

Original Research Article

Stronger Legs, Quicker Moves: Why Body Mass Didn't Stand in the Way of Agility

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Received: May 2, 2025
Accepted: May 15, 2025
Published: June 30, 2025

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Abstract: This study investigated the mediating effect of body mass index (BMI) on the relationship between leg power and agility among college students enrolled in Physical Activity Towards Health and Fitness (PATHFit) classes on Camiguin Island. Grounded in the Biomechanical Principles of Force and Momentum, which suggest that greater body mass may hinder acceleration despite muscular force, the research examined whether BMI impairs agility by limiting the influence of muscular power. A total of 165 students aged 18 to 25 participated, with measurements taken for BMI (using World Health Organization standards), leg power (using the Sprint Power Test), and agility (using the Illinois Agility Test). A significant negative correlation was found between leg power and agility; however, no significant mediating effect was observed from BMI. While higher BMI was individually associated with poorer agility and greater leg power—possibly due to increased absolute force from higher body mass—it did not account for the overall power-agility link. These findings highlight the critical role of muscular strength in agility performance and suggest that PE interventions should prioritize leg power development over BMI-based categorization. The study advocates for more inclusive and individualized approaches in physical education programming, particularly in under-resourced academic settings, such as Camiguin Island.

Keywords: agility, body mass index, leg power, physical education, mediation analysis

Introduction

Obesity is a pressing global public health concern that has been extensively studied within the fields of Physical Education (PE), sports science, and health disciplines (Leszczak *et al.*, 2022; World Health Organization, 2020). Overweight and obesity rates globally now exceed those of underweight adults, indicating a pervasive health issue (World Health Organization, 2020). In the Philippines, the obesity rate among university students (33.0%) surpasses the national average (31.1%), demonstrating a unique vulnerability in this group. This is likely driven by sedentary behavior, poor dietary choices, and academic stress (Ramosa & Bulusan, 2020). These lifestyle patterns, alongside reduced engagement in structured physical activity and limited access to fitness programs, underscore the need to address obesity within educational and healthcare frameworks (Leszczak *et al.*, 2022; Liu & Kan, 2021).

In light of this pressing issue, this study investigates the mediating role of body mass in the relationship between leg power and agility among college students. A practical problem arises in current physical education (PE) instruction: standardized assessments and uniform programming often overlook individual differences in body composition and physical ability (Essel *et al.*, 2022; Leszczak *et al.*, 2022). Such uniformity can be detrimental, especially for overweight students who struggle with shuttle

runs, jumping exercises, or endurance circuits. These experiences may lead to embarrassment, discouragement, and disengagement from PE (Essel *et al.*, 2022; Witkoś & Hartman-Petrycka, 2021).

Further compounding this problem are findings that confirm obesity has an adverse effect on motor skills, agility, and overall athletic performance (Hsieh *et al.*, 2021; Leszczak *et al.*, 2022; Muin & Nugroho, 2022). Obese individuals often show reduced coordination, postural control, and neuromuscular efficiency—key factors in athletic tasks (Fiori *et al.*, 2020; Hariadi *et al.*, 2019). Notably, higher body fat, particularly in females due to hormonal and physiological differences, negatively correlates with vertical jump performance—an essential marker of lower-body power relevant to sports such as basketball, volleyball, and track and field. Additionally, leg power itself varies by gender and body mass (Fischerova *et al.*, 2021; Liu *et al.*, 2020). The mechanisms at play here indicate that excess body weight has been shown to lower mechanical efficiency and increase ground reaction forces, thereby reducing agility and movement economy (Kondapalli *et al.*, 2019; Verlaan *et al.*, 2021). Despite these findings, few studies have explored body mass as a mediating factor in the power–agility relationship, especially in practical physical education contexts.

Recognizing this gap, the mediating effect of body mass on the relationship between leg power and agility remains underexplored. Addressing this knowledge gap is crucial for developing inclusive physical education (PE) strategies that support learners with diverse physiological profiles. Scholars emphasize that equitable PE instruction must consider body composition and muscular capacity to enhance participation and outcomes (Essel *et al.*, 2022; Witkoś & Hartman-Petrycka, 2021). This study examines this issue among college students in Camiguin Island, Northern Mindanao, a rural setting characterized by limited PE facilities, minimal instructional equipment, and a scarcity of specialized instructors. These constraints influence students' ability to participate fully in physical activities, illustrating the importance of localized research. Indeed, Camiguin serves as a model for understanding how under-resourced environments impact the effectiveness of PE programming when body mass differences are not addressed.

