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The nutrition survey EsKiMo II – design, execution and public health policy relevance

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Abstract

Regular nutrition surveys are important for health policy measures. As part of the second wave of the "German Health Interview and Examination Survey for Children and Adolescents" (KiGGS Wave 2; 2014–2017), the nutrition study – EsKiMo II – was once again conducted about ten years after the first "Eating Study as a KiGGS Module» (EsKiMo; 2006). In the period from June 2015 to September 2017, nutritional data were collected from 2,644 children and adolescents. Parents of children aged 6 to 11 years were instructed in how to keep a food record for a total of four days; nutrition interviews were conducted with 12- to 17-year-old adolescents using the modified diet history software known as DISHES. The results of EsKiMo II will provide actual data on the nutrition status of children and adolescents aged 6 to 17 years living in Germany, and will therefore offer an information basis for policy decisions.

Keywords: children and adolescents, food consumption, intake of nutrients, KiGGS, EsKiMo

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Background

Optimal intake of energy and nutrients is particularly important for children and adolescents as they are still developing [1]. However, our dietary behavior is in a state of constant change. Trends such as "superfoods", organic foods, and the current vegan trend, as well as the growing range of products available in supermarkets are all factors that can influence our dietary habits [2]. In addition, living conditions have changed in recent years: An increasing proportion of children and adolescents are now being taken care of at daycare facilities [3]. However, the food available in communal contexts, such as schools and daycare facilities, is often the subject of much criticism. For instance, studies on meal quality have shown that only a fifth of daycare centers and only a quarter of schools base their menus on the quality standards of the German Nutrition Society (*Deutsche Gesellschaft für Ernährung* [DGE]) [4, 5].

During childhood taste preferences and dietary habits develop, and it is highly likely that these preferences and habits will continue into adulthood [6, 7]. Overweight during childhood and adolescence which occurs due to poor diet among other factors, often persists into adulthood, bringing with it all of the associated health consequences. Therefore, essential foundations for a healthy lifestyle are already being laid in childhood and adolescence. However, many children and adolescents grow up in an environment that facilitates weight gain, resulting in people becoming overweight [8]. For example, sweets and pastries are often sold in kiosks in schools. "Children's foods" often contain too much sugar and fat. The food industry tries to influence the purchasing behavior as well as children's and adolescent's dietary habits by using colorful advertisements aimed at children or advertising messages directed at parents that emphasize the health benefits of their products [9]. In 2006, as part of the baseline study of the "German Health Interview and Examination Survey for Chil-

dren and Adolescents" (KiGGS) conducted by the Robert Koch Institute (RKI), the Germany-wide "Eating Study as a KiGGS Module" (EsKiMo, hereinafter referred to as EsKiMo I) was conducted for the first time with 2,506 children and adolescents aged 6 to 17 years. EsKiMo I showed that children and adolescents in Germany had an adequate intake of most vitamins and minerals, but were not eating enough plant-derived foods such as fruit, vegetables, potatoes, bread, and other fiber-rich foods. The proportion of carbohydrates in the overall food intake did correspond to German Nutrition Society recommendations, but most carbohydrates were consumed in the form of foods with a high sugar content or in the form of foods made of white flour. The main sources of sugar were sweets and sugar sweetened beverages, which were consumed by children and adolescents too frequently and in too large amounts. Furthermore, the recommended consumption levels for meat and sausages were greatly exceeded, which led to an increased intake of undesirable saturated fatty acids [10].

Policy measures and intervention programs have been established as an effort to improve this situation. The national action plan "IN FORM – German national initiative to promote healthy diets and physical activity", launched in 2008, aims to bring lasting improvements in dietary and physical activity habits in Germany by 2020. IN FORM has supported various health promotion and disease prevention projects in recent years, such as projects to improve the quality of food provided in schools [11]. The German government's latest sustainability strategy deals with existing and planned measures for the prevention of overweight and obesity in children and adolescents, including plans to further develop the national action plan IN FORM [12].

In order to draw conclusions about the extent to which the described changes will influence dietary habits, and as a result, the quality of nutrition among children and adolescents in Germany and their nutritional and health status, regular, representative assessment of food and nutrient intake is required.

