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Editorial: New information from and about the KiGGS study

This issue of the Journal of Health Monitoring focuses on one main topic: presenting the very first results from KiGGS Wave 2. After the first population-based health examination survey for children and adolescents (KiGGS baseline study) and its first follow-up survey (KiGGS Wave 1), many people are looking forward to the results of KiGGS Wave 2 – not just epidemiologists, but also (health) policy makers, paediatricians, representatives of the public health service, health insurers and also many parents. As the people responsible for planning and implementing KiGGS Wave 2, we certainly feel the same way. The eagerness with which everyone is awaiting the results reflects the relevance of this study. Information about the effectiveness of interventions and preventive measures, about whether the goals and sub-goals defined in the national health target 'Growing up healthy' have been achieved, and about developments in health during the transition from adolescence to adulthood can help deliver a strong foundation for the future promotion of the health of children and adolescents living in Germany. We could have continued working on the preparation and quality assurance of our data for several more months before presenting as many findings as possible as part of a single 'major' project. Instead, we have decided to hold a public symposium under the motto 'New information from and about the KiGGS study' on March 15, 2018 and to publish the first findings from KiGGS Wave 2 in this issue of the Journal of Health Monitoring. It will be followed up by a series of further issues that set out the results.

The articles in the current issue on the 'cross-sectional' and 'longitudinal' components of KiGGS (KiGGS Wave 2 cross-sectional study – participant acquisition, response rates and representativeness, KiGGS Wave 2 longitudinal component – data collection design and developments in the numbers of participants in the KiGGS cohort) lay the foundations for understanding and classifying further results from KiGGS Wave 2. This is essential because KiGGS is a highly complex study consisting of two components and two different concerns.

On the one hand, we want to present representative findings about the health and health-related behaviour of the next generation: how high is the proportion of overweight or obese children and adolescents? Has this percentage continued to increase over the last eleven years or has the increase been stopped? Do more or fewer teenagers smoke today? Which developments have taken place in relation to physical activity? In short: is the health of children and adolescents in Germany getting better or worse? And, have prevention measures already begun to show results? Our population-based cross-sectional data can be used to draw conclusions about trends such as these. As part of the health monitoring framework, KiGGS is focused on one of the most important fields of action in public health: monitoring the health and the health-

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related behaviour of a vital section of the population – children and adolescents. Studies such as KiGGS always leave us better informed than we were before they were undertaken; for instance, changes in the educational and social structures always have an impact on health and they are reflected in our results.

The other – no less important – set of issues covered by the study are the developments in health that occur during the life course. If we are to understand when is the most favourable window to implement preventive measures and interventions or to set the course for health-related behaviour in years to come, we will need more than just a description of trends. What are the chances of an obese child having a normal weight during adulthood? At what age is smoking particularly dangerous, because after that, it becomes very difficult to quit? Is there a specific influencing factor, which, in the presence of allergic sensitisation, later leads to allergic diseases and the symptoms that they are associated with? These questions can be answered using data from the second component of KiGGS Wave 2 – the KiGGS cohort.

Data for 'our' KiGGS cohort is collected from the children and adolescents who took part in the KiGGS baseline study between 2003 and 2006. During the baseline study, we asked the participants whether they would be willing to take part in the cohort – we received an overwhelmingly positive response. Nevertheless, it was and will continue to be difficult to integrate people who are now between 10 and 31 years of age into our study. This problem was further complicated by the study design of KiGGS Wave 2: in order to improve field-work efficiency and minimise costs, the examinations were conducted in the same 167 sample points used for the baseline study. There, examinations were undertaken for the participants of the new cross-sectional sample as well as the children, adolescents and young adults from the KiGGS cohort. This decision came with a price: on the one hand, it made the work of the field teams, the study office and the home visits prior to the survey enormously complex, employing various instruments during the examinations and interviews required a lot of concentration and could not be allowed to have an impact on each of the other parts of the study. It was not possible to achieve this equally well in every case and at all locations. On the other hand, establishing examination centres in the 167 sites where the KiGGS baseline study was conducted came with a disadvantage for the young adults belonging to the cohort, as they were often unable to participate in on-site examinations. Young adults are a highly mobile group and a large proportion of the cohort no longer lives in the locations where they were examined for the baseline study – the 167 places of residence at the beginning of the study have now transformed into almost 2,000. As such, we could only write to the participants who had moved away, send them a questionnaire, and ask them to return it. Unfortunately, in many cases this meant that a central aspect of the study was missing – the examination. A lot of effort was put into encouraging the participants to fill out the questionnaire online within an extension period. Since the cohort is such a valuable component of KiGGS and remains unique in Germany, the follow-ups were only finished in August 2017. This is why for the KiGGS symposium and this issue of the Journal of Health Monitoring, analyses on topics from the interviews could only be performed using data from

the KiGGS baseline study and KiGGS Wave 1. The cohort interview data from KiGGS Wave 2 are simply not ready. For the participants who were examined in the study centres, however, the cohort data set from KiGGS Wave 2 was ready earlier, and this means that it was possible to calculate transition probabilities for overweight and obesity, for example. For the participants who also submitted a blood sample, laboratory parameters could be analysed to study developments that had occurred between the two points in time. The corresponding 'laboratory data set' has got again a different sample size. In order to spare Journal readers and participants at the KiGGS Symposium any confusion, the various data sets – including sample sizes – are set out in Table 1.

In addition, the urgent need to be able to plan the future of the KiGGS study also influenced our decision to publish results from both the cohort and the cross-sectional component in a timely manner. We will be able to run KiGGS as a cross-sectional study and finance it with the help of the Federal Ministry of Health as long as observing the health of children and adolescents in Germany continues to be a defined task within the framework of Federal Health Monitoring. At the same time, the participants of the KiGGS baseline study will probably all be of adult age by the time the next wave is conducted; strictly speaking, this will make the study's subtitle 'German Health Interview and Examination Survey for Children and Adolescents' obsolete. It is clear that this part of KiGGS can no longer be funded using financing from our health monitoring system. However, in our view, and from the perspective of public health, this part of the study is very important, highly valuable, and unique even at the international level. We will also have to change the design of this part of the study (which brings to an end the principle of undertaking examinations in examination centres) and employ different methods to those that have been used so far (will we succeed in decentralising measurements, obtaining information using health apps and binding young adults to the study through cleverly chosen incentives?). As such, the questions employed in the study and the methods of analysis will change; in fact, this has already begun to take place. The first three waves of examinations and interviews, which also contain information obtained through the parents, generated about 200 million data points. We are currently in the process of using a doctoral project to develop new methods of digital epidemiology, machine learning and pattern recognition to identify correlations at the descriptive level. We then intend to model and test the results using classical epidemiological methods. Incidentally, our cohort dataset holds so much potential and is so complex and valuable that we will soon begin to undertake joint analyses through cooperation agreements as part of in-depth analysis projects.

In addition to information on health status and health-related behaviour, which we would very much like to continue collecting for life course research, we will also be adding new content that reflects the changing living and working environments of young adults. We are highly enthusiastic about our work and have numerous new ideas that we would like to implement. The sword of Damocles hanging over the study – our lack of funding – means that we will have to consider all of the options for financing if we are to continue the cohort study.

In the meantime, and until we solve the problem of financing, we will continue to do our utmost to hold on to

our 'original KiGGS participants', to contact them and to interest and motivate them with our exciting results. We have also produced a results booklet from the findings published in this issue, and we would be very happy to send you a copy. Finally, if you have any further ideas about how KiGGS could be continued, we would very much like to hear about them.

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Table 1
Overview of the numbers of participants in the KiGGS cross-sectional study and the KiGGS cohort according to study wave
Source: KiGGS baseline study (2003-2006), KiGGS Wave 1 (2009-2012), KiGGS Wave 2 (2014-2017)

	KiGGS baseline study (cross-sectional and longitudinal components)	KiGGS Wave 1 (cross-sectional component)	KiGGS Wave 1 (longitudinal component)	KiGGS Wave 2 (cross-sectional component)	KiGGS Wave 2 (longitudinal component)
Age group (years)	0-17	0-17	6-24	0-17	10-31
Participants in the study (total)	17,641	12,368	11,992	15,023	10,853
Participants in interviews and examinations	17,641	–	–	3,567	6,465
Participants with blood tests	14,386	–	–	3,016	6,044
Cohort participants with an interview	100%	–	68.0%	–	61.5%
Cohort participants with an interview and examination	100%	–	–	–	36.6%

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The general health of children and adolescents in Germany. Results of the cross-sectional KiGGS Wave 2 study and trends

Abstract

Data from KiGGS Wave 2 show that 95.7% of parents who participated in the survey rated the overall health of their 3 to 17 year-old children as very good or good. This proportion is higher than the figures identified by the KiGGS baseline study across all age groups. The proportion of children rated as in very good health is highest among 3 to 6 year-olds and decreases with age. Among 14 to 17 year-olds, the proportion of girls in very good health is well below the level found among boys. A pronounced social gradient is still clear from the data: the proportion of parents who assess the overall health of their children as very good or good rises with increasing social status. This highlights the need for strategies to reduce health inequalities that involve society as a whole, and the need for target group-specific measures in prevention and health promotion.

GENERAL HEALTH · CHILDREN AND ADOLESCENTS · SUBJECTIVE HEALTH · HEALTH MONITORING

Background

Good general health is an important resource in helping young people to successfully tackle the numerous developmental tasks they face during childhood and adolescence. Moreover, a good state of health – defined broadly – can also be understood as demonstrating that these developmental tasks have been tackled successfully. Adverse health effects that appear at an early age can continue from childhood through adolescence and into adulthood, and encourage the emergence of and reinforce long-term health problems [1].

Subjective assessments of general health are an integral aspect of many health surveys. Data collection is facilitated by means of a simple question. The comprehensive assessments of a person's own or a child's health are complex indicators as they include both objective and subjective aspects of health, and have no set time scale. However, studies of adults have repeatedly shown that self-rated health is a good predictor of morbidity in later life, increased uptake of health care and even mortality [2, 3]. There is also a correlation between self-rated health and physical and mental illnesses, psychological and social well-being, as well as health-related behaviour and the use of health services among children and adolescents [4, 5]. Nevertheless, studies that consider the prognostic value of general health as an indicator in children and adolescents are still rare. In Germany, data from the KiGGS cohort has shown that self-rated adolescent general health has a predictive value for the later onset of chronic illness and the use of health services, and that the information supplied by parents can also provide important indications about future health developments [6].

Studie zur Gesundheit von Kindern und Jugendlichen in Deutschland

KiGGS Wave 2

Second follow-up to the German Health Interview and Examination Survey for Children and Adolescents

Data owner: Robert Koch Institute

Aim: Providing reliable information on health status, health-related behaviour, living conditions, protective and risk factors, and health care among children, adolescents and young adults living in Germany, with the possibility of trend and longitudinal analyses

Study design: Combined cross-sectional and cohort study

Cross-sectional study in KiGGS Wave 2
Age range: 0-17 years
Population: Children and adolescents with permanent residence in Germany
Sampling: Samples from official residency registries - randomly selected children and adolescents from the 167 cities and municipalities covered by the KiGGS baseline study
Sample size: 15,023 participants

KiGGS cohort study in KiGGS Wave 2
Age range: 10-31 years
Sampling: Re-invitation of everyone who took part in the KiGGS baseline study and who was willing to participate in a follow-up
Sample size: 10,853 participants

KiGGS survey waves
- KiGGS baseline study (2003-2006), examination and interview survey
- KiGGS Wave 1 (2009-2012), interview survey
- KiGGS Wave 2 (2014-2017), examination and interview survey

More information is available at www.kiggs-studie.de/english

Indicator and methodology

The German Health Interview and Examination Survey for Children and Adolescent (KiGGS) is part of the health monitoring programme undertaken at the Robert Koch Institute. The survey involves repeated cross-sectional surveys of children and adolescents aged between 0 and 17 (KiGGS cross-sectional study) that are representative of the German population. After carrying out the baseline study as an interview and examination survey (between 2003 and 2006) and KiGGS Wave 1 as an interview-based survey (between 2009 and 2012), KiGGS Wave 2 took place between 2014 and 2017 as a combined examination and interview survey.

A detailed description of the methodology used in KiGGS Wave 2 can be found in New data for action. Data collection for KiGGS Wave 2 has been completed in issue S3/2017 as well as KiGGS Wave 2 cross-sectional study – participant acquisition, response rates and representativeness in issue 1/2018 of the Journal of Health Monitoring [9, 10].

KiGGS Wave 2 collected data via parental assessments of the general health of their 0 to 17 year-old children and through self-assessments of health made by 11 to 17 year-olds using a written questionnaire [7]. According to a wording recommended by the World Health Organization (WHO) [9], the participants were asked, 'How is your child's health in general?' or, if applicable, 'How is your health in general?'. The respondents were given a response scale consisting of five possible answers: 'very good', 'good', 'fair, 'bad' and 'very bad'.

This article employs information provided by parents on the general health of their 3 to 17 year-old children, as data is available for this entire age range, unlike the self-reported data collected from older children and adolescents. The analyses are based on valid data from 13,315 adolescents (6,682 girls, 6,633 boys). In the following, the five-step response scale is grouped into three categories ('fair, 'bad' and 'very bad' were grouped into one category) and the data is arranged according to gender, age and socioeconomic status (SES) [10]. In addition, the response categories 'very good' and 'good' were summarised to aid comparison of data from the KiGGS baseline study with KiGGS Wave 2. The analyses were stratified by age and gender.

The calculations were carried out using a weighting factor that corrects deviations within the sample from the population structure with regard to age in years, gender, federal state, nationality and the parents' educational distribution (Microcensus 2013 [11]).

A statistically significant difference between groups is assumed to have been demonstrated in cases where a p-value (after weighting and the survey design have been taken into account) was lower than 0.05.

Results and discussion

The information provided by parents demonstrates that 95.7% of children and adolescents aged between 3 and 17 have good or very good health. If all age groups are considered together, no significant gender difference was found among the children with good or very good health. However, differences were identified according to age and gender in the five-step response categories, and this was particularly the case with very good health. Among both girls and boys, the proportion of children rated as having very good health is highest among 3 to 6 year-olds; this rate

More than 95% of parents who participated in KiGGS Wave 2 rate the general health of their 3 to 17 year-old children as 'very good' or 'good'. This figure is higher in all age groups than the rate identified by the KiGGS baseline study.

The proportion of children rated as in 'very good' health is highest among 3 to 6 year-olds and decreases with age.

decreases with age (Table 1). However, parents of girls aged 10 or under are more likely to rate their general health as very good in comparison with boys.

As was the case with the data from 2003 to 2006 [12, 13], the proportion of girls aged between 14 and 17 with very good health (45.3%) is significantly lower than the rate identified among boys (52.4%). In this age group, the proportion of girls with very good health is lower than the proportion of those with good health; moreover, the proportion of girls aged 14 to 17 with fair or bad health is well above the level found among younger girls (Table 1). Similarly, a decline in the proportion of boys with very good health was also identified; however, as there was a particular increase in the proportion of boys with good health, the proportion of boys with fair or bad health across all age groups increased only slightly (Table 1).

The latest information provided by parents on the general health of adolescents supports the findings from the KiGGS baseline study, and, therefore, the self-assessments made by the adolescents themselves: girls aged between

	Very good		Good		Fair/Bad/Very bad	
	%	(95% CI)	%	(95% CI)	%	(95% CI)
Girls (total)	**58.0**	**(56.1-59.9)**	**37.9**	**(36.3-39.7)**	**4.0**	**(3.4-4.7)**
Age						
3-6 Years	67.0	(63.3-70.5)	30.2	(27.0-33.6)	2.7	(1.7-4.4)
7-10 Years	63.9	(60.7-67.0)	33.4	(30.4-36.5)	2.7	(1.9-3.7)
11-13 Years	57.0	(53.7-60.3)	39.5	(36.3-42.7)	3.5	(2.5-4.9)
14-17 Years	45.3	(42.2-48.3)	48.0	(44.8-51.2)	6.8	(5.3-8.5)
Socioeconomic status						
Low	50.4	(45.6-55.2)	42.8	(38.3-47.5)	6.8	(5.1-9.0)
Medium	56.7	(54.6-58.8)	39.4	(37.4-41.4)	3.9	(3.2-4.6)
High	71.3	(68.7-73.8)	27.6	(25.2-30.2)	1.0	(0.6-1.7)
Boys (total)	**56.2**	**(54.2-58.1)**	**39.2**	**(37.3-41.2)**	**4.6**	**(3.8-5.5)**
Age						
3-6 Years	61.9	(58.5-65.2)	34.0	(30.8-37.4)	4.1	(2.9-5.8)
7-10 Years	56.5	(53.2-59.8)	39.1	(35.9-42.4)	4.3	(3.0-6.4)
11-13 Years	54.0	(50.5-57.5)	40.8	(37.5-44.2)	5.2	(3.7-7.3)
14-17 Years	52.4	(48.8-56.0)	42.8	(39.3-46.5)	4.8	(3.3-6.9)
Socioeconomic status						
Low	46.7	(42.4-51.1)	44.8	(40.2-49.4)	8.5	(6.2-11.6)
Medium	56.0	(53.7-58.3)	39.7	(37.4-42.1)	4.2	(3.4-5.2)
High	66.1	(63.3-68.9)	32.2	(29.6-35.0)	1.6	(1.0-2.5)
Total (Girls and Boys)	**57.1**	**(55.6-58.5)**	**38.6**	**(37.3-40.0)**	**4.3**	**(3.8-4.9)**

CI=confidence interval

Table 1
Prevalence of parent-rated general health according to gender, age and socioeconomic status (n=6,682 girls, n=6,633 boys)
Source: KiGGS Wave 2 (2014-2017)

Figure 1
Prevalence of parent-rated very good or good general health according to age, comparing data from the KiGGS baseline study (n=7,173) and KiGGS Wave 2 (n=6,682) for 3 to 17 year-old girls
Source: KiGGS baseline study (2003-2006), KiGGS Wave 2 (2014-2017)

Parents of 14 to 17 year-old children rate the general health of girls as 'very good' much less frequently than they do with boys.

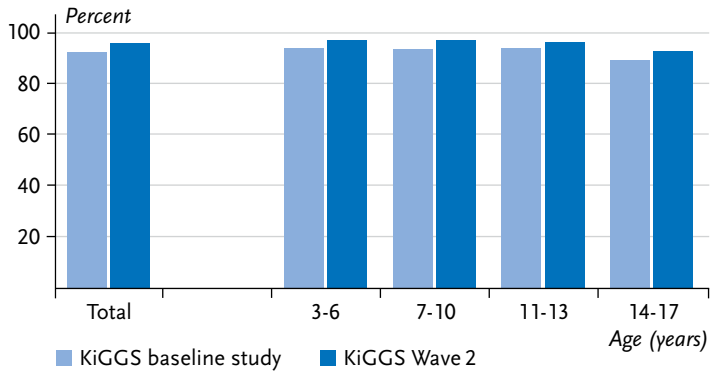
Figure 2
Prevalence of parent-rated very good or good general health according to age, comparing KiGGS baseline study (n=7,457) and KiGGS Wave 2 (n=6,633) for 3 to 17 year-old boys
Source: KiGGS baseline study (2003-2006), KiGGS Wave 2 (2014-2017)

14 and 17 rate their health as fair or very bad significantly more often than boys [14]. In addition, this difference in self-rated health between adolescent boys and girls is also clear from current data from KiGGS Wave 2 (data not shown). The data collected for the KiGGS study over the years demonstrate a phenomenon that has been identified in other countries: whereas a similar proportion of girls and boys aged 13 or below rate their health as fair or bad, about twice as many girls as boys do so during adolescence [1].

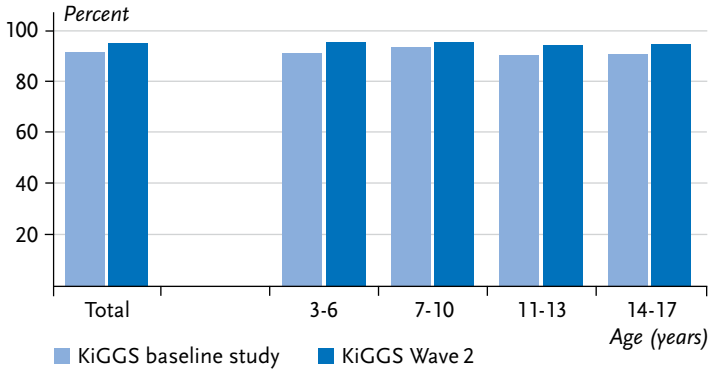
Debates about these issues focus on explanations such as the fact that developmental tasks not only become more complex during adolescence but also more gender-specific and that girls and boys face different forms of physiological and psychological stress during this time [15]. In addition, gendered differences in the perception and management of these demands and pressures are also under discussion as possible explanations [16, 17].

The data from KiGGS Wave 2, like the data from previous KiGGS surveys, emphasise that the chances of growing up in very good or good health are not evenly distributed: a highly pronounced social gradient still exists between boys and girls from families with high, medium and low social status. As a result, the proportion of parents who assess their children's overall health as very good or good increases with rising social status [10].

Over the last ten years, the data collected for the KiGGS study during its three survey periods – the KiGGS baseline study, KiGGS Wave 1 and KiGGS Wave 2 – show that parents are increasingly assessing the general health of the vast majority of children and adolescents in Germany in more favourable terms [13]. This is demonstrated by the fact that KiGGS Wave 2 (Figure 1 and Figure 2) identified



a significantly higher rate than the KiGGS baseline study. However, an analysis that differentiates between the subjective and objective aspects of this trend cannot be conducted using data on self-rated health alone [18, 19]. Instead, overall developments in KiGGS indicators on physical and mental health, health-related quality of life and living conditions also need to be considered, as they provide valuable information for comprehensive health monitoring over time. Undoubtedly, however, subjective health remains an important integrative indicator that can be used to assess



the health of children and adolescents in Germany – as the analyses differentiated according to gender, age and social status make clear. For example, current evidence suggests that parents with a low social status are significantly more likely to assess the health of their children as fair, bad, or very bad than parents from medium or high status groups. This underscores the need for strategies to reduce health inequalities that involve society as a whole, and the need for target group-specific measures in prevention and health promotion [10].

Overall, the population-based, cross-sectional data from KiGGS Wave 2 provide information about the current health of the population and factors associated with health and health-related behaviour. As such, they enable analyses of developments to be conducted over time. Research still needs to be undertaken into the factors that promote the healthy development of children and adolescents into young adulthood despite difficult individual social and health conditions. Also factors which could be used as starting points for target group-specific interventions need to be identified. Consequently, evaluations of the existing interview and examination data gathered recurrently from the participants of the KiGGS cohort are needed and additional data gained from a continued study of the KiGGS cohort will help to contribute towards resolving these issues in the future.

The proportion of parents who rate their children's overall health as 'very good' or 'good' increases with rising social status.

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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.

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Conflicts of interest

The authors declared no conflicts of interest.

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Overweight and obesity among children and adolescents in Germany. Results of the cross-sectional KiGGS Wave 2 study and trends

Abstract

For some time, there have been indications that the prevalence of overweight and obesity among children and adolescents in Germany has stabilised at a high level. The second wave of the German Health Interview and Examination Survey for Children and Adolescents (KiGGS Wave 2, 2014-2017) once again provides nationwide measurements on height and weight of children and adolescents aged 3 to 17 years. The results are confirming this trend. The prevalence of overweight is 15.4% and 5.9% for obesity. There are no differences between girls and boys. Overweight and obesity prevalence increases with age. Children and adolescents with low socioeconomic status (SES) are more likely to be overweight and obese than those with high SES. Compared to the KiGGS baseline study (2003-2006), there was no further increase in overweight and obesity prevalence overall and in all age groups.

OVERWEIGHT · OBESITY · EXAMINATION SURVEY · HEALTH MONITORING · KIGGS

Background

The high prevalence of overweight and obesity in childhood and adolescence is a global health problem and a major public health challenge in the 21st century. The prevention of excessive weight gain in children and adolescents has a high relevance for various reasons: Children with overweight and obesity are more likely to suffer from cardiovascular risk factors such as high blood pressure, as well as disorders in lipid and in glucose metabolism, when compared to their normal-weight peers [1]. In addition, a high body mass index (BMI) in childhood and adolescence is associated with a higher likelihood of type 2 diabetes, hypertension and cardiovascular disease in adulthood [2]. Furthermore, overweight and obesity in children and adolescents are associated with a significant reduction in quality of life [3] and a higher risk of bullying [4].

Since the mid-1970s, an increase in the prevalence of overweight and obesity among children and adolescents has been observed worldwide [5]. However, since the beginning of the 2000s, it has become apparent for many high-income countries that the trend of increasing overweight and obesity prevalences is not continuing [6, 7]. There are also indications for Germany that the prevalences are not increasing, or that the trend is slowing down, or even levelling off [8-13].

According to the results of the German Health Interview and Examination Survey for Children and Adolescents (KiGGS baseline study), which was conducted between 2003 and 2006, a total of 15% of children and adolescents aged 3 to 17 years were either overweight or obese. Obesity was observed in 6.3% of children and adolescents [14]. From the first follow-up survey (KiGGS Wave 1), which took

Studie zur Gesundheit von Kindern und Jugendlichen in Deutschland

This article has been corrected as of July 19, 2018 (see erratum, page 22)

KiGGS Wave 2

Second follow-up to the German Health Interview and Examination Survey for Children and Adolescents

Data owner: Robert Koch Institute

Aim: Providing reliable information on health status, health-related behaviour, living conditions, protective and risk factors, and health care among children, adolescents and young adults living in Germany, with the possibility of trend and longitudinal analyses

Study design: Combined cross-sectional and cohort study

Cross-sectional study in KiGGS Wave 2
Age range: 0-17 years
Population: Children and adolescents with permanent residence in Germany
Sampling: Samples from official residency registries - randomly selected children and adolescents from the 167 cities and municipalities covered by the KiGGS baseline study
Sample size: 15,023 participants

KiGGS cohort study in KiGGS Wave 2
Age range: 10-31 years
Sampling: Re-invitation of everyone who took part in the KiGGS baseline study and who was willing to participate in a follow-up
Sample size: 10,853 participants

KiGGS survey waves
- KiGGS baseline study (2003-2006), examination and interview survey
- KiGGS Wave 1 (2009-2012), interview survey
- KiGGS Wave 2 (2014-2017), examination and interview survey

More information is available at www.kiggs-studie.de/english

place between 2009 and 2012, self-reported data on body height and weight were available, complemented by measured values from a subsample. In order to compare the self-reported data with the measured values of the KiGGS baseline study, the self-reported data were adjusted using a correction formula. The prevalence of overweight and obesity among children and adolescents had not increased further, but they were still at a high level [9, 10].

With KiGGS Wave 2, which was conducted between 2014 and 2017, measurements on height and weight of children and adolescents aged 3 to 17 years living in Germany are now available again. Thus, the most recent national population-based estimates of overweight and obesity can be provided and the development since the last survey eleven years ago can be reported.

Indicator and methodology

KiGGS is part of the health monitoring system undertaken at the Robert Koch Institute. It includes repeated cross-sectional surveys that are representative for children and adolescents aged between 0 and 17 years in the German population (KiGGS cross-sectional study). After conducting the baseline study as an interview and examination survey between 2003 and 2006, and KiGGS Wave 1 as an interview-based survey between 2009 and 2012, KiGGS Wave 2 was conducted between 2014 and 2017 as a combined interview and examination survey.

A detailed description of the methodology used in KiGGS Wave 2 can be found in New data for action. Data collection for KiGGS Wave 2 has been completed in issue S3/2017 as well as KiGGS Wave 2 cross-sectional study – participant acquisition, response rates and representativeness in issue 1/2018 of the Journal of Health Monitoring [15, 16].

In the physical examination component of KiGGS Wave 2, standardised measurements of body height and weight of participants aged 3 to 17 years were obtained. The body mass index (BMI, kg/m²) was calculated from body weight divided by the square of body height. 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 years, BMI percentile curves from a reference population, taking age and gender into account, are used to classify an individual BMI value. In Germany, overweight and obesity are based on the national reference percentiles according to Kromeyer-Hauschild [17, 18]. Children and adolescents are defined as overweight if their BMI is above the 90th age- and gender-specific percentile. A BMI above the 97th percentile is defined as obesity.

The analyses are based on data from 3,561 participants (1,799 girls and 1,762 boys) aged 3 to 17 years with valid measurements of height and weight. The results are presented as prevalences (frequencies) stratified by gender, age and socioeconomic status (SES) [19].

In the calculations a weighting factor was used to correct for deviations of the sample from the German population with regard to age, gender, federal state, German nationality as well as the distribution of parental levels of education (Microcensus 2013 [20]).

This article reports the prevalences with 95% confidence intervals (95%CI). The calculation of trends between the KiGGS baseline study and KiGGS Wave 2 is based on

KiGGS Wave 2 (2014-2017) once again provides measurements on height and weight of 3 to 17 year-old children and adolescents living in Germany.

The prevalence of overweight (including obesity) in girls and boys aged 3 to 17 years is 15.4% and the prevalence of obesity is 5.9%.

age-standardised prevalence for both survey points and differences were tested through univariable logistic regression. Differences between groups are interpreted as statistically significant if the calculated p-value is smaller than 0.05 taking weighting factor and survey design into account.

Results and discussion

In KiGGS Wave 2, the prevalence of overweight (including obese) girls and boys aged 3 to 17 years is 15.4%. The prevalence of obesity is 5.9%. There are no statistically significant gender differences. Overweight and obesity prevalences increase with age. The proportion of overweight children is 10.8% for 3 to 6 year old girls and 7.3% for boys. It rises to 16.2% for girls aged 14 to 17 years and 18.5% for boys in this age group. Children and adolescents with low SES have a higher prevalence of overweight than girls and boys with medium and high SES (Table 1).

The obesity prevalence among 3 to 6 year old girls is 3.2%, and 1.0% among boys. This proportion rises to 7.7% for girls aged 14 to 17 years and 9.2% for boys (Table 2). Children and adolescents with low SES are considerably more often affected by obesity: Girls and boys with low SES are about four times as often affected by obesity as children and adolescents with high SES (girls 8.1% vs. 2.0%; boys 11.4% vs. 2.6%). However, this result is only statistically significant among boys.

The results from KiGGS Wave 2 indicate that the increase in overweight and obesity prevalences observed in the KiGGS baseline study in comparison to the reference population has not continued (Figure 1 and Figure 2). Compared to the 1990s reference percentiles, according to which, by definition, 10% of children and adolescents were considered to be overweight (BMI >90th percentile), the results of the KiGGS baseline study showed that the prevalence of overweight (including obesity) in the population had risen to 15%. The prevalence of obesity, by definition 3% of the reference population (BMI >97th percentile), had even doubled to 6% [14]. Since the survey 2003-2006,

Table 1
Prevalence of overweight (>90th percentile, including obesity) according to gender, age and socioeconomic status (n=1,799 girls, n=1,762 boys)
Source: KiGGS Wave 2 (2014-2017)

Girls	%	(95% CI)
Girls (total)	**15.3**	**(13.1-17.8)**
Age		
3-6 Years	10.8	(7.0-16.5)
7-10 Years	14.9	(10.9-20.2)
11-13 Years	20.0	(15.0-26.2)
14-17 Years	16.2	(12.6-20.7)
Socioeconomic status		
Low	27.0	(20.3-34.9)
Medium	13.0	(10.8-15.5)
High	6.5	(3.8-10.8)
Total (girls and boys)	**15.4**	**(13.7-17.4)**

Boys	%	(95% CI)
Boys (total)	**15.6**	**(13.0-18.6)**
Age		
3-6 Years	7.3	(4.7-11.1)
7-10 Years	16.1	(11.7-21.8)
11-13 Years	21.1	(15.5-28.1)
14-17 Years	18.5	(14.2-23.8)
Socioeconomic status		
Low	24.2	(17.7-32.3)
Medium	14.1	(11.2-17.7)
High	8.9	(5.4-14.2)
Total (girls and boys)	**15.4**	**(13.7-17.4)**

CI=confidence interval

Table 2
Prevalence of obesity (>97th percentile) according to gender, age and socioeconomic status (n=1,799 girls, n=1,762 boys)
Source: KiGGS Wave 2 (2014-2017)

Girls	%	(95% CI)
Girls (total)	**5.5**	**(4.3-7.0)**
Age		
3-6 Years	3.2	(1.6-6.3)
7-10 Years	4.7	(2.9-7.5)
11-13 Years	6.5	(3.6-11.3)
14-17 Years	7.7	(5.2-11.4)
Socioeconomic status		
Low	8.1	(4.7-13.7)
Medium	4.7	(3.5-6.4)
High	2.0	(0.5-7.3)
Total (girls and boys)	**5.9**	**(5.0-7.0)**

Boys	%	(95% CI)
Boys (total)	**6.3**	**(4.9-8.0)**
Age		
3-6 Years	1.0	(0.4-2.5)
7-10 Years	6.8	(4.2-11.0)
11-13 Years	8.0	(4.8-13.0)
14-17 Years	9.2	(6.2-13.4)
Socioeconomic status		
Low	11.4	(7.2-17.7)
Medium	5.2	(3.6-7.5)
High	2.6	(1.1-5.9)
Total (girls and boys)	**5.9**	**(5.0-7.0)**

CI=confidence interval

overweight and obesity prevalences have remained stable overall and across all age groups, albeit at a high level.

These findings are in line with the results of other national studies: although data from school entry health examinations in the federal states showed an increase until 2004, there was no overall increase in the prevalence of overweight and obesity among children at school entry age between 2004 and 2008. However, overweight and obesity prevalences vary widely between federal states [12, 13]. Measurements of body height and weight of children and adolescents between the ages of 4 and 16 years, carried out in paediatric practices and other health centres, also showed a decrease or stabilisation in the prevalence of overweight and obesity [8, 11].

Figure 1 (on the left)
Trend for overweight prevalence (>90th percentile, including obesity) by age group (KiGGS baseline study n=7,215 girls, n=7,531 boys, KiGGS Wave 2 n=1,799 girls, n=1,762 boys)
Source: KiGGS baseline study (2003-2006), KiGGS Wave 2 (2014-2017)

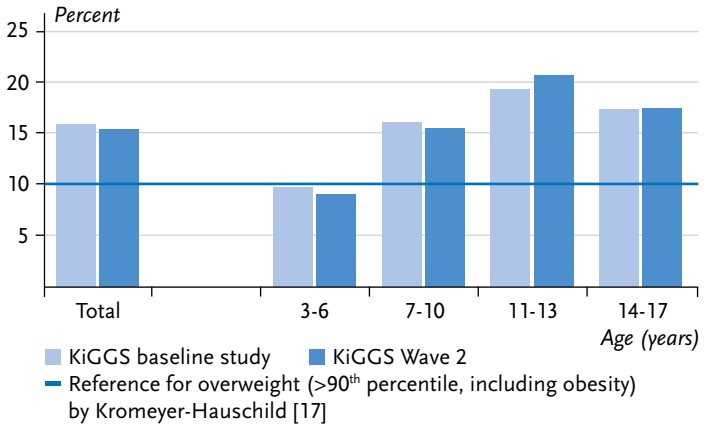
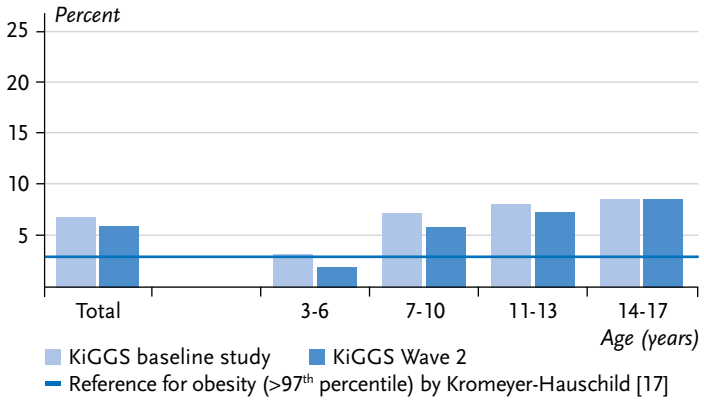


Figure 2 (on the right)
Trend for obesity prevalence (>97th percentile) by age group (KiGGS baseline study n=7,215 girls, n=7,531 boys, KiGGS Wave 2 n=1,799 girls, n=1,762 boys))
Source: KiGGS baseline study (2003-2006), KiGGS Wave 2 (2014-2017)



Participants with a low socio-economic status are significantly more likely to be overweight than adolescents in the highest status group.

