivity [8]. Finally, a very high level of alcohol in the blood can lead to intoxication, and this can be fatal. A blood-alcohol level of 0.5 mg per millilitre can cause children and adolescents to lose consciousness [6].

Research into adolescent health-related behaviour has identified various individual and societal factors that influence their tobacco and alcohol consumption [9-11]. In addition to age, gender and education (the type of school that a person attends or attended), these specifically include their parents’ and peers’ alcohol- and tobacco-related attitudes and behaviour [12].

Adolescence is a sensitive stage in life, and it is during this time that the foundations are laid for patterns of health-related behaviour in later life. Adolescents often attempt to distance themselves from family or school norms; try out their own behaviour, cross borders and take risks. During this period, their peers become increasingly important (even more important than their parents), and this affects their behaviour, including in terms of their (excessive) use of alcohol or tobacco.

Studies have shown that early use of alcohol or tobacco can encourage regular use in later life [13-15]. The longitudinal analyses of the KiGGS cohort demonstrate that a high proportion of children and adolescents who smoke continue to do so into young adulthood [16]. In a society where alcohol and tobacco use is relatively widespread (despite a trend towards a reduction) [17-19], it is important to encourage young people to develop a responsible, low-risk approach to alcohol. Similarly, young people need to be prevented from starting to smoke wherever possible and those who have already begun to smoke should be encouraged to quit.

Due to the high public health relevance of these issues and the resulting need for action, the cooperation network gesundheitsziele.de has developed the national health targets ‘Reduce tobacco consumption’ [20, 21] and
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‘Reduce alcohol consumption’ [22]. Repeated epidemiological studies can be used to assess whether these goals have been achieved. In addition, regularly collected, representative data can provide information about the current situation and trends in tobacco and alcohol use among children and adolescents in Germany. The representative surveys undertaken by the Federal Centre for Health Education (BZgA) [23, 24], the international study Health Behaviour in School-Aged Children (HBSC), which is carried out with the support of the World Health Organization (WHO), [25] and the KiGGS study [26], provide significant sources of data that make this possible.

This article presents current, cross-sectional findings on the prevalence of smoking and alcohol use among children and adolescents from KiGGS Wave 2 and compares developments in tobacco and alcohol use with corresponding indicators from the KiGGS baseline study and KiGGS Wave 1. Finally, it includes an analysis of the relationships between current smoking, school type and smoking by parents and peers.

2. Methodology
2.1 Study design and study population

The KiGGS study is part of the health monitoring system undertaken at the Robert Koch Institute and includes repeated cross-sectional surveys of children and adolescents aged between 0 and 17 years that are representative for the German population (KiGGS cross-sectional study). The KiGGS baseline study (2003-2006) was carried out as an examination and interview survey; KiGGS Wave 1 was a telephone-based interview survey (2009-2012) and KiGGS Wave 2 (2014-2017) was a combined examination and interview survey. The concept behind KiGGS and its design have been described in detail elsewhere [27-30]. Participants were randomly selected for KiGGS Wave 2 from the population registries held by the 167 representative cities and municipalities that had been chosen for the baseline study. A variety of measures was used to improve participant numbers and sample composition [28, 31]. These include conducting phone calls or home visits to access hard-to-reach groups and to encourage them to participate.

A written questionnaire on child health for the parents and an additional written health questionnaire for children and adolescents aged 11 years or above were used with all of the participants. A total of 15,023 study subjects (7,538 girls, 7,485 boys) participated in KiGGS Wave 2 (response rate 40.1%). The analyses of tobacco and alcohol consumption are based on data from 6,599 participants (3,423 girls, 3,176 boys) aged between 11 and 17 years. Depending on the indicator used, a varying number of participants had to be excluded from the analyses due to missing values.

2.2 Indicators

Data was gathered about the smoking-related behaviour and alcohol consumption of 11- to 17-year-old girls and boys for KiGGS Wave 2 using a written questionnaire that was filled out by the respondents themselves. The questionnaire included the question: ‘Do you currently smoke?’ with the following answers: ‘No’, ‘Daily’, ‘Several times a week’, ‘Once a week’ or ‘Less (than once a
week’). In the analyses that follow, respondents who stated that they smoked (at all) are grouped together as ‘current smokers’. However, this group is also subdivided and the prevalences of tobacco use are reported for ‘regular smokers’ (those who smoke at least once a week) and ‘daily smokers’. ‘Regular smokers’ also includes young people who smoke daily. Young people who smoke were also asked: ‘How many cigarettes do you currently smoke?’

Data on the social and environmental factors associated with tobacco consumption by children and adolescents were gathered for KiGGS Wave 2 by asking the parents: ‘Which type of school does your child go to?’ with the following response categories ‘primary school (Grundschule)’, ‘secondary school (Hauptschule)’, ‘middle school (Realschule)’, ‘school with secondary and middle educational program (Schule mit Haupt- und Realschulbildungsgang)’, ‘integrated comprehensive school (Gesamtschule)’, ‘Academic secondary school (Gymnasium)’, ‘Technical secondary school (Fachober­schule)’, ‘special school’, ‘other’. In the analyses that follow, secondary schools were grouped dichotomously into ‘academic/technical secondary school’ and ‘Haupt/Real-/Gesamtschule’. In cases where a young person had already left school at the point when the survey was conducted, the highest level of education that she or he had achieved, was used for classification purposes.

In order to gather data on parental smoking-related behaviour, both parents were asked ‘Do you currently smoke?’ (response categories ‘Yes, daily’, ‘Yes, occasionally’, ‘No’). ‘Parental smoking’ was defined as having at least one parent who smoked occasionally or daily. Irrespective of the parents’ smoking-related behaviour, the parents were also asked whether people smoke in the flat in the presence of their child (response categories ‘Everyday’, ‘Several times a week’, ‘Once a week’, ‘Less often’, ‘Never’). ‘Never’ was categorised as ‘No’; all other responses were categorised as ‘Yes’.

The children and adolescents were asked about the smoking-related behaviour of their close friends: ‘Do friends who are important to you smoke?’ (response categories ‘Yes’ or ‘No’).

As data on smoking status was collected in a similar manner for the KiGGS baseline study, KiGGS Wave 1 and KiGGS Wave 2 [32], these data can be used to assess developments over time and for trend analyses.

Four questions were used to collect data on alcohol consumption. In order to assess the lifetime prevalence of alcohol consumption respondents were asked: ‘Have you ever drunk alcohol?’ (response categories ‘Yes’ or ‘No’). Respondents who answered ‘Yes’ were asked three follow-up questions of the brief alcohol screen AUDIT-C (Alcohol Use Disorders Identification Test-Consumption) in order to collect data on the levels of at-risk alcohol consumption and the distribution of heavy episodic drinking [33]. The first AUDIT-C question asks how often children and adolescents have a drink containing alcohol, such as a glass of wine, beer, mixers, spirits or liqueurs (response categories ‘Never’, ‘Monthly or less’, ‘2 to 4 times a month’, ‘2 to 3 times a week’, or ‘4 or more times a week’. These respondents were then asked the second question: ‘How many drinks containing alcohol do you have on a typical day when you are drinking?’ (response categories ‘1 to 2’, ‘3 to 4’, ‘5 to 6’, ‘7 to 9’, ‘10 or more alcoholic
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2.3 Statistical analysis

In the descriptive analysis of tobacco and alcohol use prevalences (frequencies) and mean values with 95% confidence intervals (95% CI) differentiated according to gender, age and survey period are calculated. Differences in socioeconomic status [35] are considered separately in the article Socioeconomic differences in the health behaviour of children and adolescents in Germany. Results of the cross-sectional KiGGS Wave 2 study, which is published in this issue of the Journal of Health Monitoring [36]. The link between current smoking and important factors in the social settings of children and adolescents is initially analysed by comparing smoking prevalences across groups. Logistic regression models were then fitted to estimate age-adjusted odds ratios (ORs) in the first step, which indicate how much higher the odds of smoking are for a particular group compared to a reference group. In the second step a full model containing further variables for adjustment was computed. The differences that were identified between the groups were tested for statistical significance using Pearson’s chi-squared tests, which were corrected in accordance with Rao and Scott and converted to F-statistics. Regression models (t-tests) were used to test for linear trends between survey waves. A significant difference was assumed to have been identified when confidence intervals did not overlap or if the calculated p-value was less than 0.05.

Cross-sectional analyses were carried out using a weighting factor that adjusted for deviations within the sample from the population structure with regard to age,
7.2% of 11- to 17-year-old children and adolescents currently smoke; half of them daily (3.7%).

However, from this age onwards a significant increase in the percentage of smokers can be identified, with girls tending to start smoking earlier than boys (Figure 2).

3. Results
3.1 Tobacco use

The data from KiGGS Wave 2 show that the vast majority of girls and boys do not smoke. 7.2% of 11- to 17-year-old children and adolescents smoke at least occasionally; 3.7% of adolescents, about half of all smokers, use cigarettes every day; 5.6% do so at least weekly. No significant differences in tobacco consumption were identified between girls and boys (Table 1). The proportion of children and adolescents who smoke increases significantly with age: whereas less than 1% of 11- and 12-year-olds smoke, around 20% of 17-year-olds do so (Figure 1). Adolescents who smoke at least weekly smoke an average of 6.2 cigarettes a day. The average age at which 17-year-olds who regularly smoke took up smoking was 15.3 years. Until the age of 13 years, less than 20% had begun to smoke regularly.
Previous KiGGS survey waves can be used to study trends in tobacco use. The proportion of young smokers has declined significantly since the KiGGS baseline study (2003-2006). The KiGGS baseline study found that 21.4% of 11- to 17-year-olds smoked at least occasionally. In contrast, the first follow-up survey (2009-2012) found that 12.4% smoked, whereas the current KiGGS wave found that this had dropped to just 7.2%. A similar development can also be observed with regard to daily smoking. The proportion of children and adolescents who

<table>
<thead>
<tr>
<th>11-13 Years</th>
<th>14-17 Years</th>
<th>Total</th>
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<tbody>
<tr>
<td>%</td>
<td>95% CI</td>
<td>%</td>
</tr>
<tr>
<td><strong>Girls</strong></td>
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<tr>
<td>Smoking, current</td>
<td>0.6 (0.2-1.6)</td>
<td>11.9 (9.9-14.2)</td>
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<td>Smoking, regularly</td>
<td>0.2 (0.1-0.5)</td>
<td>8.9 (7.2-10.8)</td>
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<tr>
<td>Smoking, daily</td>
<td>0.1 (0.0-0.4)</td>
<td>5.9 (4.6-7.6)</td>
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<tr>
<td>Average number of cigarettes smoked</td>
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<tr>
<td><strong>Alcohol consumption, ever</strong></td>
<td>14.9 (12.7-17.5)</td>
<td>76.7 (73.6-79.4)</td>
</tr>
<tr>
<td>Alcohol consumption, at-risk drinking</td>
<td>0.1 (0.0-0.5)</td>
<td>22.7 (20.1-25.6)</td>
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<tr>
<td>Alcohol consumption, heavy episodic drinking</td>
<td>0.1 (0.0-0.5)</td>
<td>9.2 (7.5-11.3)</td>
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<tr>
<td><strong>Boys</strong></td>
<td></td>
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<tr>
<td>Smoking, current</td>
<td>0.9 (0.3-2.8)</td>
<td>11.1 (9.4-13.0)</td>
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<tr>
<td>Smoking, regularly</td>
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<td>9.3 (7.7-11.2)</td>
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<tr>
<td>Smoking, daily</td>
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<td>Average number of cigarettes smoked</td>
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<tr>
<td><strong>Alcohol consumption, ever</strong></td>
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<td>6.0 (5.0-7.2)</td>
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<td>Average number of cigarettes smoked</td>
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<td>Alcohol consumption, heavy episodic drinking</td>
<td>0.1 (0.0-0.2)</td>
<td>11.7 (10.4-13.2)</td>
</tr>
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</table>

CI = Confidence interval
* Case numbers for all participants in the age group 11 to 17 years without missing values for the individual indicators on substance use
* For those who smoke at least weekly; due to the limited number of cases, summarised percentages are shown for the age group 11 to 17 years

Table 1: Smoking and alcohol consumption among 11- to 17-year-olds according to gender and age (n=3,423 girls, n=3,176 boys)

The proportion of smokers among 11- to 17-year-olds has fallen significantly from 21.4% to 7.2% since the KiGGS baseline study (2003-2006).

