

Prevalence of vegetarian diet among children and adolescents in Germany

Results from EsKiMo II

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Introduction

Vegetarian diet, defined as a diet that is mainly or exclusively plant-based (♦ Table 1), has increasingly become a focus of public attention in recent years. Various studies show that the proportion of persons following a vegetarian diet continues to increase, also among adolescents [1]. However, current data does not allow reliable quantification of trends about vegetarian diet [2], especially among children and adolescents [3].

According to the “German Health Interview and Examination Survey for Adults” (DEGS, 2008–2011), 4.3% of women and men usually follow a vegetarian diet, with the proportion being the highest among 18- to 29-year-olds [4]. Among youngsters aged between 3 and 17 who participated in the “German Health Interview and Examination Survey for Children and Adolescents” (KiGGS baseline survey 2003–2006), 1.7% of the boys and 3.2% of the girls followed a predominantly vegetarian diet [2].

The most important reasons for adults to follow a vegetarian diet consider ethical and moral, health, ecological, and religious aspects [5, 6]. These different motivations also play a role during childhood and adolescence [7]. In addition, many children and adolescents adapt their parents’ behavior or want to set themselves apart from their parents by adopting a predominantly vegetarian diet [8].

In general, a mainly vegetarian diet is associated with health benefits such as a lower risk for overweight, cardiovascular disease and type 2 diabetes [9]. However, it is often questioned whether a plant-based diet can provide all the nutrients needed. Generally, iron and vitamin D are among the most critical nutrients during childhood and adolescence. Deficiencies can lead to health consequences and damage, such as disorders in blood formation [10]. Adolescents following a vegetarian or vegan diet had better levels of vitamin C and

Abstract

Vegetarianism has increasingly been placed in the focus of public attention, especially in recent years. Ten years after the first “Eating study as a KiGGS Module” (EsKiMo; 2006) the second nutritional study – EsKiMo II (2015–2017) was carried out. A total of 3.4% vegetarians (1.5% among 6- to 11-year-olds; 5.1% among 12- to 17-year-olds) was identified. Compared to EsKiMo I, the number of vegetarians among adolescents has increased. Vegetarians are more often girls between 12 and 17 years, more likely to be students at an upper secondary school [*Gymnasium*] and to come from families with high economic status. They less frequently eat school meals, are more likely to use dietary supplements and to exercise more than 2 hours per week than non-vegetarians.

More detailed analyses of the nutrient intake and eating patterns of adolescents following a vegetarian diet could determine deficits associated with a vegetarian diet among children and adolescents and possibly identify actions required.

Keywords: vegetarians, EsKiMo II, children and adolescents, plant-based diet, eating habits

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Name	Avoids
Ovo-lacto vegetarian	meat and fish products
Lacto vegetarian	meat and fish products, eggs
Ovo vegetarian	meat, fish, and dairy products
Vegan	all foods derived from animals (meat, fish, milk, eggs, honey)

Tab. 1: Forms of vegetarianism (based on [4])

folic acid and a higher intake of dietary fiber, better blood lipid values and a lower risk of overweight [1]. Deficits were observed in the supply of vitamin B₁₂, zinc, calcium, iron, and vitamin D, although low values were also observed among non-vegetarians [1, 11].

According to the German Nutrition Society (DGE) a balanced and varied ovo-lacto vegetarian diet can meet the energy and nutrient requirements of children and adolescents. The total elimination of animal products from the diet is not recommended by the DGE as a permanent diet pattern for adolescents [12]. The American Academy of Nutrition and Dietetics, on the other hand, supports both vegetarian and vegan diets for children and adolescents. It is required that the diet is well planned and contains either vitamin B₁₂ fortified foods or dietary supplements [13].

There are only a few up-to-date publications about vegetarianism and its implications during childhood and adolescence [1].

The Eating study as a KiGGS Module EsKiMo II offers current information on specific nutritional patterns in children and adolescents, including vegetarian diets. The aim of the following assessments is to present the prevalence of vegetarian children and adolescents in Germany according to sociodemographic variables and differences in weight status and “other behavior patterns” (exercise activity, participation in school meals, and use of dietary supplements).

