Nutritional behavior of sports students in Karlsruhe

An empirical study on dietary patterns, nutritional motives, and self-perceived physical-sporting performance

Hannah Zimmermann, Annelie Speckmaier, Karin Bergmann, Klaus Bös

Abstract

Increasingly, people are choosing a vegan or vegetarian diet for ethical, health, or environmental reasons. The growing number of individuals following alternative dietary styles necessitates a more precise scientific examination of the potential and expected impacts on health and athletic performance. This pilot study is the first to investigate omnivorous, vegetarian, and vegan diets among sports students at the Karlsruhe university location and includes the participants' self-perceived physical-sporting performance (spsp). Based on 206 fully completed online questionnaires collected between 22.12.2022 and 26.01.2023, data were evaluated descriptively across all three groups and comparatively analyzed between omnivorous and vegetarian students using three-factor variance analyses. The results reveal differences between the groups in sample characteristics, nutritional motives, and spsp. Furthermore, the study highlights gender-specific variations in dietary and sports practices among sports students. These findings need to be analyzed in more detail in follow-up studies and should be taken into account in professional nutritional counseling and information for young adults.

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Introduction

A plant-based diet is recommended in food-based dietary guidelines by national and international professional institutions [1–3]. This is defined as a diet "that consists mainly or almost entirely of plant-based foods" [4]. In veganism, only plant-based foods are consumed, while the proportion of animal products increases from vegetarian to flexitarian to omnivorous diets. Vegetarians largely avoid fish and meat, whereas flexitarians consume them only occasionally compared to omnivores [5]. Although vegetarianism and veganism have become firmly established diets in Germany, there is a lack of scientific data on the specific health expectations of student athletes in relation to these diets, including the desired improvements in performance.

Sports students are particularly well positioned to reflect the attitudes and expectations of health-conscious young people. Health, physical and mental performance, as well as environmental protection are generally important reasons for switching from an omnivorous to a flexitarian, vegetarian, or vegan diet. Adherents of the omnivorous diet – hereinafter referred to as omnivores – are not necessarily indifferent to environmental protection concerns. However, different weightings of reasons seem to shape individual dietary behavior [6].

Comparative knowledge between omnivorous, vegetarian, and vegan sports students can be useful in two ways: On the one hand, professional nutritional counseling can support sports students with targeted recommendations more specifically. On the other hand,

the role model function that sports students have for other young adults can be specifically utilized in counseling work.

Current state of research

Population-representative surveys indicate that the proportion of people who identify with a vegetarian or vegan diet has increased in recent years. The Nuremberg Society for Consumer Research (GfK) published the first data on the number of vegetarians in Germany around 1983. At that time, the proportion of vegetarians was 0.6% of the German population [7]. About 40 years later, the Federal Ministry of Food and Agriculture (BMEL) estimates the number of vegetarians at 8% of the population and vegans at 2% [6].

The existing differences in how respondents understand and use the terms flexitarian, vegetarian (in various forms), and vegan could not be resolved by previous clear conceptual distinctions. This is problematic both for describing the state of research and for the semantic design of survey methods. As a result, some statements, for example about the proportion of vegetarians, cannot be clearly interpreted [5]. A new definition approach to plant-based nutrition represents the currently very different use of the term and proposes a definition [8]. It is being discussed in the professional community but has yet to be established in survey methodology.

Considering gender affiliation, women are more likely to follow a vegetarian or vegan diet than men. Previous surveys show a significant overrepresentation of young people in terms of meat-free diets [9].

A central subject of sports science research is physical-sporting performance (psp). This is understood as "the unity of execution and outcome of a sporting action or a complex sequence of actions, measured or evaluated in relation to certain social norms" [10]. A sporting performance can succeed or fail and can be evaluated on a scale of difficulty and compared with other performances. The athlete's performance can be improved and subsequently rated higher by assigning a higher rank or difficulty level compared to other or previous performances [11].

Nutrition as a lever for physiological readiness has particularly great potential, as it influences the anatomical and physiological conditions of the human body, especially body composition and physiological processes. Thus, nutrition can significantly influence psp, which in turn determines the outcome, the sporting performance [12–13]. The International Olympic Committee (IOC) has highlighted the significant impact of nutrition on athletic performance in its recent publications, particularly since the publication of the consensus report on "Relative Energy Deficiency in Sport" (REDs) in 2023 [14].

Individual energy and nutrient needs are determined by many factors, including age, gender, body weight, body composition, nutritional status, health status, and physical activity [15]. Physical activity, in particular, as a flexible component that can be consciously influenced, can vary greatly [15]. Athletes generally have higher activity levels than the average population due to their different training and competition loads, which can vary in duration and intensity. This often results in an increased need for energy and nutrients [16–17].

