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RELATIONSHIP BETWEEN THE POWER GRIP STRENGTH AND SLEEP ON PERFORMANCE IN CRICKET PLAYERS: A CORRELATIONAL STUDY.

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Abstract

Cricket, or the gentleman's game, is a very traditional, popular, and simple past time today (Shah et al., 2017). It is one of the physically demanding sports with a variety of specialties that require for a variety of abilities and forms of fitness. Cricket players must have both the hand grip strength and shoulder power necessary to perform a variety of tasks. One of the key components to playing success is strength. Athletes must possess great levels of muscular strength to compete in several sports (Sathya et al., 2016). One of a person's most fundamental biological functions is sleep. It is a procedure in which the body's tissues recuperate from metabolic activities carried out throughout the day and get ready for the following day's efficient physiological functioning (Chandrasekaran et al., 2020). The objective of the study is to check the effect of power grip strength and sleep pattern on performance in cricket players. A Descriptive Correlation study, consisted of 85 cricketer age ranging between 18-35 years and were selected based on selection criteria from Gurugram District, Haryana. All consenting players completed the Athlete Sleep Behaviour Questionnaire on one occasion and the subject's hand grip strength was measured using a hydraulic hand-held dynamometer. The result found that power grip strength and performance were two independent variables while sleep and performance are weakly correlated to each other ($p < 0.05$). The study demonstrated the positive correlation between sleep and performance of the cricketers, but no relation between the power grip strength and performance.

Keywords: Power Grip Strength, Hand Grip Strength, sleep, sleep habits, sleep pattern, Athlete, Performance.

Introduction:

A team's psychological preparation is just as crucial in today's competitive environment as teaching the various game mechanics according to scientific principles because sports are psycho-social activities. These days, there has been more focus on the use of psychological principles to enhance athletic performance. Sports psychology studies

how psychological elements impact an athlete's performance as well as how exercise and sports affect athletes' psychological health. Successful and less successful players were differentiated based on their psychological profiles and capacities to perceive higher performances (Solanki *et al.,* 2021).

Self-assurance and psychological state anxiety both played a vital role in separating successful and unsuccessful competitors (Fahim *et al.,* 2020). It aids in the development of sports-based knowledge, confidence, awareness, and motivation that serve as a way to track performance and strengthen relationships between coaches and athletes. (Solanki *et al.,* 2021). Athletes put significant effort into enhancing their sports performance and overcoming obstacles (Dehghani *et al.,* 2018).

Although psychological factors have always been crucial in the context of sports, they didn't start to become particularly relevant until around 20 years ago. Currently, it is unthinkable for a sports team to not work with a psychologist in order to get the most out of practice and competition (Castro-Sanchez *et al.,* 2019).

Sports participation is linked to a variety of psychological and physical advantages, including better heart health, higher levels of self-esteem and body satisfaction, as well as better emotional well-being (Grossbard *et al.,* 2009). It is impossible to overstate the significance of fitness in any sport. You will play better if you are more physically fit. Cricket requires a high degree of fitness for a professional player to perform well because it is a team sport and all players must be active for up to five days during a match (Jain and Shah, 2021).

One of a person's most fundamental biological functions is sleep. It is a procedure in which the body's tissues recuperate from metabolic activities carried out throughout the day and get ready for the following day's efficient physiological functioning (Chandrasekaran *et al.,* 2020). The likelihood that an athlete will get enough sleep can be affected by a variety of factors, including their training and competition schedules, travel, stress, and the demands of their academic obligations (Watson, 2017). Sleep may be given less importance by athletes than other training requirements. Our contemporary culture has a strong belief that the capacity to bear minimal sleep is a strength and is seen as a badge of pride (Simpson *et al.,* 2017).

Inadequate sleep duration can affect the metabolism, endocrine system, athletic and cognitive outcomes, and it can also increase the perceived effort required for exercise (Charest and Grandner, 2020). It is well accepted that adequate sleep is necessary for elite athletes to recuperate and perform at their best. However, despite the abundant evidence of sleep impairment in professional athletes, especially during competition, sleep is frequently given lower priority by athletes. Generally, young, healthy persons (18–25 years) should get 7-9 hours of sleep per night; however, athletes should get 8–10 hours to make up for the extra demands of training and competition (McEwan *et al.,* 2020). Running's repetitive eccentric muscular contractions result in a particular type of exhaustion that needs a long recovery period (Noakes and Durandt, 2000).

Additionally, it is demonstrated that altering the usual sleep environment had a negative impact on sleep quality (Saidi *et al.,* 2022).Studies conducted in the past on the use of electronic devices, sleep, and athletic performance have revealed unfavourable consequences due to the circadian rhythm of sleep being altered by late-night light

exposure (Riederer, 2020). The scheduling of training sessions and contests, as well as poor sleep-onset as a result of increased arousal prior to competition or the usage of electronic devices before bedtime, are typical sleep-affecting factors (Kolling *et al.*, 2019).

