ORIGINAL ARTICLE ISSN: 2455-5274

Is Simple Reaction Time Influenced by Arm Span, Neck Length and Arm Span to Height Ratios of individuals?

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Date of Submission: ***24-11-2017***
Date of Acceptance: ***13-03-2018***
Date of Publishing: ***21-05-2018***

ABSTRACT

Background: Aims: The purpose of this study was to examine the relationship between arm span, neck length and arm span to height ratio (AHR) with simple reaction time (RT). **Methods:** The study was conducted amongst 501 (232 females and 269 males) untrained University of Cape Coast students whose ages ranged from 17-29 years. **Results:** In this study it was found that there was significant correlation between AHR and RT in both males and females, there washowever no significant correlation between arm span nor neck length of participants and RT. **Conclusion:** AHR appears to significantly correlate with simple reaction time, but the direction of correlation appears to differ in males and females.

Keywords: *Simple reaction time, Arm span, Neck length, Arm span to Height Ratio*

INTRODUCTION

Reaction time (RT) and factors that influence it have been of interest for many years. The use of RT cuts across many field including neuroscience, psychology and sports were it has been found to be an important determinant of success in certain sports such as sprint races and in more recent times has become a useful tool for assessing concussions in sports medicine.[1-3] Factor that have been found to influence RT include: gender, age, fatigue and handedness.[1,3-13]

There is some debate as to whether anthropometric measure influence RT. Recent evidence suggests that some anthropometric measure may influence RT Skurvydas A. et al and Nene et al respectively observed slower reaction time in young males and young female who had greater body mass index (BMI) Similar Kim et al,[14-16] also found that in women height and arm length significantly correlates with mean reaction time.

For any muscle to move, nerve impulses generated in the motor cortex, has to travel through the corticospinal tract into nerve of the limbs and subsequently to the effector muscle. The longer the distance the impulse has to travel the longer the conduction time of the impulse. Hence it is has been theorized that anthropometric measures such as height, vertebral column, upper and lower extremity lengths should influence RT in individuals.

The aim of this study is thus to find out if anthropometric indices such as arm span and height influence the simple reaction time as there appears to be no studies in this area.

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MATERIALS AND METHODS

Measurement of Simple reaction time

The simple reaction time was measured by a the technique described by Eckner et al.[3]

The apparatus was a measuring stick, 1.0 m long, embedded in a weighted rubber disk and marked in 0.5cm increments. Participant sat with their forearm resting comfortably on a horizontal surface of a table, such that the proximal edge of the hypothenar eminence was positioned at the edge of table with the fingers overlapping the edge.

The examiner suspended the apparatus vertically, with the weighted disk positioned inside the participants opened hand, such that the superior surface of the weighted disk was aligned with the plane of the first 2 digits and no part of the subject's hand was in contact with the weighted disk. The examiner released the apparatus at predetermined, randomly assigned time intervals of between 2 and 5 seconds to prevent the subject from anticipating the time of release. Subjects then caught the apparatus as quickly as possible as it began to fall.

The fall distance was measured from the superior surface of the weighted disk to the most superior aspect of the subjects hand and was converted into a reaction time (in milliseconds) using the formula for a body falling under the influence of gravity ($d = \frac{1}{2}gt^2$), where 'd' is distance, 'g' is acceleration due to gravity, and 't' is time.

Anthropometric Measurements

Height

Height (m) was measured with a height seca 224 telescopic measuring rod attached to the seca column scale to the nearest 0.01 cm with respondents standing upright following standard protocol.

Arm Span

With the subject standing against the wall, with both arms abducted at an angel of 90˚, elbows and wrist extended and the palms facing directly forward; the arm span of participants was obtained by measuring the distance from the tip of the right middle finger to the tip of the left middle finger to the nearest 0.1cm. Arm span to Height ratio (AHR) of every participant was then calculated by dividing arm span by height (Arm span/Height).

