CORRELATION BETWEEN PHYSICAL ACTIVITY, BODY MASS INDEX, AND HAND GRIP STRENGTH IN EARLY YEARS OF HEALTH SCIENCES UNDERGRADUATES

Hashini Madhurangi Wijayasinghe[1], Esther Liyanage[2]

[1]Department of Paediatrics, Faculty of Medicine, University of Peradeniya, Sri Lanka
[2]Department of Physiotherapy, Faculty of Allied Health Sciences, University of Peradeniya, Sri Lanka

Abstract. *Background:* Physical activity (PA), Body Mass Index (BMI), and Hand Grip Strength (HGS) collectively form integral components in gauging health and well-being. PA, spanning daily activities to structured exercise, influences body composition by expending energy, reducing fat stores, and enhancing muscle mass. BMI provides a standardized measure for assessing weight status, transcending age and gender, while HGS serves as a robust indicator of overall muscle potency. Understanding the interplay between these factors is crucial for comprehensive health assessment. *Objective:* To assess the correlation between PA, BMI, and HGS in early years of Allied Health Science undergraduates at the University of Peradeniya. *Methodology:* A descriptive cross-sectional design was employed, encompassing 212 second-year undergraduates from various Allied Health Science disciplines. Data collection included demographic information, anthropometric measurements, BMI assessment, PA level using International Physical Activity Questionnaire (IPAQ) short form and HGS evaluation using a hand dynamometer. Spearman's correlation test elucidated associations between PA, BMI, and HGS. *Results:* Significant positive correlations were observed between PA and HGS on both dominant (r=0.535) and non-dominant sides (r=0.546), indicating increased PA associated with enhanced HGS. A weak positive correlation emerged between BMI and HGS on both sides (r=0.282 dominant, r=0.276 non-dominant), highlighting a subtle connection. A very weak positive correlation was found between PA and BMI (r=0.144), emphasizing multifaceted influences on BMI. *Conclusion:* This investigation elucidates nuanced correlations among PA, BMI, and HGS in early health science graduates. The findings underscore the importance of holistic perspectives in health-related data interpretation. These insights inform targeted interventions to enhance PA and well-being among Health Sciences graduates, with broader implications for public health.

Keywords: Physical activity, Body Mass Index, Hand Grip Strength, Allied Health Sciences, Undergraduates.

Хашіні Мадхурангі Віджаясінхе, Естер Ліянаге
КОРЕЛЯЦІЯ МІЖ ФІЗИЧНОЮ АКТИВНІСТЮ, ІНДЕКСОМ МАСИ ТІЛА ТА СИЛОЮ СТИСКУ РУКИ В ПЕРШІ РОКИ НАВЧАННЯ СТУДЕНТІВ МЕДИЧНИХ НАУК

Анотація. *Передумови:* фізична активність (ФА), індекс маси тіла (ІМТ) та сила стиску руки (ССР) є невід'ємними компонентами оцінки здоров'я та самопочуття. ФА, що охоплює повсякденну діяльність та структуровані фізичні вправи, впливає на склад тіла, витрачаючи енергію, зменшуючи запаси жиру та збільшуючи м'язову масу. ІМТ є стандартизованим показником для оцінки вагового статусу незалежно від віку та статі, тоді як ССР слугує надійним індикатором загальної м'язової сили. Розуміння взаємодії між цими факторами має вирішальне значення для комплексної оцінки стану здоров'я. *Мета дослідження* – оцінити кореляцію між ФА, ІМТ та ССР у студентів перших курсів спеціальності «Науки про здоров'я» в Університеті Пераденії. *Методологія:* було застосовано описовий дизайн різних груп, який охопив 212 студентів другого курсу, які вивчали різні дисципліни суміжних наук про здоров'я. Збір даних включав демографічну інформацію, антропометричні вимірювання, оцінку ІМТ, вивчення рівня фізичної активності за допомогою короткої форми Міжнародного опитувальника рухової активності (IPAQ) та оцінку ССР за допомогою ручного динамометра. Коефіцієнт рангової кореляції Спірмена виявив зв'язок між ФА, ІМТ та ССР. *Результати*: значні позитивні зв'язки спостерігалися між ФА та ССР як на домінантній (r=0,535), так і на недомінантній стороні (r=0,546), що вказує на те, що підвищена ФА асоціюється з підвищеною ССР. Слабкий позитивний зв'язок виявлено між ІМТ та ССР з обох сторін (r=0,282 домінантна сторона, r=0,276 недомінантна сторона). Дуже слабка позитивна кореляція була виявлена між ФА та ІМТ (r=0,144), що підкреслює багатогранний вплив на ІМТ. *Висновок:* дослідження встановило нюанси кореляції між ФА, ІМТ та ССР у студентів молодших курсів медичних факультетів. Отримані результати підкреслюють важливість цілісного підходу до інтерпретації даних, пов'язаних зі здоров'ям. Ці висновки допоможуть розробити цільові заходи, спрямовані на підвищення рівня фізичної активності та покращення самопочуття серед студентів медичних факультетів, що позитивно впливатиме на громадське здоров'я.

