

EFFECT OF GENDER DIFFERENCE IN RESPONSE TO SUSTAINED ISOMETRIC EXERCISE USING HANDGRIP DYNAMOMETERYumnam Anjana¹, Keisam Reetu²**HOW TO CITE THIS ARTICLE:**

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ABSTRACT: Studies on gender differences in cardiovascular responses to isometric exercise have been numerous and conflicting. The present study aims to measure the Endurance time and Blood Pressure response to sustained isometric exercise using handgrip dynamometer in both male and female. Thirty healthy subjects (16 males, 14 females) were taken for the study and the Endurance time and Blood Pressure response was determined and data obtained was analysed using SPSS software version -16. The present study showed that the Endurance time was longer in females as compared to males while the Blood pressure response was higher in males as compared to females. We can conclude from our study that females have less muscle mass so there is less mechanical compression of vasculature & hence less imbalance between blood supply & demand & delayed fatigability, thus accounting for the prolonged endurance time & lesser blood pressure response.

KEYWORDS: Isometric exercise, Hand grip dynamometer, Blood pressure response.

INTRODUCTION: Exercise using a hand grip dynamometer is a type of isometric exercise where voluntary muscle activity is associated with sympathetic outflow¹ to cardiovascular system to increase the heart rate & blood pressure. The rise in HR is also due to parasympathetic withdrawal & activation of other central command.² Handgrip strength, which can be measured easily & objectively using a dynamometer is predictive of multiple outcomes among a variety of subjects. Forearm muscles are used frequently in daily functional activities such that handgrip strength is used as an indicator of overall muscle strength & has been reported to highly predict disability with ageing.³ Grip strength measurement is one of the most commonly used evaluation of hand function. Many activities of daily living require a sustained effort exerted over a period of time. Therefore muscle endurance is an important aspect of physical performance & needs to be considered when assessing musculoskeletal function.

Studies on gender differences in cardiovascular responses to isometric exercise have been numerous and conflicting. Prema Joshi et al, found that Endurance time was significantly higher in females as compared to males.⁴ Sandra et al, found that the endurance time of women was greater than that for the men and that endurance time was inversely related to the absolute force sustained during the contraction. This difference in endurance time was accompanied by similar increases in electromyogram (EMG) during the fatiguing contraction for the men and women but by a reduced pressure response for the women.⁵

B. Gantscy et al, in their study found that blood pressure responses to handgrip tended to be slightly greater in men than women.⁶ Joaquin U Gonzales et al, in their study concluded that no gender difference was found in the fatigability of the forearm muscle during intermittent submaximal handgrip contractions, independent of muscle strength.⁷ Jones et al., found that gender did not influence sympathetic neural reactivity to stressors such as isometric handgrip exercise.⁸

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Hence considering the importance of isometric handgrip exercise and the contradictory findings from previous studies, the present study was conducted to study the variation in Endurance Time & Blood Pressure responses to sustained isometric exercise using hand grip dynamometer in both males & females.

MATERIAL & METHODS: Thirty untrained healthy subjects (16 males, 14 females) in the age group of 21-25yrs were taken from among the MBBS students studying at Jawaharlal Nehru Institute of Medical Sciences (JNIMS), Imphal, Manipur.

Subjects having diseases interfering with the autonomic nervous system, including diabetes mellitus/Renal and liver diseases/ Parkinson's disease/porphyria and amyloidosis/ cardiovascular diseases / neurological diseases or subjects taking drugs that interfered with the ANS including antihypertensive, diuretic, adrenergic inhibitor, anti-arrhythmic, sedative, hypnotic, epileptic drugs were also excluded from the study.

The subjects were informed and explained about the test procedure and a written consent was taken. The institutional Ethical Committee clearance was taken. Female subjects were asked about their menstrual cycle history and the test was done during the early follicular phase (between days 1-5) of their menstrual cycle; when both estradiol & progesterone levels are believed to be at lowest.

Instrument used: Handgrip Dynamometer (Labotech), Sphygmomanometer, stethoscope, weighing machine, height measuring instrument.