Given the expanding research about sleep and athletic performance and recovery, there are numerous management techniques to address sleep difficulties in athletes. It is critical to educate athletes on the importance of sleep and how greater sleep will boost their performance on the field as well as their personal health. Because this population may lack understanding on these principles, discussing excellent sleep habits and good sleep hygiene might be beneficial. Furthermore, several factors of athletes' schedules put them at danger of disrupting excellent sleeping patterns. (Malhotra, 2017)

Cricket, or the gentleman's game, is a very traditional, popular, and simple past time. The game of cricket first appeared in the south-east of England in the late 16th century. It was adopted as the nation's national sport in the 18th century, expanded globally in the 19th and 20th centuries, and is still the most played sport in the world today (Shah *et al.*, 2017). It is one of the physically demanding sports with a variety of specialties that require for a variety of abilities and forms of fitness. Excellent eye-hand coordination, upper extremity strength, hand grasp dexterity, and synchronised shoulder, arm, and wrist movements are all necessary. A batsman's ability to utilise their forearm strength when batting is crucial because cricket is an endurance and strength-based sport (Sathya *et al.*, 2016). Bowlers are an integral part of any cricket team and each bowler's goal is to eliminate the opposing side's batsmen while limiting the number of runs they score (Vickery *et al.*, 2018).

As the single interface between the batsman and the cricket bat, via which all force and energy must be communicated, the grip is a crucial component of effective batting. It's common practise to use hand grip strength as a gauge for overall body health. An accurate assessment of hand strength can serve as a quantitative measure of overall upper body strength (Sathya and Shah, 2016).

For a cricket player to smash the ball during batting, throwing the ball, bowling, etc., shoulder power is very important. Cricket players must have both the hand grip strength and shoulder power necessary to perform a variety of tasks. One of the key components to playing success is strength. Athletes must possess great levels of muscular strength to compete in several sports (Sathya *et al.*, 2016).

The shoulder and elbow complexes must be strong for the hand to function properly in space and carry out the task. The hand cannot work independently of these structures. The muscles in the hands and arms play a key role in grip strength (Sathya *et al.*, 2016). The hand is a sophisticated anatomical structure with 27 bones, 15 joints, and about 30° of rotational and translational freedom that is used to grasp and exert force on objects of all sizes and shapes as well as to carry out a variety of complicated, highly coordinated actions (Cronin *et al.*, 2017).

The strength of one's grasp is sometimes disregarded or taken for granted, although it is crucial for injury avoidance and strength progression (Sathya *et al.*, 2016). The power grip is the outcome of the patient flexing their fingers as forcefully as they can under normal biokinetic circumstances, using their maximum voluntary force (Sathya and

Shah, 2016). Thus, the cricket player's entire physical strength can be inferred from the hand grip strength (Sathya *et al.*, 2016).

Strength can be defined as the ability to produce force. It is a crucial element in power production, which makes it a potential determinant of sports performance (Stone *et al.*, 2002). In most of the sport, grip strength is assessed as a part of hand function. One of the best measures of a limb's total strength is its grip strength, which is the combined performance of multiple muscles that may be generated during a single muscular activation. It is generally acknowledged that grip strength serves as an objective indicator of the functional integrity of the upper extremity (Confortin *et al.*, 2022). Maximum power grip strength is frequently used to evaluate how well the upper extremities are working (McGorry and Lin, 2007).

Muscle strength is a crucial aspect of fitness that makes it possible to carry out a variety of daily tasks and engage in sports throughout one's lifetime. Handgrip strength (HGS), which often reflects overall muscle strength, is a sign of general health. This clinically significant indication is related to physical function, health/morbidity, nutritional status, muscle mass, and morbidity. Even in adolescence, HGS can forecast future events like mortality and diminished functional capacity (Confortin *et al.*, 2022).

When making powerful cricket strokes, developing upper body strength is crucial in the game of cricket. Batsmen have the greatest chance of scoring boundaries when they execute powerful cricket strokes at the right moment. Since the introduction of Twenty/20 (T/20), cricket batsmen must continuously hit boundaries in order to be competitive. Therefore, having strong upper body muscles is essential for a cricket hitter to succeed (Taliep *et al.*, 2010).

The hand-held dynamometer is the most popular tool used to measure grip strength. The muscle force produced by the forearm and hand's flexor mechanisms is measured using hand-held grip dynamometry (Sathya *et al.*, 2016). It has been discovered that the Jamar dynamometer provides the most precise and reliable measurements of grip strength, and a pinchmeter is used to measure the strength of the finger pinches. (Incel *et al.*, 2002). The grip strength was significantly stronger when the elbow was held at 90 degrees flexion as compared to completely extended (Gilbertson and Barber-Lomax, 1994).

Poor sports performance is just one of many unintended consequences of experiencing worry before and during athletic tournaments (Schaefer *et al.*, 2016). Performers may go through a variety of emotions, all of which may be preceded by various assessments of various stressors and which may have various action inclinations (Mellalieu *et al.*, 2009).

Athletic performance outcomes depend on people's capacity to deal with physiological and psychological stressors, which is influenced by a variety of variables, including experience, fitness, motivation, and the daily fluctuations of physiological and behavioural processes. Athletes should rationally balance these stressors with adequate recuperation in order to improve performance and adaptation while lowering injury risk. The regulation of an athlete's sleep, especially during hard training and competition, is a vital component of this stress-recovery balance (Fullagar *et al.*, 2015).