Therefore, this study aims to examine the mediating effect of body mass on the relationship between leg power and agility among college students. Anchored in the Biomechanical Principles of Force and Momentum (Knudson, 2003), this research assumes that leg power directly influences agility, but this effect may be moderated by an individual's body mass. Additionally, the study relies on Newton's Second Law ($F = ma$), which suggests that greater body mass requires more force to produce equivalent acceleration—a key dynamic in understanding agility tasks.

This assumption is further corroborated by the idea that higher body mass, while contributing to force production, may also hinder the efficient execution of agile movements due to the physiological and mechanical load on the body. Hence, the study hypothesizes that body mass mediates the link between leg power and agility.

The research specifically addresses the following objectives:

1. To measure and analyze the leg power, agility, and body mass index of participants.
2. To determine if there is a significant direct relationship between leg power and agility.
3. To assess whether body mass mediates the relationship between leg power and agility.

To explore these objectives, the following null hypotheses will be tested:

- H_{01} : The participants' leg power does not significantly influence their agility.
- H_{02} : There is no mediation effect of the body mass index on the relationship between leg power and agility.

This study contributes to the theoretical and practical discourse by examining how body mass affects agility through leg power. It offers actionable insight for PE teachers, coaches, and curriculum developers by encouraging individualized instruction, such as adapting fitness assessments or incorporating alternative movement formats. Findings may inform more inclusive, equitable practices in PE, particularly in under-resourced academic settings. This research also aims to spark further studies addressing similar performance disparities caused by physiological diversity.

Methods and Materials

The study employed a descriptive correlational design to examine the relationships between leg power, agility, and body mass index (BMI) without manipulating the variables (Essel *et al.*, 2022; Saputra *et al.*, 2024). This design was chosen because it allowed the researcher to observe associations among naturally occurring variables in a real-world educational setting, where experimental manipulation (e.g., altering body mass) was neither practical nor ethical. Furthermore, mediation analysis was employed to elucidate the role of BMI in the relationship between leg power and agility, as it facilitates the identification of indirect pathways and mechanisms between the independent and dependent variables.

The study involved 165 college students enrolled in PATHFit courses during the first semester of the 2024–2025 academic year. All 280 enrolled students were invited, and the final sample of 165 participants was selected using total sampling and a drawing-of-lots method stratified by class section to ensure balanced representation. Inclusion criteria required participants to be 18–25 years old, consistently enrolled, medically cleared, and willing to provide informed consent.

To accurately measure the variables in question, BMI was calculated using height and weight data based on the World Health Organization (WHO) standards (Dieny *et al.*, 2022). Agility was assessed using the Illinois Agility Test, a reliable change-of-direction ability (Hachana *et al.*, 2013). Leg power was evaluated using the Sprint Power Test validated in Tomopong (2024), which involved a 20-meter sprint. This comprehensive test calculated acceleration, force, and average power and was shown to have high reliability and validity. Notably, the test was pilot-tested in the current study prior to full-scale implementation to ensure contextual suitability.

In adherence to ethical research standards, the study followed protocols approved by the institution's Research Ethics Committee. Participants underwent an orientation session, a health screening using the Physical Activity Readiness Questionnaire (PAR-Q), and then signed an informed consent form. Additionally, data were collected over four weeks and were anonymized using coded identifiers. Records were stored securely and handled in compliance with the Data Privacy Act to protect participant confidentiality.

To analyze the data, descriptive statistics (mean, standard deviation, and frequency) were employed for summarization. Subsequently, multiple regression was used to determine predictive relationships between leg power and agility. Following this, mediation analysis was conducted to assess whether BMI explained part of the relationship between these variables (Joyce *et al.*, 2022). Overall, these methods ensured an ethical, systematic, and evidence-based approach to addressing the research questions.

Results

Table 1 presents the descriptive statistics on the participants' BMI, classified according to the WHO standards (*see p. 73*). The mean BMI of the participants was 20.37 kg/m², with a standard deviation of 3.53, corresponding to the *normal* weight category, indicating that most participants maintained a healthy body composition. The majority of the participants, specifically, 51.7% ($n = 61$), have a *normal* weight (18.5–24.9 kg/m²). However, a notable portion of the sample exhibited *undernutrition*, as indicated by the relatively high prevalence of underweight individuals. A considerable proportion, 34.7% ($n = 41$), were classified as *underweight*, while 11.0% ($n = 13$) were categorized as *overweight*. Only a small percentage, 2.5% ($n = 3$), were classified as *obese*.