Again, a nutrition module (EsKiMo II) was implemented in a new wave of the KiGGS study, KiGGS Wave 2. The aim of EsKiMo II is to collect up-to-date data to provide a representative overview of the current nutritional status of 6–17-year-old children and adolescents living in Germany. The results of EsKiMo II will show the extent to which the nutrition situation described above still applies today. The methods used in the EsKiMo study are very effort-intensive, which is why further details about the conduct of the study are described below. This should also provide a foundation for future publications. The planned usage of the results of EsKiMo II is also specified.

Methods

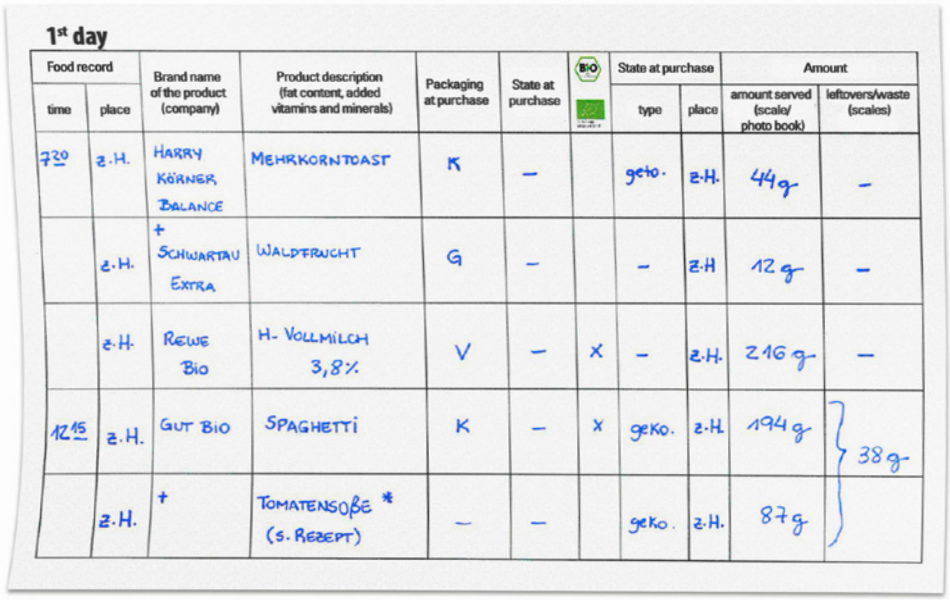
The KiGGS Study

The KiGGS study is part of the health monitoring for Germany and is performed by the RKI at regular intervals. One of its aims is to gather population data on the health status of children and adolescents living in Germany. The KiGGS baseline study was conducted by the RKI nationwide at 167 sample points from 2003 to 2006 as a combined interview and examination survey with 17,641 children and adolescents. The first follow-up survey, KiGGS Wave 1, was conducted by telephone from 2009 to 2012. The second follow-up survey, KiGGS Wave 2, was once again conducted as a combined interview and examination survey from 2014 to 2017. Participants from the baseline study were invited to take part again. In addition, a new sample was taken, allowing representative statements to be made for the age group of 0–17 years. A total of 15,023 children and adolescents were surveyed for the first time, and a subsample of them also underwent a physical examination [13]. This means that there are also a number of biochemical parameters, such as blood lipid levels, available, which may allow conclusions to be drawn about nutritional status.

Study population

KiGGS offers the opportunity to study subgroups of the study population in greater detail regarding specific issues using modules. Thanks to this arrangement, it was possible to conduct the nutritional survey EsKiMo II as a module study within the framework of KiGGS Wave 2 from June 2015 to September 2017. In order to ensure that the data gathered was representative, the regional and seasonal distribution of the sample points visits was considered in the study design. The target sample size for EsKiMo II was about 2,600 participants. This number is based on an equal distribution of boys and girls across each year of age included in the study (at least 100 boys and 100 girls from each year of age band) and an equal distribution across the sample points. Participants who took part in examinations and interviews in the cross-sectional part of KiGGS Wave 2 at the age of 6–17 years who had given their consent for being contacted again were invited to participate in EsKiMo II. Details about the study are described elsewhere [14].