In comparison to the KiGGS baseline study (2003-2006), there was no further increase in the prevalence of overweight and obesity.

Whether the increase in overweight and obesity prevalence has actually stopped, levelled off or even been reversed is being discussed extensively in science. Aside from methodological factors [21], population-wide interventions and prevention could have led to a stagnation of prevalences over time. In its report "Ending Childhood Obesity", the World Health Organization (WHO) describes overweight and obesity in childhood and adolescence as a 'complex and multi-dimensional problem'. Preventive actions for changing individual behavior thus only lead to a limited solution to the problem. Rather, approaches to change the living environment such as altering an increasingly overweight and obesity-promoting ("obesogenic") environment, should be implemented and considered as a task for the whole of society [22]. Overweight and obesity prevalence among children and adolescents in Germany has not increased further over the last decade. The objective of the WHO's Global Action Plan for the Prevention and Control of Non-Communicable Diseases to "halt the rise in obesity" by 2025 has thus been achieved. This also applies to the goal of the federal government's National Sustainable Development Strategy 2016, which is to ensure that the proportion of young people with obesity in Germany does not increase further by 2030 [23, 24]. Nevertheless, the prevalence of overweight and obesity remain at a high level. Against this background, health promotion and prevention activities that contribute to the reduction of overweight and obesity prevalences in the population must continue.

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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.

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Conflicts of interest

The authors declared no conflicts of interest.

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Erratum, page 18
In the original article, the number of cases of the KiGGS baseline study and KiGGS Wave 2 were switched in the titles of Figure 1 and Figure 2 on page 18. The number of cases was corrected for the current version in both figure titles: KiGGS baseline study n=7.215 girls, n=7.531 boys; KiGGS Wave 2 n=1.799 girls, n=1.762 boys.

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Physical activity among children and adolescents in Germany. Results of the cross-sectional KiGGS Wave 2 study and trends

Abstract

Self-reported data from wave 2 of the German Health Interview and Examination Survey for Children and Adolescents (KiGGS Wave 2, 2014-2017) provides the basis for assessing whether the levels of physical activity of children and adolescents in Germany meet the levels recommended by the World Health Organization (WHO). Merely 22.4% of girls and 29.4% of boys in the 3-17 age group are physically active for at least 60 minutes per day and therefore meet the WHO recommendations. Prevalence of recommended levels of physical activity decreases continuously with age, both for girls and boys. In KiGGS Wave 2, girls in the 3-10 age group met the levels of physical activity recommended by the World Health Organization significantly less often than in KiGGS Wave 1. Low levels of physical activity were highest amongst adolescent age girls, as well as among boys and girls of low socioeconomic status. The results indicate a great potential to promote physical activity.

PHYSICAL ACTIVITY · MOVEMENT GUIDELINES · CHILDREN AND ADOLESCENTS · HEALTH MONITORING · KIGGS

Background

Physical activity is defined as any kind of movement by skeletal muscles that leads to an increased use of energy [1]. According to the Global Burden of Disease Study 2016 [2], lack of physical activity in Germany is behind 12.3% of coronary heart disease, 7.6% of stroke, 3.1% of diabetes mellitus, 3.4% of colorectal cancer and 1.8% of breast cancer deaths. Participation in school sports and higher levels of physical activity during leisure time is moreover linked to a lower risk of mental illnesses [3]. Promoting physical activity at child and adolescent age can contribute towards prevention of obesity [4, 5] and attention deficit/hyperactivity disorder [6], promotion of healthy development [7] and greater cognitive and academic achievements [8], as well as increased levels of physical activity at adult age [9].

The WHO's 'Global action plan on physical activity 2018-2030' also highlights the particular importance of childhood and adolescence for the promotion of physical activity [10]. The Action Plan contains specific recommendations for action to achieve the 'voluntary global target' of reducing the prevalence of insufficient levels of physical activity by 10% between 2010 and 2025 [11]. According to the WHO definition, children and adolescents should achieve at least 60 minutes of moderate- to vigorous-intensity physical activity daily [12]. According to the German Health Interview and Examination Survey for Children and Adolescents 2009-2012 (KiGGS Wave 1), 25.4% of girls and 29.4% of boys aged 3-17 meet the levels recommended by the WHO [13]. This article presents the surveyed prevalence of physical activity among children and adolescents in Germany

Studie zur Gesundheit von Kindern und Jugendlichen in Deutschland

This article has been corrected as of April 12, 2018 (see corrigendum, page 30)

KiGGS Wave 2

Second follow-up to the German Health Interview and Examination Survey for Children and Adolescents

Data owner: Robert Koch Institute

Aim: Providing reliable information on health status, health-related behaviour, living conditions, protective and risk factors, and health care among children, adolescents and young adults living in Germany, with the possibility of trend and longitudinal analyses

Study design: Combined cross-sectional and cohort study

Cross-sectional study in KiGGS Wave 2
Age range: 0-17 years
Population: Children and adolescents with permanent residence in Germany
Sampling: Samples from official residency registries - randomly selected children and adolescents from the 167 cities and municipalities covered by the KiGGS baseline study
Sample size: 15,023 participants

KiGGS cohort study in KiGGS Wave 2
Age range: 10-31 years
Sampling: Re-invitation of everyone who took part in the KiGGS baseline study and who was willing to participate in a follow-up
Sample size: 10,853 participants

KiGGS survey waves
- KiGGS baseline study (2003-2006), examination and interview survey
- KiGGS Wave 1 (2009-2012), interview survey
- KiGGS Wave 2 (2014-2017), examination and interview survey

More information is available at www.kiggs-studie.de/english

in KiGGS Wave 2 and compares it to the levels reported in KiGGS Wave 1.

Indicator and Methodology

KiGGS forms part of the health monitoring program 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 of the German population (KiGGS cross-sectional study). After having carried out the baseline study as an interview and examination survey between 2003 and 2006, and KiGGS Wave 1 as an interview-based survey between 2009 and 2012, KiGGS Wave 2 was implemented between 2014 and 2017 as a combined interview and examination survey.

A detailed description of the methodology used in KiGGS Wave 2 can be found in New data for action. Data collection for KiGGS Wave 2 has been completed in issue S3/2017 as well as KiGGS Wave 2 cross-sectional study – participant acquisition, response rates and representativeness in issue 1/2018 of the Journal of Health Monitoring [14, 15].

In KiGGS Wave 2 physical activity data was self-reported (11-17 age group) or provided by parents and legal guardians (3-10 age group) via a self-administered questionnaire. Participants were asked, '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 ranged from 'On no day' to 'On seven days'. Based on this data, the survey assessed whether interviewees met the WHO recommended 'at least 60 minutes of moderate- to vigorous-intensity physical activity daily' [12]. An indicator for 'low levels of physical activity' was created for those who engage in physical activity of at least 60 minutes per day on less than two days per week. A trend for the recommended levels of physical activity can only be established between KiGGS Wave 1 and 2, as the question to survey physical activity was the same in both waves and an analogous indicator can therefore be calculated.

The analysis is based on the data received from 12,981 children and adolescents (6,532 girls and 6,449 boys) aged 3 to 17 with valid responses on physical activity. The results are presented as prevalences (expressed as percentages) and stratified by gender, age and socioeconomic status (SES) [16].

The calculations were conducted applying a weighting factor that corrects deviations within the sample from the German population with regard to age, gender, federal state, nationality and the parents' level of education (Microcensus 2013 [17]).

The calculation of trends between KiGGS Wave 1 and 2 is based on weighted age-standardised prevalence (age and gender by population structure as of 31 December 2015). Logistic regression (t-Test) was used to test the statistical relevance of developments over time. This article reports the prevalence with 95% confidence intervals (95% CI). A statistically significant difference between groups is assumed to have been demonstrated with p-values of less than 0.05 (once weighting had been applied and the survey design had been taken into account).

Results

KiGGS Wave 2 results indicate that fewer girls (22.4%) meet the recommendations on physical activity than boys (29.4%, Table 1). Gender differences are particularly marked in the

Table 1
Prevalence of 'at least 60 minutes of physical activity daily' ('WHO recommendation achieved') according to gender, age and socioeconomic status (n=6,532 girls, n=6,449 boys)
Source: KiGGS Wave 2 (2014-2017)

WHO: World Health Organization

Girls	Prevalence (%)	(95% CI)
Girls (total)	**22.4**	**(20.9-24.0)**
Age		
3-6 Years	42.5	(39.0-46.0)
7-10 Years	22.8	(20.1-25.8)
11-13 Years	16.5	(14.1-19.1)
14-17 Years	7.5	(6.0-9.2)
Socioeconomic status		
Low	25.2	(21.5-29.4)
Medium	20.8	(19.3-22.4)
High	24.4	(21.5-27.5)
Total (Girls and Boys)	**26.0**	**(24.7-27.4)**

Boys	Prevalence (%)	(95% CI)
Boys (total)	**29.4**	**(27.6-31.2)**
Age		
3-6 Years	48.9	(45.2-52.6)
7-10 Years	30.0	(27.1-33.1)
11-13 Years	21.4	(18.7-24.3)
14-17 Years	16.0	(13.8-18.6)
Socioeconomic status		
Low	31.1	(26.7-35.9)
Medium	28.6	(26.6-30.7)
High	30.6	(27.9-33.4)
Total (Girls and Boys)	**26.0**	**(24.7-27.4)**

CI=confidence interval

Merely 22.4% of girls and 29.4% of boys in the 3-17 age group meet the physical activity recommendations of the World Health Organization.

14-17 age group (Figure 1). With increasing age girls and boys achieve the recommended levels of physical activity less often. For boys, no link between recommended levels of physical activity and SES is apparent. The result for girls is inconsistent.

Girls (11.1%) more frequently show low levels of physical activity compared to boys (7.0%, Table 2). Prevalence of low levels of physical activity increases significantly in the 14-17 age group and is twice as high for girls compared to boys. Prevalence of low levels of physical activity is significantly higher for girls and boys with low SES compared to those with medium and high SES.

For girls, weighted and age-standardised prevalence of recommended levels of physical activity decreased significantly (from 25.9% to 22.4%) between KiGGS Wave 1 (2009-2012) and KiGGS Wave 2 (2014-2017). For boys the

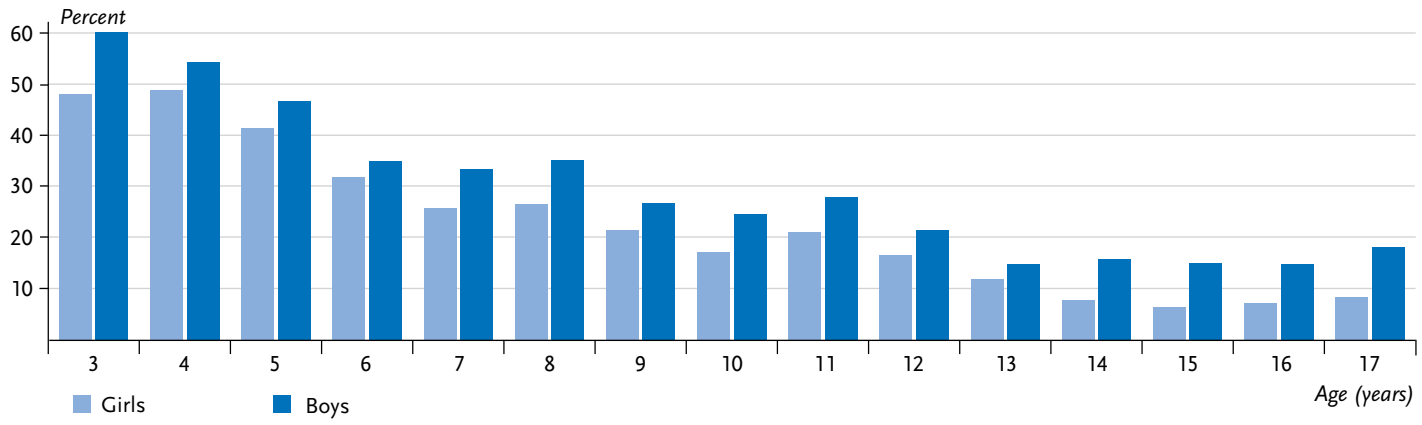

Figure 1
Prevalence of 'at least 60 minutes of physical activity daily' ('WHO recommendation achieved') according to age (n=6,532 Girls, n=6,449 Boys)
Source: KiGGS Wave 2 (2014-2017)

WHO: World Health Organization

Table 2
Prevalence of '60 minutes of physical activity on less than two days per week' ('low levels of physical activity') according to gender, age and socioeconomic status (n=6,532 girls, n=6,449 boys)
Source: KiGGS Wave 2 (2014-2017)

Girls	Prevalence (%)	(95% CI)
Girls (total)	**11.1**	**(9.9-12.4)**
Age		
3-6 Years	6.7	(5.1-8.6)
7-10 Years	5.7	(4.4-7.4)
11-13 Years	8.4	(6.6-10.8)
14-17 Years	22.0	(19.2-25.0)
Socioeconomic status		
Low	19.4	(15.8-23.6)
Medium	9.6	(8.3-11.1)
High	7.6	(6.2-9.4)
Total (Girls and Boys)	**9.0**	**(8.3-9.8)**

Boys	Prevalence (%)	(95% CI)
Boys (total)	**7.0**	**(6.2-8.0)**
Age		
3-6 Years	5.8	(4.4-7.6)
7-10 Years	4.4	(3.2-6.1)
11-13 Years	6.7	(5.0-9.0)
14-17 Years	10.8	(8.7-13.5)
Socioeconomic status		
Low	11.6	(8.6-15.5)
Medium	6.3	(5.3-7.4)
High	4.4	(3.3-5.8)
Total (Girls and Boys)	**9.0**	**(8.3-9.8)**

CI=confidence interval

The share of children and adolescents who meet the physical activity recommendations of the World Health Organization decreases continuously with age.

same prevalence did not change during this time (29.7% and 29.4%, data not shown). Figure 2 shows the trend between KiGGS Wave 1 and 2 by age groups. Decreasing prevalence among girls is related to the significant decrease in prevalence in the 3-10 age group (from 40.7% to 32.6%, Figure 2). Age-standardised prevalence of low levels of physical activity have increased significantly between KiGGS Wave 1 and 2 – the prevalence rose from 8.0% to 11.1% for girls and 4.6% to 7.0% for boys (data not shown).

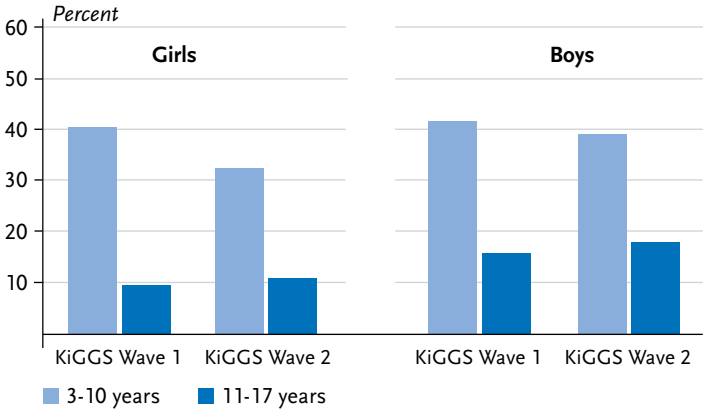

Figure 2
Trend for prevalence of 'at least 60 minutes of physical activity daily' ('WHO recommendation achieved') between KiGGS Wave 1 and KiGGS Wave 2 according to age (n=11,526 girls, n=11,518 boys)
Source: KiGGS Wave 1 (2009-2012), KiGGS Wave 2 (2014-2017)

WHO: World Health Organization

Discussion

KiGGS Wave 2 reveals similar patterns for the relationship between achieving the recommended levels of physical activity and gender, age and SES as observed in KiGGS Wave 1 [13].

The secular trend, in terms of the slight decrease of prevalence for girls to meet the recommended levels of physical activity between KiGGS Wave 1 and 2 is in line with the results of the WHO's survey Health Behaviour in School-aged Children (HBSC). Between 2010 and 2014, the prevalence of girls who meet the recommended levels of physical activity decreased slightly in Germany, while the prevalence among boys remained unchanged [18]. When interpreting this trend, it is important to consider that the survey method changed between KiGGS Wave 1 (telephone interview) and KiGGS Wave 2 (self-administered

Prevalence of low levels of physical activity increases significantly with age and is twice as high for girls in the 14-17 age group than for boys.

In KiGGS Wave 2, girls in the 3-10 age group meet the levels of physical activity recommended by the World Health Organization significantly less often than in KiGGS Wave 1.

questionnaire). We cannot exclude the possibility that social desirability led to an overestimation of the reported levels of physical activity in KiGGS Wave 1.

To calculate the indicator regarding the achievement of the WHO recommendations on physical activity, the survey used self-reported total physical activity, which included sports, as well as routine daily activities. Sports activities often included aerobic endurance activities, a type of activity explicitly commended by the WHO recommendations on physical activity due to their particularly beneficial effects on health [12]. Further KiGGS cohort-based [19] analyses indicate that children and adolescents from high SES family backgrounds are more frequently physically active members of sports clubs [13] and show higher levels of aerobic fitness [20] than children and adolescents from low SES family backgrounds. Keeping up physical activity from childhood to adolescence thereby depends on a number of family, health, behaviour and social environment factors [21], which need to be considered when planning measures to promote physical activity at child and adolescent age. Germany's national health target 'Grow up healthy' includes promoting physical activity and is also supported by IN FORM – Germany's national initiative to promote healthy diets and physical activity. Over three quarters of girls and two thirds of boys do not achieve the WHO's recommended levels of physical activity, pointing to the great need for measures that promote physical activity. WHO physical activity guidelines are only a minimum recommendation, any physical activity beyond these levels can provide additional health benefits. Recognition of this fact is reflected in Germany's National Recommendations for Physical Activity and Physical Activity Promotion that recommends at least 180 minutes of daily physical activity for children at Kindergarten and 90 minutes of daily physical activity for primary school aged children and adolescents, as well as a general reduction of the amount of time spent sitting [22]. Promoting the physical activity of children and adolescents should follow a settings-based approach and include measures to make Kindergartens, schools and the places where children and adolescents live, more movement-friendly. This should include health-oriented city planning, the reduction of risks and environmental pollution from road traffic, expanding foot and bike paths as well as child- and adolescent-friendly design of parks and recreation and sports facilities [22].

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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.

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Conflicts of interest

The authors declared no conflicts of interest.

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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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Corrigendum, page 23
An earlier version of this Fact sheet gave the following incorrect figures on page 23: 'According to the Global Burden of Disease Study 2016 [2], lack of physical activity in Germany is behind 22.7% of coronary heart disease, 6.3% of stroke, 2.3% of diabetes mellitus, 3.3% of colorectal cancer and 2.0% of breast cancer deaths.'
These figures incorrectly reported the proportion of overall mortality due to the diseases mentioned, irrespective of physical activity.
The correct sentence reads: 'According to the Global Burden of Disease Study 2016 [2], lack of physical activity in Germany is behind 12.3% of coronary heart disease, 7.6% of stroke, 3.1% of diabetes mellitus, 3.4% of colorectal cancer and 1.8% of breast cancer deaths.' The wording of the article in issue 1/2018 was corrected accordingly.

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Consumption of sugary soft drinks among children and adolescents in Germany. Results of the cross-sectional KiGGS Wave 2 study and trends

Abstract

Consuming large amounts of sugary beverages has been related to developing obesity, diabetes mellitus type II and other chronic diseases. KiGGS Wave 2 (2014-2017) provides data on the consumption of sugary soft drinks in the 3-17 year age group in Germany. Overall, 13.7% of girls and 17.6% of boys consume one to three times a day sugary soft drinks and 3.3% of girls and 4.7% of boys four or more times. Consumption frequency increases with age and is higher among children and adolescents with low socioeconomic status (SES) than for those of the same age with high SES. The share of adolescents who drink sugary soft drinks daily has decreased since the KiGGS baseline study (2003-2006).

SOFT DRINKS · BEVERAGE CONSUMPTION · HEALTH SURVEY · CHILDREN AND ADOLESCENTS · KIGGS

Background

Constituting a risk factor for overweight and obesity, the consumption of sugary beverages has been in the scientific and political spotlight in recent years [1]. Many studies indicate a link between high levels of consumption of sugary soft drinks among children and adolescents and weight increase [2]. While drinking sufficient amounts of liquid is important, as far as this need is mainly met with sugary soft drinks, it can in the long term lead to weight gain. Comparably, large amounts of calories are ingested without a corresponding effect on satiety. If these extra calories are not counterbalanced in energy expenditure, this may cause overweight in the long term. Consuming large quantities of sugary soft drinks also increases the risk for diabetes mellitus type II [3]. Blood sugar levels increase rapidly after consumption and the body produces greater amounts of insulin. Larger fluctuations in blood sugar levels appear, which can damage the insuline producing cells in the pancreas in the long term. Furthermore, consuming sugary soft drinks stresses the teeth because both the sugar and acids often contained in soft drinks attack tooth enamel and promote caries [4]. Studies, moreover, indicate a link between consumption of sugary soft drinks and reduced bone density at adolescent age, potentially caused by the acids contained in, for example, cola beverages (such as phosphoric acid) [5]. The German Nutrition Society (DGE) therefore recommends drinking mainly water and other low-calory beverages to cover liquid needs [6].

Against this backdrop, it is worrying that the per capita consumption of soft drinks, most of which contain sugar, is relatively high in Germany [7, 8]. Current data provided by the Federal Ministry of Food and Agriculture (BMEL) show

KiGGS
Studie zur Gesundheit von Kindern und Jugendlichen in Deutschland

KiGGS Wave 2

Second follow-up to the German Health Interview and Examination Survey for Children and Adolescents

Data owner: Robert Koch Institute

Aim: Providing reliable information on health status, health-related behaviour, living conditions, protective and risk factors, and health care among children, adolescents and young adults living in Germany, with the possibility of trend and longitudinal analyses

Study design: Combined cross-sectional and cohort study

Cross-sectional study in KiGGS Wave 2
Age range: 0-17 years
Population: Children and adolescents with permanent residence in Germany
Sampling: Samples from official residency registries - randomly selected children and adolescents from the 167 cities and municipalities covered by the KiGGS baseline study
Sample size: 15,023 participants

KiGGS cohort study in KiGGS Wave 2
Age range: 10-31 years
Sampling: Re-invitation of everyone who took part in the KiGGS baseline study and who was willing to participate in a follow-up
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More information is available at www.kiggs-studie.de/english

that the consumption of soft drinks has increased from 117 litres in 2008 to 126 litres per capita in 2013. Nonetheless, consumption levels have again dropped since 2013 and were down to 119 litres per capita in 2015 [7]. Between 2012 and 2016, per capita lemonade consumption dropped from 83 to 78 litres [8]. Surveys on individual beverage consumption patterns from recent years indicate the popularity of sugary soft drinks in Germany, in particular among children and adolescents [9]. Data of KiGGS Wave 2 (2014-2017) provide a current overview of childrens and adolescents consumption of soft drinks and an evaluation of the development of consumption levels since the KiGGS baseline study (2003-2006).

Indicator and methodology

KiGGS is part of the health monitoring system at the Robert Koch Institute. It includes repeated cross-sectional surveys that are representative for children and adolescents aged between 0 and 17 years in Germany (KiGGS cross-sectional study). After conducting the baseline interview and examination survey between 2003 and 2006, and KiGGS Wave 1 as an interview only survey between 2009 and 2012, KiGGS Wave 2 was conducted between 2014 and 2017, again as a combined interview and examination survey.

A detailed description of the methodology used in KiGGS Wave 2 can be found in New data for action. Data collection for KiGGS Wave 2 has been completed in issue S3/2017 as well as KiGGS Wave 2 cross-sectional study – participant acquisition, response rates and representativeness in issue 1/2018 of the Journal of Health Monitoring [10, 11].

Like in the baseline study and in the German Health Interview and Examination Survey for Adults (DEGS 1, 2008-2011), in KiGGS Wave 2 the consumption of selected food items was assessed with a food frequency questionnaire [12, 13]. The questionnaire also asked about beverage consumption 'during the past four weeks'. For the 3-10 year age group, parents or legal guardians provided answers, whereas participants aged 11-17 years answered the questions themselves. The question about the frequency of soft drink consumption was: 'How often during the past four weeks did your child/did you drink sugary soft drinks (such as cola, lemonade, ice tea, malt beer or energy drinks)? This does not include diet beverages.' The possible answers were: 'never', 'once per month', '2-3 times per month', '1-2 times per week', '3-4 times per week', '5-6 times per week', 'once per day', '2 times per day', '3 times per day', '4-5 times per day', 'more than 5 times per day'. Frequencies of soft drink consumption were summarised into three categories for the analysis presented here: 'less than once per day', 'one to three times per day' and 'four or more times per day'. The average portion size was determined by asking, 'When your child/you drink sugary soft drinks, how much does your child/do you usually drink?' The answers ranged from: '½ a glass (or less)', '1 glass (200 ml)', '2 glasses', '3 glasses' and '4 glasses (or more)'.

For a comparison with the baseline study, the data on consumption frequency was converted and multiplied ((consumption frequency per 28 days x portion size (g))/28 days) to calculate estimated mean daily amounts.

The analyses are based on the data provided by 12,978 children and adolescents (6,539 girls and 6,439 boys) aged 3-17 years with valid responses on the consumption of sugary soft drinks. The results are presented as prevalence

Info box

Soft drinks include lemonades, fizzy drinks, fruit spritzers and fruit juice drinks, these usually contain added sugar. The analyses include some further drinks such as malt beer, ice teas and energy drinks [9].

Around 16.9% of girls and 22.2% of boys drink at least once a day sugary soft drinks.

(frequency) according to gender, age and socioeconomic status (SES) [14].

The calculations were conducted applying a weighting factor that corrects deviations from the German population within the sample with regard to age, gender, federal state, nationality as well as the distribution of parent levels of education (Microcensus 2013 [15]). The analyses also take the cluster design of the sample into account. This article reports prevalences with 95% confidence intervals (95% CI). Differences between groups are interpreted as statistically significant if the corresponding confidence intervals do not overlap.

Results and discussion

Overall, 13.7% of girls and 17.6% of boys drink sugary soft drinks one to three times per day and 3.3% of girls and 4.7% of boys four or more times per day. Daily consumption is slightly higher for boys than for girls of the same age. Consumption frequency rises with age and is highest among 14 to 17 year olds (girls 21.1%, boys 32.2%; Table 1).

	Less than once per day		One to three times per day		Four or more times per day	
	%	(95% CI)	%	(95% CI)	%	(95% CI)
Girls (total)	**83.1**	**(81.5-84.6)**	**13.7**	**(12.4-15.0)**	**3.3**	**(2.6-4.1)**
Age						
3-6 Years	90.5	(88.2-92.4)	8.1	(6.4-10.1)	1.4	(0.8-2.6)
7-10 Years	83.3	(80.8-85.6)	14.5	(12.4-16.8)	2.2	(1.5-3.3)
11-13 Years	79.0	(75.6-82.0)	15.6	(13.1-18.4)	5.5	(3.8-7.8)
14-17 Years	78.9	(75.8-81.6)	16.7	(14.4-19.3)	4.4	(3.1-6.3)
Socioeconomic status						
Low	74.8	(70.8-78.4)	19.8	(16.7-23.3)	5.4	(3.7-7.8)
Medium	82.1	(80.2-83.9)	14.4	(12.9-16.0)	3.5	(2.6-4.6)
High	95.0	(93.6-96.0)	4.6	(3.6-5.9)	0.4	(0.2-0.8)
Boys (total)	**77.8**	**(76.2-79.3)**	**17.6**	**(16.3-18.9)**	**4.7**	**(3.9-5.5)**
Age						
3-6 Years	87.1	(84.4-89.4)	10.3	(8.2-12.8)	2.6	(1.5-4.5)
7-10 Years	81.1	(77.9-83.9)	15.3	(13.0-18.1)	3.6	(2.5-5.2)
11-13 Years	74.8	(71.6-77.8)	19.8	(17.0-22.9)	5.4	(3.8-7.6)
14-17 Years	67.8	(64.6-70.9)	25.1	(22.3-28.1)	7.1	(5.6-9.0)
Socioeconomic status						
Low	64.5	(59.8-68.9)	25.6	(21.5-30.2)	9.9	(7.3-13.2)
Medium	77.5	(75.6-79.3)	18.2	(16.5-20.0)	4.3	(3.5-5.4)
High	91.1	(89.2-92.7)	8.0	(6.5-9.8)	0.8	(0.4-1.6)
Total (girls and boys)	**80.4**	**(79.1-81.6)**	**15.7**	**(14.7-16.7)**	**4.0**	**(3.5-4.6)**

CI=confidence interval

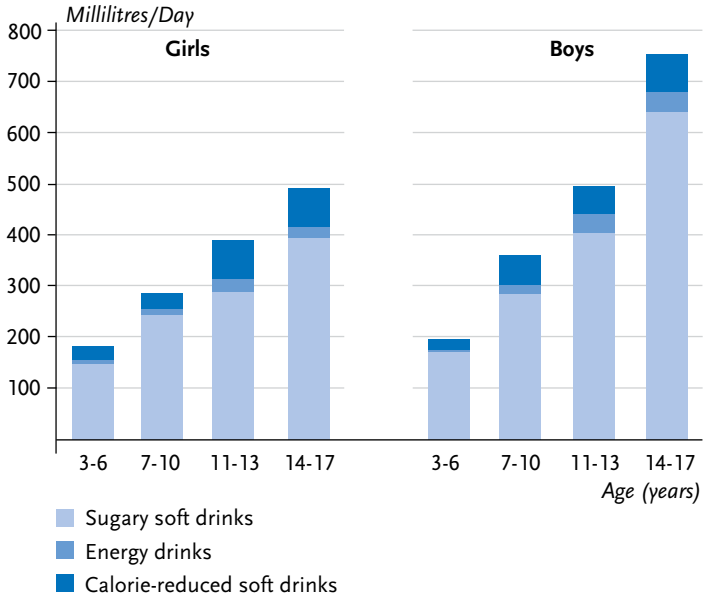
Table 1
Prevalence of sugary soft drink consumption according to gender, age and socioeconomic status (n=6,539 girls, n=6,439 boys)
Source: KiGGS Wave 2 (2014-2017)

Consumption frequency of sugary soft drinks rises with age.

Children and adolescents with low socioeconomic status consume more often sugary soft drinks compared to those of the same age with high status.

Children and adolescents with low SES drink sugary soft drinks significantly more often compared to their peers with medium SES and the latter, in turn, more than those with high SES (Table 1). This difference is statistically significant. The vast majority of children and adolescents in the 3 to 17 age group drinks less than one sugary soft drink per day. Around 16.3% of girls and 12.7% of boys never drink sugary soft drinks (data not shown). The share of children and adolescents who drink sugary soft drinks every day has decreased since the KiGGS baseline study (2003-2006). In the baseline study, 28.2% of girls and 34.0% of boys reported drinking sugary soft drinks at least once per day [16]. This figure has now dropped to 16.9% for girls and 22.2% for boys. This is a desirable development which can also be seen in some other countries. Between 2003 and 2004, nearly 80% of child respondents in the US NHANES survey (National Health and Nutrition Examination Survey) reported drinking sugar-sweetened beverages on a particular day. In the 2013-2014 survey this figure had dropped to 61% of children [17].

When comparing consumption frequencies between the KiGGS baseline study and KiGGS Wave 2, it must be considered that the corresponding questions on soft drinks are not identical. The baseline study estimated the share of calorie-reduced soft drinks in a sub-question, sports and energy drinks were asked separately. In KiGGS Wave 2, however, the consumption of calorie-reduced soft drinks was assessed in a separate question. Figure 1 shows the results of the conversion and aggregation of estimated daily intake of sugary soft drinks, calorie-reduced soft drinks and energy drinks in the KiGGS baseline study and Figure 2 for KiGGS Wave 2. These figures confirm the decrease in the levels of



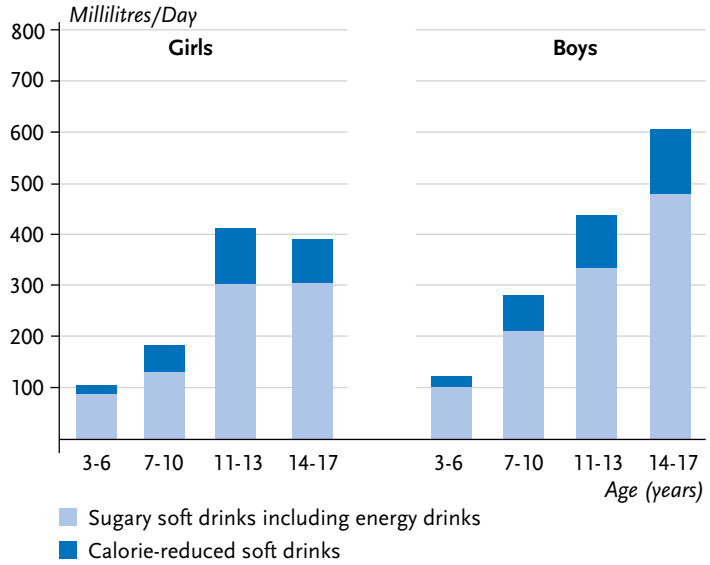


Figure 1 (on the left)
Calculated mean consumption of sugary soft drinks (millilitres/day) for participants of the KiGGS baseline study according to gender and age (n=6,847 girls, n=7,103 boys)
Source: KiGGS baseline study (2003-2006)

Figure 2 (on the right)
Calculated mean consumption of sugary soft drinks (millilitres/day) for participants of KiGGS Wave 2 according to gender and age (n=6,516 girls, n=6,424 boys)
Source: KiGGS Wave 2 (2014-2017)

consumption, indicating that the development of consumption can only minimally be contributed to differences in the questions. However, changes in social desirability norms regarding the consumption of sugary soft drinks may have led to biased answers and some underreporting of consumption.

The observed change may be considered against the backdrop of preventive measures, such as improving the availability and attractiveness of drinking water at schools and kindergartens as an alternative to sugary soft drinks [18, 19]. In spite of the reported decrease, the consumption of sugary soft drinks remains high. Different prevention measures which may further reduce consumption are currently being discussed. Possible measures include a tax on sugary soft drinks, as well as stricter regulations for sugary soft drink advertisements directed at children and adolescents. Furthermore, it would be desirable to further extend the offer of unsweetened drinks (such as water, unsweetened teas) in nurseries, kindergartens and schools [1].

The share of adolescents who drink sugary soft drinks daily has decreased since the KiGGS baseline study (2003-2006).

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Conflicts of interest

The authors declared no conflicts of interest.

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

Abstract

Smoking behaviour during adolescence is particularly important because the pattern of a person's tobacco consumption in later life usually is established in this period. According to recent data from KiGGS Wave 2, 7.4% of 11 to 17 year-old girls and 7.0% of boys of the same age smoke at least occasionally. The proportion of children and adolescents who smoke increases with age. Adolescents with high socioeconomic status smoke less frequently than their peers with medium or low socioeconomic status. Since the beginning of the first KiGGS study (2003-2006), the proportion of 11 to 17 year-olds who smoke fell from 21.4% to 12.4% (2009-2012) and has recently dropped to 7.2% (2014-2017). Despite considerable progress, however, there is still potential to improve tobacco prevention policy in Germany for example using taxation and advertising bans.

SMOKING · TOBACCO USE · CIGARETTES · HEALTH MONITORING · KIGGS

Background

Despite a decline in tobacco consumption in almost all industrialised countries, smoking remains the leading cause of premature mortality [1]. About one quarter of adults throughout the world use tobacco, and smoking is also widespread among adolescents [2]. Smoking promotes the development of severe illnesses like cancer, cardiovascular and respiratory diseases [3]. Every year around 7.2 million people die as a result of tobacco smoke – this amounts to approximately 19,600 deaths per day [4]. According to current calculations, there were around 121,000 tobacco-related deaths in Germany in 2013 (13.5% of all deaths in the country) [3].

The population's tobacco use, therefore, represents a priority from a public health perspective. The smoking behaviour of children and young people is particularly important because smoking uptake usually takes place before the age of 18 [5]. Smokers who start smoking at an early age have an increased risk of developing smoking-related diseases. This is because the organism of adolescents is particularly susceptible to damage by the toxic substances contained in tobacco smoke [5]. Furthermore, people who begin to smoke at an early age also have a lower chance of successfully quitting smoking in later life, this is partly because they are also more likely to become dependent on tobacco [6].

