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Hand Grip Strength of Dominant Hand During 4 Phases of Menstrual Cycle

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ABSTRACT

Background: The menstrual cycle is a key aspect of female reproductive health, characterized by hormonal changes that have been shown to affect various physiological functions, including muscle strength. This study aims to elucidate the relationship between the menstrual cycle and muscle strength by assessing hand grip strength in both dominant and non-dominant hands throughout all four menstrual phases, contributing to a more comprehensive understanding of the hormonal impacts on muscular performance.

Methods: A comparative cross-sectional study was carried out over a span of four months in Lahore, focusing on 30 unmarried eumenorrheic females aged 18-25 years with regular menstrual cycles. Exclusions were made for those with irregular cycles or medical issues. The Hand Grip Dynamometer was used for data collection and SPSS 21.0 for analysis, employing independent sample t-tests for comparing mean strength across menstrual phases.

Results: The investigation included 52 participants with a mean age of 22.92 years. The data revealed that during the menstruation phase, the mean hand grip strength was 18.09 kg for the dominant hand and 19.11 kg for the non-dominant hand. The follicular phase showed a slight increase in mean strength to 18.24 kg for the dominant hand and 19.33 kg for the non-dominant hand. A marginal decrease was observed during ovulation, with the dominant hand averaging 17.96 kg and the non-dominant hand at 16.66 kg. In the luteal phase, the dominant hand's mean strength increased to 18.67 kg, while the non-dominant hand averaged 16.78 kg.

Conclusion: The findings suggest that the menstrual cycle has a measurable impact on hand grip strength, with the dominant hand experiencing a slight decrease in strength during ovulation and the non-dominant hand showing a decrease during both the ovulation and luteal phases. These results indicate that hormonal fluctuations throughout the menstrual cycle can influence muscular strength and should be considered in contexts of functional capacity and exercise performance.

Keywords: Menstrual Cycle, Muscle Strength, Hand Grip Dynamometer, Ovulation Phase, Luteal Phase, Hormonal Fluctuations, Eumenorrheic Females.

INTRODUCTION

The menstrual cycle represents a fundamental component of female reproductive health, entailing a sequence of natural physiological modifications in the uterus and ovaries that recur monthly (1, 2). It plays a crucial role in preparing the uterus for potential pregnancy, starting with the follicular phase which involves the maturation of an egg and culminating with menstruation should fertilization not occur. This cycle typically unfolds over a duration of approximately 30 days, commencing with menstruation which generally persists for 3 to 7 days, during which the lining of the uterus is expelled, composed of blood, endometrial cells, and mucus (3, 4). The apex of the cycle is ovulation, occurring around the 14th day, where an egg is released and, if not fertilized, will eventually deteriorate (5, 6).

The initial phase of the cycle is characterized by the shedding of the uterine lining, an event that can extend for a week's duration. This phase is instigated by the hypothalamus, which triggers the secretion of follicle-stimulating hormone (FSH), leading to the development of ovarian follicles and the thickening of the uterine lining (7, 8). Subsequent to menstruation, the follicular phase ensues, signified by the release of a mature egg from the ovary. This event is propelled by a surge in luteinizing hormone (LH) and FSH, with the egg having a viability of only one day unless it meets a sperm (9, 10). Post-ovulation, the remnants of the follicular eggs develop into the corpus

luteum, secreting hormones that assist in further thickening of the uterine lining. In the absence of pregnancy, the corpus luteum withers away, signaling the cycle to recommence (11).

The influence of the menstrual cycle extends beyond reproductive capacities, impacting other physiological aspects like muscle strength. Hand grip strength is particularly sensitive to the hormonal fluctuations inherent to the menstrual cycle (12). A hand dynamometer, the instrument used to measure grip strength, is specifically designed to accommodate the thenar and hypothenar eminences of the hand while inhibiting thumb movement to ensure accurate strength evaluation. To garner reliable readings, it is advisable to perform a series of three trials with the dynamometer. In clinical environments, hand dynamometers are esteemed for their reliability, user-friendliness, portability, and economic viability, especially when compared to more intricate devices such as isokinetic machines (13, 14).

The interaction between the menstrual cycle and physical parameters has been the subject of various studies. For instance, Nirmala S. Annand (2018) examined the cardiovascular responses to isometric hand grip exercises and discovered notable discrepancies in cardiovascular parameters between the follicular and luteal phases, indicating phase-sensitive variances in physical reactions (16). Amruta S. Bennal (2016) observed muscle performance throughout the menstrual cycle in medical students and reported minimal variations in hand grip strength, suggesting that the menstrual cycle's impact on such activities is trivial, thus implying no necessity for female athletes to modulate their training in accordance with their menstrual phases (17).

