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BMI, pre-exercise meal timing, and running performance in college students: A mediation model

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ABSTRACT

Background: Body Mass Index (BMI) is widely used as an indicator of body composition and nutritional status, yet its interaction with nutritional habits—particularly pre-exercise meal timing—remains underexplored among college students. Understanding these relationships is important for promoting active and healthy lifestyles within this population. **Objectives:** This study aims to test a mediation model in which pre-exercise meal timing serves as a potential mechanism linking BMI to running performance among college students. **Methods:** This quantitative study involved 213 college students who completed an online questionnaire reporting self-reported BMI, pre-exercise meal timing, and running pace (minutes per kilometre). Mediation analysis using the PROCESS macro (Model 4) in SPSS with bootstrapping procedures was applied to examine the mediating role of pre-exercise meal timing. **Results:** BMI was positively associated with running pace, indicating that higher BMI values were linked to slower running performance. The model explained 24.3% of the variance in running pace ($R^2 = 0.243$). The indirect effect of pre-exercise meal timing was minimal and not statistically significant ($B = -0.004$, 95% CI [−0.010, 0.001]), suggesting a limited mediating role. Students with higher BMI tended to consume meals closer to exercise time, reflecting potential behavioral differences. **Conclusion:** Although the mediating role of pre-exercise meal timing was negligible, BMI remained a significant predictor of running performance among college students. These findings suggest that physiological factors may play a more prominent role than short-term dietary timing in endurance outcomes. Campus health interventions may benefit from integrating body composition management with balanced nutritional strategies to enhance student fitness and well-being.

Keywords: BMI; pre-exercise meal timing; running performance; mediation model; college students

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Authors' Contribution: a – Study Design; b – Data Collection; c – Statistical Analysis; d – Manuscript Preparation; e – Funds Collection

INTRODUCTION

College students often face challenges in maintaining regular physical activity due to sedentary lifestyles and academic demands (Carballo-Fazanes et al., 2020). Such inactivity contributes to increasing Body Mass Index (BMI), which in turn affects health and physical performance negatively (Alves et al., 2021). BMI, a key indicator of nutritional status, influences both physical and metabolic health, with overweight and obesity associated with chronic diseases such as diabetes and cardiovascular disorders (Scully et al., 2021). Conversely, underweight individuals are at risk of nutrient deficiencies that impair physical function (Scully et al., 2021). With the increasing prevalence of obesity among college students, it is essential to examine the impact of BMI on physical performance, particularly in activities like running. However, it remains unclear whether nutritional behaviours partially explain this relationship or serve as modifiable factors to improve performance outcomes.

Running is one of the most accessible and popular forms of exercise among college students (Capsi & Llopis-Goig, 2023). Running performance, often measured by speed, reflects aerobic capacity, cardiovascular fitness, and muscle efficiency (Dempsey et al., 2022; Lockie et al., 2023). Students with higher VO_2 max values tend to sustain faster running paces over longer distances (Carrier et al., 2023), highlighting the importance of physical conditioning in maintaining fitness.

Despite this, nutritional factors—especially the timing of meals before exercise—are often overlooked. Research indicates that consuming meals 3-4 hours before exercise optimises glycogen availability and minimises gastrointestinal distress, thereby enhancing endurance performance (Burke et al., 2019; Colberg et al., 2016). Conversely, running immediately after eating may lead to gastrointestinal discomfort and reduced performance (Guntoju & Pramod, 2024; Ribichini et al., 2023). However, whether meal timing independently affects performance or mediates the effect of BMI on running performance remains empirically untested in college students. Students' irregular eating habits can lead to inconsistent energy levels, which may affect their ability to perform effectively (Edinburgh et al., 2022). These behaviours could interact with BMI to influence running performance, suggesting that both physiological and nutritional factors should be considered together.

While the relationship between BMI and running performance has been widely documented (Sedeaud et al., 2014; Vincent et al., 2020), and the impact of meal timing on acute exercise outcomes is recognised (Burke et al., 2019; Edinburgh et al., 2022), no studies have examined whether pre-exercise meal timing mediates the effect of BMI on running performance. Specifically, it is unknown whether students with higher BMI may exhibit different meal timing behaviours that subsequently influence their running pace, or whether meal timing acts as an independent pathway. This study aims to address this gap by testing a mediation model in which pre-exercise meal timing serves as a potential mechanism linking BMI to running performance among college students.