Before the study began, it was approved by the Ethics Committee of Hannover Medical School and the German Federal Commissioner for Data Protection and Freedom of Information. An interview was conducted after information had been given and a written declaration of consent had been obtained from the legal guardians of minors and from adolescents themselves if aged 14 years or over.



1st day

Food record		Brand name of the product (company)	Product description (fat content, added vitamins and minerals)	Packaging at purchase	State at purchase	BIO	State at purchase		Amount	
time	place						type	place	amount served (scale/ photo book)	leftovers/waste (scales)
7:30	z.H.	HARRY KÖRNER BALANCE	MEHRKORNTOAST	K	–		geto.	z.H.	44g	–
	z.H.	+ SCHWARTAU EXTRA	WALDFRUCHT	G	–		–	z.H	12g	–
	z.H.	REWE BIO	H-VOLLMILCH 3,8%	V	–	X	–	z.H.	216g	–
12:15	z.H.	GUT BIO	SPAGHETTI	K	–	X	geko.	z.H.	194g	38g
	z.H.	+	TOMATENSOßE * (S. REZEPT)	–	–		geko.	z.H.	87g	

Fig. 1: **Example page from a food record**
(table translated from German original for better understanding)

Dietary assessment

Dietary assessments are a particular challenge when it comes to children and adolescents. Younger children require help from their parents because they lack nutritional knowledge and the required memory capacity [15]. As for adolescents, a method that is both less time-consuming and burdensome needs to be used in order to keep dropout rates to a minimum [16]. This is why EsKiMo II uses different dietary assessment tools depending on the age of the participant. In order to ensure good comparability between the results from EsKiMo I and EsKiMo II, widely the same dietary assessment tools were used.

Food records

For the 6 to 11-year-old age group, the parents (or legal guardians) were asked to keep a weighted food record for three days and for one additional separate day. The days to be recorded were established in advance using a randomized procedure. The foods consumed were recorded in detail, including specifications such as the brand name of the product, a product description (e.g. fat content), the time and location of consumption, the weighted amount served, and the weighted plate waste (◆Figure 1). An additional, shortened version of the weighted food record was provided for situations in which the amount of food consumed could not be weighted (e.g. in school canteens or restaurants) [14]. House visits were conducted by trained nutritionists from the EsKiMo team, in which instructions on how to fill out the food record and how to use the digital kitchen scale provided by the EsKiMo II study were given. The instruction lasted about 30 minutes. The parents or legal guardians of the participants had the option to contact the EsKiMo team by telephone or e-mail with any questions. The study participants sent the completed food records back to the RKI in a postage-paid envelope and received a gift voucher with a value of €20 as an incentive, as experience has shown that this increases willingness to participate. In addition, after a few weeks, a personal nutritional evaluation was sent, containing information on average total energy intake from the four days as well as the proportion of energy intake accounted for by individual energy contributing nutrients, compared to the German Nutrition Society recommendations [1].

Dietary interviews

For adolescents aged 12 to 17 years, the DISHES (Dietary Interview Software For Health Examination Studies) software was used. DISHES is a computer program developed by the RKI that is used to record usual dietary intake over the past four weeks using a modified dietary history method. In an about one hour-long face-to-face interview, the consumption frequencies and portion sizes of all foods consumed were recorded by trained nutritionists, organized by meal (breakfast, lunch, dinner, late-night snacks, or other snacks). Details about the DISHES software can be found elsewhere [17]. When conducting the interviews, it was essential to recognize and use regional food names. For example, the various regional synonyms for bread rolls ["*Brötchen*"], such as "*Semmeln*", "Wecken", or "*Schrippen*" were used in order to record the consumption of bread rolls. Following the interview, the adolescents received €15 in cash as a thank you for their participation. Furthermore, after a few weeks, an individual nutritional evaluation was sent, containing information on total energy intake and the proportion of energy intake accounted for different macronutrients. The overview also provides information about average daily intake levels of selected vitamins and minerals such as vitamin C, iron, and magnesium, and about the most important food sources of these substances which were mentioned in the interview. In addition, nutrition information about which foods are particularly good for balancing out any potential deficits was also sent.

