Original Article

Association Between Sleep Quality and Grip Strength Among Young Adults Aged 18–25 Years: A Cross-Sectional Study

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Abstract

Background: Sleep is a critical physiological process that is important for the maintenance of optimal physical, psychological, endocrine and metabolic health. Good quality sleep is vital for cognitive function, tissue repair, immune competence, hormonal regulation and musculoskeletal recovery. The present lifestyle changes such as prolonged screen use, academic stress, irregular sleep timings and the increasing psychosocial stress have led to a significant increase in sleep disturbances among young adults. Poor sleep quality is identified as a major public health problem worldwide and has been associated with impaired attention, reduced academic performance, obesity, cardiovascular diseases, diabetes mellitus, depression and decreased quality of life. Moreover, there is emerging evidence to suggest that inadequate sleep may negatively impact skeletal muscle metabolism, muscle protein synthesis, neuromuscular coordination and physical performance. Handgrip strength is considered as an objective marker of general muscle strength and functional capacity. It is easy, inexpensive, reproducible and has been widely used as a surrogate marker of nutritional status, sarcopenia, frailty and future morbidity. Although many studies have investigated the association between sleep quality and muscle strength in middle-aged and elderly people, there is limited evidence for the association in healthy young adults. Moreover, previous studies presented inconsistent results and it is important to evaluate if sleep quality is a significant factor on muscle strength in this age group. The objective is to find out the correlation between sleep quality and handgrip strength among healthy young adults in the age group of 18-25 years. **Material and Methods:** The study was observational and cross-sectional and involved a sample of 130 healthy young adults between the ages of 18 and 25 years. Sleep quality was evaluated with the validated Pittsburgh Sleep Quality Index (PSQI) and handgrip strength was evaluated with a calibrated handgrip dynamometer. Anthropometric measurements such as age, height, weight and body mass index (BMI) were measured using standard procedures. The characteristics of the participants were summarized using descriptive statistics. Associations between PSQI score, sleep duration, sleep efficiency and grip strength were evaluated using Pearson correlation analysis. Grip strength was compared using independent sample t-tests between participants with good sleep quality (PSQI ≤5) and those with poor sleep quality (PSQI >5). Statistical significance was set at $p<0.05$. **Results:** The average age of the participants was 20.51 ± 1.49 years. The study population consisted of 83 males (63.8%) and 47 females (36.2%). Sleep quality was generally poor among participants, with a mean PSQI score of 6.11±2.72. Poor sleep quality was reported by more than half of the study population (53.8%). The mean grip strength was 30.01±10.89 kg. Pearson correlation analysis showed a weak negative correlation between PSQI score and grip strength ($r = –0.058$, $p = 0.511$), indicating that poorer sleep quality was more likely to be associated with lower grip strength, but the association was statistically insignificant. Sleep duration ($r = 0.003$, $p = 0.971$) and sleep efficiency ($r = 0.052$, $p = 0.556$) did not show any statistically significant relationship with grip strength. The mean grip strength in those with poor sleep quality was lower than good sleepers (29.62 kg vs. 30.46 kg) but this difference was not statistically significant. **Conclusion:** Poor sleep quality was very common among healthy young adults. Participants with poorer sleep quality had marginally lower grip strength, but we did not find statistically significant association between sleep quality and handgrip strength. These results may indicate that muscle strength in healthy young adults can be explained by various physiological and lifestyle factors, not only sleep quality. Further multicentric prospective studies with objective sleep assessment techniques are warranted to elucidate this relationship.

Keywords: Sleep quality, Pittsburgh Sleep Quality Index, Handgrip strength, Young adults, Muscle strength, Sleep efficiency, Cross-sectional study.

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Introduction

Sleep is an essential physiological process that is required to maintain physical, cognitive, emotional, and metabolic homeostasis. It is required for memory consolidation, tissue repair, protein synthesis, hormone regulation, immune function and neuromuscular recovery. Thus, insufficient sleep time or poor sleep quality may negatively influence different physiological systems and health status.[1,2]

Sleep disturbances are especially common in adolescents and

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young adults because of academic demands, irregular schedules, excess screen time, psychological stress, caffeine consumption, and poor sleep hygiene. Epidemiological studies show that nearly half of young adults report insufficient or poor sleep quality, making sleep disturbance an important public health issue.[2-11] Sleep quality is a multidimensional concept that includes subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication and daytime dysfunction. The Pittsburgh Sleep Quality Index (PSQI) developed by Buysse et al,[1] is one of the most widely validated instruments to assess global sleep quality in clinical and community settings.

