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Original article

Relationship between body mass index and agility of female undergraduates in Faculty of Medicine, University of Colombo, Sri Lanka

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ABSTRACT

Background & Aim: Agility is the ability to change direction quickly. Main factors influencing a person's agility are speed, strength, coordination, balance and body type. Body type is more commonly known as body mass index (BMI). The purpose of this study was to determine the relationship of agility with height, weight and BMI among female undergraduates in Sri Lanka.

Methods: A cross-sectional analytical study was conducted on a sample of 96 female undergraduates of the Faculty of Medicine, University of Colombo, Sri Lanka selected by non-probability sampling. Agility was measured using 4 x 10m shuttle run test. Data was analysed using relevant descriptive and inferential statistics on SPSS version 23. Ethical clearance was obtained from the Faculty of Medicine, University of Colombo, Sri Lanka.

Results: The mean age of the study sample was 23.69 (standard deviation [SD]=1.348) years. Mean BMI was 21.2(SD=3.87) kg/m2 and mean 4 x 10 m shuttle run test completion time (agility time) was 15.91(SD=1.62) seconds. Statistically significant positive correlation was present between weight and agility ($r=0.394$, $p<0.001$) and BMI and agility ($r=0.396$, $p<0.001$). There was no significant correlation between height and agility ($r=0.050$, $p=0.630$).

Conclusions & Recommendations: A weak but significant positive correlation was found between both BMI and agility, and weight and agility, among female undergraduates indicating that higher BMI and body weight are associated with lower agility levels. In contrast, no significant relationship was observed between height and agility, suggesting that height does not have a measurable impact on agility in this population.

Keywords: *agility, body mass index, undergraduates*

Introduction

Physical fitness is the capacity to carry out everyday activities with vigour and alertness without experiencing undue fatigue and with the energy to engage in leisure activities and respond to emergencies. There is a strong correlation between physical fitness and overall health, with fitter individuals generally experiencing better health outcomes (1). There are two categories of physical fitness: health-related and motor-related. Cardiorespiratory endurance, muscle strength, muscular endurance and flexibility are physical fitness factors related to health. Power, agility and balance are physical fitness elements related to motor function (2).

Agility is the ability to move quickly and change velocity or direction in reaction to a stimulus (3). It is also defined as the capacity to hold one's proper body position under control while fast-changing directions through a sequence of motions (4). Agility includes rapid reactions, coordination, balance, speed and the ability to react appropriately to changing circumstances. Agile is being able to react to environmental inputs and translate them into bodily positions that will keep a person in balance and under control (4).

The main factors that influence a person's agility are genetic factors; others include speed, strength, coordination and balance (ref). Boys and girls do not differ before puberty, but after adolescence, boys perform with greater agility than girls (5). Agility is important in many sports and physical activities. Shuttle runs are commonly used both as a training exercise to enhance athletic agility and as a standard test to assess it.

Dynamic balance refers to the capacity to maintain control of a moving centre of mass over a shifting base of support (ref). Agility training can help with this. Exercises that enhance our quickness and reactivity strengthen our natural reflexes and help us move more quickly during our daily activities. According to Liu-Ambrose et al. (2004), older women's balance confidence increases with resistance or agility exercises (6). Therefore, agility plays a major role in maintaining body balance. It causes a minimized risk of falling.

Body types influence agility. A person's body type is more commonly assessed by body mass index (BMI). The global rise in overweight and obesity rates is becoming a growing concern for health and education professionals. Various factors contribute to this trend, including genetic susceptibility to obesity, lack of physical activity, low physical fitness, and poor lifestyle choices (7). Several studies have explored the association between agility and BMI (8-14), but there is a lack of research specifically focusing on university students, particularly in Sri Lanka. Both agility and BMI play a significant role in determining health outcomes, fitness levels, and the prevalence of non-communicable diseases.

University students, as representatives of Sri Lanka's youth, were an ideal group for this study. While males may tend to be more engaged in outdoor activities, females tend to avoid physical activities due to concerns about injuries and lack of confidence in their fitness. Therefore, improving agility, particularly among young women, is crucial for enhancing their overall physical health and fitness. In the Sri Lankan context, female students often face additional social and environmental barriers, such as limited access to safe exercise spaces, conservative social norms, and academic pressure that reduce their participation in regular physical activity. These context-specific factors may influence the relationship between BMI and agility in ways not captured in studies conducted elsewhere.