The current scientific data on sports nutrition does not support vegetarian or vegan diets as a means of enhancing athletic performance [18–21]. However, there is evidence that a well-planned vegetarian and vegan diet does not negatively affect athletic performance compared to omnivorous diets and can therefore lead to at least equal performance [22–25].

Objectives and research questions

The guiding interest of this study builds on these data by first capturing the dietary behavior of sports students in a differentiated manner, based on sociodemographic, health, and physical-sporting aspects. Secondly, expectations, attitudes, and action options regarding their own dietary and performance optimization are to be described.

The evaluation is divided into two parts. In the first part of the evaluation, vegetarians and omnivores are analyzed, and differences are identified considering gender and performance level (see Methodology). The following three research questions are considered in detail:

1. Do vegetarians and omnivores differ in terms of selected sample characteristics (gender, living situation, Body Mass Index [BMI])?
2. Do vegetarians and omnivores differ…
   a. … in their perception of various aspects of dietary pattern?
   b. … in their reasons for their dietary pattern?
   c. … in their intentions to change their behavior regarding their dietary pattern?
3. Do vegetarians and omnivores differ…
   a. … in terms of physical-sporting activity?
   b. … in terms of self-perceived physical-sporting performance (spsp)?

In the second part of the evaluation, the sample of vegan students is described concerning selected parameters.

Methodology

Sample

The target group of this study was sports students at the Karlsruhe university location. In Karlsruhe, a total of 1,017 people study sports at the University of Education (PH) and the Karlsruhe Institute of Technology (KIT). All sample numbers (n) presented below are listed in ◆ Table e1 in the eSupplement. The invitation to participate in this study and to complete the questionnaire was sent via the mailing lists of sports students at PH and KIT [26]. A total of 257 students participated in the survey, with 206 questionnaires fully completed. This corresponds to approximately 20% of the total sports students in Karlsruhe.

More women (60.2%) than men (39.8%) participated in the survey. 131 (63.6%) of the respondents were from KIT and 75 (36.4%) from PH. The students were on average 23 years old (SD = 2.82). 110 (53.4%) were enrolled in bachelor's programs and 96 (46.6%) in master's programs. Four people (1.9%) were classified as underweight (BMI < 18.50 kg/m²) according to the WHO definition, 182 (87.9%) as normal weight (BMI 18.50–24.99 kg/m²), 21 (10.2%) as overweight (BMI > 25.00 kg/m²), of which two (1%) were obese (BMI > 29.99 kg/m²) [27]. 95 (46.1%) lived in a shared apartment or dormitory, 53 (25.7%) lived at home with their family, 50 (24.3%) lived with their partner, and eight (3.9%) lived alone. Of the 206 students in the survey sample, 102 (49.5%) followed an omnivorous diet, 71 (34.5%) were vegetarians, 14 (6.8%) were pescatarians, and 12 (5.8%) were vegans. The group of pescatarians was included with the vegetarians for further analysis. Another seven people (3.4%) could not be assigned to any of the mentioned groups and indicated "Other". From the descriptions of dietary forms (e.g., "I eat very little meat and fish, so mostly vegetarian but not completely"), four people were assigned to the vegetarians. One person indicated that they do not consume fish products but eat all other foods. This person was therefore assigned to the omnivores. Two people could not be assigned to any dietary pattern and were eliminated from further calculations.

All respondents (sports students) engage in sports, 118 (57.3%) at a recreational level and 88 (43.7%) at a competitive or performance level. On average the respondents train twice a week outside their sports studies. The most practiced sports are team sports (N = 113; 54.9%), followed by strength training (N = 90; 43.5%) and endurance sports (N = 72; 35%). Almost all respondents rated their own fitness as good to very good. A short version of the psp self-assessment questionnaire (FFB Mot) was used as a scale [28]. On average, the respondents achieved a score of 4.15 (standard deviation [SD] = 0.50) on the five-point scale (1 = very poor; 5 = very good).

Questionnaire

Due to the lack of published questionnaires, a custom questionnaire was developed for this study and tested for comprehensibility and acceptance in pilot studies. Participants were asked about their sports and dietary styles. For self-perception of their dietary pattern, they could choose from the options "vegetarian", "omnivore", "vegan", "pescatarian", and "other". The online questionnaire comprised a total of 28 questions regarding (1) the type of sport practiced, (2) the type of diet, (3) motivation and reasons for their dietary pattern, (4) intentions to change behavior, (5) self-perceived physical-sporting performance (spsp), and (6) socio-demographic characteristics (gender, BMI, living situation) required for the study or evaluation design. Completing the questionnaire took about ten minutes. The complete questionnaire is presented in ◆ Table e2 in the eSupplement.

Analysis Methods

The survey data were statistically analyzed using the SPSS program (IBM SPSS, Version 29.0, Armonk, NY, USA). For the descriptive analysis, mean values (MV), standard deviations (SD), and percentiles were considered. To investigate group differences, chi-square tests (χ^2) and three-factor variance analyses were conducted, considering the factors dietary style (vegetarian, omnivorous), gender (male, female), and performance level (recreational, competitive). This aims to detail the target group characteristics. A significance level of 0.05 was set for the statistical analysis. Eta-square (η^2) was used to determine the effect size.

