Analysis of sleep quality and its impact on body composition on the pre-competition day in natural bodybuilders

Análisis de la calidad del sueño y su impacto en la composición corporal en culturistas naturales el día previo a la competencia

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Abstract

Introduction: Bodybuilding is a sport that evaluates athletes based on their muscle mass, symmetry, and muscle definition, unlike conventional sports that are usually based on athletic performance in competition.
Objective: The objective of the study was to determine the relationship between fat mass (FM) and skeletal muscle mass (SMM) through bioimpedance with sleep quality in Chilean natural bodybuilders on pre-competition day.
Methodology: Twenty-six natural bodybuilders participated in the WNBF Chilean championship. The objective was to evaluate body composition to obtain data regarding SMM and FM. Additionally, the PSQI was applied.
Results: significant relationships were obtained with SMM and PSQI (p= 0, 02, R = -0,38, R^2= 0.14) and a moderate correlation between FM and PSQI (p= 0.04, R = 0.40, R^2= 0.15). Sleep efficiency showed a negative correlation (p= 0.001, R = -0.55, R^2= 0.31) with FM and a positive correlation (p = 0.002, R = 0.58, R^2= 0.34) with SMM. Sleep duration showed a negative correlation (p = 0.024, R = -0.39, R^2= 0.15) with FM and a positive correlation (p = 0.021, R = 0.45, R^2= 0.20) with SMM.
Discussion: A lack of sufficient sleep has been linked to adverse effects on body composition, including reduced fat loss and muscle gain. Additionally, insufficient sleep has been associated with a decline in athletic performance.
Conclusions: The findings of this study indicate that poor sleep quality is associated with higher body fat and better sleep quality with a higher skeletal muscle mass, underscoring the significance of sleep for achieving optimal body composition and performance in natural bodybuilders.

Keywords

Bodybuilding; muscle hypertrophy; peak week; physical conditioning; sleep quality.

Resumen

Introducción: El culturismo es un deporte que evalúa a los atletas en función de su masa muscular, simetría y definición muscular, a diferencia de los deportes convencionales que suelen basarse en el rendimiento deportivo en competencia.
Objetivo: El objetivo fue determinar la relación entre la masa grasa (FM) y la masa muscular esquelética (SMM) por medio de bioimpedancia con la calidad del sueño en fisicoculturistas naturales el día previo a la competencia.
Metodología: Veintiséis culturistas naturales participaron en el campeonato WNBF. Se evaluó la composición corporal para obtener datos de SMM y FM. Además, se aplicó el PSQI.
Resultados: Se obtuvieron relaciones significativas entre SMM y PSQI (p= 0.02, R = -0.38, R^2= 0.14) y una correlación moderada entre FM y PSQI (p= 0.04, R = 0.40, R^2= 0.15). La eficiencia del sueño mostró una correlación negativa (p= 0.001, R = -0.55, R^2= 0.31) con la FM y una correlación positiva (p = 0.002, R = 0.58, R^2= 0.34) con el SMM. La duración del sueño mostró una correlación negativa (p = 0.024, R = -0.39, R^2= 0.15) con la FM y una correlación positiva ((p = 0.021, R = 0.45, R^2= 0.20) con el SMM.
Discusión: Se reporta que el sueño insuficiente afecta negativamente la composición corporal, con menos pérdida de grasa y menor ganancia muscular.
Conclusión: Una mala calidad del sueño se relaciona con una mayor grasa corporal y una mejor calidad del sueño con una mayor masa muscular, lo que subraya la importancia del sueño para lograr una composición corporal y un rendimiento óptimos en los culturistas naturales.

Palabras clave

Calidad del sueño; condición física; culturismo; hipertrofia muscular; puesta a punto.