A number of factors influence whether young people actually start smoking. Young people are more likely to smoke if their parents, siblings or peers do so. At the same time, they are more likely to smoke if they are exposed to tobacco advertising, if tobacco use is deemed socially acceptable and when tobacco products are cheap and readily accessible [3].

KiGGS
Studie zur Gesundheit von Kindern und Jugendlichen in Deutschland

KiGGS Wave 2

Second follow-up to the German Health Interview and Examination Survey for Children and Adolescents

Data owner: Robert Koch Institute

Aim: Providing reliable information on health status, health-related behaviour, living conditions, protective and risk factors, and health care among children, adolescents and young adults living in Germany, with the possibility of trend and longitudinal analyses

Study design: Combined cross-sectional and cohort study

Cross-sectional study in KiGGS Wave 2
Age range: 0-17 years
Population: Children and adolescents with permanent residence in Germany
Sampling: Samples from official residency registries - randomly selected children and adolescents from the 167 cities and municipalities covered by the KiGGS baseline study
Sample size: 15,023 participants

KiGGS cohort study in KiGGS Wave 2
Age range: 10-31 years
Sampling: Re-invitation of everyone who took part in the KiGGS baseline study and who was willing to participate in a follow-up
Sample size: 10,853 participants

KiGGS survey waves
- KiGGS baseline study (2003-2006), examination and interview survey
- KiGGS Wave 1 (2009-2012), interview survey
- KiGGS Wave 2 (2014-2017), examination and interview survey

More information is available at www.kiggs-studie.de/english

Over the last 20 years, Germany has stepped up its tobacco prevention policy and implemented various measures aimed at reducing the population's tobacco consumption, in particular, preventing the uptake of smoking in young people [7]. These measures include the implementation of significant tax increases between 2002 and 2005, non-smoker protection laws at the national and federal-state level and raising the age limit for purchasing and using tobacco products from 16 to 18. Furthermore, they have been accompanied by various setting-based prevention campaigns and programs.

In addition, the Framework Convention on Tobacco Control (FCTC) is an international agreement that was negotiated between numerous countries under the auspices of the World Health Organization and was ratified by Germany in 2003. One of the FCTC's key aspects is a catalogue of measures that signatory states are required to put in place to reduce the population's tobacco use [3].

In Germany, these measures are being implemented within the framework of the national health target 'Reduction of tobacco consumption'; this target was introduced in 2003, evaluated in 2009 and last revised in 2015 [8]. In the context of adolescent smokers, the target focuses on ensuring that teenagers and young adults do not take up smoking and on protecting the population from passive smoking.

In order to be able to review these targets, however, it is essential that reliable, representative data is collected regularly on the smoking behaviour of children and adolescents in Germany. This is done by studies such as the second wave of the German Health Interview and Examination Survey for Children and Adolescents (KiGGS).

Indicator and methodology

KiGGS forms part of the health monitoring program 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 of the German population (KiGGS cross-sectional study). After having carried out the baseline study as an interview and examination survey between 2003 and 2006, and KiGGS Wave 1 as an interview-based survey between 2009 and 2012, KiGGS Wave 2 was implemented between 2014 and 2017 as a combined interview and examination survey. A detailed description of the methodology used in KiGGS Wave 2 can be found in New data for action. Data collection for KiGGS Wave 2 has been completed in issue S3/2017 as well as KiGGS Wave 2 cross-sectional study – participant acquisition, response rates and representativeness in issue 1/2018 of the Journal of Health Monitoring [9, 10].

Data on the smoking behaviour of 11 to 17 year-old girls and boys were collected for KiGGS Wave 2 using written questionnaires and information provided by the respondents. The questionnaire included the question, 'Do you currently smoke?'. The response categories were 'No', 'Daily', 'Several times a week,' 'Once a week' and 'Less [than once a week]'. The KiGGS baseline survey used the same approach to gather data on a participant's smoking habits [11]. In contrast, KiGGS Wave 1 was conducted by telephone and participants were asked, 'Have you ever smoked?' (Answer categories were: 'Yes' and 'No'). If a participant stated that they had smoked at some point in their life, this was followed up by the question 'How often do you smoke at the moment?'. The answers categories were very similar to those used during the other survey waves 'Daily',

The latest data from KiGGS Wave 2 show that 7.2% of adolescents between 11 and 17 smoke and that around half of them do so daily.

There are no significant differences between girls and boys in terms of smoking behaviour.

'Several times a week', 'Once a week', 'Less than once a week' and 'Not at all' [12]. In the following, all respondents who stated that they smoke tobacco – including only occasionally – are grouped together as 'current smokers'. The following also provides details of the prevalence of daily smoking.

The latest KiGGS data is based on information collected from 5,747 adolescents (2,996 girls and 2,751 boys) aged between 11 and 17 years-of-age with valid data on smoking behaviour. The results are presented as prevalences (frequencies) and are stratified by gender, age and socioeconomic status (SES) [13].

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, nationality and the parents´ level of education (Microcensus 2013 [14]). In addition, the calculation of trends over time between the KiGGS waves is based on prevalences that were age-standardised according to the structure of the German population as of 31 December 2015.

This article reports prevalences with 95% confidence intervals (95% CI). A statistically significant difference between groups is assumed to have been demonstrated with p-values of less than 0.05 (once weighting had been applied and the survey design had been taken into account).

	Current smoking (daily or occasionally)		Daily smoking	
	%	(95% CI)	%	(95% CI)
Girls (total)	**7.4**	**(6.2-8.9)**	**3.6**	**(2.8-4.7)**
Age				
11-13 Years	0.6	(0.2-1.6)	0.1	(0.0-0.4)
14-17 Years	11.9	(9.9-14.2)	5.9	(4.6-7.6)
Socioeconomic status				
Low	9.2	(6.0-13.9)	5.8	(3.5-9.3)
Medium	7.6	(6.2-9.4)	3.4	(2.5-4.7)
High	4.3	(2.6-7.0)	1.5	(0.7-3.0)
Boys (total)	**7.0**	**(5.9-8.2)**	**3.9**	**(3.0-5.0)**
Age				
11-13 Years	0.9	(0.3-2.8)	0.5	(0.1-3.4)
14-17 Years	11.1	(9.4-13.0)	6.1	(4.7-8.0)
Socioeconomic status				
Low	6.7	(4.2-10.4)	2.7	(1.3-5.3)
Medium	8.2	(6.7-10.1)	4.9	(3.6-6.7)
High	3.7	(2.3-5.9)	1.9	(0.9-3.6)
Total (girls and boys)	**7.2**	**(6.3-8.2)**	**3.7**	**(3.1-4.5)**

CI=confidence interval

Table 1
Prevalence of current and daily smoking according to gender, age and socioeconomic status (n=2,996 girls, n=2,751 boys)
Source: KiGGS Wave 2 (2014-2017)

Since the beginning of the KiGGS study (2003-2006), the proportion of 11 to 17 year-olds who smoke has steadily declined from 21.4% to 7.2% (2014-2017).

Lower smoking rates were found among children and adolescents with high socioeconomic status compared to their peers with low or medium socioeconomic status.

Results and discussion

According to data from KiGGS Wave 2, 7.2% of 11 to 17 year-old children and adolescents in Germany smoke, about half of them do so daily (3.7% of 11 to 17 year-olds). No significant differences were identified according to gender (Table 1). The proportion of children and adolescents who smoke increases steadily with age: whereas less than 1% of girls and boys aged between 11 and 13 smoke at least occasionally, this rate increases among 14 to 17 year-olds to more than 11% (Table 1). The proportion of children and young people who smoke is also related to the socioeconomic status of their family of origin. Both girls and boys from the high status group smoked less frequently than their peers from families with a medium or low socioeconomic status (Table 1).

During the course of the KiGGS study, the proportion of children and adolescents who smoke has fallen sharply. Whereas 21.4% of 11 to 17 year-olds still smoked when the baseline study was conducted (2003-2006), the proportion of smokers had almost halved (to 12.4%) by the time the first follow-up survey was undertaken (2009-2012). Moreover, the proportion of smokers has since fallen to 7.2% (Figure 1). The developments shown by the KiGGS study are in line with findings from other studies in Germany [15]. According to data from the representative surveys conducted by the Federal Centre for Health Education, the proportion of 12 to 17 year-olds who smoke decreased from 22.5% to 7.8% between 2003 and 2015 [16]. In line with the presented results previous KiGGS waves [17] and other studies [18] show that lower rates of smokers are found among children and adolescents with a high socioeconomic status than among their socially disadvantaged peers. Furthermore, clear differences have been found depending on the type of secondary school that young people attend: grammar school students smoke less frequently than pupils from high schools, comprehensives or other secondary school forms [15, 19].

Interpretations of the KiGGS data need to take into account the fact that the study uses information provided by the respondents. Therefore, the results may have been distorted by the provision of socially desirable responses, as respondents may tend to provide what they view as the most socially acceptable answer. This would cause the data to underestimate the actual proportion of smokers [17].

Despite the desirable trend towards fewer adolescents starting to smoke, there is still room for improvement with regard to tobacco prevention policy in Germany. In comparison to other European countries, Germany particularly lags behind in terms of consistently protecting non-smokers from second-hand smoke, as well as in terms of tobacco taxation and the implementation of extensive advertising bans on tobacco products [20].

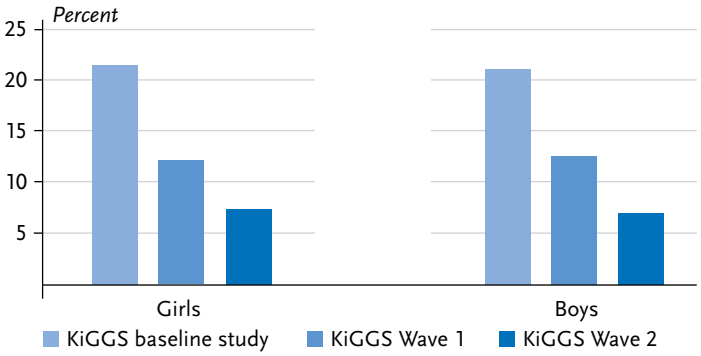

Figure 1
Trends in current smoking among 11 to 17 year-old girls and boys (KiGGS baseline study n=6,729, KiGGS Wave 1 n=4,944, KiGGS Wave 2 n=5,747)
Source: KiGGS baseline study (2003-2006), KiGGS Wave 1 (2009-2012), KiGGS Wave 2 (2014-2017)

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Smoking during pregnancy. Results of the cross-sectional KiGGS Wave 2 study and trends

Abstract

Maternal smoking during pregnancy poses a significant risk to the development of unborn children. Data from KiGGS Wave 2 shows that 10.9% of mothers of 0 to 6 year-old children smoked during pregnancy. Mothers who were under 25 when giving birth smoked about two to three times more often than older mothers. Furthermore, there is a distinct social gradient in maternal smoking: a higher socioeconomic status is associated with a lower proportion of children with a mother who smoked during pregnancy. A comparison with data from the KiGGS baseline study shows that the proportion of mothers who smoked during pregnancy fell from to 19.9% to 10.9% between the two study periods. Thus, the KiGGS results are in line with those from the perinatal survey, which also found that the proportion of pregnant women who smoke has declined significantly since the mid-1990s.

MATERNAL SMOKING · TOBACCO · PREGNANCY · HEALTH MONITORING · KIGGS

Background

Maternal smoking during pregnancy poses a significant risk to the development of an unborn child [1-3]. Complications during pregnancy such as miscarriages, premature births and stillbirths occur more frequently among women who smoke. The harmful substances contained in tobacco smoke pass through the placenta into the bloodstream of unborn children and impair the supply of oxygen, thus inhibiting growth and essential processes of fetal maturation. Therefore, babies born to mothers who smoke are, on average, both smaller and lighter and have a smaller head circumference at birth than babies born to non-smokers [4]. Maternal smoking during pregnancy also promotes the development of congenital malformations [5] and is a major risk factor linked to sudden infant death syndrome [6]. It also increases the long-term risk of numerous diseases and developmental disorders in childhood, including asthma [7], otitis media [8], overweight [9] and behavioural problems [10].

Mothers who stop smoking before or during pregnancy can significantly reduce their risk of complications and of adverse health effects for both mother and child [11]. As such, tobacco prevention, cessation and control among pregnant women and women of childbearing age are high priorities from a public health point of view [12]. The health target 'Reduction of tobacco consumption', which was developed as part of the process to develop national health targets in Germany and revised in 2015, includes one out of five sub-goals that aims at reducing maternal smoking rates during pregnancy [13]. The health target 'Health before, during and after birth', which was adopted in 2017, additionally aims to reduce the numbers of women who smoke

KiGGS
Studie zur Gesundheit von Kindern und Jugendlichen in Deutschland

KiGGS Wave 2

Second follow-up to the German Health Interview and Examination Survey for Children and Adolescents

Data owner: Robert Koch Institute

Aim: Providing reliable information on health status, health-related behaviour, living conditions, protective and risk factors, and health care among children, adolescents and young adults living in Germany, with the possibility of trend and longitudinal analyses

Study design: Combined cross-sectional and cohort study

Cross-sectional study in KiGGS Wave 2
Age range: 0-17 years
Population: Children and adolescents with permanent residence in Germany
Sampling: Samples from official residency registries - randomly selected children and adolescents from the 167 cities and municipalities covered by the KiGGS baseline study
Sample size: 15,023 participants

KiGGS cohort study in KiGGS Wave 2
Age range: 10-31 years
Sampling: Re-invitation of everyone who took part in the KiGGS baseline study and who was willing to participate in a follow-up
Sample size: 10,853 participants

KiGGS survey waves
- KiGGS baseline study (2003-2006), examination and interview survey
- KiGGS Wave 1 (2009-2012), interview survey
- KiGGS Wave 2 (2014-2017), examination and interview survey

More information is available at www.kiggs-studie.de/english

during pregnancy [14]. In order to monitor how well these goals are being achieved, repeated epidemiological studies of the spread of tobacco use among pregnant women are needed. This is the only way to identify risk groups, develop suitable measures for the reduction of maternal smoking during pregnancy and evaluate the effectiveness of such measures [3]. The latest German Health Interview and Examination Survey for Children and Adolescents (KiGGS Wave 2) provides data that can be used for this purpose.

Indicator and methodology

KiGGS forms part of the health monitoring programme 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 of the German population (KiGGS cross-sectional study). After having carried out the baseline study as an interview and examination survey between 2003 and 2006, and KiGGS Wave 1 as an interview-based survey between 2009 and 2012, KiGGS Wave 2 was implemented between 2014 and 2017 as a combined interview and examination survey. A detailed description of the methodology used in KiGGS Wave 2 can be found in New data for action. Data collection for KiGGS Wave 2 has been completed in issue S3/2017 as well as KiGGS Wave 2 cross-sectional study – participant acquisition, response rates and representativeness in issue 1/2018 of the Journal of Health Monitoring [15, 16].

Data on maternal smoking during pregnancy was recorded retrospectively for KiGGS Wave 2 using information provided by a child's parents or guardians as part of a written questionnaire. This included asking the question, 'Did the mother of the child smoke during pregnancy?'. The response categories were 'Yes, regularly,' 'Yes, sometimes' and 'No, never'; the first two categories are combined below [3].

The findings presented here are based on data from 4,838 children aged 0 to 6 with valid data on maternal smoking habits during pregnancy. The results are presented as prevalences (frequencies) and are stratified by age of the mother at the time the child was born [3], socioeconomic status (SES) of the family [17] and migration background [18]. Comparable data from the KiGGS baseline study are used to analyse trends over time.

The calculations were carried out using a weighting factor that corrects for deviations within the sample from the population structure with regard to age in years, gender, federal state, nationality and the parents' level of education (Microcensus 2013 [19]).

This article reports prevalences with 95% confidence intervals (95% CI). A statistically significant difference between groups is assumed to have been demonstrated with p-values of less than 0.05 (once weighting had been applied and the survey design had been taken into account).

Results and discussion

Data from KiGGS Wave 2 demonstrate that 10.9% of mothers of children aged between 0 and 6 and born between 2007 and 2016 smoked during pregnancy. Mothers who were under 25 when they gave birth had a 22.5% prevalence of smoking during pregnancy; this was around twice as high as the prevalence identified among women who gave birth between 25 and 29 years of age. The proportion of women who smoked during pregnancy was about three times higher in mothers under 25 than among mothers who were 30 or above when they gave birth (Table 1). In

Table 1
Prevalence of maternal smoking during pregnancy according to the mother's age when giving birth, socioeconomic status and migration background
Source: KiGGS Wave 2 (2014-2017), children aged between 0 and 6 (n=4,838)

	%	(95% CI)
Mother's age when giving birth		
<25	22.5	(17.5-28.5)
25-29	12.7	(10.4-15.4)
30-34	7.4	(5.9-9.3)
≥35	7.6	(5.7-10.0)
Socioeconomic status		
Low	27.2	(22.8-32.1)
Medium	9.2	(7.8-10.9)
High	1.6	(0.9-2.9)
Migration background		
None	12.2	(10.5-14.0)
One-sided	9.6	(6.4-14.4)
Two-sided	6.2	(4.2-9.0)
Total	**10.9**	**(9.6-12.4)**

CI=confidence interval

The proportion of mothers who smoked during pregnancy dropped from 19.9% to 10.9% between the KiGGS baseline study and KiGGS Wave 2.

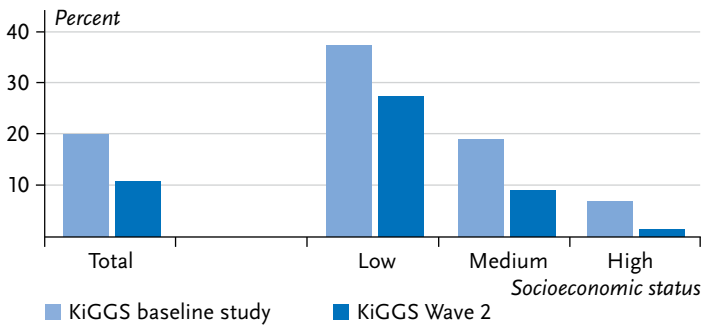
Mothers who were under 25 when they gave birth smoked about two to three times more often during pregnancy than older mothers.

addition, a clear social gradient could be observed: the higher the socioeconomic status (SES) of a family, the lower the proportion of children with a mother who smoked during pregnancy (Table 1). Whereas more than one in four children (27.2%) from the low SES group were exposed to tobacco smoke due to maternal smoking during pregnancy, this applied to just one in eleven children (9.2%) from the medium SES group and very few children (1.6%) from the high SES group. Whereas 12.2% of children with no recent family history of migration were exposed to maternal smoking during pregnancy, children with a one-sided migration background were slightly less (9.6%), and children with a two-sided migration background were much less affected (6.2%) (Table 1).

The results from KiGGS Wave 2 are consistent with the findings from the two previous KiGGS waves; other studies also show that smoking during pregnancy is particularly common among certain risk groups [3, 20-23]. These risk groups include mothers who are relatively young when they give birth and socially disadvantaged women. The fact that mothers of children with a two-sided migration background smoked less often during pregnancy was demonstrated by the KiGGS baseline study and KiGGS Wave 1 after taking into account the facts that these families usually face worse social conditions and that mothers in this group are usually younger when they give birth [3].

A comparison of the data on maternal smoking during pregnancy from KiGGS Wave 2 (0 to 6 year-old children; 2007-2016 birth cohorts) with corresponding data from the KiGGS baseline study (0 to 6 year-old children; 1996-2006 birth cohorts) demonstrated that the proportion of mothers who smoke during pregnancy has fallen from 19.9% to 10.9% (Figure 1). Although the data also point to a decrease in the prevalence of smoking among mothers with higher SES as well as among those from disadvantaged groups, the existing pronounced social inequalities in maternal smoking behaviour during pregnancy have remained largely stable. The German Perinatal Survey also found that the proportion of pregnant women who smoke has declined since the mid-1990s [24]. The study, which is undertaken as part of external inpatient quality assurance, gathers data on cigarette smoking during pregnancy from all women who give birth in German hospitals. Scholz et al. use this data to demonstrate that the proportion of pregnant women who smoke decreased from 23.5% to 11.2% between the period ranging from 1995 to 1997 and from 2007 to 2011 [24]. Although data from international studies from many countries indicates a decline in prevalence over the past 10 to 20 years, they also demonstrate that a

Figure 1
Trends in smoking behaviour during pregnancy among mothers of 0 to 6 year-old children in total and according to their socioeconomic status
Source: KiGGS baseline study (2003-2006, birth cohorts 1996-2006, n=6,525) and KiGGS Wave 2 (2014-2017, birth cohorts 2007-2016, n=4,838)



The higher the socioeconomic status, the lower the proportion of children whose mother smoked during pregnancy.

significant proportion of women continue to smoke during pregnancy in most Western countries [25, 26]. The 2013 European Perinatal Health Report also indicates that the proportion of mothers who smoke during pregnancy decreased between 2004 and 2010 in countries such as the UK, France and the Netherlands [27].

However, a number of limitations need to be taken into account when analysing the KiGGS data [3]. On the one hand, the results presented here cannot be compared directly with interview surveys conducted with pregnant women. KiGGS collected its data on maternal smoking during pregnancy retrospectively from parents of 0 to 6 year-old children. By the time the mothers participated in KiGGS, up to six years had elapsed since their pregnancy; as such the information they supplied could be affected by recall bias. On the other hand, the well-known phenomenon of participants' providing what they view to be socially acceptable responses could also have led to an underestimation of the actual proportion of smokers within the data (social desirability bias). Moreover, the data from KiGGS Wave 1 were not taken into account in the results presented here for methodological reasons, since the birth cohorts (2002-2012; 0 to 6 year-olds) that participated in KiGGS Wave 1 largely overlap with those of the KiGGS baseline survey and that of KiGGS Wave 2. For the sake of completeness, however, it should be noted that KiGGS Wave 1 found that 12.0% of mothers smoked during pregnancy, which is slightly higher than the figures identified from KiGGS Wave 2.

Despite these limitations, the KiGGS data on maternal smoking during pregnancy provide valuable information for epidemiological research and health policy-making. The cross-sectional data, and, in particular, the data from the KiGGS cohort [15, 28], can be used to examine both short-term and long-term links between maternal tobacco use in pregnancy and a child's health development. Future target group-specific tobacco prevention and cessation measures should increasingly focus on young and socially disadvantaged women. Given that pregnancy provides a window of opportunity for measures that can encourage people to change their behaviour [2], midwives, doctors and other professionals who regularly work with pregnant women should ask mothers about their use of tobacco, educate smokers about the risks, and recommend to quit smoking; where appropriate, support services should be offered [29].

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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.

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Conflicts of interest

The authors declared no conflicts of interest.

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Allergic rhinitis and asthma among children and adolescents in Germany. Results of the cross-sectional KiGGS Wave 2 study and trends

ALLERGIC RHINITIS · ASTHMA · TRENDS · CHILDREN AND ADOLESCENTS · HEALTH MONITORING

Background

Allergic diseases such as allergic rhinitis and bronchial asthma belong to the most common conditions suffered by children and adolescents. In many cases, the symptoms have a severe effect on the everyday lives of patients. Allergic rhinitis is an allergic inflammation of the nasal mucosa, and is accompanied by itchiness, sneezing attacks, increased secretion of mucus, and impaired nasal breathing. Frequently the condition also affects the eyes. Allergens ranging from pollen, fungi, epithelial animal tissue to house dust mites may all trigger symptoms. Bronchial asthma, in turn, is caused by a hypersensitivity of the bronchi to various compounds. This hypersensitivity causes reversible, sudden constriction of the bronchial system that leads to coughing, shortness of breath and wheezing. Asthma in the majority of children has an allergic cause [1, 2].

From the mid-20th century, the prevalence of allergic diseases in western industrialised nations saw a significant increase. The results of the international ISAAC study (International Study of Asthma and Allergies in Childhood) and the repeated examination of children at school-entry age in East and West Germany during the 1990s, revealed a further, albeit not so pronounced increase in Germany [3–5]. As far as the development over the past ten years can be assessed, the results from the baseline study of the German Health Interview and Examination Survey for Children and Adolescents (KiGGS) between 2003 and 2006 served as a benchmark for a comparison with the prevalence measured in KiGGS Wave 2 between 2014 and 2017.

Indicators and methodology

The German Health Interview and Examination Survey for Children and Adolescents is part of the health monitoring programme undertaken at the Robert Koch Institute. It involves repeated cross-sectional surveys of children and adolescents aged between 0 and 17 that are representative of the German population (KiGGS cross-sectional study). After carrying out the baseline study as an interview and examination survey (2003-2006) and KiGGS Wave 1 as an interview-based survey (2009-2012), KiGGS Wave 2 took place between 2014 and 2017 as a combined examination and interview survey.

A detailed description of the methodology used in KiGGS Wave 2 can be found in New data for action. Data collection for KiGGS Wave 2 is completed in issue S3/2017 as well as KiGGS Wave 2 cross-sectional study – participant acquisition, response rates and representativeness in issue 1/2018 of the Journal of Health Monitoring [6, 7].

On the basis of data from the KiGGS baseline study and KiGGS Wave 2, this article reports the trends in the 12-month

Studie zur Gesundheit von Kindern und Jugendlichen in Deutschland

KiGGS Wave 2

Second follow-up to the German Health Interview and Examination Survey for Children and Adolescents

Data owner: Robert Koch Institute

Aim: Providing reliable information on health status, health-related behaviour, living conditions, protective and risk factors, and health care among children, adolescents and young adults living in Germany, with the possibility of trend and longitudinal analyses

Study design: Combined cross-sectional and cohort study

Cross-sectional study in KiGGS Wave 2
Age range: 0-17 years
Population: Children and adolescents with permanent residence in Germany
Sampling: Samples from official residency registries - randomly selected children and adolescents from the 167 cities and municipalities covered by the KiGGS baseline study
Sample size: 15,023 participants

KiGGS cohort study in KiGGS Wave 2
Age range: 10-31 years
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KiGGS survey waves

- KiGGS baseline study (2003-2006), examination and interview survey
- KiGGS Wave 1 (2009-2012), interview survey
- KiGGS Wave 2 (2014-2017), examination and interview survey

More information is available at www.kiggs-studie.de/english

prevalence of allergic rhinitis and bronchial asthma in the group of children and adolescents aged between 3 and 17. In both survey waves parents were asked, whether a physician had ever diagnosed their children with the condition, whether the condition had occurred during the last twelve months and whether their child had taken any corresponding medication during the last twelve months. For the group of children and adolescents diagnosed with allergic rhinitis or atopic dermatitis with a positive allergy test result, the survey also compared parents' answers regarding specific immunotherapy between the baseline study and KiGGS Wave 2.

All calculations were carried out using a weighting factor that corrects for deviations within the sample from the population structure with regard to age in years, gender, federal state, nationality and parent level of education (Microcensus 2013 [8]).

This article reports prevalences with 95% confidence intervals (95% CI). A statistically significant difference between groups is assumed to have been demonstrated with p-values of less than 0.05 (once weighting had been applied and the survey design had been taken into account).

Results

Allergic rhinitis

In KiGGS Wave 2, the 12-month prevalence of physician-diagnosed allergic rhinitis in the 3 to 17 age group was 9.9% (95% CI 9.2-10.7) and has therefore remained nearly unchanged compared to the KiGGS baseline study (9.6%; 95% CI 9.0-10.1). Equally unchanged are the observed charateristic differences by gender and age, with prevalence higher for boys than for girls (KiGGS Wave 2: 11.9% vs. 7.9%) and a clear increase of prevalence with age for both genders.

Asthma

In KiGGS Wave 2, the 12-month prevalence of physician-diagnosed bronchial asthma in the 3 to 17 age group was 4.0% (95% CI 3.5-4.5). Overall prevalence also has not changed significantly in comparison to the KiGGS baseline study (3.7%; 95% CI 3.3-4.1). Stratified by gender, prevalence among girls between the two survey points remained unchanged (3.0% vs. 3.1%) and increased slightly for boys (5.0% vs. 4.2%). This increase in prevalence is owed mainly to increases in the groups of boys aged 7 to 10 (5.7% vs. 4.1%) and 11 to 13 (7.1% vs. 5.7%).

Specific immunotherapy

The proportion of children and adolescents who have been medically diagnosed with allergic rhinitis or atopic dermatitis including a positive allergy test result and subsequent specific immunotherapy has increased significantly in the 11 to 17 age group. During the KiGGS baseline study 24.3% (95% CI 21.3-27.6) of elder children and adolescents reported having undergone a specific immunotherapy treatment, in KiGGS Wave 2 this proportion had increased to 30.1% (95% CI 26.5-33.9).

Discussion

For both allergic rhinitis and bronchial asthma, KiGGS Wave 2 results, when compared to the KiGGS baseline study, show that following the secular trends with a significant increase in the number of cases registered during the second half of the 20th century, there are strong indications

of a stabilisation of this trend, albeit at a high level. Stratified by gender, the results indicate that the trends for girls and boys might be developing differently, particularly regarding bronchial asthma. Whereas the survey observed no changes in 12-month prevalence among girls between KiGGS baseline and KiGGS Wave 2, there has been a slight increase of prevalence for boys aged 7 to 13. The new results, however, give little reason for contentedness: allergic rhinitis still affects over one million children and adolescents aged between 3 and 17, and nearly half a million suffer from asthma.

The increase in the number of cases receiving specific immunotherapy treatment as the single causal therapy for elder children with allergic rhinitis or atopic dermatitis is positive. The guidelines developed jointly by the German Society for Allergology and Clinical Immunology (DGAKI) and other allergy associations on specific immunotherapy to treat allergic diseases recommend an early onset of therapy in particular at child and adolescent age [9] to reduce the risks for new sensitisation and asthma. Overall, early diagnosis and adequate care provision for allergic diseases are important not only for patients but also from a macroeconomic perspective.

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Data protection and ethics

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The developmental course of mental health problems among children and adolescents. Results of the KiGGS cohort

MENTAL HEALTH · MENTAL DISORDERS · PHASES OF LIFE · CHILDHOOD AND ADOLESCENCE · HEALTH MONITORING

Background

Children and adolescents with poor mental health are more adversely affected in their quality of life than those with physical illnesses [1]. Therefore, an analysis of the factors that contribute to the development of mental health problems during the course of a child's life can specifically be used to develop appropriate interventions and reduce the psychological strain faced by young people. Mental health problems among children and adolescents are indicated when their behaviours and feelings do not comply with social expectations given their age as well as their stage of development [2]. In accordance with this definition, 20% of children and adolescents show signs of mental health problems in Germany. The prevalence of poor mental health remained stable over two survey periods of the German Health Interview and Examination Survey for children and adolescents (KiGGS, 2003-2006 and 2009-2012) [3]. However, the development of emotional and behavioural problems identified among Children and Adolescents compared to adults is characterized by permanent changes. Mental health problems disappear within one year in every second child. Nevertheless, symptoms can persist over a long period of time and may increase over the course of a child's development [4]. In order to identify risk groups and phases of life during which young people are most vulnerable to mental health problems, longitudinal data from the KiGGS cohort were analysed according to gender and age.

Indicator and methodology

Data on mental health problems were collected using Goodman's [5] Strengths and Difficulties Questionnaire (SDQ), a validated, internationally accepted instrument. In accordance with the purpose of the KiGGS study, the questionnaire was used to identify risk groups for mental health disorders in children and adolescents among various population groups. The screening questionnaire included subscales for emotional symptoms, peer relationship problems, conduct problems and hyperactivity/inattention. All analyses were based exclusively on the parent-rated SDQ of 3 to 17 year-old participants. A total of 6,459 participants (3,198 girls, 3,261 boys) were surveyed at the KiGGS baseline study (2003-2006) and KiGGS Wave 1 (2009-2012). In order to examine the course of mental health problems among children and adolescents at various stages of their lives, different age groups were analysed (32.2% were aged between 3 and 5 years, 35.1% were aged between 6 and 8 years, and 32.8% were aged between 9 and 11 years at the KiGGS baseline study). The analysis focused on children and adolescents with normal and abnormal mental health problem scores at the KiGGS baseline study, who displayed

Studie zur Gesundheit von Kindern und Jugendlichen in Deutschland

The KiGGS study

The German Health Interview and Examination Survey for Children and Adolescents

Data owner: Robert Koch Institute

Aim: Providing reliable information on health status, health-related behaviour, living conditions, protective and risk factors, and health care among children, adolescents and young adults living in Germany, with the possibility of trend and longitudinal analyses

Study design: Combined cross-sectional and cohort study

KiGGS survey waves

- KiGGS baseline study (2003-2006), examination and interview survey
- KiGGS Wave 1 (2009-2012), interview survey
- KiGGS Wave 2 (2014-2017), examination and interview survey

KiGGS cross-sectional study

Population: Children and adolescents with permanent residence in Germany
Age range: 0-17 years

KiGGS cohort study

Sampling: Re-invitation of everyone who took part in the KiGGS baseline study (n=17,641) and who was willing to participate in a follow-up
Age range KiGGS Wave 1: 6-24 years (n=11,992)
Age range KiGGS Wave 2: 10-31 years (n=10,853)

More information is available at www.kiggs-studie.de/english

abnormal scores at KiGGS Wave 1. Probabilities were calculated for all transitions between statuses of mental health problems (i.e. normal to abnormal or abnormal to abnormal) at the KiGGS baseline study and Wave 1. The possibility of selective (re)participation was partially corrected by multivariate weighting [6].

Results

Among children and adolescents with no mental health problems at the KiGGS baseline study, 12% displayed emotional and behavioural problems at KiGGS Wave 1; while 88% had no mental health problems at both survey periods (Figure 1). Only every second child and adolescent who had mental health problems at the KiGGS baseline study still displayed symptoms at KiGGS Wave 1.

Differences in the course of mental health problems among boys and girls were identified with respect to different age groups (Figure 2). The proportion of children and adolescents who showed no symptoms during the first survey period (KiGGS baseline study) but displayed abnormal mental health scores six years later (KiGGS Wave 1) was highest (18%) among 3 to 5 year-old boys (compared to all other age groups and girls). Among boys, this proportion decreases with age, dropping to 8% among 9 to 11 year-olds, whereas the proportion of girls affected by mental health problems remains relatively constant across age groups.

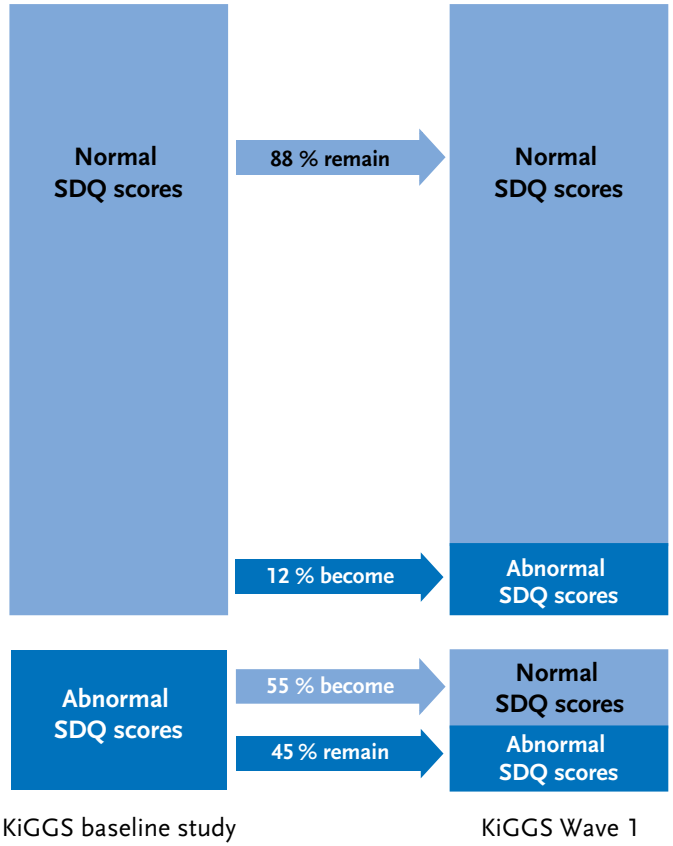
The proportion of children and adolescents who showed mental health problems during the first survey period (KiGGS baseline study) with persistent abnormal scores at KiGGS Wave 1 was highest (52%) among 3 to 5 year-old boys (compared to all other age groups and to girls). The proportion of boys who demonstrated abnormal symptoms during both study periods decreased to 38% among children aged between 9 and 11 years. Meanwhile, girls with abnormal scores at both study periods showed an increase with age (38% vs. 45% vs. 47%).