Table 2

<table>
<thead>
<tr>
<th></th>
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<th>KiGGS Wave 2</th>
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<td>%</td>
<td>95% CI</td>
<td>%</td>
<td>95% CI</td>
</tr>
<tr>
<td><strong>Girls</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoking, current</td>
<td>21.6 (19.9-23.3)</td>
<td>12.2 (10.5-14.2)</td>
<td>7.4 (6.2-8.9)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Smoking, daily</td>
<td>13.8 (12.3-15.4)</td>
<td>5.5 (4.3-7.0)</td>
<td>3.6 (2.8-4.7)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Average number of cigarettes smoked*</td>
<td>8.1 (7.4-8.8)</td>
<td>6.4 (5.1-7.7)</td>
<td>6.3 (5.1-7.2)</td>
<td>0.001</td>
</tr>
<tr>
<td>Average age when 17-year-olds smokers began to smoke</td>
<td>14.2 (13.9-14.4)</td>
<td>15.0 (14.6-15.4)</td>
<td>15.0 (14.7-15.4)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Alcohol consumption, ever</td>
<td>63.5 (61.6-65.5)</td>
<td>55.9 (53.2-58.5)</td>
<td>51.7 (49.5-54.0)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Alcohol consumption, at-risk drinking</td>
<td>17.1 (15.0-19.4)</td>
<td>13.5 (12.0-15.2)</td>
<td>10.2 (8.6-12.1)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Alcohol consumption, heavy episodic drinking</td>
<td>10.2 (8.6-12.1)</td>
<td>5.6 (4.6-6.8)</td>
<td>3.7 (3.1-4.5)</td>
<td>0.001</td>
</tr>
<tr>
<td><strong>Boys</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoking, current</td>
<td>21.2 (19.5-23.0)</td>
<td>12.6 (10.9-14.5)</td>
<td>7.0 (5.9-8.2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Smoking, daily</td>
<td>14.5 (13.0-16.2)</td>
<td>5.8 (4.6-7.2)</td>
<td>3.9 (3.0-5.0)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Average number of cigarettes smoked*</td>
<td>9.4 (8.8-10.1)</td>
<td>6.9 (5.8-7.9)</td>
<td>6.1 (5.0-7.2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Average age when 17-year-olds smokers began to smoke</td>
<td>14.1 (13.8-14.5)</td>
<td>15.1 (14.7-15.6)</td>
<td>15.6 (15.3-15.9)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Alcohol consumption, ever</td>
<td>64.3 (62.2-66.3)</td>
<td>55.3 (52.5-58.1)</td>
<td>50.2 (47.7-52.8)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Alcohol consumption, at-risk drinking</td>
<td>15.8 (13.8-18.1)</td>
<td>10.8 (9.2-12.6)</td>
<td>8.4 (7.1-9.8)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Alcohol consumption, heavy episodic drinking</td>
<td>13.8 (11.9-15.9)</td>
<td>10.2 (8.6-12.1)</td>
<td>7.0 (6.2-7.9)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoking, current</td>
<td>21.4 (20.1-22.7)</td>
<td>12.4 (11.2-13.8)</td>
<td>7.2 (6.3-8.2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Smoking, daily</td>
<td>14.2 (13.0-15.4)</td>
<td>5.7 (4.9-6.6)</td>
<td>3.7 (3.1-4.5)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Average number of cigarettes smoked*</td>
<td>8.8 (8.3-9.3)</td>
<td>6.7 (5.8-7.5)</td>
<td>6.2 (5.4-7.0)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Average age when 17-year-olds smokers began to smoke</td>
<td>14.1 (13.9-14.4)</td>
<td>15.1 (14.8-15.4)</td>
<td>15.3 (15.1-15.6)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Alcohol consumption, ever</td>
<td>63.9 (62.2-65.6)</td>
<td>55.6 (53.5-57.7)</td>
<td>51.0 (49.1-52.8)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Alcohol consumption, at-risk drinking</td>
<td>16.5 (14.8-18.3)</td>
<td>12.1 (11.0-13.4)</td>
<td>7.0 (6.2-7.9)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Alcohol consumption, heavy episodic drinking</td>
<td>12.0 (10.6-13.6)</td>
<td>7.0 (6.2-7.9)</td>
<td>3.7 (3.1-4.5)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

CI = confidence interval
* Case numbers for all participants in the age group 11 to 17 years without missing values for the individual indicators on substance use
* For those who smoke at least weekly; due to the limited number of cases, summarised percentages are shown for the age group 11 to 17 years

The proportion of smokers among 11- to 17-year-olds smoke daily decreased from 14.2% (KiGGS baseline study) to 5.7% (KiGGS Wave 1) and then to 3.7% (KiGGS Wave 2). Moreover, it is not only the proportion of adolescent smokers that has declined; the average number of cigarettes that adolescents smoke every day has also dropped. Furthermore, the average age of smoking onset among 17-year-olds has risen over time from 14.1 years (KiGGS baseline study) to 15.3 years (KiGGS Wave 2) (Table 2). The data from the current KiGGS wave also show that children and adolescents with a high socio-
Table 3
Current smoking among 11- to 17-year-olds according to factors in the social setting (n=2,996 girls, n=2,751 boys)

<table>
<thead>
<tr>
<th>Prevalence variable</th>
<th>Prevalence of current smoking</th>
<th>Model 1: age-adjusted</th>
<th>Model 2: mutually adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Girls</td>
<td>Boys</td>
<td>Girls</td>
</tr>
<tr>
<td></td>
<td>% (95% CI)</td>
<td>% (95% CI)</td>
<td>% (95% CI)</td>
</tr>
<tr>
<td>Type of school</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Academic/technical  secondary school</td>
<td>52.8 (50.1-55.5)</td>
<td>45.3 (42.4-48.2)</td>
<td>5.7 (4.2-7.6)</td>
</tr>
<tr>
<td>Gymnasium/Fachoberschule</td>
<td>47.2 (44.5-49.9)</td>
<td>54.7 (51.8-57.6)</td>
<td>8.0 (6.3-10.1)</td>
</tr>
<tr>
<td>Haupt-/Real-/Gesamtschule</td>
<td>47.2 (44.5-49.9)</td>
<td>54.7 (51.8-57.6)</td>
<td>8.0 (6.3-10.1)</td>
</tr>
<tr>
<td>Missing values (n=642)²</td>
<td>37.4 (34.9-40.0)</td>
<td>40.8 (38.0-43.6)</td>
<td>9.7 (7.7-12.2)</td>
</tr>
<tr>
<td>Parental smoking</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>37.4 (34.9-40.0)</td>
<td>40.8 (38.0-43.6)</td>
<td>9.7 (7.7-12.2)</td>
</tr>
<tr>
<td>No</td>
<td>62.6 (60.0-65.1)</td>
<td>59.2 (56.4-62.0)</td>
<td>4.9 (3.6-6.6)</td>
</tr>
<tr>
<td>Missing values (n=417)²</td>
<td>29.5 (27.4-31.8)</td>
<td>31.6 (29.5-33.8)</td>
<td>21.9 (18.4-26.0)</td>
</tr>
<tr>
<td>Friends who smoke</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>70.5 (68.2-72.6)</td>
<td>68.4 (66.2-70.5)</td>
<td>0.8 (0.5-1.4)</td>
</tr>
<tr>
<td>No</td>
<td>29.5 (27.4-31.8)</td>
<td>31.6 (29.5-33.8)</td>
<td>21.9 (18.4-26.0)</td>
</tr>
<tr>
<td>Smoking at home in the presence of the child</td>
<td>10.6 (8.8-12.8)</td>
<td>12.9 (10.8-15.3)</td>
<td>14.6 (10.0-20.8)</td>
</tr>
<tr>
<td>No</td>
<td>89.4 (87.2-91.2)</td>
<td>87.1 (84.7-89.2)</td>
<td>6.4 (5.2-7.7)</td>
</tr>
<tr>
<td>Missing values (n=144)²</td>
<td>11.6 (10.8-12.8)</td>
<td>12.9 (10.8-15.3)</td>
<td>14.6 (10.0-20.8)</td>
</tr>
</tbody>
</table>

OR = odds ratio, CI = confidence interval, Ref. = reference, Bold = statistically significant (p < 0.05)
² Only cases with valid data on smoking status were included in the mutually adjusted model; all other cases were included in the multivariate model
¹ Adjusted for age
² Adjusted for age, school type, parental smoking, friends who smoke, smoking in the home in the presence of the child

The smoking-related behaviour of children and adolescents is linked to that of their friends.
economic status smoke less frequently than those with a low or medium socioeconomic status [32, 36].

In addition to findings about the frequency and quantity of tobacco consumption, KiGGS also provides information about the smoking-related behaviour of adolescents’ family and peers (Table 3). 30.6% of girls and boys aged between 11 and 17 years have good friends who smoke. 39.0% have at least one parent who smokes, and 11.7% are confronted with people smoking in their presence while being at home.

However, significant differences occur when the smoking status of children and adolescents is analysed in relation to the smoking-related behaviour of their family and peers as well as the type of school they attend (Table 3). Age-adjusted odds ratios show that girls and boys with parents who smoke are twice as likely to smoke as adolescents with non-smoking parents. If good friends of 11- to 17-year-olds smoke, the odds that these individuals will smoke increase by a factor of 21.0 for girls and 18.4 for boys. A statistically significant association can also be observed regarding the type of school an individual attends. Girls and boys who do not attend a academic/technical secondary school have a higher odds of smoking compared to those who do (girls 2.0 times higher, boys 1.8 times higher). Girls who live in homes where people smoke in their presence have an almost twice as high odds of smoking compared to those who live in homes where this is not the case.

Even after controlling for all other variables, the strong effect associated with friends who smoke still persists: Adolescents who have good friends who smoke have higher odds of smoking than girls and boys who do not (girls 13.5 times higher; boys 15.1 times higher). Furthermore, in boys smoking-related behaviour is significantly linked to that of their parents: after mutual adjustment, boys who have one parent who smokes are also more likely to smoke.

3.2 Alcohol consumption

A total of 51.0% of children and adolescents aged between 11 and 17 years (girls 51.7%, boys 50.2%) have ever consumed alcohol. No significant differences were identified between girls and boys (Table 1). The proportion of girls and boys who have ever drunk alcohol increases with age (data not shown). The figures are 3.7% (95% CI 2.1%-6.3%) for 11-year-old girls and 6.3% (95% CI 4.3%-9.3%) for 11-year-old boys. By the time they reach the age of 17, 87.3% (95% CI 80.5%-92.0%) of girls and 88.5% (95% CI 82.2%-92.7%) of boys have drunk alcohol. The lifetime prevalence of alcohol consumption has steadily declined during the period beginning with the KiGGS baseline study (63.9%) and stretching from KiGGS Wave 1 (55.6%) to KiGGS Wave 2 (51.0%) (Table 2). If the lifetime prevalence of alcohol consumption is calculated for 11- to 13-year-olds and 14- to 17-year-olds and according to gender, it becomes clear that alcohol consumption has particularly declined among 11- to 13-year-olds. This development applies equally to girls and boys (Figure 3). The lifetime prevalence of alcohol consumption is lower among boys from families with low socioeconomic status than among boys from families with a medium or high socioeconomic status. No marked differences were found among girls in terms of the socioeconomic status of the family of origin [36].
by the time they reach 14 years of age, 3.9% of girls
and 1.0% of boys drink at-risk. By the age of 17 years, this
rate has risen to 39.9% of girls and 33.8% of boys
(Figure 4). Findings about developments over time in
terms of at-risk drinking can only be made using data
from KiGGS Wave 1 and KiGGS Wave 2. Among 11- to
17-year-old girls and boys, the proportion of at-risk
drinkers fell from 17.1% to 13.5% and from 15.8% to
10.8%, respectively, over this period (Table 2).

Heavy episodic drinking (at least monthly consump-
tion of six or more alcoholic drinks on one occasion) is
reported by 7.0% of 11- to 17-year-olds. As is the case
with at-risk drinking, the prevalence of heavy episodic
drinking among 11- to 13-year-olds is basically zero.
Among 14- to 17-year-olds, however, 9.2% of girls and
14.2% of boys practice heavy episodic drinking (11.7% of
the total). In contrast to at-risk alcohol consumption, an
inverse relationship between the genders was identified
for heavy episodic drinking: a significantly higher preva-
lence of heavy episodic drinking was found among male
adolescents. The analysis of developments over time
shows that the proportion of regular 11- to 17-year-old
heavy episodic drinkers fell during the period between
KiGGS Wave 1 and KiGGS Wave 2 from 10.2% to 5.6%
(among girls) and from 13.8% to 8.4% (among boys).

