The Paradox of Knowledge and Practice: Nutritional Status and Diet Quality Among Indonesian Food and Nutrition Science Students

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Abstract

Nutritional status and dietary adequacy are fundamental to health and well-being, particularly among university students who often struggle to maintain balanced diets due to academic pressures and lifestyle constraints. Paradoxically, students enrolled in food and nutrition science programs, despite their academic exposure, may still exhibit suboptimal dietary behaviours. This study aimed to evaluate Indonesian undergraduate students' nutritional status and macronutrient adequacy in food and nutrition science. A descriptive cross-sectional survey was conducted involving 130 participants. Anthropometric measurements were collected to calculate Body Mass Index (BMI), and dietary intake was assessed using self-reported food records. Nutrient intakes were analyzed and compared against individual estimated requirements to determine adequacy. The BMI data showed that 17% of students were underweight, 45% had a normal weight, and 38% were overweight or obese. Mean energy intake (1287.66 ± 429.38 kcal) was substantially below the estimated requirement (1830 ± 323 kcal), with only 72.07% adequacy. Carbohydrate intake was critically low, meeting just 53.90% of the requirement, with 86% of students consuming inadequate amounts. Protein intake reached moderate adequacy (81.36%), while fat intake exceeded recommended levels in over half of the respondents (110.87% adequacy). Furthermore, 65% of students had inadequate energy intake and 55% consumed excess fat. These findings reveal the coexistence of undernutrition and overnutrition, reflecting a double burden of malnutrition in a population expected to possess greater nutritional awareness. The disconnect between knowledge and practice underscores the urgent need for strengthened nutrition education and campus-based interventions to foster healthier dietary habits and mitigate long-term health risks.

Introduction

Adequate nutritional status is a fundamental determinant of university students' health, cognitive development, and academic performance. As young adults transition from adolescence into early adulthood, they undergo physiological, psychological, and social changes that profoundly influence dietary behaviours and nutritional needs (Das et al., 2017). This life stage is characterised by increased autonomy in food choices, exposure to novel dietary environments, and a heightened risk of adopting poor eating habits that may have long-term health implications (Balhara, 2022; Winpenny et al., 2020).

In the context of higher education, particularly within science and technology disciplines such as Food and Nutrition Science, students are often expected to possess not only theoretical knowledge of nutrition but

also embody its practical application in daily life. However, existing literature suggests that nutritional knowledge does not always translate into healthy dietary behaviour (Plichta and Jezewska-Zychowicz, 2023). Students in higher education frequently report irregular meal patterns, high consumption of fast foods and sugar-sweetened beverages, and low intake of fruits, vegetables, and protein-rich foods (Gande et al., 2023). Such practices contribute to a growing burden of both undernutrition and overnutrition, often referred to as the "double burden of malnutrition" (DBM), which is increasingly evident among young adults in Indonesia (Maehara et al., 2019).

The prevalence of DBM is especially concerning in academic populations, where the demands of mental performance, prolonged sedentary activity, and psychological stress converge to shape energy and

nutrient requirements (Nagy et al., 2019). While national health surveys, such as (Kementerian Kesehatan Republik Indonesia, 2018) have documented rising trends in obesity and chronic energy deficiency among adolescents and young adults. The prevalence of overweight and obesity among adolescents (13–18 years old) reaches 9.5% and 4%, respectively. Additionally, the rates of overweight and obesity among adults (>18 years) have risen to 13.6% and 21.7%, respectively. Data on the specific nutritional status and dietary adequacy of university students, particularly those enrolled in food-related disciplines, remain scarce.

The presence of institutional resources, including digital nutrition platforms, subsidised food services, and access to subscription-based journal portals, offers a distinctive context for exploring the relationship between academic exposure to nutrition and students' real-world dietary behaviours. Paradoxically, anecdotal evidence suggests that many Food and Nutrition Science students may not fully apply their academic understanding of nutrition to optimise their own health and dietary intake (Mengist et al., 2022). Given these concerns, this study was conducted to assess the nutritional status and dietary adequacy of Indonesian students enrolled in the Food and Nutrition Science undergraduate program. Specifically, the study aimed to characterise the anthropometric profile of Indonesian Food and Nutrition Science students using Body Mass Index (BMI) and evaluate the prevalence of macro-nutrient adequacy levels. The findings are expected to provide empirical evidence to inform the design of campus-based nutrition interventions and to bridge the gap between nutritional literacy and healthful behavior in future food professionals.

