UNIVERSITY OF THESSALY

Department of Physical Education and Sport Science

“Επίδραση της χρήσης της κουβέρτας βαρύτητας 7 κιλών στα επίπεδα χαλάρωσης και εγρήγορσης”

Από

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Πτυχιακή Διατριβή που υποβάλλεται στο καθηγητικό σώμα για τη μερική εκπλήρωση των υποχρεώσεων απόκτησης του Τίτλου Πτυχίου του Προγράμματος του Τμήματος Επιστήμης Φυσικής Αγωγής και Αθλητισμού του Πανεπιστημίου Θεσσαλίας.

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ΕΠΙΒΛΕΠΩΝ ΚΑΘΗΓΗΤΗΣ:

ΔΡ. ΣΑΚΚΑΣ ΓΕΩΡΓΙΟΣ

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Contents

List of tables

List of Abbreviations

Con: control blanket

CI: confidence interval

HR: heart rate

EEG: electroencephalography

MD: Mean Difference

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Abstract

Background: Poor sleep has become a major health issue across the world, affecting many aspects of our well-being. The use of weighted blankets has been seen beneficial in many studies by promoting relaxation and reducing anxiety, leading to increased sleep quality.

Purpose: The current study aimed at assessing whether nap quality can meaningfully be enhanced by using weighted blankets and evaluating both subjective and objective outcomes.

Methods: 20 young adults with no diagnosed sleep disorders were included. Participants took a 30-minute nap using either a 7kg weighted blanket or a control blanket, with conditions being a week apart. Sleep quality was objectively measured using an EEG system, while physical and subjective parameters were assessed pre and post nap.

Results: The EEG results indicated that participants fell asleep faster by 2.7 minutes (MD) and experienced up to 2 less awakenings (MD -1) when using the weighted blanket. However, even though both conditions, naturally, influenced most subjective and physical parameters, no significant difference was found between the conditions.

Conclusion: These findings suggest that weighted blankets may contribute to improved nap quality, which could, in turn, support daily function and overall health. Further studies with diverse population and settings are needed to fully explore the potential benefits of weighted blankets on sleep quality and well-being

Περίληψη

Υπόβαθρο: Η χαμηλή ποιότητα ύπνου αποτελεί πλέον σημαντικό ζήτημα για όλο τον κόσμο, επηρεάζοντας την υγεία μας πολυδιάστατα. Η χρήση βαριάς κουβέρτας φαίνεται επωφελής για την υγεία σε πολλές έρευνες, αυξάνοντας την χαλάρωση και μειώνοντας το άγχος, οδηγώντας σε βελτιωμένη ποιότητα ύπνου.

Σκοπός: η έρευνα αυτή σκοπεύει να αξιολογήσει εάν η ποιότητα του σύντομου ύπνου μπορεί να βελτιωθεί σημαντικά με την χρήση βαριάς κουβέρτας, υπολογίζοντας υποκειμενικούς και αντικειμενικούς δείκτες.

Μέθοδος: συμμετείχαν 20 νεαροί ενήλικες χωρίς προβλήματα ύπνου. Οι συμμετέχοντες κοιμήθηκαν για 30 λεπτά χρησιμοποιώντας είτε βαριά κουβέρτα είτε κουβέρτα control, με τις συνθήκες να απέχουν μια βδομάδα μεταξύ τους. Η ποιότητα ύπνου μετρήθηκε αντικειμενικά με την χρήση συστήματος εγκεφαλογράφησης, ενώ οι σωματικοί και υποκειμενικοί δείκτες μετρήθηκαν πριν και μετά τον ύπνο.

Αποτελέσματα: το εγκεφαλογράφημα έδειξε πως οι συμμετέχοντες κοιμήθηκαν 2.7 λεπτά (MD) πιο γρήγορα και είχαν έως και 2 λιγότερα ξυπνήματα (MD -1) με την χρήση της βαριάς κουβέρτας. Παρόλα αυτά, παρότι και οι δύο συνθήκες, αναμενόμενα, επηρέασαν τους σωματικούς και υποκειμενικούς δείκτες, δεν βρέθηκε στατιστικά σημαντική διαφορά ανάμεσα τους.