The objective of the study is to check the effect of power grip strength and sleep pattern on performance in cricket players.

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Methodology:

Study Design: Descriptive Correlation study

Study Setting: Various cricket grounds of Gurugram: Six Flag Cricket Ground, Aradhaya Cricket Academy, KFG Sports Club, Battle Station Cricket Ground, The Sports Park.

Study Subjects: The study population consisted of Cricketers age ranging between 18-35 years from Gurugram District, Haryana. Participants were selected based on the following selection criteria.

Inclusion Criteria: Healthy male cricketers, Ages between 18 to 35 years, Having BMI under normal range of WHO 18.5-24.9 kg/m^2.Players who are playing cricket since 3 to 5 years.

Exclusion Criteria: Players with recent history of any musculoskeletal injuries. Any known neurological impairment. Any history of recent surgery. Uncooperative players.

Statistical methods: The data analysed using pandas software from python. Pearson coefficient of correlation test was used to determine the correlation between the power grip strength and performance & sleep and performance.

Result and Discussion:

Batsmen: The correlation between the sleep and performance of batsmen. The result reveals that there is no significant correlation between these two factors and they are independent to each other ($r = 0.14$, $p = 0.506$). Higher Global score indicates the poor sleep behaviour of the batsmen and lower global score indicates the good sleep behaviour of the batsmen. Performance is recorded as Batting Strike Rate for the Batsmen. High batting strike rate indicates the better performance of the batsmen and vice-versa. Batting strike rate is the average number of runs scored per 100 balls faced by the batsmen. The result shows that there is no relationship between the sleep and performance, they are not related to each other, increase and decrease in one variable doesn't have any effect on other.

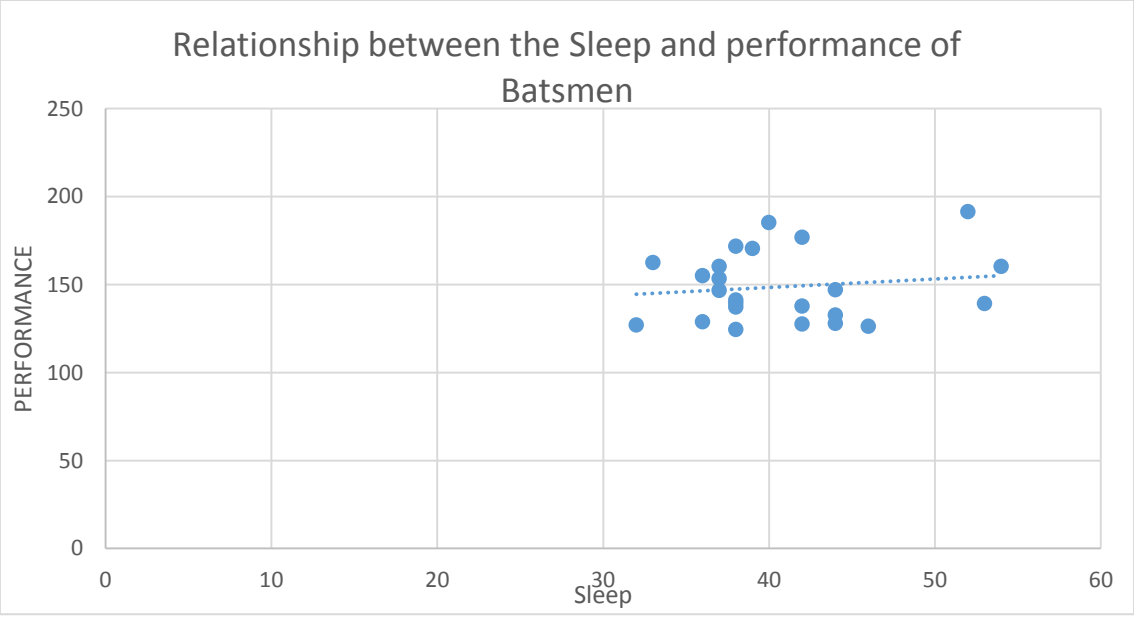

Figure 1: Relationship between the sleep and performance of Batsmen.

- The correlation between the Power Grip Strength and performance of batsmen. The result reveals that as per score test and fairly low p value the given factors are weakly however, inversely related to each other (r = -0.35, p = 0.084).