METHOD

Research Design

This study employed a quantitative cross-sectional design to examine the relationships among body mass index (BMI), pre-exercise meal timing, and running performance among college students. A mediation analysis framework was applied using Hayes' PROCESS macro (Model 4) to test whether pre-exercise meal timing mediates the relationship between BMI (independent variable) and running pace (dependent variable). The cross-sectional approach allowed for efficient collection of self-reported data to identify associations among variables at a single time point.

Participants

The sample consisted of 213 college students, comprising 137 males (64.3%) and 76 females (35.7%). The mean age of participants was 19.12 years (SD = 1.1; range = 18-20). Inclusion criteria were (1) active enrolment in an undergraduate programme, (2) regular participation in physical activity (at least once per week), and (3) willingness to complete all components of the online questionnaire. Exclusion criteria included (1) known cardiovascular conditions, (2) physical limitations preventing running activity, and (3) incomplete

r inconsistent responses in the questionnaire. Participants were recruited through convenience sampling via academic networks and social media platforms to ensure a broad and diverse sample from the target population.

Instruments and Measures

Data were collected using a structured online questionnaire designed to assess key variables relevant to the research objectives. The instrument consisted of the following components: (i) Demographic Information: Age and gender were recorded through self-report. (ii) Body Mass Index (BMI): Participants reported their body weight (kg) and height (cm). BMI was calculated using the standard formula: BMI = weight (kg) / height² (m^2). (iii) Pre-Exercise Meal Timing: Participants reported the time elapsed (in hours) between their last meal and the start of running activity. This variable was measured via self-report and served as the mediator in the model. (iv) Running Pace: Running performance was assessed as running pace expressed in minutes per kilometre (min/km). Participants completed a measured running activity and recorded their pace. Prior to full-scale data collection, the questionnaire underwent validity and reliability testing to ensure measurement accuracy and consistency. Statistical procedures confirmed acceptable psychometric properties of the instrument.

Procedure

Data collection was conducted online between July and August 2024. The questionnaire was distributed through academic networks and social media platforms to reach a broad and diverse sample of college students. Participants accessed the survey via a secure online link and completed it at their convenience. Ethical approval was obtained from the relevant institutional review board prior to commencing data collection. Participants were informed about the study's purpose, confidentiality measures, and their right to withdraw at any time without penalty. Informed consent was obtained electronically before participants proceeded with the questionnaire. The online format allowed for wide geographic reach and efficient data acquisition from the target population. While the study relied on self-reported data for meal timing, which may introduce recall bias, this approach facilitated large-scale data collection within the specified period.

Statistical Analysis

Mediation analysis was performed using the PROCESS macro (Model 4) (Hayes, 2018) in SPSS version 25.0 (IBM Corp., Armonk, NY). In this model, BMI served as the independent variable (X), pre-exercise meal timing as the mediator (M), and running pace as the dependent variable (Y). The analysis aimed to determine the total effect (c), direct effect (c′), and indirect effect (a × b) of BMI on running pace through pre-exercise meal timing as the mediating pathway. Bootstrapping procedures with 5,000 resamples and bias-corrected 95% confidence intervals were used to assess the significance of the indirect (mediation) effect. An indirect effect was considered statistically significant if the confidence interval did not include zero. Age was included as a covariate to control for potential confounding influences on the relationships being tested. Prior to conducting the mediation analysis, assumption testing was performed. The Kolmogorov–Smirnov test was used to assess the normality of continuous variables. All variables met the assumption of normality ($p > 0.05$). Results were interpreted based on standardised regression coefficients (β) with a significance threshold set at $p < 0.05$. Effect sizes were evaluated using R^2 to determine the proportion of variance in running pace explained by the model.

RESULTS AND DISCUSSION

Results

Table 1 displays the distribution of data concerning age, Body Mass Index (BMI), meal timing prior to exercise, and running pace (min/km). The table presents an overview of the demographic characteristics and eating habits of the students participating in this study. The mean age of respondents was 19.12 years (range = 18-20). The participants exhibited an average BMI of 22.46 kg/m^2 (range = 15.57-40.16). The mean duration

since the last meal prior to running was 3.62 hours (range = 0.25-9), and the mean running pace of students was 7.36 minutes per kilometre (range = 3.79-12.1).