Συμπέρασμα: τα ευρήματα αυτά δείχνουν πιθανή βελτίωση σύντομου ύπνου με την χρήση βαριάς κουβέρτας, που κατ' επέκταση βελτιώνει την καθημερινή λειτουργία και γενική υγεία. Περισσότερες έρευνες με διαφορετικό πληθυσμό και συνθήκες είναι απαραίτητες για την πλήρη κατανόηση πιθανών ωφελημάτων της χρήσης βαριάς κουβέρτας για την ποιότητα ύπνου και την γενική υγεία.

Introduction

Sleep is a fundamental aspect of health, yet 1/3 of adults in the USA suffer from sleep deficiency (Liu et al., 2016). Individuals with lower socioeconomic status, educational attainment and social standing tend to experience poor sleep quality, which can further exaggerate their overall quality of life (Etindele Sosso et al., 2022). A growing body of evidence indicates that sleep quality has a significant impact on overall health and well-being. Sleep deviation is associated with an increased risk of mortality, diabetes, hypertension, cardiovascular diseases, coronary heart diseases, and obesity (Itani et al., 2017). In addition to the individual consequences, insufficient sleep has a significant impact on the global economy, said estimated $680 million lost annually across just the five of the organization for Economic Cooperation and development (OECD) counties (Hafner et al., 2017). Taken together, poor sleep quality affects a substantial proportion of the global population and is associated with a range of adverse health outcomes.

One significant contributor to poor sleep is stress experienced in the period leading up to bedtime. In a study conducted by Åkerstedt and colleagues (2012), it was found that stress experienced prior to bedtime correlates to higher chances of poor sleep quality. Additionally, maintaining consistent sleep timing and regular sleep patterns are essential for good health in adults (Chaput et al., 2020), yet stress has a detrimental impact on both sleep timing and consistency (Bei et al., 2016; Mezick et al., 2009). That negative impact can further undermine the restorative processes of sleep, leading to adverse health consequences. Thus, stress before sleep negatively impacts many aspects of sleep quality highlighting the need for interventions that promote relaxation.

A promising intervention for enhancing sleep quality and addressing pre-sleep anxiety is the use of weighted blankets. The effectiveness of these blankets in alleviating anxiety and promoting a calm state conducive to sleep with long-lasting effects has been demonstrated in numerous studies (Clapp, 2019; Ekholm et al., 2020; Hjort Telhede et al., 2022). Furthermore, research has indicated that the use of weighted blankets increases salivary melatonin levels prior to sleep (Meth et al., 2023), which can regulate circadian rhythms (Zisapel, 2018) and encourage a more consistent bedtime. These combined effects suggest that weighted blankets may provide a simple and effective solution to reduce pre-sleep stress and enhance sleep patterns, ultimately supporting higher quality sleep.

The purpose of this study is to examine whether using a 7kg weighted blanket for daytime naps can improve nap quality by promoting relaxation and reducing pre-nap stress. Investigating the effects of weighted blankets on daytime naps is essential, as they may offer a non-invasive accessible intervention to address the rising need for effective relaxation tools in an increasingly stressful world. By assessing both subjective and objective nap outcomes, this study aims to determine whether weighted blankets can meaningfully enhance nap quality, support daily functioning, and contribute to overall well-being and mental health.

Literature review

The belief of sleep in ancient Greece

In Greek mythology, sleep was personified as a deity, deeply intertwined with the natural and spiritual world. Sleep's mother was Nyx, the goddess of night, his twin brother was Thanatos, the personification of death, and his offspring were the gods of dreams. Sleep was believed to possess healing powers, a concept deeply rooted in ancient Greek culture.