Discussion

Our results emphasise that a large proportion of children and adolescents showed no mental health problems (i.e. had normal scores) at both study periods. Overall boys were more likely to display emotional and behavioural problems compared to girls [3]. The occurrence of symptoms screened for by the SDQ undergoes permanent changes during the developmental process. Descriptively, boys at pre-school age (3 to 5 year-olds) and the end of primary school (9 to 11 year-olds) are most vulnerable to the onset of mental health problems. In addition, boys not only develop more problems during this stage of life compared to girls, moreover, the symptoms they do develop are also more persistent. The proportion of boys with emerging and persistent mental health problems reduces with age. Compared to boys, the proportion of girls with emerging mental health problems remains constant until adolescence. However, the proportion of girls who show persistent symptoms increases over both survey periods with advancing age. Girls seem to be particularly vulnerable to mental health problems during the transition from the end of primary school (9 to 11 year-olds) to late adolescence (15 to 17 year-olds). Compared to boys, emotional and behavioural problems are more persistent during this period in descriptive analysis.

The differences in the individual courses according to gender and age can be partly explained by categorising

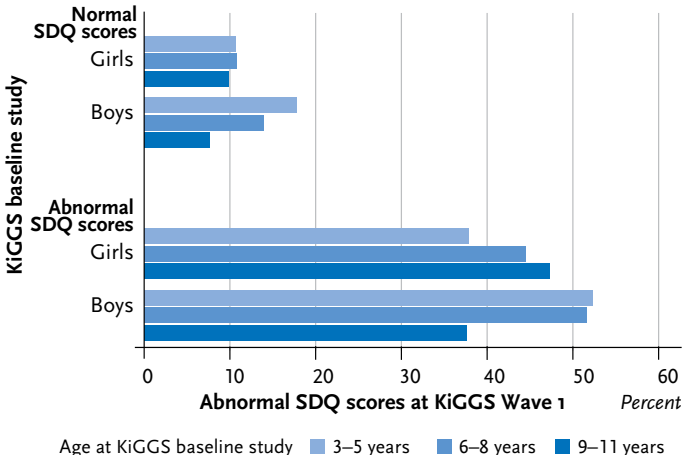
Figure 1
The course of individual mental health problems (according to SDQ scores) among children and adolescents at the KiGGS baseline study and KiGGS Wave 1 (n=6,459)
Source: KiGGS baseline study (2003-2006), KiGGS Wave 1 (2009-2012)



mental health problems into inward (internalising) and outward (externalising) symptoms [7]. Externalising mental health problems (i.e. aggression and inattention) tend to be reported more frequently among boys, internalising problems (i.e. anxiety and depression) are more common among girls [3, 8]. In general, externalising mental health problems are transient over the course of childhood and adolescence, which may be an explanation for the decrease in these symptoms among boys. Among girls, mental health problems increase over time, as internalising symptoms become more pronounced with age [8]. Still, the reported values are probably underestimated because internalising mental health problems are comparatively difficult to detect by parents and, therefore, less frequently identified [3].

Future analyses will need to particularly focus on the significance of psychosocial changes in the transition from childhood to adolescence and early adulthood (such as separations from parents, the importance and influence of friends and associated risk-related behaviour) on the course and stability of mental health problems. Thus, it is possible that a highly vulnerable child may not develop mental health problems until adolescence, because they might have been compensated in an earlier, psychosocial more stable developmental stage. In addition, psychosocial protective factors might help children develop into healthy adults despite displaying mental health problems during childhood. These and other questions could be addressed using data from the next wave of the KiGGS longitudinal survey (KiGGS Wave 2, 2014-2017) and following future KiGGS cohort studies.

Figure 2
The presence of mental health problems (according to SDQ scores) at KiGGS Wave 1 for children and adolescents with normal and abnormal mental health scores at the KiGGS baseline study according to gender and age (n= 6,459)
Source: KiGGS baseline study (2003-2006), KiGGS Wave 1 (2009-2012)



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Data protection and ethics

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Developments in smoking behaviour during the transition from adolescence to young adulthood. Results of the KiGGS cohort

SMOKING · TRANSITION · YOUNG ADULTS · HEALTH MONITORING · KIGGS COHORT

Background

The consumption of tobacco products is regarded as the largest preventable risk factor for a large number of serious diseases. It causes around 121,000 deaths per year in Germany alone [1]. Over the last two decades, various tobacco control measures have been taken and extended over time such as increasing tobacco taxes, advertising bans and implementing age restrictions as well as smoking bans to protect non-smokers from second hand smoke exposure. Overall, tobacco consumption has decreased during this period [2] and the proportion of smokers among children and adolescents declined significantly. However, as a large proportion of the population continues to smoke, reducing tobacco consumption remains one of the key objectives of public health [3, 4]. Smoking in childhood and adolescence may still be experimental in character, but it often proves to be the beginning of a consumption pattern that is highly stable over the life course [5, 6]. In this context, this article uses longitudinal data from the KiGGS cohort to examine trajectories of smoking behaviour during the transition from adolescence to young adulthood.

Indicator and methodology

The analyses presented here are based on self-reports on current smoking (any smoking, even occasional) and on the age of smoking initiation. The data is taken from the KiGGS cohort, a study that follows the participants of the KiGGS baseline study (2003-2006) [7] into adulthood. The sample includes 2,159 young adults (1,159 women; 1,000 men) aged 19 and 24 years old who have participated again in the first follow-up telephone survey of KiGGS Wave 1 (2009-2012). In total, 57.8% of the original 3,736 14 to 17 year-olds in the KiGGS baseline study with valid information on current smoking at both measurement times were included. Transition probabilities were calculated, that means the percentage probability of the transition from smoking to non-smoking or vice versa from the KiGGS baseline study to KiGGS Wave 1. Socioeconomic status (SES) was determined using the data provided by parents on education, occupation and income at the time of the KiGGS baseline study [8]. Possible bias caused by selective re-participation was partially taken into account through multivariate weighting [7].

Studie zur Gesundheit von Kindern und Jugendlichen in Deutschland

The KiGGS study

The German Health Interview and Examination Survey for Children and Adolescents

Data owner: Robert Koch Institute

Aim: Providing reliable information on health status, health-related behaviour, living conditions, protective and risk factors, and health care among children, adolescents and young adults living in Germany, with the possibility of trend and longitudinal analyses

Study design: Combined cross-sectional and cohort study

KiGGS survey waves

- KiGGS baseline study (2003-2006), examination and interview survey
- KiGGS Wave 1 (2009-2012), interview survey
- KiGGS Wave 2 (2014-2017), examination and interview survey

KiGGS cross-sectional study

Population: Children and adolescents with permanent residence in Germany
Age range: 0-17 years

KiGGS cohort study

Sampling: Re-invitation of everyone who took part in the KiGGS baseline study (n=17,641) and who was willing to participate in a follow-up
Age range KiGGS Wave 1: 6-24 years (n=11,992)
Age range KiGGS Wave 2: 10-31 years (n=10,853)

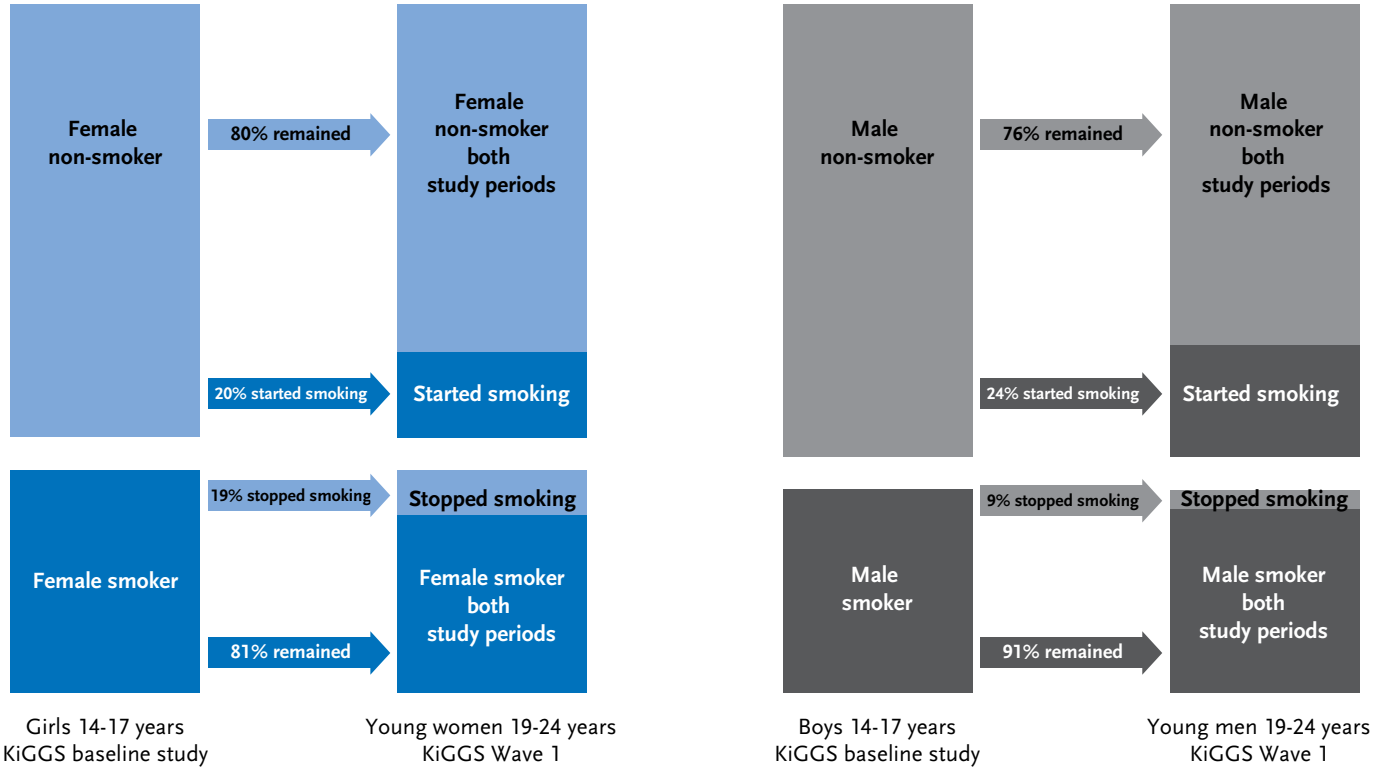
More information is available at www.kiggs-studie.de/english

Results

The proportion of people in the sample who smoked increased from 32% to 43% between the periods during which the KiGGS baseline study and KiGGS Wave 1 were undertaken. 85% of adolescents who smoked and 78% of non-smoking adolescents did not change their smoking behaviour in young adulthood. Whereas 15% of young people who smoked quit smoking between the two survey periods, 22% of non-smokers starting smoking during this time. The analyses of data covering the age when a respondent began to smoke show that almost nine out of ten participants who ever smoked started smoking before the age of 18.

Although no differences were found between the proportions of girls and boys who smoked during adolescence, the proportion of smoking in young adulthood increases more considerable in young men than in women. The main reason for this difference is that women who smoked as adolescents quit smoking significantly more often than men (19% vs. 9%) during the transition into adulthood. At

Figure 1: Developments in smoking behaviour during the transition from adolescence to young adulthood (n=1,159 female, n=1,000 male)
Source: KiGGS baseline study (2003-2006), KiGGS Wave 1 (2009-2012)



the same time, formerly non-smoking male adolescents have started smoking more often; however, this difference is not statistically significant (Figure 1).

Finally, there is a strong correlation between SES and smoking behaviour. For both survey periods, a larger proportion of people in the low status group smoked than in the high status group (KiGGS baseline study: 37% vs. 23%; KiGGS Wave 1: 49% vs. 33%). Non-smoking adolescents with a low SES started smoking more often as young adults, and young smokers with a low SES quit smoking slightly less frequently than those with a high SES. However, these social differences of individual changes are not statistically significant.

Discussion

The results demonstrate that smoking behaviour remains relatively stable during the transition from adolescence to young adulthood; this finding is in line with the existing literature [6]. A large proportion of non-smoking adolescents do not start smoking during the transition into adulthood; nevertheless, only a minor proportion of the smoking adolescents quit smoking during young adulthood. These figures illustrate the importance of preventing children and adolescents from starting to smoke. In addition, the results indicate that the social differences in smoking behaviour that are already evident among adolescents become stabilised in later life, and therefore contribute to long-term health inequalities. However, it has to be acknowledged that smoking participants with a low SES more often did not take part in KiGGS Wave 1. This may have led to an underestimation of prevalence. It was not possible to completely offset this dropout using weighting.

Trend analyses of the cross-sectional data from KiGGS show that smoking prevalence rates among adolescents in Germany have steadily decreased over the past ten years [3]. However, the results set out here demonstrate that on an individual level the smoking behaviour of the formerly adolescent participants of the KiGGS cohort remains relatively stable during the transition into adulthood; most people who smoked during young adulthood started this behaviour during adolescence. These results illustrate the added value of the longitudinal data gained by continuation of the KiGGS cohort. Future analyses should aim to identify influencing factors that prevent or encourage smoking and that also promote or make it more difficult to quit. The results of such analyses could then be used to develop target group-specific interventions in tobacco prevention and smoking cessation or rather to evaluate the measures that are currently in place.

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Allergic sensitisations during the life course. Results of the KiGGS cohort

IGE ANTIBODIES · CHILDREN AND ADOLESCENTS · COHORT STUDY · HEALTH MONITORING

Background

Allergic sensitisations of the immune system involve the formation of specific immunoglobulin E (IgE) antibodies after (initial) contact with certain otherwise harmless substances (allergens). Repeated contact with allergens, however, sensitises the immune system. On subsequent contact, the immune system recognises these allergens and this triggers a reaction by its defence mechanisms. Allergic reactions can affect different organs, have different degrees of severity and show various symptoms. Although allergic sensitisations are measurable by analysing the levels of IgE antibodies in the blood, detecting these antibodies does not provide a measurement of disease, rather they are merely associated with an increased risk of allergic diseases [1].

There are four different types of allergic reaction. Type I hypersensitivity, also referred to as the immediate type, is the most common form and it is mediated by IgE antibodies. Some of the best known manifestations of Type I allergies include hay fever and (allergic) asthma. These conditions are among the most common chronic diseases in childhood and adolescence, they place significant burdens on health and have strong socioeconomic consequences [2, 3]. An important aspect of epidemiological allergy research is the extent to which sensitisations persist and how they may develop or even decline during the life course. In particular, this applies to sensitisations to important inhalant allergens that play a significant role in the development of hay fever and asthma. Only limited data are available that can be used to calculate transition probabilities. However, as part of the KiGGS cohort – the largest cohort for children and adolescents in Germany – measurements were taken of important specific IgE antibodies that are associated with the most commonly occurring allergic diseases. These measurements were made during the KiGGS baseline study (2003-2006) and KiGGS Wave 2 (2014-2017). This data can help answer the important question about the extent to which allergic sensitisations persist, arise or even decline over a period of more than ten years. This article, therefore, uses the longitudinal data from the KiGGS cohort to investigate the transition probabilities of allergic sensitisations during the transition from childhood to young adulthood.

Indicator and methodology

The analyses are based on measurements made of specific IgE antibodies that react against the allergen mixture SX1, a mixture of eight common inhalant allergens (timothy, ryegrass, birch, mugwort, cat and dog dander, house dust mite and the fungus Cladosporium herbarum – Phadia, now Thermo Scientific, Freiburg). Measurements were made

Studie zur Gesundheit von Kindern und Jugendlichen in Deutschland

KiGGS Wave 2

Second follow-up to the German Health Interview and Examination Survey for Children and Adolescents

Data owner: Robert Koch Institute

Aim: Providing reliable information on health status, health-related behaviour, living conditions, protective and risk factors, and health care among children, adolescents and young adults living in Germany, with the possibility of trend and longitudinal analyses

Study design: Combined cross-sectional and cohort study

Cross-sectional study in KiGGS Wave 2

Age range: 0-17 years
Population: Children and adolescents with permanent residence in Germany
Sampling: Samples from official residency registries - randomly selected children and adolescents from the 167 cities and municipalities covered by the KiGGS baseline study
Sample size: 15,023 participants

KiGGS cohort study in KiGGS Wave 2

Age range: 10-31 years
Sampling: Re-invitation of everyone who took part in the KiGGS baseline study and who was willing to participate in a follow-up
Sample size: 10,853 participants

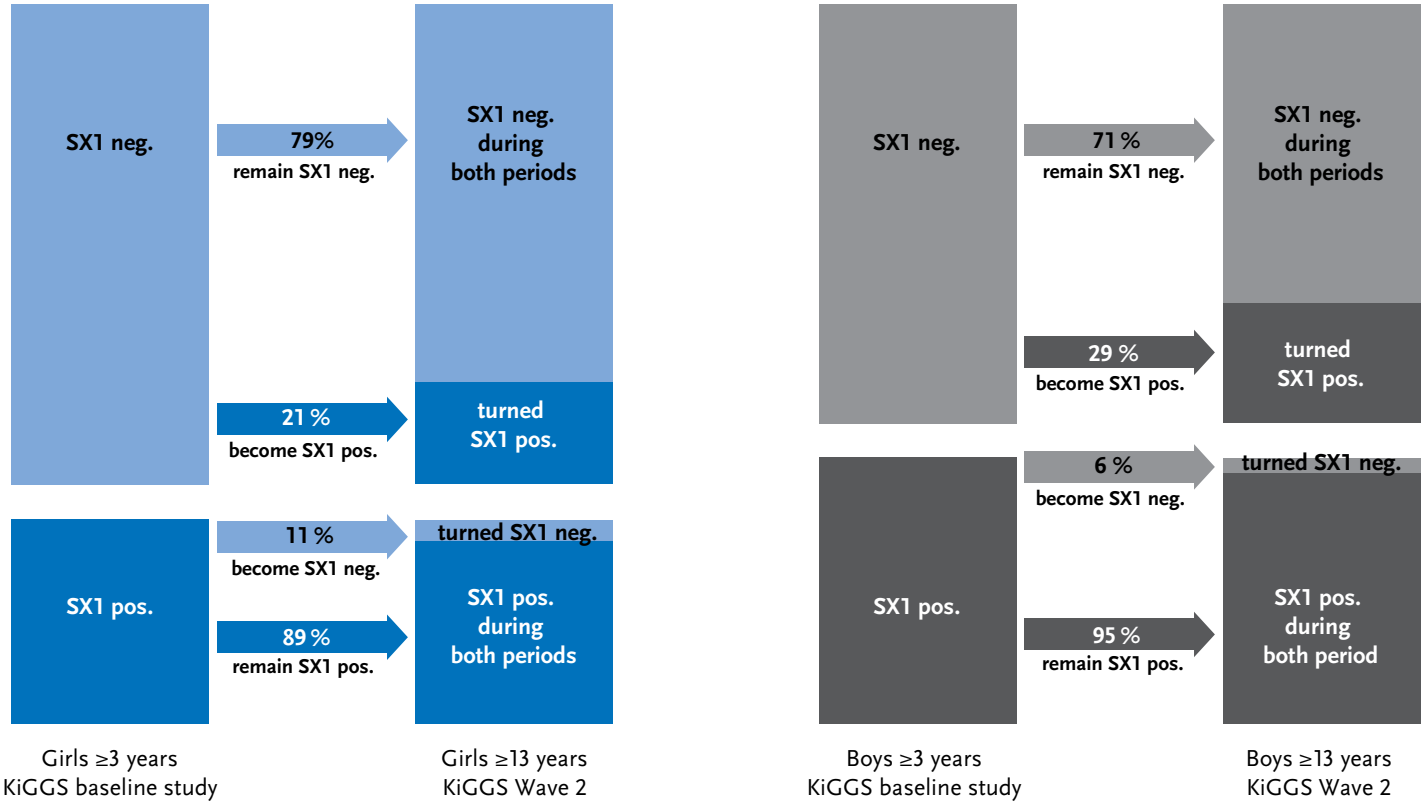
KiGGS survey waves

- KiGGS baseline study (2003-2006), examination and interview survey
- KiGGS Wave 1 (2009-2012), interview survey
- KiGGS Wave 2 (2014-2017), examination and interview survey

More information is available at www.kiggs-studie.de/english

from 2,041 girls and 2,143 boys who participated in the cohort study and who were examined both during the baseline study (2003-2006) and during KiGGS Wave 2 (2014-2017). The participants were aged 3 years or older at the time of the first measurement. Transition probabilities were calculated as the percentage probability of a transition from non-sensitisation to sensitisation to the allergen mixture SX1 or vice versa during the period beginning with the KiGGS baseline study and ending with KiGGS Wave 2. The value of ≥0.35 kU/l was used to set the limit of positive sensitisations. A possible bias due to selective re-participation was partially offset by multivariate weighting [4, 5].

Figure 1: Sensitisation to an allergen mixture of eight common inhalant allergens (SX1 test) over a 10-year period of the life course (n=2,041 girls, n=2,143 boys)
Source: KiGGS baseline study (2003-2006), KiGGS Wave 2 (2014-2017)



neg. = negative
pos. = positive

Results

Data from the KiGGS baseline study show that 30% of girls aged 3 years or older and 39% of boys from the same age group (which is significantly more) were found to be sensitive to at least one of eight major inhalant allergens; in other words, their SX1 test proved positive. Most of these children also continued to have positive SX1 sensitisation a good ten years later (Figure 1). Only a small proportion of girls (11%) and boys (6%) who had shown sensitisation during the baseline study no longer did so during Wave 2. Among the girls and boys who showed no SX1 sensitisation at the time of the KiGGS baseline study, the probability of becoming sensitised was 21% and 29% respectively (a statistically significant difference). This also means that 79% of girls and 71% of boys remained SX1-negative after a good ten years.

Discussion

This study identified clear positive transition probabilities for sensitisation to a mix of eight major inhalant allergens (SX1 test) for the 10-year follow-up among both genders. As such, a far greater level of SX1 sensitisation developed over the life course than receded. Overall, this development, which was more pronounced among boys than girls, reflects the typical differences in gender and age in the incidence of IgE-mediated allergic diseases. The results underscore the need to further study the factors linked to immune system dysregulation, especially among children with a genetic predisposition to allergies. This would enable relevant preventive and therapeutic measures to be developed.

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Data protection and ethics

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Funding

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Acknowledgement

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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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Development of overweight and obesity in children. Results of the KiGGS cohort

BODY MASS INDEX · OVERWEIGHT · OBESITY · HEALTH MONITORING · KIGGS COHORT

Background

In recent years, the prevalence of overweight and obesity among children in Germany has stabilised at a high level [1]. Children and adolescents with overweight or obesity have an increased risk that an excessive body weight will persist throughout childhood and adolescence until adulthood [2]. For Germany, there are only a few prospective studies available that have examined the development of overweight and obesity among children and young people [3-5].

With the completion of KiGGS Wave 2, measurements of body height and weight in a population-based cohort are once again available. This allows us to describe the progression of children and adolescents with and without overweight or obesity at the time of the initial examination (KiGGS baseline study, 2003-2006) over a period of eleven years. The focus of this article is overweight and obesity among children who were aged 2 to 6 years at the time of the KiGGS baseline study and the transition probabilities until they reach the ages of 12 to 17 years at the time of KiGGS Wave 2.

Indicator and methodology

The KiGGS baseline interview and examination survey (2003-2006) included 17,641 children and adolescents aged 0 to 17 years, of which 4,820 were aged 2 to 6 years [6, 7]. In the second follow-up survey (KiGGS Wave 2, 2014-2017) 10,853 children and adolescents aged 10 to 31 years old participated again [8]. The present analyses are based on data from children and adolescents for which valid measurements on body height and weight were available both for the KiGGS baseline study at the age of 2 to 6 years as well as at the age of 12 to 17 years at the time of KiGGS Wave 2 (n=2,568 children and adolescents; n=1,311 girls, n=1,257 boys).

The body mass index (BMI, in kg/m²) was calculated from body weight and height. Normal weight (≤90th percentile, P90), overweight (>P90 to ≤P97) and obesity (>P97) were defined using the national German percentiles [9, 10]. Overweight is thus defined as overweight without obesity.

In the present article, the proportions (%, including 95% confidence intervals, 95% CI) of cohort participants with and without overweight or obesity at the time of participation in the KiGGS baseline study and KiGGS Wave 2 are reported. Furthermore, transition probabilities (%, 95% CI) for overweight and obesity within the observation period of eleven years are presented.

In the analyses, weighting factors were used to take into account possible bias due to drop-out and selective reparticipation [8].

Studie zur Gesundheit von Kindern und Jugendlichen in Deutschland

This article has been corrected as of January 31, 2019 (see erratum, page 77)

KiGGS Wave 2

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Data owner: Robert Koch Institute

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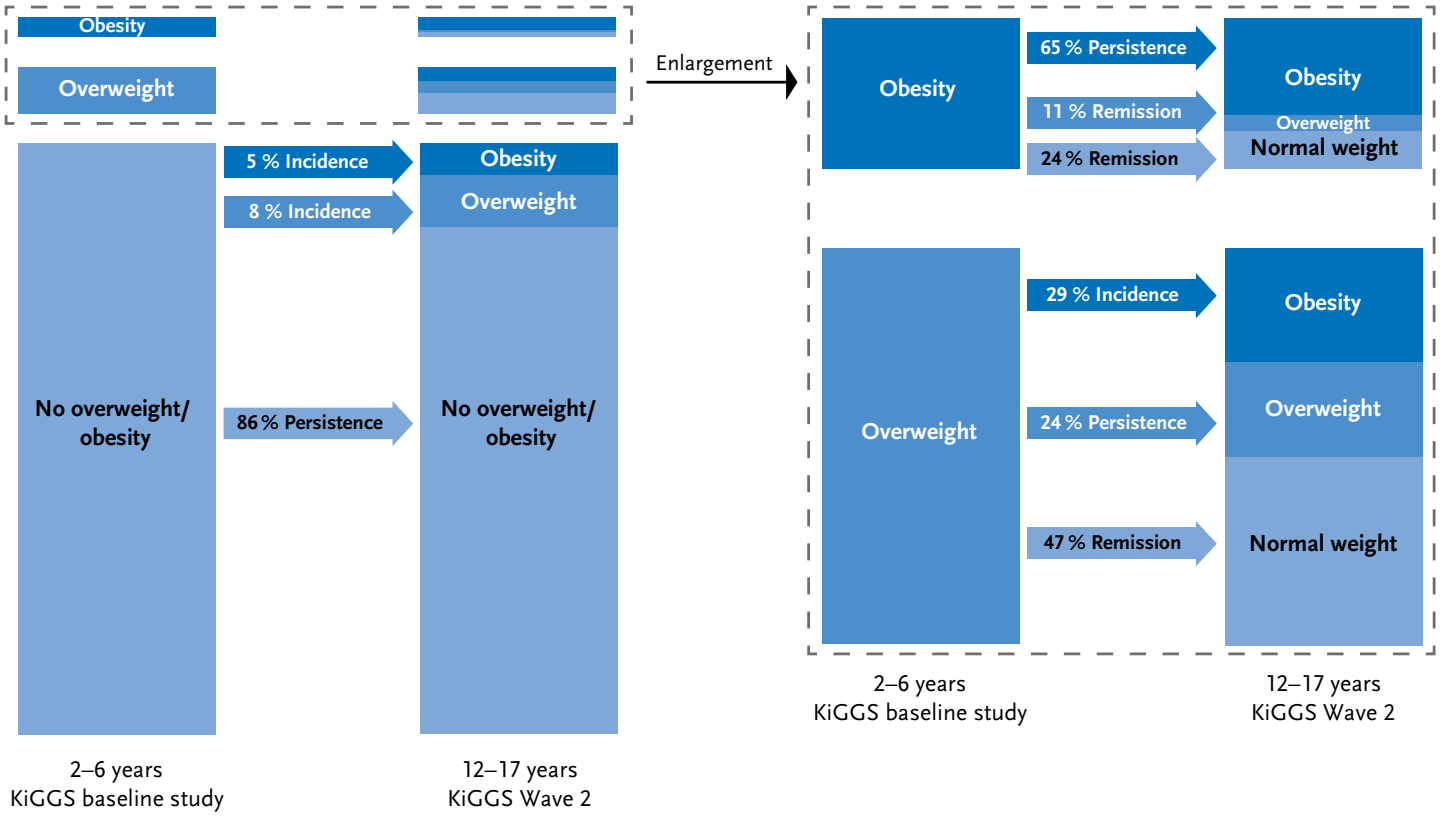
More information is available at www.kiggs-studie.de/english

Results

At the beginning of the KiGGS cohort study, 7% (95% CI: 6%-8%) of the study population aged 2 to 6 years were overweight and 3% (95% CI: 2%-4%) were obese. After eleven years of follow-up at the time of KiGGS Wave 2, the proportion of adolescents who presented with overweight (9%; 95% CI: 8%-11%) or obesity (8%; 95% CI: 7%-10%) was considerably higher.

The majority of the 2 to 6 year-old girls and boys without overweight or obesity at the KiGGS baseline study had no overweight or obesity in adolescence, either (86%, 95% CI: 84%-88%). 8% (95% CI: 7%-10%) of these children developed overweight and 5% (95% CI: 4%-7%) obesity. Of the 2 to 6 year-old children without obesity, 93% (95% CI: 91%-95%) continued without obesity in adolescence.

Figure 1: Development of overweight and obesity (n=1,311 girls, n=1,257 boys)
Source: KiGGS baseline study (2003-2006), KiGGS Wave 2 (2014-2017)



Of the 2 to 6 year-old children with overweight, 24% (95% CI: 17%-33%) remained in this category after eleven years, 29% (95% CI: 20%-39%) changed to obesity and 47% (95% CI: 37%-57%) were no longer overweight or obese in adolescence. Of the children with obesity, 65% (95% CI: 47%-80%) remained obese, while 11% (95% CI: 5%-24%) changed to the category overweight and 24% (95% CI: 12%-42%) shifted into the normal weight category in adolescence (Figure 1).

Discussion

The first results of the KiGGS cohort on the development of overweight and obesity over time indicate that the vast majority of children in kindergarten and preschool age within the study period are neither affected by overweight nor by obesity. However, the proportion of overweight and obese children in this young age group increases considerably during school age until adolescence. These changes can also be observed with prevalence estimates over time (trends) from the cross-sectional surveys of the KiGGS study [7, 8].

The first analyses of individual tracking of overweight and obesity in the KiGGS cohort also indicate that an excessive body weight among children in kindergarten and preschool age often remains until adolescence. Obesity in children in the age group 2 to 6 years is still present in more than half of them in adolescence; in addition, approximately one in four of the overweight children changes to the obesity category with increasing age. In summary, more than half of the 2 to 6 year-old children with overweight or obesity remain overweight or obese as adolescents. This result is also confirmed by a systematic review of cohort studies published so far [2]. In addition, in the KiGGS cohort approximately 1 in 12 children without overweight or obesity develops obesity from kindergarten and preschool age, and approximately 1 in 19 children develops obesity.

The results of the KiGGS cohort confirm that a higher body weight acquired at young ages often remains until adolescence. This illustrates the necessity to prevent the development of obesity both during kindergarten and school age. Less than half of the children manage to develop normal weight once they have acquired overweight or obesity. When interpreting these results, it must be taken into account that in longitudinal studies, such as the KiGGS cohort, the estimates are likely to be optimistic, since it cannot be excluded that adolescents with an excessively high body weight have participated less frequently in the study of KiGGS Wave 2 and that the proportions of persistent obesity or overweight are thus underestimated.

Due to different classification systems for overweight and obesity at the age of less than 18 years (percentiles) compared to adults starting at the age of 18 years (fixed cutoffs, e.g. 30 kg/m² for obesity), the present analysis was restricted to the age group of 2 to 6 year-old children at the time of the KiGGS baseline study, so that they remained under 18 years of age in KiGGS Wave 2. In further analyses, it will be necessary to investigate the older age groups in more detail in order to describe the development of overweight and obesity through young adulthood. In addition, it is planned to identify determinants of different development states of overweight and obesity, and to describe the effects of overweight and obesity on future health behaviour.

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Erratum, page 73
In an earlier version of this article, the labels of the columns "overweight" and "obesity" were switched in Figure 1 on page 73. The labelling has been corrected for the current version.

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KiGGS Wave 2 cross-sectional study – participant acquisition, response rates and representativeness

Abstract

For the third time, wave 2 of the German Health Interview and Examination Survey for Children and Adolescents (KiGGS), which is conducted in the context of health monitoring at the Robert Koch Institute, now provides representative cross-sectional data for Germany. Completed in 2017, data for the cross-sectional component of KiGGS Wave 2 was collected in the form of an interview and examination survey. Interview survey data was collected from 15,023 participants, meaning that the required number of participants has been reached. A randomly selected subgroup of 3,567 participants was also examined. The overall response rate was 40.1%. Differences in response rates were registered regarding certain socio-demographic characteristics. Weighting was applied to compensate for differences in willingness to participate related to age, gender, geographic region, nationality and education factors. Weighting ensures that assessments of the health of children and adolescents in Germany are representative for the population. The data serves to estimate prevalence rates and, through comparison with the results from previous survey waves, to analyse trends. A set of measures were taken to recruit a sufficiently large group of participants and ensure that the net sample reflects the composition of the overall population to the highest degree. For future surveys, further measures ought to be taken in order to improve the integration of hard-to-reach subgroups.

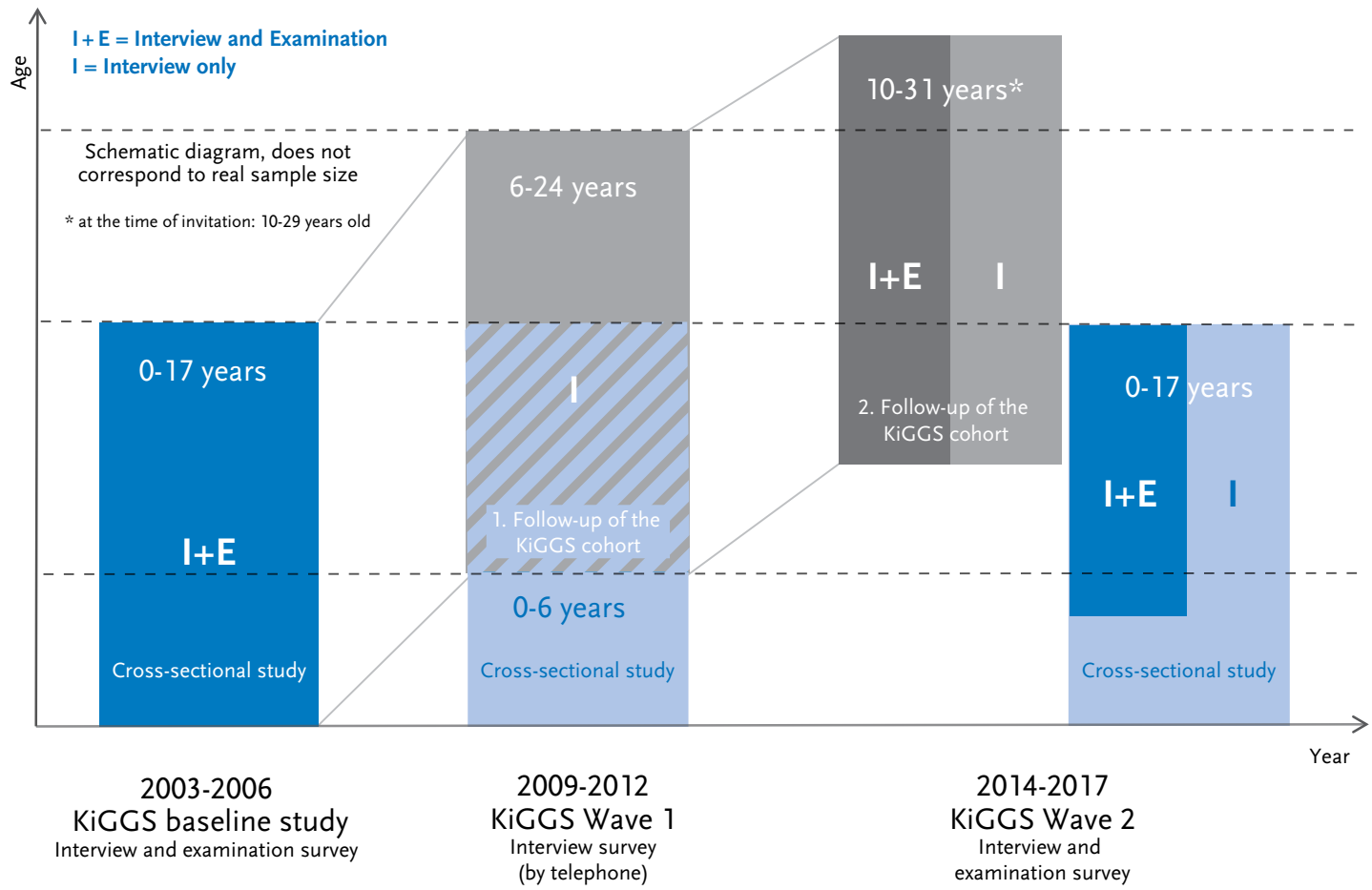
RESPONSE RATE · REPRESENTATIVENESS · KIGGS · CHILDREN AND ADOLESCENTS · HEALTH MONITORING

1. Background

The German Health Interview and Examination Survey for Children and Adolescents (KiGGS) forms part of the health monitoring at the Robert Koch Institute (RKI) [1, 2]. An important goal of KiGGS is to regularly provide reliable information on the health, health behaviour and utilisation of health care services by children and adolescents aged 0 to 17 years in Germany. With the completion of KiGGS Wave 2 in 2017, the RKI now has, following the KiGGS baseline study (2003-2006) and KiGGS Wave 1 (2009-2012), for the third time collected up-to-date cross-sectional data on the health of children and adolescents in Germany. Based on this data, the RKI can estimate prevalence rates for the surveyed indicators and – by comparing these with those surveyed in previous waves – identify trends. Moreover, KiGGS, by returning to study participants in the baseline study (2003-2006) [3], contains a longitudinal component (KiGGS cohort) that serves to analyse longitudinal relationships and describe individual level developments [4].