Ключові слова: фізична активність, індекс маси тіла, сила стиску руки, суміжні медичні науки, студенти.

Introduction
Physical Activity, Body Mass Index and Hand Grip Strength

Physical activity (PA), encompassing a spectrum of movements from daily tasks to structured exercise, is instrumental in shaping body composition (Maddison et al., 2007). Increased activity levels lead to higher energy expenditure, consequently reducing fat stores and enhancing muscle mass (Westerterp, 2015). The International Physical Activities Questionnaire (IPAQ) provides a standardized framework for categorizing activity levels, highlighting the importance of maintaining an active lifestyle for optimal health outcomes (Maddison et al., 2007). Body Mass Index (BMI) serves as a valuable tool in assessing an individual's weight status in relation to their height (Khanna et al., 2022). It offers insights into overall health and

nutritional well-being, categorizing individuals into underweight, normal weight, overweight, or obese (Khanna et al., 2022). Despite its widespread application, BMI values transcend age and gender, allowing for a universal assessment of weight status (Gutin & Hill, 2019) Grip strength, denoted as Hand Grip Strength (HGS), encompasses the force exerted by the hand to grasp, pull, or suspend an object (Lameira et al., 2019). This metric stands as a dependable gauge for evaluating the operational proficiency of the hand and its gripping capabilities (Lameira et al., 2019). Age, gender, BMI, and hand dominance are among the various factors known to influence these values (Ertem et al., 2005). Additionally, the robustness of skeletal muscles hinges on an array of elements, including physique, composition, physical exertion, and hormonal

milieu. (Ertem et al., 2005) HGS serves as an encompassing reflection of overall muscle potency and physical fitness, thus emerging as a potent indicator of bodily strength (Lameira et al., 2019). HGS provides valuable insights into overall muscle potency and PA, making it a potent indicator of bodily strength (Lameira et al., 2019).

Relationship between Physical Activity and Body Mass Index

One previous study underscores the inverse relationship between PA and BMI, with heightened activity levels correlating with lower susceptibility to cardiac injury and obesity (Strasser, 2013). This phenomenon is particularly pertinent in combatting the rising prevalence of obesity, especially among females. Encouraging PA emerges as a pivotal strategy in mitigating surplus body fat and promoting overall physical well-being (Romieu et al., 2017).

The Influence of Physical Activity on Hand Grip Strength

Studies consistently demonstrate significantly lower HGS among sedentary individuals compared to their physically active counterparts engaged in regular sports activities (Park et al., 2020). This reinforces the utility of HGS in identifying sedentary tendencies within a population and predicting susceptibility to non-communicable ailments. However, it is imperative to consider various influencing factors when interpreting HGS values (Ramesh & Kosalram, 2023).

The Intersection of Body Mass Index and Hand Grip Strength

While some studies suggest an inverse correlation between BMI and HGS (Dhananjaya et al., 2017; Wen et al., 2022), others propose a positive correlation between BMI and HGS (Liao, 2016; Park et al., 2020). The relationships between these parameters remain a subject of ongoing investigation. This study seeks to bridge this gap by undertaking a comprehensive comparative analysis, shedding light on the nuanced interplay between BMI, HGS, and HGE among early health science graduates.

Understanding the intricate relationships between PA, BMI, and HGS is of paramount importance in promoting holistic health among early health science graduates. This study endeavors to contribute to the growing body of knowledge in this field, ultimately paving the way for more targeted interventions and strategies to optimize health outcomes in this demographic. Through a comprehensive analysis, we aim to unravel the multifaceted interactions that underlie these vital health parameters, ultimately advancing our understanding of holistic health in early health science graduates.

