WOMEN STUDIES

Effect of Morningness – Eveningness Chronotypes on Grip Strength in College Women Shuttle Badminton Players

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Abstract

The primary objective of this study was to examine the influence of chronotype ("Morningness" and "Eveningness" types) on right-hand grip strength (R), left-hand grip strength (L), and average grip strength (AVG). To achieve this aim, sixteen (n=16) female shuttle badminton team members, all pursuing undergraduate studies in Bachelor of Technology programs, were selected as participants. The instruments utilized for data collection included the Morningness-Eveningness Questionnaire (Horne & Östberg, 1976) to assess chronotype, and an electronic hand dynamometer to measure grip strength. Following the determination of chronotype, measurements of right-hand grip strength (R), left-hand grip strength (L), and average grip strength (AVG) were recorded. Statistical analysis using ANOVA revealed significant differences in right-hand grip strength (R) between chronotype groups. However, no significant differences were observed in left-hand grip strength (L) or average grip strength (AVG) across chronotype categories, as confirmed by post-hoc tests.

Keywords: M-Type, E- Type, Chrono type, Grip strength.

ISSN: 2582 - 2594

Introduction

Achieving excellence in their chosen sport is the primary goal of elite athletes. The drive to win, the desire for success, and the ambition to surpass existing performance limits are critical characteristics associated with attaining elite status. Athletes must consistently strive to reach and maintain peak performance levels to remain competitive at the highest level. In field sports, contemporary players are required to move more rapidly, anticipate actions more effectively, exhibit superior technical and tactical skills, and sustain high levels of effort for longer durations compared to their predecessors. The commitment demanded of clubs, coaches, and athletes in the pursuit of perfection necessitates substantial investments of time and financial resources, particularly as the margin between victory and defeat becomes increasingly narrow. Consequently, the foundations for training and competition must be rooted in objective, evidence-based approaches rather than relying solely on subjective assessments of athlete performance or traditional coaching practices passed down through generations.

Materials and Methods

Participants

Sixteen (n=16) female college shuttle badminton players, selected to represent their institution in intercollegiate tournaments, participated in this study. The participants were students from an engineering college in Thiruvananthapuram. The age of the subjects ranged from 20 to 25 years, with a mean age of 22.5 ± 2.69 years. Data were collected during a ten-day coaching camp organized for the team.

Instrumentation

Morningness-Eveningness questionnaire (MEQ)

The Morningness-Eveningness Questionnaire (MEQ), developed by Horne and Östberg (1976), is designed to evaluate an individual's habitual wake-up and bedtimes, self-reported preferred times for physical and mental activity, and subjective alertness. The MEQ consists of nineteen items, utilizing Likert-type responses, with four answer choices provided for each question. Based on the total score, individuals are categorized into one of five chronotypes: definite morning type (DMT), moderate morning type (MMT), intermediate type (IT), moderate evening type (MET), and definite evening type (DET). For several items, a time-scale format is used, divided into 15-minute intervals over a seven-hour period. Total scores range from 16 to 86. Scores between 70 and 86 indicate a definite

morning type (DMT), scores between 59 and 69 indicate a moderate morning type (MMT), scores between 42 and 58 indicate an intermediate type (IT), scores between 31 and 41 indicate a moderate evening type (MET), and scores between 16 and 30 indicate a definite evening type (DET). Time scale responses are rated from 1 to 5, progressing from high eveningness to high morningness.

Electronics hand dynamometer (Model No EH101).

The participants' physical strength was assessed using a static arm pull test with an electronic hand dynamometer (Model No. EH101). During testing, the dynamometer handle was adjusted so that each participant's forearms were flexed at 90 degrees, with the upper arms positioned vertically, parallel to, and adjacent to the torso. Participants were instructed to stand upright with legs straight, back straight, and feet flat on the ground. Each participant grasped the sides of the handlebar connected to the load cell and was required to exert an upward and vertical force within the sagittal plane. Force generation was isolated to the arms, and shoulder movement was minimized. Participants were instructed to gradually pull the handle with maximum effort, avoiding jerky movements, for a duration of up to 30 seconds. Strength measurements were displayed on the dynamometer in kilograms (kg). To ensure accuracy, the test was conducted three times for each participant, and the average of the three trials was calculated.