Poor sleep quality has been linked to several negative health outcomes, such as obesity, insulin resistance, hypertension, cardiovascular disease, depression, weakened immunity, chronic inflammation, and reduced cognitive performance.[2,12] In addition to these systemic effects, sleep is important for skeletal muscle physiology. The interactions between central and peripheral biological clocks coordinate circadian regulation of muscle protein synthesis, mitochondrial function, glucose metabolism, tissue repair, and muscle recovery.[6] Therefore, disturbed sleep patterns may impair muscle performance and recovery.

Sleep is also important in endocrine regulation. The secretion of growth hormone is mainly during slow-wave sleep which stimulates muscle protein synthesis and tissue regeneration. Adequate sleep is also necessary for normal testosterone levels, sleep deprivation increases cortisol secretion, promotes catabolism and muscle recovery impairment.[3] Experimental studies have shown that short sleep duration reduces muscle protein synthesis and impairs recovery after physical activity.[4]

Handgrip strength is a simple, objective, and reliable measure of overall muscle strength and function. Its low cost, ease of administration, and excellent reproducibility when measured using a handgrip dynamometer have resulted in its extensive application in clinical practice and epidemiological research. Lower handgrip strength has been associated with frailty, sarcopenia, disability, cardiovascular disease, postoperative complications, and higher mortality risk, emphasizing its importance as a key biomarker of overall health.[5,12]

A potential relationship between sleep quality and muscle strength is supported by several biological mechanisms. Adequate sleep improves neuromuscular coordination, replenishment of muscle glycogen, hormonal balance and tissue repair whereas chronic sleep deprivation may impair motor unit recruitment, reduce maximum voluntary contraction, extend recovery time and increase inflammatory cytokines involved in muscle fatigue.[3,4]

However, despite this biological plausibility, epidemiological evidence is inconsistent. Confortin et al. found only a weak association between sleep duration and handgrip strength among adolescents.[7] In contrast, Chen et al,[8] Li et al,[9] and Liu et al,[10] found significant associations between poor sleep quality or abnormal sleep duration and decreased handgrip strength in middle-aged and young adults. These differences may reflect differences in age, study populations, physical activity, nutritional status, body composition, and the presence of chronic diseases. Evidence is still scarce for healthy young adults, as most of the previous studies have focused on elderly populations.

Young adulthood is a critical period for the development of long-term health behaviours. It is important for preventive medicine, sports science and public health to determine if sleep quality independently affects muscle strength in this age group. So, the present study was conducted to assess the relationship between sleep quality and handgrip strength in healthy young adults aged 18-25 years with the help of Pittsburgh Sleep Quality Index and standardized handgrip dynamometry.

Aim: To investigate the relationship between sleep quality and handgrip strength in young adults aged 18–25 years.

Objectives:

1. To determine the sleep quality of healthy young adults by Pittsburgh Sleep Quality Index (PSQI).
2. Assessing handgrip strength with a calibrated handgrip dynamometer.
3. To assess the association of global PSQI score with handgrip strength.
4. To investigate the relationship between sleep duration, sleep efficiency and handgrip strength.
5. Grip strength comparison of participants with good versus poor sleep quality.

Materials and Methods

Study Design: This cross-sectional observational study assessed the association between sleep quality and handgrip strength among healthy young adults aged 18–25 years. The study was conducted in accordance with the Declaration of Helsinki using standardized instruments and validated assessment tools.

Study Setting and Participants: The study was conducted in the Department of Physiology among apparently healthy young adults. A total of 130 participants with complete datasets were included in the final analysis. Participants were recruited by simple random sampling.

Inclusion Criteria

Healthy individuals aged 18–25 years of either sex who provided written informed consent, were able to complete the Pittsburgh Sleep Quality Index (PSQI), and could perform maximal voluntary handgrip effort were included.

Exclusion Criteria

Participants with upper-limb musculoskeletal disorders, neurological or neuromuscular diseases, previous upper-limb fracture or surgery, congenital hand deformity, current upper-limb pain, rheumatological or inflammatory disorders, diagnosed sleep disorders under treatment, current sedative use, acute febrile illness, pregnancy, or unwillingness to participate were excluded.