LC Pallavi (2017) embarked on an investigation into musculoskeletal strength and fatigue levels during the menstrual cycle in young adults. The findings suggested an elevation in strength and a reduction in fatigue in the follicular phase relative to other phases, with the highest fatigue occurring during menstruation (18). Additional research has assessed the menstrual cycle's effects on heart rate variability, revealing fluctuations in sympathetic and parasympathetic nervous system activities across different phases, possibly related to hormonal shifts (19). Goncalves TM (2011) explored the hormonal influences on maximal force in females, concluding that the phases of the menstrual cycle do not exert a significant impact on maximal occlusal force among physically fit women (20).

Sheila Loureiro (2011) evaluated muscle strength during resistance exercises throughout the menstrual cycle and found no substantial differences in performance across various body segments (21). In a similar vein, Hamid Arazi (2019) compared strength, muscular endurance, and anaerobic power during different menstrual phases, deducing no significant distinctions in strength and endurance throughout the cycle (22). Tenan MS (2016) concentrated on maximum force and strength fluctuation and ascertained that the menstrual cycle does not significantly influence maximum force and strength during physical exertion (23). Lastly, research by Ross Julian and Anne Hecksteden (2017) on female soccer players revealed a dip in maximum endurance during the luteal phase, yet no notable changes were observed in jumping and sprint performances (24). Blanca Romero-Moraleda (2019) examined strength and power during various menstrual phases and recognized consistent performance in muscular strength and power in half-squat exercises across all cycle phases (25). The objective of this study to determine the muscular performance in dominant and non-dominant hand by comparing handgrip strength during four phases of the menstrual cycle.

MATERIAL AND METHODS

In a comparative cross-sectional study carried out in Lahore over a period of four months, the researchers focused on a community-based population. The subjects of the study were 30 unmarried eumenorrheic females, whose ages ranged from 18 to 25 years. These participants were carefully selected based on their regular menstrual cycles and the absence of any known medical or gynecological problems. The researchers implemented a simple convenient sampling method, deliberately excluding individuals who reported irregular menstrual cycles, experienced dysmenorrhea, had heavy menstrual bleeding, or were diagnosed with endocrine disorders.

The data collection process involved the use of a Hand Grip Dynamometer to measure handgrip strength and a comprehensive Performa form to capture relevant participant information. Prior to the commencement of data gathering, informed consent was obtained from all the participants, ensuring that they were fully aware of the study's purpose and their role in it.

For the analysis of the collected data, the Statistical Package for the Social Sciences (SPSS) version 21.0 was utilized. Quantitative data were summarized and presented in the form of means and standard deviations, while qualitative data were conveyed through frequencies and percentages. The visual representation of the data was facilitated by the use of pie charts for qualitative variables and bar charts for quantitative measurements. To evaluate the differences in mean values across the various phases of the menstrual cycle, an independent sample t-test was conducted. This statistical approach allowed for a robust comparison of handgrip strength at different points in the menstrual cycle, thereby enabling the researchers to draw meaningful conclusions from the study.

RESULTS

In this study, the muscle strength of the dominant and non-dominant hand was investigated across the menstrual cycle using a hand grip dynamometer. The study comprised 52 female participants with an average age of 22.92 years. The findings indicated that fluctuations in reproductive hormones affected muscular strength.

Regarding hand grip strength, during the menstruation phase, the average strength in the right (dominant) hand was 18.09, with a range between 10.53 and 30.56, while the left (non-dominant) hand showed a wider range, from 10.30 to 174.00, with an average of 19.11. In the follicular phase, the right hand's strength slightly increased, with an average of 18.24 and a range between 9.50 and 30.83. The left hand exhibited an average strength of 19.33, ranging from 10.36 to 155.00. During the ovulation phase, right hand strength decreased marginally to an average of 17.96, and the left hand strength averaged at 16.66. Notably, the right hand showed a higher difference in strength compared to the left hand during this phase.

In the luteal phase, the right hand's grip strength averaged at 18.67, showing a slight increase from the ovulation phase, while the left hand's strength averaged at 16.78. Again, the right hand exhibited higher strength during this phase as compared to the left hand.