4. Discussion

Data from KiGGS Wave 2 demonstrate that 7.2% of
11- to 17-year-old children and adolescents currently
smoke; about half of them daily. With increasing age, the
proportion of adolescents that smokes increases
The results presented here are largely in line with findings from further studies that estimate the prevalence of alcohol and tobacco use among adolescents in Germany [23, 24, 38-41].

The significant decline in the prevalence of adolescent smoking is also evident from the BZgA’s surveys of substance use: over the same period, the proportion of smokers among 12- to 17-year-olds fell from 23.5% (2004) to 7.8% (2015) [23]. The results of the HBSC study also indicate a significant decline in smoking among 11- to 15-year-old pupils since the beginning of the 2000s [38, 39]. A reduction in the prevalence of smoking among adolescents during this period can also be seen in many other similarly economically developed countries in Europe and around the world [40, 42].

Changes in adolescent smoking-related behaviour need to be seen against the background of the intensified tobacco prevention policy that has been implemented in Germany. Since the turn of the millennium, numerous measures have been put in place to curb tobacco use and to protect the population from the health hazards associated with passive smoking. First and foremost, these include significant tax rises between 2002 and 2005 that resulted in substantial price increases, raising the age limit for purchasing and consuming tobacco products to 18 years, widening the advertising ban, broadening warnings on tobacco products and passing non-smoker protection laws at the federal and federal state level. Moreover, these measures were accompanied by setting- and population-based significantly. Only slight differences between girls and boys were identified in terms of tobacco consumption. The KiGGS study demonstrates a very clear decline in tobacco use over time: the proportion of current smokers in the most recent survey wave is only one-third of the level identified by the KiGGS baseline study (KiGGS baseline study 21.4%, KiGGS Wave 1 12.4%, KiGGS Wave 2 7.2%). The average number of cigarettes smoked daily by regular smokers has also declined. Moreover, there has also been a further increase in the average age at which 17-year-olds state that they started to smoke.

The results from KiGGS also show a decline in the lifetime prevalence of alcohol consumption among 11- to 17-year-olds from 63.9% (KiGGS baseline study) to 55.6% (KiGGS Wave 1) and 51.0% (KiGGS Wave 2). The levels of heavy episodic drinkers also fell between KiGGS Wave 1 and KiGGS Wave 2 from 12.0% to 7.0%. Despite these encouraging results, alcohol consumption is still highly prevalent among certain age groups. Two in five (39.9%) 17-year-old girls, and one in three (33.8%) boys of the same age consume at-risk levels of alcohol. 16.8% of girls and 30.1% of boys over the age of 17 years still practice heavy episodic drinking at least once a month. A higher proportion of boys consumes excessive amounts of alcohol in the form of heavy episodic drinking, whereas a higher proportion of girls tends to drink at-risk levels of alcohol. It should be noticed that these prevalences are based on the thresholds taken from AUDIT-C, which applies to adults. No limits for low-risk alcohol consumption among adolescents have been established and these groups should avoid alcohol as much as possible.

Since the KiGGS baseline study, the lifetime prevalence of alcohol consumption has fallen from 63.9% to 51.0%. Furthermore, a comparison of data from KiGGS Wave 1 and KiGGS Wave 2 demonstrates a drop in the lifetime prevalence of at-risk drinking from 16.5% to 12.1% and in heavy episodic drinking from 12.0% to 7.0%.
Tobacco and alcohol use among 11- to 17-year-olds in Germany

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Also has a moderate effect on adolescent smoking-related behaviour [51, 52]. Overall, however, the link between adolescent smoking and the smoking-related behaviour of their friends and family is based on complex processes of socialisation and selection, and claims of a unicausal link lack a sufficient basis [53]. Until now, very few studies are available on the relative impact that best friends, peer groups, and group affiliation have on overall smoking-related behaviour. Therefore, more research is needed into this issue. Nonetheless, the results provide evidence of the influence that parents, friends and peers can have on adolescents and this should be considered when designing appropriate measures.

In principle, the findings on adolescent alcohol consumption are also in line with the results of the representative surveys undertaken by the BZgA. These studies show that the lifetime prevalence of alcohol consumption among 12- to 17-year-olds dropped from 75.3% (2005) to 72.6% (2011) to 63.5% (2016) [24]. However, when comparing these data, the slightly different age groups investigated in these studies should be taken into account. Even though different prevalences were identified, both studies still point towards a significant reduction in alcohol consumption for the entire period.

In terms of the prevalence of heavy episodic drinking, the data from the KiGGS and BZgA surveys show similar developments over time: between KiGGS Wave 1 and KiGGS Wave 2, the proportion of at least monthly heavy episodic drinkers (the consumption of six or more alcoholic beverages on one occasion) among 11- to 17-year-old girls and boys dropped from 12% to 7%; similarly, the Alcohol survey confirmed that the proportion of campaigns and programmes aimed at preventing smoking, especially among young people, and helping smokers to quit [3, 43-44]. International agreements also had helped push forward the advances made in tobacco prevention policy in Germany: the Framework Convention on Tobacco Control (FCTC), which was negotiated under the auspices of the WHO, contains a comprehensive catalogue of tobacco prevention measures that are to be implemented by its member states. The FCTC was ratified by Germany in 2004 [3]. At the same time, some of the measures that Germany has put in place, such as the introduction of ‘shock photos’, are based on binding requirements drawn up by the European Union as part of its regulation of tobacco products (European Tobacco Products Directive) [45].

Even though it is difficult to quantify the preventive effects of individual measures, these measures are likely to have significantly contributed to the fact that a lower proportion of children and adolescents currently smoke in Germany [46, 47].

In addition to prevalences and temporal developments in smoking-related behaviour, the results presented here demonstrate the relationship between adolescent tobacco use and the tobacco-related behaviour of their parents, and, in particular, the tobacco-related behaviour of their peers. Numerous studies have demonstrated the substantial influence that peers and friends have on adolescent smoking-related behaviour [9, 48-50]. Other studies have also shown that adolescents are by comparison more influenced by their peers than their family during this phase of life [49, 51]. Nevertheless, reviews conclude that parental tobacco consumption also has a moderate effect on adolescent smoking-related behaviour [51, 52]. Overall, however, the link between adolescent smoking and the smoking-related behaviour of their friends and family is based on complex processes of socialisation and selection, and claims of a unicausal link lack a sufficient basis [53]. Until now, very few studies are available on the relative impact that best friends, peer groups, and group affiliation have on overall smoking-related behaviour. Therefore, more research is needed into this issue. Nonetheless, the results provide evidence of the influence that parents, friends and peers can have on adolescents and this should be considered when designing appropriate measures.

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Tobacco and alcohol use among 11- to 17-year-olds in Germany

heavy episodic drinkers (young people who have drunk five or more glasses of alcohol on one occasion in the last 30 days) dropped from 15.2% (2011) to 13.5% (2016) among 12- to 17-year-olds [24].

The decline in alcohol consumption observed from the KiGGS data was also demonstrated by the HBSC study, although the indicators used are not directly comparable to those from KiGGS as different questions were posed [54]. However, overall, data from various population-based studies confirm a decline in alcohol consumption among adolescents in Germany. Nevertheless, this encouraging trend should not be permitted to obscure the fact that a high proportion of adolescents of certain age groups and genders still regularly consume hazardous levels of alcohol.

Scientific evidence demonstrates the relationship between alcohol prices and alcohol consumption: higher prices lead to a decline in consumption, and this is most evident among price-sensitive groups such as adolescents [57-59]. Taxes can have a strong influence on alcohol prices [59]. However, a selective increase in individual taxes is unhelpful because it creates a risk that consumers will merely switch to other alcoholic drinks. In Germany, spirits, sparkling wines, beer, alcopops and intermediate products are subject to different excise duties. Wine is not subject to a separate excise tax, and the tax rate on beer is only slightly higher than the minimum rate stipulated by the EU. Overall, Germany has far fewer restrictive measures in place on alcohol consumption than other countries [60].

The WHO’s Regional Office Europe has identified 10 areas for action in its Action Plan to Reduce the Harmful Use of Alcohol between 2012 and 2020, some of which specifically target young people. These include a minimum purchase age of 18 years, reducing the availability of alcohol and the opening hours of places selling alcohol, restrictions on alcohol marketing, and implementing pricing measures, such as tax increases [55].

The availability of alcohol to young people is regulated in Germany by § 9 Jugendschutzgesetz (§ 9 of the Protection of Young Persons Act). The act prohibits the provision of spirits or drinks containing spirits to young people. Other alcoholic beverages (beer, wine, and drinks similar to wine including sparkling wine) can only be provided to young people aged 16 years or over. In addition, § 6 des Gaststättengesetzes (§ 6 of the Restaurant Code) stipulates that restaurants must sell at least one soft drink at the same price as the cheapest alcoholic beverage. This policy aims to ensure that alcoholic drinks are not merely consumed because they are cheaper than soft drinks. However, these regulations require effective control as well as awareness and information on the part of the stakeholders for them to be effective. The campaign 'Jugendschutz: Wir halten uns daran’ by the Federal Ministry for Family Affairs, Senior Citizens, Women and Youth is important in this respect. In accordance with the WHO recommendations, the German Centre for Addiction Issues states that children and adolescents under the age of 18 years should not drink alcohol and that the protection of minors needs to be extended to the age of 18 [56].

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Behaviour-related preventative measures are aimed at educating young people about the dangers of alcohol and encouraging them to deal responsibly with the issue
of alcohol. ‘Alkohol – Kenn dein Limit’ was the motto of a campaign run by the BZgA aimed at young people about the responsible use of alcohol that specifically targeted young people aged 16 years or older and young adults. The BZgA’s campaign ‘Null Alkohol – volle Power’ aims to encourage children and adolescents aged 16 years or below to adopt a critical approach to alcohol use and to delay their entry into alcohol consumption. The alcohol prevention project ‘HaLT - Hart am Limit’ is particularly aimed at young people who have already begun found to be consuming hazardous levels of alcohol, such as through hospitalizations due to alcohol poisoning.

In contrast to the issue of smoking-related behaviour, the KiGGS data faces a limitation when it comes to alcohol use as no information was collected about alcohol consumption by family members and peers. In addition, no data was gathered about the times when alcohol was consumed. Sports associations are considered to be relevant settings for preventative measures in terms of encouraging young people to deal with alcohol responsibly and in a low-risk manner [61]. The first analyses that have been undertaken using data from KiGGS Wave 2 on the links between alcohol consumption and physical activity in sports clubs among 14- to 17-year-old girls and boys show that (once the socioeconomic status of the family and a recent family history of migration have been taken into account) boys who do sports in a sports club are twice as likely to consume at-risk levels of alcohol as boys who do not (data not shown). No corresponding relationship was found among girls. In this regard, the BZgA has established the action alliance ‘Alkoholfrei Sport geniessen’. The alliance has joined the German Olympic Sports Confederation, the German Football Association, the German Sports Youth and other sports federations [62]. The alliance aims to empower children and adolescents in their personal development and to enable them to cope with their lives without turning to addictive substances. Coaches in sports clubs act as essential role models in this respect. Finally, the alliance is aimed at ensuring that the people responsible in sports clubs are made aware of this issue.

Another limitation to this study lies in the survey mode used by KiGGS. Information provided by the respondents on their own alcohol and tobacco use may be biased as it is possible that the respondents provided socially desirable responses. In addition, different survey modes were implemented for the various KiGGS waves: whereas the KiGGS baseline study and Wave 2 collected data using questionnaires that the respondents filled out themselves, KiGGS Wave 1 opted for a telephone survey. As a result, the stronger tendency towards providing socially desirable responses during telephone interviews, which is known from methodological research, may have produced a response bias [34, 63]. Be this as it may, the trends that have been demonstrated are very similar to those from other surveys that have been undertaken of the population in Germany, and no methodological changes were put in place for these studies. In addition, the cross-sectional analyses that were undertaken of the behaviour and associated factors for children and adolescents do not permit causal findings to be drawn. Finally, age, period and cohort effects can only be distinguished to a limited extent when evaluating trends.
Conclusion

Alcohol and tobacco use among 11- to 17-year-old children and adolescents has dropped significantly over the last decade. The smoking rate identified by KiGGS Wave 2 is already close to the 2020 national health target ‘Reduce tobacco consumption’ (reducing the smoking rate among young people aged 12 to 17 years to below 7% by 2020) [21]. The strategy that has been pursued until now of combining structural and behavioural prevention measures seems to have been effective. For certain age and gender groups, however, there is still a need for prevention and action. Thus, key areas of action set out in the WHO Action Plan to Reduce the Harmful Use of Alcohol have yet to be implemented. Germany lags behind compared to the rest of Europe when it comes to issues such as non-smoker protection, tobacco taxes and widening advertising bans on tobacco products [64]. Since the KiGGS study is designed as a combined longitudinal and cross-sectional survey [65], future surveys will enable participants’ consumption patterns to be tracked over time and analyses to be conducted of the factors that influence alcohol and tobacco use [16, 65].