Ethical Considerations: Ethical approval was obtained from the Institutional Ethics Committee. Written informed consent was obtained from all participants before enrolment. Participation was voluntary, confidentiality was maintained using unique identification numbers, and participants could withdraw at any stage without consequence.

Data Collection

Anthropometric Measurements

Age, sex, height, and weight were recorded using standard procedures. Height was measured with a stadiometer to the nearest 0.1 cm, while weight was measured using a calibrated digital weighing scale to the nearest 0.1 kg. Body mass index (BMI) was calculated as weight (kg)/height (m^2).

Assessment of Sleep Quality: Sleep quality was evaluated using the Pittsburgh Sleep Quality Index (PSQI), which assesses seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. The global PSQI score ranges from 0 to 21, with scores ≤5 indicating good sleep quality and >5 indicating poor sleep quality.

Handgrip Strength Measurement: Handgrip strength was measured using a calibrated handgrip dynamometer following the American Society of Hand Therapists' guidelines. Participants were seated with the shoulder adducted, elbow flexed at 90°, forearm in neutral position, and wrist slightly extended. Two measurements were obtained from each hand with a one-minute rest interval, and the average value was used for analysis.

Quality Control: Standardized measurement protocols, calibrated equipment, trained investigators, duplicate grip-strength measurements, immediate questionnaire verification, and double data entry were employed to ensure data quality and minimize measurement errors.

Statistical Analysis: Data were entered into Microsoft Excel and analysed using statistical software. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Pearson's correlation coefficient assessed associations between grip strength and PSQI score, sleep duration, and sleep efficiency. Grip strength was compared between good and poor sleepers using the independent Student's t-test. A two-tailed $p<0.05$ was considered statistically significant.

Outcome Measures: The primary outcome was the association between global PSQI score and handgrip strength. Secondary outcomes included the distribution of sleep quality, mean grip strength, relationships between sleep duration and grip strength, sleep efficiency and grip strength, comparison of grip strength between good and poor sleepers, and anthropometric characteristics of the participants.

Results

A total of 130 young adults aged 18–25 years participated in the study and completed all study procedures. Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), while handgrip strength was measured using a calibrated handgrip dynamometer. Demographic characteristics, anthropometric variables, sleep parameters, and grip strength measurements were analysed using descriptive and inferential statistical methods.

Table 1: Baseline Demographic Characteristics of the Study Population (n = 130)

Variable	Mean ± SD	Minimum	Maximum
Age (years)	20.51 ± 1.49	18	25
Height (cm)	166.42 ± 8.94	148	186
Weight (kg)	59.18 ± 11.76	39	93
Body Mass Index (kg/m²)	21.33 ± 3.31	15.8	31.9

The study population represented healthy young adults with a relatively homogeneous age distribution. The mean age of 20.51 years indicates that the majority of participants were undergraduate or early postgraduate students, representing an age group in which sleep disturbances are increasingly prevalent because of academic workload, altered lifestyle patterns, social commitments, and excessive electronic media exposure.

The average height and weight were within expected ranges for healthy Indian young adults. The mean BMI of 21.33 kg/m² falls within the normal range according to World Health Organization classification, indicating that the majority of participants had normal nutritional status. This is an important consideration because both undernutrition and obesity are known to influence skeletal muscle strength independently of sleep quality.

Overall, the anthropometric profile suggests that the study population was generally healthy, thereby reducing the likelihood that chronic illness or abnormal body composition substantially influenced the observed relationship between sleep quality and handgrip strength.

Table 2: Gender Distribution of Participants

Gender	Number	Percentage (%)
Male	83	63.8
Female	47	36.2
Total	130	100.0

Among the 130 participants, males constituted nearly two-thirds of the study population (63.8%), while females accounted for 36.2%. The relatively higher proportion of male participants is expected to influence the overall average handgrip strength because males generally possess greater skeletal muscle mass, higher lean body mass, and increased androgen concentrations compared with females.

Despite this difference in gender distribution, inclusion of both sexes improves the external validity of the study by providing information applicable to a broader young adult population. Nevertheless, sex remains an important biological determinant of muscular strength and should be considered while interpreting grip strength values.