To keep the presentation clear for readers, the complete result tables with all descriptive statistics and F-values for the three-factor variance analyses are documented in ◆ Tables e3–e8 in the eSupplement.

In the manuscript, the presentation is reduced to the central main effect (comparison of vegetarians and omnivores). If there are other significant main effects or interactions between the considered group characteristics (factors), these are discussed in the text.

Results

In the first part of the results, the differences between vegetarians and omnivores regarding their dietary style, physical activity, and self-perceived physical-sporting performance (spsp) are elaborated. As in other studies, the population of vegans in the present sample was low (5.8%). Nevertheless, these are described in the second part of the results concerning selected parameters (see also [26]).

Comparison of omnivores and vegetarians

Sample characteristics

In the sample, it was found that female students were significantly more likely to follow a vegetarian diet (57.8%), than male students (28.9%) ($\chi^2(1) = 15.33$; $p < 0.001$; Cramér's V[1] = 0.28).

More than half of the vegetarians (55.1%) live in a dormitory or shared apartment, 25.8% live with a partner. Only 15.7% live with their family, and 3.4% live alone. In contrast, among omnivores, only 41.7% live in a dormitory or shared apartment. 34.0% live with their family, 20.4% with a partner, and 3.9% live alone ($\chi^2(3) = 8.65$; $p = 0.034$; Cramér's V = 0.21).

Among vegetarians, only 2.2% have a BMI over 25 kg/m², while it is 18.0% among omnivores. Overall, vegetarians in the present sample have a significantly lower BMI (MV = 21.66 kg/m²; SD = 1.68) compared to omnivores (MV = 23.09 kg/m²; SD = 3.22), ($F(1, 190) = 14.31$; $p < 0.001$; $\eta^2 = 0.07$).

Nutritional motives

Aspects of dietary pattern

To assess the importance of various aspects of their current dietary style, participants were asked: "Which aspects of nutrition are important to you?". On a five-point Likert scale (1 = not important at all to 5 = very important), they could rate the aspects "healthy diet", "balanced diet", "conscious diet", and "ecologically sustainable diet". The scale values for all four aspects ranged from 4.09 (SD = 0.79) (balanced diet) to 3.42 (SD = 0.94) (ecologically sustainable diet).

Vegetarians rate all four aspects as more important compared to omnivores, with the differences being significant except for the balanced diet (◆ Figure 1). The difference is particularly pronounced in the aspect of ecologically sustainable diet ($F(1, 184) = 11.05$; $p = 0.001$; $\eta^2 = 0.06$).

Gender differences are evident in the balanced diet, with female students considering this aspect (w = 4.24 vs. m = 3.86) as particularly important ($F(1, 184) = 7.56$; $p = 0.007$; $\eta^2 = 0.04$). Female students also place greater importance on the other aspects. Additionally, there are significant interactions between gender and performance level in the aspects of balanced and ecologically sustainable diet. Recreational female athletes consider these aspects more important compared to competitive female athletes, while the trend is reversed for male students: competitive male athletes consider these aspects more important compared to recreational male athletes (balanced diet: $F(1, 184) = 3.69$; $p = 0.056$; $\eta^2 = 0.02$; ecologically sustainable diet: $F(1, 184) = 8.54$; $p = 0.004$; $\eta^2 = 0.04$).

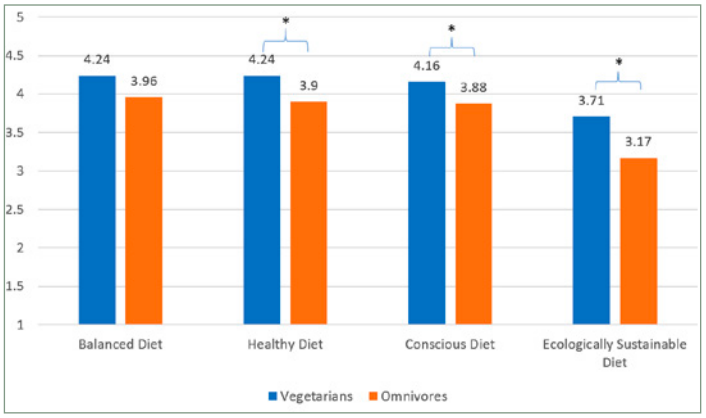

Fig. 1: **Comparison of mean values between vegetarians and omnivores regarding various aspects of dietary pattern**
Response scale: 1 = completely unimportant to 5 = very important
Significant differences are marked with an asterisk (*).

