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Original Article

Physical Activity Level and Reaction Time Relationship in University Students

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Abstract

Objectives: This study aimed to determine whether there is a relationship between physical activity level and reaction time in university students, as physical exercise has been shown to significantly impact the development of these functions. Reaction time, a key indicator of both physical and cognitive abilities, measures how quickly a person responds to a stimulus.

Methods: The study included 40 healthy university students aged 20 to 30. The *International Physical Activity Questionnaire* was used to divide the participants into two groups based on their physical activity levels (n_1=20, n_2=20). Reaction times were assessed using the *Nelson Hand Reaction Test* and computer-based reaction time measurements for individuals with high and low levels of physical activity.

Results: The *Nelson Hand Reaction Test* results indicated that individuals who engaged in more physical exercise performed better than those who did not (p=0.000). However, no statistically significant correlation was found between reaction time and physical activity level (p>0.05).

Conclusion: Reaction time is shorter in physically active individuals. Increasing physical activity levels is important at all ages, as leading an active lifestyle can support better brain function. Therefore, encouraging regular physical exercise may be a valuable strategy to enhance cognitive and motor performance.

Keywords: Physical activity, reaction time, young adult.

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Reaction time (RT) is defined as the duration required to detect a signal that does not necessitate conscious recognition or perception of stimuli. It refers to the time needed for a voluntary response to a given stimulus.[1] Given its relevance to activities of daily living, such as driving and sports, RT is considered a crucial component of reaction-based tasks. Additionally, it serves as a measure for assessing the duration of mental activities, including processing incoming stimuli, making decisions, and programming responses.[2]

Recent studies have identified several factors that influence RT, including gender, neuromuscular and neurophysiological factors, force production, structural and neural properties of muscles, and information processing speed.[3–5] RT measurements serve two primary purposes: first, to evaluate an individual's ability to respond in situations such as traffic signals or sporting events, and second, to assess the duration of cognitive processes, including decision-making and response programming.[4]

Physical activity is defined as any movement requiring energy expenditure through the activation of skeletal muscles. It has positive effects on muscle strength, balance, flexibility, posture, reaction time, and motor skills.

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[5] However, the relationship between physical activity and cognitive performance is complex. Cognitive load varies depending on the type of task and exercise involved, with some cognitive performance parameters improving, declining, or remaining unchanged following exercise.[6]

Physical activity appears to play a significant role in RT development, with the most substantial improvements observed between the ages of 11 and 14, peaking at age 15 when RT development is considered complete.[7] As individuals age, their physical activity levels typically decline, which may negatively impact RT.[8] Despite this, no studies have examined the impact of physical activity levels on RT among university students in our country.

The aim of this study was to investigate the relationship between university students' physical activity levels and their RTs. RT is a key indicator of both physical and cognitive performance. While physical activity is known to enhance cognitive functions, its specific effect on RT remains unclear. By comparing the RTs of students with higher and lower levels of physical activity, this study seeks to provide insights into the role of exercise in cognitive and physical performance.

Materials and Methods

The study was conducted with Bahçeşehir University students between April 5, 2023, and May 1, 2023. Inclusion criteria were applied to select 40 healthy individuals for participation. The participants were classified into two groups based on their physical activity levels using the International Physical Activity Questionnaire (IPAQ) (n_1=20, n_2=20). Reaction times were assessed using the Nelson Hand Reaction Test and the Reaction Time Measurement with Computer for individuals with high and low levels of physical activity. The university's ethics committee approved the study (Reference No: E-20021704-604.02.02.02-54678), and all procedures adhered to the principles of the Declaration of Helsinki. The study was registered in the clinical trials database under the identifier NCT05801081.

In Bargal et al.'s[9] study, the effect size was calculated as 0.98, using the 'International Physical Activity Questionnaire' as a reference. The required sample size for this study was determined using the G*Power program (version 3.1.9.7), which indicated that 18 participants per group were necessary to achieve 80% power with a 0.05 type I error. To account for potential dropouts, 20 participants were included in each group.

Participants

The study included healthy participants aged 20–30 years. The study excluded participants with eye issues, carpal tunnel syndrome diagnoses, musculoskeletal conditions limiting movement in the upper extremities, and neuromuscular illness diagnoses.