Short questionnaire

In addition to the dietary assessment tools described above, further information such as special dietary hab-

its, school catering, supplements, and consumption of specific foods such as raw ground meat and raw eggs was also collected in a short questionnaire as a computer-assisted interview. The questionnaire was completed by the parents of 6- to 11-year-olds after the food record instruction, and by the 12- to 17-year-olds immediately after the DISHES interview.

Non-responder questionnaire

Persons who were invited to participate but did not participate in EsKiMo II were asked by telephone or written questionnaire whether any of the following reasons for non-participation applied: "Absent at the time of the interview", "child acutely/chronically ill", "other family member acutely/chronically ill", "child undergoing treatment/in hospital at the time of the interview", "no time", "no interest/not convinced about the need for and purpose of the study", "worries about data protection", "too much effort (takes too long)", "never take part in surveys", "because of the funding organisation", "child does not want to/child is frightened/burdensome for the child", "child is healthy", "too many surveys", or "other reasons".

Comprehensive information from KiGGS Wave 2 is available regarding all participants invited to take part in EsKiMo II, meaning that it is possible to perform a detailed comparison of non-participants versus participants.

Practical execution

Training

Prior to the start of the field phase, the interviewers (four nutritionists) were trained in how to conduct the visits with the study participants. The content of the training included a general overview of both studies KiGGS and EsKiMo, as well as a presentation of and theoretical and practical introduction to the dietary assessment tools used. In addition, more detailed information was provided regarding the field execution of the study, how to act with participants, recruiting participants, arranging appointments by telephone, and the data protection and organizational aspects of the field phases of the study. Practical training was also performed: The instruction procedure on how to fill in the food records was practiced on RKI employees who have children aged 6 to 11 years and who voluntarily agreed to take part. In order to emulate realistic field conditions, four house visits were also organized with parents who have children in the target age group. Parents were instructed in how to fill in the food records and answered the short questionnaire regarding dietary habits. In addition, DISHES interviews were conducted with volunteers in order to establish an interview routine and to standardize the conduct of the interviews. These interviews were observed by the study coordinators so that a debriefing session could follow. During the debriefing, any questions raised and any ambiguities brought to light by the conduct of the interviews were addressed in order to achieve optimized, standardized procedures.