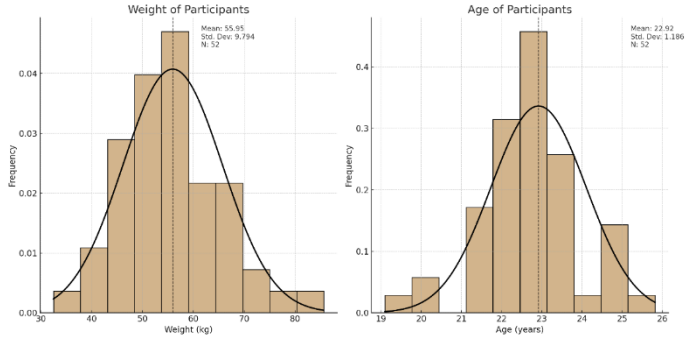

Figure 1 Weight and Age Histograms

The study's analysis revealed that the dominant hand (right hand) generally exhibited higher grip strength across the menstrual cycle phases, with some variability in strength levels. These variations in grip strength between the dominant and non-dominant hand across different phases underscore the influence of menstrual cycle fluctuations on muscular strength. The study's findings provide valuable insights into the varying dynamics of hand grip strength in relation to the menstrual cycle.

Table 1 Group statistics during all phases of menstrual cycle.

Phase	Hand	N (Number of Participants)	Mean	Std. Deviation	Std. Error Mean	Sig (2-tailed)
Hand Grip Strength During Menstruation Phase	Right Hand	52	18.09	3.948	0.547	0.745
	Left Hand	52	19.11	22.192	3.07	0.745
Hand Grip Strength During Follicular Phase	Right Hand	52	18.24	4.093	0.567	0.694
	Left Hand	52	19.33	19.603	2.71	0.695
Hand Grip Strength During Ovulation Phase	Right Hand	52	17.96	3.614	0.501	0.050
	Left Hand	52	16.66	3.062	0.424	0.050
Hand Grip Strength During Luteal Phase	Right Hand	52	18.67	4.269	0.592	0.018
	Left Hand	52	16.78	3.738	0.518	0.018

This table organizes the data clearly, showing the hand grip strength during different phases of the menstrual cycle

DISCUSSION

The discussion of the study delves into the complex relationship between the menstrual cycle and muscle strength, particularly in the dominant and non-dominant hands. The study, involving 52 unmarried females aged 18-25, investigates hand grip strength across all four phases of the menstrual cycle, revealing notable variations in muscle strength due to hormonal fluctuations.

Reflecting on previous research, such as Nirmala S. Anand's work, which focused on cardiovascular responses in the follicular and luteal phases, this study extends the scope by including all menstrual phases and examining hand grip strength. Notably, the current study observed a reduction in grip strength in the dominant hand during the ovulation phase and in the non-dominant hand during the luteal phase (16).

Amruta S. Bennal's 2016 study, assessing muscular performance in medical students, found no significant change in maximum voluntary contraction, but a variation in time to fatigue during different menstrual phases. In contrast, the present study highlights slight differences in grip strength during the ovulation phase for the dominant hand and in the luteal phase for the non-dominant hand (17).

LC Pallavi's research on fatigue levels across menstrual phases showed higher hand grip strength in the follicular phase compared to others. This study, however, includes all four phases and notes minor changes in strength, with more significant variations in the non-dominant hand (18).

The study also touches upon research in related fields, like Tejinderkaur's investigation into heart rate variability across menstrual phases, and Goncalves's study on the impact of hormonal changes on muscle tone and strength, which did not show significant effects on maximum occlusal force during the menstrual cycle. (20, 26) Similarly, a 2011 study on muscular strength in resistance exercises and Hamid Arazi's 2019 research on strength, endurance, and hormonal changes in physically fit girls, showed no marked changes across menstrual phases (22, 27).

In conclusion, the study underscores that while previous research has primarily focused on three phases of the menstrual cycle, this study's broader scope reveals nuanced changes in muscle strength in both the dominant and non-dominant hands. These findings suggest that hormonal fluctuations can influence muscle strength and potentially impact functional capacity and exercise performance with age.

CONCLUSION

The current study found that handgrip strength slightly decreased in the ovulation phase (14th day) of the menstrual cycle in the dominant hand, while in the non-dominant hand, strength decreased during both the ovulation and luteal phases. Notably, the decrease in non-dominant handgrip strength was more pronounced compared to the dominant hand. This study faced several limitations, including participant dropout due to irregular menstrual cycles and reluctance stemming from the necessity of repeated data collection across different menstrual phases. Additionally, precise timing for data collection was challenging due to participant unavailability. Despite these challenges, the findings of this study are significant as they highlight the hormonal impact on muscle strength, offering valuable insights for future research. This is particularly relevant for studies focusing on randomized control methods and populations with left-hand dominance.

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