Examining the relationship between agility and BMI is important for understanding how body composition affects physical performance. Agility, which involves quick and controlled movements, can be influenced by factors like muscle mass, body fat, and overall fitness levels. Higher BMI, often associated with excess body fat, may lead to reduced agility due to the additional weight, which can strain the body, making it harder to move quickly and efficiently. Conversely, individuals with lower BMI may experience better agility due to less body fat, allowing for faster and more coordinated movements (8). Studying this relationship may help identify students who could benefit from targeted fitness programs to improve both their agility and overall health. Additionally, understanding how BMI impacts agility enables the tailoring of fitness strategies to promote physical well-being, reduce injury risk, and enhance students' physical and mental performance, creating a healthier and more active university community. These findings may inform culturally appropriate interventions and public health policies aimed at encouraging active lifestyles among young women in similar settings.

Methods

Study design and participants

This analytical cross-sectional study aimed to examine the relationship between BMI and agility among female undergraduates at the University of Colombo. The study took place at the girls' hostels of the University. The study population consisted of 96 female undergraduates aged 20-30 years from the Faculty of Medicine, representing young adults in the country. The sample size of 96 was chosen based on feasibility, considering the number of eligible participants available during the study period and practical limitations. Participants were selected using convenience sampling, based on their availability and willingness to participate. This sampling approach may introduce selection bias, which is acknowledged as a limitation of the study. Inclusion criteria included Sri Lankan nationality, current enrolment at the Faculty of Medicine, and provision of informed written consent. Exclusion criteria included students engaged in physical activity or exercise programs likely to affect BMI; those with musculoskeletal, neurological, or cardiorespiratory diseases; individuals with musculoskeletal injuries; and those with cognitive impairments or mental health disorders.

Data collection

Data collection involved several steps. Participants filled out a self-administered questionnaire, which gathered personal information, medical history, and other relevant details to assess their eligibility. Participants' weight and height were measured using a stadiometer and a digital body scale, and their BMI was calculated using the standard formula: BMI =Weight(kg)/Height^2(m^2). Measuring tools such as a tape measure, stopwatch, marker cones, and wooden blocks were also utilized during the agility test. The test was chosen for its simplicity and practicality, requiring less space and no new skills for the participants.

The height was measured with a PRESTIGE™ portable stadiometer, ensuring a straight posture. Measurements were taken twice and the average value was recorded to the nearest millimetre. For weight measurement, participants were asked to remove extra layers of clothing and stand on the EUROSONIC™ digital weighing scale, ensuring even distribution of weight. Weight was also measured twice and averaged and recorded to the nearest 0.1 kg. To assess agility, participants performed the 4x10 m shuttle run test, running back and forth between two 10-meter lines, picking up wooden blocks, and running back to the starting line. The best time from the two trials was recorded, with a 10-minute rest period between tests. All assessments were conducted by a single trained examiner to ensure intra-rater reliability, minimise variability in measurement, and enhance consistency across participants. All measurements were conducted under supervision, ensuring accuracy and consistency. The entire data collection process took approximately 30 minutes.

Statistical analysis

SPSS version 23.0 was used to perform standard descriptive and inferential statistical analyses. The relationships between height and agility, weight and agility, BMI and agility were analysed using Pearson's correlation. The level of statistical significance was set at $p<0.05$. Results with $p<0.001$ were considered highly significant. Before applying Pearson's correlation, the assumptions of normality, linearity, and homoscedasticity were assessed. Normality was assessed via the Shapiro-Wilk test and visual inspection of histograms. Linearity and homoscedasticity were examined using scatterplots.

The assumptions were found to be adequately met, justifying the use of Pearson's correlation. Effect sizes for Pearson's correlations were interpreted according to Cohen's (1988) conventions: r=0.1 was considered a small effect, r=0.3 a medium effect, and r=0.5 a large effect. These benchmarks were used to contextualize the practical significance of the relationships.

