ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

The Effect of Temperature on Forearm Muscle Activity in Male and Female Medical Students: A Comparative Study.

Ivan R K[1]*, Muhammad Jamil[2], Annazatul Zaimah Hussin[2], Tharani Maniam[2], Grace Tan Zhen wen[2], Loo Jin Qian[2], Jason Khoo Teng Shen[2], Adi Farhan Bin Sabri[2], and Abdulkhaleq Dawman[2].

[1]Lecturer, Department of Physiology, Faculty of Medicine, MAHSAUniversity, Kuala Lumpur
[2]Year 2 MBBS student, Faculty of Medicine, MAHSA University, Kuala Lumpur

ABSTRACT

Activities of the forearm muscles are influenced by various factors, namely temperature, blood supply, fatigability to name a few. The aim of this experiment is to investigate the forearm muscle activity to cold water immersion measured by the number of pulls of the fore-fingers. About 100 medical students of MAHSA University was selected using convenient sampling method. The students were asked to perform the finger pull exercise for about 1 minute by using handheld dynamometer and number of pulls was recorded. After 2 minutes rest, they immerse their forearm in ice cold water for about 20 seconds and repeated the exercise and data recorded. The data was analyzed using SPSS software. Results revealed that, the overall performance slightly decreased after exposure to cold water immersion. Decrease is more evident in the forearm muscle activity of the males in comparison to females after cold water immersion.

Keywords: Temperature, forearm, muscular activity

Corresponding author

ISSN: 0975-8585

INTRODUCTION

It is known that the activities of the forearm muscles are influenced by various factors like temperature, fatigability, blood supply, electrolyte compositions etc. Temperature can be described as the degree of sensible heat or cold, expressed in terms of a specific scale also influence muscle activities. [1]Temperature plays a vital role in muscle activity by its effects on the rate of ATP hydrolysis.

Study by Halder, Gao and Miller[2]on skeletal muscle performance to cold water immersion (CWI) at certain temperatures reveals that there was a significant reduction of isometric maximum force in the tibialis anterior muscle ($P < 0.001$)indicating that moderate CWI of any said local area for about 20 min at10°C cold water, may influence maximal muscle performance.

Study by Yeung and Ting[3]on CWI and blood flow in regard to muscle oxygenation and performance indicates that bouts of CWI decreases tissue oxygenation levels which may affect the performance of the muscles.

Majority of the research is aimed at studying the effects of cold water exposure (above 5 degree Celsius) on limb muscle performance .Whereas this research aims to investigate the forearm muscle activity to a sudden exposure to ice cold (4degree Celsius) water immersion measured by number of pulls (NOP) of the fore-fingers among the male and female university medical students.

MATERIALS AND METHODS

A total of 100 students were selected for this cross sectional study with informed consent after obtaining ethical committee clearance based on inclusion exclusion criteria from the medical faculty of MAHSA University using convenient sampling method. The subjects varied in gender and age group.

On the day of the experiment based on the pre-conditioning criteria, brief procedure of the experiment was explained to the participating subjects. The subjects were asked to remove their watches, bracelets or other items from their wrists before the experiment.

Initially, the subjects were asked to perform voluntary contraction of the fore finger pull /(flexion-extension) exercise for 1 minute using hand held dynamometer, wherein the fore fingers contracted and relaxed with pre-determined weight. The NOP where recorded in the set time.

After, 2 minutes of rest, the subjects were asked to immerse their forearms in ice cold water (4 degree Celsius) for about 20 seconds and immediately followed by repeating the finger pull exercise as previously done. Data was collected and recorded for the NOP after set time in both situations that is before ice cold water immersion of forearm and after.

RESULTS AND DISCUSSION

Statistical analysis

Descriptive statistics was done to investigate the result of forearm muscle activity affected by temperature. SPSS package version 18 was used for analysis.

The data was analysed using Statistical Package for Social Science (SPSS) Version 18.0 software. Parameters ware expressed in mean ± standard deviation (SD).Gender and physical life style distribution pattern is summarised in Table-1.