Introduction

Bodybuilding is a sport that evaluates athletes based on their muscle mass, symmetry, and muscle definition, in contrast to conventional sports which are often based on physical ability or athletic performance. The season consists of various stages, including the muscle gain phase, commonly known as the 'off-season,' the body fat loss stage, and the week before the event, referred to as 'peak week' (Iraki et al.,2019). In the days before competition, bodybuilders undergo a caloric restriction of about 45% (de Moraes et al. 2019), which allows them to reach levels of <5% body fat (Rossow et al.,2013). Natural bodybuilding is a discipline that seeks to enhance muscle development and physical improvement using methods that do not involve the use of banned substances, such as anabolic steroids or hormonal agents, as these are harmful to health. (Liokaftos, 2019; Vanegas & Peña, 2024). Natural bodybuilding is based on three fundamental principles: strength training, controlled nutrition, and adequate rest. Unlike conventional bodybuilding, which may employ chemical aids to maximize results, natural bodybuilding follows strict anti-doping standards, promoting fair and healthy competition. Furthermore, it emphasizes long-term health benefits, avoiding the risks associated with the use of doping substances, such as metabolic and cardiovascular side effects (Liokaftos, 2019).

Bodybuilders must be able to effectively manage the variables associated with resistance training, including volumes in the range of 10 to 20 sets per muscle group at moderate to high intensities (Alves et al., 2020). These intensities should be performed in repetitions near or to muscle failure for each of the programmed sets and exercises (Alarcón-Rivera et al., 2024; Grgic et al., 2022; Schoenfeld & Grgic, 2019). Frequency is also a key factor in the training program as it determines the distribution of volume by muscle group and the efficient management of rest periods (Schoenfeld et al., 2016; Schoenfeld et al., 2019). Despite the progress made in understanding how bodybuilders can optimize muscle gains through training and nutrition, prolonged periods of stress and social pressure can negatively impact their sleep quality (de Moraes et al., 2019).

Sufficient sleep is vital for muscle recovery, muscle protein synthesis, and overall performance (Dáttilo et al., 2020; Erlacher & Vorster, 2023; Vitale et al.,2019). Sleep deprivation or sleep restriction can alter muscle strength production and exercise-related hormonal responses, such as the ratio of testosterone to cortisol (Dattilo et al., 2011; Knowles et al., 2018; Pardue et al., 2017). Also, it decreases insulin ($p=0,003$) sensitivity in men (Wong et al., 2015). Likewise, sleep restriction can lead to decreased performance during training and may be associated with an increase in body fat gain (Craven et al., 2022; Knowles et al., 2022; Wang et al.,2018). Actually, a 1-hour restriction in total sleep time significantly reduces ($p=0.016$) the loss of fat mass and total mass (Wang et al., 2018). Even greater consequences are observed at higher sleep restrictions (~5 hours of sleep) in physically trained women, with a reported 15% decrease ($p=0.002$) in performance speed in compound exercises such as the back squat, deadlift, and bench press, as well as a reduction in total session volume ($p=0.003$), compared to a group sleeping approximately 7 hours (Knowles et al., 2022)

The Pittsburgh Sleep Quality Questionnaire (PSQI) is a commonly used tool for evaluating sleep quality. It has been previously utilized to assess athletes during competitive periods (Halson et al., 2022; Simim et al., 2020). The 'peak week' is a stage during which bodybuilders focus on progressively increasing their carbohydrate intake while reducing the volume and intensity of their training. The goal is to achieve an optimal physical look for the day of the show. Bodybuilders often experience high levels of anxiety and stress during this week and the days leading up to the competition, which can negatively impact their sleep quality (Chappell & Simper, 2018). Nevertheless, there is a paucity of scientific evidence examining the impact of sleep quality on body composition in natural bodybuilders. Most studies have concentrated on other elements of training and nutrition, thereby creating a knowledge gap regarding the potential direct impact of sleep on the distribution of muscle mass and body fat. Moreover, research on sleep in athletes frequently concentrates on endurance or team sports, rather than on aesthetic sports such as bodybuilding. Therefore, the objective of the study was to determine the relationship between fat mass (FM) and skeletal muscle mass (SMM) with sleep quality in Chilean natural bodybuilders on pre-competition day.

Method

This observational cross-sectional study examined the relationship between sleep quality and body composition in a group natural Chilean bodybuilders during their pre-competition day. This study followed the guidelines of the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) statement to ensure clear and detailed reporting of methods and results.