Materials and Methods
Study Design and Population

This research employed a descriptive cross-sectional design to assess undergraduate students' nutritional status and dietary adequacy in the Food and Nutrition Science program, Indonesia. The study population consisted of active students in the second year of study during the 2024–2025 academic year. A total of 130 students participated in the study, selected using total sampling based on inclusion criteria: willingness to participate, enrollment in the Food and Nutrition Science program, and absence of diagnosed metabolic or dietary disorders that could alter typical nutritional intake.

Data Collection Procedure

Data collection was carried out between February and March 2025. Anthropometric measurements were conducted to determine nutritional status, while dietary intake was assessed using a food record form. Food record were obtained on three non-consecutive days, including two weekdays and one weekend day, to capture habitual intake patterns and account for intra-individual variability (Huang et al., 2022).

Anthropometric Assessment

Body weight was measured to the nearest 0.1 kg using a calibrated digital scale, and height was recorded to the nearest 0.1 cm using a microtoise. Body Mass Index (BMI) was calculated using the standard formula: weight (kg) divided by height squared (m²). Nutritional status was classified according to the World Health Organization (WHO) BMI classification for Asia-Pasific : underweight (<18.5 kg/m²), normal (18.5–22.9 kg/m²), overweight (23.0–24.9 kg/m²), obesity class I (25.0–29.9 kg/m²), and obesity class II (≥30.0 kg/m²) (Knapik and Hoedebecke, 2023).

Dietary Intake Analysis

The collected dietary data were analyzed using Indonesian food composition tables and standardized nutrient analysis software (Nutri Survey). The intake of energy, carbohydrates, proteins, and fats was compared to individual nutritional requirements calculated based on Basal Metabolic Rate (BMR) by Harris Benedict formula, adjusted for age, sex, and physical activity level. Nutrient adequacy was categorized as inadequate (<80% of requirement), adequate (80–100%), or excessive (>100%).

Data Analysis

Descriptive statistics were used to summarize participant characteristics, nutrient intakes, and nutritional status. Means and standard deviations (SD) were calculated for continuous variables. Frequencies and percentages were used for categorical variables. All analyses were conducted using Microsoft Excel 2019.

Results and Discussion
Respondent Characteristic

The study involved 130 respondents from the Food and Nutrition Science undergraduate program. Most participants were female (90%, n=117), while males accounted for only 10% (n=13). The age distribution was predominantly concentrated in the 20-year-old group (54%), followed by the 19-year-old (43%), indicating that most participants were in their early adult developmental phase. The average height was 159.89 cm, and the average body weight was 57.20 kg (Table 1). This demographic pattern suggests a relatively homogeneous age group within late adolescence and early adulthood, which is critical from a nutritional perspective, given the increased demands for macro- and micronutrients during this life stage to support ongoing physiological development, cognitive function, and academic productivity (Akseer et al., 2017).

Table 1. Respondent characteristic

Characteristic	N	%
Gender		
Male	13	10
Female	117	90
Age		
18	1	1
19	56	43
20	70	54
21	3	2
Height		
Mean (cm)	159.89	
Weight		
Mean (kg)	57.20	

Nutritional Status

Assessment of nutritional status using Body Mass Index (BMI) as a proxy indicator revealed a heterogeneous distribution among respondents, reflecting the emerging double burden of malnutrition (DBM) commonly observed in developing and transitioning countries, including Indonesia (Sartika and Rosiyati, 2020). The nutritional status data can be seen in Table 2. The data indicated that 17% of the students were underweight (BMI <18.5 kg/m²), 45% were within the normal range (18.5–22.9 kg/m²), 15% were categorized as overweight (23.0–24.9 kg/m²), 18% had obesity class I (25.0–29.9 kg/m²), and 5% student population exhibits obesity class II status, a significant proportion faces both undernutrition and overnutrition. Such a profile aligns with national trends reported in the RISKESDAS (Kementerian Kesehatan Republik Indonesia, 2018), which documented an increasing prevalence of both thinness and obesity in the young adult population.

