Effect of Time of the Day on Selected Motor Abilities among the Early Chronotype Athletes

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Abstract

The aim of the study was, to find the time of the day best suited for the agility, speed and lower body explosive strength of the early chronotype athletes. A total of 15 young early chronotype athletes of age 18-22 years of LNIPE, Gwalior participated in the study.The participants' chronotype was determined using the Horne and Östberg Morningness and Eveningness questionnaire. The study showed that the performance of early chronotype athletes is better during the early hours of the day. A significant relation between performance of agility, speed and lower body explosive strength on three different times of the day on the early chronotype athletes was observed. There was a clear indication that chronotype can be affected by the time of the day. This was evident by the results that the early chronotype athletes can show better potential during early hours of the day. Giventhat the best time to perform for early chronotype athletes is the early hours of the day, the coaches are recommended to considering the athletes' chronotype during implementation of changes in the schedule and training of the athlete for the best outcome.

KEYWORDS-Early chronotype, circadian rhythm, speed, agility, lower body explosive strength, time of day.

Introduction

Chronobiology and circadian rhythms. Chronobiology is the science that studies endogenous biological rhythms, which are the internal cycles of all living beings (Postolache et al. 2020). There are several types of biological rhythms, circadian, ultradian, and infradian, being the circadian the most relevant because they act in the period of time corresponding to 24 hours (Postolache et al. 2020; Vitale and Weydahl 2017; Vitosevic 2017). The ultradian refers to a period of time shorter than 20 hours, and the infradian to cycles longer than 28 hours; within the latter, circaseptan (7 days), circatrigintan (30 days), and circa-annual (360 days) are distinguished (Bellastella et al. 2019). The organism has a "central biological clock" located in the hypothalamus, specifically in the suprachiasmatic nucleus (SCN), which receives and emits information (Postolache et al. 2020; Vitale and Weydahl 2017; Vitosevic 2017). These rhythms are adjusted to environmental elements, mainly the light/dark cycle, with light being its main environmental synchronizer (zeitgeber) (Roden et al. 2017; Vitale and Weydahl 2017). Other exogenous stimuli are food intake, stress, physical activity or sleep, which are also called zeitgebers, a Germanword referred to any external stimulus capable of helping to maintain the periodicity of circadian rhythms (Postolache et al. 2020). The SCN receives light stimuli via the retinohypothalamic pathway, and with this information, it coordinates the rest of the "peripheral clocks" via endocrine or neural signals (Aoyama and Shibata 2020). These "clocks" also have the ability to function autonomously and independently, and are located throughout the body: kidney, pancreas, adipose tissue, muscle tissue (Mirizio et al. 2020). The time of individual biological preference to do activities and to rest is known as chronotype (Postolache et al. 2020).Thus, the morning preference for activities and going to bed early is named morning chronotype or lark, while the evening chronotype or owl places the moments of greatest activity in the afternoon, delaying the time to go to sleep. Between both, the intermediate-chronotype is located, the majority among the adult population (Roden et al. 2017).As previously mentioned, these cycles rely on various endogenous and exogenous factors for their synchronization. The presence of zeitgebers, such as light while sleeping, ingestion at night, or activity during moments of rest, cause the circadian rhythms to become unbalanced, and therefore, to produce alterations in sports performance, as energy metabolism and secretion of hormones are affected (Postolache et al. 2020). Diet has a great influence on circadian rhythms, been the first meal after the longest fast, that is, breakfast, the main synchronizer. This time of day is when the body requires higher energy levels to cope with the rest of daily activities, since the greatest sympathetic activity early in the day causes the greatest number of metabolic reactions. Likewise, there is an increase in gastric emptying, which leads to greater intestinal absorption, with higher glucose tolerance (Ruddick-Collins et al. 2018). Athletes must watch the type of diet and the frequency (regularity) of their feedings (Postolache et al. 2020). Lipid levels in the body are under circadian control, with the involvement of numerous "peripheral clocks",These endogenously driven near 24 h circadian rhythms are controlled by the suprachiasmatic nucleus (SCN), which is situated in the anterior hypothalamus . Neural and hormonal outputs from the SCN drive a multitude of behavioural and physiological rhythms, with notable factors being temperature regulation, hormonal release and gene expression. Circadian rhythms are also synchronised/entrained by exogenous factors such as light and social signals. An individual's predisposition towards the morning or evening, commonly termed one's chronotype, can be grouped into either early chronotypes (ECT), late chronotypes (LCT) or those in between (intermediate chronotypes) . ECTs, or 'larks', have significantly early sleep-wake cycles compared to LCTs, or 'night owls', who prefer to function later in the day. These differences are not only observed in sleep patterns but also in multiple physiological, behavioural and genetic oscillations that occur over a near 24 h period. According to the two process model of sleep regulation, humans' tendency to sleep is determined by the time passed since the last sleep episode (homeostatic factor) as well as by time of day (circadian factor) . The homeostatic factor is evident in humans' rising need for sleep after sustained wakefulness, while the circadian factor is evident in the increasing sleep propensity that normally occurs during the dark part of the 24-h d. Studies have taken different approaches in investigating how sleep deprivation and circadian disruption affect athletic performance. Some studies have focused on physiological measures, while others assess athletic performance. Furthermore, sports differ greatly as to which skills are important for successful performance.The previous researches were done mostly on the late chronotype athletes or irrespective of the chronotype only the peak performance time of the athletes was found. This is a huge research gap. None of the researches mentioned the peak performance time for the early chronotype athletes. The peak performance time for late chronotype athletes is 18:00 hours. No research was done on females only. The previous researches mainly measured the aerobic capacity not the anaerobic capacities. So this research will fill the research gaps by testing anaerobic motor abilities of the early chronotype athletes at different times of the day.