A study by Quanjer et al [17] found that the average AHR ratio for Ghanaian male was 1.07 while that of females was 1.05. Using these values as cut off points male and female participants were subsequently divided into two subgroup each. For males the 1st subgroup comprised of individual who had their AHR ≤1.07 while the 2nd subgroup consisted of persons who had AHR > 1.07 subgroup. For female participants the 1st group had participants whose AHR was ≤1.05 while the 2nd subgroup had persons with and AHR > 1.05 subgroup

Neck Length

With the subject standing upright and the neck held in the neutral position. The cervical vertebral length was measured as the linear distance between the base of the external occipital protuberance and the spinous process of C7 vertebra.

Analysis

Pearson correlation was used to analyse the linear relationship between mean RT of both hands and variables of AHR, arm span and neck length with an alpha level of 0.5. All data was analysed using SPSS version 19.0

RESULTS

Table 1: Correlation between Reaction Times of Right and Left hands and Arm span to height ratio

	Female AHR	Male AHR
Right Hand Reaction Time (ms)	-0.063	-0.096
Left Hand Reaction Time (ms)	-0.128	-0.077

r=.116

Table 2: Correlation between Reaction Times of Right and Left hands and Arm span to height ratio within the various subgroups

	Male		Female	
	AHR ≤1.07	AHR >1.07	AHR ≤1.05	AHR >1.05
Right Hand Reaction Time (ms)	-0.086	-0.219	-0.006	0.109
Left Hand Reaction Time (ms)	0.000	-0.121	-0.131	0.173

r=.164

Table 3: Correlation between Reaction Times of Both hands, Arm Span and Neck Length.

	Female		Male	
	Arm Span	Neck Length	Arm Span	Neck Length
Right Hand Reaction Time (ms)	-0.072	0.058	0.019	-0.067
Left Hand Reaction Time (ms)	-0.091	0.082	0.050	-0.077

r=.116

DISCUSSION

In this study it was observed that for either males or female participants there was a negative correlation between the mean RT of both left and right hands and that of their AHR. This observation however was only significant for the mean RT of the left hand of females and their AHR.

For female participants with AHR ≤1.05 this negative correlation was still evident, however in the subgroup that had AHR >1.05 a positive correlation was observed between the mean RT and AHR. This positive

correlation was found to be significant with the mean RT of the left hand. This suggests that RT particularly in females probably becomes faster with increasing AHR until at a certain critical measure of AHR when the correlation reverses and RT begins to get slower.

For male participants however this reversal of correlation was not observed when testing was done in individual with AHR ≤1.07 as well as those with AHR > 1.07. Hence this change in correlation direction appears to be restricted to females.

In both males and females there was no significant correlation between arm span of participants and mean RT of either hand. A similar observation was also made when neck length was correlated with mean RT. In a study conducted byTønnessen et al,[2] they also found no relationship between standing height and reaction time. Similarly Kim et al,[16] also observed that there was no statistical significant correlation when arm length and height of male subjects were correlated with their mean RT. However in the case of female participants they found that, height and arm length showed statistically significant, correlation with mean reaction time

In theory it was expected that persons with longer arm spans and neck lengths should have exhibited slower reaction time than persons with shorter arm span and neck lengths the reason being that in the former group nerve impulses would be conducted over a longer distance and hence will require a longer time to reach effector muscles.

CONCLUSION

In conclusion only AHR appears to significantly influence simple reaction time. It is also important to note that the direction of correlation appears to differ for males and females.

This difference is of importance as it may impact how RT is used as an assessment tool in the different sexes.

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How to cite this article: Brown AA, Kwarteng LD, Ackom CK, Kwakwa QS, Atta RI, Takyi V**.** Is Simple Reaction Time Influenced by Arm Span, Neck Length and Arm Span to Height Ratios of individuals? Acad. Anat. Int. 2018;4(1):28-30.

Source of Support: Nil, **Conflict of Interest:** None declared.