Table 2 presents the descriptive statistics on the participants' agility performance based on the Illinois Agility Test norms for male and female participants (*see p. 73*). The table revealed the mean agility time for females was 25.67 seconds (SD = 4.07), while the mean for males was 23.27 seconds (SD = 5.01), both falling within the poor performance description. These findings indicate that, overall, both male and female participants exhibited *poor* agility performance levels. Moreover, the majority of participants demonstrated *poor* agility performance, as noted in the Illinois Agility Test norms. Among the female participants, 75.0% ($n = 66$) were classified in the *poor* category, while among the male participants, 81.0% ($n = 34$) fell within the same classification. Only a small proportion of participants achieved *good* agility ratings, with 11.4% ($n = 10$) of females and 2.4% ($n = 1$) of males categorized as *good* performers. A further 13.6% ($n = 12$) of females and 14.3% ($n = 6$) of males obtained a *fair* agility rating. Notably, none of the female participants achieved *outstanding* or *very good* agility ratings, whereas one male participant (2.4%) reached the *outstanding* category.

Table 3 presents descriptive statistics of the participants' leg power, as measured by the Sprint Power Test, according to sex-specific class standards (*see p. 73*). The participants' leg power performance showed generally moderate results. The mean leg

power for female participants was 255.84 watts ($SD = 264.87$), corresponding to the *good* category, while the mean for male participants was 427.40 watts ($SD = 439.38$), corresponding to the *fair* category based on the Sprint Power Test class norms. Among the female participants, 42.0% ($n = 37$) were categorized as having *poor* leg power, while 26.1% ($n = 23$) were classified as having *fair* leg power. For male participants, a majority (59.5%, $n = 25$) also fell under the *poor* category. Only a small proportion achieved outstanding or very good leg power ratings, with 17.0% ($n = 15$) of females and 19.0% ($n = 8$) of males classified as outstanding.

Regarding the significant influence of participants' leg power on agility, Table 4 presents the regression analysis of the relationship between participants' leg power and agility (see p. 74). Prior to analysis, the data for BMI, leg power, and agility were transformed to ensure that the assumptions of normality and linearity were met. The Shapiro-Wilk test and Q-Q plot assessments confirmed that the transformed data met the necessary statistical assumptions. Moreover, the table shows a statistically significant influence of leg power on agility, with a standardized beta coefficient of -0.394 ($t = -4.789$, $p < .001$). The model had an R value of 0.394 and an R^2 of 0.155 , indicating that approximately 15.5% of the variance in agility scores could be explained by leg power. The F -statistic ($F = 22.930$, $p < .001$) further confirmed the model's significance. These findings suggest that leg power is a meaningful predictor of agility performance, with greater power associated with lower agility times (i.e., better performance). Accordingly, the null hypothesis, stating that the participants' leg power does not significantly influence their agility, is rejected.

Furthermore, Table 5 presents the results of the mediation analysis examining whether body mass index (BMI) mediates the relationship between agility and leg power among the participants (see p. 74). The study revealed a significant direct effect of leg power on agility ($\beta = 0.251$, $z = -4.354$, $p < .004$), confirming that higher leg power is associated with better agility performance. However, the indirect effect of leg power on agility through BMI was not significant ($\beta = -0.10$, $z = -1.214$, $p = 0.257$), indicating that BMI did not mediate the relationship between leg power and agility. The total effect remained significant ($\beta = 25.34$, $z = -4.827$, $p < .001$), further reinforcing the direct influence of leg power on agility. Thus, there is not enough evidence to reject the null hypothesis, indicating that BMI does not have a mediating effect on the relationship between leg power and agility.

Despite this, the path coefficients provide additional insight. Figure 1 visually represents the statistical paths and supports the conclusion that while leg power significantly predicts BMI, it does not significantly predict agility, thereby disconfirming a mediation effect (see p. 74).