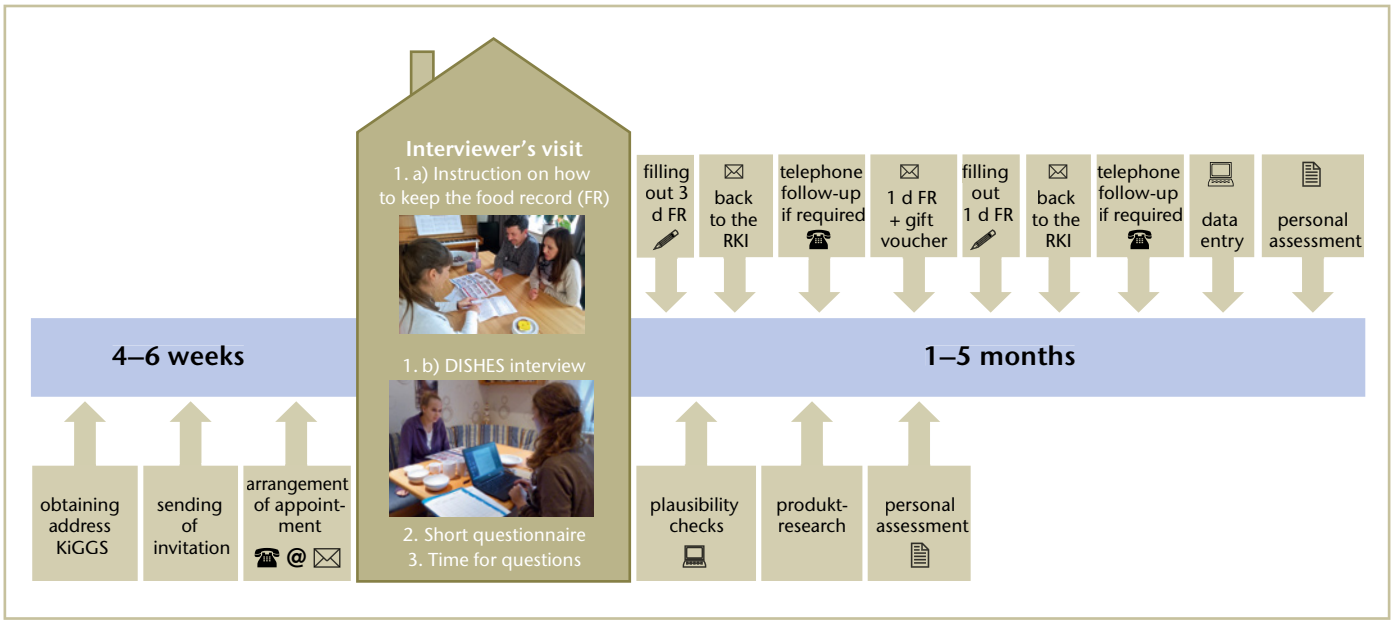


Fig. 2: **Schedule for each tour in the EsKiMo study**
d = day; DISHES = Dietary Interview Software for Health Examination Studies; FR = food record; KiGGS = German Health Interview and Examination Survey for Children and Adolescents [Studie zur Gesundheit von Kindern und Jugendlichen in Deutschland]; RKI = Robert Koch Institute

Subsequently, up until the start of the field phase, interviews were conducted with RKI employees and with adolescents within the target age group as further training.

Process of the field phase of EsKiMo II

◆ Figure 2 gives an overview of the process of EsKiMo II. During the field phase, which generally took place 3 to 6 months after KiGGS Wave 2, a total of 167 KiGGS sample points were visited once again in a total of 33 tours. During each tour, three interviewers visited one or two study locations each, and were on the road between 5 and 10 days. Interviews and instructions on how to use the food records also took place on Saturdays. The data collection period for each of the individual sample points was determined using a route plan. The invitations were sent out five weeks prior to the beginning of data collection. Those contained a cover letter addressed to the parents and a letter addressed to adolescents aged 12 years and above, as well as a flyer that provided information about the study, its contents, and its aims. In addition, a declaration of consent, complete with a return envelope was included with the invitation letter, and the recipient was asked to sign the declaration and send it back to the RKI. At the same time, the recipient was asked to provide up-to-date telephone numbers and suitable times to call to arrange an appointment. A data protection sheet was provided to inform the participants themselves and the parents or legal guardians about data protection issues.

Prior to each tour, appointments were arranged with the participants or their parents (or legal guardians), mostly by telephone. Generally, the appointments were conducted at the participant's home. If a home visit was not possible or not desired, the instructions or the interviews could also be conducted in the EsKiMo car. A total of 2.2% of the interviews took place in the car.

Documentation of the field phase

Personal data, such as addresses and telephone numbers, and study-specific data, such as attempts to arrange appointments and date agreements with the participants were documented in a database. In addition, other important information about the participants, such as completion of the dietary assessment, the appointments for the one-day food records, reasons for non-participation, and the creation of the personal nutritional assessment, was recorded. Standard letters were generated using the database and their dispatch was noted in the participant database.

Efforts to increase response and number of participants

Various measures were used to reach the target sample size of about 2,600 participants. In order to increase the number of participants, the interviewers were given follow-up training on telephone recruitment of participants, led by internal RKI experts. During the follow-up training, the existing guidelines for conversations and argumentation examples were discussed. In addition, the interviewers were given individual telephone coaching.

After about half of the data collection period had passed, the interviewers also contacted participants on site if no valid telephone number was available or if the participants could not be reached by telephone. This measure resulted in the recruitment of 15 additional participants.

Another measure that was used to increase the response was conducting the instructions for the weighted food records by telephone if it was not possible to arrange an appointment with the parents of the participants during the time in which the EsKiMo interviewers were on site. The required documentation and materials were sent by post in advance. Thanks to the telephone instruction measure, additional 109 participants were recruited.

During the final third of the data collection period, the invited sample size was increased. Originally, it was planned to only invite those who had taken part in the physical examination in KiGGS Wave 2 to take part in the EsKiMo study. However, this group of KiGGS participants was too small to achieve the target sample size. Therefore, those who only took part in the interview part of the KiGGS study were invited as well.