Justification

The assessment of the correlation between physical activity (PA), body mass index (BMI), and hand grip strength (HGS) in the early years of Allied Health Science undergraduates at the University of Peradeniya is of paramount importance for several compelling reasons. Firstly, understanding these intricate relationships is essential in promoting comprehensive health and well-being among students pursuing careers in the allied health sciences. These disciplines play a critical role in the healthcare sector, requiring practitioners to possess both physical aptitude and academic prowess. By examining the associations PA, BMI, and HGS, we aim to provide valuable insights that can inform tailored interventions and training programs, ultimately enhancing the overall proficiency and resilience of these future healthcare professionals.

The selection of Allied Health Science undergraduates at the University of Peradeniya serves as an ideal cohort for this study due to the institution's comprehensive curriculum that encompasses a diverse range of disciplines including Radiography/Radiotherapy, Physiotherapy, Nursing, Pharmacy, and Medical Laboratory Sciences. This inclusivity ensures that the research findings will be broadly applicable across the spectrum of allied health professions, enriching the collective knowledge base of the field. Furthermore, targeting students in their second year, before the initiation of clinical practice in their third year, allows us to capture a baseline assessment of their physical health status. This early-stage assessment empowers us to implement preventive measures and tailored interventions that can significantly impact the long-term health and effectiveness of these budding healthcare practitioners. The University of Peradeniya's esteemed reputation for academic excellence and research provides an optimal environment for conducting this study, offering access to state-of-the-art facilities and a diverse student population, thereby ensuring the robustness and validity of our findings.

Objective

To assess the correlation between physical activity (PA), body mass index (BMI), and hand grip strength (HGS) in the early years of Allied Health Science undergraduates at the University of Peradeniya.

Methodology

The study employed a descriptive cross-sectional design, aimed at investigating the correlation between physical activity (PA), body mass index (BMI), and hand grip strength (HGS) among second-year undergraduates within the Faculty of Allied Health Sciences at the University of Peradeniya. The study was conducted exclusively within the premises of the Faculty of Allied Health Sciences at the University of Peradeniya, providing a controlled and focused setting for data collection.

The target population for this study comprised all second-year undergraduates enrolled in the Faculty of Allied Health Sciences at the University of Peradeniya. This comprehensive approach ensured a representative sample that encapsulated the diversity of students across the five departments, including Nursing, Pharmacy, Physiotherapy, Radiography/Radiotherapy, and Medical Laboratory Sciences. Inclusion criteria were established to ensure the participants met specific eligibility requirements. Participants were required to be registered undergraduates of the Faculty of Allied Health Sciences and fall within the age range of 20 to 30 years. Exclusion criteria were applied to mitigate potential confounding factors. Undergraduates with chronic illnesses or disabilities, those actively participating in University or other-level sports teams, and those engaged in regular physical exercise routines were excluded from the study.

Permission to conduct the study was obtained from the respective department heads within the Faculty of Allied Health Sciences. From the pool of consenting participants who met the inclusion criteria, the sample was selected from each department for data collection. Data collection was facilitated through a structured data collection sheet, divided into two main sections. The first section gathered demographic information, including age, gender, department, anthropometric measurements, BMI, and handedness, disability, or chronic

illness and PA level using International Physical Activity Questionnaire (IPAQ) short form. The second section was dedicated to assessing HGS, a pivotal metric for evaluating muscular strength. HGS measurements were obtained using a hand dynamometer, with three consecutive measurements taken per hand, allowing a 30-second rest period between each measurement. This approach followed established protocols for accurate and reliable grip strength assessment. Ethical clearance for the study was obtained from the Ethics Review Committee of the Faculty of Allied Health Sciences at the University of Peradeniya, ensuring the protection of participants' rights and confidentiality. All collected data were securely stored, and individual participant details were kept strictly confidential, in compliance with ethical guidelines.

Results

The study involved the analysis of data obtained from 212 graduates in the field of Health Sciences from the University of Peradeniya. The subjects were from Medical Laboratory Sciences (n=28), Nursing (n=48), Pharmacy (n=28), Physiotherapy (n=46) and Radiography/Radiotherapy (n=62) departments. There were 61 male undergraduates and 151 female undergraduates recruited for the study. Among them, 199 students' dominant hand was right, and 13 students' dominant hand was left. The average age of the participants was 23 ± 1 year. The demographic attributes of the study cohort are presented in Table 1.

Correlation between PAL, BMI and Hand Grip Strength

The results of Spearman's correlation test for correlation between PAL, BMI and HGS is presented in Table 2.

Spearman's correlation coefficient (r) is a statistical metric used to quantify the degree of a monotonic association between paired data points. These are the cut off marks for the correlation coefficient (Alsaqr, 2021).