Data protection and ethics

KiGGS Wave 2 is subject to strict compliance with the data protection provisions set out in the Federal Data Protection Act. Hannover Medical School’s ethics committee assessed the ethics of the study and provided its approval (No. 2275-2014). Participation in the study was voluntary. The participants and/or their parents/legal guardians were also informed about the aims and contents of the study, and about data protection. Informed consent was obtained in writing.

Funding

KiGGS is funded by the Federal Ministry of Health and the Robert Koch Institute.

Conflicts of interest

The authors declared no conflicts of interest.
Tobacco and alcohol use among 11- to 17-year-olds in Germany

Acknowledgement

Foremost we would like to express our gratitude to both the participants and their parents. We would also like to thank everyone at the 167 study sites who provided us with space and active support on site.

KiGGS Wave 2 could not have been conducted without the dedication of numerous colleagues at the Robert Koch Institute. We would especially like to thank the study teams for their excellent work and their exceptional commitment during the three-year data collection phase.

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Tobacco and alcohol use among 11- to 17-year-olds in Germany


Socioeconomic differences in the health behaviour of children and adolescents in Germany. Results of the cross-sectional KiGGS Wave 2 study

Abstract
Childhood and adolescence are key determining stages for health behaviour in the life course. Frequently, health-related attitudes and patterns of behaviour that develop at young age are also maintained at adult age. As studies show, already during childhood and adolescence, patterns of health risk behaviour are more common in certain population groups. KiGGS Wave 2 results confirm that 3- to 17-year-old children and adolescents from families with low socioeconomic status (SES) eat a less healthy diet, do fewer sports and are more often overweight or obese than their peers from more affluent backgrounds. Whereas socioeconomic differences appear to have little effect on levels of alcohol consumption among 11- to 17 year-olds, girls and boys with low SES smoke more frequently than their peers with high SES. Prevention and health promotion encourage children and adolescents to adopt healthy lifestyles, and aim to drive structural changes to stimulate behaviour which promotes good health. Combining measures that target individual behaviour and a settings-based approach appears to be the most promising preventative approach to reduce health inequalities among young people. Due to the clear impacts of socioeconomic differences on health behaviour already at young age measures for disadvantaged children and adolescents and their living conditions should be given an even stronger focus in the future.

1. Introduction
For public health measures of prevention and health promotion, childhood and adolescence are particularly appropriate life stages [1, 2]. Health-related attitudes and patterns of behaviour that develop at young age are often maintained at adulthood (‘early determination’) [3, 4]. Correspondingly, childhood and adolescence have great significance for the promotion of healthy lifestyles. This fact also reflects in the national health targets ‘Grow up healthy: life competence, physical activity, nutrition’ [5], ‘Reduce tobacco consumption’ [6] and ‘Reduce alcohol consumption’ [7] and in their particular focus on the young generation. Furthermore, the health-related targets of Germany’s sustainability strategy aim to stop the spread of tobacco consumption and obesity among children and adolescents [8].
Patterns of behaviour relevant to health develop through individual life experiences, knowledge and beliefs. They are also, however, related to material, structural and cultural factors, as well as historic contexts and traditions. Initially, family background and the social environment a child grows up in, influence health behaviour. As role models, parents play a particularly important role in the health behaviour of their children, in particular during their early years [9]. Parent food purchasing and consumption patterns, for example, define the family’s eating habits. Parents also provide feedback to a child’s natural desire for physical activity, either by encouraging or blocking it. Their health attitudes and preferences, as well as consumption patterns are thereby often, at least in part, adopted by their children.

As they get older, children and adolescents become more detached from their parents and begin to take independent health-related decisions, which can also be influenced by their peers [2, 9]. This applies, for example, to the use of psychoactive substances that many adolescents try and then either give up or maintain [10]. Besides the family, further environments and places with social interaction such as day care centres, schools, clubs and associations, as well as friends can influence the health behaviour of children and adolescents [11]. Yet for tobacco consumption, for example, family background does appear to weigh heavy. Studies reveal that adolescents whose parents and/or siblings smoke, smoke cigarettes and consume other tobacco products far more often themselves [12-14].

Socio-epidemiological studies indicate that child and adolescent health behaviour is affected by age and gender, and that social background also has an impact [15-17]. Consequently, socioeconomically disadvantaged children and adolescents are more likely to have an unhealthy diet [18], do less sport and a greater number of them will be either overweight or obese [19, 20] than girls and boys of the same age from more affluent backgrounds. Tobacco consumption too shows a social gradient: adolescents with low socioeconomic status (SES) smoke more frequently than those with high SES [21]. As child and adolescent health behaviour patterns are conceivably maintained at adult age and, in the long-term, play a role in the development of socioeconomic differences in morbidity and mortality [22, 23], reducing them makes a significant contribution to reducing unequally distributed health opportunities.

Developing and evaluating measures to close the social gradient in the health-relevant behaviour of children and adolescents requires regular, reliable and robust data. Based on the cross-sectional data from the German Health Interview and Examination Survey for Children and Adolescents (KiGGS Wave 2, 2014-2017), this article provides an overview of the current extent of socioeconomic differences in the health behaviour of children and adolescents.

2. Methodology

2.1 Study design and sample

KiGGS is part of the health monitoring system at the Robert Koch Institute (RKI) and includes repeated representative cross-sectional surveys for Germany of children and adolescents aged 0 to 17. Whereas the KiGGS
baseline study (2003-2006) was designed as an examination and interview survey, the first follow-up survey (KiGGS Wave 1, 2009-2012) was conducted as an interview-based survey by telephone. KiGGS Wave 2 (2014-2017) again collected examination and interview data, whereas, unlike the KiGGS baseline study, many participants were only interviewed and not examined. The concept and design of KiGGS have already been described [24-27]. A total of 15,023 respondents (7,538 girls and 7,485 boys) took part in KiGGS Wave 2 (response rate 40.1%). 3,567 children and adolescents were examined (1,801 girls and 1,766 boys) (response rate 41.5%).

2.2 Indicators

This article analyses four areas of health-relevant behaviour in childhood and adolescence: diet, physical activity, body mass index and substance use. For each of these four areas two exemplary indicators were analysed, the majority of which were included as Fact sheets in issue 1/2018 of the Journal of Health Monitoring. Family socio-economic status (SES) serves as an independent variable; its operationalisation has also already been described in detail in issue 1/2018 of the Journal of Health Monitoring [28].

Diet

In KiGGS Wave 2 – like in the KiGGS baseline study – the consumption of selected food items was assessed with a food frequency questionnaire [29, 30]. Amongst others, the questionnaire collected data on fresh fruit intake and consumption of sugary soft drinks (Cola, lemonade, ice tea, malt beer and energy drinks) ‘during the past four weeks’. There was a total of eleven answer categories, stretching from ‘never’ to ‘more than five times per day’. Parents (or guardians) answered the questions for the group of 3- to 10-year-olds, children and adolescents aged 11 to 17 answered themselves [30]. This article presents the proportion of children and adolescents who ate fresh fruit or consumed sugary soft drinks daily during the last four weeks.

Physical activity

Data on physical activity (including sports) was collected in KiGGS Wave 2 by self-reporting (11- to 17-year-olds) or based on the answers of guardians (3- to 10-year-olds) in a written questionnaire [31]. Levels of physical activity were defined based on the following question: ‘On how many days of a normal week are you/is your child physically active for at least 60 minutes on a single day’? The eight answer categories spanned from ‘On no day’ to ‘on seven days’. The present analyses are based on the recommendations of the World Health Organization (WHO), which recommends at least 60 minutes of moderate- to vigorous-intensity physical activity daily [32]. The question: ‘Do you/does your child do sports?’ measured sport activity. A comment was included stating that: ‘This covers all kinds of sport, in or outside of a club, except for sports at school and/or sport activities in kindergarten’. The present analysis shows the proportion of children and adolescents who do sports during leisure time.
Body mass index
In KiGGS Wave 2 body height and weight of respondents aged 3 to 17 were measured by applying a standardised procedure in line with the baseline study [33]. A person’s body mass index (BMI) was calculated from the ratio between body weight and height (kg/m²). Since the relationship between body height and weight changes during childhood and adolescence due to growth, there is no uniform cutpoint for all age groups from which a child or adolescent is classified as overweight or obese. For this reason, up to the age of 18 year, BMI percentile curves are applied which reflect BMI distribution with regard to a reference population and take age and gender into account. In Germany, overweight and obesity are usually defined based on the recommendations of the Arbeitsgemeinschaft Adipositas im Kindes- und Jugendalter (AGA), and by applying national reference percentiles according to Kromeyer-Hauschild et al. [34, 35]. Children with a BMI above the 90th percentile are considered overweight and obesity is defined as a BMI above the 97th percentile.

Substance use
In KiGGS Wave 2 substance use was only measured in the 11- to 17-age group. Participants responded in writing to questions about smoking behaviour and alcohol consumption [11]. Respondents answered the question, ‘Do you currently smoke?’ by choosing between one of the following answers: ‘No’, ‘Daily’, ‘Several times per week’, ‘Once per week’ and ‘Less than once per week’. All respondents who stated that they smoke tobacco – including only occasionally – are grouped as current smokers [36]. The question ‘Have you ever drunk alcohol?’ (answer categories ‘Yes’ and ‘No’) measured lifetime prevalence of alcohol consumption.

Socioeconomic status
In KiGGS Wave 2 the socioeconomic status (SES) was measured through an index based on the information parents provided on educational background, occupational status and income situation (equivalised disposable income) [28]. The operationalisation applied corresponds to the KiGGS Wave 1 approach [37]. For the purpose of analysis, the three groups of low, medium and high status were established, with the low and high status group each comprising of around 20% and the medium status group of around 60% of the study population [28].

2.3 Statistical analysis
In the fields of diet and physical activity, the analyses are based on the data of 13,568 respondents (6,810 girls, 6,758 boys) aged 3 to 17, for substance use on the data of 6,599 respondents (3,423 girls, 3,176 boys) aged 11 to 17. For certain indicators, a varying number of respondents were excluded from the analyses because they did not provide all the necessary answers. The analysis of BMI values is based on the data of 3,561 adolescents (1,799 girls, 1,762 boys) aged 3 to 17 with valid answers on body height and weight. The results are stratified by gender and socioeconomic status (SES) based on prevalence with a 95% confidence interval (CI 95%). Moreover, adjusted odds ratios (aOR) with 95% confidence
3. Results

3.1 Diet

According to the results of KiGGS Wave 2, more than half (55.8%) of all children and adolescents aged 3 to 17 in Germany eat fresh fruit daily. Girls eat fresh fruit daily more often than boys (59.5% vs. 52.2%). With increasing age the proportion of girls and boys eating fresh fruit every day decreases. Regardless of gender, a higher SES translates into a greater proportion of children and adolescents who eat fresh fruit daily (Figure 1). Whereas only 47.2% of children and adolescents with low SES eat fresh fruit daily, the rate for children and adolescents with medium SES is 55.7% and, at 65.4%, significantly higher in particular for those with high SES.

Intervals are provided that indicate the factor by which the statistical probability is increased for a certain behaviour to be present in the low or medium status groups compared to the high status group defined as reference category. The underlying logistic regression analysis statistically controls structural differences in the composition of status groups regarding age, gender and family migration background [38].

To achieve representative data, the calculations were carried out using a weighting factor that corrected for deviations within the sample from the population structure with regard to age in years, gender, federal state, German citizenship (as of December 31, 2014) and the parents’ level of education based on the Comparative Analysis of Social Mobility in Industrial Nations (CASMIN) [39] (Microcensus 2013 [40]). A specific weighting factor, i.e. one which is related to the examination participants, was applied to measurement results for overweight and obesity.

All analyses applied Stata 14.2 to the KiGGS Wave 2 dataset (Version 5) (Stata Corp., College Station, TX, USA, 2015). To adequately account for the clustering of participants at sample points and weighting in the calculation of confidence intervals and p-values, Stata survey commands were used [41]. A statistically significant difference between groups is assumed to have been demonstrated among groups with p-values of less than 0.05.