Results and Discussion

The dependent variables — right-hand grip strength (R), left-hand grip strength (L), and average grip strength (AVG) — were measured across four different chronotype categories: definite morning type (DMT), moderate morning type (MMT), moderate evening type (MET), and intermediate type (IT).

The results are summarized as follows: For the definite morning type (DMT), the mean right-hand grip strength was 29.27 kg (SD = 2.005), and the mean left-hand grip strength was 25.55 kg (SD = 2.382). For the moderate morning type (MMT), the mean right-hand grip strength was 25.57 kg (SD = 3.553), and the mean left-hand grip strength was 24.87 kg (SD = 5.268). For the moderate evening type (MET), the mean right-hand grip strength was 27.78 kg (SD = 4.403), and the mean left-hand grip strength was 26.04 kg (SD = 3.986). For the intermediate type (IT), the mean right-hand grip strength was 27.61 kg (SD = 3.816), and the mean left-hand grip strength was 26.25 kg (SD = 4.197).

Regarding the average grip strength (AVG), the definite morning type showed a mean value of 27.41 kg (SD = 2.10), the moderate morning type recorded a mean

 ISSN: 2582 - 2594

Table 1 Descriptive statistics were computed for the dependent variables — right-hand grip strength, left-hand grip strength, and average grip strength — in relation to the participants' Morningness-Eveningness (M and E) types.

		N	Mean	Std. Deviation	Std. Error
Grip (R)	Definitely Morning	11	29.27	2.005	0.604
	Moderate Morning	23	25.57	3.553	0.741
	Moderate Evening	54	27.78	4.403	0.599
	Intermediate	88	27.61	3.816	0.407
	Total	176	27.50	3.955	0.298
Grip (L)	Definitely Morning	11	25.55	2.382	0.718
	Moderate Morning	23	24.87	5.268	1.099
	Moderate Evening	54	26.04	3.986	0.542
	Intermediate	88	26.25	4.197	0.447
	Total	176	25.96	4.194	0.316
Grip AVG	Definitely Morning	11	27.4091	2.09545	0.63180
	Moderate Morning	23	25.2174	3.83414	0.79947
	Moderate Evening	54	26.9074	3.91306	0.53250
	Intermediate	88	26.9318	3.74717	0.39945
	Total	176	26.7301	3.75190	0.28281

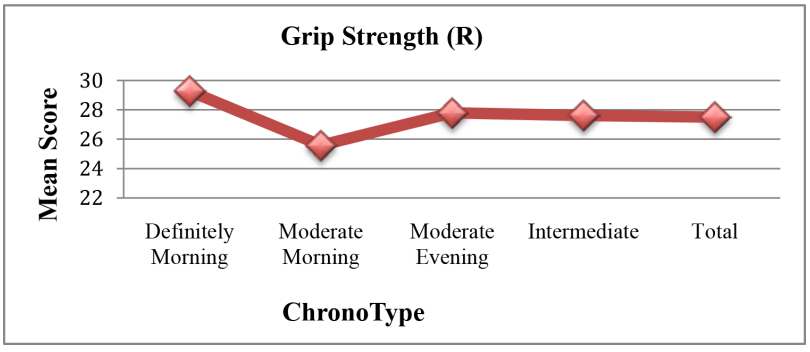

Fig.1 Marginal Mean score of grip Strength right hand in relationship with circadian

of 25.22 kg (SD = 3.83), the moderate evening type had a mean of 26.91 kg (SD = 3.91), and the intermediate type showed a mean of 26.93 kg (SD = 3.75).