Dietary motives

Participants were given nine predefined aspects as motives for their current dietary pattern, which they could select. Multiple responses were possible. The results show that taste preferences (58.3%) and health reasons (57.8%) are the most frequently mentioned. Other significant reasons include ecology/sustainability (47.4%), animal welfare (43.2%), social environment (41.7%), and performance improvement (37.5%). Few to none of the respondents selected weight loss (7.3%), diet (0.5%), or religion (0.0%) as a reason. Additionally, it was pos-

[1] Measure of the strength of the correlation between two variables (V = 0.1: small effect; V = 0.3: medium effect; V = 0.5: large effect)

sible to specify other reasons under "Other". Cultural reasons and stress were mentioned as additional reasons for an omnivorous diet. Financial reasons also play a role in a vegetarian diet (mentioned by three people).

Significant differences between vegetarians and omnivores are evident in animal welfare (68.5% vegetarians vs. 21.4% omnivores) and ecology/sustainability (75.3% vegetarians vs. 23.3% omnivores) (◆ Figure 2). Both motives are more frequently chosen by vegetarians (animal welfare: $F(1, 184) = 48.21$; $p < 0.001$; $\eta^2 = 0.21$; ecology/sustainability: $F(1, 184) = 61.78$; $p < 0.001$; $\eta^2 = 0.25$).

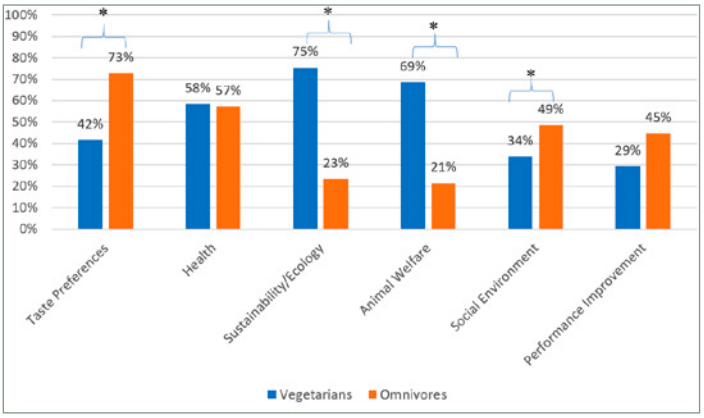

Fig. 2: **Comparison of vegetarians and omnivores regarding the motives for their dietary style[2]**
Significant differences are marked with an asterisk (*).

For taste (41.6% vegetarians vs. 72.8% omnivores) and social environment (33.7% vegetarians vs. 48.5% omnivores), there are significant differences between vegetarians and omnivores, as these were significantly more frequently chosen by omnivores (taste reasons: $F(1, 184) = 26.46$; $p < 0.001$; $\eta^2 = 0.13$; social environment: $F(1, 184) = 4.35$; $p = 0.038$; $\eta^2 = 0.02$). There are no significant differences between vegetarians and omnivores for health (58.4% vs. 57.3%) and performance improvement (29.2% vegetarians vs. 44.7% omnivores). However, there is a trend indicating that performance improvement is of greater importance for omnivores.

For the variables gender and performance level, significant differences were found only in the aspects "taste preferences" and "animal welfare": Female participants chose the motive "taste preferences" more frequently than male participants (62.1% female vs. 52.6% male; $F(1, 184) = 7.69$; $p = 0.006$; $\eta^2 = 0.04$). For the aspect "animal welfare", it was found that recreational athletes chose this more frequently than competitive athletes (50.0% recreational athletes vs. 34.1% competitive athletes; $F(1, 184) = 4.25$; $p = 0.041$; $\eta^2 = 0.02$). For the reason "performance improvement", there is a significant interaction "gender x performance level" ($F(1, 184) = 6.76$; $p = 0.010$; $\eta^2 = 0.04$). In competitive sports, performance improvement seems to be equally relevant for both genders (50.0% male vs. 40.9% female), while in recreational sports, performance improvement plays a stronger role for male athletes (60.5% male vs. 16.7% female).

Intentions for behavioral change

Participants were also asked whether they are considering adjusting their consumption in various food groups (fish, meat, fruits and vegetables, animal products) in the future. The response options included "eat less", "change nothing", and "eat more". Both omnivores and those who prefer a vegetarian diet expressed a desire to consume less meat in the future.

Among vegetarians, 6.7% indicated that they want to consume less meat in the future. Among omnivores, 25.2% aim to reduce their meat consumption ($F(1, 184) = 10.95$; $p = 0.001$; $\eta^2 = 0.06$). Regarding the consumption of animal products (e.g., eggs and dairy products), 27.0% of vegetarians plan to reduce this in the future, while 13.6% of omnivores intend to do so (difference not significant). Both groups show a tendency to increase their consumption of fruits and vegetables in the future: 32.6% of vegetarians and 37.9% of omnivores intend to increase their consumption (difference not significant). For fish, 4.5% of vegetarians plan to consume less, while 11.7% of omnivores indicate they want to increase their fish consumption (difference not significant).

