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COMPARISON OF THE CORE STRENGTH, BALANCE ABILITY AND GAIT VELOCITY BETWEEN ARCHERS AND SEDENTARY INDIVIDUALS

Erie Zuraidee Zulkifli[1], Siti Hairuneesha Zainuddin[1], *Rosniwati Ghafar[1], Foong Kiew Ooi[1], Chee Keong Chen[1] & Jiun Sien Lau[2]

[1]School of Health Sciences, Health Campus,
Universiti Sains Malaysia,
Kubang Kerian, 16150 Kota Bharu, Kelantan, Malaysia.

[2]School of Rehabilitation Sciences, Faculty of Health Sciences,
Universiti Sultan Zainal Abidin,
Gong Badak Campus, 21300 Kuala Nerus, Terengganu, Malaysia

*Corresponding author's email: rosnikk@usm.my

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ABSTRACT

Sedentary lifestyle is a global problem. Although, many awareness campaigns have been carried out but the issue of physical inactivity still remained as a challange. Hence, more information is needed to increase the level of awareness among the sedentary population to change their lifestyle. Comparing quantitatively the most important features in their daily lives is an option. The objective of this research was to quantify the advantages of archery training to the body's essential elements in performing daily activities which are core strength, balance ability and gait analysis. Thirty (n=30) young adults aged between 13 and 21 years old were recruited and assigned into archer and sedentary groups for this study. Comparisons were made between archer and sedentary groups for core strength, balance ability and gait analysis using curl-ups test, uni-pedal stance test and gait velocity. Results from this study showed that there were significant advantages by training archery regularly. Core strength test showed that the archer group were able to perform more average curl ups which is 34 repetitions per minute compared to 24 repetitions per minute by the sedentary group ($p<0.05$). Significant difference shown in balance ability in open eyes condition with a median result of 160.00 s for archer group while the sedentary group was 96.25 s ($p<0.05$). The archer group also had higher gait velocity compared to the sedentary group ($p<0.05$). Based on the results, sports training seems to provide better standing ability, stronger core and lower limb strength which will ease daily activities.

Keywords: *archery, sedentary, strength, balance, gait*

INTRODUCTION

People are aware that health problems are mostly related to a sedentary lifestyle, but most of us still choose to be in it for an easy way out. Sedentary lifestyle offers temporary comfort to the individuals, but it will not provide any health benefits in the long term. One must give up leisure activities like extra sleeping time, reading (for pleasure) or any other idle activities in order to lead an active lifestyle. Benefits from a more physically active lifestyle such as lower risk of chronic diseases, better muscle build, greater stabilization and more functional ability can only be realized later in life (Kalache & Kickbusch, 1997). Different approach of awareness should be initiated in order to make a shift in the mind-set for sedentary individuals to choose a healthy lifestyle over the sedentary lifestyle. The adverse effects of sedentary lifestyle should be emphasised and make aware to the people as early as possible. This should be done continuously and repeatedly so they will choose an active lifestyle without hesitation and procrastination over sedentary lifestyle.

Most chronic diseases which reduce the quality of life are related to a sedentary lifestyle, which is a modifiable factor according to Jahan (2024). It is possible to have a good health condition as long as we start an active lifestyle as soon as possible without procrastination and other reasoning as we realized that we are in the sedentary lifestyle. It is essential to consistently emphasize the negative impacts of sedentary behaviour and the advantages of a healthy lifestyle across various information platforms to enhance understanding and encourage lifestyle changes.

The negative consequences of a sedentary lifestyle are frequently associated with conditions like arthritis, diabetes, obesity, cancer, and cardiovascular diseases (Mandili et al, 2022). The complication of these diseases will deteriorate the quality of life and sometimes in a worst case scenario, the patients will be disabled (Tjahjono & Arthamin, 2024). When the disease is diagnosed, the individuals have to restrict their movement due to poor health condition. This situation will further deteriorate the health status of the individuals. Healthy lifestyle should begin while we are still healthy and have no limitations in terms of movement. There is a single principle governing the functioning of our muscles: use it or lose it. All forms of exercise have been proven to show a lot of benefits to the body and mind. It can be stated that any bodily movements with a slight resistance to strength provides a stimulus to the body's muscles. This includes the mechanism by which the task is completed; all of the muscles involved will receive the stimulus, which will cause them to either maintain or increase in strength when exposed to a variety of stimuli.