Table 1. Distribution of Data Regarding Age, BMI, Pre-Exercise Meal Timing, and Running Pace

Category	Min	Max	Mean (sd.)
Age	18	20	19.12(1.1)
BMI	15.57	40.16	22.46(4.56)
Pre-exercise meal	0.25	9	3.62(1.11)
Running pace	3.79	12.1	7.36(1.49)

Prior to conducting the mediation analysis, assumption tests were performed. The Kolmogorov–Smirnov test indicated that all continuous variables were normally distributed ($p > 0.05$), confirming that the data met the requirements for parametric statistical procedures.

Figure 1 illustrates the mediation model examining the relationship between BMI, pre-exercise meal timing, and running pace. The total effect of BMI on running pace was positive (B = 0.192, β = 0.589, $p < 0.001$), indicating that higher BMI values were associated with slower running pace. However, the indirect effect via pre-exercise meal timing was very small (B = -0.004, β = -0.004) and statistically non-significant (95% CI [-0.010, 0.001]). The direct effect of BMI on running pace (B = 0.062, $p < 0.05$) remained significant and represented the primary pathway of influence.

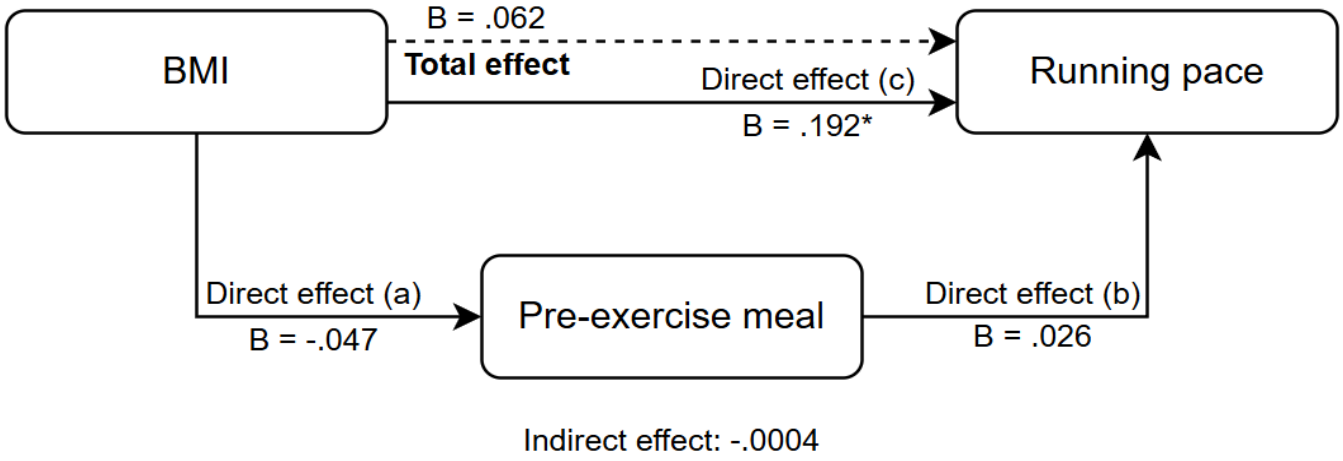

Figure 1. Results of Mediation Analysis

The results indicate that BMI has a stronger direct influence on running pace than the mediating role of meal timing, suggesting that performance outcomes are more physiologically than behaviourally determined in this sample. The effect size of the model was modest, explaining 24.3% of the variance in running pace ($R^2 = 0.243$). This indicates that while BMI is a meaningful predictor of running performance, approximately 76% of performance variability is attributable to other factors not captured in this model, such as cardiorespiratory fitness, training history, running biomechanics, and motivation. **Table 2** presents the detailed coefficients, standard errors, and confidence intervals from the mediation analysis.