[2] The three reasons mentioned by less than 10% of respondents are not further presented.

Sporting activity and self-perceived physical sporting performance (spsp)

Sporting activity

Regarding their sporting activity, participants were asked about the type of sport(s) they currently practice. Multiple responses were possible, and they could choose between the categories endurance, strength, team, and combat sports. The most frequently mentioned were team sports (56.3%), followed by strength (42.2%), endurance (33.3%), and combat sports (3.1%). It was found that endurance athletes are significantly more likely to follow a vegetarian diet compared to an omnivorous diet ($F(1, 184) = 4.34$; $p = 0.039$; $\eta^2 = 0.02$) (◆ Figure 3).

There is also a significant difference between recreational and competitive athletes (definition according to the questionnaire, see ◆ Table e2 in the eSupplement). While more recreational athletes are active in endurance and strength sports, there are more competitive athletes in team sports (endurance sports: $F(1, 184) = 4.15$; $p = 0.043$; $\eta^2 = 0.02$; strength sports: $F(1, 184) = 6.10$; $p = 0.014$; $\eta^2 = 0.03$; team sports: $F(1, 184) = 15.79$; $p < 0.001$; $\eta^2 = 0.08$). There is a gender-specific difference in team sports, with significantly more male (73.7%) than female students (44.8%) being active ($F(1, 184) = 9.30$; $p = 0.003$; $\eta^2 = 0.05$).

On average, respondents train twice a week. There is no significant difference between vegetarians (MV = 2.36; SD = 2.10) and omnivores (MV = 2.12; SD = 1.85) ($F(1, 184) = 2.39$; $p = 0.124$; $\eta^2 = 0.01$). Not surprisingly, competitive athletes (MV = 2.86; SD = 2.03) train significantly more frequently than recreational athletes (MV = 1.82; SD = 1.88) ($F(1, 184) = 12.84$; $p < 0.001$; $\eta^2 = 0.07$).

Self-perceived physical-sporting performance (spsp)

Participants were asked to position themselves on various statements (1 = I absolutely don't agree to 5 = I completely agree). Statements were given for the dimensions of endurance, strength, coordination, and flexibility. Among the respondents, both vegetarians and omnivores consider themselves physically fit (vegetarians: MV = 4.16; SD = 0.57; omnivores: MV = 4.10; SD = 0.44). A significant difference is evident in the endurance dimension. Vegetarians rate themselves as having greater endurance than omnivores ($F(1, 184) = 5.37$; $p = 0.022$; $\eta^2 = 0.03$). Since endurance athletes in this sample are more likely to follow a vegetarian diet, the individual sports were examined more closely. Both strength athletes ($F(1, 73) = 6.12$; $p = 0.016$; $\eta^2 = 0.08$) and combat athletes ($F(1, 2) = 30.00$; $p = 0.032$; $\eta^2 = 0.93$) rate themselves as having significantly greater endurance compared to omnivores.

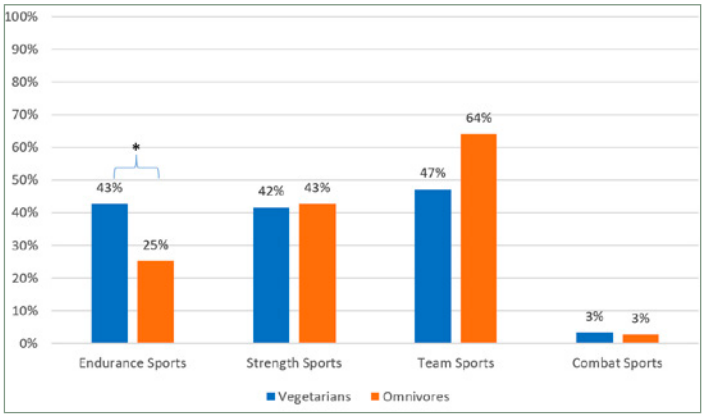

Fig. 3: **Comparison of vegetarians and omnivores regarding the types of sports practiced**
Significant differences are marked with an asterisk (*).

Gender-specific differences are found in the dimensions of endurance, strength, coordination, and flexibility. Male students rate themselves as having greater endurance ($F(1, 184) = 23.10$; $p < 0.001$; $\eta^2 = 0.11$) and strength ($F(1, 184) = 33.20$; $p < 0.001$; $\eta^2 = 0.15$), while female students rate themselves as having better coordination ($F(1, 184) = 4.57$; $p = 0.034$; $\eta^2 = 0.02$) and flexibility ($F(1, 184) = 21.09$; $p < 0.001$; $\eta^2 = 0.10$).