Outcome Measures

Before the study, participants provided informed consent and completed a demographic information form, which collected data on age, gender, height, weight, and dominant hand.

International Physical Activity Questionnaire (IPAQ)

The IPAQ short form was used to assess physical activity levels. This seven-item questionnaire evaluated time spent sitting, walking, and engaging in moderate to vigorous activity. Each activity had to be performed for at least 10 minutes. Participants were categorized into low, moderate, or high physical activity groups based on their total physical activity scores.[10]

Nelson Hand Reaction Test

The Nelson Hand Reaction Test was conducted using a ruler. Participants were seated comfortably with their hands and forearms resting on a table. The thumb and forefinger were positioned parallel to each other, 8–10 cm outside the table. The physiotherapist held a ruler between the participant's thumb and index finger and released it unexpectedly. The distance at which the participant caught the ruler was recorded. Each participant performed the test five times, and the three best results were averaged.[11]

Reaction Time Measurement with Computer

Reaction time was measured using the website https://faculty.washington.edu/chudler/java/redgreen.html on a computer or tablet. The program, developed by Dr. Eric H. Chudler at the University of Washington, displayed a traffic light with three colors: red, yellow, and green. The yellow light signaled the start, after which participants prepared their dominant hand over the keyboard. The red light then appeared, instructing participants to wait. When the green light appeared at a random interval, participants were required to press the designated key as quickly as possible. The program displayed the first reaction time value on the screen. Each participant completed five trials, and the three best results were averaged and recorded.

Statistical Analysis

Data analysis was conducted using the Statistical Package for the Social Sciences (SPSS) Version 22.0 (SPSS Inc., Chicago, IL, USA). The Shapiro-Wilk test was used to assess the normality of the data distribution. Variables following

Table 1. Physical characteristics of the participants

	Group 1	Group 2	p
Age	22.80± 2.73	22.25±2.07	0.477
Height	176.15±10.00	173.50±10.17	0.411
Weight	69.70±15.81	71.65±16.42	0.704
BMI	22.28±3.56	23.55±3.89	0.290
Gender			
Female	10	10	1.000
Male	10	10	
Dominant hand			
Right	20	18	1.000
Left		2	

p<0.05 value was considered statistically significant. BMI: Body mass index (kg/m^2).

a normal distribution were expressed as mean ± standard deviation (SD). Depending on the properties of the data, several methodologies were used to conduct statistical analysis. Student's t-tests were used to compare means between two groups for normally distributed variables. Additionally, correlation analysis using the Pearson and Spearman coefficients were carried out to look at the connections between continuous variables. In cases where the data did not meet the assumptions of normality, non-parametric tests like the Mann Whitney-U test were used to compare group differences.

Results

A total of 45 individuals were initially evaluated for the study. Two participants were excluded due to vision problems, and three were excluded due to a diagnosis of carpal tunnel syndrome. Consequently, 40 individuals met the inclusion criteria and participated in the study. No participants dropped out during the study, and all 40 individuals successfully completed it (Table 1).

An analysis of the demographic data of the study participants indicates that the groups were evenly distributed (p<0.05) (Table 2).

Reaction time and physical activity levels were compared between the two groups. Individuals in Group 2 achieved better results on the Nelson Hand Reaction Test compared to those in Group 1 (p=0.000) (Table 3).

No statistically significant relationship was found between reaction time and physical activity levels (p>0.05).

Discussion

Reaction time (RT) is a measure of how quickly the nervous system processes and responds to external stimuli. It refers to the interval between the onset of a stimulus and the initiation of a movement response. Longer reaction times suggest that more time is required for information processing, indicating increased complexity for the central nervous system. In this study, we evaluated individuals with different levels of physical activity in terms of their reaction times.[12] Our results showed that physically active individuals performed better on the Nelson Hand Reaction Test. However, no significant difference was observed between the two groups in the Computer-Based Reaction Time Test.