Table 2. Nutritional status based on BMI classification

IMT (kg/m²)	Classification	N	%
< 18,5	Underweight	22	17
18.5 – 22.9	Normal	59	45
23.00 – 24.9	Overweight	19	15
25.00 – 29.9	Obesitas I	24	18
>30.00	Obesitas II	6	5

The 17% prevalence of underweight in this population is a cause for concern, as it may reflect chronic energy deficiency (CED), suboptimal dietary intake, or psychosocial factors such as disordered eating behaviors and academic stress-related anorexia (Karimpour and Afroughi, 2022). University students, especially females, may engage in weight-control behaviors, including caloric restriction, meal skipping, or excessive dieting, often influenced by sociocultural norms around body image (Jiménez-Limas et al., 2022). Furthermore, economic constraints may limit access to nutritionally adequate diets, particularly for students living away from home and managing personal food expenses (Gande et al., 2023). From a physiological perspective, underweight individuals are at risk of impaired immune response, reduced muscle mass, delayed wound healing, and micronutrient deficiencies, all of which may compromise academic performance and long-term health outcomes (Seyoum et al., 2019).

Conversely, the combined prevalence of overweight and obesity (class I and II) was 38%, exceeding the national average for this age group and indicative of a nutritional transition toward energy-dense, nutrient-poor dietary patterns (Lafia et al., 2022). The obesogenic environment on many university campuses, characterized by widespread availability of high-fat foods, sugar-sweetened beverages, and sedentary routines due to academic workload and screen time, may contribute to excessive energy intake and reduced caloric expenditure (Li et al., 2022). The consumption of processed or fried foods, often more affordable and accessible, likely plays a central role in adiposity accumulation (Haghighatdoost et al., 2022). Obesity in early adulthood is particularly worrisome due to its strong association with increased risk of metabolic syndrome, type 2 diabetes, cardiovascular disease, and non-alcoholic fatty liver disease later in life. Studies have shown that BMI trajectories established during adolescence and young adulthood are often sustained into midlife, thus reinforcing the importance of early prevention strategies (Correa-Burrows et al., 2021). Moreover, central adiposity, usually not captured by BMI alone, may also be prevalent and should be evaluated using waist circumference or body composition analysis in future studies (Ferguson et al., 2019).

Although 45% of students had normal BMI, this metric alone may not adequately reflect nutritional well-being. Normal weight individuals can still be metabolically obese or suffer from subclinical nutrient deficiencies—a condition known as "normal weight obesity" (NWO) (Żegleń et al., 2024). Without data on body fat percentage, physical activity, or biochemical parameters, it is possible that some normal weight students are still at nutritional risk due to inadequate intake of essential nutrients, as suggested by the previously reported low energy and protein consumption (Gallo et al., 2021).

Nutritional Intake and Adequacy

This study compared respondents' average daily nutritional requirements with their actual intake and the resulting adequacy levels. This comparison provides insight into whether the respondents are meeting, exceeding, or falling short of recommended dietary guidelines. Table 3 shows a comparison between nutritional requirements, actual intake, and nutritional adequacy.

The data presented in Table 3 demonstrate significant discrepancies between the recommended daily nutritional requirements and the actual intake observed among Food and Nutrition Science students. Notably, energy intake was insufficient, meeting only approximately 72% of the average daily requirement. This energy deficit could have adverse implications on academic performance, immune function, and metabolic health, especially considering the cognitive demands and often sedentary lifestyle associated with university life (Zaika and Yevarnytskyi, 2023).

Table 3. Comparison of Nutritional Requirements, Actual Intake, and Nutritional Adequacy

Component	Nutritional Requirements (±SD)	Nutritional Intake (±SD)	Nutritional Adequacy (±SD)
Calories	1830 ± 323 kkal	1287.66 ± 429.38 kkal	72.07 ± 24.83%
Carbohydrate	274.43 ± 48.48 gram	144.38 ± 61.37 gram	53.90 ± 22.75%
Protein	68.61 ± 12.12 gram	54.58 ± 19.23 gram	81.36 ± 29.66%
Fat	50.82 ± 8.98 gram	55.11 ± 20.48 gram	110.87 ± 42.57%

Table 4. Distribution of nutritional adequacy levels based on nutrient type

Component	Inadequate		Adequate		Over	
	N	%	N	%	N	%
Calories	85	65	27	21	18	14
Carbohydrate	112	86	13	10	5	4
Protein	66	51	30	23	34	26
Fat	29	22	29	22	72	55