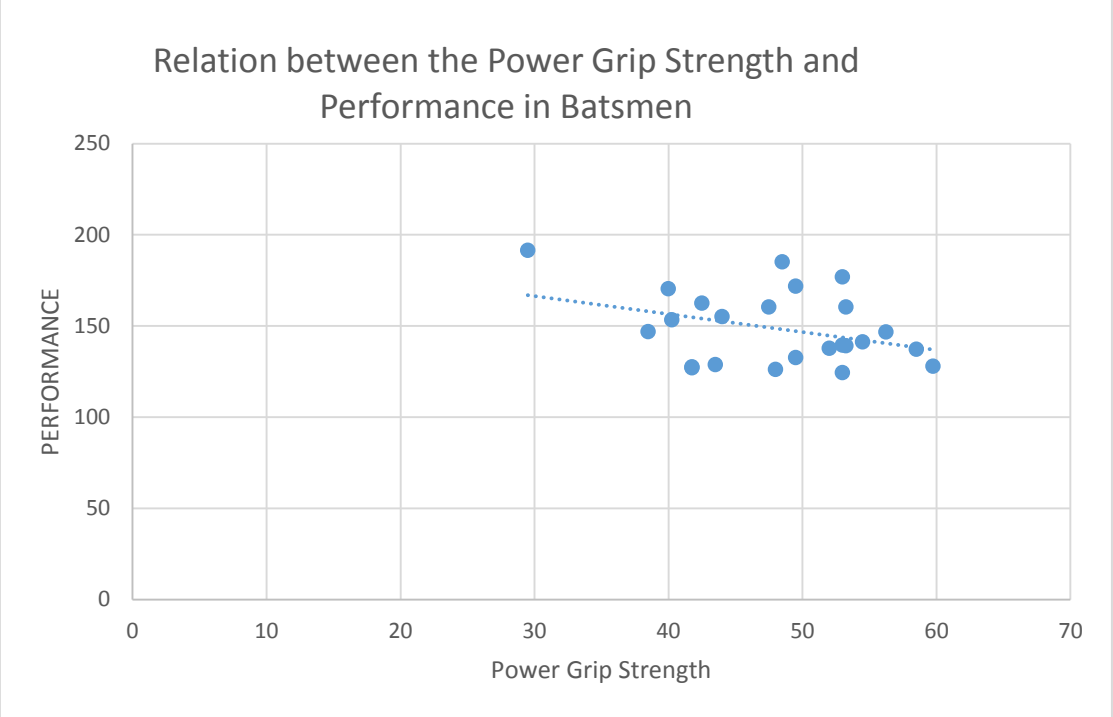

Figure 2: Relationship between the Power Grip Strength and Performance in Batsmen.

Bowlers: The correlation between the Sleep (Global Score) and performance. The result reveals that as per score test and fairly low p value, there is significant correlation between these two factors and they are fairly however inversely related to each other (r = -0.37, p = 0.033).

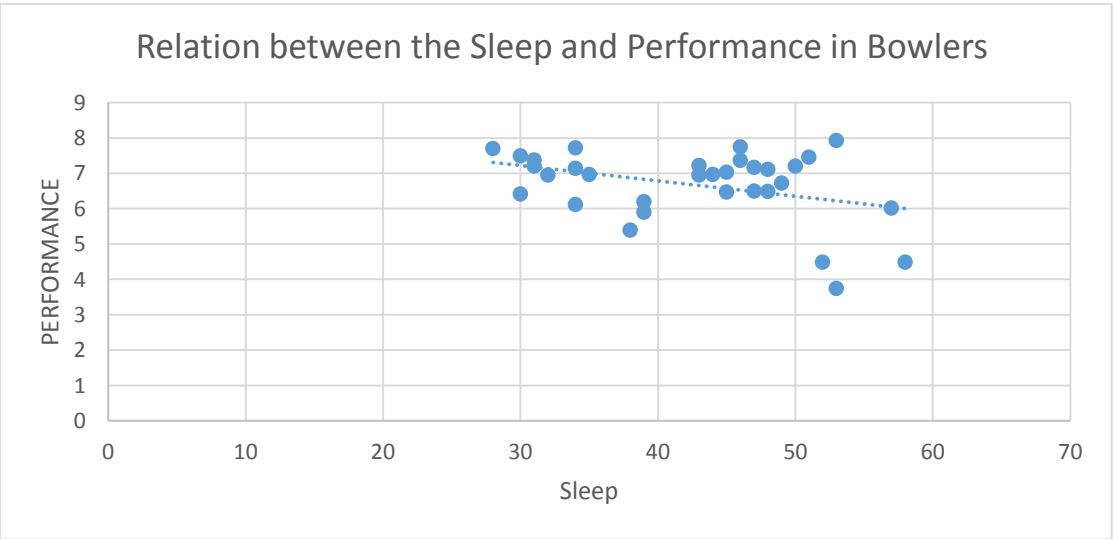

Figure 3: Relationship between the sleep and performance of Bowlers.

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- The correlation between the Power Grip Strength and performance of bowlers. The result reveals that as per score test and high p value, there is no significant correlation between these two factors and they are independent to each other (r = -0.12, p = 0.509).