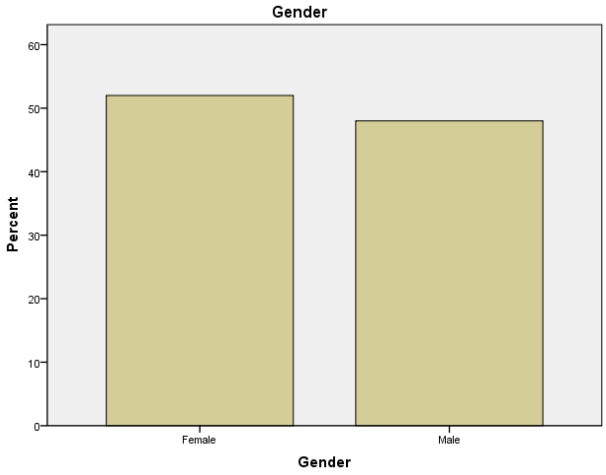
ISSN: 0975-8585

Table 1: Descriptive analysis

Gender – Distribution

		Frequency	Percent	Valid Percent
Valid	Female	52	52.0	52.0
	Male	48	48.0	48.0
	Total	100	100.0	100.0

Figure 1: Gender – Distribution



Physical lifestyle – Distribution

		Frequency	Percent	Valid Percent
Valid	Regular Physical Activity-Gym	27	27.0	27.0
	Sedentary	65	65.0	65.0
	Trained athlete	2	2.0	2.0
	Untrained athlete	6	6.0	6.0
	Total	100	100.0	100.0

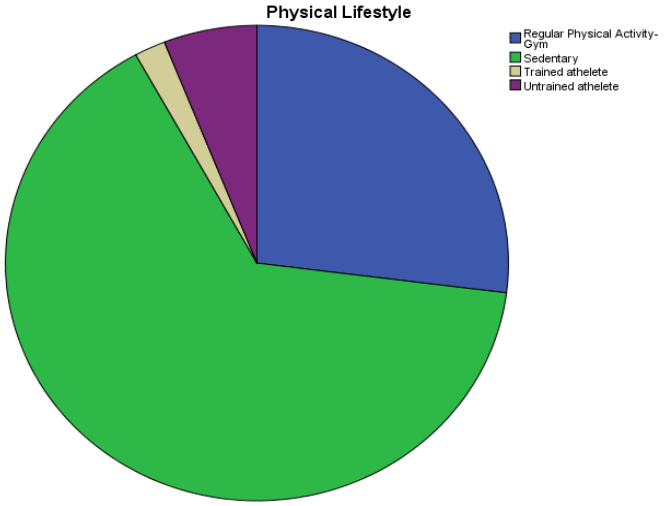


Figure 2: Physical lifestyle – Distribution

ISSN: 0975-8585

About half of the students were females(n=52,52%) and the rest of them males(n=48,48%) (Table-1,1.1).It was also noted that majority of the students were leading sedentary life style (n=65,65%), whereas regular assorted exercising students accounting for (35%) that is gym goers about (n=27,27%),Trained athlete(n=2,2%),Untrained athlete (n=6,6%).(Table-1,1.2)

Table 2: Analysis

Overall comparison: Number of pulls (NOP) –before and after immersion

	N	Minimum	Maximum	Mean	Std. Deviation
NOP before treatment	100	16	115	60.13	21.227
NOP after treatment	100	13	121	57.53	20.177
Valid N (listwise)	100				

Male –female comparison: Number of pulls (NOP) –before and after treatment

Gender		NOP before treatment	NOP after treatment
Female	Mean	61.15	61.12
	Std. Deviation	21.046	21.761
Male	Mean	59.02	53.65
	Std. Deviation	21.589	17.721
Total	Mean	60.13	57.53
	Std. Deviation	21.227	20.177

Paired Samples Test –Mean difference

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	NOP before treatment - NOP after treatment	2.600	15.834	1.583	-.542	5.742	1.642	99	.104

Paired samples test was used to compare the muscle endurance for temperature of 100 samples. Confidence interval of 95% was observed, significant value of Levene's test less than 0.05 (p≤0.05) was taken as significant value. (mean ± standard error of mean) (Table-2.4)

Levene's Test

Levene's Test of Equality of Error Variances[a]				
	F	df1	df2	Sig.
NOP before treatment	1.279	19	80	.221
NOP after treatment	.992	19	80	.479

Physical lifestyle -comparison: Number of pulls (NOP) –before and after treatment				
Descriptives				
Physical Lifestyle		*NOP before treatment*	*NOP after treatment*	*Mean difference*
Regular Physical Activity-Gym	*Mean*	*53.96*	*53.26*	*0.08*
	Std. Deviation	*19.691*	*15.573*	