Carbohydrate intake was especially low, meeting only 53.90% of the recommended value. Given that carbohydrates are the primary fuel for brain function, this inadequacy may directly affect concentration, memory retention, and overall cognitive efficiency (Sünram-Lea and Owen, 2017). The low intake also indicates a possible dietary pattern that prioritizes protein or fat over complex carbohydrates such as whole grains, legumes, and fruits (Nestel and Mori, 2022). Protein intake showed relatively better adequacy at 81.36%, suggesting that some students may have access to or prioritize protein-rich foods. However, the mean value still falls short of the recommended level, which may impact muscle maintenance and recovery, especially in active students (Evans et al., 2023). Interestingly, fat intake exceeded the recommended requirement, reaching 110.87% adequacy. This trend suggests a possible over-reliance on high-fat foods such as fried snacks, processed meals, and fast food—readily available and affordable options in many university environments. While fat is a necessary macronutrient, its excessive intake, especially from poor-quality sources, may predispose students to dyslipidemia and other metabolic disturbances (Szudzik et al., 2024).

Distribution of Nutritional Adequacy

To further elucidate the extent of dietary imbalance within the study population, the distribution of nutrient adequacy levels was analyzed categorically across four principal macronutrients: energy, carbohydrate, protein, and fat. This stratification allows a more granular understanding of how individual students align with, fall short of, or exceed their nutritional requirements. Such an approach is critical in identifying at-risk subgroups and dietary excesses that may not be fully captured through mean values alone. Table 4 presents the proportion of students whose intake was classified as inadequate, adequate, or excessive, offering key insights into the variability and potential consequences of current dietary behaviors among Indonesian Food and Nutrition Science students.

Table 4 provides a categorical overview of the adequacy distribution across four key macronutrients. The prevalence of inadequate energy intake in 65% of students reinforces earlier concerns about widespread caloric insufficiency. Only 21% of students consumed energy at an adequate level, while 14% consumed more than necessary, likely reflecting variability in meal timing, frequency, and food quality among individuals.

Carbohydrate inadequacy was most prevalent, affecting 86% of respondents. This overwhelming figure may stem from the underconsumption of staple carbohydrate sources such as rice, bread, or starchy vegetables, or from substitution with non-nutritive calorie sources (Mohan et al., 2018). The minimal percentage (4%) consuming excess carbohydrates further highlights the risk of dietary energy imbalance. Protein adequacy displayed a more balanced distribution: 51% were deficient, 23% adequate, and 26% exceeded requirements. This dispersion suggests that individual dietary patterns vary substantially—some students may have consistent access to protein sources (e.g., eggs, legumes, tofu, or meat), while others may face economic or knowledge-based barriers (Martinez-Lacoba et al., 2020).

Fat intake, in contrast, was excessive in over half the population (55%). This points toward a dominant consumption of high-fat processed foods. The equivalent proportion of adequate (22%) and inadequate (22%) fat intake indicates that while some students maintain healthy fat intake levels, a large subset exceeds recommended thresholds, contributing to potential long-term cardiometabolic risk (Martinez-Lacoba et al., 2020).

Conclusion

This study reveals a nutritional imbalance among Indonesian Food and Nutrition Science students, with 38% categorized as overweight or obese and 17% as underweight. It highlights a significant paradox between nutritional knowledge and dietary behavior, despite their academic exposure to nutrition principles, many exhibited inadequate energy and carbohydrate intake, alongside excessive fat consumption. The coexistence of undernutrition and overnutrition within this population reflects a double burden of malnutrition and raises concerns about the practical application of their academic knowledge. These findings emphasize the necessity for more integrative and behavior-focused nutrition education, as well as campus-based interventions aimed at translating knowledge into healthier dietary practices and preventing long-term health consequences.