Description of vegan students

A total of twelve vegans (5.8% of the sample; six women, six men) participated in the survey. Eight out of twelve reported following a vegan diet for less than five years (66.7 %), while the other three individuals indicated practicing this dietary style for five to nine years (33.3%). Most vegans live either with a partner (41.7%) or with their family (33.3%), while few live in a shared apartment or alone (16.7% and 8.3%, respectively). The sample of vegans is of normal weight, with only one person having a BMI over 25 kg/m².

Vegans are strongly convinced of their dietary pattern. For 83.3%, a meat- and fish-free diet is very important. A healthy diet is considered very important by 58.3%, while 33.3% regard an ecologically sustainable diet as very important.
The decision for a vegan dietary pattern is influenced by various motives. Animal welfare is mentioned by all (100%), followed by sustainability/ecology (91.0%) and health (83.3%). Performance improvement also plays a role (41.7%), while social or taste reasons are less important (16.7% and 8.3%, respectively). Religion, weight loss, or diet are not mentioned as motives (0.0%).
Regarding intentions for behavioral change, vegans are determined to continue avoiding meat, fish, and animal products in the future. Two participants aim to increase their consumption of fruits and vegetables (16.7%).
In terms of sporting activities, most respondents report engaging in strength training (66.7%), followed by endurance sports (50.0%), team sports (41.7%), and combat sports (16.7%).
Half of the respondents train three to four times a week (50.0%). 33.3% train one to two times a week. One person each (8.3%) trains five to six times a week or every day. Overall, all surveyed vegans rate their self-perceived physical-sporting performance (spsp) as very good (MV = 4.57; SD = 0.35). They rate themselves particularly well in the dimensions of flexibility (MV = 4.88; SD = 0.23) and coordination (MV = 4.75; SD = 0.29), followed by endurance (MV = 4.33; SD = 0.89) and strength (MV = 4.31; SD = 0.54).

Summary of results

Vegans differ significantly in their responses from the other two groups (vegetarians and omnivores). They strongly adhere to and

		Omnivores (n = 103)	Vegetarians (n = 89)	Vegans (n = 12)
Important aspects of dietary style	meat-/fish-free diet	1.0%	48.3%	83.3%
	healthy diet	20.4%	40.4%	58.3%
	ecologically sustainable diet	4.9%	20.2%	33.3%
Motives for the chosen dietary style	animal welfare	21.4%	68.5%	100%
	ecology/sustainability	23.3%	75.3%	91.0%
	health	57.3%	58.4%	83.3%
	performance improvement	44.7%	29.2%	41.7%
	social environment	48.5%	33.7%	16.7%
	taste	72.8%	41.6%	8.3%
Type of sports	endurance training	25.2%	42.7%	50.0%
	strength training	42.7%	41.6%	66.7%
	combat sports	2.9%	3.4%	16.7%
	team sports	64.1%	47.2%	41.7%
Training frequency	every day	3.9%	5.6%	8.3%
	5- to 6-times a week	9.7%	2.2%	8.3%
	3- to 4-times a week	17.5%	23.6%	50.0%
	1- to 2-times a week	37.9%	46.1%	33.3%
	< 1-times a week	23.3%	14.6%	0.0%
	irregularly	7.8%	5.6%	0.0%
Self-perceived physical-sporting performance (spsp)	endurance	MW = 3.50; SD = 1.20	MW = 3.70; SD = 1.12	MW = 4.33; SD = 0.89
	coordination	MW = 4.67; SD = 0.47	MW = 4.70; SD = 0.57	MW = 4.75; SD = 0.29
	strength	MW = 4.08; SD = 0.73	MW = 3.92; SD = 0.72	MW = 4.31; SD = 0.54
	flexibility	MW = 4.17; SD = 1.03	MW = 4.34; SD = 1.00	MW = 4.88; SD = 0.23
	total	MW = 4.10; SD = 0.44	MW = 4.16; SD = 0.57	MW = 4.57; SD = 0.35

Tab. 1: **Comparison of the main differences in dietary and sports behavior between omnivores and vegetarians** (descriptive results of vegans included for completeness)
in % or mean value (MV)/standard deviation (SD)

are very convinced of their practiced dietary style. For example, while animal welfare is very important for 68.5% of vegetarians, it is important for all vegans (100%). Ecology (91.0%) and health (83.3%) are also important and more significant for vegans than for the other two groups. Vegans train more frequently (> 50% at least three times a week) and prefer strength training (66.7%) and endurance sports (50.0%). The high prevalence of strength training among vegans is somewhat unexpected as only 42.7% of omnivores and 41.6% of vegetarians report engaging in strength training.

Of all three groups, vegans also rate their performance the highest (MV = 4.57 vs. omnivores MV = 4.10, vegetarians MV = 4.16, on the 5-point scale). Although the group of vegans is relatively small with N = 12, the results are very typical, and the group of vegans responds very homogeneously, as reflected in the small standard deviations.