The path coefficients revealed that leg power significantly predicted BMI ($\beta = 0.003$, $p = 0.003$), while BMI itself did not predict substantial agility ($\beta = -0.142$, $p = 0.185$). This suggests that while BMI increases in association with higher leg power, possibly due to increased absolute body mass, this increased BMI does not subsequently explain changes in agility. In other words, the demand for greater force production rises with increased body mass, but this does not automatically translate to improved agility performance.

Discussion

The BMI results of the participants in this study align with previous findings among college students and young adults. Dewi *et al.* (2021) reported a normal BMI among school-aged participants, with a notable percentage also found to be underweight or overweight, consistent with the trends observed in this study. Similarly, Roy *et al.* (2022) observed normal BMI levels among Asian adolescents, although some are underweight or overweight due to variations in nutritional habits and activity levels across the population. Suhaimi *et al.* (2021) also noted increased rates of overweight and obesity in young Filipino adults, but many still fell within the normal BMI range. The mean BMI in this study was estimated at 20.37 kg/m^2 , with 51.7% of participants in a healthy weight range, 34.7% classified as underweight, and 11.0% as overweight. These findings highlight the double burden of malnutrition among young adults, where undernutrition persists alongside a rising prevalence of overweight, especially among Asians and island populations experiencing rapid lifestyle and dietary changes.

The participants' BMI profiles indicated that most were of normal weight, although a substantial proportion was either underweight or overweight. This finding is consistent with previous research on college-aged samples, particularly in Asia. A study (Dewi *et al.*, 2021) suggests that the high prevalence of underweight in Southeast Asia is contributed to by inadequate dietary consumption, maladaptive dieting behaviors, and socioeconomic constraints that hinder access to a balanced diet. Additionally, Roy *et al.* (2022) noted that differences in BMI are generally due to irregularities in routine meals and Western dietary habits, leading to undernutrition or excessive consumption. In the Philippines, Mangompit (2024) describes a phenomenon termed the *festival food syndrome*, which refers to periodic feasting and daily caloric deficit, both of which may mean variability in BMI. Suhaimi *et al.* (2021) also noted that increased overweight trends, even among traditionally lower body mass index (BMI) groups,

due to less physical activity associated with academic challenges and sedentary behavior, were augmented among university students. Together, these factors indicated that nutritional imbalances, changing lifestyles, and reduced routine physical activity were affecting the BMI distribution of participants, as well as the everyday struggles faced by college students living in areas such as Camiguin Island.

Findings regarding agility align with previous research, which revealed equally low levels of agility performance in both general college and non-athletic samples. Dewi *et al.* (2021) reported that both overweight and underweight adolescents exhibited lower agility performance compared to those of a healthy weight, suggesting that obesity or underweight may impact movement efficiency. Likewise, Fiori *et al.* (2020) demonstrated that overweight youths had significantly lower agility and coordination scores in fitness tests conducted in school settings, which aligns with the observation in this study that the majority of participants received only fair to poor agility ratings. Furthermore, body composition and physical inactivity were identified as essential factors associated with performance in agility, in line with previous findings established in Patel and Thakrar (2024), stating that university students with higher body fat percentages exhibited slower agility performances.

Regarding leg sprinting power, the results are consistent with prior research assessing leg power in general college student populations. As highlighted in Pituk and Cagas (2019), the leg power performance levels of male and female university students in the Philippines were moderate and low, respectively, when compared to those of other international athletes. This is likely due to decreased muscular strength and power that result from limited strength training and lower habitual physical activity levels.

Similarly, Irawan *et al.* (2020) also noted that non-athletic university students have lower explosive power, particularly in the lower limbs, due to a sedentary lifestyle, and they tend not to participate in organized sports. This notion is supported in Gunasekar and Balamurugan (2021), stating that explosive strength must be developed through structured neuromuscular training, which is typically lacking in the general education environment. The current result is consistent with previously conducted studies. It indicates that without targeted intervention and proper physical conditioning, leg power may remain within a fair to poor classification amongst non-athletic college students.

The result regarding the significant influence of participants' leg power on agility has important implications for physical education programming. It suggests that targeted development of lower body strength and power, through sprints, jumps, and resistance exercises, can enhance agility among college students. These findings align with previous research. Fischerova *et al.* (2021) emphasized that anaerobic leg power significantly contributes to agility and sport performance. Pituk and Cagas (2019) further reported that non-athletic students often lack sufficient leg power, negatively impacting their agility performance. Thus, the present findings reinforce the consensus that leg power is a crucial determinant of agility.