Materials and methods

Participants

For the purpose of the study Horne Osberg Questionnaire was distributed among the girls of LNIPE, Gwalior. The result of the questionnaire on the basis of the norms was evaluated to identify the early chronotype samples. The individuals scoring within the range of 70-86 were identified as early chronotype population. The subjects were selected from the age group of 18 -22 years with mean and sd. It was confirmed that the subjects were of early chronotype.

Morningness eveningness questionnaire

Chronotype was evaluated using the Horne and Östberg (1976) Morningness and Eveningness Questionnaire (MEQ). The MEQ is a self-assessment questionnaire which categorizes individuals based on their preference toward performing particular activities in the morning or evening (e.g., *If you had no commitments the next day and were entirely free to plan your own day, what time would you get up?*). The questionnaire consists of 19 questions and yields scores ranging from 16 to 96 with lower scores indicating participants' preference toward evening activities and higher scores indicating participants toward morning activities. Chronotype scores were determined using the Horne and Östberg classification system (16-41 = evening type; 42-58 = intermediate type; 59-86 = morning type).(Lastella, M., Roach, G. D., Halson, S. L., & Sargent, C. (2016)).

50m dash

The aim of this test is to determine acceleration and speed.The test involves running a single maximum sprint over 50 meters, with the time recorded.Start from a stationary standing position (hands cannot touch the ground), with one foot in front of the other. The front foot must be behind the starting line. Once the subject is ready and motionless, the starter gives the instructions "set" then "go."

4X10m shuttle run

This is a test of speed, body control and the ability to change direction (agility).Mark two lines 10 meters apart using marking tape or cones. The two blocks are placed on the line opposite the line they are going to start at. On the signal "ready", the participant places their front foot behind the starting line. On the signal, "go!" the participant sprints to the opposite line, picks up a block of wood, runs back and places it on or beyond the starting line. Then turning without a rest, they run back to retrieve the second block and carry it back across the finish line. A total of 40m is covered. Two trials are performed.

Standing broad jump

This test is to measure the explosive power of the legs.The athlete stands behind a line marked on the ground with feet slightly apart. A two foot take-off and landing is used, with swinging of the arms and bending of the knees to provide forward drive. The subject attempts to jump as far as possible, landing on both feet without falling backwards

Procedure

The subjects were given the Horne ostberg morningness eveningness questionnaire.

On the basis of the score the subjects were sorted as early and late chronotype. The early chronotype athletes were tested three times of the days i.e. in the morning , afternoon and evening for their speed, lower body explosive strength and agility. Before the tests the subjects were informed about the procedure of the tests and the rules and regulations to be maintained during the tests.

Data analysis

One-way repeated measure ANOVA was employed for analysis of data for lower body explosive strength, speed and agility at 0.05 level as the data was taken three times of the day from the same group of subjects and on the same variables. The data was analysed by the help of SPSS 20.