KiGGS
Studie zur Gesundheit von Kindern und Jugendlichen in Deutschland

Figure 1
KiGGS study design
Source: Based on Mauz et al. [4]



Lange et al [5] presents this longitudinal data from KiGGS Wave 2 in this issue. Figure 1 illustrates the KiGGS study design.

Whereas KiGGS Wave 1 was conducted purely as a telephone interview survey, KiGGS Wave 2 (like the baseline study) comprised an interview and examination component. Surveying in KiGGS Wave 2 again included collecting data on physical and mental health, health behaviour, utilisation of health care services and prevention as well as data on social, family and environmental factors. In KiGGS Wave 2, interviews were conducted with all participants. In addition, for a randomly selected subgroup, physical examinations, tests and laboratory analyses of blood and urine samples were conducted [6]. As in previous KiGGS surveys, surveying instruments were differentiated according to age groups [7]. A detailed description of the methodology can

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Age range: 10-31 years
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More information is available at www.kiggs-studie.de/english

be found in New data for action. Data collection for KiGGS Wave 2 has been completed [4]. A set of independent modules flanks the core survey and collected specific data on determined questions in subsamples. KiGGS survey data is used in federal health reporting, epidemiological analyses as well as public health research. Moreover, the data is made available to researchers (via public use files) [4]. The generated results are an important basis of information for health policy, health care and prevention stakeholders [2].

To reliably estimate prevalence rates a cross-sectional sample is required. It needs to be both sufficiently large and also needs to representatively reflect the composition of the target population – in this case all children and adolescents aged under 18 with permanent residence in Germany.

The aim of this article is to enhance the assessment of the data published in this issue and future publications of cross-sectional results from KiGGS Wave 2. Initially, we present the sampling method used and the measures taken to recruit participants. Subsequently, we present the response rates that were achieved and how the composition of the realised sample was controlled. This is followed by a description of how we developed weighting factors, which were then applied to compensate for the different levels of participation between surveyed subgroups. To conclude, we discuss the approach and provide an outlook on further planned analyses.

2. Methodology

2.1 Sample

The survey estimates prevalence rates for children and adolescents aged 0 to 17 years with permanent residence in Germany. To represent this population, a sampling process involving two steps was applied:

- In a first step, sample points were selected. The survey used the 167 sample points that were selected in co-operation with GESIS (Leibniz Institute for the Social Sciences, formerly the ZUMA) for the KiGGS baseline study [8]. The selection procedure ensures that sample points reflect Germany's regional structure regarding federal state and type of municipality (BIK classification [9]). The validity of these sample points was re-assessed for KiGGS Wave 2. Drawing of points was biased towards municipalities in former East Germany to produce more precise information on this region.

- The second step involved randomly selecting addresses of children and adolescents from the corresponding municipal population registries for each sample point. To achieve the stipulated same number of cases from all sample points, a different number of addresses was drawn for each age cohort depending on size of municipality, region and the response rates that were achieved in the KiGGS baseline study. An oversampling factor of 1.5 was applied to children and adolescents, who do not hold German nationality to compensate for the expected higher share of quality neutral losses and the lower response rates of this segment of the population [8].

Participants who do not belong to the target population are defined as quality neutral losses (see chapter 2.6).

Once the addresses of selected children and adolescents – hereafter referred to as study participants – had been received from the corresponding population registries, they were randomly divided into two groups at the Robert Koch Institute. Participants in the first group covering the total age range from 0 to 17 years were invited only to the interview component (interview group). Those in the second group in the age range 3 to 17 years were also invited to take part in the examination component (called the examination and interview group in the following). Concerning the number of cases (net sample), the goal was to recruit 9,000 children and adolescents for the interview group and 3,750 for the combined examination and interview group. Hence, the plan was to collect interview data from a total of 12,750 participants. Both groups were kept strictly separated during the entire process from invitation to data collection. Study participants could not switch between the two groups.

The KiGGS Wave 2 cross-sectional survey provides up-to-date population-based representative data on the health of children and adolescents in Germany.

2.2 Data collection process

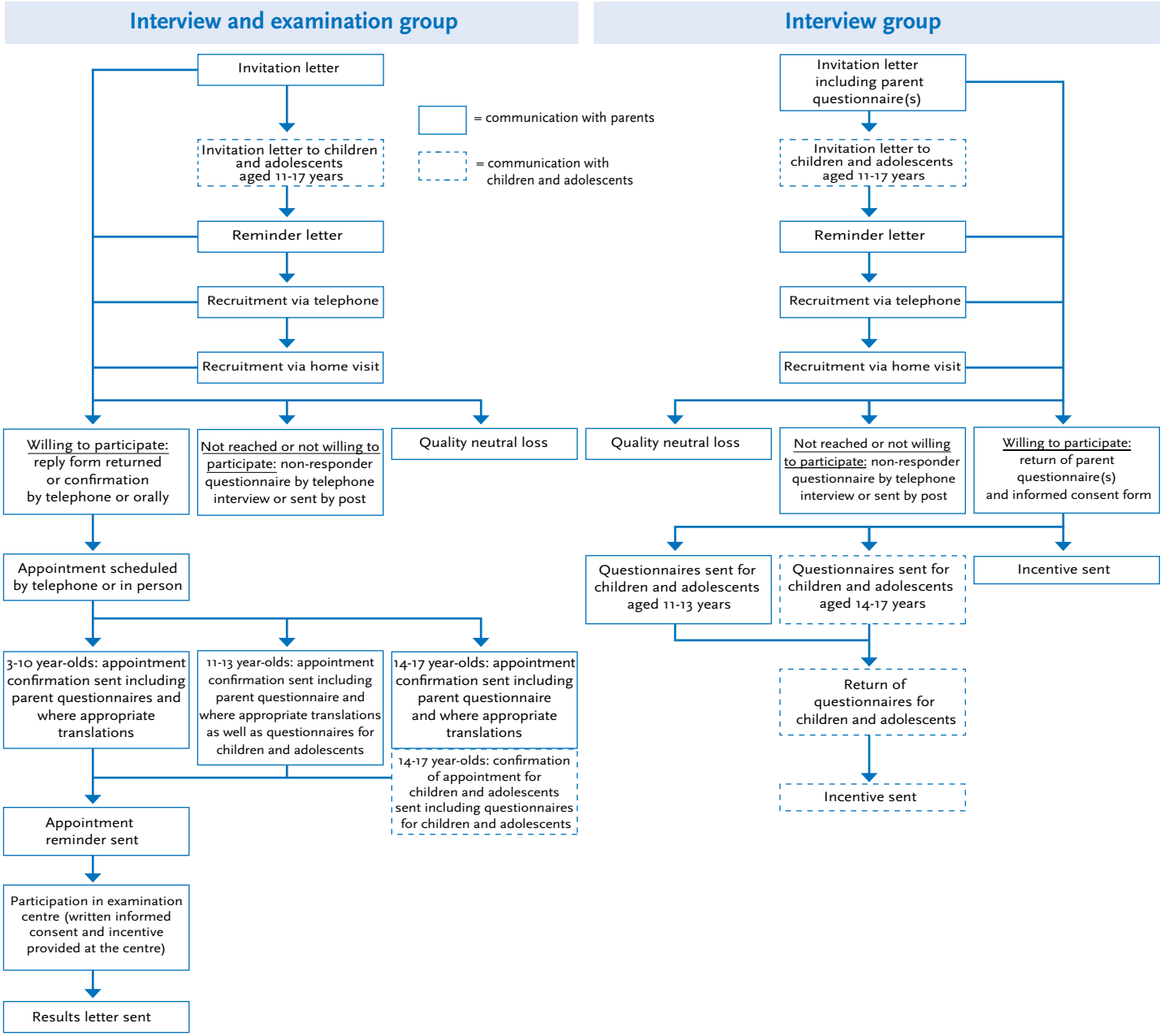
Cross-sectional data collection in KiGGS Wave 2 was conducted between September 2014 and June 2017. The parents of all study participants received a child health questionnaire and an additional health questionnaire for children and adolescents aged at least eleven years. They also received a questionnaire on dietary habits to be filled out by the parents, or by the children and adolescents themselves when aged at least eleven. As a pilot study neither indicated an increase in willingness to participate nor a positive effect on sample composition in a target population aged under 18 through the additional use of online questionnaires, the survey exclusively used self-administered paper questionnaires [10].

Examinations were conducted at examination centres created specifically for this reason at the sample points over an eight-day period. Examination staff teams worked in parallel, meaning that examinations were conducted simultaneously at three locations. The order in which sample points were visited was systematically scheduled in a so-called road map to reduce the effect of seasonal or regional factors [11].

2.3 Invitation and recruiting of participants

Invitations were sent for both groups simultaneously based on the schedule laid out by the road map. Invitation letters (Figure 2) were usually sent to parents or legal guardians (for reasons of simplification called parents below) six weeks before the opening of an examination centre at a particular sample point. As the study participants were minors, for legal and ethical reasons, parents were the contact persons in the survey. Invitation letters included a comprehensive information brochure that gave details about the survey institution, survey content and data protection. Usually three days after the invitation letter, children and adolescents, who were aged at least eleven years, received their own letter of invitation, providing them with information, which was adapted specifically for this age group. These letters were followed by three further steps to increase the number of participants, in an attempt to reach as many

Figure 2
Participant recruiting in the interview and examination group and the interview group
Source: Own diagram



A total of 15,023 children and adolescents from Germany and their parents took part in the cross-sectional KiGGS Wave 2 survey. A response rate of 40.1% was achieved.

of those parents, who had failed to answer the invitation. First, about ten days after the initial invitation, parents were sent a reminder. Second, about two weeks later, parents were contacted by telephone to convince them to participate. Telephone numbers were researched through commercially available telephone number registries. This was carried out because the number of available telephone numbers was limited, as many households no longer have a landline and the telephone numbers of many people are no longer registered in telephone books [12]. If it was not possible to find out a person's telephone number (or call a person), the third measure consisted of visiting parents during the week before the examination centre opened its doors. Contacting potential participants by telephone and, in particular, visiting them at their homes prior to the survey, proved an important step in recruiting participants. One-to-one conversations can help dispel reservations, close information gaps and increase trust in the survey goals and the integrity of the survey institution. Specially trained staff was employed in these recruitment measures.

2.4 Further measures to increase participation

Numerous measures aimed to increase participation in the cross-sectional and longitudinal components of KiGGS Wave 2 with regard to size and composition of the realised sample. Lange et al. [5] describes the specific measures applied in the longitudinal component.

- **Information management:** All of the information material used during survey implementation was developed to ensure it conveys the relevant information for each of the specific target groups. The focus was on preparing the information in a way that it is adequate for the different target groups, easily understandable and visually appealing. Potential participants could also access further information from the survey website (www.kiggs-studie.de). Furthermore, a free phone number was provided, and email contact in case of any questions was also always possible. Local public relations efforts at each sample point were processed and aimed to ensure coverage of the survey in local media and the spreading of information.
- **Incentives to participate:** A set of incentives was featured in the information material and during telephone calls and personal contact. Participants in the interview component were offered a shopping voucher. People, who took part in the examination component, were offered non-monetary gifts, cash, as well as a personal results report including laboratory test results depending on the age of the study participant.
- **Reducing barriers to participation:** This included the provision of self-addressed envelopes marked "postage to be paid by recipient" and aimed to make it easier for participants to return the forms, questionnaires and consent forms (Figure 2).
- **Appointment management in the examination component:** Appointments were scheduled to take account of the limited time of parents, children and adolescents. Appointments were therefore also possible either in the early morning or in the early evening. Appointments on Saturdays were also possible. People who were willing to participate, yet for whom no (fitting) appointment could be made, were put on a waiting list to be

contacted at short notice by telephone in case an appointment at another time became vacant. Examinations were scheduled to take approximately two hours depending on the survey programme (differentiated by age). To reduce the amount of time participants spent at the examination centres, they received the questionnaires in advance (Figure 2), and were asked to fill them out at home beforehand.

- **Measures for migrants:** Finally, there was a set of measures aimed to improve participation in the survey of people with migration background. They are described in detail in Frank et al. [13] in this issue and included translated invitation letters, questionnaires and consent forms. Moreover, the entire survey staff received culture-sensitive communication training.

Interview data is available for all children and adolescents. For a subgroup of 3,567 children and adolescents aged at least three years, physical examinations, tests and laboratory analyses were also conducted.

2.5 Non-responder follow-up

The children of parents, who were unable or unwilling to participate in the survey, were asked about the reasons for their decision and, subsequently, to fill out a short questionnaire. This questionnaire comprised questions on health and health behaviour as well as socio-demographic characteristics that were also surveyed for participants. Based on this information, it becomes possible to compare non-responders and participants against key indicators and potentially determine systematic differences between the two groups.

2.6 Response rate calculation

Study participants were excluded from the gross sample as quality neutral losses when they did not belong to the target population. Reasons for this classification were majority age, decease, twofold drawn, invalid addresses (invitation was undeliverable, address outside the sample point) or moved to a foreign country. Another reason was the impediment of adequate communication with parents through language barriers. These exclusions were necessary in order to ensure sufficient actual information of the parents about the survey and the examination programme for ethical and medical reasons.

Response rates are calculated according to AAPOR Response Rate 2 [14]. It is the number of participants divided by the number of gross sample members reduced by quality neutral losses.

2.7 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 examined and approved the ethics of the study (No. 2275-2014). The Federal Commissioner for Data Protection and Freedom of Information in Germany received the KiGGS Wave 2 study concept and had no objections. Together with the invitation to the survey, participants, their parents and/or legal guardians were informed about those responsible for the survey, the objectives and content of the survey, voluntary participation and data protection. They provided their informed consent in writing.

3. Response rates and representativeness

3.1 Comparison of unadjusted and adjusted gross sample

39,247 people (19,044 girls, 20,203 boys) received an invitation to participate in the survey. Of them, 9,230 children and adolescents (4,439 girls, 4,791 boys) were invited to participate in the examination and interview programme (unadjusted gross sample). The composition of both samples was compared regarding the information provided by population registries (age, gender and nationality) or regarding the information from the sample scheme (size of municipalities and regions (West and East German federal states, Berlin)) to ensure the independence of both of the samples drawn. The analysis showed no significant differences between groups.

For the examination and interview group, the share of quality neutral losses was 6.8% and was therefore slightly higher than for the interview group (3.9%). This is primarily owing to the exclusion of people with only rudimentary knowledge of German (see chapter 2.6).

A set of measures aimed to ensure the greatest number of participants possible and achieve a net sample that reflects as far as possible the composition of the overall population.

3.2 Number of participants and response rates

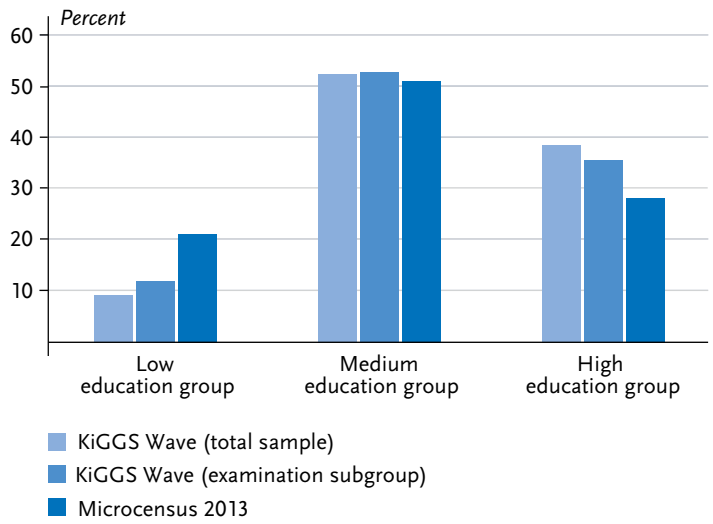
A total of 15,023 people (7,538 girls, 7,485 boys) participated in KiGGS Wave 2 (total sample, Table 1; stratified by age, see Annex 1). They provide the basis for all analyses referring to interview data. 3,567 children and adolescents (1,801 girls, 1,766 boys) also took part in the examination component. This subgroup participated in medical examinations and tests and provided blood and urine samples. The response rate was 40.1% for the total sample, and with 41.5% slightly higher for the examination subgroup.

The analysis of response rates regarding sociodemographic characteristics revealed the influence of the nationality for both the total gross sample and the examination and interview subgroup. The response rate of study participants with German nationality was significantly higher in the total sample (42.6%) than of those without German nationality (17.0%). However, the examination and interview subgroup managed to attract a higher number of participants without German nationality (response rate 27.9%). Furthermore, the response rates of female participants were generally slightly higher than those of male partici-

Table 1
Overview of study participants in KiGGS Wave 2
Source: KiGGS Wave 2 (2014-2017)

	Total sample (Examination and interview + interview group)			Examination subgroup (Examination and interview group)		
	Girls	Boys	Total	Girls	Boys	Total
Initial gross sample	19,044	20,203	39,247	4,439	4,791	9,230
Quality neutral losses	838	989	1,827	288	345	633
Gross sample	18,206	19,214	37,420	4,151	4,446	8,597
Participants	7,538	7,485	15,023	1,801	1,766	3,567
Non-responders	10,668	11,729	22,397	2,350	2,680	5,030
Response rate	41.4%	39.0%	40.1%	43.4%	39.7%	41.5%

Figure 3
Comparison of highest parental education group of participants and head of household in Microcensus 2013 (total sample n=14,762, examination subgroup n=3,426)
Source: KiGGS Wave 2 (2014-2017), Research Data Centres of the Federal Statistical Office and Statistical Offices of the Länder [16]



pants, as well as slightly higher for the former East German than for the West German federal states and Berlin. For nearly all age groups, the response rates ranged between 39.0% and 42.0%, yet were considerably higher in the 7 to 10 year-old examination and interview subgroup (47.0%). Willingness to participate was significantly greater in municipalities with under 20,000 inhabitants than in larger cities for the overall sample and the interview-only subgroup. In the examination subgroup, this pattern was observed for municipalities with up to 100,000 inhabitants.

3.3 Composition of the realised sample

The representativeness of the realised sample is assessed by comparing it to data from official statistics (Microcensus 2013). Even though little data is available one key feature can be taken into account regarding the educational distribution. It is related to health parameters and represented by the same indicator (highest parental educational degree according to the CASMIN classification [15]).

Figure 3 shows the share of educational level groups in the realised samples. Medium and higher education groups were incorporated commensurate to their share in the population. However, the lower education group, despite the measures aimed at increasing the participation of this group in the survey, has not been reached to the same degree. Weighting factors, however, that close the gap between the realised sample and official statistics largely balance the impact of this deviation on the health parameters surveyed.

4. Weighting

The KiGGS Wave 2 cross-sectional sample involved calculating two weighting variables. One variable was applied to the total number of participants, the other to the examination subgroup. Both weighting variables were calculated based on the same proceeding. Weighting was applied both at the level of survey design and an adjustment to account for known population distributions. Weighting at the survey design level affects two probabilities: selection of a particular sample point and selection of participants within the sample point. After this weighting at the survey design level, data was adjusted to account for official population statistics regarding age in years, gender, federal state (as of 31 December 2015) and foreigner status (German nationality yes/no; as of 31 December 2014). Additionally, the distribution of the highest parental education levels according to the CASMIN classification [15] was adapted to match

the distribution of head of household education levels surveyed in the Microcensus (2013 [16], limited to households with children under 18 years).

5. Discussion and conclusion

Key factors for developing population-based representative information about the health of children and adolescents in Germany are a sufficiently large group of participants and an unbiased composition of the net sample as far as possible. The KiGGS Wave 2 cross-sectional survey does justice to these requirements thanks to several, sometimes complex, measures.

Firstly, an adequate and established method for drawing representative population samples was applied. The selected sample points ensured a representative model of Germany's settlement structure.

Secondly, a broad set of measures aim to achieve the highest level of participation possible. They were particularly important because filling out the questionnaires and, in particular, the appointments at examination centres, involved a considerable investment of time by participants. Overall, the survey recruited the stipulated number of participants and produced a reliable sample for the target population. Against the backdrop of a widespread decline in willingness among the population to participate in empirical surveys [17, 18], the achieved response rates are satisfactory and comparable to those achieved in other health monitoring surveys (telephone interview survey in KiGGS Wave 1 cross-section (2009-2012): 38.8% [19]; health interview and examination survey for adults DEGS cross-section (2008-2011): 42.0% [20], GEDA 2014/2015-EHIS 26.9% [21]). The measures to recruit participants are not only important in achieving high levels of participation, but also in achieving a composition of the realised sample which is as unbiased as possible [22]. While recruiting participants through telephone calls or visiting them at their homes does cost a lot of time, it is well worth the effort as it increases response rates by so-called "hard-to-reach" groups. The described differences in the composition of the realised total sample and the examination subgroup can be largely put down to the fact that the survey did not have sufficient capacities to approach all potential participants with the same focus (in particular concerning visiting potential participants at their homes) as was the case for the examination and interview group. The higher share of non-German nationality participants, as well as those with low-education backgrounds in the examination and interview group, is owed mainly to this personal contact. The slightly higher willingness to participate in the examination and interview group may also be due to the greater attractiveness of examinations and tests, in particular, because participating children and adolescents received their results individually.

Thirdly, the composition of the realised sample was controlled using known parameters. To compensate for slight biases of the sample with regard to the total population, weighting factors were calculated to analyse survey data.

Overall, the survey showed that continuously monitoring the results of participant recruitment during the process itself is important in order to be able to already have taken adequate measures during the survey. This concerns both ensuring high response rates and sample composition. Against this backdrop, further analyses are planned

to discern the degree by which individual measures contributed towards increasing the participation of hard-to-reach segments of the population in health monitoring surveys. It also became clear that the current methods and concepts only inadequately represent those segments of the population with only rudimentary knowledge of German. In future, more needs to be done to overcome language and cultural barriers, both during the recruiting of participants and during interviews and examinations. Feasibility studies are currently testing multilingual interviewers, examination instructions and tele interpretation services [13].

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Conflicts of interest

The authors declared no conflicts of interest.

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Annex 1
Net sample according to gender and age
Source: KiGGS Wave 2 (2014-2017)

Age	Interview and examination group			Interview group			Total sample		
	Girls	Boys	Total	Girls	Boys	Total	Girls	Boys	Total
0				297	279	576	297	279	576
1				251	227	478	251	227	478
2				180	221	401	180	221	401
3	104	101	205	260	272	532	364	373	737
4	112	123	235	322	361	683	434	484	918
5	97	116	213	333	353	686	430	469	899
6	114	118	232	328	323	651	442	441	883
7	108	114	222	325	341	666	433	455	888
8	112	123	235	335	336	671	447	459	906
9	129	118	247	349	352	701	478	470	948
10	88	119	207	271	312	583	359	431	790
11	141	131	272	392	369	761	533	500	1,033
12	139	140	279	381	370	751	520	510	1,030
13	131	134	265	346	352	698	477	486	963
14	137	118	255	333	359	692	470	477	947
15	127	124	251	386	318	704	513	442	955
16	134	96	230	349	297	646	483	393	876
17	128	91	219	299	277	576	427	368	795
0-2				728	727	1,455	728	727	1,455
3-10	864	932	1,796	2,523	2,650	5,173	3,387	3,582	6,969
11-17	937	834	1,771	2,486	2,342	4,828	3,423	3,176	6,599
Total	1,801	1,766	3,567	5,737	5,719	11,456	7,538	7,485	15,023

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KiGGS Wave 2 longitudinal component – data collection design and developments in the numbers of participants in the KiGGS cohort

Abstract

The German Health Interview and Examination Survey for Children and Adolescents (KiGGS) is conducted within the health monitoring framework that has been established at the Robert Koch Institute (RKI). In addition to regular cross-sectional studies of the current health of children and adolescents living in Germany, KiGGS also includes a longitudinal component – the KiGGS cohort. The longitudinal data, which can be linked individually throughout the various waves of the study, enables developments in health and their associated influencing factors to be analysed during the life course. Participants from the KiGGS baseline study form the baseline of the KiGGS cohort. The baseline study was carried out between 2003 and 2006 as a nationwide interview and examination survey of children and adolescents aged between 0 and 17 years. The KiGGS cohort comprises the 17,641 participants who, after taking part in the baseline study, also agreed to participate in recurring follow-ups that are to continue through adolescence into adulthood. Until now, two follow-up studies have been conducted: KiGGS Wave 1 (2009-2012, n=11,992) and KiGGS Wave 2 (2014-2017), which, in line with the baseline study, was conducted as an interview and examination survey. A total of 10,853 repeat participants were interviewed for KiGGS Wave 2; 6,465 people also took part in an examination. As such, 61.3% of the people who originally participated in the baseline study also provided data from interviews for KiGGS Wave 2. In addition, 50.8% have provided various forms of data for all three of the survey's waves. This data pool can help answer numerous questions from the epidemiological life course discipline regarding the population living in Germany; at the time of the baseline study, these participants were children and adolescents. In order to exploit the full potential of the study for life course research and to be able to trace the health and social development of different generations in the future, the concepts on which the study is based are to be further developed, and innovative strategies for participant retention are to be drawn up.

KIGGS COHORT · LONGITUDINAL COMPONENT · REPEAT PARTICIPATION · CHILDREN AND ADOLESCENTS · HEALTH MONITORING

1. Background

1.1 The KiGGS cohort at the Robert Koch Institute

The Robert Koch Institute (RKI) is a German public health institute that has been tasked with monitoring developments in the health of the population living in Germany as part of the health monitoring framework [1-3]. The German Health Interview and Examination Survey for Children and Adolescents (KiGGS) is conducted at regular intervals and acts as a central source of information that collects

KiGGS
Studie zur Gesundheit von Kindern und Jugendlichen in Deutschland

KiGGS Wave 2

Second follow-up to the German Health Interview and Examination Survey for Children and Adolescents

Data owner: Robert Koch Institute

Aim: Providing reliable information on health status, health-related behaviour, living conditions, protective and risk factors, and health care among children, adolescents and young adults living in Germany, with the possibility of trend and longitudinal analyses

Study design: Combined cross-sectional and cohort study

Cross-sectional study in KiGGS Wave 2
Age range: 0-17 years
Population: Children and adolescents with permanent residence in Germany
Sampling: Samples from official residency registries - randomly selected children and adolescents from the 167 cities and municipalities covered by the KiGGS baseline study
Sample size: 15,023 participants

KiGGS cohort study in KiGGS Wave 2
Age range: 10-31 years
Sampling: Re-invitation of everyone who took part in the KiGGS baseline study and who was willing to participate in a follow-up
Sample size: 10,853 participants

KiGGS survey waves
- KiGGS baseline study (2003-2006), examination and interview survey
- KiGGS Wave 1 (2009-2012), interview survey
- KiGGS Wave 2 (2014-2017), examination and interview survey

More information is available at www.kiggs-studie.de/english

wide-ranging, reliable data on child and adolescent health. KiGGS comprises a cross-sectional and a longitudinal component, each of which has different objectives [4, 5].

The cross-sectional component comprises the recurrent collection of representative data on the health status of children and adolescents in Germany aged between 0 and 17 years. Until now, three nationally representative studies of the children and adolescents living in Germany during each study period have been conducted: the KiGGS baseline study (2003-2006), KiGGS Wave 1 (2009-2012) [6] and KiGGS Wave 2 (2014-2017) [7]. The data gathered for these studies provides a profound basis with which to calculate prevalences and conduct context analyses for each period while identifying changes over time (trends) among children and adolescents aged between 0 and 17 years in Germany [4, 8].

The KiGGS cohort is the longitudinal component of the study, and it involves the repeated collection of data of KiGGS baseline participants into adulthood. To date, two follow-up studies have been conducted of the KiGGS cohort: KiGGS Wave 1 [9] and KiGGS Wave 2 [7] (Figure 1). In both cases, data was also gathered for the respective cross-sectional component of the KiGGS survey at the same time as the follow-ups were conducted. The approach was aimed at ensuring economic synergies. This includes the shared use of study infrastructure for participant recruitment, data collection and analysis. All previous studies undertaken with the KiGGS cohort have been supplemented by two independent longitudinal modular studies. The BELLA mental health module and the MoMo motor performance and physical activity module are issue-based, in-depth studies and the data gathered for them can be linked to data collected for the KiGGS cohort.

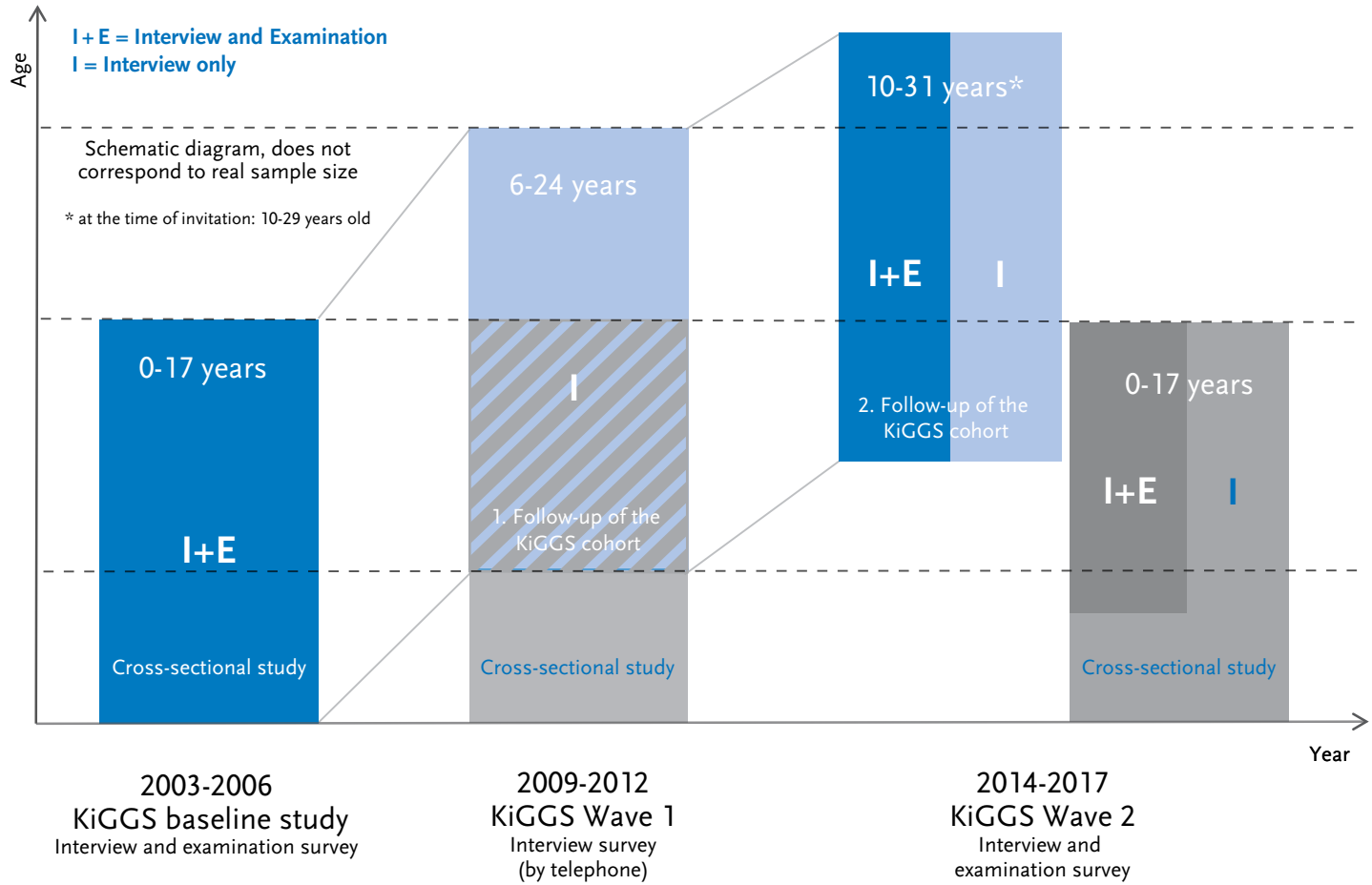
1.2 The KiGGS baseline study and its follow-up studies

The baseline sample of the KiGGS cohort comprises all of the 17,641 children and adolescents who participated in the representative KiGGS baseline study (age range: 0 to 17 years). The baseline study was carried out between 2003 and 2006 as an examination and interview survey at 167 sample points [10]. The two-stage sampling procedure is described in detail elsewhere [8, 10, 11]. Data collection was conducted in temporary examination centres set up for this purpose. Medical measurements and tests were conducted and blood and urine samples were taken as part of the examinations [10]. In retrospect, one participant out of 17,641 asked to have their contact and study data deleted. Content related analysis, therefore, is based on data gathered from 17,640 participants.

Those who provided their consent were invited to participate in the follow-ups (KiGGS Wave 1 and KiGGS Wave 2). In order to reliably identify developments in health during the life course and their associated influencing factors, it is essential that as many of the participants from the baseline study as possible participate in subsequent study waves. Furthermore, it is important to avoid systematic bias as far as possible, with regard to repeat participation in order to deliver valid results.

The first follow-up survey – KiGGS Wave 1 – was conducted between 2009 and 2012 as a computer-assisted telephone interview survey with a reduced range of topics [6]. A total of 11,992 (6,078 females, 5,914 males) of the people who had participated in the KiGGS baseline study repeatedly participated. There was a slightly reduced willingness to participate in KiGGS Wave 1 among adult-aged members of the cohort (Figure 2).