.00-.19: Very Weak
.20-.39: Weak
.40-.59: Moderate
.60-.79: Strong
.80-1.0: Very Strong

The findings from Table 2 revealed that there was a moderate positive correlation between PA level and hand grip strength on the dominant and non-dominant sides (dominant side r=0.535, p value<0.05; non-dominant side r-0.546, p value<0.05). Also there was a weak positive correlation between BMI and HGS on both dominant and non-dominant sides (dominant side r=0.282, p value<0.05; non-dominant side (r=0.276, p value<0.05). There was a very weak positive correlation between PA level and BMI (r=0.144, p value<0.05).

Discussion

The primary aim of this investigation was to assess the correlation between physical activity (PA), body mass index (BMI), and hand grip strength (HGS) in the early years of Allied Health Science undergraduates at the University of Peradeniya.

Previous research emphasized a robust connection between physical activity and various attributes such as body strength, shape, size, form, BMI and overall structure of an individual (Malina et al. 1987; Ross & Rösblad 2002). Aligning with this established literature, the present study further

Table 1

Demographic characteristics of the participants

		Age (years)	Height (m)	Weight (kg)	Body Mass Index (kgm⁻²)	HGS in Dominant hand (kg)	HGS in nondominant hand (kg)
Male(N=61)	Mean	22.77	1.6359	59.7138	22.4472	38.8494	37.2108
	Std. Deviation	.739	.07469	7.73795	3.45207	6.60409	6.69930
	Range	3	.29	36.00	14.34	36.00	28.50
Female(N=151)	Mean	22.83	1.5525	52.4404	21.9344	19.9636	18.3610
	Std. Deviation	.752	.06218	8.76447	3.49673	7.39535	6.95991
	Range	4	.45	56.00	18.70	57.80	49.07
Total (N=212)	Mean	23	1.58	54.53	22.08	25.4	23.78
	Std. Deviation	1	.08	9.08	3.48	11.17	10.97
	Range	4	.55	56	17.70	57.8	49.07

HGS, Hand Grip Strength

Table 2

Correlation between PAL and BMI, and HGS (N = 212)

	HGS in dominant side	HGS in nondominant side
PAL	p-.000** r-.535	p-.000** 546
BMI	p=.000** r=0.282	p=.036* r=0.276

*BMI, BodyMass Index; HGS, Hand Grip Strength; PAL, Physical Activity Level, ** p<0.05 Correlation is significant at the 0.01 level (2-tailed), * p<0.05 Correlation is significant at the 0.05 level (2-tailed)*

substantiates these associations by revealing a significant positive correlation between PA, BMI, and both dominant and nondominant HGS across male and female students. This correlation may be attributed, in part, to physiological mechanisms that underscore the intricate relationship between PA and body composition. For instance, regular PA has been shown to influence muscle mass and fat distribution, both of which contribute to variations in BMI and grip strength (Matei et al., 2023). The engagement in PA stimulates muscle protein synthesis, leading to muscle hypertrophy and increased strength over time. Simultaneously, it promotes the oxidation of fatty acids, reducing adipose tissue and positively influencing BMI (Distefano & Goodpaster, 2018).

Additionally, exercise can enhance cardiovascular health, potentially influencing the overall physiological efficiency that manifests in improved HGS. Aerobic activities, in particular, contribute to increased blood flow, optimizing nutrient and oxygen delivery to the muscles (Nystoriak & Bhatnagar, 2018). This vascular enhancement not only supports muscle function during exercise but also contributes to the overall endurance and strength observed in grip measurements(Pollock et al., 2000). Improved cardiovascular fitness may also positively impact the functioning of the neuromuscular system, leading to better coordination and control, further enhancing HGS (Pollock et al., 2000).

These findings suggest that beyond the observed statistical correlations, there exist intricate physiological reasons for the interplay between PA, BMI, and HGS, providing a more comprehensive understanding of the complex connections among these factors.

Our findings, illuminate a moderate positive correlation between PA level and HGS on both the dominant ($r = 0.535$, $p < 0.05$) and non-dominant sides ($r = 0.546$, $p < 0.05$). This denotes that heightened levels of PA are associated with increased hand grip strength among Health Sciences graduates. Notably, a weak positive correlation emerged between BMI and HGS on both dominant ($r = 0.282$, $p < 0.05$) and non-dominant sides ($r = 0.276$, $p < 0.05$). This weak association aligns with existing literature, suggesting a complex interplay between BMI and muscle strength (Morse & Onambe, 2016).