ISSN: 0975-8585

Sedentary	*Mean*	*62.97*	*59.98*	*3.09*
	Std. Deviation	*21.167*	*21.605*	
Trained athelete	*Mean*	*44.50*	*38.50*	*6*
	Std. Deviation	*16.263*	*19.092*	
Untrained athelete	*Mean*	*62.33*	*56.50*	*5.83*
	Std. Deviation	*26.523*	*20.715*	

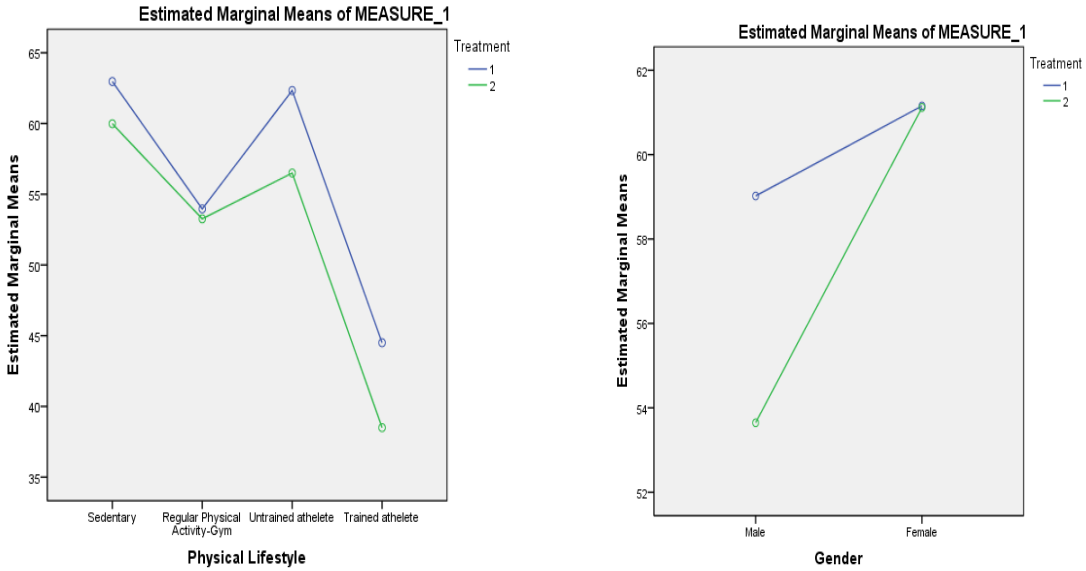


Figure 3

Data analysis was combined to improve the power of statistical analysis for both male and female participants to study the effect of forearm immersion on ice cold water. Overall comparison reveals that about (Mean 57.53±20.177) decreased number of pulls when compared to about (Mean 60.13±21.227) pulls before immersion.(Table-2,2.1)with the mean difference being 2.600 from Paired Samples Test (Table-2,2.3)

Data comparison for male and female participants reveals that males show a slight decrease in the number of pulls after immersion(53.65±17.721) when compared to before immersion (59.02± 21.589) on the other hand data on females showed no significant change in the number of pulls after immersion (61.12 ± 21.761) when compared to before immersion(61.15 ± 21.046).(Table-2,2.2)

Descriptive overall comparison of physical activity reveals that students with sedentary life style showed a slight decrease in the number of pulls after immersion (59.88 ± 21.605) when compared to before immersion (62.97 ±21.167). On the other hand data on students who regularly went for Gym exercise showed least mean difference among all the physical exercise activity in terms of number of pull after immersion (53.26 ±15.573) when compared to before immersion (53.96 ± 19.691).Trained athlete, and untrained athlete showed there is no significant change in the number of pulls after immersion when compared to before immersion.(Table-2,2.5)

This research was done as a routine elective project by the year two MBBS students studying in MAHSA University Malaysia. Previous research implies that forearm muscle activities are affected by various factors like distribution of fat, rate of nerve conduction, blood supply to the tissues etc.