The inclusion of both male and female participants also enables future subgroup analyses exploring sex-specific relationships between sleep quality and muscular performance.

Table 3: Sleep Characteristics of the Study Population

Variable	Mean ± SD
Global PSQI Score	6.11 ± 2.72
Sleep Duration (hours)	6.22 ± 1.08
Sleep Efficiency (%)	85.95 ± 13.58

The average global PSQI score of 6.11 exceeded the internationally accepted cut-off value of 5, suggesting that poor sleep quality was common among the study participants. This observation is consistent with contemporary literature reporting increasing sleep disturbances among university students and young adults due to academic stress, excessive smartphone usage, irregular sleep schedules, and psychosocial factors.

The mean sleep duration of 6.22 hours was lower than the 7–9 hours recommended for healthy young adults. Although sleep duration alone does not define sleep quality, persistent reduction in sleep duration may impair endocrine function, cognitive performance, neuromuscular recovery, and physical functioning over time.

The average sleep efficiency was 85.95%, indicating that most participants spent a substantial proportion of time asleep while in bed. However, the relatively large standard deviation demonstrates considerable inter-individual variation, suggesting that some participants experienced marked sleep fragmentation or prolonged sleep latency.

Collectively, these findings indicate that although participants were generally healthy, disturbances in sleep quality were highly prevalent within the study population.

Table 4: Distribution of Sleep Quality Categories According to PSQI Score

Sleep Quality Category	Frequency	Percentage (%)
Good Sleep (PSQI ≤5)	60	46.2
Poor Sleep (PSQI >5)	70	53.8
Total	130	100.0

More than half of the participants (53.8%) were classified as poor sleepers according to the Pittsburgh Sleep Quality Index, while only 46.2% demonstrated good sleep quality.

This finding highlights the considerable burden of impaired sleep quality among apparently healthy young adults. The high prevalence of poor sleep observed in the present study closely parallels findings reported in several national and international studies involving university students.

Poor sleep quality during young adulthood is particularly concerning because it may negatively affect academic achievement, emotional well-being, physical performance, immune competence, and long-term metabolic health. Although many young adults perceive inadequate sleep as a temporary lifestyle issue, chronic sleep disturbances may produce cumulative physiological consequences that become clinically significant over time.

The present findings therefore emphasize the need for greater awareness regarding healthy sleep hygiene among young adults.

[Figure 1] Distribution of Sleep Quality Categories

The distribution of sleep quality among study participants demonstrated that 53.8% of participants had poor sleep quality (PSQI >5), whereas 46.2% had good sleep quality (PSQI ≤5). The predominance of poor sleepers reflects the increasing prevalence of sleep disturbances within the young adult population and underscores the importance of evaluating the potential impact of sleep quality on physiological outcomes such as muscular strength.

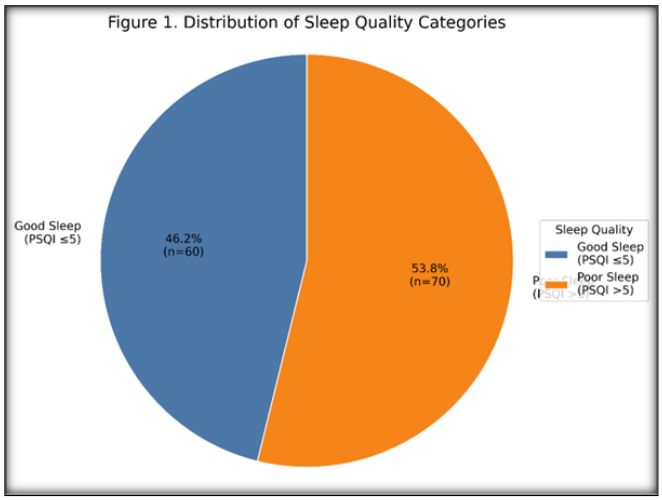


Table 5: Descriptive Statistics of Handgrip Strength

Variable	Mean ± SD	Minimum	Maximum
Grip Strength (kg)	30.01 ± 10.89	12.4	57.8

The mean handgrip strength of 30.01 kg observed in the present study is consistent with expected values among healthy young adults reported in previous physiological investigations.

Handgrip strength represents an objective indicator of overall muscular strength and functional capacity. The relatively wide range of observed values reflects normal biological variability attributable to differences in sex, body size, muscle mass, habitual physical activity, nutritional status, and genetic factors.