Quality assurance and data management

Immediately after each tour, a meeting between the interviewers and the coordinators took place in order to share experiences and clarify any problems. During the field phase, the field coordinator conducted regular visits in order to check the interviewers' approach, how they dealt with the participants, and whether they were conducting the interviews and providing the instructions correctly. Afterwards, the visits were evaluated with the interviewers.

Food records

Once the food records were received at the RKI, an initial check on their completeness and plausibility was performed. Any ambiguities, such as missing entries for amounts or inaccurate product details, were clarified by telephone, generally within one week after the food record was received by post.

Data entry of the information from the food records was performed by trained nutritionists in accordance with a standardized data entry manual. The data from the food records were coded using a software that was specially developed by Paderborn University (EAT version 5.3) using the German Nutrient Data Base version 3.02. The average time taken to enter the data of a complete food record (all four days) was two

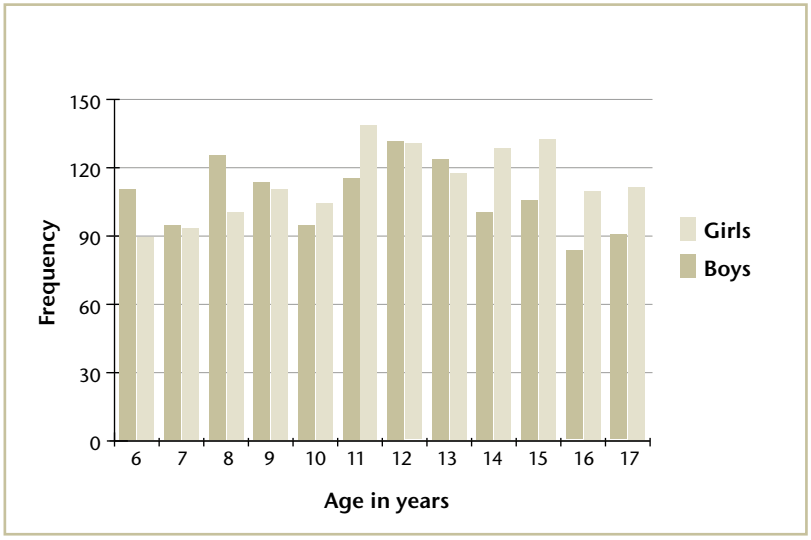


Fig. 3: **EsKiMo participants by age and sex**

hours. Problems with data capture, for example how to proceed on the coding of foods that were not included in the German Nutrient Data Base version 3.02, were documented and dealt with promptly.

In order to ensure the quality of the data entry from the food records, the coded data was checked by a second colleague by sampling and checking randomly selected weighted food records. In addition, the food records of 60 participants on individual, randomly selected record days were captured once again by a trained student assistant with a nutritional background. This second data capture procedure showed that there was a low rate of error in the initial data entry – 15 out of 975 codes (1.5%) required correction. After the entries were made, the nutritional data (amounts of particular foods, e.g. very high or very low beverage intake < 500 mL or > 3,000 mL per day, or energy intake < 1,000 kcal or > 2,500 kcal per day) and body size and body weight were checked for plausibility. In addition, the specified recipes were checked with regard to method of preparation, portion sizes, and the presence of cooking water or cooking liquids, and fats used for cooking or frying.

Nutrition interviews

Promptly after each tour, the data from the DISHES interviews were processed. The foods recorded in DISHES are coded according to German Nutrient Data Base version 3.02. During data processing, foods that were mentioned in the interview, but were not recorded in the program, were added. In addition to the tests for completeness that are already integrated into the DISHES software, various plausibility tests were conducted on the personal and consumption data from DISHES. For instance, very low or very high reported amounts of individual foods were checked because very high or very low total energy intake may indicate data entry errors. With the consent of the participants, a digital audio recording of the interview was made for quality assurance purposes. The audio files allowed post hoc checking of any data that appeared to be implausible. Regular listening to the audio files allowed systematic data entry errors to be detected. In addition, this allowed feedback on the quality of the interview to be given to the interviewers as well as measures for improvement of the standardization of the execution of the interview to be taken.