Figure 1

Dietary habits of 3- to 17-year-olds according to gender and socioeconomic status

(Fruit n=6,473 girls, n=6,375 boys; Sugary soft drinks n=6,467 girls, n=6,372 boys)


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Children and adolescents with low SES eat fresh fruit less frequently daily and consume sugary soft drinks more often daily than their peers with high SES.
Around one fifth (19.6%) of 3- to 17-year-old children and adolescents in Germany drinks sugary soft drinks daily – boys (22.2%) significantly more often than girls (16.9%) [30]. With age, the proportion of girls and boys who drink sugary soft drinks daily increases. Moreover, the results confirm a pronounced social gradient: the proportion of children and adolescents, who drink sugary soft drinks daily is higher the lower their SES [30]. Whereas nearly one third (30.5%) of children and adolescents with low SES drinks sugary soft drinks daily, it is around one fifth (20.2%) in the medium SES group and a mere 7.1% of children and adolescents from the high SES group. These pronounced differences are evident in both genders (Figure 1).

3.2 Physical activity

Around one quarter (26.0%) of 3- to 17-year-old children and adolescents in Germany is physically active for at least 60 minutes on every day of a normal week and thus fulfils the WHO recommendations for physical activity [31]. The proportion for boys (29.4%) is higher than for girls (22.4%). With increasing age, the share of girls and boys who meet the WHO recommendations for physical activity gradually decreases. For the physically active, family SES appears not to make any significant difference to girls or boys (Figure 2). For the physically inactive (defined as physically active for at least 60 minutes on fewer than two days per week), however, pronounced socioeconomic differences are apparent, with a greater proportion of girls and boys with low SES in this group than of girls and boys with medium and high SES (data not shown, see [31]).

3.3 Body mass index

The values measured for body height and weight in KiGGS Wave 2, indicate that, based on the reference values published by Kromeyer-Hauschild et al. 2015 [34], 15.4% of 3- to 17-year-old children and adolescents in
Germany are overweight [33]. Obesity prevalence is at 5.9%. No significant gender differences are apparent in overweight and obesity prevalence figures. For both genders, however, the proportion of overweight and obese children and adolescents rises with age. Figures for overweight reveal a social gradient, with a lower SES correlating to a higher proportion of overweight children and adolescents (Figure 3). Whereas a total of around one quarter (25.5%) of 3 to 17-year-olds in the low status group is overweight, the same applies for only one in around seven children (13.5%) in the medium status group and one in thirteen (7.7%) in the high status group. The proportion of obese children, too, is also significantly higher in socioeconomically disadvantaged families than in more affluent families (low SES 9.9%, medium SES 5.0%, high SES 2.3%) (Figure 3).

### 3.4 Substance use

Based on KiGGS Wave 2 data, 7.2% of 11- to 17-year-olds smoke at least occasionally – with in total only small differences between girls and boys [11, 36]. For both genders, smoking prevalence increases with age. Overall, smoking rates for adolescents from low (8.0%) and medium (7.9%) SES backgrounds is around twice as high, compared to those of high SES background (4.0%). For girls, the most pronounced difference was registered between the low and high status groups, for boys between the medium and high status groups (Figure 4).

In KiGGS Wave 2, around half (51.0%) of 11- to 17-year-old adolescents stated that they had drunk alcohol at least once. Whereas the proportion for girls (51.7%) and
Regarding diet, for example, compared to the high SES reference group, the odds of eating fresh fruit daily, is only half as high for those with low SES (aOR 0.48 (0.41-0.56)), whereas the probability of consuming sugary soft drinks daily is increased by a factor of about 6 (aOR 5.91 (4.87-7.19)). As regards physical activity, the findings are less clear. No significant differences in levels of physical activity can be found between status groups (based on the WHO recommendations: at least 60 minutes of physical activity daily) (aOR 1.12 (0.92-1.35)). However, the odds of doing sports during leisure time and outside of kindergarten and school is significantly lower for children and adolescents with low SES compared to those with high SES (aOR 0.29 (0.24-0.34)).

Data on body height and weight and the corresponding BMI values evidence that the risk of being overweight (aOR 3.44 (2.13-5.55)) or obese (aOR 4.26 (1.76-10.31)) is around three to four times as high for children and adolescents with low SES compared to those with high SES. Regarding substance use, the results for the relation between tobacco and alcohol consumption and SES differ. While the results on lifetime prevalence of alcohol consumption in 11- to 17-year-olds show a lower risk for children and adolescents with low SES (aOR 0.65 (0.47-0.89)), results on tobacco consumption show that children and adolescents with low SES smoke around twice as often as those with high SES (aOR 2.06 (1.20-3.51)).

For the majority of indicators considered, both children and adolescents with low SES, and also those with medium SES, far more frequently show risky health behaviour compared to their peers with high SES (Table 1). For some indicators, such as sugary soft drink

**Figure 5**

Alcohol consumption (lifetime prevalence) for 11- to 17-year-olds according to gender and socioeconomic status (n=3,165 girls, n=2,876 boys)

consumption or leisure time sports activities, multivariate results moreover indicate a marked social gradient, with a higher SES being associated with a lower risk for risky health behaviour and/or a higher likelihood of behaviour which promotes good health. With a few notable exceptions, socioeconomic differences impact on the health behaviour of girls and boys in a very similar way. One such exception is the lifetime prevalence of alcohol consumption: whereas for girls the differences between status groups are not significant (aOR 0.83 (0.51-1.36)), among boys, those with low SES are less likely to have drunk alcohol at least once, compared to their peers with high SES (aOR 0.52 (0.34-0.81)).

4. Discussion

Health-relevant behaviour plays a fundamental role in the development and course of chronic diseases. KiGGS Wave 2 results indicate that socioeconomic differences already become apparent in health behaviour during consumption or leisure time sports activities, multivariate results moreover indicate a marked social gradient, with a higher SES being associated with a lower risk for risky health behaviour and/or a higher likelihood of behaviour which promotes good health. With a few notable exceptions, socioeconomic differences impact on the health behaviour of girls and boys in a very similar way. One such exception is the lifetime prevalence of alcohol consumption: whereas for girls the differences between status groups are not significant (aOR 0.83 (0.51-1.36)), among boys, those with low SES are less likely to have drunk alcohol at least once, compared to their peers with high SES (aOR 0.52 (0.34-0.81)).

Whereas socioeconomic differences in alcohol consumption are less pronounced, more girls and boys with low SES smoke than their peers with high SES.

### Table 1

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Age</th>
<th>SES low vs. high</th>
<th>SES medium vs. high</th>
<th>SES low vs. high</th>
<th>SES medium vs. high</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diet</td>
<td></td>
<td>aOR (95% CI)</td>
<td>aOR (95% CI)</td>
<td>aOR (95% CI)</td>
<td>aOR (95% CI)</td>
</tr>
<tr>
<td>Daily consumption of fresh fruit during 3-17</td>
<td>0.49</td>
<td>(0.39-0.61)</td>
<td>0.71</td>
<td>(0.61-0.83)</td>
<td>0.47</td>
</tr>
<tr>
<td>Daily consumption of sugary soft drinks during the past four weeks</td>
<td>6.27</td>
<td>(4.49-8.75)</td>
<td>3.97</td>
<td>(3.04-5.18)</td>
<td>5.85</td>
</tr>
<tr>
<td>Physical activity</td>
<td></td>
<td>aOR (95% CI)</td>
<td>aOR (95% CI)</td>
<td>aOR (95% CI)</td>
<td>aOR (95% CI)</td>
</tr>
<tr>
<td>Physical activity (physically active for at least 60 minutes per day)</td>
<td>1.26</td>
<td>(0.96-1.66)</td>
<td>0.88</td>
<td>(0.74-1.05)</td>
<td>1.02</td>
</tr>
<tr>
<td>Sports during leisure time</td>
<td></td>
<td>(0.20-0.35)</td>
<td>(0.47-0.71)</td>
<td>(0.23-0.40)</td>
<td>(0.48-0.73)</td>
</tr>
<tr>
<td>Body mass index</td>
<td></td>
<td>aOR (95% CI)</td>
<td>aOR (95% CI)</td>
<td>aOR (95% CI)</td>
<td>aOR (95% CI)</td>
</tr>
<tr>
<td>Overweight (according to Kromeyer-Hauschild et al. 2015 [34])</td>
<td>3.83</td>
<td>(1.90-7.72)</td>
<td>2.08</td>
<td>(1.12-3.83)</td>
<td>3.21</td>
</tr>
<tr>
<td>Kromeyer-Hauschild et al. 2015 [34])</td>
<td>0.91-17.86</td>
<td>(0.65-9.18)</td>
<td>(1.50-12.91)</td>
<td>(0.76-5.53)</td>
<td>(1.76-10.31)</td>
</tr>
<tr>
<td>Obesity (according to Kromeyer-Hauschild et al. 2015 [34])</td>
<td>4.04</td>
<td>(0.65-9.18)</td>
<td>(1.50-12.91)</td>
<td>(0.76-5.53)</td>
<td>(1.76-10.31)</td>
</tr>
<tr>
<td>Substance use</td>
<td></td>
<td>aOR (95% CI)</td>
<td>aOR (95% CI)</td>
<td>aOR (95% CI)</td>
<td>aOR (95% CI)</td>
</tr>
<tr>
<td>Current smoking</td>
<td>11-17</td>
<td>2.14</td>
<td>(1.04-4.40)</td>
<td>1.71</td>
<td>(0.98-2.98)</td>
</tr>
<tr>
<td>Alcohol consumption (lifetime prevalence)</td>
<td>11-17</td>
<td>0.83</td>
<td>(0.51-1.36)</td>
<td>1.09</td>
<td>(0.77-1.54)</td>
</tr>
</tbody>
</table>

aOR=adjusted odds ratio; SES=socioeconomic status; WHO=World Health Organization; CI=confidence interval; bold=statistically significant (p<0.05)
childhood and adolescence. Socioeconomically disadvantaged children and adolescents eat less healthy food, do less leisure time sports activities and are more prone to being overweight or obese; and they smoke more often compared to their more affluent peers. The only areas, where no such differences to the detriment of disadvantaged children and adolescents were found, are physical activity according to the WHO recommendations, and the lifetime prevalence of alcohol consumption. The two previous KiGGS Waves – the KiGGS baseline study (2003-2006) and KiGGS Wave 1 (2009-2012) – reported similar results [42, 43]. The KiGGS results are thereby highly compatible with national and international research [15, 17]. For example, the German school entry health examinations indicate that socioeconomically disadvantaged children are significantly more prone to being overweight or obese compared to those from more affluent families [44-46]. International comparative studies, such as the WHO-funded Health Behaviour in School-aged Children study (HBSC) [47], indicate, that in western industrialised nations, there are manifest social differences in the health behaviour of growing generations – usually to the detriment of children and adolescents from socioeconomically disadvantaged families [18, 48, 49].