Participants

A total of 26 athletes of the category's Men's bodybuilding and Men's physique (28.26 ± 5.49 years) voluntarily participated in the study. The evaluations were carried out at the Astor theater, in the city of Talca (Chile) one day before the WNBFCHILE national natural bodybuilding championship in the mandatory evaluations to participate in the event. The inclusion criteria were as follows: a) affiliation with WNBFCHILE as a natural athlete, b) age over 18 years, c) Strength training experience of at least 2 years. The exclusion criteria were a) consumption of sleep-inducing stimulants during preparation, and b) use of pacemakers or other devices that interfere with body composition testing. The procedures were designed in accordance with the guidelines set forth by the Medical Association's Declaration of Helsinki of 1975, as revised in 2013, for the conduct of human studies and the confidentiality of the information collected was guaranteed (World Medical Association, 2013).

Procedure

Athletes who voluntarily agreed to participate in the study. The athletes were evaluated individually in the afternoon (between 16:00 and 19:00) in a room that had been equipped for this specific purpose. First had their body composition assessed by a qualified staff member (graduate sports science). They then completed the PSQI questionnaire by hand in a quiet and undisturbed individual seat. The room temperature was approximately 20º Celsius, and qualified staff assisted with any questions about the questionnaire.

Sleep quality

Sleep quality index was measured using PSQI, a tool that analyzes sleep quality and disturbances. Through nineteen different items, seven "component" scores are obtained, addressing aspects such as subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of medications, sleep and daytime dysfunction (Buysse, 1989). A score of >6 is indicative of poor sleep quality (Halson et al., 2022). The participants were instructed to sit comfortably at a desk and complete the questionnaire as objectively as possible.

Body composition

Fat mass (FM) and skeletal muscle mass (FFM) were measured using multifactorial electrical bioimpedance (InBody 270, Biospace, California, USA). The InBody is a reliable instrument for evaluating body composition (Czartoryski et al., 2020). The athletes were instructed to wear only competition swimsuits and no footwear while recording data on the machine.

Data analysis

Statistical analysis was performed using Graphpad Prism software (version 9.0). Analyzed data at an a priori significance level of <0.05. The results were described using measures of central tendency, such as mean and standard deviation. The Shapiro-Wilk normality test was performed to determine the distribution of the data. Pearson's parametric test was employed to establish a relationship between FM and SMM variables and sleep efficiency, sleep duration, and PSQI. Based on the correlation coefficient (r-value), the relationships were interpreted as weak (0 to 0.39), moderate (0.4 to 0.69), and strong (0.7 to 1) (Akoglu, 2018). In addition, the coefficient of determination (R^2) was calculated to quantify the proportion of the variance in the dependent variable that is explained by the independent variable.

Results

Table 1 presents a summary of the general characteristics of the participants. The mean age of the participants was 28.26 ± 5.49 years. The mean body weight was 76.65 ± 23.31 kg. The mean height was 170.91 ± 8.86 cm. The mean body mass index (BMI) was 24.59 ± 2.90. Regarding the findings pertaining to sleep quality, the mean sleep efficiency was determined to be 84.6%± 10.35, with an average duration

of 6.84± 1.14 hours per night. The mean PSQI score was 7.28± 2.90. In terms of body composition, the mean SMM was found to be 50.95 ± 2.97%, while the mean FM was 10.93 ± 4.89%.