Previous literature suggests that low physical activity and inactivity may contribute to decreased muscle strength and mass, potentially leading to slower reaction times. Conversely, regular physical activity has been shown to enhance performance by reducing reaction time, while also improving balance, flexibility, and overall neuromuscular function.[13,14]

In our study, participants with different physical activity levels demonstrated varying reaction times, but this difference was only observed in the Nelson Hand Reaction Test. We attribute this to the test's greater reliance on motor function compared to computerized tests. Similarly, Caliskan et al.[15] examined the effects of video game duration on hand and foot reaction times and physical activity levels. They used the Nelson Hand Reaction Test and the International Physical Activity Questionnaire (IPAQ) but found no significant correlation between reaction time and physical activity level.

Another study investigated the impact of weekly boxing training over 12 weeks, revealing that boxers had significantly faster reaction times compared to non-boxers.[3] Additionally, Iri et al.[16] examined how physical exercise influences children's hand-eye coordination and reaction

Table 2. Comparison of the evaluation results between groups

	Group 1	Group 2	p
Total physical activity	2520.85±1125.52	6583.48±1950.72	0.00*
Computer timed reaction measurement	0.41±0.11	0.45±0.11	0.318**
Nelson hand reaction measurement	6.20±3.74	38.05±34.31	0.00*

p<0.05 value was considered statistically significant. *: Independent T test, **: Mann Whitney U.

Table 3. Correlation values between reaction time and physical activity

	Computer		Nelson	
	R	p	R	p
Age	0.422	**0.007**	-0.178	0.271
Height	-0.058	0.724	-0.316	0.047
Weight	0.072	0.657	-0.120	0.461
BMI	0.151	0.353	0.051	0.756
High physical activity	-0.081	0.621	0.034	0.836
Moderate physical activity	0.027	0.871	0.117	0.473
Walking physical activity	0.336	**0.034**	-0.011	0.948
Sitting physical activity	0.107	0.511	0.141	0.386
Total physical activity	0.150	0.356	0.122	0.454

$p<0.05$ value was considered statistically significant. BMI: Body mass index (kg/m^2).

times. They concluded that physical activity positively affects motor skills, including reaction time, in addition to enhancing physical development.

Alpkaya et al.[4] explored the relationship between physical activity and reaction time, finding that a 10-week exercise program improved reaction times. Similarly, Sharma et al.[17] reported that physical activity influenced both visual and auditory reaction times, albeit with variations. In our study, we used a computer-based method to assess visual reaction time but did not find a correlation between physical activity levels and reaction time. We believe this may be due to the fact that physical activity primarily influences motor function, whereas visual reaction time is more closely associated with cognitive abilities.

Klasnja et al.[7] investigated the effects of video games and regular exercise on reaction times in adolescents aged 10–14. The study divided participants into two groups based on their exercise frequency and gaming habits and used the same computer program as our study to assess reaction time. Their findings indicated no significant difference in reaction speeds between the two groups, aligning with our results.

Conversely, Li et al.[18] examined the relationship between physical fitness, hand grip strength, and reaction time in preschool children. Their results indicated a negative correlation between physical fitness level and reaction time, meaning that higher fitness levels were associated with faster reaction times. However, our study did not find such a correlation, possibly due to differences in participant age ranges. The development of reaction time and physical activity levels may not be synchronized in older individuals, as was the case in our study.

The speed of cognitive processing and intelligence is closely linked to reaction time. Regular physical activity has been shown to enhance brain function, benefiting attention, memory, and decision-making. Cai et al.[19] similarly reported that physically active university students exhibited better reaction times. Our findings further support the notion that increasing physical activity levels at all ages can enhance cognitive performance.

Study Limitations

This study has several limitations. First, physical activity levels were self-reported, which may introduce bias. Additionally, the cross-sectional study design limits our ability to establish causal relationships between physical activity and reaction time. The exclusion of individuals with specific health conditions also restricts the generalizability of our findings. Moreover, this study only utilized two reaction time assessments, which may not comprehensively capture all aspects of cognitive and physical performance. Future research should consider using a broader range of assessments and a more diverse participant pool.

Conclusion

Our findings suggest that physically active individuals exhibit shorter reaction times, indicating that regular physical exercise may enhance cognitive performance by improving response speed. This highlights the importance of promoting physical activity across all age groups. An active lifestyle not only benefits physical health but also supports cognitive functions, including faster information processing and decision-making. Encouraging physical activity could have significant implications for improving both cognitive and physical well-being.