Figure 1
The study design of the KiGGS cohort
Source: Adapted from Mauz et al. [7]



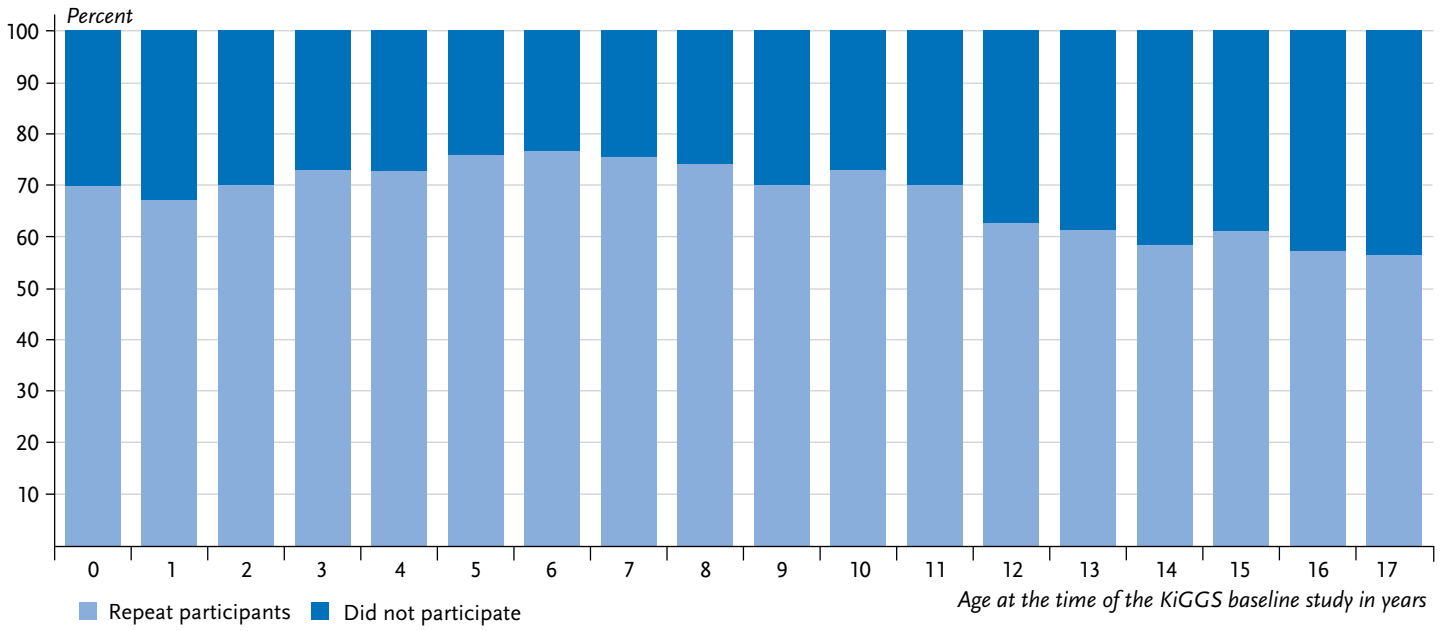
Developments in the health of the participants from the KiGGS baseline study are followed into adolescence and adulthood in the KiGGS cohort.

In addition to age, factors such as male gender, coming from a family with migration background or a single parent family, as well as low socioeconomic status were associated with lower willingness to participate in KiGGS Wave 1. Longitudinal weighting was employed in KiGGS Wave 1 in order to compensate for bias in the cohort, as far as possible (see Section 3.4).

1.3 The aims of this article

This article describes the methodology applied in the second KiGGS follow-up survey – KiGGS Wave 2. It will be described for which subgroups data from interviews and/or examinations are available. Furthermore, this article explains the implemented measures to ensure that data for KiGGS Wave 2 could be gathered from as many

Figure 2
Repeat participation in the first telephone interview follow-up survey KiGGS Wave 1 according to age at the time of the baseline study (n=8,655 girls; n=8,986 boys)
Source: KiGGS Wave 1 (KiGGS cohort)



The cohort study provides longitudinal data that enables analyses to be made of developmental trajectories and their influencing factors.

baseline study participants as possible. The results section also states the number of people (who were children and adolescents at the time of the baseline study) who were recruited to Wave 2 despite having declined to participate in KiGGS Wave 1. After a brief discussion of weighting factors, this article closes with a summary and an outlook.

2. The methodology employed in KiGGS Wave 2

2.1 The initial KiGGS cohort sample

Work with the KiGGS cohort during KiGGS Wave 2 began with a focus on the 17,641 people who had participated in the KiGGS baseline study (as was the case with KiGGS Wave 1, see Section 1.2). KiGGS Wave 2 aimed to recruit as many of the study's initial participants – hereafter referred to as study participants – regardless as to whether they had participated in KiGGS Wave 1. Invitations were not sent out to study participants if it was clear that they had moved abroad, had died, if it had not been possible to locate them for Wave 1 or if they had asked not be contacted in the future. Among the latter, after the baseline study had been completed, one study participant requested the retrospective deletion of all contact and survey data relating to their person. Two study participants from the cohort had changed their information on gender from female to male by the time KiGGS Wave 2 was conducted.

2.2 Planning the study

In line with the baseline study, KiGGS Wave 2 was carried out as an examination and interview survey. However, it covered a broader range of topics [7]. The study design for KiGGS Wave 2 was developed with the aim of recruiting as many study participants from the KiGGS baseline study as possible and ensuring that they provided interview data at the very least. In addition, measures were undertaken to collect examination data from as many people as possible. Whereas the interviews could be conducted by sending out self-administered paper questionnaires to the study participants wherever they lived, the examination programme relied on a specific spatial infrastructure (attendance at an examination centre). The high level of mobility among the now adult-aged cohort members meant that potential study participants were no longer merely distributed between 167 sample points but across almost 2,000 different municipalities. As KiGGS Wave 2 involved the simultaneous conduction of both an up-to-date cross-sectional study and the second follow-up of the cohort study, temporary examination centres were established in the original 167 sample points out of economic and logistical reasons for both the cross-sectional component of KiGGS [8] and the KiGGS cohort (see Section 2.3). Both study participants from the cross-sectional sample and cohort members who still lived in their original places of residence were invited to an examination centre. The current place of residence of the people from the baseline sample was determined immediately prior to the invitation being sent out using information gained from municipal population registries. This led the study participants to be divided into two groups: a group of potential study participants who still lived in the original sample point (and therefore were to be examined and interviewed), and a group comprising all of the other study participants (who were therefore only to be interviewed). The invitations were then sent by post to anyone who had not stated that they no longer wished to be contacted (see Section 2.1).

Until now, two KiGGS follow-up studies have been conducted: KiGGS Wave 1 and KiGGS Wave 2.

2.3 Data collection

Collection of the longitudinal data for KiGGS Wave 2 was conducted between September 2014 and August 2017. The examination programme was carried out at the nationwide level by three examination staff teams working in parallel; this enabled examinations to be undertaken in three places at the same time. A so-called road map was devised at the beginning of the study which set out the order in which the sample points were to be visited [8]. All potential participants received self-administered paper questionnaires by post. In the case of young children, the parents or legal guardians were asked to provide information about their child's health. Children and adolescents aged 10 years or above were asked to answer the questionnaires by themselves. A questionnaire on nutrition was also sent out, and this was also to be answered by the children and adolescents. Potential study participants who had now reached adult-age received two questionnaires to be filled out by themselves: one on health and one on nutrition. Study participants who did not attend their examination were sent a questionnaire by mail on physician-diagnosed conditions to replace the personal medical interview that would have been conducted at the examination centre.

2.4 Invitations and participation

The invitation to participate in an examination and interview or an interview was sent out by post in accordance with the road map. Invitations were usually sent out six weeks before the examination centre opened at each sample point (Figure 3). When the invitations to KiGGS Wave 2 were sent out, the people who had participated in the KiGGS baseline study were already between 10 and 29 years old (by the time they participated, some of them were already 31 years old). In the case of minors, their parents or legal guardians were contacted (simply called parents below). Legal and ethical reasons meant that the parents acted as the central point of contact for all survey matters. Prospective study participants aged 18 or older were contacted directly. The letters of invitation contained a booklet detailing information about the current study wave. About three days after the invitation letter, children and adolescents aged 10 or above received a letter of invitation specifically addressed to them, accompanied by an age-appropriate information sheet [8].

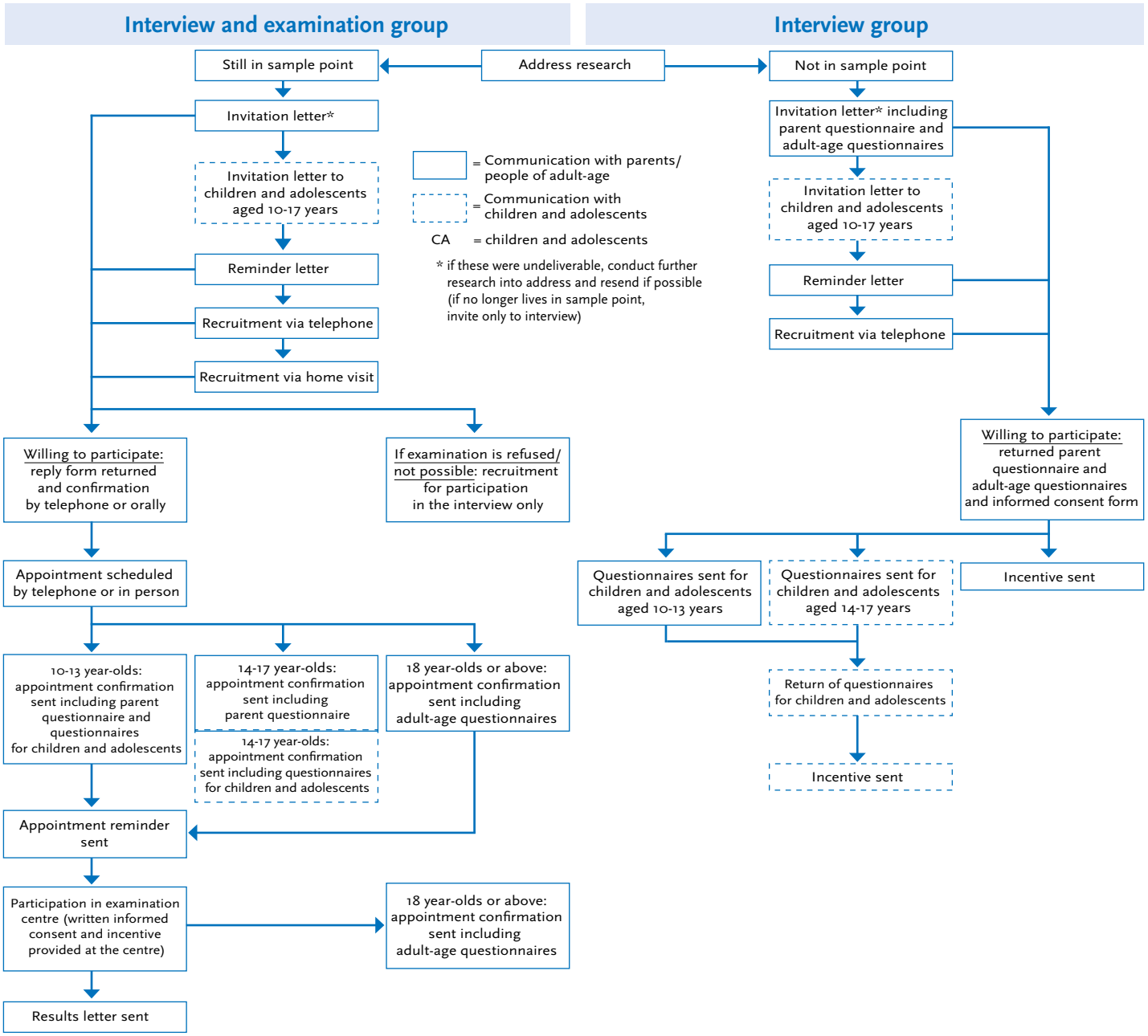
The invitation was followed by three further recruitment stages, as was the case with the cross-sectional survey, aiming to reach those parents and adult-aged study participants who had yet to answer. First, a reminder was sent out about ten days after the initial invitation. Second, an attempt was made to contact the parents or adult-aged study participants by telephone. Usually at least one, if not more, telephone numbers were available for each of the study participants from the KiGGS baseline study and from the telephone interviews conducted for KiGGS Wave 1. Due to limited staff and financial resources, however, phone calls – which necessitate a lot of time and personnel – were initially only carried out to the full extent for people who had been invited to an examination. This focus was necessary because the temporary nature of the examination centres essentially required to hold to the time slots allocated within the road map. Less exhaustive attempts were initially made to contact study participants who had only been invited for an interview; efforts were increased at a later date. Third, home visits were conducted to recruit the parents and now adult-aged study participants who were still living in the same sample point and who had been invited to an examination. These home visits were conducted one week prior to the examination centre opening. In general, telephone and personal conversations are a useful means of clearing individual reservations, balancing information deficits and building trust in the study's goals. By contacting cohort members directly, emphasis could be put on the importance of previous participation in the study and the value of repeated participation. Specially trained staff was employed in these recruitment measures. A more detailed description of the procedure is available in the article KiGGS Wave 2 cross-sectional study – participant acquisition, response rates and representativeness [8].

A total of 11,992 repeat participants were interviewed for KiGGS Wave 1.

2.5 Further measures to improve participation

A variety of measures were implemented to improve participation in the study both in terms of numbers and participant composition. Some of the measures concern information management, providing incentives (such as allowances) or reducing barriers to participation and managing appointments in the examination component [8].

Figure 3
Study participant recruitment for the cohort in KiGGS Wave 2
Source: Own diagram



A total of 10,853 repeat participants were interviewed for KiGGS Wave 2; 6,465 participated in an examination.

Measures to improve the participation of people with migration background are described in detail in the article Improving the inclusion and participation of children and adolescents with a migration background in KiGGS Wave 2 [12]. For example, the examination staff teams and the staff responsible for telephone or home visit recruitment took part in intercultural skill trainings. While some measures were also employed in the cross-sectional component, the longitudinal component of KiGGS Wave 2 also included the following specifically designed measures:

- **Additional research was conducted to find out where people lived when invitations were returned as undeliverable:** Invitations were resent if "Deutsche Post" provided a new address for people whose invitations were returned as undeliverable. If the new address was outside of the original sample point, the person was only invited to an interview. On the other hand, if an invitation was returned without a new address, existing telephone numbers were used to contact the study participants and ask for a valid address. If it was only possible to reach the parents of adult-aged study participants, the parents were asked to inform their children about the study and to ask them to contact the RKI. If no or no valid telephone number was available, the same request was sent out in writing to parents whose addresses – known from the baseline study or from KiGGS Wave 1 – differed from that of their child.

- **Recruitment for interviews in cases where people opted not to take part in an examination:** If participation in an examination was either not possible or if a parent or adult-aged study participant declined to (have their child) take part, they were asked to participate in an interview. This was subject to that the reason why they declined to take part in an examination did not argue against the participation in an interview. This happened both during the various phases of recruitment (see Section 2.4) and in cases of non-attendances at an examination appointment. As such, some study participants were invited to participate in an examination, but only participated in the interview.

In addition, several measures were implemented on a one-off basis (as such, they are not included in Figure 3) in order to increase the number of participants among adult-aged members of the cohort. Among others, these measures included:

- **Additional examination slot in Berlin:** An unscheduled examination centre was established in Berlin during the last road map slot. Adult-aged study participants who lived in Berlin or had moved there from another sample point and who had not been reached until that time were contacted again and invited to participate in an examination. This includes adult-aged study participants who had initially been invited to an examination and those who had only been invited to an interview.

- **Additional online questionnaire:** Study participants who had not been reached by mid-May 2017 and were currently of adult-age were invited again by post. They were provided with the opportunity to answer an online

questionnaire. This invitation was sent out on the assumption that adults who had not participated in an examination and/or self-administered paper questionnaire sent out by post might be more willing to take part in an online questionnaire. In order to increase the attractiveness of participating, the interview programme was shortened and only included the questionnaire on health (no information was sought from the questionnaire on nutrition). In addition, a higher allowance was offered. This questionnaire was sent out to adults who had initially been invited to an examination and those who had only originally been invited to an interview.

2.6 Data protection and ethical considerations

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 examined and approved the ethics of the study (No. 2275-2014). The Federal Commissioner for Data Protection and Freedom of Information in Germany received the KiGGS Wave 2 study concept and had no objections. Together with the invitation to the survey, participants, their parents and/or legal guardians were informed about those responsible for the survey, the objectives and content of the survey, voluntary participation and data protection. They provided their informed consent in writing.

3. Participation in KiGGS Wave 2 and the number of study participants who participated in the cohort over time

3.1 Participation in KiGGS Wave 2

A total of 13,085 study participants (6,203 female, 6,882 male) were assigned to a group envisaged for an examination and interview; 4,556 study participants (2,451 female, 2,105 male) were assigned to a group that was only invited to an interview.

In total, 10,853 of the 17,641 people who participated in the KiGGS baseline study also took part in KiGGS Wave 2. Data from interviews are available from all of these study participants. Thus, a total of 61.5% of the study participants who took part in the baseline study participated in the second follow-up. A greater number of female study participants (66.9%) repeatedly participated in KiGGS than males (56.3%). Additional examination data are available for 6,465 of these individuals. This amounts to 36.6% of the baseline sample. The most important reason that examination data is not available from a larger number of study participants is related to the study design: study participants were only invited to an examination if they lived in the same sample point as during the baseline study. 13,084 study participants were assigned to an examination, and 49.4% took part. Once again, participation was higher among females (52.5%) than males (46.7%).

If the data is viewed according to age (the study participants were aged between 0 and 17 years when they participated in the baseline study), it becomes clear that a lot less examination data are available for people who are now

Table 1
Overview of cohort participants in KiGGS Wave 2
Source: KiGGS baseline study (2003-2006), KiGGS Wave 2 (2014-2017)

	Repeat participants with interview data			Subgroup of repeat participants with additional examination data		
	Female*	Male*	Total	Female*	Male*	Total
Baseline sample (participants in the KiGGS baseline study)	8,655	8,986	17,641	8,654	8,987	17,641
Participated in KiGGS Wave 2	5,790	5,063	10,853	3,254	3,211	6,465
Proportion of KiGGS Wave 2 participants in the baseline sample	66.9%	56.3%	61.5%	37.6%	35.7%	36.6%

* Details on gender provided for KiGGS Wave 2

adults (Figure 4). This can be explained by their reduced willingness to participate and by the fact that a higher proportion of older study participants no longer lives in the original sample point and were therefore not invited to an examination (data not shown).

3.2 Developments in the numbers of study participants across all study waves

Of the 17,641 people who took part in the KiGGS baseline study, 8,979 people (4,796 female, 4,183 male), in other words, 50.9% of the baseline sample, provided data for all

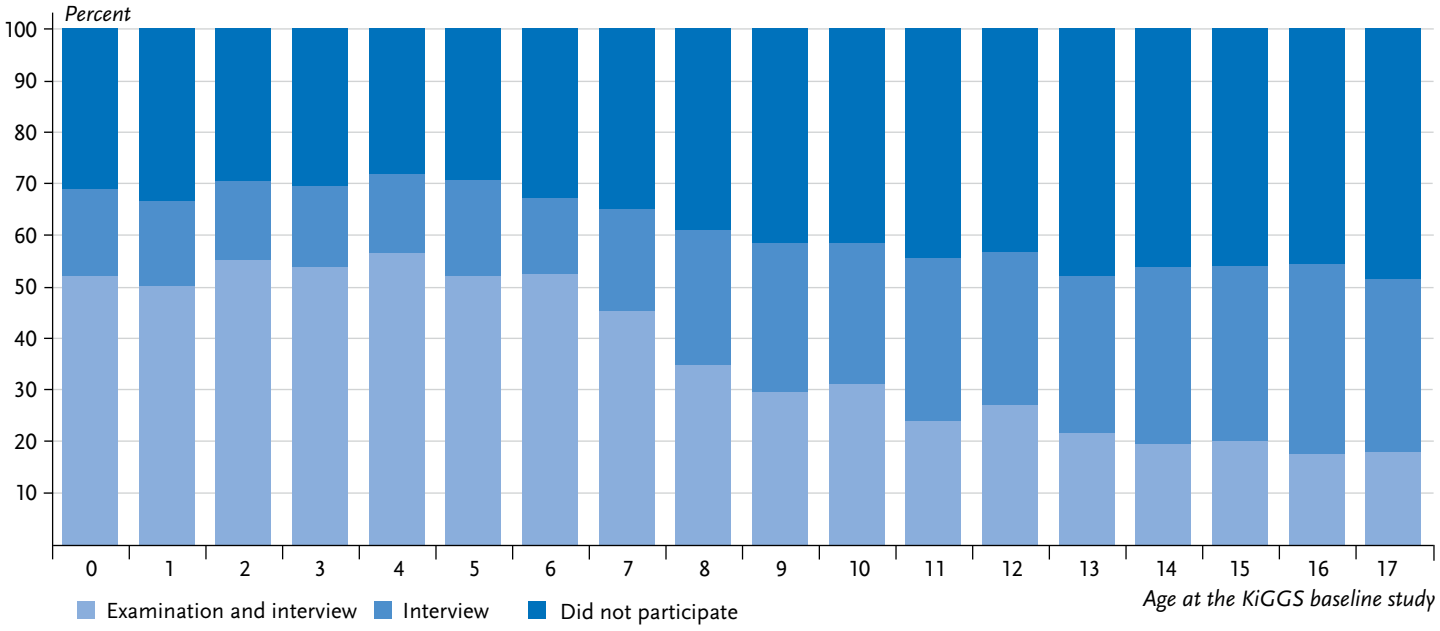
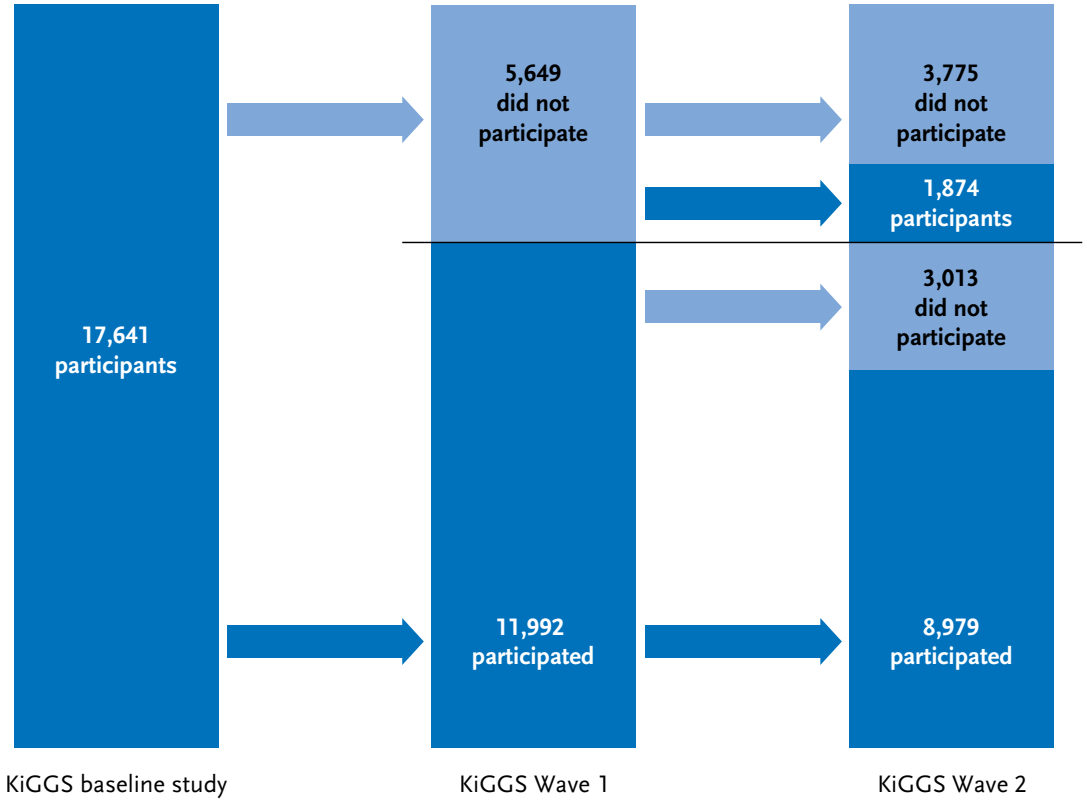


Figure 4
Repeat participation by study participants from the baseline sample in examinations and interviews or only interviews for KiGGS Wave 2 according to age at the time of the baseline study (n=8,654 female, n=8,987 male)
Source: KiGGS Wave 2 (KiGGS cohort)

Figure 5
Participation of the baseline sample in the various KiGGS study waves
Source: KiGGS baseline study (2003-2006), KiGGS Wave 1 (2009-2012), KiGGS Wave 2 (2014-2017)



three study waves (Figure 5). 1,874 people (994 female, 880 male) who participated in KiGGS Wave 2 did not take part in KiGGS Wave 1 (this corresponds to 10.6% of the baseline sample). 3,013 people (1,732 female, 1,281 male), in other words 17.1%, provided data for the baseline study and Wave 1, but did not do so for Wave 2. In total, 3,775 study participants from the baseline study (1,583 female, 2,192 male) could not be recruited for either of the two follow-up surveys. This corresponds to 21.4% of the people who participated in the baseline study.

3.3 Repeat participation

During each wave of the study, parents and adult-aged study participants were asked whether they would consent to being invited to participate again in the future. By the end of the second KiGGS Wave 4% of the original sample had declined to be contacted again, meaning that these individuals cannot be invited to any future follow-up.

3.4 Weighting

As described in Section 3.1, 61.5% of the people who took part in the KiGGS baseline study participated in KiGGS Wave 2. Willingness to participate in further study waves can vary between different groups of the study population, leading to bias in longitudinal analyses. Weighting factors are calculated in order to compensate for this problem. This involves employing a logistic regression model to predict the likelihood of non-participation using socio-demographic and health-related indicators developed from the KiGGS baseline study. This results in a higher weighting for groups that tend to be less willing to participate. Three separate weighting factors were calculated: a) for the entire study population (with data from interviews), b) for study participants who took part in an examination and interview, and c) for the subgroup of study participants with laboratory analyses. The weighting factors were developed primarily using socio-demographic characteristics such as age, socioeconomic status of the family of origin, education, migration background, size of the residential district, as well as the participant's mother's smoking behaviour.

4. Summary, discussion and outlook

The KiGGS baseline study was the first national population-based study of the health of children and adolescents in Germany. It provides wide-ranging data on the health and social situation of 0 to 17 year-old children and adolescents in Germany. The 17,641 people who participated in the baseline study deliver a solid basis for further study waves of the KiGGS cohort.

Now that KiGGS Wave 2 has been completed, data from two further study waves are available from the people who participated in the baseline study. This longitudinal data, which can be individually linked across the survey's waves, means that it is possible to observe and analyse health and social developments into adulthood among these individuals who were children and adolescents at the time of the baseline study. The oldest study participants are now 31 years old.

61.5% of the people who participated in the baseline study took part in the interview component of KiGGS Wave 2. Therefore, wide-ranging data from interviews have been gathered from a total of 10,853 participants. This means that KiGGS Wave 2 reached a similarly large proportion of participants from the baseline study as the telephone-based survey conducted in KiGGS Wave 1. Although the range of questions employed during Wave 1 was continued, it was also partially broadened and covered the topics of health, health-related behaviour and social life situation [7]. The data provides the opportunity to answer numerous questions from epidemiological life course disciplines for the population living in Germany, which, at the time of the baseline study, was still in childhood and adolescence.

Nevertheless, a significantly lower proportion (36.6%) of the baseline study participated in an examination and an interview for KiGGS Wave 2. This was partly due to the fact that examinations were only carried out in the same sample points that were used during the baseline study. Thus, people could only be invited to an examination if they still lived in the same sample point as they did during the baseline study. Of those who were assigned to an exami-

nation, 49.4% took part in the examination programme. Consequently, examination data are available for two observation periods for a total of 6,465 study participants. These data are supplemented by wide-ranging data from interviews which can be used to conduct differentiated longitudinal analyses. The first descriptive course analyses that have been published cover obesity and allergic sensitisation.

Unfortunately, much less examination data are available for adults compared to minor-aged study participants. On the one hand, this is because adults are particularly mobile compared to young people and, therefore, could not always be invited to examinations. However, they were also less willing to participate in examinations. Detailed analyses of these aspects are planned. A lower level of participation may affect the validity of longitudinal analyses if groups differ significantly in their likelihood of participating again. Nevertheless, such differences can be compensated for by weighting, provided that they can be explained by survey variables covered by previous study waves.

There certainly is a good basis for continuing the KiGGS cohort. Despite the large intervals between follow-ups, many study participants are apparently strongly committed to KiGGS. This is clear from the fact that about two-thirds of the baseline study took part in Wave 2 and that during the entire study period only 4% of study participants or their parents decided to cut ties with the study. The fact that 33% of the cohort who did not participate in KiGGS Wave 1 were 'won back' for Wave 2 was a welcome development. Nevertheless, 21% of the baseline sample neither participated in Wave 1 nor Wave 2. This includes study participants who were no longer invited (because they no longer wished to be contacted, had died or moved abroad) as well as people who were invited, but declined to participate. Further analysis is needed on this group's composition, of whether some of these study participants could indeed be recruited in the future, and, if so, which measures would be needed to do so.

The adult-aged study participants will continue to be of particular importance in future KiGGS waves. More than half of the participants in the KiGGS cohort have already reached adult-age. Moreover, the entire cohort will have reached adulthood by 2024. Thus, the KiGGS cohort will gain a significance of its own and will no longer merely be associated with monitoring the health of children and adolescents. In view of the great potential that the cohort provides for innovation and research, new concepts for survey content and methods as well as for the analysis of ever more complex datasets will have to be developed. The first ideas have already been considered and need to be tested, discussed, evaluated, published and implemented.

From the point of view of public health, the KiGGS cohort constitutes a valuable resource for developing evidence-based measures that can improve the health of the population, beginning in childhood and adolescence. In terms of its representative basis (for children and adolescents living in Germany at the beginning of the 21st century), the size of the sample and the breadth of its data means that the KiGGS cohort continues to be unique in Germany.

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Conflicts of interest

The authors declared no conflicts of interest.

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Socioeconomic status and subjective social status measurement in KiGGS Wave 2

Abstract

This article describes the method applied to measure socioeconomic status (SES) and subjective social status (SSS) in the current wave of the German Health Interview and Examination Survey for Children and Adolescents (KiGGS Wave 2), which was conducted over three years between 2014 and 2017. The composite multidimensional SES index was calculated as a sum of point scores for the parents' education level, occupational status and equivalised disposable income. SSS was assessed in the 11 to 17 year age group using a German version of the MacArthur Scale for children and adolescents. To demonstrate the use of both instruments, we present examples that highlight the association between SES and SSS with the general health of children and adolescents in the 3 to 17 and/or 11 to 17 age groups. Over 95% of parents rated the general health of their children as 'very good' or 'good'. However, the analyses clearly reveal that children and adolescents from families with low SES and SSS have poorer general health than their better-off peers. Even when mutually adjusted, both low SES and SSS are independently associated with poorer general health. In addition to the SES index, studies on the health of children and adolescents should therefore also consider SSS. In this way, additional aspects of the socioeconomic conditions of families can be taken into account.

SOCIOECONOMIC STATUS · SUBJECTIVE SOCIAL STATUS · METHODS · HEALTH MONITORING · KIGGS

1. Introduction

Numerous national and international studies have shown the close link between child and adolescent health and the socioeconomic status of the families they grow up in [1-6]. Data from the baseline study of the German Health Interview and Examination Survey for Children and Adolescents (2003-2006) and the subsequent KiGGS Wave 1 (2009-2012) [7-9] conducted by the Robert Koch Institute (RKI) have also highlighted this fact. As these studies indicate, children and adolescents from low socioeconomic status backgrounds have significantly poorer health compared to their peers from socioeconomically more affluent families. This fact reveals itself in the general state of health and in psychosocial health, for example with regard to behavioural problems, attention deficit hyperactivity disorder (ADHD) and eating disorders [6, 7, 9-11]. Furthermore, social differences in health behaviours are evident, for example regarding tobacco consumption, physical activity and dietary habits. The same applies to healthcare system utilisation, as much regarding the use of medical services, as also preventive healthcare and health promotion services [6, 9, 12-14].

In the KiGGS study, a composite index is used to measure socioeconomic status, which is based on information

Studie zur Gesundheit von Kindern und Jugendlichen in Deutschland

KiGGS Wave 2

Second follow-up to the German Health Interview and Examination Survey for Children and Adolescents

Data owner: Robert Koch Institute

Aim: Providing reliable information on health status, health-related behaviour, living conditions, protective and risk factors, and health care among children, adolescents and young adults living in Germany, with the possibility of trend and longitudinal analyses

Study design: Combined cross-sectional and cohort study

Cross-sectional study in KiGGS Wave 2
Age range: 0-17 years
Population: Children and adolescents with permanent residence in Germany
Sampling: Samples from official residency registries - randomly selected children and adolescents from the 167 cities and municipalities covered by the KiGGS baseline study
Sample size: 15,023 participants

KiGGS cohort study in KiGGS Wave 2
Age range: 10-31 years
Sampling: Re-invitation of everyone who took part in the KiGGS baseline study and who was willing to participate in a follow-up
Sample size: 10,853 participants

KiGGS survey waves
- KiGGS baseline study (2003-2006), examination and interview survey
- KiGGS Wave 1 (2009-2012), interview survey
- KiGGS Wave 2 (2014-2017), examination and interview survey

More information is available at www.kiggs-studie.de/english

regarding the parents' education, occupational status and income [15]. This 'index of socioeconomic status' (SES index) is used in a comparable manner in all of the established health monitoring surveys at the RKI [16]. The only difference is that in the KiGGS study, the status determining data is collected from the participants' parents, whereas in the RKI's surveys among adults, participants self-report this data. The comparable and consistent construction of the SES index in the surveys conducted at the RKI make it possible to relate the results of the surveys and to analyse trends over time. Meanwhile, many other epidemiologic studies in Germany have been applying the SES index, as much to study child and adolescent health as well as the health of middle-aged and elder adults [17].

In addition to the SES index, the health surveys conducted at the RKI will in future also assess subjective social status (SSS), which measures a participant's subjective perception and assessment of their socioeconomic situation [18-20]. SSS can have independent health implications above and beyond the effects of objective SES, which can be observed not only in adulthood, but also in adolescence [21-23].

In the following sections, we provide a detailed description of how the socioeconomic variables were operationalised in the KiGGS Wave 2 study and how the SES index was designed and generated. Moreover, we describe how SSS was measured in this survey. Subsequently, we provide examples of results that reveal the association of both, SES index and SSS with general health among children and adolescents aged 3 to 17 and 11 to 17 years. The results aim to show the extent of socioeconomic differences in general health among children and adolescents in Germany. Moreover, they provide insights regarding whether the SES index and SSS are each independently associated with child and adolescent health.

2. Methods

2.1 Data basis and statistical analysis

As part of health monitoring at the RKI, KiGGS is a central source of information to assess the health of the adolescent generation in Germany [24, 25]. For the 0 to 17 age group, KiGGS regularly provides representative cross-sectional data. Furthermore, the KiGGS cohort, which has been designed as a longitudinal follow-up study, interviews and examines the participants in the KiGGS baseline study repeatedly up to adult age.

The KiGGS baseline study (2003-2006) consisted of interviews, examinations and laboratory analyses. In KiGGS Wave 1 (2009-2012), data was collected by telephone interviews [26]. 17,641 children and adolescents aged 0 to 17 from 167 locations in Germany took part in the KiGGS baseline study. The response rate was 66.6% [27]. The KiGGS Wave 2 (2014-2017) sample consisted of a new sample from the population registry of the original 167 KiGGS baseline study sample points (Infobox). KiGGS Wave 2 therefore comprises a new nationwide cross-sectional survey for 0 to 17 year-old children and adolescents in Germany and the second follow-up of the KiGGS cohort [28]. A total of 15,023 children and adolescents (7,538 girls, 7,485 boys) aged 0 to 17 took part in the KiGGS Wave 2 cross-sectional survey (response rate 40.1%) [29].

All surveys at the Robert Koch Institute are subject to strict compliance with the data protection regulations of

Germany's Federal Data Protection Act. The Hannover Medical School ethics committee has considered and approved the survey under ethical guidelines (No. 2275-2014). The Federal Commissioner for Data Protection and Freedom of Information in Germany had no objections to the study. Participation in the study was voluntary. Participants, their parents and/or legal guardians were informed about the objectives and content of the study and data protection, and provided their informed consent in writing.

The analyses of the relationship between socioeconomic status and/or subjective social status and the general health of children and adolescents are based on parents' assessment of the health of their children [30]. As recommended by the World Health Organization, parents were asked [31]: 'How would you rate your child's health in general?' (Answer categories: very good, good, fair, bad and very bad). The results concern children and adolescents aged 3 to 17 (n=13,568). For subjective social status, the results concern participants aged 11 to 17 (n=6,599), because SSS was not assessed in younger children. The results reflect prevalence rates, as well as, through binary logistic regression, age-adjusted odds ratios. The odds ratios presented express the degree to which a specific group has a higher statistical odds of fair, bad or very bad health compared to the defined reference group.