Results obtained in this research clearly showed that over all comparison of effect of temperature on forearm muscle activity, that is by NOPs lightly decreased after immersion of forearm in ice cold water compared with data before immersion which is in line with a study by Mark Cornwall[3], A bout of immense cold water exposure for a short period of time decreases muscle activity and also from the past research there is indication that reducing tissue temperature by cold water exposure can change sensory and motor nerve conduction causing hypoalgesic effect on nerve conduction. [4, 5] This might be one of the reasons of slight decrease in the overall performance.

Based on the data for physical activity it's evident that students with regular gym exercise had the least mean difference in comparison to students with sedentary life style and athletes indicating regular exercise may help tolerance to cold. Study by Foxen-Craft and Dahlquist[6] reveals that cold pressor tolerance significantly increased during the exercise conditions compared to non-exercising groups.

Further, study by Stephens and Halson[7] clearly showed that a significant decrease in core temperature following CWI of low mass and low fat(LM-LF) (0.03 ± 0.01°C/min) group compared to the high mass and high fat (HM-HF) (0.01 ± 0.001°C/min) group with P = 0.002. Muscle temperature decreased to a greater extent during CWI in the LM-LF and high mass and low fat (HM-LF) groups (8.6 ± 3.0°C) compared with HM-HF (5.1 ± 2.0°C, P < 0.05).

In gender comparison male students showed slight decrease in NOP after immersion of forearm into ice cold water when compared to NOP by the female students which reveals a relatively no statistically significant decrease. Study by Tashani and Astita[8] showed that body mass index(BMI) and distribution of body fatmay play a vital role in influencing sensory perception. It was seen that obese individuals were more sensitive than normal range BMI individuals to pressure pain but not to thermal pain.

According to Stephenson and Kolka[9,10] Gender-related differences in body size, body shape and composition, and hormonal effects associated with the menstrual cycle May affect thermoregulatory response to cold. Further observation reveals, thicker subcutaneous fat layer maximises tissue insulation (Rennie et al, Nunneley,[11, 12])Since most average women physiologically have greater fat content and wider subcutaneous fat distribution than men of comparable age this may be the probable reasons why female co-hort in our study group had no significant lowering of forearm muscle activity there by no change in the number of pulls.

CONCLUSION

Over all analysis showed that there is slight decrease in the muscular activity measured by number of finger pulls with exposure to sudden cold water. Further analysis showed that male's cohort compared with females showed slight decrease in NOP. But more than gender it maybe individual body size, physical fitness, and state of acclimatization which may play more important roles.

Therefore, there is a need of further research with wider sample size, which looks into study of effects of cold exposure separately within male and female cohorts with body fat analysis. Study may also look into recruiting significant numbers of both exercising and non-exercising co-horts to understand the full impact.

ACKNOWLEDGMENT

We would like to thank and acknowledge our students for willingly participating in the research, Asso. Prof .Jaiprakash for helping us with statistical analysis and MAHSA University for allowing us to conduct this study

REFERENCE

[1] Miller-Keane and Marie T. O'Toole, EdD, RN, FAAN. Encyclopedia and Dictionary of Medicine, Nursing, and AlliedHealth. 7th Edition 2005.
[2] Halder , Gao , Miller (2014;2014:520124)J Sports Med (Hindawi Publ Corp). .
[3] Yeung , Ting , Hon , Fung , Choi , Cheng , Yeung .Medicine (Baltimore). 2016 Jan;95(1):e2455.
[4] Cornwall . J Orthop Sports Phys Ther. 1994 Aug;20(2):74-80.
[5] Herrera E1, Sandoval MC, Camargo DM, Salvini TF. Phys Ther. 2010 Apr;90(4):581-91
[6] Foxen-Craft , Dahlquist ,J Behav Med. 2017 Mar 22.
[7] Stephens , Halson , Miller , Slater , Askew . J Sports Sci. 2017 Jul13:1-10.
[8] Tashani OA1, Astita R1,2, Sharp D1, Johnson MI1 Eur J Pain. 2017 Aug;21(7):1186- 1196.
[9] Stephenson, L.A., and M.A. Kolka 1993. Exerc. Sports Sci.Rev. 21:231–262.
[10] Bernadette M. Marriott and Sydne J. Carlson. ISBN: 0-309--5, 584 pages, 6 x 9,(1996) http://www.nap.edu/catalog/5197.html

[11] Rennie, Covino, Blair, and Rodahl 1962. a .J. Appl. Physiol. 17:326–332.
[12] Nunneley SA. Med Sci Sports. 1978 Winter;10(4):250-5.