Results

Table 1:Pairwise Comparisons of Means of different Time levels agilityAbility.

		Mean difference	Std. error	Sig.
TIME(I)	TIME (J)			
1	2	-.348	.061	.000
1	3	-.797	.086	.000
2	1	.348	.061	.000
2	3	-.449	.097	.002
3	1	.797	.086	.000
3	2	.449	.097	.002

* Significant at 0.05

Table 1 has shown the pair-wise comparison (Bonferroni correction) among different levels of time factors. Here, a significant difference (p less than 0.012) is found between morning, afternoon and evening time performance also. There is significant difference between morning performance and afternoon performance of agility (P less than 0.05) also, there is significant difference between morning performance and evening performance of agility as p value is smaller than 0.05 also, there is significant difference between afternoon performance and evening performance. Here, Null hypothesis of no significant difference between all the duration in early chronotype is rejected at 0.05 level.

Figure:1

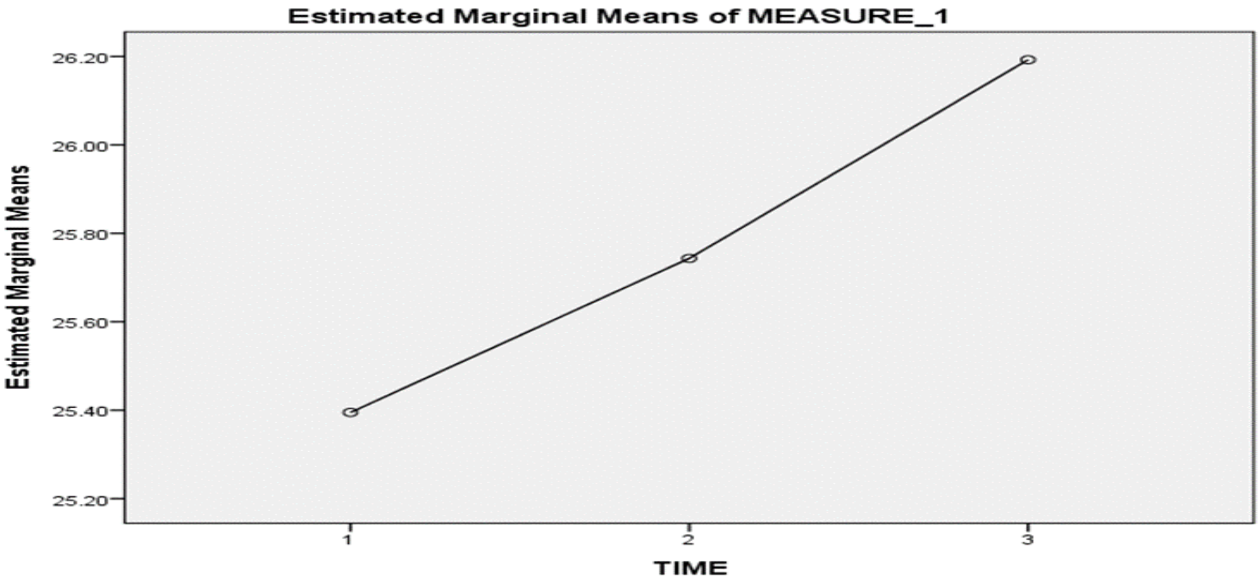

Figure 1 depicts the estimated marginal mean of measure 1 (agility ability) with respect to different time of the day. The graph shows the best timing of agility was during the time(1) i.e, the early morning (8.00 to 10.00 hours). It denotes that the early chronotype performed best for agility during the early morning.

Table 2: Pairwise Comparisons of Means of different Time levels Lower Body Explosive Strength Ability Table 1: Pairwise Comparisons of Means of different Time levels agility Ability.

		Mean difference	Std. error	Sig.
TIME(I)	TIME (J)			
1	2	.032	.005	.000
1	3	.078	.007	.000
2	1	-.032	.005	.000
2	3	0.47	.006	.000
3	1	-078	.007	.000
3	2	-047	.006	.000

* Significant at 0.05

Table 2 has shown the pair-wise comparison (Bonferroni correction) among different levels of time factors. Here, a significant difference (p less than 0.012) is found between morning, afternoon and evening time performance also. There is significant difference between morning lower body explosive strength performance and afternoon lower body explosive strength performance (P less than 0.05) also, there is significant difference between morning performance and evening performance of lower body explosive strength as p value is smaller than 0.05 also, there is significant difference between afternoon performance and evening performance. Here, Null hypothesis of no significant difference between all the duration in early chronotype is rejected at 0.05 level.