Table 2. Summary of Mediation Analysis with Effect Sizes

Path	B	B	SE	95% CI (Bootstrapped)	p-value	Interpretation
BMI → Meal Timing (a)	-0.047	-0.193	0.012	[-0.070, -0.015]	0.002	Significant
Meal Timing → Running Pace (b)	0.026	0.019	0.015	[-0.004, 0.055]	0.089	Not significant
BMI → Running Pace (Direct, c′)	0.062	0.190	0.02	[0.022, 0.102]	0.003	Significant
BMI → Running Pace (Indirect, a×b)	-0.004	-0.004	0.002	[-0.010, 0.001]	0.121	Not significant
Model R^2	0.243		-	-	-	Moderate explanatory power

Note: B = unstandardized coefficient; β = standardized coefficient; SE = standard error; CI = confidence interval.

Overall, the mediation analysis revealed that the indirect pathway through pre-exercise meal timing did not reach statistical significance and contributed minimally to the model. The direct effect of BMI on running pace remained the dominant predictor, highlighting BMI's more substantial physiological role in influencing running performance among college students.

Discussion

The mediation analysis revealed that BMI significantly predicted running pace (B = 0.062, β = 0.190, p = 0.003), with the model explaining 24.3% of the variance in running performance (R^2 = 0.243)—a moderate effect size according to conventional benchmarks. This finding confirms that BMI serves as a substantial physiological predictor of endurance performance among college students. The mediating effect of pre-exercise meal timing, however, was negligible and statistically non-significant (B = -0.004, 95% CI [-0.010, .001]), suggesting that meal timing plays a limited role in explaining the relationship between BMI and running pace. These results align with previous studies indicating that anthropometric and physiological factors exert a stronger impact on endurance performance than short-term dietary behaviours (Sedeaud et al., 2014).

The small magnitude of the indirect effect may be explained by limited variability in students' meal timingbehaviour. Many college students have irregular eating schedules influenced by academic demands, leading to insufficient differences in pre-exercise meal timing to produce significant mediating effects. Furthermore, meal timing alone might not fully represent the nutritional context before exercise, as food composition and portion size were not controlled in this study (Burke et al., 2019).

The mediation failure highlights a fundamental distinction between behaviouralpatterns and physiological effects. Although students with higher BMI ate closer to exercise time (B = -0.047, p = 0.002), this timing variation did not influence running performance (B = 0.026, p = 0.089). This pattern aligns with systematic reviews showing that pre-exercise meal timing has negligible effects on endurance performance in college-aged recreational exercisers (Stratton et al., 2025). The disconnect occurs because meal timing alone does not determine nutrient availability; rather, meal composition, portion size, and individual metabolic responses collectively shape substrate utilisation (Burke et al., 2019). For moderate-intensity running typical of college students (mean pace 7.36 min/km), adequate glycogen stores are maintained through habitual dietary intake regardless of acute pre-exercise meal timing (Stratton et al., 2025). In contrast, BMI affects performance through chronic physiological adaptations—body composition, biomechanical efficiency, and cardiorespiratory capacity—that operate independently of short-term nutritional behaviours (Vincent et al., 2020). This explains why BMI remained a robust predictor while meal timing did not mediate the relationship.

BMI continues to serve as an important predictor of physical performance, as higher BMI values are generally associated with increased body mass that elevates energy expenditure and reduces running efficiency. Prior studies have shown that runners with higher BMI adopt compensatory biomechanical strategies—such as longer ground contact times or reduced stride frequency—to maintain stability, which can slow pace (Kyung Kim et al., 2024; Vincent et al., 2020). This pattern suggests that BMI affects running performance through biomechanical and metabolic pathways rather than pre-exercise nutritional habits.

Although meal timing was not a significant mediator, understanding nutritional strategies remains relevant for optimising endurance. Previous research has shown that consuming carbohydrates three to four hours before exercise can improve glycogen availability and reduce fatigue (Colberg et al., 2016; Ravindra et al., 2022). Moreover, combining appropriate meal timing with balanced macronutrient intake may have synergistic effects on performance (Burke et al., 2019). Future studies should therefore integrate both timing and nutrient composition to better capture their joint effect on performance.