Despite substantial variation in individual grip strength measurements, the overall average suggests that the study population possessed normal muscular function. Consequently, any observed association between sleep

quality and grip strength is unlikely to have been confounded by widespread muscular weakness or underlying disease.

The descriptive findings further support the suitability of this study population for evaluating the relationship between sleep quality and skeletal muscle performance.

Following the descriptive analysis of demographic characteristics, anthropometric parameters, and sleep quality, inferential statistical analyses were performed to evaluate the association between sleep quality and handgrip strength. Pearson's correlation coefficient was used to examine relationships between sleep quality indicators and grip strength, while independent sample t-tests compared grip strength between participants with good and poor sleep quality.

Table 6: Correlation Between Global PSQI Score and Handgrip Strength

Variable	Pearson Correlation (r)	p-value
Global PSQI Score vs Grip Strength	−0.058	0.511

Pearson's correlation analysis demonstrated a very weak negative correlation between global PSQI score and handgrip strength ($r = -0.058$). This finding indicates that participants with poorer sleep quality tended to have slightly lower grip strength; however, the magnitude of this relationship was extremely small.

The observed p-value of 0.511 exceeded the predetermined level of statistical significance ($p<0.05$), indicating that the association was not statistically significant.

Although the direction of correlation was consistent with the biological hypothesis that poor sleep may adversely influence muscle function, the present findings suggest that sleep quality alone does not substantially determine muscular strength among healthy young adults.

One possible explanation is that skeletal muscle performance in this age group is influenced more strongly by physiological variables such as sex, lean body mass, nutritional status, habitual exercise, and genetic factors than by modest differences in subjective sleep quality.

These findings also suggest that healthy young adults may possess sufficient physiological reserve to compensate for temporary or moderate sleep disturbances without measurable reductions in maximal grip strength.

Table 7: Correlation Between Sleep Duration and Handgrip Strength

Variable	Pearson Correlation (r)	p-value
Sleep Duration vs Grip Strength	0.003	0.971

Correlation analysis demonstrated an almost negligible positive relationship between sleep duration and handgrip strength ($r = 0.003$).

The correlation coefficient was extremely close to zero, indicating virtually no linear relationship between the amount of sleep obtained and maximal grip strength.

The p-value of 0.971 confirmed complete statistical non-significance.

This observation suggests that within the observed range of sleep duration, variation in the number of hours slept did not influence muscular strength.

These findings are noteworthy because sleep duration alone may not accurately reflect restorative sleep. Two individuals sleeping identical durations may experience markedly different sleep quality owing to fragmented sleep, prolonged sleep latency, or repeated nocturnal awakenings.

Consequently, sleep duration should not be interpreted as the sole indicator of physiological recovery.

The results support the growing concept that qualitative aspects of sleep may be more important than duration alone when evaluating health outcomes.

Table 8: Correlation Between Sleep Efficiency and Handgrip Strength

Variable	Pearson Correlation (r)	p-value
Sleep Efficiency vs Grip Strength	0.052	0.556

Sleep efficiency demonstrated a very weak positive correlation with handgrip strength ($r = 0.052$).

Although participants with slightly better sleep efficiency tended to demonstrate marginally greater grip strength, the relationship remained extremely weak.

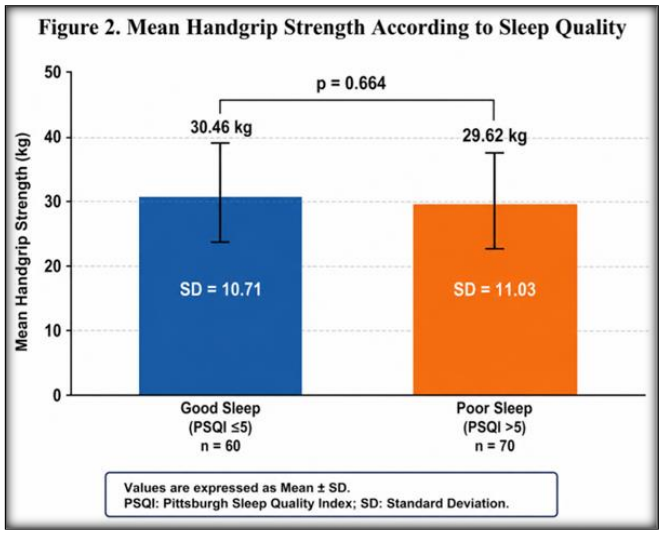
The p-value of 0.556 confirmed that this observation was not statistically significant.