Figure:2

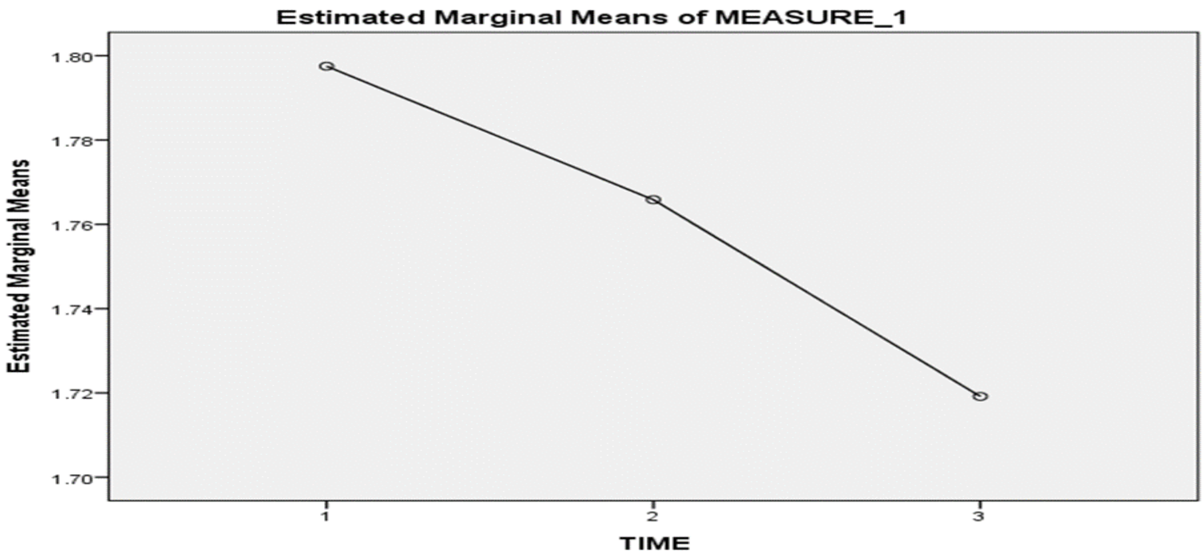

Figure 2 depicts the estimated marginal mean of measure2 (lower body explosive strength ability) with respect to different time of the day. The graph shows the best performance of lower body explosive strength was during the time (1) i.e., the early morning (8.00 to 10.00 hours). It denotes that the early chronotype performed best for lower body explosive strength during the early morning

Table 3: Pairwise Comparisons of Means of different Time levels Speed Ability

		Mean difference	Std. error	Sig.
TIME(I)	TIME (J)			
1	2	-.031	.007	.004
1	3	-.072	.010	.000
2	1	.031	.007	.004
2	3	-.042	.009	.003
3	1	.072	.010	.000
3	2	.042	.009	.003