This study's reliance on self-reported data represents an important limitation. Participants may have inaccurately recalled their last meal time or running duration, introducing potential recall bias. While previous work suggests that self-reported BMI can be reliable (Wirnitzer et al., 2022), the accuracy of self-reported running pace may vary depending on individuals' familiarity with tracking performance metrics. Future research should adopt objective measures such as wearable GPS tracking or digital food logs to improve data precision. Additionally, the cross-sectional design precludes causal inferences—longitudinal studies

manipulating meal timing experimentally would provide stronger evidence for (or against) its role in mediating BMI effects. Furthermore, the sample consisted of college students from a specific geographic and cultural context, which may limit generalisabilityto other populations, such as older adults, elite athletes, or individuals from different dietary cultures.

Despite these constraints, this study contributes valuable evidence by applying a mediation framework to explore how BMI and pre-exercise meal timing interact to influence running performance among college students. The findings establish a methodological basis for examining behavioural and physiological predictors of endurance performance in non-athletic pupulations and highlight the need for integrated health promotion strategies that address both body composition and nutritional literacy. Future research should expand this framework by incorporating additional mediators such as physical activity levels, sleep quality, cardiorespiratory fitness (VO_2 max), and chronic dietary patterns to build a more comprehensive model of performance determinants.

CONCLUSION

This study demonstrates that Body Mass Index (BMI) was positively correlated with running pace (min/km), meaning that individuals with higher BMI values tended to run more slowly. The mediating role of pre-exercise food consumption was minimal and not statistically significant, indicating that meal timing had a limited influence on running performance. Therefore, BMI remains the dominant factor affecting running pace, emphasising the physiological rather than nutritional determinants of performance among college students. Additionally, students with higher BMI values reported shorter time intervals between their last meal and exercise onset, suggesting behavioural adaptations possibly linked to weight control rather than performance optimisation. These findings underscore the need for integrated strategies that combine balanced nutrition and body composition management to improve endurance performance. Future research should incorporate objective measures of nutrition and performance, as well as a broader range of mediating variables, to provide a more comprehensive understanding of how health and fitness interact in young adult populations.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this article. The research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

REFERENCES

Alves, J. M., Yunker, A. G., DeFendis, A., Xiang, A. H., & Page, K. A. (2021). BMI Status and Associations Between Affect, Physical Activity and Anxiety among U.S. Children during COVID-19. *Pediatric Obesity*, *16*(9), e12786. https://doi.org/10.1111/ijpo.12786

Burke, L. M., Castell, L. M., Casa, D. J., Close, G. L., Costa, R. J. S., Melin, A. K., Sygo, J., Desbrow, B., Peeling, P., Witard, O. C., Halson, S. L., Saunders, P. U., Bermon, S., Lis, D. M., Slater, G. J., & Stellingwerff, T. (2019). International Association of Athletics Federations Consensus Statement 2019: Nutrition for Athletics. *International Journal of Sport Nutrition and Exercise Metabolism*, *29*(2), 73–84. https://doi.org/10.1123/ijsnem.2019-0065

Capsi, J., & Llopis-Goig, R. (2023). Understanding the Expansion of Running from a Social Practice Theory Perspective. A Case Study Focused on the City of Valencia. *Sport in Society*, *26*(1), 67–87. https://doi.org/10.1080/17430437.2021.1970139

Carballo-Fazanes, A., Rico-Díaz, J., Barcala-Furelos, R., Rey, E., Rodríguez-Fernández, J. E., Varela-Casal, C., & Abelairas-Gómez, C. (2020). Physical Activity Habits and Determinants, Sedentary Behaviour and Lifestyle in University Students. *International Journal of Environmental Research and Public Health*, *17*(9), 3272. https://doi.org/10.3390/ijerph17093272

Carrier, B., Helm, M. M., Cruz, K., Barrios, B., & Navalta, J. W. (2023). Validation of Aerobic Capacity (VO2max) and Lactate Threshold in Wearable Technology for Athletic Populations. *Technologies*, *11*(3), 71. https://doi.org/10.3390/technologies11030071

Colberg, S. R., Sigal, R. J., Yardley, J. E., Riddell, M. C., Dunstan, D. W., Dempsey, P. C., Horton, E. S., Castorino, K., & Tate, D. F. (2016). Physical Activity/Exercise and Diabetes: A Position Statement of the American Diabetes Association. *Diabetes Care*, *39*(11), 2065–2079. https://doi.org/10.2337/dc16-1728