It is crucial for us to have both muscle mass and strength in our daily lives. Both of these are also related to functional ability as shown in Figure 1, where we aim to reach our full potential during adolescence in order to maintain as much independence as possible and maintain the largest feasible gap between the disability threshold. Maximising other factors such as core strength, standing ability and gait features also increase the functional ability graph where we can perform daily activities independently without relying on others. We cannot move or transport our bodies from one position to another without good muscle and core strength. Muscle strength is essential for carrying out daily tasks. Thus, preserving muscle strength should be a priority in maintaining a healthy lifestyle and independent living for the elderly (Bårdstu et al, 2022). There a few types of strength that can be measured but in this study we choose to measure the core strength.

In every movement, balance ability is also very important. We have to balance ourselves first before initiating the first action. Our regular routines will be disrupted by the loss of balance which will make daily activities harder to complete. We may occasionally need to utilize assistive equipment like canes or have to consider or restrict our activity into sitting or lying on the bed. Gait is also indirectly related to an individual's health condition and tends to deteriorate with age. Pathological gait patterns may often be identified directly based on their characteristics. The gait features of individuals who regularly engage in specific sports differ from those of sedentary individuals; sports practice often strengthens certain body parts and muscles depending on the activity (Kamarudin et al., 2021).

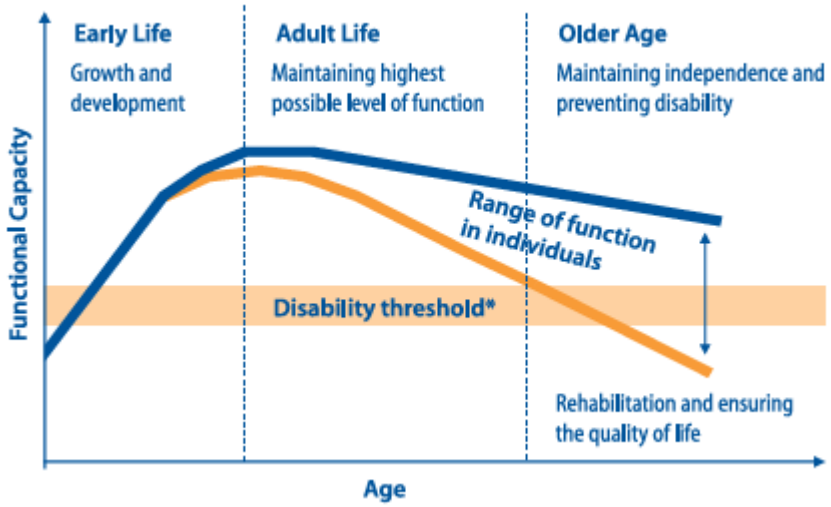

Figure 1: The functional capacity graph (WHO, 2002)

Strength and balance are trained while practicing archery, where the individual must shoot an arrow toward the target area. The archer has to pull the arrow with a certain force which involves muscular strength. While executing the whole process, that is from drawing the arrow to releasing the arrow and follow through, the archer must maintain a balanced stance to minimize movement, thereby engaging in balance training. A well-balanced archer is likely to achieve a more precise shooting score. Benefits of archery were well known to the public, but available resources is still limited (Subbash, 2018). Research on archery previously done focusing on skills and performances development for the athletes. More research is needed to spread out the benefits of archery training to the community. One intervention research using archery exercise has been carried out on patients with Parkinson's disease (Chen et al., 2023). Their results showed positive changes in the exercise group compared to the control group at post intervention. Archery exercise showed significant improvement in the Purdue pegboard test, the Unified Parkinson's Disease Rating Scale I to III, lower extremity muscle strength, timed up and go test.