On top of that, a very weak positive correlation was discerned between PA level and BMI ($r = 0.144$, $p < 0.05$), highlighting a minimal association between PA level and BMI. This finding underscores the multifaceted nature of factors influencing BMI (Mahmoud, 2022). This indicates that BMI is influenced by a complex interplay of various factors beyond just PA levels. Factors such as dietary habits, genetic predispositions, metabolic rates, and other lifestyle elements may collectively contribute to the observed variations in BMI (Mahmoud, 2022).

While our statistical findings reveal these correlations, delving into the physiological aspects provides a deeper understanding of the observed relationships. The positive correlation between PA level and HGS could be attributed to the physiological adaptations induced by regular PA, including increased muscle mass, improved neuromuscular coordination, and enhanced overall muscle function (Shah et al., 2022). Similarly, the weak positive correlation between BMI

and HGS may reflect the influence of body composition on muscle strength, where individuals with higher muscle mass, possibly resulting from increased PA, tend to exhibit stronger hand grip (Mahmoud, 2022).

Moreover, the minimal association between PA level and BMI suggests that factors beyond PA contribute significantly to variations in BMI. Physiologically, this could be explained by the intricate balance between energy expenditure through PA and energy intake from dietary habits and other metabolic processes (Liao, 2016). Genetic predispositions and individual metabolic rates further contribute to the complexity of BMI regulation (Lad et al., 2012). These physiological insights enrich our understanding of the correlations observed, emphasizing the need for a holistic perspective that considers both lifestyle and inherent factors in interpreting the relationships among PA level, HGS, and BMI in Health Sciences graduates (Lad et al., 2012).

These results hold significant implications, particularly in the context of early undergraduate education. The positive correlation between PA level and HGS suggests that incorporating PA into educational programs may contribute to the development of HGS in Health Sciences students. This insight could inform curriculum planning, encouraging institutions to integrate PA initiatives that not only promote overall health but also potentially enhance specific physical attributes like hand grip strength, which could be beneficial for future healthcare professionals.

Considering the weak positive correlation between BMI and HGS, it becomes essential to explore whether targeted exercise programs designed to improve muscle strength could have positive effects on BMI regulation. This opens avenues for further research into the potential use of HGS as an outcome measure in exercise interventions aimed at managing body composition.

Moreover, the minimal association between PA level and BMI underscores the need for a holistic approach to address factors influencing BMI beyond PA levels. This emphasizes the importance of incorporating comprehensive lifestyle interventions in educational settings, encompassing dietary education, genetic awareness, and metabolic health promotion to effectively manage BMI among Health Sciences graduates.

Conclusion

In conclusion, the present investigation has unveiled a nuanced spectrum of correlations within our cohort of Health Sciences graduates. We observed a moderate positive correlation between Physical Activity Level (PAL) and hand grip strength (HGS) on both dominant and non-dominant sides. Additionally, a weak positive correlation manifested between Body Mass Index (BMI) and HGS across both dominant and non-dominant sides. Furthermore, a very subtle positive correlation was identified between PAL and BMI.

These findings underscore the imperative of embracing a comprehensive perspective when deciphering and situating health-related data. The intricate associations uncovered here not only contribute to the existing body of knowledge but also hold potential implications for devising interventions and strategies geared towards enhancing PA and overall well-being among Health Sciences graduates and, by extrapolation, the wider population.

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ІНФОРМАЦІЯ ПРО АВТОРІВ

Хашіні Мадхурангі Віджаясінхе hashinimadurangi624@gmail.com
кафедра педіатрії, медичний факультет, Університет Пераденія,
шосе Кінзі, Коломбо – 08, Шрі-Ланка
Естер Ліянаге https://orcid.org/0000-0001-5967-8025, estherl@ahs.pdn.ac.lk
кафедра фізіотерапії, факультет суміжних медичних наук, Університет Пераденія,
Августа Хілл, Шрі Амараванса Маватха, Пераденія, Шрі-Ланка

INFORMATION ABOUT THE AUTHORS

Hashini Madhurangi Wijayasinghe hashinimadurangi624@gmail.com
Department of Paediatrics, Faculty of Medicine, University of Peradeniya,
Kynsey Road, Colombo – 08, Sri Lanka
Esther Liyanage https://orcid.org/0000-0001-5967-8025, estherl@ahs.pdn.ac.lk
Department of Physiotherapy, Faculty of Allied Health Sciences, University of Peradeniya,
Augusta Hill, Sri Amarawansa Mawatha, Peradeniya, Sri Lanka