When interpreting these findings, it is important to bear in mind that health-relevant behaviour should not be analysed without factoring in structural conditions and environmental determinants, which evidently influence behaviour [50, 51]. To a certain extent, such interdependencies can explain, why socioeconomically disadvantaged children and adolescents have a greater tendency towards risky health behaviour. Individual behaviour and complex behaviour patterns are only based on free choice to a limited degree. They are also always the result of a confrontation with the currently dominant living conditions [52]. For example, the probability of people being physically active in leisure time and the amount of time they spend active, also depends on their living environment (parks, playgrounds, sports offers, traffic and safety etc.). Conversely, the probability of having an unhealthy diet (in particular for people whose income is low) increases, if the offering in the neighbourhood consists mainly of fast food restaurants, in particular, when their products are cheaper than unprocessed fresh products such as fruit and vegetables. If the complex causes of health behaviour and the role played by living conditions (settings, material resources, education, environmental factors etc.) are not considered, there is a danger of one-sidedly blaming the victim i.e., that segment of the population, which is affected by the majority of health risks [53]. It will require comprehensive structural measures to improve the overall health behaviour of children and adolescents, and mitigate the role played by socioeconomic differences in the health behaviour of the growing generation. It is clear from past experiences that educational approaches and individual measures such as training sessions or courses, which merely aim to change the behaviour of individuals (prevention through lifestyle modification), have only a limited effect [54]. Moreover, there is a certain risk that socioeconomic differences in health behaviour further increase because disadvantaged population groups are not or not so easily reached by such measures (prevention dilemma) [51, 55, 56]. Demonstrably better results are achieved when Behavioural pre-
Socioeconomic differences in the health behaviour of children and adolescents in Germany

Promotion published in 2016, conclude that evidence so far is insufficient for developing recommendations to reduce the impact of socioeconomic differences on levels of physical activity among children and adolescents [54]. However, the literature indicates three types of interventions that could lead to more equal opportunities in society: 1. Interventions focusing on a settings approach, 2. Interventions targeted directly at socioeconomically disadvantaged individuals (target group orientation), 3. Interventions with the active participation of target groups in decisions regarding design and implementation (participation) [54]. Under the guidance of Germany’s Federal Centre for Health Education (BZgA), the co-operation network Equity in Health offers a comprehensive database of cases focused on promoting the health of disadvantaged children and adolescents, develops quality criteria and identifies projects of good practice to be recommended [62, 63]. In 2015, Germany adopted the Preventive Health Care Act, which provides additional resources for setting-oriented measures [64]. The Act obliges social insurance carriers, federal states and municipalities to work more closely together on matters relating to prevention and health promotion. It specifically highlights the importance of a settings-orientation to ‘determine health-relevant social systems’ (section 20 of the German social insurance code SGB, book V), which provide the framework for everyday conditions of living, learning and working. For different stages in life, the relevant settings and target groups are also different. As children and adolescents spend a great deal of time at child day care centres [65] and schools [66], these institutions are particularly appropriate settings for promot-

vention is supported by broader measures that target specific living conditions and/or social structures and therefore the underlying factors that influence health behaviour (settings approach). A setting approach aims to change people’s living conditions in ways that ‘make the healthier choice the easier choice’ [57]. Behavioural prevention and a setting approach are not mutually exclusive approaches, rather, they can complement each other [58]. Actually, a combination of behavioural prevention and setting approaches in the sense of a policy mix seems to be particularly promising. Several stakeholders indicate this, such as the German Alliance against Non-communicable Diseases (NCD Alliance), an association of 20 scientific medical expert panels, associations and research institutes that have been promoting sustainable and national level primary prevention in Germany since 2010 [55, 59].

After the initial results of the KiGGS baseline study became available, Germany adopted its federal government strategy to promote child health that explicitly aims to promote equal opportunities in health for children and adolescents [60]. Moreover, as part of national health targets (gesundheitsziele.de), the health and health behaviour of children and adolescents are being granted central importance. For example, the national health target ‘Grow up healthy’, created in 2003 and updated in 2010, not only promotes life competencies but also puts a focus on diet and physical activity [5]. The same applies to the national action plan IN FORM, which aims to improve dietary choices and levels of physical activity in Germany in the long-term [61]. Germany’s national recommendations for physical activity and physical activity promotion published in 2016, conclude that evidence so far is insufficient for developing recommendations to reduce the impact of socioeconomic differences on levels of physical activity among children and adolescents [54]. However, the literature indicates three types of interventions that could lead to more equal opportunities in society: 1. Interventions focusing on a settings approach, 2. Interventions targeted directly at socioeconomically disadvantaged individuals (target group orientation), 3. Interventions with the active participation of target groups in decisions regarding design and implementation (participation) [54]. Under the guidance of Germany’s Federal Centre for Health Education (BZgA), the co-operation network Equity in Health offers a comprehensive database of cases focused on promoting the health of disadvantaged children and adolescents, develops quality criteria and identifies projects of good practice to be recommended [62, 63]. In 2015, Germany adopted the Preventive Health Care Act, which provides additional resources for setting-oriented measures [64]. The Act obliges social insurance carriers, federal states and municipalities to work more closely together on matters relating to prevention and health promotion. It specifically highlights the importance of a settings-orientation to ‘determine health-relevant social systems’ (section 20 of the German social insurance code SGB, book V), which provide the framework for everyday conditions of living, learning and working. For different stages in life, the relevant settings and target groups are also different. As children and adolescents spend a great deal of time at child day care centres [65] and schools [66], these institutions are particularly appropriate settings for promot-
For central fields of health behaviour (for example diet, physical exercise and substance use), an early determination of behaviour patterns can be assumed that then become relatively stable at later stages in life. From a public health point of view, this creates the challenge (and opportunity) for achieving long-term results through co-ordinated, evidence-based interventions at childhood and adolescence. Socioeconomic differences in the health behaviour of children and adolescents demand a combination of behaviour and settings-oriented prevention measures, as well as socially sensitive prevention policies [3]. Their success should always be measured in terms of the degree to which they manage to reach socioeconomically disadvantaged population groups. In addition to health policy, further policy fields should be included in line with the Health in All Policies approach in order to anchor health-related questions and the goal of health equity at all levels and spheres of politics and society [69, 70].

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Please cite this publication as
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Data protection and ethics
KiGGS Wave 2 is subject to strict compliance with the data protection provisions set out in the Federal Data Protection Act. Hannover Medical School’s ethics committee assessed the ethics of the study and provided its approval (No. 2275-2014). Participation in the study was voluntary. The participants and/or their parents/legal guardians were also informed about the aims and contents of the study, and about data protection. Informed consent was obtained in writing.

Funding
KiGGS is funded by the Federal Ministry of Health and the Robert Koch Institute.

Conflicts of interest
The authors declared no conflicts of interest.

Acknowledgement
Foremost we would like to express our gratitude to both the participants and their parents. We would also like to thank everyone at the 167 study sites who provided us with space and active support on site.

KiGGS Wave 2 could not have been conducted without the dedication of numerous colleagues at the Robert Koch Institute. We would especially like to thank the study teams for their excellent work and their exceptional commitment during the three-year data collection phase.

References
Socioeconomic differences in the health behaviour of children and adolescents in Germany


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The subjective health of adults in Germany

Abstract
The term ‘subjective health’ reflects not only existing illnesses and health complaints, but particularly emphasizes the personal well-being. Studies often collect data on subjective health by asking participants to provide self-assessments of their general state of health. This was also the case with GEDA 2014/2015-EHIS, which employed the internationally renowned Minimum European Health Module (MEHM) as part of the study. Its results demonstrate that 68.2% of adults in Germany rate their general health as very good or good, with the remaining 31.8% rating it as fair, poor or very poor. The proportion of women who rate their general health as very good or good is slightly lower than the proportion of men who do so (66.6% compared to 69.9%). With increasing age, women and men view the condition of their general health as worsening. The study also identified educational differences which showed that men and women with low levels of education tend to rate their health worse compared to self-assessments provided by women and men with higher levels of education, and in some cases also regional differences.

Introduction
Subjective health plays an integral role in numerous population-based health studies [1]. On the one hand, it includes existing illnesses and complaints, however, it also particularly takes people’s personal well-being into account. As such, a measurable relationship exists between objective and subjective health, however, these factors are not completely identical [2]. Subjective health is often measured with the self-assessment of general health, which has been shown to be a reliable predictor of future health service utilization and mortality [3-6]. Furthermore, a correlation exists between the incidence of chronic diseases and functional impairments over time, and the ratings that a person has previously provided of their health [7, 8]. Associations also exist between health-related behaviour and the motivation that people have to adopt a health-promoting lifestyle and to actively participate in society [9, 10]. Social differences in self-assessments of general health, such as those between educational and income groups, therefore, also provide indications of health disparities, which, in turn, are reflected in socially unequal distributions of diseases, complaints and health risks and the resulting need for care [11].

Indicator
Data on subjective health was gathered for the GEDA 2014/2015-EHIS study using information provided by the respondents as part of a questionnaire that was either completed on paper or online. In accordance with World Health Organization (WHO) recommendations, respondents were
asked, ‘How is your health in general?’ [12]. They were able to select one of five predefined options: ‘very good’, ‘good’, ‘fair’, ‘bad’ or ‘very bad’. This question forms part of the internationally renowned Minimum European Health Module (MEHM), which is often used in health surveys [13]. The GEDA studies that took place in 2009, 2010 and 2012 were conducted as telephone interviews and also used this questionnaire to collect data on subjective health [14]. The results presented in the following either encompass all five answer options, or focus on the respondents who assessed their health as very good or good.

The following analyses are based on data from 23,906 participating individuals aged 18 years or older (13,077 women, 10,829 men) who provided valid information about the general state of their health. Calculations were carried out using a weighting factor that corrected the sample for deviations from the population structure (on 31 December 2014) in terms of gender, age, municipality type and level of education. The municipality type reflects the degree of urbanisation in a particular area and corresponds to the way in which urbanisation is distributed throughout Germany. The International Standard Classification of Education (ISCED) was used to classify the participants’ educational and occupational qualifications [15]. A statistically significant difference between groups was assumed to have been demonstrated if p-values were lower than 0.05.

A detailed description of the methodology employed for GEDA 2014/2015-EHIS can be found in Lange et al. 2017 [16] as well as in the article German Health Update: New data for Germany and Europe in issue 1/2017 of the Journal of Health Monitoring [17].

Results and discussion

According to the data collected for the GEDA 2014/2015-EHIS survey, 68.2% of adults in Germany rate their general health as very good or good. However, the proportion of women who do so is at 66.6% somewhat lower (Table 1) than men (69.9%, Table 2). Differences also exist between age groups: 18- to 29-year-olds most frequently rate their general health as very good or good (85.0%). Among people aged 65 or above, this is the case with just 47.5%. Moreover, a comparison of the various age groups demonstrates that the differences between women and men only exist in the youngest age group: 80.4% of women aged between 18 and 29 years rate their health as very good or good, compared to 89.3% of men in the same age group. Although the proportion of women in other age groups who rate their general health as very good or good is also slightly lower than men in the same age groups, these differences are not statistically significant.

Significant differences were identified between educational groups (Table 1 and Table 2): a total of 77.9% of people with a high level of education rate their general health as very good or good compared to just 56.5% of those with a low level of education. In addition, 68.4% of people with a medium level of education describe their general health as very good or good. This educational gradient – which disadvantages people with low levels of education – is equally evident among women and men, however, educational differences are more pronounced in some age groups than others.
The subjective health of adults in Germany

Two-thirds of adults in Germany describe their general health as very good or good.

The proportion of people who rate their health as very good decreases with age. These regional differences were identified (Figure 1). The proportion of people who rate their general health as very good or good is highest in Bavaria and Hamburg (both 71.8%) and Baden-Württemberg (71.7%). In Brandenburg, Saxony-Anhalt and Mecklenburg-Vorpommern, this proportion is lowest at 60.3%, 63.2% and 63.9%, respectively. These regional differences were identified among both women and men.

Compared to the GEDA studies that were conducted in 2009, 2010 and 2012, the proportion of women and men who rate their general health as very good or good is slightly lower in the GEDA 2014/2015-EHIS survey. However, it should be noted that previous GEDA studies were conducted as telephone interviews. The literature clearly demonstrates that survey methods have an impact on results (‘mode effect’). In this case, participants would tend to provide a more favourable assessment of their own health when questioned using telephone surveys than, for example, written surveys [18, 19]. Nevertheless, the results of the GEDA studies consistently show that the majority of adults in Germany view their own general health as very good or good. However, people who are seriously ill, impaired or in hospital may have been less likely to participate in the study. The differences in age, gender and