Acknowledgments

References

Akseer, N., Al-Gashm, S., Mehta, S., Mokdad, A., Bhutta, Z.A., 2017. Global and regional trends in the nutritional status of young people: a critical and neglected age group. Ann N Y Acad Sci 1393, 3–20. https://doi.org/10.1111/nyas.13336

Balhara, M., 2022. Evaluating trends in consumption of ultra-processed foods from adolescence to young adulthood, with implications for human health. Proceedings of the Nutrition Society 81, E159. https://doi.org/10.1017/S0029665122001884

Correa-Burrows, P., Rogan, J., Blanco, E., East, P.,

Lozoff, B., Gahagan, S., Burrows, R., 2021. Resolving early obesity leads to a cardiometabolic profile within normal ranges at 23 years old in a two-decade prospective follow-up study. Sci Rep 11, 18927. https://doi.org/10.1038/s41598-021-97683-9

Das, J.K., Salam, R.A., Thornburg, K.L., Prentice, A.M., Campisi, S., Lassi, Z.S., Koletzko, B., Bhutta, Z.A., 2017. Nutrition in adolescents: physiology, metabolism, and nutritional needs. Ann N Y Acad Sci 1393, 21–33. https://doi.org/10.1111/nyas.13330

Sartika, R.A.D., Rosiyati, E., 2020. Body mass index of adults, pre-elderly and elderly in Indonesia (Indonesian Family Life Survey 2014). Malays J Nutr 26, 157–164. https://doi.org/10.31246/mjn-2019-0045

Evans, C., Rojas, J., Curtis, J., Antonio, J., 2023. Recent Perspectives on the Role of Dietary Protein in Physically Active Individuals. Research Directs in Health Sciences 3. https://doi.org/10.53520/rdhs2023.10451

Ferguson, L.D., Brown, R., Celis-Morales, C., Welsh, P., Lyall, D.M., Pell, J.P., McInnes, I.B., Siebert, S., Sattar, N., 2019. Association of central adiposity with psoriasis, psoriatic arthritis and rheumatoid arthritis: a cross-sectional study of the UK Biobank. Rheumatology 58, 2137–2142. https://doi.org/10.1093/rheumatology/kez192

Gallo, L.A., Gallo, T.F., Young, S.L., Fotheringham, A.K., Barclay, J.L., Walker, J.L., Moritz, K.M., Akison, L.K., 2021. Adherence to Dietary and Physical Activity Guidelines in Australian Undergraduate Biomedical Students and Associations with Body Composition and Metabolic Health: A Cross-Sectional Study. Nutrients 13, 3500. https://doi.org/10.3390/nu13103500

Gande, S., Mangal, R.K., Stead, T.S., Ganti, L., 2023. State of nutrition amongst US college students: dataset of a national survey study. BMC Res Notes 16, 10. https://doi.org/10.1186/s13104-023-06273-7

Haghighatdoost, F., Atefi, M., Mohammadifard, N., Daryabeygi-Khotbehsara, R., Khosravi, A., Mansourian, M., 2022. The relationship between ultraprocessed food consumption and obesity indicators in Iranian adults. Nutrition, Metabolism and Cardiovascular Diseases 32, 2074–2085. https://doi.org/10.1016/j.numecd.2022.05.019

Huang, K., Zhao, L., Guo, Q., Yu, D., Yang, Y., Cao, Q., Yuan, X., Ju, L., Li, S., Cheng, X., Xu, X., Fang, H., 2022. Comparison of the 24 h Dietary Recall of Two Consecutive Days, Two Non-Consecutive Days, Three Consecutive Days, and Three Non-Consecutive Days for Estimating Dietary Intake of Chinese Adult. Nutrients 14, 1960. https://doi.org/10.3390/nu14091960

Jiménez-Limas, K., Miranda-Barrera, V.A., Muñoz-Díaz, K.F., Novales-Huidobro, S.R., Chico-Barba, G., 2022. Body Dissatisfaction, Distorted Body Image and Disordered Eating Behaviors in University Students: An Analysis from 2017–2022. Int J Environ Res Public Health 19, 11482. https://doi.org/10.3390/ijerph191811482

Karimpour, F.F., Afroughi, S.A., 2022. Prevalence of weight status and associated factors of underweight among the medical students in Iran. THE NEW ARMENIAN MEDICAL JOURNAL 91–99. https://doi.org/10.56936/18290825-2022.16.2-91

Knapik, J.J., Hoedebecke, S.S., 2023. Association of Body Mass Index with Injuries: A Systematic Review and Meta-Analyses Comparing Healthy Weight Military Service Members with Underweight, Overweight, and Obese. Journal of Special Operations Medicine 23, 96. https://doi.org/10.55460/WHH7-63P7

Lafia, A.T., Ketounou, T.R., Honfoga, J.N.B., Bonou, S.I., Zime, A.K.B., 2022. Dietary habits, prevalence of obesity and overweight in developed and developing countries. Research, Society and Development 11, e249111032769. https://doi.org/10.33448/rsd-v11i10.32769

Kementerian Kesehatan Republik Indonesia, 2018. Laporan Riskesdas 2018 Nasional.