Methods

Study population

EsKiMo is a nationwide representative study about the dietary behavior of children and adolescents in Germany aged between 6 and 17, which was carried out as a module of KiGGS, the German Health Interview and Examination Survey for Children and Adolescents. EsKiMo I took place in 2006 in the course of the KiGGS baseline survey (2003–2006). Around 10 years later, a stratified, clustered, and randomized sub-group of the second follow-up survey of the KiGGS study, KiGGS Wave 2 (2014–2017) of 2,644 persons aged between 6 and 17 participated in EsKiMo II (2015–2017). A new random sample was taken for KiGGS Wave 2, which is representative for the 0- to 17-year-olds in Germany [14].

The participants of EsKiMo II were questioned about their dietary behavior and food consumption in 167 communities (sample points) in Germany. Great efforts were made during KiGGS

Wave 2 and EsKiMo II to ensure that samples were highly representative, including a broad involvement of national and local media, extensive contact and exchange of information with local multipliers. In addition, regional distribution and seasonality were also considered during the conduction of the studies.

EsKiMo II received a positive vote from the ethics committee of the Hannover Medical School and the Federal Commissioner for Data Protection and Freedom of Information. Before taking part on the survey, participants were informed of the study procedures and gave written informed consent.

The concept and design of EsKiMo II are described in detail elsewhere [15, 16].

Recording of specific dietary behavior

In addition to food intake assessment, information was also collected about general dietary behavioral aspects through a computer-assisted personal interview with the adolescents (12–17 years) and with the parents (or legal guardians) of the children (6–11 years). The questions concerned, amongst other things, participation in school meals, joint family meals and specific eating habits. It was recorded whether the children and adolescents followed a particular dietary pattern or diet. The possible answer included:

- vegan diet (exclusively plant-based food)
- vegetarian diet
- lactose-free diet
- gluten-free diet
- low phenylalanine diet
- low fructose/fructose-free diet
- other (with free text field)
- no specific diet

Multiple answers were possible.

For the subsequent analysis, the term “vegetarian diet” applies to all participants who stated following a vegetarian and/or vegan diet.

Other variables

Within the short interview from EsKiMo II, data was collected on the intake of dietary supplements (DS) in the last year (6- to 11-year-olds) or the last 4 weeks (12- to 17-year-olds), and also on the possibility and frequency of having a school meal. The reference periods for reporting DS intake were selected in order to enable an estimate of the usual nutrient intake through food and DS. Adolescents’ food intake over the last 4 weeks was obtained using a dietary history inter-

	Total	Girls	Boys
Determinants	% [95%-CI]	% [95%-CI]	% [95%-CI]
Age (years)			
6–11	1.4 [0.7–2.2]	1.5 [0.6–2.5]	1.3 [0.4–2.2]
12–17	5.0 [3.7–6.3]	8.1 [5.8–10.3]	2.2 [0.6–3.7]
Socioeconomic status of the family^a			
low	1.5 [0.0–3.4]	0.9 [0.0–2.8]	2.0 [0.0–5.4]
medium	3.4 [2.5–4.4]	5.3 [3.8–6.9]	1.6 [0.5–2.7]
high	4.6 [2.9–6.3]	7.3 [4.0–10.7]	2.3 [0.7–3.9]
Migration background			
Migrant	2.7 [0.5–4.8]	2.8 [0.7–4.9]	2.5 [0.0–6.5]
Non-migrant	3.5 [2.7–4.4]	5.6 [4.1–7.2]	1.6 [0.8–2.4]
Type of community (inh.)			
rural ($\leq 5,000$)	2.4 [1.0–3.7]	4.2 [1.7–56.6]	0.7 [0.0–1.5]
small ($5,000 < 20,000$)	2.9 [1.7–4.1]	5.0 [2.7–7.2]	0.9 [0.0–1.9]
medium ($20,000 < 100,000$)	2.8 [1.2–4.5]	3.4 [1.4–5.3]	2.3 [0.0–4.8]
large town ($\geq 100,000$)	4.8 [3.0–6.7]	7.2 [4.0–10.4]	2.7 [0.4–4.9]
School type			
primary school	1.1 [0.3–1.8]	1.1 [0.1–2.1]	1.0 [0.0–2.0]
lower secondary school	3.5 [1.8–5.2]	4.9 [2.4–7.4]	2.2 [0.0–4.7]
upper secondary school	6.5 [4.6–8.5]	10.6 [7.0–14.1]	2.4 [0.6–4.1]
other school types	3.5 [0.0–7.1]	2.9 [0.0–8.7]	3.9 [0.0–8.8]
BMI			
Underweight ($< 10^{\text{th}}$ percentile)	5.1 [2.5–7.7]	8.2 [3.7–12.7]	1.6 [0.0–3.8]
Normal weight	3.3 [2.4–4.1]	4.6 [3.3–5.9]	2.0 [0.8–3.2]
Overweight ($> 90^{\text{th}}$ percentile)	2.0 [0.1–4.0]	3.7 [0.0–7.7]	0.7 [0.0–2.0]