### Table 1

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Very good</th>
<th>Good</th>
<th>Fair</th>
<th>Bad</th>
<th>Very bad</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% (95% CI)</td>
<td>% (95% CI)</td>
<td>% (95% CI)</td>
<td>% (95% CI)</td>
<td>% (95% CI)</td>
</tr>
<tr>
<td><strong>Women (total)</strong></td>
<td>13.9 (12.2-14.7)</td>
<td>52.7 (51.6-53.7)</td>
<td>27.9 (26.9-28.9)</td>
<td>4.8 (4.3-5.3)</td>
<td>0.7 (0.6-1.0)</td>
</tr>
<tr>
<td>18-29 Years</td>
<td>24.2 (22.0-26.6)</td>
<td>56.2 (53.7-58.7)</td>
<td>17.1 (15.1-19.3)</td>
<td>2.4 (1.6-3.5)</td>
<td>0.1 (0.0-0.4)</td>
</tr>
<tr>
<td>Low education</td>
<td>20.6 (16.0-26.1)</td>
<td>49.6 (43.6-55.5)</td>
<td>25.0 (19.9-30.8)</td>
<td>4.4 (2.2-8.5)</td>
<td>0.5 (0.1-1.8)</td>
</tr>
<tr>
<td>Medium education</td>
<td>23.4 (21.0-26.1)</td>
<td>58.7 (55.3-61.9)</td>
<td>15.9 (13.5-18.6)</td>
<td>2.0 (1.2-3.4)</td>
<td>- -</td>
</tr>
<tr>
<td>High education</td>
<td>33.0 (28.3-38.0)</td>
<td>56.8 (51.5-61.9)</td>
<td>9.6 (7.0-13.0)</td>
<td>0.7 (0.2-2.0)</td>
<td>- -</td>
</tr>
<tr>
<td>30-44 Years</td>
<td>19.9 (18.3-21.5)</td>
<td>60.4 (58.2-62.5)</td>
<td>17.4 (15.8-19.2)</td>
<td>2.0 (1.4-2.7)</td>
<td>0.4 (0.2-0.7)</td>
</tr>
<tr>
<td>Low education</td>
<td>15.1 (10.6-21.1)</td>
<td>55.2 (48.6-61.7)</td>
<td>24.0 (18.5-30.7)</td>
<td>4.4 (2.5-7.6)</td>
<td>1.2 (0.4-3.8)</td>
</tr>
<tr>
<td>Medium education</td>
<td>17.0 (15.0-19.2)</td>
<td>62.0 (59.1-64.9)</td>
<td>18.7 (16.6-21.0)</td>
<td>2.0 (1.3-3.0)</td>
<td>0.2 (0.1-0.7)</td>
</tr>
<tr>
<td>High education</td>
<td>29.4 (26.1-33.0)</td>
<td>59.2 (55.5-62.7)</td>
<td>10.8 (8.9-12.9)</td>
<td>0.5 (0.2-1.2)</td>
<td>0.1 (0.0-1.0)</td>
</tr>
<tr>
<td>45-64 Years</td>
<td>12.7 (11.6-13.9)</td>
<td>54.9 (53.1-56.6)</td>
<td>27.1 (25.6-28.7)</td>
<td>4.7 (4.1-5.5)</td>
<td>0.5 (0.3-0.9)</td>
</tr>
<tr>
<td>Low education</td>
<td>9.0 (6.8-11.9)</td>
<td>47.0 (42.6-51.5)</td>
<td>34.9 (30.8-39.2)</td>
<td>7.3 (5.4-9.9)</td>
<td>1.8 (0.8-3.9)</td>
</tr>
<tr>
<td>Medium education</td>
<td>12.2 (10.8-13.7)</td>
<td>56.2 (53.9-58.4)</td>
<td>26.6 (24.7-28.7)</td>
<td>4.7 (3.9-5.7)</td>
<td>0.4 (0.2-0.7)</td>
</tr>
<tr>
<td>High education</td>
<td>17.9 (15.9-20.2)</td>
<td>57.7 (54.5-60.7)</td>
<td>21.8 (19.5-24.2)</td>
<td>2.7 (1.9-3.8)</td>
<td>- -</td>
</tr>
<tr>
<td>≥65 Years</td>
<td>4.4 (3.6-5.5)</td>
<td>41.3 (38.9-43.6)</td>
<td>44.0 (41.7-46.3)</td>
<td>8.6 (7.4-10.0)</td>
<td>1.7 (1.2-2.5)</td>
</tr>
<tr>
<td>Low education</td>
<td>4.0 (2.8-5.7)</td>
<td>34.5 (30.9-38.2)</td>
<td>49.0 (45.5-52.5)</td>
<td>10.3 (8.4-12.5)</td>
<td>2.3 (1.3-3.9)</td>
</tr>
<tr>
<td>Medium education</td>
<td>4.4 (3.2-6.0)</td>
<td>45.4 (42.3-48.5)</td>
<td>41.3 (38.1-44.6)</td>
<td>7.4 (5.7-9.5)</td>
<td>1.5 (0.9-2.7)</td>
</tr>
<tr>
<td>High education</td>
<td>6.6 (4.7-9.1)</td>
<td>50.6 (45.7-55.6)</td>
<td>34.4 (30.1-39.1)</td>
<td>7.8 (4.8-12.6)</td>
<td>0.5 (0.1-2.2)</td>
</tr>
<tr>
<td><strong>Total (women and men)</strong></td>
<td>14.8 (14.2-15.4)</td>
<td>53.4 (52.6-54.2)</td>
<td>26.3 (25.6-26.9)</td>
<td>4.8 (4.5-5.2)</td>
<td>0.7 (0.6-0.9)</td>
</tr>
</tbody>
</table>

CI = confidence interval
The subjective health of adults in Germany

### Table 2

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Very good</th>
<th>Good</th>
<th>Fair</th>
<th>Bad</th>
<th>Very bad</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men (total)</td>
<td>15.7 (14.8-16.7)</td>
<td>54.2 (53.0-55.3)</td>
<td>24.5 (23.6-25.6)</td>
<td>4.8 (4.4-5.3)</td>
<td>0.7 (0.6-1.0)</td>
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<td>0.1 (0.0-0.4)</td>
</tr>
<tr>
<td>Low education</td>
<td>28.9 (22.9-35.7)</td>
<td>53.4 (46.3-60.3)</td>
<td>16.2 (11.6-22.1)</td>
<td>1.6 (0.6-4.3)</td>
<td>-</td>
</tr>
<tr>
<td>Medium education</td>
<td>33.0 (29.3-36.9)</td>
<td>58.3 (54.1-62.4)</td>
<td>8.1 (6.2-10.5)</td>
<td>0.5 (0.2-1.0)</td>
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<td>61.4 (57.9-64.8)</td>
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<td>2.7 (1.3-5.3)</td>
</tr>
<tr>
<td>Medium education</td>
<td>8.5 (7.2-10.1)</td>
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</tr>
</tbody>
</table>

**Total (women and men)** | 14.8 (14.2-15.4) | 53.4 (52.6-54.2) | 26.3 (25.6-26.9) | 4.8 (4.5-5.2) | 0.7 (0.6-0.9) |

CI = confidence interval

People with lower levels of education rate their health worse compared to the self-assessments provided by people with higher levels of education.

In order to find concrete approaches to disease prevention, health promotion and health care measures, further analyses of specific diseases and risk factors are required.
The subjective health of adults in Germany

Figure 1
The proportion of women and men with very good or good general health according to federal state (n=13,077 women, 10,829 men)
Source: GEDA 2014/2015-EHIS

People living in Bavaria, Baden-Württemberg and Hamburg provide the most positive self-assessments of their health; the lowest ratings came from Brandenburg, Saxony-Anhalt and Mecklenburg-Vorpommern.
The subjective health of adults in Germany

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Please cite this publication as
DOI 10.17886/RKI-GBE-2018-073

References
https://edoc.rki.de/handle/176904/3266 (As at 19.02.2018)

Data protection and ethics
The GEDA study was undertaken in strict accordance with the data protection regulations set out in the German Federal Data Protection Act and was approved by the German Federal Commissioner for Data Protection and Freedom of Information. Participation in the study was voluntary. The participants were fully informed about the study’s aims and content, and about data protection. All participants provided written informed consent.

Conflict of interest
The authors declared no conflicts of interest.

Funding
The GEDA study was funded by the Robert Koch Institute and the German Federal Ministry of Health.
The subjective health of adults in Germany


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Imprint

Journal of Health Monitoring

Publisher
Robert Koch Institute
Nordufer 20
D-13353 Berlin, Germany

Editors
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Typesetting
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Translation
Simon Phillips/Tim Jack

ISSN 2511-2708

Note
External contributions do not necessarily reflect the opinions of the
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The Robert Koch Institute is a Federal Institute within
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Adult exposure to passive smoking in Germany

Abstract
Passive smoking is associated with the same consequences for health as smoking, albeit to a lesser extent. Various legislative measures have been put in place in Germany to lower exposure to passive smoking. According to data from GEDA 2014/2015-EHIS, 11.3% of non-smoking adults are regularly exposed to passive smoking in enclosed spaces, this is particularly the case with young adults. Non-smoking women who are regularly exposed to passive smoking usually come into contact with passive smoking when they are together with friends and acquaintances (51.2%). Non-smoking men most frequently face passive smoking in the work place (56.1%). People with a high level of education are much less frequently exposed to passive smoking than those with medium to lower levels of education. Action still needs to be taken to protect people against the dangers linked to passive smoking.

Introduction
Tobacco smoke is one of the leading preventable causes of illness and death [1]. About one quarter of adults around the world smoke [2]. In Germany, 23.8% of adults currently smoke [3]. The consumption of tobacco products is also widespread among young people [2]. However, there is a strong tendency in Germany towards fewer numbers of young smokers: whereas more than one in five young people and one in five 11- to 17-year-olds smoked at the beginning of the millennium, this figure has now dropped to one in fourteen [4]. Smoking not only has consequences for smokers; it also comes with significant consequences for the health of people who are regularly exposed to passive smoking.

Passive smoking is defined as the involuntary inhalation of tobacco smoke from the ambient air. This smoke comes from exhaled mainstream smoke produced by active smokers, and by sidestream smoke produced when active smokers pause between smoking and leave their tobacco products to smoulder [9]. In terms of its composition, this type of smoke does not significantly differ from the smoke inhaled by active smokers, and it contains the same toxic and carcinogenic substances [9]. Numerous studies have shown that passive smoking is associated with the same effects as smoking, albeit to a lesser extent [5, 6]. Inhalation of these substances may cause acute symptoms such as headaches, dizziness, nausea or irritation of the eyes, nasal membranes and respiratory tract. The longer-term consequences that can be caused or exacerbated by regular exposure to passive smoking include various cancers and cardiovascular diseases, asthma, and chronic obstructive pulmonary disease (COPD) [9, 10]. Children who are regularly exposed to tobacco smoke are particularly at risk because they have a faster respiratory rate and lack a fully
developed system of detoxification compared to adults [9]. Children who are regularly exposed to passive smoking are more frequently affected by conditions such as difficulty breathing, asthma, middle ear infections and upper respiratory tract infections [11-13]. Passive smoking is also a risk factor associated with sudden infant death syndrome [12, 14] and is associated with a higher risk of impaired perinatal development during pregnancy [15]. Around one in every hundred deaths worldwide is caused by exposure to passive smoking [7]. According to estimates, 3,330 passive smoking-related deaths occurred in Germany in 2005 [8]. More current estimates are not available.

Consistent smoking bans in public places, on public transport, at work, and in the gastronomy and leisure sectors can directly reduce the burden caused by tobacco smoke [16]. Over the last 15 years, various legislative measures have been put in place in Germany [6, 9, 17]. The amendment to the Arbeitsstättenverordnung in 2002 severely restricted smoking in the workplace. In 2007, the Bundesnichtraucherschutzgesetz prohibited smoking in federal government institutions and in public railway stations. Between 2007 and 2008, the federal states issued non-smoker protection laws that banned smoking in federal government institutions, as well as in educational, sports-related, cultural and health-related facilities and in the catering trade. Although most federal states provided exemptions for the catering industry, Bavaria, Saarland and North Rhine-Westphalia have implemented complete smoking bans in the bars and restaurants under their jurisdiction.

Although non-smoker protection laws are ‘only’ aimed at reducing exposure to passive smoking, by denormalising smoking in public spaces, they can contribute to an overall decline in tobacco consumption [16]. Moreover, a low level of tobacco consumption among the population is the best protection against the dangers of tobacco smoke in ambient air. In addition to the legal protection of non-smokers, various tobacco prevention measures have been implemented since the 2000s with the aim of reducing tobacco consumption in Germany [3, 17]. These include significant increases in the tax duties placed on tobacco, advertising bans, increasing the legal age for using and buying tobacco products, stronger warnings on tobacco products and expanding setting and population-based campaigns.