Disclosures

Ethics Committee Approval: The study was approved by the Bahçeşehir University Ethics Committee (no: E-20021704-604.02.02.02-54678, date: 20/03/2023).

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References

1. Ando S, Kida N, Oda S. Retention of practice effects on simple reaction time for peripheral and central visual fields. Percept Mot Skills 2004;98(3):897–900.
2. Schmidt RA, Lee TD. Motor learning and performance. Champaign (IL): Human Kinetics; 1991.
3. Çakmakçı E, Tatlıcı A, Kahraman S, Yılmaz S, Ünsal B, Özkaymakoğlu C. Does once-a-week boxing training improve strength and reaction time? Int J Sport Exerc Train Sci 2019;5:88–92.
4. Alpkaya U, Mengütay S. An investigation on effects of physical activity to reaction time. [Article in Turkish] Gazi J Phys Educ Sport Sci 2004;9:49–58.
5. Açak M, Karademir T, Taşmektepligil Y, Çalışkan E. The examination of agility and visual reaction values of hearing-impaired futsal sportsmen. Selcuk Univ J Phys Educ Sport Sci 2012;14:283–9.
6. Barthélémy S, Boulinguez P. Orienting visuospatial attention generates manual reaction time asymmetries in target detection and pointing. Behav Brain Res 2002;133(1):109–16.
7. Klasnja A, Milenovic N, Lukac S, Knezevic A, Klasnja J, Karan Rakic V. The effects of regular physical activity and playing video games on reaction time in adolescents. Int J Environ Res Public Health 2022;19(15):9278.
8. Dahlgren A, Sjöblom L, Eke H, Bonn SE, Trolle Lagerros Y. Screen time and physical activity in children and adolescents aged 10-15 years. PLoS One 2021;16(7):e0254255.
9. Bargal S, Nalgirkar V, Patil A, Langade D. Evaluation of the effect of left nostril breathing on cardiorespiratory parameters and reaction time in young healthy individuals. Cureus 2022;14(2):e22351.
10. Saglam M, Arikan H, Savci S, Inal-Ince D, Bosnak-Guclu M, Karabulut E, et al. International physical activity questionnaire: Reliability and validity of the Turkish version. Percept Mot Skills 2010;111(1):278–84.
11. Tamer K. Sporda fiziksel-fizyolojik performansın ölçülmesi ve değerlendirilmesi. Ankara: Bağırgan Yayınevi; 2000. p. 52–7.
12. Aley L, Miller EW, Bode S, Hall L, Markusic J, Nicholson M, et al. Effects of age, task complexity, and exercise on reaction time of women during ambulation tasks. J Geriatr Phys Ther 2007;30(1):3–7.
13. Karadağ A, Kutlu M. Effects of long-term soccer training on visual and auditory reaction time of dominant and non-dominant leg in footballers. [Article in Turkish] Fırat Med J 2006;11:26–9.
14. Sayaca Ç, Karaman A. The effect of daily average number of steps on equilibrium, flexibility and reaction time. [Article in Turkish] Ergoter Rehabil Derg 2021;9:57–62.
15. Çalışkan F, Sayaca Ç. The effect of computer game play time on sleep quality, hand reaction speed and physical activity level. [Article in Turkish] Gaziantep Üniv Spor Bilim Derg 2019;4:289–303.
16. İri R, Aktuğ ZB, Keskin A. The investigation of physical activity on hand-eye coordination and reaction time in children. [Article in Turkish] Spormetre 2018;16:23–8.
17. Sharma VK, Subramanian SK, Arunachalam V, Radhakrishnan K, Ramamurthy S, Ravindran BS. Auditory and visual reaction times in school going adolescents: Effect of structured and unstructured physical training - A randomized control trial. Int J Adolesc Med Health 2015;29(4).
18. Li Y, Zhou T, Lu Y, Sang M, Liu J, He X, et al. The association between the health-related physical fitness and inhibitory control in preschool children. BMC Pediatr 2022;22(1):106.
19. Cai L. Effect of physical exercise intervention based on improved neural network on college students' mental health. Comput Math Methods Med 2022;2022:4884109.