Furthermore, the findings align well with the Biomechanical Principles of Force and Momentum (Knudson, 2003), which underpin this study's theoretical framework. According to Newton's Second Law ($F = ma$), increased muscular force, such as that generated by powerful legs, leads to greater acceleration and improved change-of-direction ability—both critical components of agility. The significant relationship observed supports this biomechanical assumption and validates the theoretical model applied.

From the researcher's perspective, these findings suggest that inclusive PE instruction needs to prioritize neuromuscular development over body mass categorization when aiming to improve movement competencies such as agility. Especially in resource-limited settings like Camiguin Island, low-cost interventions focusing on leg power can yield significant improvements in agility without requiring advanced facilities. This approach fosters equity and encourages continuous participation regardless of a student's BMI classification.

Furthermore, the finding that BMI does not have a mediating effect on the relationship between leg power and agility is grounded in the Biomechanical Principle of Force and Momentum (Knudson, 2003), which posits that heavier bodies require greater force to accelerate. The data imply that higher BMI increases the mechanical demand for force, requiring greater neuromuscular control and power output to achieve similar agility levels. However, since higher BMI individuals do not inherently generate more power, they are at a disadvantage in agility tasks, highlighting that BMI is not a sufficient explanation for agility variation.

These findings are consistent with the literature that emphasizes the role of muscular power and neuromuscular coordination as primary determinants of agility (Chenoweth & Belgioioso, 2019; Fischerova *et al.*, 2021). As such, the study highlights the

need for targeted interventions that develop neuromuscular strength and coordination, particularly in overweight and obese non-athletic individuals, to compensate for the increased physical demands associated with higher body mass.

In summary, BMI does not mediate the relationship between leg power and agility; however, it influences the force required to maintain agility. This highlights the importance of individualized PE programming that enhances muscular capacity and movement efficiency, rather than relying solely on anthropometric classification. Nevertheless, even though BMI did not significantly mediate the relationship, BMI still correlated with the performance metrics, highlighting its relevance in differentiated instruction planning.

Conclusion

This study aimed to assess whether BMI mediates the relationship between leg power and agility among college students enrolled in PATHFit courses in Camiguin Island. More specifically, the study aimed to determine whether leg power and agility are related and whether the relative BMI has an impact on the relationship between the two variables. While a direct link between leg power and agility was confirmed, the results showed that BMI only minimally and not significantly mediated this relationship. However, the findings are consistent with previous literature suggesting that muscular power and neuromuscular control, rather than body mass itself, are essential determinants of agility. Therefore, despite body mass not acting as a mediator as initially expected, this outcome aligns with existing research. Although the mediation hypothesis was not supported, the study successfully investigated and clarified the relationship between leg power, agility, and body mass.

Furthermore, the study results have additional implications in relation to the theoretical framework employed. Grounded in the Biomechanical Principle of Force and Momentum, the findings confirmed the established principle that force production and movement effectiveness are directly correlated to muscle power and acceleration. While body mass contributes to force and momentum values, the results indicate that it is neither the sole nor primary factor driving agility performance in non-athletic college populations. Instead, this research emphasizes neuromuscular control and explosive strength as more direct determinants of agility. This suggests that, although the core principles of the theoretical framework were supported, body mass may be interpreted as merely one of several influencing factors, rather than a key mediator.

In addition, the study identified significant research gaps. It was found that while many previous studies have suggested body mass is a critical factor in physical performance, BMI did not mediate the relationship between leg power and agility in a non-athletic college population. Thus, future studies could explore alternative mediators such as neuromuscular coordination, training frequency, psychological readiness, or muscle quality. Investigating these different contexts could provide better explanations for the variations observed in agility performance. Furthermore, this suggests a need for more research to engage underrepresented students who are not involved in sports and to facilitate targeted interventions within physical education contexts that prioritize developing power and skill beyond traditional demographic classifications based on body mass. These gaps highlight the need for a more comprehensive and nuanced understanding of fitness performance, surpassing what traditional anthropometric markers can offer.