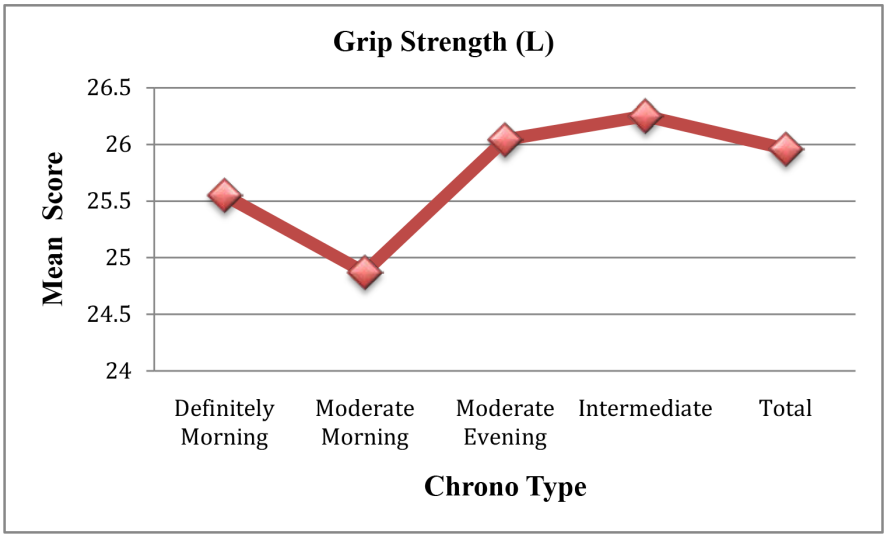

Fig.2 Marginal Mean score of Grip Strength Left in relationship with circadian rhythm.

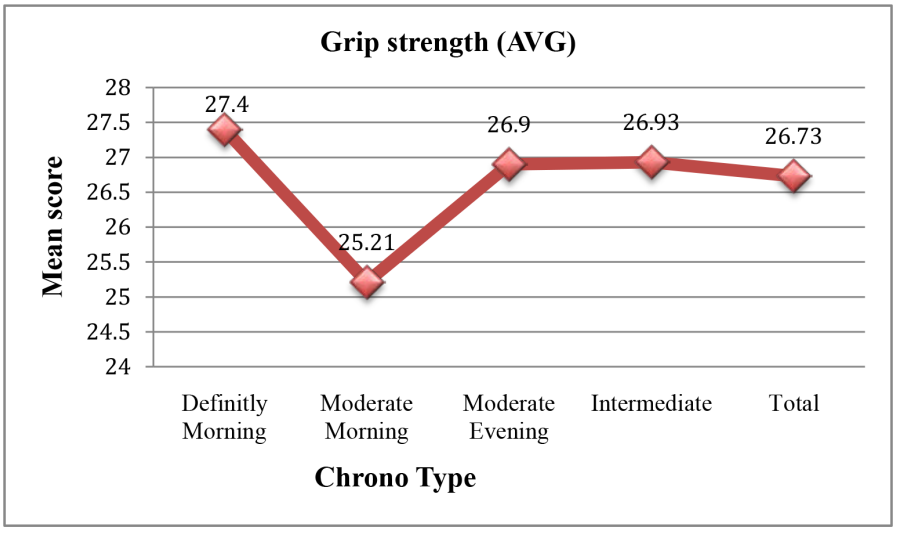

Fig.3 Marginal Mean score of Average Grip Strength Right and Left in relationship with circadian rhythm.

ISSN: 2582 - 2594

Table 2 An analysis of variance (ANOVA) was conducted to examine differences in right-hand grip strength, left-hand grip strength, and average grip strength (combined right and left hand) across different chronotype categories (Morningness-Eveningness types).

		Sum of Squares	df	Mean Square	F	Sig.
Grip (R)	Between Groups	125.969	3	41.990	2.765	.044
	Within Groups	2612.031	172	15.186		
	Total	2738.000	175			
Grip (L)	Between Groups	36.960	3	12.320	.697	.555
	Within Groups	3041.762	172	17.685		
	Total	3078.722	175			
Grip AVG	Between Groups	62.980	3	20.993	1.504	.215
	Within Groups	2400.450	172	13.956		
	Total	2463.430	175			

***> p.05 (2.25)**

An analysis of variance (ANOVA) was conducted to determine whether significant differences existed among the dependent variables — right-hand grip strength (R), left-hand grip strength (L), and average grip strength (AVG) — across the four chronotype categories: definite morning type (DMT), moderate morning type (MMT), moderate evening type (MET), and intermediate type (IT). As shown in Table 2, a significant difference was observed in right-hand grip strength (R) between chronotype groups ($F = 2.765$, $p = 0.044$). However, no significant differences were found for left-hand grip strength (L) or average grip strength (AVG), and thus, the null hypothesis of no difference among the means of the four chronotype groups can be accepted for these variables at the 5% significance level. Consequently, post hoc analysis was performed only for the right-hand grip strength

(R), as no significant differences were detected for left-hand grip strength (L) or average grip strength (AVG).