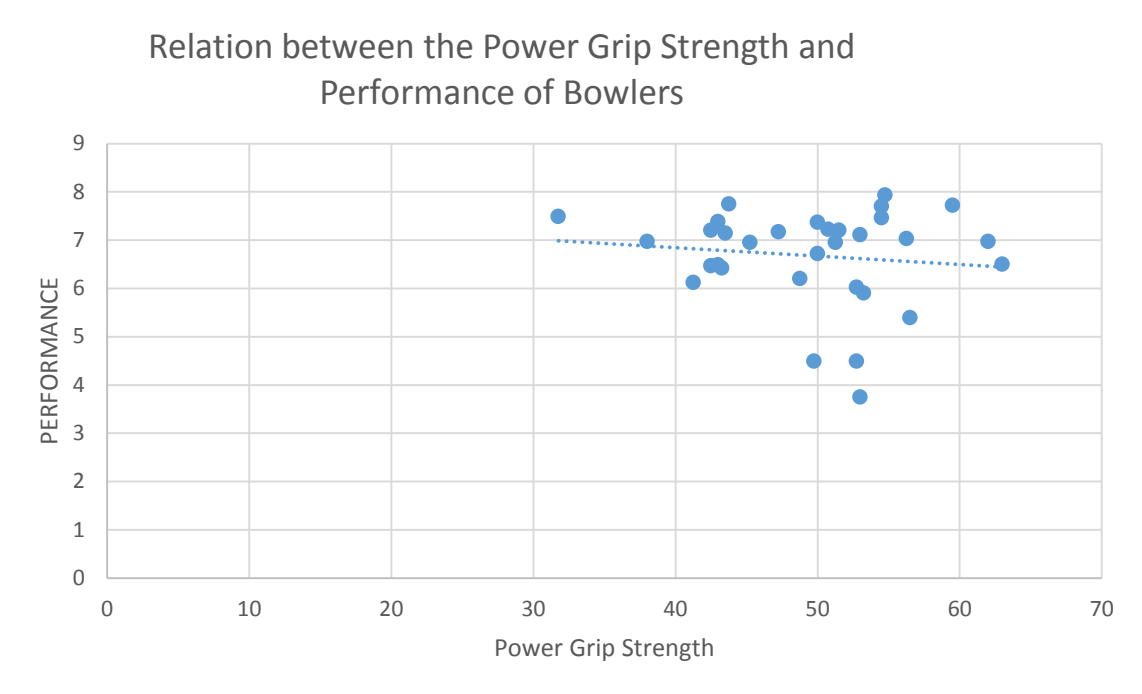

Figure 4: Relationship between the Power Grip Strength and Performance in Bowlers.

All-Rounders: The correlation between the Sleep and performance of All-rounders. The result reveals that as per score test and fairly low p value, as per the data there is significant correlation between these two factors and they are weakly however, inversely related to each other (r = -0.12, p = 0.5).

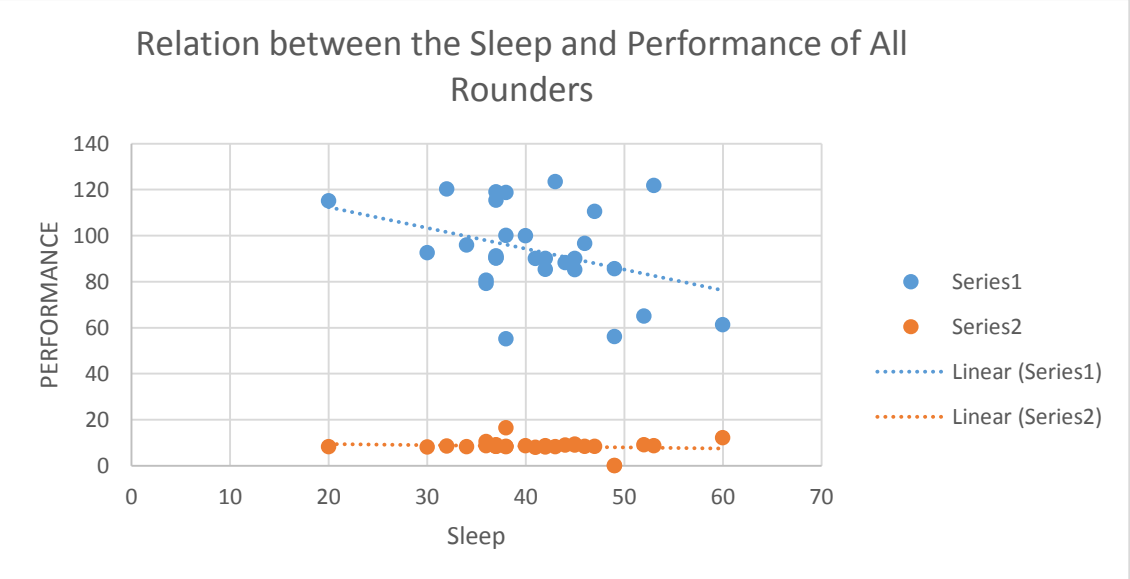

Figure 5: Relationship between the Sleep and Performance in All-Rounders.

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- The correlation between the Power Grip Strength and performance of All-rounders. The result reveals that as per score test and high p value, as per the data there is no significant correlation between these two factors and they are not related to each other (r = -0.009, p = 0.96).