Considering the results of this study, PE teachers may want to consider developing fitness programs that directly enhance leg power and agility, rather than relying solely on body mass classifications as indicators of physical ability. Similarly, PE curriculum developers could incorporate more flexible and individualized approaches to fitness into lesson plans, enabling students to tailor their training to focus on leg power and agility based on their body mass profiles. Such strategies may encourage students to engage continually in lower body strength and agility exercises, such as sprint drills, plyometrics, or balance activities, while focusing on improving their skills rather than their body weight. Moreover, school administrators may support initiatives that ensure facilities, equipment, and programs are available to promote strength and agility development among students across a wide range of body mass classifications in physical education programs. Finally, future studies may consider additional potential mediators, like neuromuscular coordination, frequency of physical activity, and psychological readiness, to gain a comprehensive understanding of the factors influencing agility performance beyond BMI.

Conflict of Interest: *The author declares that there is no conflict of interest regarding the publication of this article.*

Acknowledgements: The researcher extends heartfelt gratitude to the school administrators, teachers, students, and parents of the participating school in Camiguin for their support and cooperation throughout the study. Special thanks are extended to the research panel members who guided the research's direction.

Funding: This research received no external funding and was supported solely by the personal resources of the primary author.

Ethical Approval: The study was reviewed and approved by the Research Ethics Committee of Lourdes College, Inc., in accordance with the ethical standards outlined in the Belmont Report. Informed consent was obtained from student participants, ensuring full ethical compliance.

AI Declaration: This study utilized artificial intelligence tools to assist in preparing this article. Specifically, ChatGPT was used to convert the full thesis manuscript into a reduced journal article format with human supervision and editing, ensuring academic rigor and integrity. Additionally, Grammarly AI was used to enhance the language quality, clarity, and tone of the final manuscript. The author carefully reviewed and edited all outputs to maintain scholarly standards.

Data Availability Statement: The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request. Requests for access will be evaluated in accordance with ethical guidelines and data privacy policies.

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Table 1*Descriptive Statistics of the Participants' BMI*

Range in kg/m2	Description	BMI	
		Frequency	Percentage
≥ 30	Obese	3	2.5
25.00 29.90	Overweight	13	11.0
18.50 24.90	Normal Weight	61	51.7
<18.5	Underweight	41	34.7
TOTAL		118	100
Mean		20.37	
Description		Normal Weight	
Standard Deviation		3.53	

Table 2*Descriptive Statistics of the Participants' Agility Performance*

					Agility				
					Female		Male		
Range (Seconds)									
Female		Male		Description		f	%	f	%
< 16.9		< 15.1		Outstanding		0	0.0	1	2.4
17.00	17.90	15.20	16.10	Very Good		0	0.0	0	0.0
18.00	21.70	16.20	18.10	Good		10	11.4	1	2.4
21.80	23.00	18.20	19.30	Fair		12	13.6	6	14.3
> 23.1		> 19.4		Poor		66	75.0	34	81.0
TOTAL						88	100	42	100
Mean						25.67		23.27	
Description						Poor		Poor	
Standard Deviation						4.07		5.01	

Table 3*Descriptive Statistics of the Participants' Leg Power Performance*

					LEG POWER			
					Female		Male	
Range (Seconds)				Description	f	%	f	%
Female	Male							
> 380	> 653			Outstanding	15	17.0	8	19.0
303.00	379.00	542.00	652.00	Very Good	7	8.0	3	7.1
224.00	302.00	429.00	541.00	Good	6	6.8	0	0.0
147.00	223.00	318.00	428.00	Fair	23	26.1	6	14.3
< 146	< 317			Poor	37	42.0	25	59.5
TOTAL					88	100	42	100
Mean					255.84		427.40	
Description					Good		Fair	
Standard Deviation					264.87		439.38	

Table 4*Regression Analysis of the Influence of Leg Power on Agility*

Individual Influence of Predictor	Agility		
	Standardized Coefficient	t	p
Leg Power	-0.394	-4.789	<0.001
Model Summary			
R=0.394	R ² =0.155	F=22.930	p <0.001

Table 5*Mediation Analysis of the Relationship Between Leg Power and Agility with BMI as Mediator*

Effect Type	Path	Estimate	z	p	Interpretation
Direct	Leg Power → Agility	0.251	-4.354	< .004	Significant
Indirect	Leg Power → BMI → Agility	-0.10	-1.214	0.257	Not significant
Total	Leg Power → Agility	25.34	-4.827	0.001	Significant

Note: Estimation method = Maximum Likelihood (ML).**Figure 1***Path Plot Illustrating the Mediation Model of BMI on the Relationship Between Leg Power and Agility*