Indicator
The German Health Update (GEDA 2014/2015-EHIS) used a paper-based and online questionnaire to gather data about respondents’ exposure to passive smoking. The respondents were asked, ‘How often are you exposed to tobacco smoke in enclosed spaces?’ and were provided with the following response categories: ‘Never or almost never’, ‘Less than 1 hour a day’ or ‘1 hour a day or more’. The following sets out the results from these three categories and also subsumes the last two into a further category: ‘regular exposure to passive smoking’. The findings presented here only consider people who stated that they did not smoke. The results have been differentiated according to gender, age and educational level. The results for ‘regular exposure to passive smoking’ have been differentiated according to gender, educational level and place of exposure. Data on the place of exposure was collected using the question: ‘And where does this happen? ...’ The

GEDA 2014/2015-EHIS

Data holder: Robert Koch Institute

Aims: To provide reliable information about the population’s health status, health-related behaviour and health care in Germany, with the possibility of a European comparison

Method: Questionnaires completed on paper or online

Population: People aged 18 years and above with permanent residency in Germany

Sampling: Registry office sample; randomly selected individuals from 301 communities in Germany were invited to participate

Participants: 24,016 people (13,144 women; 10,872 men)

Response rate: 26.9%

Study period: November 2014 - July 2015

More information in German is available at www.geda-studie.de
A total of 8.2% of non-smoking women and 14.7% of non-smoking men are regularly exposed to passive smoking in enclosed spaces.

results and discussion
At present, 11.3% of the non-smoking adult population in Germany is exposed to passive smoking on a regular basis (Table 1 and Table 2). This includes 3.4% of non-smokers who are exposed to passive smoking for at least one hour a day and 7.9% who are exposed to passive smoking for less than one hour per day. Women are exposed less frequently to passive smoking than men (8.3% compared to 14.7%). The highest rate of exposure to passive smoking was identified among young adults aged between 18 and 29 years. Levels of exposure to passive smoking decrease with age, and this is particularly the case with people aged 65 or older. The data from GEDA 2014/2015-EHIS enables research to be undertaken regarding the places where non-smokers are exposed to passive smoking (Figure 1 and Figure 2). Women are much less likely to be exposed to passive smoking at work than men (2.2% compared to 8.2%). However, this figure underestimates the problem because it refers to the entire population [16]. Once the calculation has been limited to the population of working age (18 to 64), the proportion of non-smoking women and men exposed to passive smoking at work rises to 3.9% and 12.2%, respectively. More men than women are exposed to passive smoking in pubs, cafés, bars and clubs as well as with friends and acquaintances.

In the case of people who are regularly exposed to passive smoking, women are primarily exposed to passive smoking either when they are together with friends and acquaintances (51.2%) or at home (49.1%). In contrast, men are mainly exposed to passive smoking at work (56.1%) but also with friends and acquaintances (41.3%) (data not shown).

The data from the GEDA 2014/2015-EHIS study show clear differences according to education: both women and men with higher levels of education are exposed to passive smoking in enclosed spaces less often than those with medium to lower levels of education (Table 1 and Table 2). This difference is evident across all age groups; however, both the actual level of exposure and the differences between educational groups are markedly lower in the cases of people aged 65 years or older. The higher level of exposure to passive smoking in the lower and middle
In cases where non-smoking women are regularly exposed to passive smoking, this usually occurs together with friends and acquaintances (51.2%). In cases where non-smoking men are regularly exposed to passive smoking, this usually happens at work (56.1%).

### Table 1
Exposure to passive smoking among non-smoking women according to age and educational level (n=10,262)

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Never or almost never</th>
<th>Less than 1 hour a day</th>
<th>1 hour a day or more</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% (95% CI)</td>
<td>% (95% CI)</td>
<td>% (95% CI)</td>
</tr>
<tr>
<td>Women (total)</td>
<td>91.7 (91.0-92.4)</td>
<td>5.2 (4.7-5.7)</td>
<td>3.0 (2.6-3.6)</td>
</tr>
<tr>
<td>18-29 Years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low education</td>
<td>80.2 (77.3-82.8)</td>
<td>13.2 (11.2-15.4)</td>
<td>6.6 (4.9-8.9)</td>
</tr>
<tr>
<td>Medium education</td>
<td>80.8 (77.5-83.7)</td>
<td>13.9 (11.4-16.8)</td>
<td>5.3 (3.7-7.6)</td>
</tr>
<tr>
<td>High education</td>
<td>90.0 (86.5-92.7)</td>
<td>8.8 (6.3-12.2)</td>
<td>1.2 (0.6-2.6)</td>
</tr>
<tr>
<td>30-44 Years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low education</td>
<td>80.8 (77.5-83.7)</td>
<td>13.9 (11.4-16.8)</td>
<td>5.3 (3.7-7.6)</td>
</tr>
<tr>
<td>Medium education</td>
<td>81.1 (78.6-83.2)</td>
<td>14.7 (12.2-17.6)</td>
<td>4.2 (2.7-6.5)</td>
</tr>
<tr>
<td>High education</td>
<td>93.0 (90.5-95.3)</td>
<td>6.4 (4.8-8.3)</td>
<td>0.6 (0.2-1.2)</td>
</tr>
<tr>
<td>45-64 Years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low education</td>
<td>80.4 (77.5-83.1)</td>
<td>14.6 (12.1-17.4)</td>
<td>5.0 (3.5-7.6)</td>
</tr>
<tr>
<td>Medium education</td>
<td>81.9 (78.9-84.7)</td>
<td>13.9 (11.4-17.6)</td>
<td>4.2 (2.7-6.5)</td>
</tr>
<tr>
<td>High education</td>
<td>92.9 (90.3-95.2)</td>
<td>7.2 (4.9-10.2)</td>
<td>0.8 (0.4-1.5)</td>
</tr>
<tr>
<td>≥ 65 Years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low education</td>
<td>81.2 (79.5-82.9)</td>
<td>13.8 (12.1-15.6)</td>
<td>4.8 (3.6-7.0)</td>
</tr>
<tr>
<td>Medium education</td>
<td>82.7 (80.3-85.2)</td>
<td>14.8 (12.5-17.2)</td>
<td>4.2 (2.7-6.3)</td>
</tr>
<tr>
<td>High education</td>
<td>94.9 (92.8-96.8)</td>
<td>5.0 (3.9-6.6)</td>
<td>0.4 (0.2-1.0)</td>
</tr>
<tr>
<td>Total (women and men)</td>
<td>88.7 (88.1-89.3)</td>
<td>7.9 (7.4-8.4)</td>
<td>3.4 (3.0-3.8)</td>
</tr>
</tbody>
</table>

CI=confidence interval
Table 2
Exposure to passive smoking among non-smoking men according to age and educational level (n=8,109)
Source: GEDA 2014/2015-EHIS

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Never or almost never</th>
<th>Less than 1 hour a day</th>
<th>1 hour a day or more</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% (95% CI)</td>
<td>% (95% CI)</td>
<td>% (95% CI)</td>
</tr>
<tr>
<td>Men (total)</td>
<td>85.3 (84.3-86.3)</td>
<td>10.9 (10.0-11.8)</td>
<td>3.8 (3.3-4.4)</td>
</tr>
<tr>
<td>18-29 Years</td>
<td>73.3 (69.7-76.6)</td>
<td>20.4 (17.4-23.6)</td>
<td>6.4 (4.7-8.7)</td>
</tr>
<tr>
<td>Low education</td>
<td>71.6 (63.1-78.9)</td>
<td>20.2 (14.2-27.9)</td>
<td>8.2 (4.8-13.8)</td>
</tr>
<tr>
<td>Medium education</td>
<td>71.2 (66.8-75.3)</td>
<td>21.7 (17.9-25.9)</td>
<td>7.1 (4.9-10.3)</td>
</tr>
<tr>
<td>High education</td>
<td>83.7 (77.2-88.6)</td>
<td>15.8 (10.9-22.3)</td>
<td>0.5 (0.1-2.6)</td>
</tr>
<tr>
<td>30-44 Years</td>
<td>83.7 (81.1-86.0)</td>
<td>12.0 (10.0-14.4)</td>
<td>4.2 (3.1-5.8)</td>
</tr>
<tr>
<td>Low education</td>
<td>83.9 (74.1-90.5)</td>
<td>12.6 (6.8-22.2)</td>
<td>3.5 (1.1-10.1)</td>
</tr>
<tr>
<td>Medium education</td>
<td>78.0 (74.2-81.4)</td>
<td>15.8 (12.7-19.5)</td>
<td>6.2 (4.3-8.9)</td>
</tr>
<tr>
<td>High education</td>
<td>92.3 (89.7-94.3)</td>
<td>6.2 (4.4-8.7)</td>
<td>1.5 (0.8-2.8)</td>
</tr>
<tr>
<td>45-64 Years</td>
<td>85.8 (84.2-87.2)</td>
<td>10.8 (9.5-12.2)</td>
<td>3.4 (2.7-4.4)</td>
</tr>
<tr>
<td>Low education</td>
<td>76.7 (70.1-82.3)</td>
<td>15.5 (11.2-21.2)</td>
<td>7.8 (4.8-12.3)</td>
</tr>
<tr>
<td>Medium education</td>
<td>82.8 (80.4-85.0)</td>
<td>13.5 (11.6-15.7)</td>
<td>3.7 (2.7-5.1)</td>
</tr>
<tr>
<td>High education</td>
<td>92.9 (91.1-94.3)</td>
<td>5.2 (4.0-6.7)</td>
<td>1.9 (1.2-3.1)</td>
</tr>
<tr>
<td>≥ 65 Years</td>
<td>93.0 (91.8-94.1)</td>
<td>4.5 (3.7-5.6)</td>
<td>2.4 (1.8-3.2)</td>
</tr>
<tr>
<td>Low education</td>
<td>92.5 (89.5-94.8)</td>
<td>5.1 (3.4-7.7)</td>
<td>2.3 (1.1-4.7)</td>
</tr>
<tr>
<td>Medium education</td>
<td>93.1 (91.2-94.6)</td>
<td>4.5 (3.3-6.1)</td>
<td>2.5 (1.6-3.7)</td>
</tr>
<tr>
<td>High education</td>
<td>93.2 (91.1-94.8)</td>
<td>4.4 (3.2-6.2)</td>
<td>2.4 (1.6-3.6)</td>
</tr>
<tr>
<td>Total (women and men)</td>
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<td>3.4 (3.0-3.8)</td>
</tr>
</tbody>
</table>

CI=confidence interval
Adult exposure to passive smoking in Germany

Non-smoking women and men with higher levels of education are much less frequently exposed to passive smoking than those with medium to lower levels of education.

educational groups among non-smoking women is primarily due to the fact that they face an increased level of exposure at home and together with friends and acquaintances (Figure 1). Among non-smoking men, this difference can be explained by their higher level of exposure to passive smoking at work (Figure 2).

Although various studies provide an indication of temporal developments and trends in terms of passive smoking among adults, no long-term time series are currently available [6]. Data from previous GEDA survey waves demonstrate that the proportion of non-smoking adults exposed to passive smoking at least one day a week decreased from 33% to 27% between 2009 and 2012. However, since GEDA 2014/2015-EHIS employed different questions and answer categories in accordance with changes made to the European Health Interview Survey [20], these data are not comparable with those from previous GEDA surveys. Consequently, the data gathered from GEDA 2014/2015-EHIS cannot be used to study developments over time or trends in passive smoking. Data from the Epidemiological Survey on Substance Abuse also show a reduction in the level of exposure to passive smoking since the introduction of legislation protecting non-smokers. Whereas in 2006, 31% of the working population and trainees were exposed to passive smoking in the workplace, by 2009, this rate had dropped to 15%. Furthermore, the proportion of the non-smoking population exposed to passive smoking decreased from 27% to 14% during the same period; however, the proportion of non-smoking women and men exposed to tobacco smoke at home remained relatively constant (2006 11%, 2009 10%) [21, 22]. Data from two waves of the “Gesundheitsmonitor” also show a significant decrease in exposure to passive smoking between 2007 and 2014 at work, at home and during leisure time [23].

Even if it is difficult to quantify the effectiveness of individual measures, the declining trend in passive smoking, which is also evident among children and adolescents [24, 25], can be viewed as the result of improved protection for non-smokers, and stronger tobacco prevention policies in Germany. Despite these successes, there is still considerable room for improvement when it comes to non-smoker protection and prevention policy, such as in terms of nationwide advertising bans on tobacco products [26]. Major players in the field of tobacco prevention are calling for the current climate of acceptance regarding smoking bans among the population to be used to enforce uniform, nationwide non-smoking protection measures and to remove exemptions in the catering trade and the broader workplace [23, 27].

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Please cite this publication as
Adult exposure to passive smoking in Germany.
DOI 10.17886/RKI-GBE-2018-074
Data protection and ethics
The GEDA study was undertaken in strict accordance with the data protection regulations set out in the German Federal Data Protection Act and was approved by the German Federal Commissioner for Data Protection and Freedom of Information. Participation in the study was voluntary. The participants were fully informed about the study’s aims and content, and about data protection. All participants provided written informed consent.

Conflict of interest
The authors declared no conflicts of interest.

Funding
The GEDA study was funded by the Robert Koch Institute and the German Federal Ministry of Health.

References
FACT SHEET

Adult exposure to passive smoking in Germany


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Imprint

Journal of Health Monitoring

Publisher
Robert Koch Institute
Nordufer 20
D-13353 Berlin, Germany

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ISSN 2511-2708

Note
External contributions do not necessarily reflect the opinions of the
Robert Koch Institute.

The Robert Koch Institute is a Federal Institute within
the portfolio of the German Federal Ministry of Health