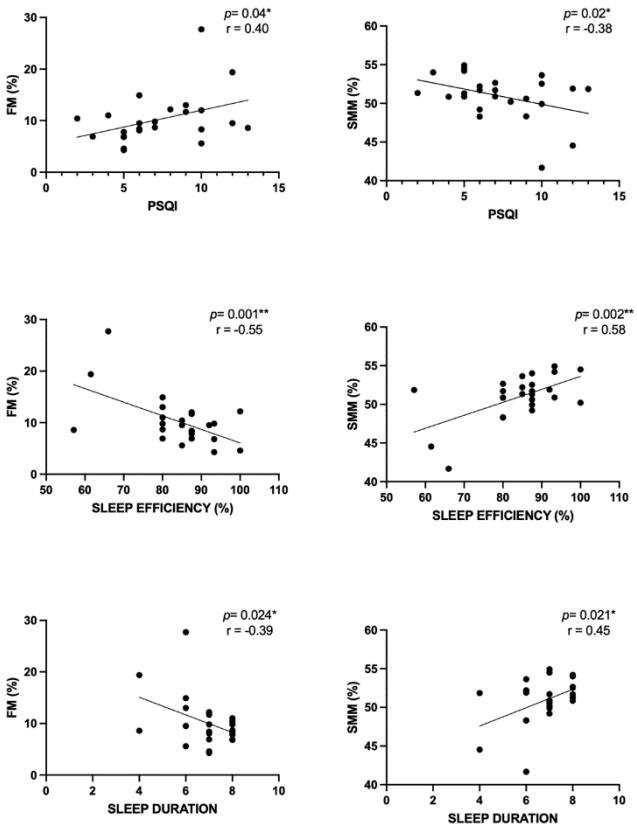
Table 1.
Characteristics of the sample (n=26)

	Min	Max	Mean	SD
Age (years)	18,12	38,29	28.26	5.49
Heigth (cm)	158.00	187.00	170.91	8.86
Body weight (kg)	45,80	96.1	76.65	23.31
BMI (kg/m²)	18,10	33.50	24.59	2.90
Sleep Efficaccy (%)	57.10	100	84.60	10.35
Sleep Duration (hours)	4	8	6.84	1.14
PSQI Score	2	13	7.28	2.90
FM (%)	4.3	27.7	10.93	4.89
SMM (%)	41.67	54.93	50.95	2.97

Note: BMI: body mass index; SD: standard deviation; PSQI: Pittsburgh Sleep Quality Questionnaire; FM: fat mass; SMM: skeletal muscle mass.

The correlation analysis between body composition and PSQI indicate a statistically significant weak correlation between SMM and PSQI (p= 0.02, R= -0.38) and a statistically significant moderate correlation between FM and PSQI (p= 0.04, R= 0.40). Sleep efficiency demonstrated a statistically significant negative correlation (p = 0.001, R = -0.55) with FM and a statistically significant positive correlation (p = 0.002, R = 0.58) with SMM. Furthermore, the results demonstrated a statistically significant correlation between sleep duration and SMM (p = 0.021, R = 0.45), indicating a moderate character. Additionally, a significant negative correlation was observed between sleep duration and FM (p = 0.024, R = -0.39). The aforementioned results are depicted in Figure 1.

Figure 1. Relationship of SMM, FM with PSQI, Sleep Efficiency and Sleep Duration The figure explains the inverse correlations between SMM and PSQI and the positive correlations between FM and PSQI. Moderate inverse correlations between sleep efficiency and sleep duration for FM and moderate positive correlations between sleep efficiency and sleep duration for SMM are observed. *: p<0.05; **: p<0.01.



Furthermore, the R^2 value for the correlation between SMM and PSQI was observed to be 0.14, while the R^2 value for the correlation between FM and PSQI was 0.15. About the correlation between sleep

efficiency and FM, the R^2 values observed were 0.31 and 0.34, respectively, in the correlation between sleep efficiency and SMM. Finally, an R^2 of 0.15 was observed for the correlation between sleep duration and FM, and an R^2 of 0.20 was observed for the correlation between sleep duration and SMM.

Discussion

The objective of the study was to determine the relationship between fat mass (FM) and skeletal muscle mass (SMM) with sleep quality in Chilean natural bodybuilders on pre-competition day. The results demonstrated a statistically negative correlation between PSQI and SMM, as well as a statistically positive correlation between PSQI and FM. Current research on the relationship between sleep quality and body composition in bodybuilders is limited. However, there are a few reports on this topic in the literature on pre-competition bodybuilders. One study reported that the average fat mass of amateur bodybuilders was 10.5% (de Moraes et al., 2019). The mean value for the athletes in our study was 10.4%, which leads us to hypothesize in accordance with the findings of by de Moraes et al. (2019) that the sleep quality is affected by elevated levels of pre-competition stress. Similarly, it has been documented that a reduction in sleep duration to less than six and a half hours per night results in a diminished rate of fat loss when compared to subjects who maintain a normal sleep duration of seven or more hours. The findings of this study indicate that reducing sleep duration by one hour has a statistically significant negative impact on fat loss (p=0.016).