Tab. 2: Prevalence of vegetarians aged between 6 and 17 years according to sociodemographic characteristics and weight status (N = 2,641, weighted)

^a Index based on details from parents or guardians regarding their professional status, level of education, and net household income

BMI = Body-Mass-Index; inh. = inhabitants

view. For the children, weighted food records over a total of four days were used. In addition, the long-term use of DS was inquired using a computer-supported personal interview in order to estimate usual consumption from the current nutrient intake in the weight records [15, 16].

The body mass index (BMI) was calculated using information reported by legal guardians of the 6- to 11-year-olds and self-reported by the 12- to 17-year-olds. BMI was categorized based on the age and sex-specific percentiles from Kromeyer-Hauschild. A BMI value over the 90th percentile was defined as overweight (including obesity), under the 10th percentile as underweight [17].

Further information was obtained from the core data of KiGGS Wave 2. For calculation

of socioeconomic status (SES), an index was established based on the details given by parents or legal guardians about their professional status, level of education, and net household income, and this was divided into three categories (low, medium, high) [18].

The additional information from KiGGS Wave 2 are type of school (primary education; lower secondary education [*Hauptschule/Realschule/Gesamtschule*]; upper secondary education [*Gymnasium*]; other education), size of the community (rural $\leq 5,000$ inhabitants, small $5,000 < 20,000$ inhabitants, medium $20,000 < 100,000$ inhabitants, large town $\geq 100,000$ inhabitants) and migration background (migrant, non-migrant). Details about physical activity were taken from the KiGGS self-reported questionnaire (not active, ≤ 2 hours/week and > 2 hours/week).

Statistical methods

The analysis is based on 2,641 adolescents, for whom data from EsKiMo II was available. Three adolescents without corresponding short interview information were excluded.

The prevalence of adolescents following a vegetarian diet is presented below in percentage with a 95%-confidence interval (CI) according to selected determinants.

It is assumed that there is a statistically significant difference between the determinants' categories and between girls and boys if the associated CIs do not overlap. In this process, a weighting factor was used to take into account deviations from the population structure regarding age, sex, federal state (as of: 31.12.2015), nationality (as of: 31.12.2014) and education level of the parents (Microcensus 2013 [19]) as well as differences in participation according to seasonality, SES of the family, and school type attended by the child. The statistical analysis was carried out using the survey procedures of SAS version 9.4 (SAS Institute, Cary, NC/USA), taking the cluster design of the sample into account.

Results

Overall, a total of 3.3% of children and adolescents in Germany follow a vegetarian diet; 0.1% ($n = 3$) follow a vegan diet. Among girls, the proportion of following a vegetarian diet is significantly higher than among boys (♦ Figure 1).

♦ Table 2 shows the distribution of a vegetarian diet according to sociodemographic characteristics and weight status. In the 12- to 17-year age group, the proportion is significantly higher at 5.0% than in the 6- to 11-year age group (1.4%). The proportion of adolescents following a vegetarian diet tends to increase with increasing SES, but not significantly: 4.6% of children and adolescents from families with high SES, 3.4% from families with medium SES, and 1.5% from families with low SES. There is a larger proportion of vegetarians among the upper secondary school [*Gymnasium*] students (6.5%) than among the students from lower secondary school types [*Haupt-/Real-/Gesamtschule*] (3.5%); this difference is, however, also not significant.

A comparison between community sizes shows a higher proportion of vegetarian children and adolescents in larger cities (4.8%) than in smaller communities. The proportion of vegetarians does not differ according to migration background or weight status.