Ethical considerations

Ethical approval was obtained from the Ethics Review Committee of the Faculty of Medicine, University of Colombo, Sri Lanka (ERC reference number: UCP/AL/17/418). Permission to conduct the study was received from the Dean, Faculty of Medicine, University of Colombo, and the Head, Department of Allied Health Sciences, Faculty of Medicine, University of Colombo. Each participant was informed about the research procedure and voluntary participation. Informed consent was obtained through a consent form prior to data collection.

Results

Demographic and anthropometric characteristics of the subjects

The study sample consisted of individuals between 21-26 years (n=96). The mean age of the participants was 23.69 (SD=1.348) years.

Table 1 includes a descriptive analysis of the anthropometric characteristics, which gives a basic profile of the study subjects. Weight, BMI, and agility time were normally distributed, whereas height was not.

Table 1. Descriptive analysis of the demographic and anthropometric characteristics

Characteristic	Mean	Median	Standard deviation
Weight(kg)	52.30	51.40	10.20
Height(m)	1.568	1.566	0.059
BMI(kg/m^2)	21.25	20.66	3.87
Agility time(s)	15.91	16.01	1.62

Abbreviations: kg: kilogram, m: meter, kg/m^2: kilograms per square meter, s: second

Table 2. Relationship between height, weight and BMI with agility time

Body composition	Agility time	
	Pearson correlation (r)	Significance (*p*)
Weight	0.050	0.630
Height	0.394	<0.001*
BMI	0.396	<0.001*

**p<0.001, statistically significant*

Relationship between height, weight and BMI with agility

Results for Pearson's test for correlation between height and agility time are given in table 2. A weak positive correlation was found between participants' weight and agility time (r=0.394, p<0.001). A very weak, non-significant correlation was found between height and agility time (r=0.050, p=0.630, p>0.05). A weak but significant relationship was found between BMI and agility time (r=0.396, p<0.001) for BMI and agility time.

Discussion

The results of the present study highlight that there is a weak but significant positive correlation between BMI and agility time (r=0.396, p<0.001), meaning that higher BMI was linked to slower agility. Similarly, weight showed a weak but significant positive correlation with agility time (r=0.394, p<0.001), indicating that heavier participants tended to be less agile. However, height had a very weak and non-significant correlation with agility time (r=0.05, p=0.63); therefore, it was not related to agility in this group.

WHO expert consultation suggests that the Asian population has different relationships between BMI, body fat, and risk factors for various health conditions. BMI values are categorized as underweight, healthy weight, overweight and obesity according to the Centres for Disease Control and Prevention (CDC) classification (8). However, in the present study, BMI values were recorded as continuous data. The mean BMI value (21.25 kg/m^2) of the study population falls within the normal weight category. This is consistent with a study done in India to identify the relationships of height, weight and BMI with agility and speed of male university players, which found that the mean BMI is within the normal weight category (9).

Another study done in Spain to quantify the effect size of overweight on the results of speed-agility in adolescents and to report percentile tables based on sex, age and BMI showed similar results to our study. They stated that most of the female adolescents were in the normal weight category (21.89 kg/m^2) (10). However, this study was done in Spain, representing a different geographical location and in secondary school students, which may have caused differences in the results.

In the present study, the mean agility time was 15.91 (SD=1.62) seconds. This is comparable to a study done in India, to investigate the relationships of height, weight and BMI with agility and speed of male kabaddi players. In that study, agility was measured by 4x10 m shuttle run test and time recorded in seconds, which was the same test that was used in our study. According to the author, the mean agility time was 10.849 (SD=0.788) seconds (11). The current study showed a comparatively significant increase in mean agility time. However, the study sample was different, being a non-athletic female group compared to the Indian study.

Agility is affected by skeletal muscle strength, coordination and flexibility (12). In the present study, the significant increase in agility time could be due to the difference in skeletal muscle strength, coordination and flexibility.