Weighting factors are used to account for unequal sampling probabilities and to adjust the distribution of the sample by age, gender, region, nationality and level of parental education to match the official German population statistics for 2014/2015 and the 2013 microcensus. Additionally, the weighting factor adjusts for differences in the rate of participants in the KiGGS baseline study and KiGGS Wave 1, who took part again [28]. To account for weighting and correlation of participants within one municipality, confidence intervals and logistic regression models are calculated using procedures for complex samples. Differences are considered statistically significant when p-values are lower than 0.05. All analyses are conducted with the statistics software Stata 14.2 SE.

Children and adolescents from socially disadvantaged families are more likely to have health problems and unfavourable health behaviours.

2.2 Operationalisation of the SES index

In KiGGS Wave 2, the three dimensions education, occupation and income, which are generated as household characteristics based on the data provided by parents, are used to determine SES. Operationalisation of the index is comparable to the method first used in KiGGS Wave 1 (on the operationalisation of the three status dimensions see Annex Table 1). In the KiGGS baseline study, the index was initially developed differently, but was later re-calculated based on the new template, so that the results from KiGGS Wave 1 and KiGGS Wave 2 are now comparable to baseline study results [15].

For indexing, point scores are calculated for each status dimension (see Annex Table 2). Regarding education and occupation, the SES index registers the highest point score a child's parents provide. Only children who lived in exclusively single-parent households without their partner are assigned the score of their single parent directly. Scores for each dimension ranged from 1 to a maximum of 7. The sum of point scores from the individual dimensions become equal parts of the SES index.

As the first SES dimension, levels of education are assigned based on the international CASMIN (Compara-

tive Analysis of Social Mobility in Industrial Nations) classification [32]. This classification distinguishes nine levels of education, which are defined as distinct combinations of school degrees and vocational qualifications. The standardised point scores used in the SES index range between 1 and 7 reflect the average salaries people earn based on their educational attainments in Germany. A regression model is used to determine the point scores based on the gross hourly wages of the German workforce aged 30 to 59 using data from the 2013 German Socioeconomic Panel (SOEP) study. Children and adolescents are assigned the maximum point score their parents provided, except in cases, where the child lived exclusively with only one parent (without a partner).

We use Ganzeboom and Treimann's International Socio-Economic-Index of Occupational Status (ISEI) as a criterion to assign point scores for occupational status as a second dimension of SES [33]. The ISEI index is based on occupations coded according to the 2008 International Standard Classification of Occupations (ISCO-08) [34]. The point scores included in the SES index vary between 1 and 7 and are generated based on the data provided by parents on their occupational activity. Parent occupations are coded applying a standardised procedure according to the classification of occupations of the Federal Statistics Office (2010) and then semi-automatically transferred to the ISCO-08 classification. Each child and adolescent is assigned the maximum score provided by parents, except if he or she lived exclusively with only one parent (without a partner).

Income as the third dimension of SES is measured by needs-adjusted net household income (equivalised disposable income) as an indicator in accordance with the guidelines of Germany's federal reporting on poverty and wealth and the recommendations for reporting on social cohesion in Europe [17, 35]. In cases where parents did not provide exact salary amounts but a salary range, these salaries are evenly distributed across the corresponding interval analogous to the German Microcensus [36]. For income categories such as a range from €2,000–2,500 we so not assume the mean value of €2,125, but take distribution-based random values within this interval. Missing values for net household income are imputed through regression imputation [16]. To estimate missing values for income, data on the age of parents, their levels of education and occupational status, as well as regional information of the German Federal Statistical Office on mean net household income in the participants' residential area is used. Point scores are determined by defining 13 equally large income groups (equivalised disposable income), which are then consolidated into seven SES point scores for income. The intervals between the point scores for educational attainment and occupational status reflect equidistant intervals with regard to external criteria. We can therefore assume a metric scale for the individual SES dimensions.

The socioeconomic status (SES) index is generated as a household characteristic based on parental levels of education, occupational status and income.

2.3 Calculation of the multidimensional SES index and delimitation of socioeconomic groups

The SES index is calculated as a sum of point scores based on the values assigned to the three dimensions of education, occupational status and income. It is used as a household characteristic, which means that all participants in one particular household are assigned the same index

Table 1
Family socioeconomic status in KiGGS Wave 2 (n=7,426 girls, n=7,381 boys)
Source: KiGGS Wave 2 (2014-2017)

Name of category	Quintile of SES	Lowest point score	Highest point score	Weighted percentage
Low	1st quantile	3.2	8.7	20.1%
Medium	2nd quantile	8.8	11.3	20.1%
	3rd quantile	11.4	13.7	20.5%
	4th quantile	13.8	16.9	19.4%
High	5th quantile	17.0	21.0	20.0%

SES = socioeconomic status

Subjective social status (SSS) describes the individual perception of objective living conditions.

value. The three equally weighted subscales of education, occupational status and income provide the basis for calculating the SES index, which means that SES index values ranged between 3.0 and 21.0. The SES index can enter the analysis as a metric variable or be categorised in various socioeconomic groups. These groups then reflect a ranking of children and adolescents with regard to their household socioeconomic status. We propose a distribution-based classification into five equally large groups (quintiles), whereby the three groups in the middle are combined. Through the accumulation of educational qualifications, occupational status and income, this three-step scale – low SES (first quintile), medium SES (second to fourth quintile) and high SES (fifth quintile) – facilitates comparisons between the 20% of children and adolescents who grow up in the most and least socioeconomically affluent families, with a broadly defined medium segment comprising the other 60% of children and adolescents. Table 1 shows the categories, cut-off points and corresponding share of participants in KiGGS Wave 2. The share of missing values was less than 1.5%.

Table 2 shows the statistical association between the SES index and its three dimensions based on correlation coefficients. The values for the overall SES index correlated with the individual dimensions between r=0.83 and r=0.85. The correlations are comparable to KiGGS Wave 1 [15], as well as to the correlations among adult participants in the German Health Update (GEDA) study [16].

Table 2
Correlation coefficients for the relationship between the SES index score and the education, occupation and income subscores (n=7,426 girls, n=7,381 Boys)
Source: KiGGS Wave 2 (2014-2017)

	Indicator	(1)	(2)	(3)	(4)	(5)	(6)
(1)	SES index score	1.00					
(2)	SES quintile	0.97	1.00				
(3)	SES groups	0.89	0.90	1.00			
(4)	SES subscore education	0.85	0.82	0.77	1.00		
(5)	SES subscore occupation	0.85	0.82	0.76	0.64	1.00	
(6)	SES subscore income	0.83	0.82	0.74	0.52	0.54	1.00

SES = socioeconomic status

2.4 Operationalisation of subjective social status

In health research and epidemiology, the definition of SES based on 'objective' status indicators such as education, occupation and income is more and more often supplemented by subjective status indicators. Whereas objective status indicators assign people to the 'upper and lower rungs' of society, subjective status indicators capture how people themselves view their social standing and the status group that they feel they belong to [18-20]. Objectively assigned and subjectively perceived status do not always have to coincide.

The additional collection of data on subjective social status (SSS) in epidemiologic studies adds a subjective dimension to the measurement of socioeconomic status and grants the individual perception of living conditions and relative social standing a role in health opportunities and disease risks. In recent years, evidence has been accumulated suggesting an independent effect of SSS on health

and disease above and beyond the effects of objective SES [18, 19, 37-39]. The effect is thereby visible not only at adult age, but already at adolescent age [21-23, 40]. For example, it is assumed that perceptions of relative disadvantage can evoke feelings of shame, injustice or envy that cause stress and can therefore increase the risk of physical and mental health problems [41-44]. To a certain degree, a person's subjectively perceived social status is likely to reflect aspects of their socioeconomic situation such as wealth, over-indebtedness or social security, which the traditional indicators of education, occupation and income do not capture.

Adolescence is a phase in life in which young people increasingly make their own experiences with social inequality [21, 45]. The radius of interaction with society and the contact with diverse social groups outside the family increase. Adolescents therefore increasingly compare their social situation to that of others and their perception of social disparities and the advantages and disadvantages in accessing wealth, consumption, education opportunities, power and social recognition grows. Adolescents then increasingly develop their own perception and understanding of their social status and that of their families. Subjective indicators of social status can capture these perceptions, which objective status indicators cannot account for.

In KiGGS Wave 2, SSS was measured using a German version of the MacArthur Scale for children and adolescents. Initially, the MacArthur Scale was developed to record SSS for adults in the US [18]. Recently, the Robert Koch Institute developed a German version of this scale for adults [20, 46]. The instrument uses the image of a ladder with ten rungs that represent society as a visual analogue scale. Respondents mark their subjectively felt position on this 'social ladder'. Goodman et al. [21] have developed a version for adolescents, as the original instrument asks adults where they see themselves compared to other people from their country regarding levels of education, occupation and income. Adolescents, however, mostly still go to school, have not yet embarked on their career and are not financially independent so their status is defined by the status of their families. The version for adolescents therefore asks where adolescents would position their family on the ladder. For KiGGS Wave 2 the English language scale was translated into German and adapted for use with a German sample. The scale became part of the questionnaires for the 11 to 17 age group. The German question wording can be found in Annex Table 3.

Table 3 shows the mean MacArthur Scale values of responses in KiGGS Wave 2. The self-assessments of 11 to 17 year-olds show that the girls and boys in this age group on average position themselves slightly above the middle of the ten-rung scale. Girls mark a mean value of 6.2 and boys 6.3. The mean value for girls in the 11 to 13 age group are higher than in the 14 to 17 age group (p=0.041), a difference not observable for boys (p=0.672). More pro-

Table 3
Mean and standard deviation of subjective social status ratings in the 11 to 17 age group (n=3,105 girls, n=2,822 boys)
Source: KiGGS Wave 2 (2014-2017)

	Girls (M (SD))	Boys (M (SD))
Total	6.23 (1.37)	6.30 (1.39)
Age		
11-13	6.31 (1.39)	6.32 (1.38)
14-17	6.17 (1.36)	6.29 (1.39)
Objective SES		
Low	5.52 (1.52)	5.41 (1.47)
Medium	6.24 (1.24)	6.32 (1.26)
High	7.04 (1.16)	7.16 (1.12)

M = mean; SD = standard deviation; SES = socioeconomic status

Table 4
Correlation coefficients for the relationship between subjective social status and objective indicators of socioeconomic status in the 11 to 17 age group (n=3,105 girls, n=2,822 boys)
Source: KiGGS Wave 2 (2014-2017)

Indicator	Girls (SSS)	Boys (SSS)
SES index score	0.39	0.42
SES subscore education	0.30	0.29
SES subscore occupation	0.28	0.32
SES subscore income	0.36	0.42

SES = socioeconomic status (objective); SSS = subjective social status

Children and adolescents from families with low SES or low SSS have poorer general health than their better-off peers.

nounced differences are observable in an analysis stratified by objective SES. Mean SSS gradually increases with higher objective family SES, both for girls ($p<0.001$) and boys ($p<0.001$). Correlation analysis reveals a clearly positive association between SSS and the objective status indicators of the SES index (Table 4). The correlation with the objective family SES index score is $r=0.39$ for girls and $r=0.42$ for boys. Among the three single SES subscores, family income shows the strongest correlations with SSS of girls and boys.

3. Links between socioeconomic status, subjective social status and general health

According to the parent ratings, 2.7% of 3 to 10 year-old and 5.4% of 11 to 17 year-old girls have fair to very bad general health. The figures for boys are 4.2% of 3 to 10 year-olds and 5.0% of 11 to 17 year-olds (Figure 1) [30]. When controlled for age, no statistically significant differences are discernible between girls and boys.

When comparing children and adolescents against the backdrop of the socioeconomic status of their families, clear differences in general health become evident. Children and adolescents from low SES family backgrounds are more likely to have only fair to very bad general health. The share of girls in the 3 to 10 age group with fair to very bad general health is 4.5% for children in the lowest socioeconomic group, whereas it is 2.6% for those from medium and 0.9% for those from high socioeconomic backgrounds. For girls in the 11 to 17 age group, health differences related to SES are 8.8% for the low, 5.3% for the medium and 1.2% for the high socioeconomic group. Similar SES-related differences in general health are observed for boys in both age groups (Figure 2).

When the age of children and adolescents is statistically controlled for in logistic regression models, the results indicate an approximately six times increased odds of only fair to very bad general health for children and adolescents from low SES families compared to those from high SES families. For children and adolescents from the medium socioeconomic group, the odds is about three times as high compared to those from a high socioeconomic group (Table 5). However, in the high socioeconomic group, the prevalence of fair to very bad general health is very low

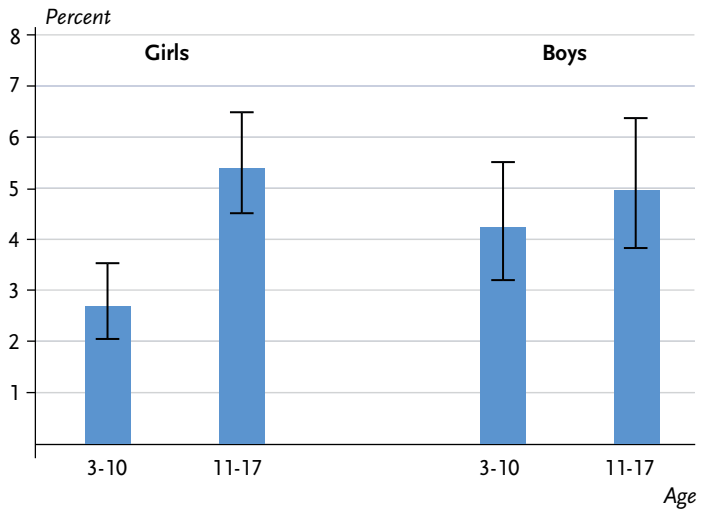
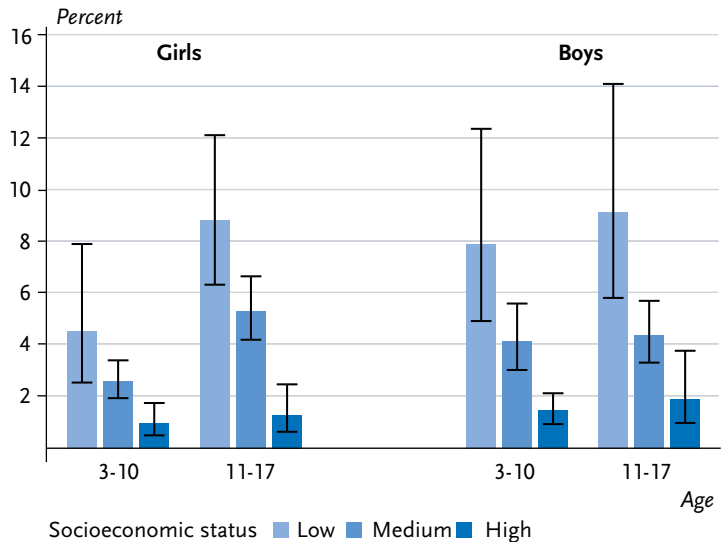


Figure 1
General health (fair to very bad) among girls and boys according to age group (n=6,682 girls, n=6,633 boys)
Source: KiGGS Wave 2 (2014-2017)

Figure 2
General health (fair to very bad) among girls and boys according to socioeconomic status and age group (n=6,650 girls, n=6,610 boys)
Source: KiGGS Wave 2 (2014-2017)



The SES index and SSS each are individually associated with the general health of children and adolescents.

(Figure 1 and Figure 2), which means that the high odds ratios must be interpreted with caution.

Subjective social status (SSS) too shows a close association with the general health of children and adolescents. The prevalence of only fair to very bad general health for 11 to 17 year-old girls and boys with low SSS (scale values of 1–4) is also clearly higher than the prevalence for those with high SSS (scale values of 7–10, Figure 3). Controlled for age, the odds of fair to very bad general health in the low SSS group is five and a half times higher than in the high SSS group. In the medium SSS group, the odds is about two and half times higher (Table 6).

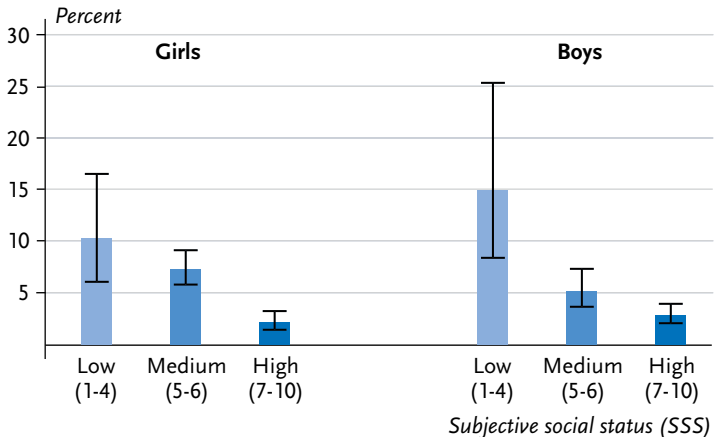
Figure 4 shows the odds ratios for fair to very bad general health by objective and subjective status. SES and SSS are simultaneously added to the regression models. As the results show, both a low SES and a low SSS remain independently associated with fair to very bad general health

Table 5
Associations between socioeconomic status and general health (fair to very bad) in the 3 to 17 age group. Results of binary logistic regression models (OR with 95% CI and *p*-value, n=6,650 girls, n=6,610 boys)
Source: KiGGS Wave 2 (2014-2017)

	Low SES	Medium SES	High SES
	OR (95%-CI) *p*-value	OR (95%-CI) *p*-value	
Girls*			
3 – 10	5.14 (2.19-12.09) 0.00	2.88 (1.35-6.13) 0.01	Ref.
11 – 17	7.15 (3.35-15.25) 0.00	4.27 (1.98-9.21) 0.00	Ref.
Total	6.28 (3.71-10.62) 0.00	3.61 (2.13-6.14) 0.00	Ref.
Boys*			
3 – 10	5.97 (3.10-11.50) 0.00	3.00 (1.72-5.25) 0.00	Ref.
11 – 17	5.17 (2.17-12.30) 0.00	2.34 (1.09-5.02) 0.03	Ref.
Total	5.57 (3.18-9.76) 0.00	2.65 (1.60-4.42) 0.00	Ref.
Total**			
3 – 10	5.68 (3.22-10.02) 0.00	2.96 (1.88-4.66) 0.00	Ref.
11 – 17	5.89 (3.25-10.69) 0.00	3.05 (1.77-5.24) 0.00	Ref.
Total	5.83 (3.87-8.78) 0.00	3.01 (2.10-4.32) 0.00	Ref.

SES = socioeconomic status; OR = odds ratio; CI = confidence interval; Ref. = reference group
* adjusted for age; ** adjusted for age and gender

Figure 3
General health (fair to very bad) in the 11 to 17 age group according to subjective social status (n=3,090 girls, n=2,817 boys)
Source: KiGGS Wave 2 (2014-2017)



after mutual adjustment. The associations are slightly weaker than when considering them separately (Table 5 and Table 6). Although the two status indicators correlated with one another, both show independent associations with the general health of girls and boys in the 11 to 17 age group.

4. Discussion

Health monitoring at the Robert Koch Institute regularly provides data on the health of children, adolescents and adults and has in the past few years contributed significantly to improving the data basis for epidemiologic research and health reporting in Germany. This also applies to social epidemiological research and its focus on the relationship between socioeconomic status and health [47]. The conceptual development and use of an index that serves to measure socioeconomic status (SES index) across all health surveys, are therefore important elements considering the future challenges for the analysis of trends over time and longitudinal analyses on the effects of socioeconomic status on health and the course of diseases. To increase the index's international comparability, the measurement of socioeconomic variables and their categorisation apply internationally established methods and instruments such as the CASMIN classification for school education and occupational qualifications [32] or the ISEI index for occupational status [33]. Using equivalised disposable income instead of household net income takes account of national and international recommendations to consider household size and member structure when assessing the income level of study participants [35].

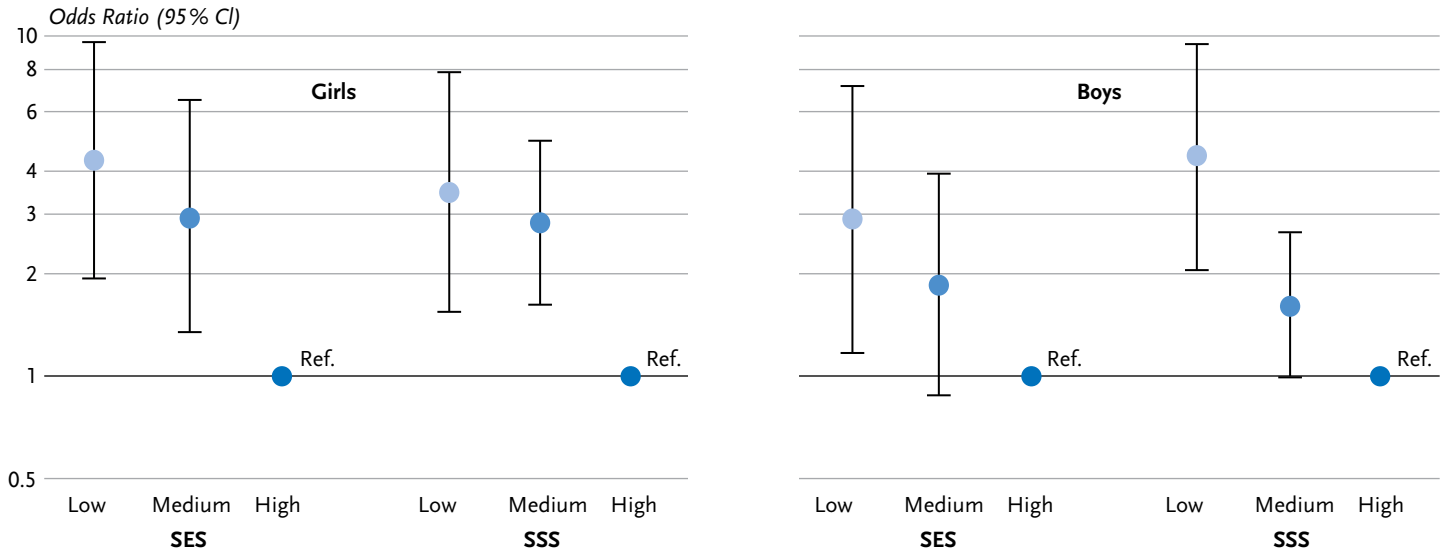
Data on education, occupation and income was converted to metric scales. By dividing the SES index into quintiles, this allows for a distribution-based delimitation of socioeconomic groups. For health monitoring, the groups were split into high and low (20%, i.e. first and fifth quintile) and the medium status group (second to fourth quintile) comprising of 60% of the population. An

Table 6
Associations between subjective social status and general health (fair to very bad) in the 11 to 17 age group. Results of binary logistic regression models (OR with 95% CI and *p*-value, n=3,090 girls, n=2,817 boys)
Source: KiGGS Wave 2 (2014-2017)

	Girls (11-17)*		Boys (11-17)*		Total (11-17)**	
	OR (95%-CI)	*p*-value	OR (95%-CI)	*p*-value	OR (95%-CI)	*p*-value
Low SSS (1-4)	4.99 (2.30-10.87)	0.00	6.02 (2.84-12.78)	0.00	5.57 (3.15-9.85)	0.00
Medium SSS (5-6)	3.55 (2.07-6.07)	0.00	1.86 (1.12-3.11)	0.02	2.57 (1.74-3.79)	0.00
High SSS (7-10)	Ref.		Ref.		Ref.	

SSS = subjective social status; OR = odds ratio; CI = confidence interval; Ref. = reference group
* adjusted for age; ** adjusted for age and gender

Figure 4
Associations of objective socioeconomic status (SES) and subjective social status (SSS) with general health (fair to very bad) in the 11-17 age group.
Results of binary logistic regression models (OR with 95% CI, n=3,080 girls, n=2,808 boys)
Source: KiGGS Wave 2 (2014-2017)



SES and SSS are mutually adjusted and all results are controlled for age; SES = socioeconomic status; SSS = subjective social status
OR = odds ratio; CI = confidence interval Ref. = reference group

The established SES index has an important function in transferring the results on child and adolescent health inequality to the political sphere and practice.

analysis of all five socioeconomic groups (first to fifth quintile) is however also conceivable, and depends on the research question, as would be a division into tertiles or quartiles. The concept of relative social and health inequality provides the conceptual basis for a distribution-based distinction of socioeconomic groups. This rests on the assumption that belonging to the least or most socioeconomically disadvantaged group remains a relevant health determinant even when the overall wealth of a society increases and living conditions improve. For the analysis of trends over time, this means that at any specific point in time the 20% of the population facing the greatest socioeconomic disadvantages are compared with the 20% of the population with the greatest socioeconomic advantages, regardless of the overall levels of socioeconomic resources at that time.

A composite multidimensional SES index is suitable for describing the extent and development of health inequalities. An index based on a clear concept and simple operationalisation through three socioeconomic groups makes an analysis of the relationship between socioeconomic status and health understandable to a broad audience. Analyses based on the SES index therefore fulfil an important function in transferring the results to the realms of politics and practice. On the other hand, SES index-based analyses of health inequalities have only limited explanatory power regarding broader explanations or the definition of specific target groups for interventions. To this end, analyses based on the individual indicators education, occupation and income are more informative. They provide better conclusions for example on material living conditions, social participation or health-relevant attitudes and behaviours [17, 48].

An analysis of subjective social status, which was first surveyed in KiGGS Wave 2, can provide further insights. In line with international research, the results presented as examples for general health, reveal the clear association between SSS and child and adolescent health [21-23, 40, 49]. This relationship remains evident even when the SES index is also taken into account in multivariate analysis. This points to the need to assess SSS in addition to objective SES indicators in surveys on child and adolescent health. This would create a perspective on aspects of the socioeconomic conditions of families that a mere look at objective indicators such as education, occupation and income cannot provide. Income says nothing about whether a family is over-indebted, which is, nonetheless, a dimension of socioeconomic status. However, children and adolescents from these families probably experience the financial difficulties daily, and this then will reflect in their subjective perception of the family's social status. Moreover, this can make the beliefs, values and attitudes of adolescents about social inequalities and the socioeconomic situation of their families come into effect. For example, children and adolescents may give greater weight to particular socioeconomic factors than others, if they consider them to be particularly important for the living conditions of their families. Surveys limited to traditional objective SES indicators are blind to such subjective factors. Nonetheless, these subjective factors may be related to feelings of shame, injustice, envy or a sense of inferiority, disadvantage and deprivation that can impact on health and well-being. Hence, the concept of SSS opens up a number of new perspectives for advances in research into health inequality and is a promising extension to objective SES indicators in epidemiological studies.

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The authors declared no conflicts of interest.

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Annex Table 1 (in German)
Questions on the operationalisation of socioeconomic status in KiGGS Wave 2 – parent questionnaire
Source: KiGGS Wave 2 (2014-2017)

Bereich	Frage	Antwortkategorien
	Bei den folgenden Fragen, die Vater und Mutter betreffen, meinen wir die Personen, die mit dem Kind in einem Haushalt leben. Mit der Bezeichnung „Mutter" oder „Vater" sind auch diejenigen Personen gemeint, die an die Stelle der leiblichen Eltern treten, z. B. Lebenspartnerin des Vaters, Stiefvater o. a.	
Bildung	Welchen höchsten allgemeinbildenden Schulabschluss haben Sie?	Noch keinen Abschluss (noch Schüler)
		Abschluss nach höchstens 7 Jahren Schulbesuch
		Haupt-/Volksschule
		Realschule/Mittlere Reife/Mittlerer Schulabschluss (MSA)/Polytechnische Oberschule (POS)
		Abitur, allgemeine oder fachgebundene Hochschulreife, erweiterte Oberschule (EOS), Fachhochschulreife/Fachoberschule
		Anderer Schulabschluss (z. B. im Ausland erworben)
	Welchen höchsten beruflichen Abschluss haben Sie?	Keinen Abschluss, noch in beruflicher Ausbildung, z. B. Student/in, AZUBI, Berufsvorbereitungsjahr, Praktikant/in
		Keinen Berufsabschluss und nicht in Ausbildung
		Lehre, also beruflich-betriebliche Ausbildung
		Ausbildung an Berufsfachschule, Handelsschule, also beruflich-schulische Ausbildung
		Fachschule, z. B. Meister-, Technikerschule, Berufs- oder Fachakademie
		Fachhochschule, Ingenieurschule
		Universität oder Hochschule
		Anderen Ausbildungsabschluss (z. B. im Ausland erworben)
Beruf	Sind Sie derzeit...	...Vollzeit erwerbstätig
		...Teilzeit erwerbstätig
		...Geringfügig erwerbstätig
	Welche berufliche Stellung haben Sie in Ihrer Haupterwerbstätigkeit? *Wenn Sie derzeit nicht oder nicht mehr berufstätig sind, nennen Sie bitte die berufliche Stellung, die Sie zuletzt innehatten.*	Angestellte/r
		Arbeiter/in
		Beamtin/Beamter (auch Anwärter/in)
		Landwirt/in im Haupterwerb
		Selbstständig erwerbstätig mit Mitarbeitern
		Selbstständig erwerbstätig ohne Mitarbeiter
		Mithelfende/r Familienangehörige/r (unbezahlt)
		Auszubildende/r (auch Praktikant/in, Volontär/in)
		Freiwillig Wehrdienst- oder Bundesfreiwilligendienstleistende/r
		Freiwilliges soziales/ökologisches/kulturelles Jahr
		Noch nie erwerbstätig gewesen
Beruf	Nehmen Sie eine Führungsaufgabe wahr, d. h. sind Sie Mitarbeitern/ Mitarbeiterinnen gegenüber weisungsbefugt, die keine Auszubildenden sind?	Ja, als Führungskraft (mit Entscheidungsbefugnis über Personal, Budget und Strategie)
		Ja, als Aufsichtskraft (Anleiten und Beaufsichtigen von Personal, Verteilen und Kontrollieren von Arbeit)
		Nein

Annex Table 1 continued

Bereich	Frage	Antwortkategorien
Einkommen	Wie hoch ist in etwa das monatliche Netto-Einkommen Ihres Haushalts insgesamt? *Bitte zählen Sie die monatlichen Einkommen aller Haushaltsmitglieder (einschließlich Elterngeld, Kindergeld usw.) nach Abzug von Steuern und Sozialabgaben zusammen.*	*Betrag als offene Angabe in EURO*
		(Bei Verweigerung) Einkommen in Kategorien erfassen
	Wie viele Personen leben ständig in Ihrem Haushalt, Sie selbst mit eingerechnet?	*Anzahl der Personen*
	Wie viele Personen in Ihrem Haushalt sind jünger als 14 Jahre?	*Anzahl der Personen unter 14 Jahren*

Annex Table 2 (in German)
Basis to calculate the SES index in KiGGS Wave 2
Source: KiGGS Wave 2 (2014-2017)

Punkte von	Punkte bis unter	Bildung Schulische und berufliche Qualifikation nach CASMIN-Klassifikation	Beruf Berufliche Stellung nach EHIS (Berufl. Stellung, Führungsaufgaben)	Einkommen Nettoäquivalenzeinkommen
1,0	1,5	1a (Kein schulischer Abschluss und kein beruflicher Abschluss) 1,0 Pkt.	Landwirt im Haupterwerb: 1,0 Pkt.	78 EUR – 609 EUR: 1,0 Pkt.
1,5	2,0	1b (Abschluss nach höchstens 7 Jahren Schulbesuch/Haupt-/Volksschule und kein beruflicher Abschluss) 1,7 Pkt.	–	610 EUR – 821 EUR: 1,5 Pkt.
2,0	2,5	–	Arbeiter o. Führungs-/ Aufsichtstätigkeit: 1,9 Pkt.	822 EUR – 960 EUR: 2,0 Pkt.
			Arbeiter o. n. A.: 2,0 Pkt.	
2,5	3,0	2b (Realschule/Mittlere Reife/Mittlerer Schulabschluss/Polytechnische Oberschule und kein beruflicher Abschluss) 2,8 Pkt.	Arbeiter Aufsichtskraft/ Führungskraft: 2,7 Pkt.	961 EUR – 1.091 EUR: 2,5 Pkt.
3,0	3,5	1c (Kein Abschluss von Realschule/Mittlere Reife/ Mittlerer Schulabschluss/Polytechnische Oberschule und abgeschlossene Lehre, also berufliche-betriebliche Ausbildung) 3,0 Pkt.	–	1.092 EUR – 1.221 EUR: 3,0 Pkt.
3,5	4,0	2a (Realschule/Mittlere Reife/Mittlerer Schulabschluss/Polytechnische Oberschule und abgeschlossene Lehre, also berufl.-betriebl. Ausbildung) 3,6 Pkt.	Sonstige: 3,8 Pkt.	1.222 EUR – 1.344 EUR: 3,5 Pkt.
		2c-gen (Abitur, allgemeine/fachgebundene Hochschulreife, Erweiterte Oberschule, Fachhochschulreife/Fachoberschule und kein beruflicher Abschluss) 3,7 Pkt.		
4,0	4,5	–	–	1.345 EUR – 1.454 EUR: 4,0 Pkt.

Annex Table 2 continued

Punkte von	bis unter	Bildung Schulische und berufliche Qualifikation nach CASMIN-Klassifikation	Beruf Berufliche Stellung nach EHIS (Berufl. Stellung, Führungsaufgaben)	Einkommen Nettoäquivalenzeinkommen
4,5	5,0	2c-voc (Abitur, allg./fachgebundene Hochschulreife, Erweiterte Oberschule, Fachhochschulreife/ Fachoberschule und beruflicher Abschluss) 4,8 Pkt.	Angestellter o. Führungs-/ Aufsichtstätigkeit: 4,4 Pkt.	1.455 EUR – 1.600 EUR: 4,5 Pkt.
			Angestellter o. n. A.: 4,7 Pkt.	
			Angestellter Aufsichtskraft: 4,8 Pkt.	
5,0	5,5	–	Selbstständig ohne Mitarbeiter: 5,1 Pkt.	1.601 EUR – 1.762 EUR: 5,0 Pkt.
5,5	6,0	–	Selbstständig mit Mitarbeitern: 5,5 Pkt.	1.763 EUR – 1.971 EUR: 5,5 Pkt.
6,0	6,5	3a (Abschluss Fachhochschule, Ingenieurschule) 6,1 Pkt.	Angestellter Führungskraft: 6,1 Pkt.	1.972 EUR – 2.260 EUR: 6,0 Pkt.
6,5	7,0	–	–	2.261 EUR – 2.833 EUR: 6,5 Pkt.
7,0		3b (Abschluss Universität oder Hochschule) 7,0 Pkt.	Beamte (alle Gruppen) 7,0 Pkt.	2.834 EUR u. m.: 7,0 Pkt.

CASMIN = Comparative Analyses of Social Mobility in Industrial Nations; o. = ohne; o. n. A. = ohne nähere Angabe; u. m. = und mehr; Pkt. = Punkte; EUR = Euro

Annex Table 3 (in German)
Questions to operationalise subjective social status in KiGGS Wave 2 – questionnaire for children and adolescents aged 11 to 17
Source: KiGGS Wave 2 (2014-2017)

Bereich	Frage	Antwortkategorien
Subjektiver Sozialstatus	**Wie siehst du die Situation deiner Familie?** *Stelle dir bitte vor, dass diese Leiter den Aufbau der Gesellschaft in Deutschland darstellt.* *Ganz oben stehen die Menschen mit dem meisten Geld, der höchsten Bildung und den besten Jobs. Ganz unten stehen die Menschen mit dem wenigsten Geld, der niedrigsten Bildung und den schlechtesten Jobs oder ohne Job.* *Nun denke an deine Familie.* **Was denkst du, auf welcher Sprosse würde deine Familie stehen? Bitte kreuze einen Kreis neben der Leiter an.**	[Bild einer Leiter mit 10 Sprossen, die den Werten 1 – 10 zugeordnet werden]

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Improving the inclusion and participation of children and adolescents with a migration background in KiGGS Wave 2

Abstract

In the context of health monitoring at the Robert Koch Institute, the baseline study of the German Health Interview and Examination Survey for Children and Adolescents (KiGGS) surveyed a sample of children and adolescents with a migration background according to their share within the general population through extensive measures. Owing to less comprehensive efforts, this was not accomplished in the follow-up KiGGS Wave 1 study. For KiGGS Wave 2, the objective therefore was, through targeted measures, to increase the willingness of children and adolescents with a migration background to participate in the survey. This article describes the approaches to include children and adolescents with a migration background, the operationalisation of migration-specific variables and the effectiveness of field visits prior to the actual survey as a tool to increase the willingness of these groups to participate in the survey. Furthermore, data on participation and the sample of children and adolescents with a migration background in the cross-sectional KiGGS Wave 2 study is presented.