Compared to non-vegetarians, children and

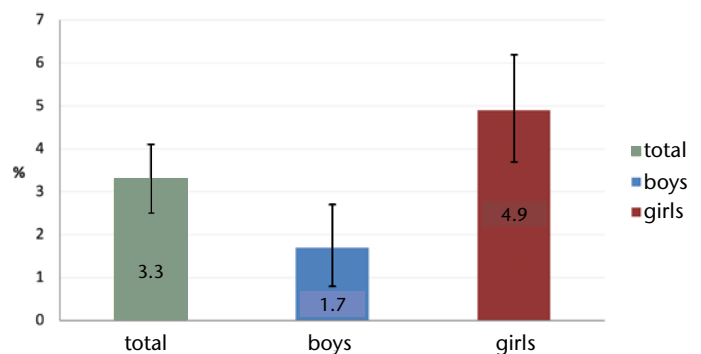


Fig. 1: Proportion of vegetarians aged between 6 and 17 years according to sex and 95%-confidence interval, weighted

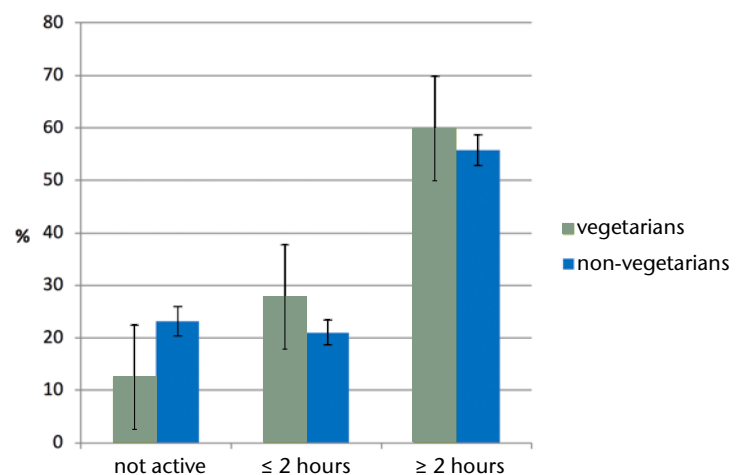


Fig. 2: Differences in exercise activity between vegetarians and non-vegetarians per week
Prevalence in percent and 95%-confidence interval, weighted

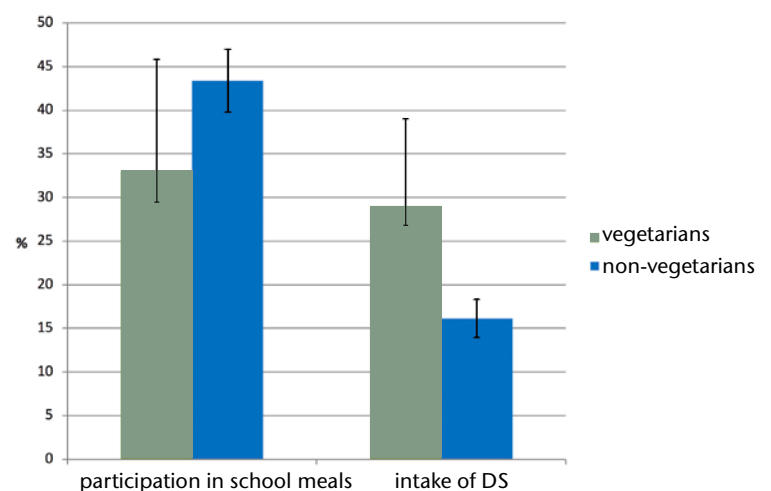


Fig. 3: Differences in behavior (participation in school meals and intake of dietary supplements [DS]) between vegetarians and non-vegetarians
Prevalence in percent and 95%-confidence interval, weighted

adolescents following a vegetarian diet are more often physically active for at least 2 hours or more per week (♦ Figure 2).

33.3% of vegetarians and 43.4% of non-vegetarians have a warm lunch at school, yet this difference is not significant.

Significantly higher is the proportion of vegetarian adolescents who take dietary supplements, such as vitamin or multi vitamin supplements: almost twice as many compared to non-vegetarians (29.4% versus 16.2%) (♦ Figure 3).

Discussion

In EsKiMo II, it was observed that 3.3% of children and adolescents in Germany follow a vegetarian diet: 1.4% of 6- to 11-year-olds and 5.0% of 12- to 17-year-olds. In EsKiMo I, there was a prevalence of 1.6% vegetarians amongst the 12- to 17-year-olds (not enquired for younger children in EsKiMo I) [20]. The prevalence of vegetarians among adolescents has, thus, increased over the last 10 years [20]. However, it must be taken into account that the formulation of the question about a specific dietary behavior differs in the two surveys. In EsKiMo I, the 12- to 17-year-olds were asked whether they generally did not eat certain food items. A vegetarian diet was then defined if the adolescents reported that they did not eat meat, poultry, sausage, and fish. A vegan diet was not analyzed separately.