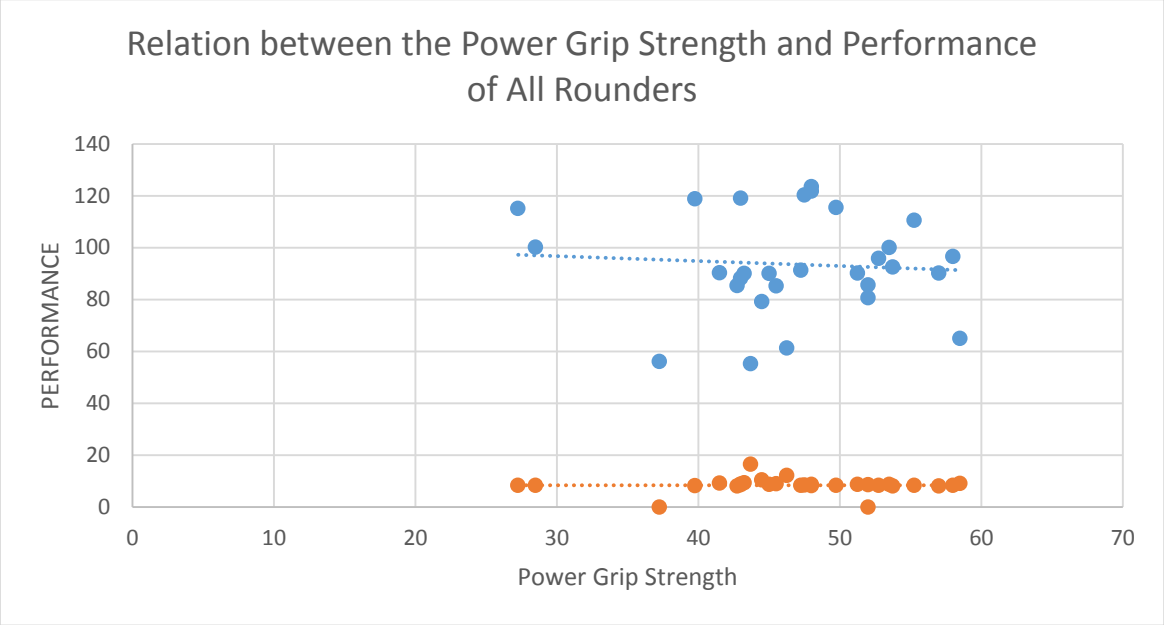

Figure 6: Relationship between the Power Grip Strength and Performance in All- Rounder's.

The author found no correlation between the power grip strength and performance, these two factors are independent to each other and sleep is fairly correlate with the performance as the cricketer with good sleep behaviour have better performance compared to the cricketer with poor sleep behaviour.

The present study has been supported by McEwan *et al.*, 2020 in his study he conclude that poorer One-Day International and Test batting performances were substantially correlated with longer sleep onset latencies and shorter total sleep periods. Due to the complicated structure of cricket and the several variables that could affect performance, including unexpected weather conditions, team cohesiveness, pitch type, spectator pressures, and opposition strength, it is challenging to quantify the extent to which sleep specifically affected performance. It's also important to conduct more study on how to quantify cricket performance, which makes it more challenging to include performance outcomes in studies of players. A study by Mah *et al.*, 2023 in his study, he concluded that peak sports performance is likely to benefit from enough sleep. Extending one's nocturnal sleep beyond the norm is likely to increase athletic performance, response time, daily drowsiness, and mood. Increased total sleep time resulted in improvements in shooting percentage, sprint timings, response speed, mood, weariness, and vigour. These findings show that optimum performance can only occur when an athlete's overall sleep and sleep patterns are perfect.

As the result reveals power grip strength is not related to performance and the author didn't find any correlation between these two factors. Previous studies shows the mixed results as Cronin *et al.*, (2017) suggest that the hand is the only point of physical contact

between the athlete and the instrument and/or object during a number of sport-specific motions, thus the functional importance of the hand to sport performance. The precision grip, power grip, or a variation of these grips are used in the majority of sports-specific motions involving the hand. HGS is thought to be an important attribute for throwing (e.g., baseball, softball, cricket, American football, European football, rugby, handball, water polo, javelin, hammer throw, discus, and shot put), bowling (i.e. overhand and underhand), punching, clinching, and grappling in hand-to-hand combat sports, paddling (e.g., row, canoe, and kayak), and Cricket, baseball, golf, tennis, squash, lacrosse, hockey and ice hockey are examples of sports that use a swinging a racket, stick, bat or club. Basketball, volleyball, rock climbing, swimming, sailing, riding/driving (e.g., horses, bulls, mountain bikes, motorbikes, and racecars), and strength athletes (e.g., weightlifting, powerlifting, and strongman) are some other activities that call for a sufficient to high degree of HGS.

References:

1. Barr, G. D. I., & Kantor, B. S. (2004). A criterion for comparing and selecting batsmen in limited overs cricket. *Journal of the Operational Research Society*, *55*(12), 1266-1274.
2. Boonstra, T. W., Stins, J. F., Daffertshofer, A., & Beek, P. J. (2007). Effects of sleep deprivation on neural functioning: an integrative review. *Cellular and molecular life sciences*, *64*, 934-946.
3. Brooks, K. A., & Carter, J. G. (2013). Overtraining, exercise, and adrenal insufficiency. *Journal of novel physiotherapies*, *3*(125).
4. Castro-Sanchez, M., Zurita-Ortega, F., Ubago-Jimenez, J. L., Gonzalez-Valero, G., Garcia-Marmol, E., & Chacon-Cuberos, R. (2019). Relationships between anxiety, emotional intelligence, and motivational climate among adolescent football players. *Sports*, *7*(2), 34.
5. Chandrasekaran, B., Fernandes, S., & Davis, F. (2020). Science of sleep and sports performance–a scoping review. *Science & Sports*, *35*(1), 3-11.
6. Charest, J., & Grandner, M. A. (2020). Sleep and athletic performance: impacts on physical performance, mental performance, injury risk and recovery, and mental health. *Sleep medicine clinics*, *15*(1), 41-57.
7. Christie, C. J. (2012). *The physical demands of batting and fast bowling in cricket* (pp. 978-953). ISBN.
8. Confortin, S. C., Batista, R. F. L., Barbosa, A. R., Wendt, A., Crochemore-Silva, I., Alves, M. T. S. S. D. B., Simoes, V. M. F., & Silva, A. A. M. D. (2022). Is sleep time associated with handgrip strength in adolescents from the 1997/1998 Sao Luis Birth Cohort?. *Ciencia & Saude Coletiva*, *27*, 1147-1155.
9. Cronin, J., Lawton, T., Harris, N., Kilding, A., & McMaster, D. T. (2017). A brief review of handgrip strength and sport performance. *The Journal of Strength & Conditioning Research*, *31*(11), 3187-3217.
10. Dehghani, M., Saf, A. D., Vosoughi, A., Tebbenouri, G., & Zarnagh, H. G. (2018). Effectiveness of the Mindfulness-Acceptance-Commitment-Based Approach on Athletic Performance and Sports Competition Anxiety: A Randomized Clinical Trial. *Electronic Physician*, *10*(5), 6749-6755.

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11. Depner, C. M., Stothard, E. R., & Wright, K. P. (2014). Metabolic consequences of sleep and circadian disorders. *Current diabetes reports*, *14*(7), 1-9.
12. Driller, M. W., Mah, C. D., & Halson, S. L. (2018). Development of the athlete sleep behavior questionnaire: a tool for identifying maladaptive sleep practices in elite athletes. *Sleep Science*, *11*(1), 37.
13. Fahim, T., Saharan, A.K., Mahajan, R., & Singh, A.K. (2020). The Relationship of Physical Self-Concept with Competition Anxiety of Young Wrestlers. *International Journal of Health Sciences and Research, 10*(6), 46-51.
14. Friedman, E. H. (1995). "Neurobiology of sleep and cardiac diseases amongst elderly people." *Journal of Internal Medicine* 237, no. 2: 216-217.
15. Fullagar, H. H., Skorski, S., Duffield, R., Hammes, D., Coutts, A. J., & Meyer, T. (2015). Sleep and athletic performance: the effects of sleep loss on exercise performance, and physiological and cognitive responses to exercise. *Sports medicine*, *45*(2), 161-186.
16. Gajardo-Burgos, R., Monrroy-Uarac, M., Belmar-Arriagada, H., van Rensburg, D. C. J., & Bascour-Sandoval, C. (2023). Sleep quality affects health-related quality of life in young athletes during competition. *Retos*, *47*, 674-679.
17. Gilbertson, L., & Barber-Lomax, S. (1994). Power and pinch grip strength recorded using the hand-held Jamar dynamometer and B+ L hydraulic pinch gauge: British normative data for adults. *British journal of occupational therapy*, *57*(12), 483-488.
18. Grossbard, J. R., Smith, R. E., Smoll, F. L., & Cumming, S. P. (2009). Competitive anxiety in young athletes: Differentiating somatic anxiety, worry, and concentration disruption. *Anxiety, Stress, & Coping*, *22*(2), 153-166.
19. Halson, S. L. (2014). Sleep in elite athletes and nutritional interventions to enhance sleep. *Sports Medicine*, *44*(Suppl 1), 13-23.
20. Incel, N. A., Ceceli, E., Durukan, P. B., Erdem, H. R., & Yorgancioglu, Z. R. (2002). Grip strength: effect of hand dominance. *Singapore medical journal*, *43*(5), 234-237.
21. Jain, S., & Shah, N. (2021). Correlation of Balance, Core Endurance and Power Performance in Male Cricketers of Different Maturity Status. *International Journal of Physical Education, Sports and Health*, *8*(4), 146-149.
22. Kolling, S., Duffield, R., Erlacher, D., Venter, R., & Halson, S. L. (2019). Sleep-related issues for recovery and performance in athletes. *International journal of sports physiology and performance*, *14*(2), 144-148.
23. Malhotra, R. K. (2017). Sleep, recovery, and performance in sports. *Neurologic clinics*, *35*(3), 547-557.
24. Martin, B. J. (1981). Effect of sleep deprivation on tolerance of prolonged exercise. *European journal of applied physiology and occupational physiology*, *47*(4), 345-354.
25. McEwan, K., Davy, J., & Christie, C. J. A. (2020). Get Sleep or Get Stumped: Sleep Behaviour in Elite South African Cricket Players During Competition. *Journal of Sports Sciences*, *38*(19), 2225-2235.