Studies on the aging process have shown that sustaining our independence throughout life depends heavily on our muscle strength and balance (de Maio Nascimento et al., 2022, Bårdstu et al., 2022). Related to this study, it is hoped that the current study on the comparison of the core strength, balance ability and gait features will provide quantitative information about the different effect of the two different lifestyles. It is possible to investigate the positive effects of archery training, which are mediated through gait characteristics, core strength, and balance.

METHODOLOGY

30 young adults aged between 13 to 21 years old and did not have any injury were recruited and assigned into archer and sedentary groups for this study. The inclusion criteria for the archer group were active archers who have been practising archery on a regular basis (3-4 times per-week). The inclusion criteria for sedentary group were individuals who did minimal exercise (less than 2 times per-week). This is a cross-sectional study. The selected parameters were measured once in a laboratory. The comparisons were made between archer and sedentary groups for the selected parameters which were core strength, standing ability, and gait features using uni-pedal stance test, curl ups test and gait analysis. The ethical approval for this research was obtained from the Human Research Ethics Committee, USM with approval code of USM/JEPem/22010050.

Curl ups test

For the curl-ups test, the participants laid in a supine position on the mat with knees bent at an approximately 140° angle, legs apart, arms straight and parallel to the trunk with the palms resting on the mat. The fingers are extended and touching the cardboard strip which was placed under the knees. The researcher stands on the strip so that it did not move during the test. When the curls-ups are performed, the fingers slide over to the other side of the strip. A participant had to perform as many curl-ups as possible while maintaining a cadence of 1 curl-up every 3 seconds but stopped at a maximum number of 75. The total curl-ups was recorded for the analysis (Morrow Jr et al., 2015).

Unipedal stance test

For the unipedal stance test (UPST), the participants were asked to wear comfortable exercise clothing and kick a ball to determine their dominant leg. This test was conducted in two different situations where the participants need to perform this test with their eyes open (EO) and eyes closed (EC) both using their dominant leg. The test was performed barefooted on a smooth surface to ensure that all the participants undergo the same conditions. The standing foot position was marked on the floor with tapes to fix the foot position during the test (Springer et al., 2007).

Gait analysis

For gait features, the participants were allowed to practice walking on the walkway to obtain the correct speed and familiarize themselves with the data collection environment. This practice helped participants to feel more comfortable and reduce anxiety during the actual tests. After that, the participants were instructed to walk barefooted at their normal pace and self-selected walking speed along 6-meter walkway from starting point to the end point. Three successful trials were recorded for each participant. The data were analysed using Kinovea for the gait features data (Adnan et al., 2018).

RESULTS AND DISCUSSION

The statistical analysis of this study was done using IBM Statistical Package for Social Sciences (SPSS) version 26 and Microsoft Excel version 2111. The tests used were descriptive tests, Independent T-test, and Mann-Whitney test. For normal distributed data, Independent T-test were used, mean and standard deviation were reported in the table. Meanwhile for skewed data, Mann-Whitney test was used to analyse the data, median and interquartile range were reported in the table. Table 1 is the summary of the anthropometric data of the participants. The participants are age-matched between the two groups, so there were no differences in the age, weight and BMI of the participants. However, there was a significant difference in height, where the archers were taller than the sedentary group.

Table 1: Anthropometric data of the participants

Demographic	Sedentary (n=15) Mean (±SD)	Archer (n=15) Mean (±SD)	*p*-value
Age (years)	14.5(±1.1)	14.5(±1.1)	1.000
Weight (kg)	48.7(±11.2)	55.6(±15.2)	0.169
Height (m)	1.56(±0.07)	1.61(±0.05)	0.020*
BMI (kg/m2)	19.9(±3.4)	21.3(±4.9)	0.412

Table 2 shows the results of the measured parameters which are curl ups test, unipedal stance test and gait analysis. For curl up test based on T-Test analysis, archers performed better with average score of 34 repetitions per minute, while the sedentary group could only perform 20 repetitions per minute for average score. Fitter and younger individuals are able to perform more curl-ups (Sidney & Jetter, 1990). This finding can be related to the previous study which compared the curl up performance. Comparison based on body mass index for sedentary students showed that students with higher BMI had lower abdominal muscle endurance and performed less in curl up test (Malayil et al., 2023).