Discussion

Sample characteristics

One of the key findings of this study is that the relative proportion of self-identified vegetarians (46.4%) and vegans (5.8%) among sports students is significantly higher than in comparable representative population surveys in Germany (vegetarian: 8%; vegan: 2%) across all age groups or the similarly aged population (vegetarian: 16%; vegan: 5%; age 14–29 years) [6]. Additionally, the sample showed that female students significantly more often prefer a vegetarian diet than male students (57.8% vs. 28.9%). This is consistent with previous study results [5, 9].

Only half of the sports students follow an omnivorous diet. Therefore, it is likely that professional nutritional information and counseling in sports-affine, young groups will encounter vegetarian and vegan diets much more frequently than in the general population.

This study also examines how long students have adhered to a vegetarian diet. It finds that 64.0% of vegetarians have been practicing their dietary style for less than five years. The average age in the sample is 23 years, meaning that vegetarians have been practicing their dietary pattern for about half their lives up to just before the survey. This leads to different personal experience backgrounds and everyday competencies among vegetarians. This finding is relevant for nutritionists, as it requires a differentiated approach in educational and advisory situations.

In general, it could be helpful in all dietary style surveys and conclusions to consider the duration of a particular dietary style, as it is generally more challenging to change long-practiced lifestyle forms. Regarding physical-sporting performance levels, no significant differences were found between vegetarians and omnivores in this study

Dietary motives

Sustainability motives are an important reason for dietary changes among sports students. Vegetarians and omnivores differ significantly in their dietary motives. The aspect of ecologically sustainable nutrition is important for all respondents but significantly more important for vegetarians. This confirms the result of the question about the motives for the current dietary pattern. Significant differences are found in animal welfare (68.5% vegetarians vs. 21.4% omnivores) and ecology/sustainability (75.3% vegetarians vs. 23.3% omnivores), as well as in taste (41.6% vegetarians vs. 72.8% omnivores) and social environment (33.7% vegetarians vs. 48.5% omnivores). No significant differences between vegetarians and omnivores are found in health (57% vegetarians vs. 58% omnivores) and performance improvement (29% vegetarians vs. 45% omnivores). In the 2023 Nutrition Report by the BMEL, based on the FORSA representative population survey, 80% of all participants cited "animal welfare" as an important motive in food selection, and 74% cited "environmental and resource conservation" [6]. While vegetarians' responses align more closely with the general population, sustainability motives in food selection are not necessarily less important for omnivorous students. Fundamental differences arise in the criterion of taste: within the study, taste is rated 31 percentage points more important by omnivores than by vegetarians. This contrasts with general population data, which identifies taste as the most important criterion for food selection. This discrepancy suggests that students overall place higher value on other motives such as sustainability or ecology and less on taste compared to the general population. It should be noted, however, that social desirability may have played a role in answering the questions, potentially leading to response bias.

The present study shows gender-specific differences in dietary preferences: female students place more importance on aspects such as balanced diet, conscious diet, and ecologically sustainable diet than male students. This suggests that female students are more likely to consider sustainability aspects in their

diet than male students. These results may indicate greater sensitivity among women to issues such as environmental protection and sustainable consumption. Interestingly, differences appear between female students in recreational versus competitive sports. Recreational female athletes place more importance on balanced and ecologically sustainable diets than competitive female athletes. This may indicate that women in recreational sports are more likely to view their diet as part of a health-oriented way of life, while women in competitive sports may be more focused on specific performance goals and place less importance on environmental aspects. A different pattern is seen among male students. While taste reasons are significantly more important for female students than for male students, performance improvement in competitive sports is equally important for both genders. However, recreational male athletes more frequently cite performance improvement as a motive for their diet than recreational female athletes. The statistical indices evaluated here show that not only general physical activity but also the extent and type of physical activity are related to individual dietary style. Structured, precise, and individual assessment of these characteristics before professional nutritional counseling provides valuable insights for a client-centered counseling session.

The study highlights the importance of gender in the relationship between dietary pattern and recreational and competitive sports. Gender-specific eating habits have been an important aspect in dietary behavior research since the early 2000s [29–31]. At the same time, there is still a need for research on the gender specificity of the topics of nutrition and sustainability [32]. The dietary motives of sports students in Karlsruhe are closely linked to ecological and social motives in a gender-specific manner. Whether this relationship can be generalized should be the subject of future investigations.

All sports students expressed a desire to consume more fruits and vegetables in the future, which could also motivate young adults in the general population. The German Nutrition Society and the EAT-Lancet Commission, in particular, emphasize the need for more plant-based consumption patterns in their current recommendations [2, 3, 33]. Strengthening the corresponding motives of sports students on the one hand and the general population on the other is of great importance to reduce the typically existing intention-behavior gap.

Sporting activity and self-perceived physical-sporting performance

More than half of the omnivorous sports students engage in team sports. Team sports are also the most frequently practiced sport among vegetarians. It was found that more competitive athletes than recreational athletes are active in team sports. This is because most, for example, football or handball players, participate in league operations and thus in competitions. Notably, endurance athletes are significantly more likely to follow a vegetarian diet than an omnivorous diet.