26. McGorry, R. W., & Lin, J. H. (2007). Power grip strength as a function of tool handle orientation and location. *Ergonomics*, *50*(9), 1392-1403.
27. Meerlo, P., Sgoifo, A., & Suchecki, D. (2008). Restricted and disrupted sleep: effects on autonomic function, neuroendocrine stress systems and stress responsivity. *Sleep medicine reviews*, *12*(3), 197-210.
28. Melguizo-Ibanez, E., Zurita-Ortega, F., Ubago-Jimenez, J. L., Lopez-Gutierrez, C. J., & Gonzalez-Valero, G. (2022). An Explanatory Model of the Relationships Between Sport Motivation, Anxiety and Physical and Social Self-Concept in Educational Sciences Students. *Current Psychology*, *8*(6), 1-11.
29. Mellalieu, S. D., Neil, R., Hanton, S., & Fletcher, D. (2009). Competition stress in sport performers: Stressors experienced in the competition environment. *Journal of sports sciences*, *27*(7), 729-744.
30. Noakes, T. D., & Durandt, J. J. (2000). Physiological requirements of cricket. *Journal of sports sciences*, *18*(12), 919-929.
31. Riederer, M.F. (2020). How Sleep Impacts Performance in Youth Athletes. *Current Sports Medicine Reports, 19*(11), 463-467.
32. Saidi, O., Pereira, B., Peyrel, P., Maso, F., Dore, E., Rochette, E., Ratel, S., Walrand, S. & Duche, P. (2022). Sleep Pattern and Staging in Elite Adolescent Rugby Players During the in-Season Competitive Phase Compared to an Age, Matched Non-Athlete Population. *European Journal of Sport Science*, *22*(4), 499-510.
33. Sathya, P. & Shah P., (2016). Comparison of grip strength in cricket players with and without shoulder injury. *International journal of Current Research*, *8*(07), 35200-35204.
34. Sathya, P., Kadhiravan, V., Ramakrishnan, K. S., & Vedak, T. M. (2016). Correlation between hand grip strength and shoulder power in cricket players. *International Journal of Science and Research*, *5*(3), 348-52.
35. Sathya, P., Kadhiravan, V., Ramakrishnan, K., & Ghodake, A. (2016). Association between hand grip strength and shoulder power in intercollegiate cricket players. *Int J Innov Res Sci Eng Tech*, *5*, 3085-3091.
36. Schaefer, J., Vella, S. A., Allen, M. S., & Magee, C. A. (2016). Competition anxiety, motivation, and mental toughness in golf. *Journal of applied sport psychology*, *28*(3), 309-320.
37. Schmidt, M. H. (2014). The energy allocation function of sleep: a unifying theory of sleep, torpor, and continuous wakefulness. *Neuroscience & Biobehavioral Reviews*, *47*, 122-153.
38. Shah, S., Hazarika, P. J., & Hazarika, J. (2017). A study on performance of cricket players using factor analysis approach. *International Journal of Advanced Research in Computer Science*, *8*(3), 656-660.
39. Simpson, N. S., Gibbs, E. L., & Matheson, G. O. (2017). Optimizing sleep to maximize performance: implications and recommendations for elite athletes. *Scandinavian journal of medicine & science in sports*, *27*(3), 266-274.

40. Solanki, R., Sakya, S., Rathi, M., & Kumar, P. (2021). A study of sports competition anxiety of national level female volleyball players. *International Journal of Physical Education, Sports and Health*, *8*(4), 33-36.
41. Soomro, N., Strasiotto, L., Sawdagar, T., Lyle, D., Mills, D., Ferdinands, R., & Sanders, R. (2018). Cricket injury epidemiology in the twenty-first century: what is the burden?. *Sports Medicine*, *48*, 2301-2316.
42. Stone, M. H., Moir, G., Glaister, M., & Sanders, R. (2002). How much strength is necessary?. *Physical Therapy in Sport*, *3*(2), 88-96.
43. Suchomel, T. J., Nimphius, S., & Stone, M. H. (2016). The importance of muscular strength in athletic performance. *Sports medicine*, *46*, 1419-1449.
44. Taliep, Mogammad S., Sebastian K. Prim, and Janine Gray. Upper body muscle strength and batting performance in cricket batsmen. *The Journal of Strength & Conditioning Research* 24, no. 12 (2010): 3484-3487.
45. Thun, E., Bjorvatn, B., Flo, E., Harris, A., & Pallesen, S. (2015). Sleep, circadian rhythms, and athletic performance. *Sleep medicine reviews*, *23*, 1-9.
46. Vickery, W., Dascombe, B. J., & Scanlan, A. T. (2018). A review of the physical and physiological demands associated with cricket fast and spin bowlers. *International Journal of Sports Science & Coaching*, *13*(2), 290-301.
47. Watson, A. M. (2017). Sleep and athletic performance. *Current sports medicine reports*, *16*(6), 413-418.
48. Yuksel, M., Yildiz, A., Demir, M., Bilik, M. Z., Ozaydogdu, N., Aktan, A., **Isik, F., Demir, S., Yazgan U. C.,** & Toprak, N. (2014). Effect of sleep quality on hemodynamic response to exercise and heart rate recovery in apparently healthy individuals. *Clinical and Investigative Medicine*, E352-E362.
49. Zielinski, M. R., & Krueger, J. M. (2011). Sleep and innate immunity. *Frontiers in bioscience (Scholar edition)*, *3*, 632.