In our study, no significant correlation was found between height and agility (r=0.05, p=0.63), indicating that height was not related to agility performance in this sample. This is compatible with a study that was conducted to assess the relationship of height, weight and BMI with agility and speed of male kabaddi players. They reported that there was no relationship between height and agility (r=0.174, p>0.05) (11). A study carried out in India found the same result. There was no significant correlation found between height and agility among university players (13). While our study found no significant relationship between height and agility, contradictory evidence exists in the literature. A study of male soccer players aged 10-16 years reported that height was significantly positively correlated with agility performance in 13–14-year-olds ($r=0.28$, $p<0.05$) but showed no significant correlations in younger or older age groups (15). These conflicting findings suggest that the height-agility relationship may be population-specific and influenced by factors such as age, maturation status, and athletic training, which may explain why our study of female university students found no significant association.

Based on the present study findings, there was a significant positive relationship between weight and agility ($r=0.0394$, $p<0.01$). In contrast, one study observed that there was a moderate to strong positive link between body weight and the 505-agility test score for female softball players ($r=0.71$, $p<0.05$) (16). Rugby players' body fat was assessed by Webb and Lander in 1983, and they found a slight positive association ($r=0.21$, $p<0.05$) between body fat and direction changing speed (17). Weight and agility were found to have a significant link ($r=0.57$, $p<0.05$) in another study (11). The current study found a weak positive association between BMI and 4x10 m shuttle run test. This result was lower than the correlation found in the softball study but stronger than the one reported in the rugby study. These differences may be due to the athletic background and fitness levels of the participants in other studies.

The results of the current study showed that there was a weakly significant positive relationship between BMI and agility ($r=0.396$, $p<0.01$). Similar to these findings, one study (17) reported that there was a significant positive relationship between BMI and agility ($r=0.546$, $p<0.05$), but the strength of that relationship was not given, limiting comparisons with the current study. A study done in India concluded that there was no significant relationship between BMI and agility among elementary school students in grades two to six (12). However, the comparatively older age in our study may have caused the difference in the result.

Another study done to analyse the effects of training on agility by the sidestep test and flexibility by the sit and reach flexibility tester to determine the effect of skin fold thickness and BMI on agility and flexibility among runners found that there was no correlation of agility and flexibility with skin fold thickness and BMI (18). In this study, they used the sidestep test to measure agility instead of the 4x10 m shuttle run test used in our study.

A study done on female university students in South Telangana also found a significant positive relationship between BMI and speed ($r=0.21$, $p<0.05$), and between weight and speed ($r=0.24$, $p<0.05$), but no significant link between height and speed ($r=0.11$, $p<0.05$) (19). These results are similar to our study findings. This further shows a common pattern across different groups of female university students, suggesting that weight and BMI may positively affect how well a person performs in agility or speed tasks, while height seems to have less impact.

As the sample size in this study was limited and restricted to the 21–26 age group, future research should include a larger and more diverse sample. Important factors such as academic year, exercise habits, diet, stress, and overall lifestyle were not assessed, which may influence BMI and agility. The analysis was limited to Pearson's correlation, which explores linear relationships between continuous variables. While appropriate for the study objective, categorizing BMI into standard classifications (e.g., underweight, normal, overweight) and comparing agility across these subgroups could have provided additional insight. Future studies may benefit from incorporating subgroup analyses to enhance interpretability and clinical relevance. In addition, the use of convenience (non-probability) sampling may introduce selection bias, potentially limiting the generalizability of the findings. Some data were obtained through self-reporting (e.g., medical history and physical activity), which could be subject to recall or reporting bias. Moreover, the cross-sectional nature of the study limits causal inference; longitudinal studies would be useful to assess changes over time.

Based on the findings, students should be encouraged to maintain a healthy BMI, and targeted agility training programs can be developed by health care professionals and trainers to improve posture control and reduce injury risk. The findings have important implications for university health promotion programs. Given the association between higher BMI and reduced agility, targeted interventions such as structured fitness programs, physical activity promotion, and nutrition education may help students maintain a healthy BMI and improve physical performance. These results can also inform university wellness policies and public health strategies aimed at young adults.

Conclusions

There was a weak but significant positive correlation between the BMI and agility, indicating that higher BMI was associated with lower agility. Similarly, a weak but significant positive correlation was found between weight and agility time, suggesting that increased body weight was linked to reduced agility. In contrast, no significant correlation was observed between height and agility, indicating that height did not have a measurable impact on agility in this population.

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Author Declarations

Competing interests: The authors declare that they have no competing interests.

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