Li, X., Braakhuis, A., Li, Z., Roy, R., 2022. How Does the University Food Environment Impact Student Dietary Behaviors? A Systematic Review. Front Nutr 9. https://doi.org/10.3389/fnut.2022.840818

Maehara, M., Rah, J.H., Roshita, A., Suryantan, J., Rachmadewi, A., Izwardy, D., 2019. Patterns and risk factors of double burden of malnutrition among adolescent girls and boys in Indonesia. PLoS One 14, e0221273. https://doi.org/10.1371/journal.pone.0221273

Martinez-Lacoba, R., Pardo-Garcia, I., Amo-Saus, E., Escribano-Sotos, F., 2020. Social determinants of food group consumption based on Mediterranean diet pyramid: A cross-sectional study of university students. PLoS One 15, e0227620. https://doi.org/10.1371/journal.pone.0227620

Mengist, G.A., Savvina, N.V., Grjibovski, A.M., Petrova, M.N., 2022. Nutritional status and eating behaviour among university students: a systematic review. Social Aspects of Population Health 68. https://doi.org/10.21045/2071-5021-2022-68-5-11

Mohan, V., Unnikrishnan, R., Shobana, S., Malavika, M., Anjana, R.M., Sudha, V., 2018. Are excess carbohydrates the main link to diabetes & its complications in Asians? Indian Journal of Medical Research 148, 531–538. https://doi.org/10.4103/ijmr.IJMR_1698_18

Nagy, G.A., Fang, C.M., Hish, A.J., Kelly, L., Nicchitta, C.V., Dzirasa, K., Rosenthal, M.Z., 2019. Burnout and Mental Health Problems in Biomedical Doctoral Students. CBE—Life Sciences Education 18, ar27. https://doi.org/10.1187/cbe.18-09-0198

Nestel, P.J., Mori, T.A., 2022. Dietary patterns, dietary nutrients and cardiovascular disease. Rev Cardiovasc Med 23. https://doi.org/10.31083/j.rcm2301017

Plichta, M., Jezewska-Zychowicz, M., 2023. Nutrition knowledge, diet quality and orthorexic behaviors in Polish students–a pre-post repeated cross-sectional study. PLoS One 18, e0287165. https://doi.org/10.1371/journal.pone.0287165

Seyoum, D., Tsegaye, R., Tesfaye, A., 2019. Under nutrition as a predictor of poor academic performance; the case of Nekemte primary schools

students, Western Ethiopia. BMC Res Notes 12, 727. https://doi.org/10.1186/s13104-019-4771-5

Sünram-Lea, S.I., Owen, L., 2017. The impact of diet-based glycaemic response and glucose regulation on cognition: evidence across the lifespan. Proceedings of the Nutrition Society 76, 466–477. https://doi.org/10.1017/S0029665117000829

Szudzik, M., Hutsch, T., Chabowski, D., Zajdel, M., Ufnal, M., 2024. Normal caloric intake with high-fat diet induces metabolic dysfunction-associated steatotic liver disease and dyslipidemia without obesity in rats. Sci Rep 14, 22796. https://doi.org/10.1038/s41598-024-74193-y

Winpenny, E.M., Winkler, M.R., Stochl, J., van Sluijs, E.M.F., Larson, N., Neumark-Sztainer, D., 2020. Associations of early adulthood life transitions with changes in fast food intake: a latent trajectory analysis. International Journal of Behavioral Nutrition and Physical Activity 17, 130. https://doi.org/10.1186/s12966-020-01024-4

Zaika, O., Yevarnytskyi, I., 2023. The consequences of physical activity deficit in the applicants of the higher education. Scientific Journal of National Pedagogical Dragomanov University. Series 15. Scientific and pedagogical problems of physical culture (physical culture and sports) 68–73. https://doi.org/10.31392/NPU-nc.series15.2023.5(164).15

Żegleń, M., Kryst, Ł., Kowal, M., Słowik, J., Woronkowicz, A., 2024. The Normal Weight Obesity (NWO) Problem—Prevalence and Time Changes in Children and Adolescents From Kraków (Poland). American Journal of Human Biology 36. https://doi.org/10.1002/ajhb.24145