The significantly higher proportion of girls amongst the vegetarians shown in EsKiMo II was also observed in other studies [4, 21]. Girls or, more generally, women are also more likely to follow a more health conscious diet than boys or men [21]. This may be one of the reasons to follow a vegetarian diet.

The proportion of vegetarians among adolescents is considerably higher than among children. At a younger age, diet is mainly determined by the family or legal guardians, whereas adolescents during puberty want to differentiate themselves from their family, develop their own personal identity or align themselves towards friends or trends [22].

The prevalence of vegetarians is higher in larger cities, as also described in the KiGGS baseline survey [2]. Several factors could play a role here: usually, the level of education is

higher in larger cities than in smaller towns or rural areas, which is, in turn, associated with a higher prevalence of vegetarians [23]. Furthermore, higher demand leads to a greater offer, so there is a better “vegetarian infrastructure” with a greater variety of foods and more vegetarian restaurants to be found in medium and large cities in Germany [24].

The proportion of vegetarians is higher among adolescents from families with high SES, but not significantly. This correlation is also described in the existing literature, also regarding adults [4, 25].

No statistically significant differences could be observed in the prevalence of vegetarian diet in relation to weight status among children and adolescents. The proportion of vegetarians, however, tended to be slightly higher in the lower BMI category. A predominantly plant-based diet is associated, among other things, with a lower risk of obesity and is discussed to be a prevention measure for obesity [1].

The proportion of children and young people following a vegetarian diet who do not have a warm lunch at school is almost 10% higher compared to non-vegetarians, however, this difference is not significant due to the large variation. The DGE published the DGE Quality Standards for school meals in 2007, in which it is recommended that one meal option per day should be ovo-lacto vegetarian [26]. A study in Saarland shows that only one out of five interrogated schools surveyed implements the recommended criterion of offering one vegetarian option each day [27]. The lack of vegetarian options could be one reason for the lower intake of school meals amongst vegetarians and indicates an improvement possibility.

The significantly higher proportion of vegetarians taking dietary supplements compared to non-vegetarians could be due to a higher health consciousness or to the purpose of balancing possible nutrient intake deficiencies due to a vegetarian diet. A connection between vegetarian diet and higher DS intake, particularly among vegetarian girls, was also observed in other studies [22, 28]. Especially in vegan diets, the abstention of taking vitamin B₁₂ supplements is to be seen critically [29].

The proportion of children and adolescents following a vegetarian diet who are more physically active is higher than among non-vegetarians. A vegetarian diet is also associated with higher levels of physical activity among adults [4]. There were no differences observed between the proportion of vegetarians and the particular BMI groups. Adolescents following a vegetarian diet generally show normal anthropometric values [1].

Strengths and limitations

The strengths of EsKiMo II include the broad information basis and the representativeness of the data of children and adolescents between the ages of 6 and 17 years in Germany. The weighted data enables population-representative statements to be made about the dietary behavior of children and adolescents in Germany.

The cross-sectional design of the study can be a limitation for certain analysis: among other things, no direct causality can be derived from the observed correlations. A possible selection bias is the previous participation in the KiGGS survey. People with a higher interest in nutrition and health show a higher willingness to participate in studies about nutrition [30]. This could mean that the prevalence of vegetarians is higher than in the total population. However, according to initial calculations from KiGGS Wave 2, this prevalence is actually slightly higher.

Conclusion

Vegetarian diet is not just a trend, but rather a lifestyle concept. The number of vegetarians in Germany has increased in recent years according to various sources [4, 24], also among adolescents. However, there are relatively few current studies about a vegetarian diet during childhood and adolescence.

In general, there are indications of differences in various behavior patterns of adolescents following a vegetarian diet compared to non-vegetarians. More detailed evaluations about nutrient intake and eating patterns among adolescents could provide further differences, e.g. in dietary behavior or in the differences in the health status of vegetarian and non-vegetarian children and adolescents in Germany. Possible deficiencies associated with a vegetarian diet could be identified and, hence, possible needs for action may be derived.

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Conflict of Interest

The authors declare to have no conflict of interest.

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