In a study conducted by Knowles et al. (2022), female fitness athletes who were subjected to greater sleep restrictions (approximately five hours of sleep) exhibited a 15% reduction in performance velocity (p=0.002) and total session volume (p=0.003) in compound exercises such as the back squat, deadlift, and bench press, when compared to a control group of women who slept for approximately seven hours. The reports indicate that poor sleep quality has a detrimental impact on both fitness and fat loss, which in turn leads to a deterioration in body composition. Disparate results were reported by an investigation in professional athletes, where no statistically significant relationship (p=0.658) was observed between the PSQI and the % of FM in this population (Khalladi et al., 2019). The results indicate that sleep and its quality are pivotal for the adaptation to and performance of sports. For instance, a systematic review by Bonnard et al. (2018), demonstrated that extending additional sleep before a competition offers substantial performance benefits, both physically and mentally. Consequently, increasing sleep beyond the typical hours could be an efficacious strategy to optimize performance in preparation for competition.

In regard to SMM, it has been reported that In the young adult population statistically significant (p= 0.036) relationships have been reported between lean mass and sleep quality as assessed by the PSQI (Yusuf et al.,2024). A further study by Nedeltcheva et al. (2010), demonstrated that a reduction in sleep duration from 7 to 5.5 hours per night resulted in a 50% decrease in fat loss and a 50% increase in muscle mass loss. This evidence suggests that insufficient sleep hinders the loss of adipose tissue and the gain of muscle mass, which are crucial factors in the pursuit of aesthetic sports such as bodybuilding (Nedeltcheva at al.,2010). Furthermore, reports indicate that insufficient or disrupted sleep patterns during the night result in alterations to growth hormone (GH) levels (Van Cauter & Plat, 1996). GH has both anabolic and catabolic properties. In the anabolic context, one of its primary functions is the uptake of amino acids by cells and their incorporation into various proteins. This process is essential for triggering muscle hypertrophy (Velloso, 2008). Moreover Leproult & Van cauter (2011), indicated that a reduction in sleep duration to 5 hours per night for a week resulted in a progressive decline in testosterone levels by 10% to 15%. This finding suggests that acute sleep restriction may have adverse effects on the maintenance and development of muscle mass (Leproult & Van Cauter, 2011).

The available scientific evidence suggests that the optimal amount of sleep for adults is between seven and nine hours per night (Hirshkowitz et al., 2015). The mean number of hours slept per night by the athletes in our study was 6.84± 1.14. In contrast with the hypothesis that the total duration and effectiveness of sleep would be altered, the case report of a drug-free bodybuilder throughout the off-season, competition, and post-competition phase demonstrated that these variables remained unaltered (Pardue et al., 2017). Moreover, a recent meta-analysis has indicated that it can be challenging for elite athletes to adhere to recommended standards of hygiene and sleep quality, given the rigorous training, recuperation, and nutritional requirements they are subjected to (Roberts et al., 2019).

It should be noted that this study has limitations. The limitations of this study are twofold. Firstly, the small sample size (n=26) may limit the study's ability to detect strong relationships. Secondly, the use of a questionnaire may introduce subjectivity due to interpretation. However, the evaluation instruments have been validated, and their strengths include the use of reliable instruments to assess body composition, sleep quality, and a representative sample of bodybuilding athletes one day before the competition.

Conclusions

In summary, the findings of this study suggest a correlation between poor sleep quality and increased fat mass, as well as better sleep quality and higher skeletal muscle mass. Existing evidence, along with our findings, highlights the importance of adequate sleep for muscle recovery, reduced fat mass, and overall performance. Sleep restriction, both in duration and quality, may impair strength training performance and hinder fat loss, negatively affecting body composition—particularly during critical periods such as pre-competition preparation.

The results of this study highlight the importance of considering sleep quality as a determinant of body composition in natural bodybuilders and suggest that improving sleep could have a significant impact on their performance and condition during pre-competition preparation.

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