Sleep efficiency reflects the proportion of time spent asleep while in bed and is considered one of the important indicators of sleep quality. However, among healthy young adults with preserved neuromuscular function, modest differences in sleep efficiency may be insufficient to produce measurable changes in muscular performance.

It is also possible that longer-term chronic sleep impairment rather than short-term variability in sleep efficiency is required before significant reductions in muscle strength become evident.

Table 9: Comparison of Grip Strength Between Good and Poor Sleepers

Sleep Quality	Mean Grip Strength (kg)	Standard Deviation	p-value
Good Sleep (PSQI ≤5)	30.46	10.71	
Poor Sleep (PSQI >5)	29.62	11.03	0.664



Participants classified as good sleepers demonstrated a slightly higher average grip strength (30.46 kg) than poor sleepers (29.62 kg).

Although the absolute difference between groups was approximately 0.84 kg, independent sample t-test revealed that this difference was not statistically significant (p = 0.664).

The findings therefore suggest that sleep quality, as measured by the Pittsburgh Sleep Quality Index, did not significantly influence maximal voluntary grip strength among the present study population.

Nevertheless, the observed trend toward lower grip strength among poor sleepers may possess biological relevance.

Sleep contributes to muscle recovery through secretion of growth hormone, testosterone, insulin-like growth factor-1, and other anabolic mediators. Chronic deterioration in sleep quality may therefore eventually impair muscular performance if maintained over prolonged periods.

The absence of statistical significance may reflect the relatively young age of participants, who generally possess greater physiological resilience than elderly individuals.

[Figure 2] Mean Handgrip Strength According to Sleep Quality

The comparison of average handgrip strength demonstrated that participants with good sleep quality had marginally greater muscular strength than participants with poor sleep quality. However, statistical analysis confirmed that this difference did not reach significance.

[Figure 3] Scatter Plot Showing Correlation Between Global PSQI Score and Grip Strength

Scatter plot analysis demonstrated considerable dispersion of individual observations without any obvious linear trend.

The regression line showed a slight downward slope, reflecting the weak negative correlation between global PSQI score and grip strength ($r = -0.058$). The broad distribution of data points further supports the conclusion that sleep quality explained only a very small proportion of variability in muscular strength within the study population.

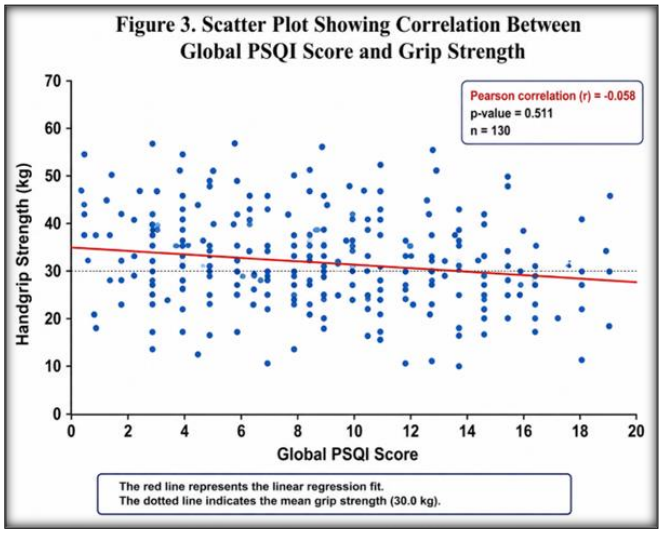


Table 10: Summary of Inferential Statistical Analysis

Variable	Statistical Test	Test Statistic	p-value	Interpretation
PSQI Score vs Grip Strength	Pearson Correlation	r = −0.058	0.511	Not Significant
Sleep Duration vs Grip Strength	Pearson Correlation	r = 0.003	0.971	Not Significant
Sleep Efficiency vs Grip Strength	Pearson Correlation	r = 0.052	0.556	Not Significant
Good vs Poor Sleepers	Independent t-test	Mean Difference = 0.84 kg	0.664	Not Significant

The inferential statistical analyses consistently demonstrated no statistically significant association between sleep quality and handgrip strength among healthy young adults aged 18–25 years.