One of the main differences between recreational and competitive athletes is the frequency of training. Competitive athletes train significantly more often, which is why special attention should be given to ensuring they meet their energy and nutrient needs. Additionally, critical supply phases can occur depending on the sport and training plan [16–17]. Therefore, both performance levels should be analyzed and specifically included in nutritional counseling and information.

Gender-specific differences are evident in all dimensions: endurance, strength, coordination, and flexibility. Men rate themselves as having greater endurance and strength, while women rate themselves as having better coordination and flexibility. Various sources have provided explanations for this, which are predominantly anatomical in nature [29–30].

In addition to the increasing prevalence of vegetarian and vegan diets among prominent personalities, including well-known top athletes who could serve as role models, the spread of this trend is driven by social media [34]. Smartphones and the internet have the highest importance in media usage among young adults and serve as the main source of information [35]. Many high-performance and top athletes, some self-proclaimed "nutrition coaches", and documentaries now advocate the view that a meat-free or purely plant-based diet can enhance physical-sporting performance (psp). Therefore, the expectation of dietary change is high. This study cannot determine whether such expectations are justified. The current state of research does not evaluate physical or mental performance improvements after switching to a vegetarian or vegan diet as either an advantage or a disadvantage [21]. Against this background, high expectations of dietary change should be critically considered. The assessment of the impact of a vegetarian or vegan diet on athletic performance cannot be conclusively clarified within this study. Expectation management is therefore a central goal of information and counseling work in the field of sports nutrition for young adults to avoid disappointment if the hoped-for results do not materialize in everyday sports.

Limitations

A primary limitation of the study's validity lies in the sample. On the one hand, the reference population ("sports students in Karlsruhe") is clearly defined. On the other hand, it is expected that vegetarians and vegans might have felt more addressed than omnivores, which could have influenced the high prevalence of the former dietary groups. However, the main interest was not in conducting a representative population study but primarily in comparing dietary styles. Therefore, the chosen research questions are likely to be minimally biased.

Data for this study were collected using a questionnaire that included a validated scale for spsp in a short version (FFB Mot) [28] as well as self-developed questions. The entire questionnaire was pre-tested beforehand. Nevertheless, for further purposes, the comprehensibility of the questions should be re-examined, and validity and reliability tests should be conducted.

Although it can be assumed that sports students have developed a well-trained sense of their own bodies, future studies should also use objective measurement methods such as ergometry in addition to the subjective assessment of physical-sporting performance. Especially for participants with a more passive and health-risky lifestyle concept, objective measurement methods are recommended.

BMI is a limited measure for assessing weight in sports students, as it does not consider muscle mass. Given the small number of individuals with a BMI over 25 kg/m², it can be assumed that the different body constitutions do not represent a confounding variable in this study.

Gender-specific differences were identified in the analysis for the present sample and show trends for the general population. However, generalization is only possible to a limited extent and must be investigated through further research.

Conclusion

An increasing number of people are choosing a vegan or vegetarian diet, whether for ethical, health, or ecological reasons. This growing number of people with alternative eating habits requires in-depth scientific investigation to better understand the possible or expected impacts on health and physical-sporting performance.

In this study, the dietary behavior of sports students in Karlsruhe was examined. In particular, the relationship between dietary pattern and self-perceived physical-sporting performance (spsp) was considered. It was shown that both the sample characteristics and the dietary motives and spsp differ significantly between the two dietary groups (vegetarian and omnivorous), and the group of vegan participants also stands out from the sample average.

So far, no connection between a vegan or vegetarian diet and increased physical-sporting performance has been proven in the research literature. Nevertheless, it is important to consider such expectations and motives of the students. A change in dietary pattern can have individually different effects, and these should be taken into account in the information and counseling of young adults.

Overall, this study highlights that there are significant differences between sports students who follow an omnivorous and a vegetarian diet. To better understand the relationships between physical activity and physical-sporting performance on the one hand and diet on the other, further studies are necessary.

If the results presented here can be confirmed in the future, a further step should be to check whether they can also be used in a focused approach to advising young adults with less affinity for sport. At best, the specific motivations of the sports students described here could motivate less sport-affine target groups to adopt a health-promoting or more sustainable diet. It is important that professional nutritionists consider the individual motives, goals, and expectations of their clients to provide tailored recommendations. Furthermore, this study emphasizes the importance of professional nutritional counseling for athletes of different performance levels to engage more deeply with the nutrition-related motivations and self-assessments of their clients.

Disclosures on Conflicts of Interest and the use of AI
The authors declare that there is no conflict of interest. AI was used for language optimization.

The eSupplement including bibliography can be found online → www.ernaehrungs-umschau.de/fachzeitschrift/heftarchiv/ issue 4/2025 with this article.