Overall, 2,994 children with a migration background aged 0 to 17 years took part in KiGGS Wave 2. In the weighted sample this corresponds to 11.8% (n=1,436) with a one-sided and 17.0% (n=1,558) with a two-sided migration background. In sum, the share of children and adolescents surveyed with a migration background (28.8%) is almost that of their share in Microcensus 2013 (31.2%). Compared to children and adolescents without a migration background, barely any differences exist in age and gender distribution, while differences are seen regarding social status; children with a two-sided migration background are significantly more often found in the low social status group. In the sample, the most often represented countries of origin were the countries of Central and South Europe, of the former Soviet Union and Turkey. Regarding the length of time parents had lived in Germany, around 40.1% of migrant families have been living in the country for over 20 years, whereas nearly one in five families has been in Germany for less than five years. A total of 12.2% of children and adolescents with a migration background migrated themselves.

By implementing a comprehensive set of measures, the degree after weighting to which children and adolescents with a migration background were included in KiGGS Wave 2 is nearly commensurate to their share in the overall population.

MIGRATION · CHILDREN · ADOLESCENTS · HEALTH MONITORING · KIGGS

Studie zur Gesundheit von Kindern und Jugendlichen in Deutschland

KiGGS Wave 2

Second follow-up to the German Health Interview and Examination Survey for Children and Adolescents

Data owner: Robert Koch Institute

Aim: Providing reliable information on health status, health-related behaviour, living conditions, protective and risk factors, and health care among children, adolescents and young adults living in Germany, with the possibility of trend and longitudinal analyses

Study design: Combined cross-sectional and cohort study

Cross-sectional study in KiGGS Wave 2
Age range: 0-17 years
Population: Children and adolescents with permanent residence in Germany
Sampling: Samples from official residency registries - randomly selected children and adolescents from the 167 cities and municipalities covered by the KiGGS baseline study
Sample size: 15,023 participants

KiGGS cohort study in KiGGS Wave 2
Age range: 10-31 years
Sampling: Re-invitation of everyone who took part in the KiGGS baseline study and who was willing to participate in a follow-up
Sample size: 10,853 participants

KiGGS survey waves
- KiGGS baseline study (2003-2006), examination and interview survey
- KiGGS Wave 1 (2009-2012), interview survey
- KiGGS Wave 2 (2014-2017), examination and interview survey

More information is available at www.kiggs-studie.de/english

1. Introduction

In 2016, around 18.6 million people in Germany had a migration background which implies that they themselves or at least one of their parents have migrated to Germany [1]. This is 22.5% of the population. In the under 18 age group, one in three people has a migration background. People in Germany with a migration background are on average significantly younger than the population without a migration background. The share is therefore highest in the age group of children under five (38.1%) [1]. Migration visibly marks the living conditions and health even for second or third generation immigrant children in Germany. Based on the results of the baseline study of the German Health Interview and Examination Survey for Children and Adolescents (KiGGS), children and adolescents with a migration background show differences regarding physical and psychosocial health, health behaviour and health system utilisation compared to their peers without a migration background [2]. The health opportunities and disease risks vary depending on country of origin and length of stay, but also depend on age, gender and socioeconomic status [2].

To assess the health of people with a migration background requires a clear definition of migration background as a concept in the corresponding data [3]. Many official statistics, as well as routine data, however, only survey nationality as a differentiating factor. Nationality, however, can only show a part of the population with a migration background. Such an approach fails to identify the migration background of, for example, ethnic Germans from Eastern Europe (German resettlers) and naturalised foreigners, as they hold German citizenship. Health surveys at the Robert Koch Institute therefore apply the criterion of country of birth of participants and/or their parents. People who were born in Germany then can nonetheless be assigned a migration background, regardless of their current nationality [2, 4, 5].

Overall, there is still only insufficient data on the health of people with a migration background [6, 7]. People with a migration background are generally systematically underrepresented in health surveys, because for different reasons their willingness to participate in such surveys is lower than that of the population without a migration background [8]. Language is one barrier to participation, as can be specific cultural factors, or fears that the health data surveyed could potentially be accessible to migration offices and therefore influence the decision on participants' residence status [9, 10]. Therefore, special measures are required to include people with a migration background in health surveys. So far, only the baseline study of German Health Interview and Examination Survey for Children and Adolescents (KiGGS) provides national representative data [11-13] that allows a detailed description of health by migration background [2].

The KiGGS baseline study (examination and interview survey, 2003-2006) was the first survey to develop and implement an approach that specifically takes migration into account [14]. The share of participants with a migration background in the weighted sample was 25.9% (unweighted 22.1%) [15]. The first follow-up survey (KiGGS Wave 1, 2009-2012) was conducted as a telephone survey and the share of children and adolescents with a migration background was 24.3% (unweighted 16.3%) in the cross-sectional sample [15]. These low levels of participation are also

After weighting children and adolescents with a migration background are represented in KiGGS Wave 2 nearly according to their share in the overall population.

due to the fact that interviews were conducted exclusively in German. Translated self-administered paper questionnaires were the only alternative offered and were used by 1.2% of parents in the cross-sectional sample. There were no home visits conducted as specific recruitment measure [16]. The second follow-up survey (KiGGS Wave 2, 2014-2017), which consisted of an interview and an examination, therefore strove to again take special measures to better represent children and adolescents with a migration background.

This article describes the measures taken to include children and adolescents with a migration background in the cross-sectional KiGGS Wave 2 study, the operationalisation of migration-specific variables and the efficiency of field visits prior to the survey as a measure to increase the willingness of people who are not German nationals to participate in the survey. Furthermore, data on levels of participation and makeup of the sample of children and adolescents with a migration background in the cross-sectional KiGGS Wave 2 study is presented.

2. Methodology

2.1 Study design

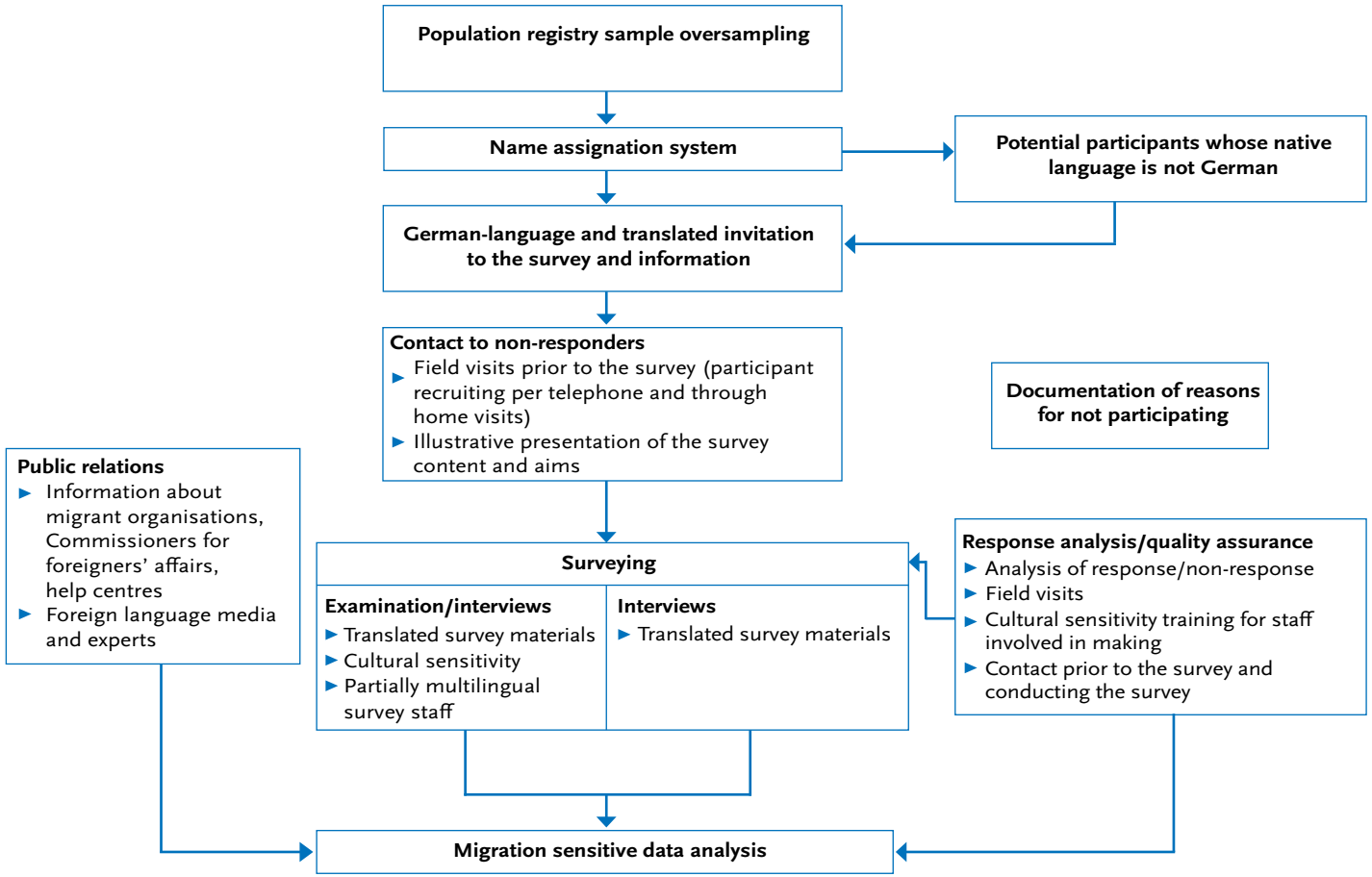
The KiGGS surveys regularly provide national data from Germany to describe the health of children and adolescents under 18 and can therefore reveal trends [12, 13, 16]. Since 2009, in the context of health monitoring at the Robert Koch Institute, KiGGS has been continued as a long-term survey. KiGGS surveys data on health status, health behaviour, living conditions, protection and risk factors as well as healthcare service utilisation. The survey concept, sampling and design as well as KiGGS Wave 2 implementation have been previously described in detail [17, 18]. Whereas all participants were interviewed, only some of the children and adolescents were subsequently also medically examined. This edition also contains a detailed description of response rates and sample composition [17].

All surveys at the Robert Koch-Institute are subject to strict compliance with the data protection regulations of Germany's Federal Data Protection Act. Hannover Medical School´s ethics committee has considered and approved the survey under ethical guidelines (No. 2275-2014). The Federal Commissioner for Data Protection and Freedom of Information in Germany received the KiGGS Wave 2 study concept and had no objections. Together with the invitation to the survey, participants, their parents and/or legal guardians were informed on those responsible for the survey, the objectives and content of the survey, voluntary participation and data protection. They provided their informed consent in writing.

2.2 Measures to include children and adolescents with a migration background

Based on the experience of previous KiGGS survey waves [2, 15], KiGGS Wave 2 continues and enhances the approach of the KiGGS baseline study [2] that specifically focused on including people with a migration background in a multi-step approach (Figure 1). To compensate for the low level of willingness of people with a migration background to participate in the survey, sampling involved the application of an oversampling factor of 1.5. The share of children and

Figure 1
The KiGGS Wave 2 approach to account for migration as a factor
Source: Based on Schenk et al. 2007 [14]



Personal contact through field visits by specifically trained survey staff is an effective measure of increasing willingness to participate in the survey.

adolescents without German nationality in the unadjusted gross sample was therefore higher than their share in the population. Invitations to the survey and questionnaires were translated into four languages (Turkish, Russian, Serbo-Croatian and English). The selection of these languages was based on the size of the language group, the extent of the language difficulties observed, as well as the experiences from the KiGGS baseline study and KiGGS Wave 1 [2, 15]. A computer-based system to assign names developed by the Humpert und Schneiderheinze GbR (H&S) (onomastic procedure) was used that allows to assign first and last names of children and adolescents to specific languages and relate these to a possible migration background. Parents or legal guardians were then sent an invitation in German as well as in the language determined by the onomastic procedure [19, 20]. Due to ethical

and legal regulations, the parents were the contact persons for concerns regarding the study [17]; following we use the term "family" when addressing survey-relevant connections between children and their parents. Families in the Arabic speaking group received an invitation in English, because no invitation and survey materials in Arabic were available.

A further measure for all families consisted in field visits prior to the survey [17]. Families that did not react to invitations and reminder letters were contacted first by telephone and, where necessary, contacted at their homes. In a personal conversation, survey staff provided these families with information on the objectives and content of the survey and answered any questions. Approaching families with a migration background in this manner aimed to increase their willingness to participate in the survey. In cases, where families could not be motivated to participate, survey staff attempted to determine their reasons for not participating. If contacting a person to clarify the objectives and contents of the survey proved impossible due to language barriers, these children and adolescents were counted as a quality neutral loss [17].

Examinations were culturally sensitive, and girls, for example, were examined only by female survey staff. To ensure participation by people with only a rudimentary knowledge of German, survey materials and consent forms were made available in four languages. Some field team staff were multilingual and this aimed to reduce language barriers in the examination centres.

Furthermore, response and non-response analyses were conducted that specifically took into account migration background and the response rate of non-German nationals was constantly monitored. Where necessary, efforts to increase these groups' willingness to participate in the survey could be stepped up in a targeted manner. For example, field visits prior to the survey to contact people with a migration background were stepped up. Moreover, field staff and examination teams received cultural awareness training for the purpose of quality assurance. To systematically record the language or cultural difficulties faced by people with a migration background, a questionnaire was developed for staff involved in field visits prior to the survey and the teams that then conducted the actual survey.

Public relations activities were also conducted and, as potential multipliers to recruit participants, migrant organisations, commissioners for foreigners' affairs and help centres at the 167 sample points were informed about the survey and its aims. All of these measures were important to ensure an analysis of data capable of accounting specifically for migration.

Due to the increase in immigration to Germany in particular in 2015, the delivered addresses from the population registry samples more often included families from crisis areas such as Syria or Iraq. With greater frequency, the survey staff involved in contacting potential participants prior to the survey documented that the people they had written to lived in centralized homes or in centres for unaccompanied minor refugees, which had made communication very difficult. Therefore, in the cross-sectional KiGGS Wave 2 study an additional survey-methodological module was developed to test accessing asylum seeker families. A short questionnaire was created and translated into Arabic and English. It was subsequently sent to all Syrian, Iraqi or Eritrean families that had not previously explicitly stated that they did not want to participate in the survey or who,

The countries of Central and Southern Europe, the former Soviet Union and Turkey were the most common countries of origin in the survey sample.

due to language barriers, had been unable to participate in the survey (quality neutral losses).

2.3 Operationalisation of migration-specific variables

A participant's migration background was established, as in previous KiGGS waves, based on the country of birth of a child or adolescent and where applicable that of their parents, as well as parent nationality [2]. A one-sided migration background was defined as having one parent not born in Germany or without German citizenship. The group of two-sided migration background included children who had themselves migrated to Germany and have at least one parent who was not born in Germany. Children and adolescents whose parents were both born in a country other than Germany or are non-German nationals also fall into this group, whether or not they themselves have migrated or were born in Germany. In single-parent households, the status of the single parent is the defining factor for child migration background.

All immigrants to Germany were asked what "immigration group" they belonged to. The following categories were provided: 1) asylum seekers, 2) recognised asylum seekers, 3) war refugees, 4) contingent refugees, 5) EU citizens, 6) family reunification, 7) labour migrants, 8) ethnic Germans from Eastern Europe, 9) students and 10) other.

The countries of origin were established based on parental country of birth and/or nationality. In families where the mother and father come from different countries, the mother's country was taken. The fathers' data was taken in cases where mothers failed to provide the corresponding data. The data on countries of origin was differentiated for further analyses if a sufficiently large number of people came from one particular country. Countries of origin for only small numbers of participants were regionally aggregated: 1) Germany, 2) Turkey, 3) countries of the former Soviet Union, 4) Poland, 5) Central and Southern Europe, 6) Canada, US, Israel and the rest of Europe, 7) Arabic countries and North Africa, 8) Latin America, 9) Asia and 10) sub-Saharan Africa (see Annex 1).

The year a participant's mother had entered Germany defines the length of time parents have lived in Germany. If this date was unknown or the mother had been born in Germany, the father's data was used for calculation. Participants were subdivided into five groups regarding length of stay: 0-5 years, 6-10 years, 11-15 years, 16-20 years and over 20 years.

All immigrants to Germany were asked whether they held permanent residency status. Parent residency status was initially established based on the data provided by mothers. Where mothers did not provide this information, were German or EU citizens, the data provided by the father was used. This system therefore differentiates between 1) Germans/EU citizens and 2) permanent and 3) temporary residency status.

Children and adolescents, who were not born in Germany, belong to the first generation. The second and subsequent generations comprise children and adolescents, who have lived in Germany since birth with at least one parent having been born outside Germany or without German citizenship.

Nearly one in five families with a migration background has been living in Germany for less than five years.

Table 1
Share of children and adolescents with a migration background in the cross-sectional KiGGS Wave 2 study compared to Microcensus 2013
Source: KiGGS Wave 2 (2014-2017), Microcensus 2013 [22]

	Cases, unweighted	Sample unweighted %	Sample weighted %	Microcensus 2013 in %
Without migration background	11,857	79.8	71.2	68.7
Total migration background	2,994	20.2	28.8	31.2
Among these:				
One-sided migration background	1,436	9.7	11.8	10.7
Two-sided migration background	1,558	10.5	17.0	20.5
Missing values	172	1.3		2.0

A migration sensitive approach provides the basis for a representative sample and a migrant-specific data analysis.

2.4 Statistical analysis

Response rates and the efficiency of field visits prior to data collection were calculated based on the citizenship of children and adolescents delivered by the population registries. Migration background, which was established from the data on children, adolescents as well as their parents collected in the health questionnaires, then provided the basis for all further analyses.

In a first step, the share of children and adolescents with a migration background in KiGGS Wave 2 was verified based on the Microcensus 2013 distribution. As a mandatory representative household survey and part of official statistics in Germany, the Microcensus also includes data on people with a migration background [1, 21]. However, the Microcensus measures and defines migration background [22] differently to the KiGGS survey so the Microcensus 2013 data had to be adapted to fit the definition used in KiGGS. Corresponding shares for one-sided and two-sided migration background were then calculated. A total of 2% of the people that the Microcensus defines as having a migration background do not fall into this category based on the definition applied by the KiGGS study.

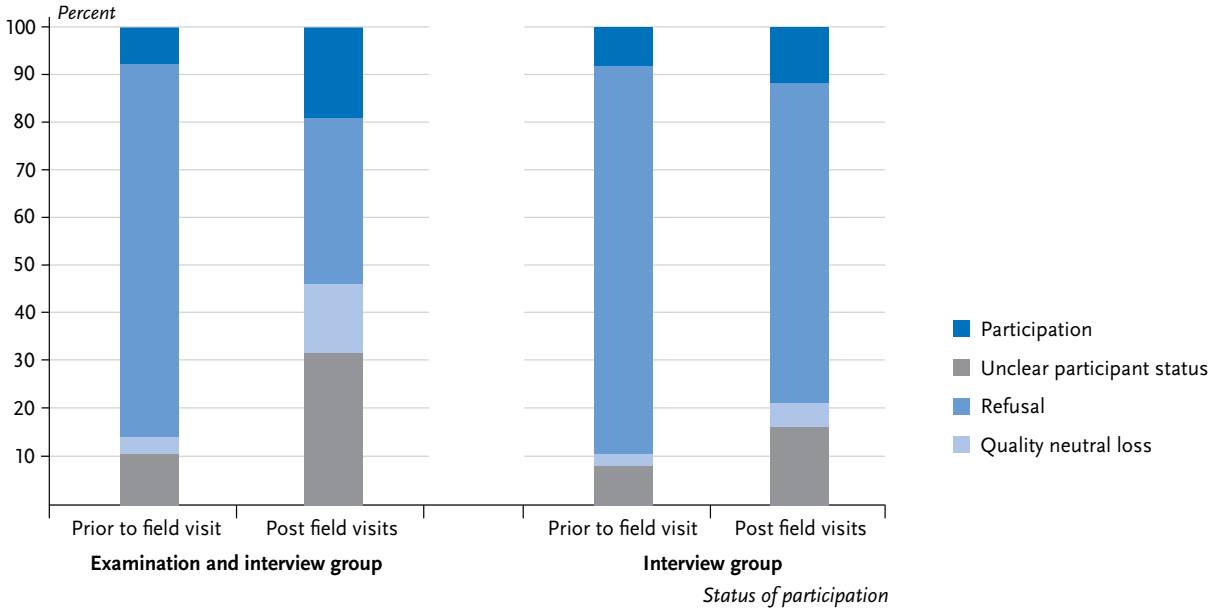
A description of weighting in the KiGGS sample is provided in Hoffmann et al. [17]. To ensure representative assessments, KiGGS data was weighted regarding foreigner status (German citizenship yes/no) on the basis of population statistics (as at 31 December 2014) [23], as well by age, gender, parents' levels of education and federal state. Hoffmann et al. describe the weighting procedure in KiGGS Wave 2. The descriptive analyses of the cross-sectional sample of children and adolescents with a migration background stratified by age, socioeconomic status and size of home town were conducted with and without weighted KiGGS data. To assess the influence of weighting on migration background and other migration-specific variables, case numbers and frequency are presented unweighted and weighted.

3. Results

3.1 Participation of children and adolescents with a migration background

The response rate of children and adolescents with non-German nationality was 17.0% overall, within the examination sample it was 27.9%. In the unweighted KiGGS sample, the share of children and adolescents of non-German

Figure 2
Increase of participation among families of non-German nationality due to visits prior to the survey (interview and examination n=482 girls, n=543 boys; interview n=1,624 girls, n=1,841 boys)
Source: KiGGS Wave 2 (2014-2017)



nationality was 3.7%. Weighting increased this share to 7%, which is in line with the population figures from the Federal Statistical Office (7.0%) [23].

Out of a total of 15,023 participants in the cross-sectional KiGGS Wave 2 study, 2,994 children and adolescents have a migration background (Table 1). Overall, 1,436 children had a one-sided migration background, which, in the weighted sample, corresponds to a share of 11.8% (unweighted 9.7%). A total of 17.0% (weighted) of children had a two-sided migration background (unweighted 10.5%). In Microcensus 2013 data, 10.7% have a one-sided and 20.5% a two-sided migration background. Overall, the weighted share of children and adolescents with a migration background (28.8%) in KiGGS Wave 2 is therefore nearly commensurate to their Microcensus 2013 share (31.2%).

Additionally, as part of the survey-methodological module on accessing asylum-seeking families subsequent to the KiGGS study, the short questionnaire was handed out to 402 Syrian, Iraqi and Eritrean nationals living in Germany. The questionnaire could not be delivered to 65 of them. The response rate was therefore 19.0% (n=64).

3.2 Field visits prior to the survey to contact non-German nationality families

An important measure to include people with a migration background in the survey consisted of contacting them prior to the survey. No analysis of the effectiveness of the other measures described under section 2.3 is provided because the effects of these measures cannot be clearly defined separately. Figure 2 shows the shares of invited

sample members' willingness to participate both before the field visits and after the data collection had finished. However, the shown results cannot be clearly assigned to the field visits, because changes in the willingness to participate could also have appeared (after the field visits and prior to the actual participation) independently of the field visits. Results are based on data of the gross sample of people without German citizenship. Among the examination sample (n=1,025), the share of cases with unknown participant status was reduced from 77.8% after the postal reminder to 34.7% after the end of data collection. This implies that the share of participating sample members doubled (from 7.9% to 19.0%) after field visits. Both the shares of refusals and quality neutral losses tripled. Among the interview sample (n=3,465), field visits were generally conducted less extensively than in the examination group [17].This also applies for the sample members without German citizenship (interview sample n=3,465). The share of cases with unclear participant status was 66.8% and therefore approximately twice as high as in the examination group. The share of participants in the gross sample increased from 8.3% to 11.8%. Both the proportion of

	Sample unweighted %			Sample weighted %		
Migration background	Without	One-sided	Two-sided	Without	One-sided	Two-sided
Age (years)						
0-2	9.3	12.8	10.4	14.9	21.8	14.3
3-6	22.6	26.0	21.2	21.0	24.5	21.1
7-10	23.3	23.9	22.7	21.5	21.1	21.6
11-13	20.6	18.4	19.3	17.7	15.1	14.8
14-17	24.3	18.9	26.4	24.9	17.6	28.2
Total	100	100	100	100	100	100
Missing values (n=0)						
Socioeconomic status						
Low	9.9	14.0	30.2	13.6	22.9	45.1
Medium	63.0	54.6	56.8	63.8	55.2	47.2
High	27.1	31.4	13.0	22.6	21.8	7.7
Total	100	100	100	100	100	100
Missing values (n=216)						
Size of town						
Rural	20.0	12.9	5.1	18.7	12.3	5.1
Small town	34.2	25.9	23.4	29.9	22.4	18.7
Medium-sized town	27.6	29.9	34.4	28.1	27.9	33.8
Large city	18.2	31.3	37.1	23.3	37.4	42.5
Total	100	100	100	100	100	100
Missing values (n=0)						

Table 2
Share of children and adolescents with a migration background by age, socioeconomic status and size of town in the cross-sectional KiGGS Wave 2 study (n=7,456 girls, n=7,395 boys)
Source: KiGGS Wave 2 (2014-2017)

refusals and quality neutral losses doubled. On the whole, there were less observable status changes in the interview sample than in the examination sample.

3.3 Socio-demographic and socioeconomic differences between children and adolescents regarding migration background

Regarding age and gender distribution hardly any differences to children and adolescents without migration background exist compared to children and adolescents with a migration background. In the unweighted sample, regardless of migration background, the share of small children aged 0 to 2 years is the lowest compared to other age groups. There were no examinations conducted in this age group. Weighting partially offset this difference. The share of children and adolescents with a two-sided migration background was highest in the 14 to 17 age group (Table 2).

Clear social differences are however apparent (Table 2). Children and adolescents with a two-sided migration background more often fall into the lower social status group (45.1% versus 13.6% without a migration background) and less in the high status group (7.7% versus 22.6% without a migration background). The social composition of the group of children and adolescents with one-sided migration background thereby tends to resemble that of their peers without a migration background. Equally, a clear urban-rural differential is evident, with a greater share of children and adolescents with a one-sided or two-sided migration background living in larger cities than in rural areas (Table 2).

Table 3
Mothers and fathers of children and adolescents with a migration background by immigrant type in the cross-sectional KiGGS Wave 2 study
Source: KiGGS Wave 2 (2014-2017)

	Mother		Father	
	Sample unweighted %	Sample weighted %	Sample unweighted %	Sample weighted %
Ethnic Germans	29.1	26.1	26.7	24.0
Family reunification	24.2	24.4	17.3	16.4
EU citizens	17.4	16.2	15.7	15.7
Asylum seekers	6.7	9.6	9.9	12.9
Other groups	8.1	8.2	8.6	8.4
War refugees	4.3	5.5	6.2	7.8
Labour migrants	4.0	4.7	7.1	7.6
Recognised asylum seekers	2.3	2.2	3.3	2.4
Students	2.9	2.1	4.2	3.6
Contingent refugees	1.0	1.1	1.1	1.1
Total	100	100	100	100

Missing values (Mother n=586, Father n=979)

Table 4
Migration-specific features of children and adolescents with a migration background in the cross-sectional KiGGS Wave 2 study (n=1,567 girls, n=1,433 boys)
Source: KiGGS Wave 2 (2014-2017)

	Cases unweighted	Sample unweighted %	Sample weighted %
Country of origin			
Germany	11,857	80.3	71.6
Turkey	332	2.2	4.2
Former countries of the Soviet Union	613	4.1	5.4
Poland	314	2.1	2.8
Central and Southern Europe	576	3.9	6.0
Canada, USA, Israel and the rest of Europe	450	3.0	3.3
Arab countries and North Africa	312	2.1	3.6
Latin America	64	0.4	0.5
Asia	164	1.1	1.5
Sub-Saharan Africa	93	0.6	1.0
Missing values	248		
Length of stay in years			
0-5	307	12.6	14.9
6-10	255	10.5	11.2
11-15	388	16.0	15.0
16-20	440	18.1	18.7
>20	1,042	42.8	40.1
Missing values	562		
Residency status			
Permanent	744	25.2	26.9
Temporary	267	9.0	11.9
German/EU citizen	1,944	65.8	61.2
Missing values	39		
Immigrant generation			
First generation	307	10.3	12.2
Second and subsequent generations	2,687	89.7	87.8
Missing values	-		

3.4 Differentiating children and adolescents within the larger group with a migration background

Differentiated on the basis of their mothers and fathers, ethnic Germans from Eastern Europe, people with a migration background, who came to Germany through family reunification regulations and EU citizens, comprise the largest immigrant groups represented in KiGGS Wave 2 (Table 3). Compared to the KiGGS baseline study, the share of asylum seekers and war refugees has increased in KiGGS Wave 2 [2].

Due to the information potentially available about particular cultural backgrounds or a country of origin's health system, parental country of birth is an important stratification variable. Most frequently the children and adolescents with a migration background had family ties to Central and Southern Europe (6.0%), the countries of the former Soviet Union (5.4%) and Turkey (4.2%) (Table 4). Considering the length of stay of parents, around 40% of migrant families have been living in Germany for over 20 years. By contrast, one in five migrant families has been in Germany for less than five years (Table 4). A total of 12.2% of children and adolescents with a migration background have migrated themselves. The majority of children and adolescents has a secure residency status, yet 11.9% of families have only temporary residency status and correspondingly only an uncertain perspective of whether they will be able to remain in Germany (Table 4). Participants spoke 72 languages at home in sum. Among these, the languages most frequently mentioned were Russian (16.9%), Turkish (16.6%), Polish (8.0%), Arabic (6.8%) and English (5.7%).

4. Discussion

The results show the success of intensified measures to motivate families with a migration background to participate in KiGGS Wave 2 and the weighted share of children and adolescents with a migration background is almost commensurate to this group's share in the overall population. However, whereas sufficient children and adolescents with a one-sided migration background participated in the cross-sectional KiGGS Wave 2 study, the unweighted KiGGS sample underrepresented children and adolescents with a two-sided migration background. Weighting approximately compensated for these differences in distribution with regard to Microcensus 2013 data. However, even after weighting, distortions concerning other variables such as length of stay or country of origin may subsist because weighting does not consider these variables. A clear limitation of the analysis is the diverging definitions of migration background, which means that full comparability with Microcensus data is not possible. This, however, only affected a very small number of people, who could not be unambiguously categorised according to the Robert Koch Institute definition. Moreover, the survey excluded people who did not speak sufficient German or who did not speak one of the four languages into which the survey materials and consent forms had been translated and which clarified the survey's aims and contents (informed consent). In particular, participation by presumably Arabic speaking families that appeared in the gross sample was limited.

Contacting and including possibly asylum-seeking families was tested using an abbreviated questionnaire that went to Syrian, Iraqi and Eritrean families following the standardised survey procedures. This additional survey-methodological module provided information on possible barriers to including asylum seekers in the survey. Nearly one in five families could not be contacted at their address. Over and above the language barrier, the greatest difficulty in contacting and including this group in KiGGS Wave 2, therefore, was the group's mobility (for example due to their re-distribution to other centres or places of accommodation). A limiting factor in this analysis is that not all families with Syrian, Iraqi or Eritrean citizenship are asylum-seekers.

Because various measures were being applied simultaneously, the efficiency of individual migration-specific measures cannot be clearly established. Specially trained survey staff, however, who had established a personal contact with families prior to the survey, proved an effective way to increase willingness to participate. In particular for the examination sample, willingness to participate in the survey doubled. Furthermore, the response rate was nearly twice as high as in the interview sample, where field visits prior to the survey were not conducted as intensively. As other surveys have revealed, while time-consuming, personal contact is a necessary effort to convince people with a migration background to participate in surveys [3, 8, 24-26].

As in the KiGGS baseline study, the response rate of non-German nationals in KiGGS Wave 2 [2] was lower than for children and adolescents without a migration background [17]. This highlights the importance of implementing a broad set of measures to ensure participation by people with a migration background to adequately represent

sub-populations that are particularly hard to reach, such as people who have limited German language skills.

To date, the KiGGS study in Germany remains the only cross-sectional health survey to include a sufficiently large number of people with a migration background. In particular, the possibilities to compare health-related markers of children and adolescents with and without a migration background promise valuable scientific findings [2]. The survey data could help close some of the current information gaps on the health of children and adolescents with a migration background and to conduct an analysis of trends. Next to cross-sectional analysis, we will analyse and present the potential of analyses of trends and possibly longitudinal analyses regarding people with a migration background within the context of KiGGS [27]. Regarding the diversity of German society, the measures described to increase the participation of people with a migration background in health statistics are truly indispensable.

The Robert Koch Institute, based on the 'Improving Health Monitoring in Migrant Populations' (IMIRA) project, therefore is currently conducting a diverse set of measures to improve the data (which is in many cases still only fragmentary) and information on people with a migration background [28]. One priority is the expansion of health monitoring at the Robert Koch Institute. In order to include adults with a migration background in Robert Koch Institute surveys in the long term, two feasibility studies will be conducted. Within the context of the feasibility study "interview", new forms of approaching and measures to recruit participants will be tested, the content and surveying instruments reviewed and, where necessary, updated. The feasibility study "examination", moreover, will test different options to reduce language barriers and difficulties between participants and the medical staff conducting examinations. Also, the project aims to expand health reporting regarding people with a migration background. In addition to health monitoring data, the aim is to increasingly use further sources of data such as that available from social insurers or the public health services.

In conclusion, it requires resource-intensive efforts to recruit a representative sample of the population with a migration background and collect data from a sufficiently large number of cases to answer migration-specific questions.

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Conflicts of interest

The authors declared no conflicts of interest.

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Annex 1
Countries of origin of children and adolescents with a migration background, KiGGS Wave 2 cross-sectional study
Source: KiGGS Wave 2 (2014-2017)

Countries of origin:
1) Germany
2) Turkey
3) Countries of the former Soviet Union: the Soviet Union, Russia, Estonia, Latvia, Lithuania, Ukraine, Belarus, Uzbekistan, Kazakhstan, Georgia, Azerbaijan, Kyrgyzstan, Tajikistan, Turkmenistan, Armenia and Moldova
4) Poland
5) Arab countries and North Africa: Lebanon, Morocco, Algeria, Iraq, Egypt, Pakistan, Syria, Jordan, Tunisia, Iran, Kuwait and Sudan
6) Southern Europe/Mediterranean: Albania, Bosnia, Bulgaria, Croatia, Slovenia, Greece, Italy, Yugoslavia, Macedonia, Spain, Portugal, Cyprus, Serbia, Kosovo, Romania and Montenegro
7) USA, Australia, Canada, Israel and the rest of Europe: Belgium, Denmark, Finland, France, Ireland, Luxembourg, the Netherlands, Norway, Austria, Slovakia, Sweden, Switzerland, the Czech Republic, Czechoslovakia, Hungary, the United Kingdom and Iceland
8) Latin America: Argentina, Brazil, Chile, Costa Rica, Dominican Republic, Ecuador, El Salvador, Colombia, Mexico, Nicaragua, Paraguay, Peru, Uruguay, Venezuela, Jamaica and Haiti
9) Asia: Bhutan, Sri Lanka, Vietnam, India, Japan, Laos, Mongolia, Nepal, Philippines, Taiwan, Korea, Thailand, China, Malaysia, Cambodia, Brunei, Indonesia and Bangladesh
10) Sub-Saharan Africa: Angola, Eritrea, Ethiopia, Nigeria, Ghana, Kenia, Congo, Liberia, Madagascar, Mauritius, Mozambique, Cameroon, South Africa, Namibia, Sierra Leone, Togo, Burkina Faso, Ivory Coast, Benin, Uganda, Cape Verde, Somalia, Senegal, Guinea and Gambia

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