Although poor sleep quality was highly prevalent within the study population, its influence on muscular strength appeared minimal. Participants with poorer sleep quality exhibited only slightly lower grip strength than those with better sleep quality, and all observed correlations were extremely weak.

These findings suggest that handgrip strength in healthy young adults is likely determined predominantly by intrinsic physiological factors such as age, sex, body composition, muscle mass, genetics, nutritional status, and habitual physical activity rather than subjective sleep quality alone.

The present results should not be interpreted as evidence that sleep lacks physiological importance. Rather, they indicate that within a relatively healthy young population, modest variations in sleep quality may not produce measurable reductions in maximal voluntary grip strength. It remains possible that more severe, prolonged, or objectively measured sleep disturbances would demonstrate stronger associations with muscle performance.

Overall, the results contribute valuable evidence to the growing body of literature investigating sleep and physical function. They suggest that while poor sleep quality is common among young adults, its independent effect on grip strength appears limited. Future longitudinal studies incorporating objective sleep assessment methods such as actigraphy or polysomnography,

together with evaluation of physical activity, nutritional status, hormonal profiles, and body composition, are warranted to clarify the complex relationship between sleep and skeletal muscle function.

Discussion

We conducted a cross-sectional study to determine the association between sleep quality and handgrip strength among healthy young adults (18–25 years) using the Pittsburgh Sleep Quality Index (PSQI) and a calibrated handgrip dynamometer. The study found a high prevalence of poor sleep quality (53.8% of participants were poor sleepers). Good sleepers had a slightly higher handgrip strength than poor sleepers, but no significant statistical relationship was found between the overall PSQI score and handgrip strength. There was no significant association between grip strength and sleep duration or sleep efficiency.

The high prevalence of poor sleep quality in this study is consistent with previous reports among university students and young adults where irregular sleep schedules, academic workload, excessive screen time, psychological stress and poor sleep hygiene are contributory factors to inadequate sleep quality.[2,11] The average sleep duration of about 6.2 hours was also less than the recommended 7–9 hours for healthy adults,[14,15] indicating that sleep deprivation is still a common issue in this population.

Sleep was inadequate and no significant relationship was found between sleep quality and muscular strength. While there was a weak negative correlation between PSQI score and grip strength, the association was not statistically significant. This suggests that subjective sleep quality alone has a limited influence on maximal handgrip strength in healthy young adults. This finding may reflect the increased physiological reserve, muscle mass, and neuromuscular plasticity that is characteristic of younger individuals and may offset the negative effects of mild or infrequent sleep disturbances.

The current results are in agreement with the study of Confortin et al,[7] that found a weak association between sleep duration and handgrip strength in adolescents. Similarly, previous studies in healthy young populations have shown little or no association between subjective sleep quality and muscle strength. In contrast, studies in young adults have found tight correlations between poor sleep and reduced grip strength. Chen et al,[8] Li et al,[9] and Liu et al,[10] demonstrated that poor sleep quality or abnormal sleep duration was linked to lower handgrip strength in middle-aged and elderly people. The differences are probably due to decline in muscle mass with age, greater burden of chronic diseases, sarcopenia and lower physiological reserve.

In the present study, handgrip strength was not significantly related to sleep duration or sleep efficiency. Sleep continuity, sleep fragmentation and sleep architecture may vary considerably among individuals with similar sleep duration, so sleep duration alone may not be a valid measure of the restorative value of sleep. Similarly, the weak positive association between sleep efficiency and grip strength was not significant. The results suggest that small variations in sleep efficiency may not be meaningful to muscle performance in healthy young adults.

The influence of physiological and lifestyle factors such as sex, body composition, genetics, nutritional status, protein intake, habitual physical activity, resistance training, hormonal profile, and neuromuscular coordination on muscle strength is well recognized. These factors may be more important for maximal grip strength than subjective sleep quality on its own. However, experimental studies have demonstrated that chronic sleep deprivation suppresses growth hormone secretion, reduces testosterone levels, increases cortisol secretion, and impairs muscle protein synthesis and recovery.[3,4] Therefore, although minor sleep disturbances may not greatly affect muscle strength in healthy young adults, chronic or severe sleep deprivation may lead to detrimental long-term consequences.