Figure:3

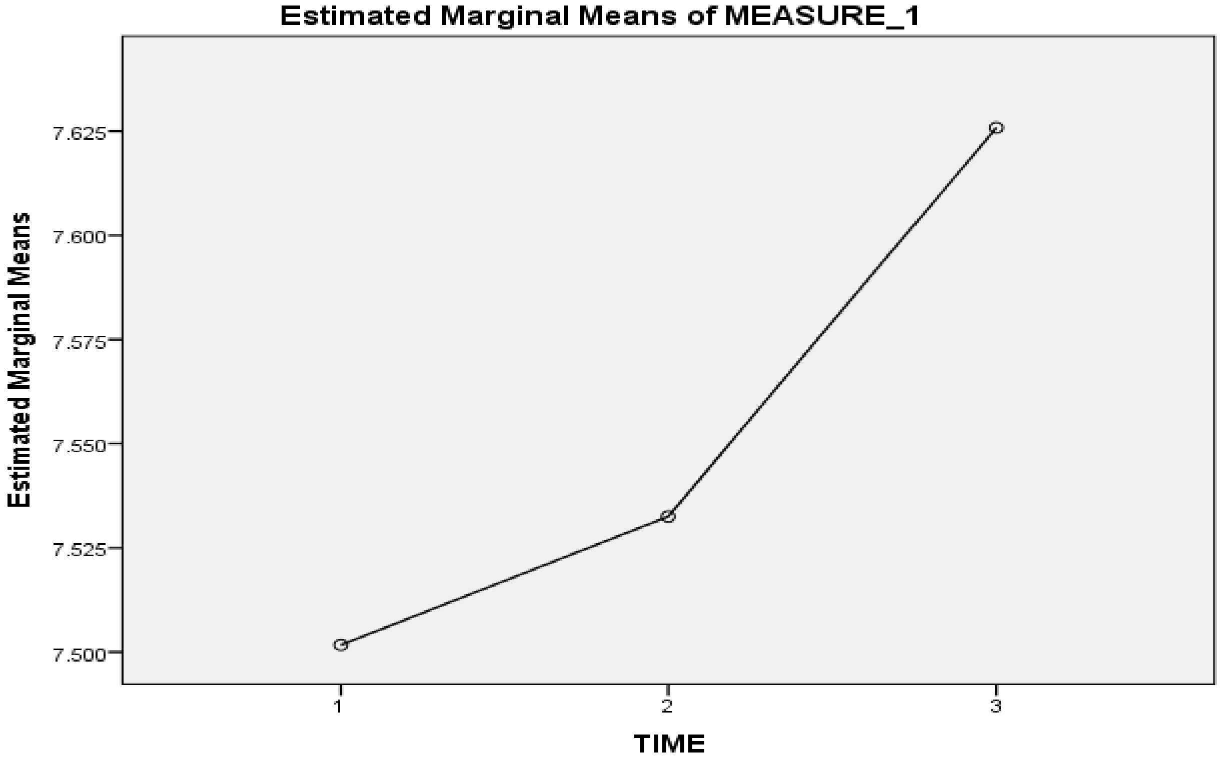

Figure 3 depicts the estimated marginal mean of measure3(speed ability) with respect to different time of the day. The graph shows the best performance of speed was during the time (1) i.e., the early morning (8.00 to 10.00 hours). It denotes that the early chronotype performed best for speed ability during the early morning.

DISCUSSION OF FINDINGS

Discussion of the Findings physical Variables: The performance of early chronotype athletes in physical variables like lower body explosive strength, speed and agility is best during the early hours of the day. The reason behind this can be that there are different types of chronotype like the Early birds(larks), neither type(intermediate) and the late owls. The different chronotypes and performance timing can be influenced by the endogenous factor that is inherited through the gene, the solar influence that means with the presence of light, our brain produces less melatonin and during darkness it produce more melatonin (sleep hormone) and the third factor is the lifestyle or social influence. Peak Performance times in athletes differ significantly between ECTs ("larks), ICTs, and LCTs ("Owls") ECTs perform best around midday, LCTs perform best in the evening. Diurnal performance curves and peak performance times depend very much on entertainment status, i.e., time since awakening/ internal biological time. Circadian rhythms are 24- hour (approx.) pattern in physiology, biochemistry, molecular biology that occur in the absence of changes in the environment. This rhythm varies from chronotype to chronotype depending on the time of their waking up and going to bed. The early chronotypes stay active e during the first hours of the day and their energy level starts to fall down from the late evening. The late chronotypes starts being active from the late morning and they stay active till late nights. There are several studies supporting this outcome. According to the study done by Jacopo Antonino Vitale and Adni weydhal (2017) M-types perceived less effort while performing a submaximal physical task in the morning than did N & E type. In addition, M type generally showed better athletic performances, as measured by variables. The peak performance was found in 18:00 hours. Sailen Das (1995) did a study to find the circadian rhythm in physical fitness. The researcher results show that the total physical fitness exhibits circadian rhythm with moderate value in the morning, lower during noon, reaching peak in the afternoon and gradually decreasing with the time of night. Although individual athletic performance generally tends to peak in the evening, individuals who exhibit a strong diurnal preference perform better closer to their circadian peak. But according to Anderson A, Murray G, Herlihy M, Weiss C, King J, Hutchinson E, Albert N, Ingram KK significant and parallel time-ofday by circadian phenotype effects on swim performance and effort; eveningtype swimmers swam on average 6% slower with 50% greater α-amylase levels in the morning than they did in the evening, and morning types required 5-7 times more effort in the evening trial to achieve the same performance result as the morning trial.

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