Dempsey, P. C., Musicha, C., Rowlands, A. V., Davies, M., Khunti, K., Razieh, C., Timmins, I., Zaccardi, F., Codd, V., Nelson, C. P., Yates, T., & Samani, N. J. (2022). Erratum: Author Correction: Investigation of a UK Biobank Cohort Reveals Causal Associations of Self-Reported Walking Pace with Telomere Length (Communications Biology (2022) 5 1 (381)). *Communications Biology*, *5*(1), 498. https://doi.org/10.1038/s42003-022-03459-w

Edinburgh, R. M., Koumanov, F., & Gonzalez, J. T. (2022). Impact of Pre-Exercise Feeding Status on Metabolic Adaptations to Endurance-Type Exercise Training. *Journal of Physiology*, *600*(6), 1327–1338. https://doi.org/10.1113/JP280748

Guntoju, S., & Pramod, N. (2024). When You Eat is as Important as What You Eat - A Kap Study on Chrono Nutrition in Athletes. *International Journal of Science and Research (IJSR)*, *13*(7), 1120–1125. https://doi.org/10.21275/sr24722094818

Hayes, A. F. (2018). Partial, Conditional, and Moderated Moderated Mediation: Quantification, Inference, and Interpretation. *Communication Monographs*, *85*(1), 4–40. https://doi.org/10.1080/03637751.2017.1352100

Kyung Kim, H., Qu, H., & Chou, L. S. (2024). Center of Mass Motion and Plantar Pressure Distribution during Walking in Overweight Individuals. *Gait and Posture*, *108*, 307–312. https://doi.org/10.1016/j.gaitpost.2024.01.003

Lockie, R. G., Orr, R. M., Montes, F., & Dawes, J. J. (2023). Change-of-Direction Speed in Firefighter Trainees: Fitness Relationships and Implications for Occupational Performance. *Journal of Human Kinetics*, *87*, 225–233. https://doi.org/10.5114/jhk/161545

Ravindra, P. V, Janhavi, P., Divyashree, S., & Muthukumar, S. P. (2022). Nutritional Interventions for Improving the Endurance Performance in Athletes. *Archives of Physiology and Biochemistry*, *128*(4), 851–858. https://doi.org/10.1080/13813455.2020.1733025

Ribichini, E., Scalese, G., Cesarini, A., Mocci, C., Pallotta, N., Severi, C., & Corazziari, E. S. (2023). Exercise-Induced Gastrointestinal Symptoms in Endurance Sports: A Review of Pathophysiology, Symptoms, and Nutritional Management. *Dietetics*, *2*(3), 289–307. https://doi.org/10.3390/dietetics2030021

Scully, T., Ettela, A., LeRoith, D., & Gallagher, E. J. (2021). Obesity, Type 2 Diabetes, and Cancer Risk. *Frontiers in Oncology*, *10*, 615375. https://doi.org/10.3389/fonc.2020.615375

Sedeaud, A., Marc, A., Marck, A., Dor, F., Schipman, J., Dorsey, M., Haida, A., Berthelot, G., & Toussaint, J. F. (2014). BMI, A Performance Parameter for Speed Improvement. *PLoS ONE*, *9*(2), e90183. https://doi.org/10.1371/journal.pone.0090183

Stratton, M. T., Holden, S. L., Davis, R., & Massengale, A. T. (2025). The Impact of Breakfast Consumption or Omission on Exercise Performance and Adaptations: A Narrative Review. *Nutrients*, *17*(2), 300. https://doi.org/10.3390/nu17020300

Vincent, H. K., Kilgore, J. E., Chen, C., Bruner, M., Horodyski, M. B., & Vincent, K. R. (2020). Impact of Body Mass Index on Biomechanics of Recreational Runners. *PM and R*, *12*(11), 1106–1112. https://doi.org/10.1002/pmrj.12335

Wirnitzer, K., Tanous, D., Motevalli, M., Wirnitzer, G., Leitzmann, C., Pichler, R., Rosemann, T., & Knechtle, B. (2022). Prevalence of Female and Male Vegan and Non-Vegan Endurance Runners and the Potential Associations of Diet Type and BMI with Performance—Results from the NURMI Study (Step 1). *Nutrients*, *14*(18), 3803. https://doi.org/10.3390/nu14183803