Table 3 Pair wise comparisons on estimated marginal means of grip strength variable right

Dependent Variable	(I) CR Type	(J) CR Type	Mean Difference (I-J)	Std. Error	Sig.
Grip (R)	Definitely Morning	Moderate Morning	3.708*	1.429	.010
		Moderate Evening	1.495	1.289	.248
		Intermediate	1.659	1.246	.185
	Moderate Morning	Definitely Morning	-3.708*	1.429	.010
		Moderate Evening	-2.213*	.970	.024
		Intermediate	-2.048*	.913	.026
	Moderate Evening	Definitely Morning	-1.495	1.289	.248
		Moderate Morning	2.213*	.970	.024
		Intermediate	.164	.674	.808
	Intermediate	Definitely Morning	-1.659	1.246	.185
		Moderate Morning	2.048*	.913	.026
		Moderate Evening	-.164	.674	.808

*. The mean difference is significant at the 0.05 level.

The pairwise comparisons presented in Table 3 revealed that right-hand grip strength (R) showed a significant difference between the definite morning type (DMT) and the moderate morning type (MMT), with a mean difference (MD) of 3.708. No significant differences were found between DMT and the other chronotype groups. The results also indicated that the moderate morning type (MMT) differed

ISSN: 2582 - 2594

significantly from both the moderate evening type (MET) (MD = -2.213) and the intermediate type (IT) (MD = -2.048). However, no significant differences were observed between the intermediate type (IT) and either the definite morning type (DMT) or the moderate evening type (MET).

Conclusions

Chronotype influences various sensory-motor, psychomotor, perceptual, and cognitive functions (Winget et al., 1985). Inter-individual differences in circadian rhythmicity have been linked to factors such as age, gender, social conditions, and lifestyle choices (Vink et al., 2001). However, individual preferences for either morning (M-type) or evening (E-type) chronotype are considered major contributors to these inter-individual variations (Vink et al., 2001; Ellis et al., 2009). More specifically, humans display considerable variation in how they organize their activities within the 24-hour cycle, with the most evident differences being the preferred times for waking, sleeping, and engaging in various activities (Roenneberg et al., 2007). Chronotype can be seen as a continuum between two extremes: at one end, the M-type, who is easily awakened early in the morning and is more alert in the morning than in the evening (Vink et al., 2001; Cavallera and Giudici, 2008); and at the other end, the E-type, who is more alert at night and prefers to sleep later in the morning (Vink et al., 2001; Cavallera and Giudici, 2008). However, many individuals fall near the middle of the spectrum and are classified as neither-type (NT) (Vink et al., 2001; Cavallera and Giudici, 2008). The present study highlights the significant influence of chronotype on the grip strength (R), grip strength (L), and average grip strength (AVG) of the college women's shuttle badminton team. A thorough analysis of the data revealed that chronotype significantly influenced right-hand grip strength (R), but had no significant effect on left-hand grip strength (L) or average grip strength (AVG). These findings align with studies such as Reilly et al. (1997), which observed diurnal peaks in isometric strength of the knee extensors at the end of the morning and late afternoon/early evening. Similarly, Colquhoun (1972) noted that tasks requiring fine motor control (e.g., hand steadiness and balance) are typically better performed in the morning, when arousal levels are lower but closer to the optimum for performance. Conroy and O'Brien (1974) also found that complex performance tasks, including mental arithmetic and short-term memory, tend to peak during the early morning hours rather than in the evening. Success in sports is determined by numerous factors, including both mental and physical components, motor skills, age, national status, physiology, psychology, training levels, genetic factors, and injury risk. Women's

sports performance, specifically, is influenced by movement-oriented behaviours that are underpinned by biological rhythms. These rhythms, which fluctuate periodically, have a significant impact on sports performance. As sports events take place at various times of the day, the findings from this study suggest that chronotype may be influenced by the timing of sports competitions or training sessions. Understanding the impact of chronotype on performance at different times of the day could offer valuable insights for coaches and athletes in optimizing training and competition strategies.

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 ISSN: 2582 - 2594

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