Despite not finding a significant association with grip strength, the high prevalence of poor sleep quality observed in this study has important clinical implications. Poor sleep has been associated with obesity, diabetes mellitus, cardiovascular disease, impaired cognition, anxiety, depression, and poor academic performance.[2,11,18] Therefore, the promotion of healthy sleep practices should continue to be an important part of preventive healthcare and student wellness programmes.

Strengths of this study include the use of validated sleep assessment questionnaire, standardized measurement of handgrip strength by calibrated dynamometer and inclusion of both male and female participants. There are however a number of limitations that need to be recognized. The cross-sectional design does not allow for causal inferences, sleep quality was assessed using a self-reported questionnaire rather than objective measures, and important confounding variables such as physical activity, dietary intake, stress, and hormonal status were not assessed. Moreover, the results may be limited in generalizability due to the relatively small sample size and the fact that recruitment was from one population.

Future longitudinal studies with objective sleep assessment techniques, body composition analysis, physical activity measurements, nutritional and hormonal evaluations are needed to further understand the relationship between sleep quality and skeletal muscle function.

Summary Poor sleep quality was common among healthy young adults but was not significantly associated with handgrip strength. These findings suggest that subjective sleep quality may not be the strongest predictor of muscle strength in this population, but rather physiological and lifestyle factors may be more important. But it is still very important to improve the quality of sleep for physical and mental well-being.

Study Strengths

- Use of Pittsburgh Sleep Quality Index validated internationally.
- Handgrip dynamometer calibrated for an objective assessment of muscular strength
- Standardized measurement protocol to reduce observer variability.
- Both male and female participants were included.
- Evaluation of various sleep parameters such as sleep duration and sleep efficiency.
- Targeting healthy young adults, an age group that has been relatively understudied in the previous literature.

Restrictions

- Cross-sectional design of the study hindered causal inference.
- Moderate sample size may have limited statistical power.
- Assessment of sleep quality relied on self-reported information.
- Physical activity, dietary habits, caffeine intake and stress levels were not assessed.
- Body composition and muscle mass are not measured.
- Participants were recruited from a small geographical area limiting external validity.

Clinical Significance

"The present study shows that poor sleep quality is very common in young adults even in the absence of chronic illness. Although sleep quality was not associated with handgrip strength, enhancing sleep hygiene remains a critical public health priority because of its well-documented effects on cognitive performance, metabolic health, cardiovascular function, psychological well-being, and academic productivity.

Using simple questionnaires such as PSQI for routine assessment of sleep quality may help to identify early those who are at risk for developing chronic sleep disturbances. Educational interventions that promote regular sleep schedules, less exposure to screens in the evening, stress management and healthy lifestyle behaviours may lead to long-term improvements in overall health. Handgrip dynamometry is a useful, inexpensive tool for the assessment of muscular fitness and may be included in routine physiological assessment, especially in sports medicine and preventive health programmes.

Future Recommendations

Future multicenter longitudinal studies with larger and more diverse populations are required to evaluate the long-term impact of sleep quality on skeletal muscle function. Objective sleep measurement by actigraphy or polysomnography, in combination with measures of lean body mass, physical activity, nutritional status, hormonal profiles and inflammatory biomarkers, would allow for a better understanding of the physiological pathways between sleep and muscular performance. Intervention studies examining whether improvement in sleep quality results in measurable improvement of muscle strength would further elucidate causality.

Conclusion

The present cross-sectional study revealed a high prevalence of poor sleep quality in healthy young adults, 18–25 years old. More than half of the participants were poor sleepers based on the Pittsburgh Sleep Quality Index. While participants with worse sleep quality had slightly lower handgrip strength compared to good sleepers, the association observed was weak and did not reach statistical significance. No significant associations were found between sleep duration and sleep efficiency and grip strength.

These results indicate that maximal muscular strength in healthy young adults is mainly determined by factors other than subjective sleep quality, such as sex, body composition, physical activity, nutritional status, and genetic factors. However, the high prevalence of poor sleep quality in this study suggests the need for continued promotion of healthy sleep behaviours in this age group. Larger prospective investigations using objective sleep assessment methods are needed to further clarify the relationship between sleep quality and skeletal muscle performance.

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Conflicts of interest

There are no conflicts of interest.

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