Sustained Handgrip Test: The subject was asked to sit comfortably in a chair. The subjects were explained about the test and the procedure. The baseline BP was recorded. Then the subject was asked to grip the handgrip dynamometer using maximum force with their dominant hand for a few second. The value was noted & the procedures were repeated thrice. The maximum value of the three readings was taken as the maximal voluntary contraction (MVC) (maximal isometric tension i.e., Tmax). Then a mark was made on the dynamometer at 30% of MVC of the subject and then the subject was asked to maintain the sustained grip on the dynamometer upto the mark with uniform intensity till failure and time is noted (Endurance Time).

After the subject had started the contraction, the BP was measured on the contralateral arm at 1st, 2nd & 4th (or any time just before release of grip if it was less than 4 minutes). One more reading was taken 2 minutes after the release of the grip. The BP response was calculated as Highest DBP during the test - Baseline DBP.

BP response to sustained handgrip test ≥ 16 mmHg was take as normal.

≥ 11 -15 mHg as Borderline

≤ 10 mHg as Abnormal.

STATISTICAL ANALYSIS: The data obtained were analyzed using SPSS software version-16. Paired 't' test was used for comparing the data between males & females. Results were expressed as Mean \pm SD. Level of significance for all tests was taken as $p < 0.05$.

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RESULTS: The mean age of males & females were 21.94 ± 0.854 & 21.71 ± 0.726 respectively and the mean BMI of males & females were 22.44 ± 1.825 & 20.43 ± 1.342 respectively as shown in Table 1.

The Endurance time was significantly longer in females (93.93 ± 9.03) as compared to males (80.31 ± 10.40), while the BP response was higher in males (26.38 ± 5.12) as compared to females (17.71 ± 3.50) (Table 2).

DISCUSSION: Our study showed significant prolonged Endurance time (ET) in females as compared to males while the BP response was higher in males as compared to females. This observed gender difference in ET following sustained isometric handgrip exercise can be attributed to limited blood flow by intramuscular pressure in stronger men contracting at a greater absolute force than women who are usually weaker than man.⁷ This greater absolute forces are associated with increased intramuscular pressures, occlusion of blood flow, accumulation of metabolites, heightened metaboreflex responses, and impairment of oxygen delivery to the muscle. Activation of the metaboreflex is inversely related to endurance time.⁸ Reduced blood flow contributes to muscle fatigue by means of decreased delivery of oxygen & glucose & also by insufficient removal of metabolic products (H^+ , Pi, H_2SO_4) associated with muscle fatigue.⁹ This fatigue mechanism has been attributed to be a cause of the reduced time to task failure seen in men during sustained handgrip exercise when blood flow is thought to be limited.¹⁰ Females have less muscle mass so there is less mechanical compression of vasculature & hence less imbalance between blood supply & demand & delayed fatigability, thus accounting for the prolonged endurance time.⁶

In contrast to our findings, others have reported no relation between handgrip strength and endurance times for isometric contractions performed at 30, 50, and 75% MVC, even though women had longer endurance time.¹¹

The present study showed higher BP response in males as compared to females (Table 2). The pressure response is a reflex-mediated adjustment in mean arterial pressure that attempts to rectify the mismatch between perfusion and muscle metabolism during an isometric contraction.¹² This reduced pressure response of the females may be due to less muscle mass and a lower target force with attenuated sympathetic neural outflow, resulting in greater muscle perfusion and different substrate utilization and lower metabolite production in females.¹³ The attenuated sympathetic neural outflow may be due to estrogen that reduced vasoconstriction, maintained muscle perfusion & prolonged endurance time.^{14,15} Thus we can conclude from our studies that gender differences do exist in cardiovascular response to sustained isometric exercise. The proposed mechanisms for explaining the gender difference in cardiovascular response are numerous and conflicting and further study is essential to elucidate the specific mechanism.

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	Male (n=16)	Female (n=14)	p-value
Age (yrs.)	21.94±0.854	21.71±0.726	0.385
BMI (kg/m ²)	22.44±1.825	20.43±1.342	0.002

Table 1: Physical characteristics of the subjects

	Male(n=16)	Female(n=14)	p-value
Endurance Time	80.31±10.40	93.93±0.03	0.001
BP response	26.38±5.12	17.71±3.50	0.000

Table 2: Comparison of endurance time and BP response in males & females

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