Participants and participation rate

A total of 4,534 children and adolescents (girls: N = 2,317; boys: N = 2,217) were invited to take part, of which 2,644 (girls: N = 1,361; boys: N = 1,283) were recruited for participation in EsKiMo II. Participants in EsKiMo II are those for whom at least one of the following is available: the DISHES interview, the food record, or the completed short questionnaire. A food record is available for 1,190 children, and a DISHES interview for 1,353 adolescents. The short questionnaire was answered by 2,641 participants. ◆Figure 3 shows participation by age and gender: participation was lowest among 6-year-old girls and 16- to 17-year-old boys, and it was highest among 11-year-old girls. 83 (1.8%) of those invited were classified as quality-neutral drop-outs because, for example, they had moved away to an unknown location, or communication with the participant or their parents was not possible due to language problems. After considering these cases, the participation rate was 59.4%. Information on the reasons for non-participation are available for 1,199 families who were invited to participate in EsKiMo II. About a third said they did not have time to participate in EsKiMo. Other common reasons given for non-participation included that it was too much effort, that the child did not want to take part, that those invited to participate were absent at the time of the interview, or that they had no interest in the study or were not convinced about the need for and purpose of the survey.

Utilisation of the results

The results of EsKiMo II will provide an up-to-date picture of the nutrition status of children and adolescents aged 6 to 17 living in Germany, and will help identify areas