Table 2: Result of measured parameters

No.	Test	Sedentary	Archer	*p*-value
1	**Curl Up Test**	**Mean (±SD)**	**Mean (±SD)**	
	Curl up (reps/min)	20.5 (±4.0)	34.5 (±10.6)	0.001*
2	**Uni-pedal Stance Test**	**Median (IQR)**	**Median (IQR)**	
	UPST Eyes Open (EO) (seconds)	96.25(53.75)	160.00(0.00)	0.001*
	UPST Eyes Closed (EC) (seconds)	25.10(20.15)	32.70(43.88)	0.372
3	**Gait Analysis**	**Mean (±SD)**	**Mean (±SD)**	
	Stride Velocity (cm/ms)	2.12(±0.30)	2.10(±0.41)	0.857
	Stance Velocity (cm/ms)	0.56(±0.08)	0.68(±0.16)	0.021*
	Swing Velocity (cm/ms)	3.70(±2.94)	3.71(±0.33)	0.965

The results of the UPST test for the dominant leg with two different conditions which is with eyes opened and eyes closed were tabulated in the second column in the Table 2. Mann-Whitney test were used in this analysis because of the skewed data distribution, median and interquartile range were reported. A significant difference was found in the open eyes condition, where the archers performed better than the sedentary group. Most of the archers can balance on the dominant leg for the maximum time during the test which was set at 160.00 s. The sedentary groups median was only 96.25 s in the open eyes condition. For the closed eyes condition, there was only a small difference between groups and it did not show any significant difference based on the Mann-Whitney test. These findings are parallel with the study conducted by Victor et al. (2014) where active participants showed higher stability in the UPST test. This study suggested that participation in regular physical activity is beneficial to the postural balance in the future.

Other than that, the results of the gait analysis using Kinovea software were tabulated in the third row in the Table 2. Our data showed that there was a significant difference in the stance velocity. The archers' stance velocity was higher than the sedentary stance velocity (0.68 vs 0.56 cm/ms respectively). Reduced in gait velocity also presented in Antonelli et al. (2024) which compared healthy elderly and young people. This study suggested reduce in velocity also related to the cognitive decline, which is also related to the ability to stabilize the trunk while walking. Reduced in velocity also presented in Zhang et al. (2021) which compared young and older female. Although small differences in the walking speed were detected, differences were found in the vertical foot acceleration and vertical trunk acceleration. The results showed that older females have lower gait stability and higher trunk movement which have higher tendency to fall.

CONCLUSION

Our findings demonstrated many benefits of archery training. The archer group performed more maximum curl ups than the sedentary group. In addition, the archer groups could balance longer during the uni-pedal stance test. The archer group also had better stance velocity in the gait features analysis compared to the sedentary group. Through regular archery training, it was shown that the archers have enhanced some of their health related parameters. However, these improvements were not observed in the sedentary group. Even though there is no sign of chronic diseases during the adolescents, comparison among the selected

parameters showed that the performance of the sedentary group was lower in all selected parameters. The gap to the disability threshold is lowered indirectly by their poor performance, and if they continue to lead a sedentary lifestyle, their performance is likely to worsen. The discrepancies in the performances should make it evident why leading a sedentary lifestyle is unhealthy for us and highlight the advantages of leading an active lifestyle, which can maximize our strength and capacity over a longer period of time than a sedentary one.

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CONFLICT OF INTREST

The authors declare no conflicts of interest related to the writing of this article.

AUTHORS CONTRIBUTIONS

EZZ data collection, manuscript writing, SHZ data collection, data analysis, RG concepts, data analysis, manuscript writing, FKO data collection, manuscript editing, CKC data collection, manuscript editing, JSL data collection, data analysis, manuscript editing.

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