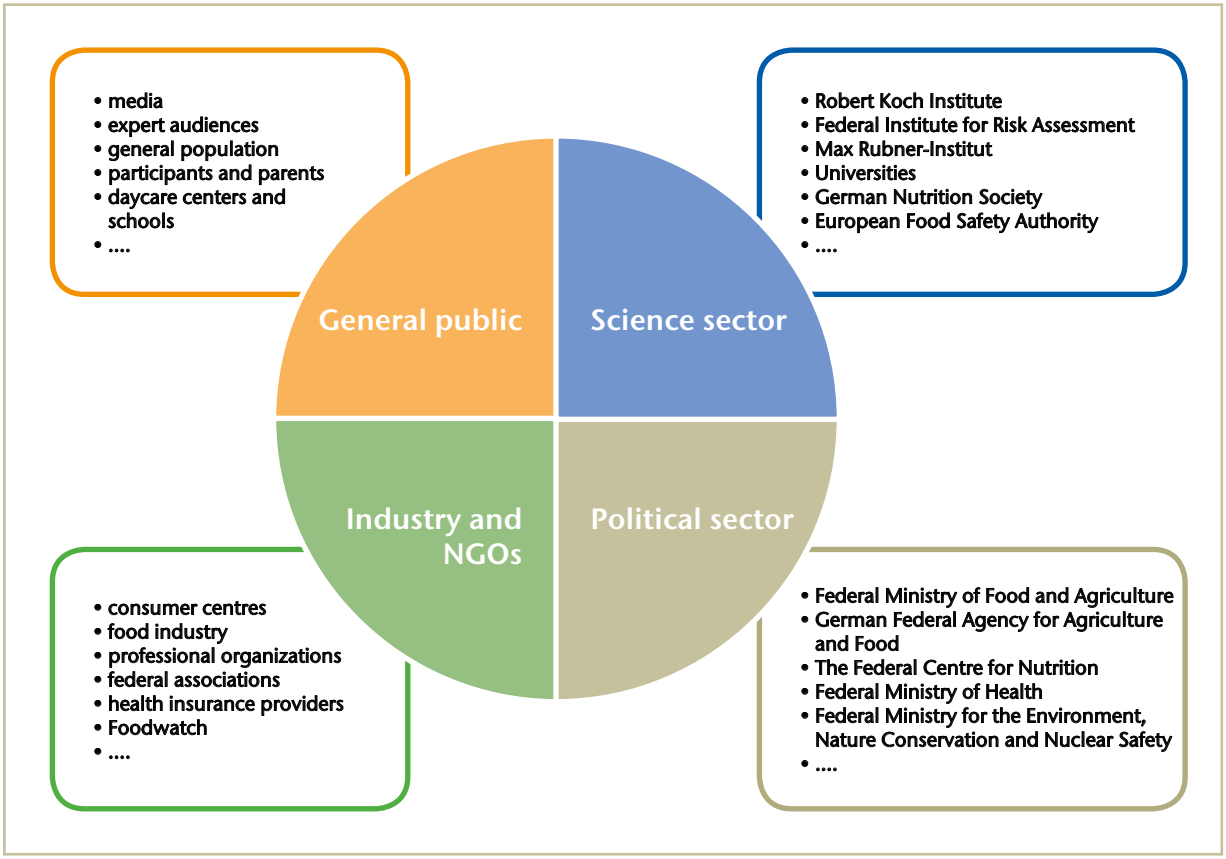


Fig. 4: **Stakeholders of the results of the EsKiMo study**

where dietary habits and nutrient intake are deficient compared to the recommendations of the German Nutrition Society. Therefore, the results will be an important source of information for politicians, economists, the general public, and other stakeholders such as health insurance providers (◆Figure 4). The results of the KiGGS baseline study and EsKiMo I have raised the public health policy relevance of nutrition, physical activity, and health issues, and various preventative measures, especially with the establishment of the action plan IN FORM, have been initiated and implemented as a result. By comparing the results of EsKiMo II with EsKiMo I it will be possible, for the first time, to perform comprehensive analyses of changes in dietary habits over the last 10 years in Germany.

Like other studies [18, 19], EsKiMo I has shown that consumption of fruit and vegetables is below the recommended levels. In particular, among the 6- to 11-year-olds, the recommended vegetable consumption was only reached by 6% of boys and 7% of girls, whereas in the group of 12- to 17-year-olds, it was reached by 18% of boys and 29% of girls. Most children and adolescents did not consume even half of the recommended amount. The data also showed that the consumption of sugar sweetened beverages, snacks, sweets, and meat and meat products was too high [10].

Since children are more and more spending all day in school or daycare, school meals have an increasing influence on dietary habits among children and adolescents. Therefore, school meals may offer an approach to improving the situation. In this context, the project *"Schule+Essen=Note 1"* ["School+Food=Grade A"] was initiated as part of IN FORM. This project supports schools in providing balanced menus. In addition, the German Nutrition Society Quality Standard for School Catering was published in 2007 and in 2008/09, networking centers for school catering were established in all German federal states with the aim of supporting schools in the development, implementation, and quality improvement of optimal catering [5, 20]. However, the standards are only recommendations. A nationwide survey of the quality of school catering conducted in 2014 showed that in recent years, the range of food available in many establishments has been expanded, the supply of beverages is satisfactory and the supply of free water has increased, for example through drinking water dispensers. However, other criteria of the German Nutrition Society Quality

Standard are still not being met. For example, meat and sausages occur on the menu too frequently and the recommended quantities of fruit and vegetables are far from being reached [5].

Against this backdrop the German Federal Ministry of Food and Agriculture established the National Quality Center for Nutrition in Daycare Centres and Schools as part of IN FORM at the beginning of 2016. In addition to the measures designed to tackle food in schools, IN FORM also focuses on measures to promote nutrition education in schools in particular [21]. Organizations such as consumer centers also use interactive learning programs, e.g. the *"Ess-Kult-Tour"* program [22], to provide interesting information on healthy enjoyment of food, food labeling, or nutrient requirements. The Prevention Act, which came into force in 2015, aims to strengthen the areas of health promotion and disease prevention, including measures to tackle nutrition-related diseases such as type 2 diabetes mellitus and obesity. Under this law, the activities of statutory health insurance funds are to be geared towards improving the living environment of daycare centers and schools. The status quo of nutrition among children and adolescents is an important source of information for the planning of appropriate measures [23].

The German Federal Ministry of Food and Agriculture is also currently working on other measures, such as a national strategy for the reduction of sugar, fats, and salt in convenience products. The introduction of a tax on sugar sweetened beverages [24] or a food traffic light system [25] – measures that the German Federal Ministry of Food and Agriculture has been critical of – are also frequently in focus in public discussions and media reports.

Outlook

The initial results of EsKiMo II will be published in the course of 2018. A comprehensive project report will be available by 2019. EsKiMo II makes it possible, for the very first time, to perform comprehensive analysis of changes in the dietary habits of children and adolescents in Germany over the last 10 years. The data could provide evidence as to whether specific measures have led to improvements, or whether there is a need for further action. This means that the results will lay the foundation for further decisions and measures in the fields of nutrition policy, consumer policy, and health policy.

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Conflict of Interest
The authors declare no conflict of interest.

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