As early as the 6th century BCE, Asclepius, the god of medicine, incorporated “incubation” or “temple sleep” into healing practices. This ritual involved sleeping in sacred spaces to experience prophetic or therapeutic dreams. By the 4th century BCE, sleep and dreams had become integral components of Greek physiotherapy. Hippocratic treatises frequently highlighted the therapeutic significance of sleep and dreams, using them as diagnostic and prognostic tools.

Dreams, according to Hippocratic thought, fell into two categories: those sent by the gods and those originating from the soul. The latter were believed to act as messengers, alerting the body to internal issues through symbolic dreams. By interpreting these dreams, Hippocrates could assess a patient’s physical condition, recommend dietary and exercise modifications, and tailor treatment to prevent disease progression.

The ancient Greeks’ exploration of sleep and dreams marked a pivotal transition, shifting these concepts from the realm of mythology into the foundation of early medical practice.(Askitopoulou, 2015)

The positive effects of sleep on health

From ancient times, sleep was used as a healing practice because of its benefits to health. Such benefits are its strong correlation with memory. It is well accepted that sleep improves motor memory, with no significant difference between the given tasks (Schmid et al., 2020). Memory consolidation is also affected by sleep, with researchers suggesting that even an “ultra short” period of sleep will trigger memory processing (LAHL et al., 2008). Sleep also plays a crucial role in our memories with offline memory reprocessing (Stickgold, 2005), a process that strengthens and reorganizes our memories without actively thinking, that usually occurs during rest. Taken together, sleep has an immense influence on many aspects and functions of our memories. A good night’s sleep can enhance the ability to retain information gathered throughout the day.

Our memories are not the only brain related activity that sleep correlates with. The glymphatic system is also influenced by sleep. When the glymphatic system is being turned on, the brain clears itself of neurotoxic waste products produced during wakefulness (Jessen et al., 2015). In a study conducted on mice researchers noticed that natural sleep or anesthesia are associated with a 60% increase in interstitial space, which significantly enhances the convective exchange between cerebrospinal fluid and interstitial fluid. This increase in convective fluxes facilitates a markedly higher rate of β-amyloid clearance during sleep (Xie et al., 2013). Jeffrey J Iliff and colleagues (2013) suggested that dysfunction of glymphatic pathway contributes to amyloid plaque deposition and Alzheimer’s disease progression, because, as said before, this system plays a crucial role in clearance of amyloid β from the brain. Diagnostic imaging of glymphatic function could also, due to recent advancements, be pivotal in characterizing the edema profiles of individual patients, potentially enabling more precise and targeted therapies (Thrane et al., 2014). Sleep is not just a restorative state; it is a fundamental process that supports memory, cognitive health, and brain waste-clearance systems, underscoring its critical role in both day-to-day functioning and long-term neurological health.

Sleep cycles and stages of sleep

In order to fully capitalize all the benefits that sleep provides, we need to understand its structure. Sleep is divided into cycles that change based on the time of sleep. Each sleep cycle is about 90 minutes long and usually four to six cycles per night. Each cycle has 4 sleep stages: N1 NREM, N2 NREM, N3 NREM, and REM, with REM meaning Rapid Eye Movement and NREM Non-Rapid Eye Movement. Even though they are part of the same cycle, their differences are more than noticeable. In more detail:

N1 NREM: It's the first stage of the sleep cycle and the lightest one. It usually lasts a few minutes, and awakening is easy to happen. Muscles tone is present, and breathing is occurring regularly. It works as a transitional phase between wakefulness and sleep. In an EEG recording it has theta waves – low voltage and accounts for about 5% of our sleep time.

N2 NREM: It's the second stage of sleep and takes the most sleep time, about 45%. The length of that stage in each cycle is longer as time goes by, dominating in the second half of a night's sleep. It's deeper sleep, with heart rate and body temperature dropping. The biggest difference of this stage are the sleep spindles and K-complexes. Sleep spindles are "brief, powerful bursts of neuronal firing in the superior temporal gyri, anterior cingulate, insular cortices, and thalamus, inducing calcium influx into cortical pyramidal cells" (Patel et al., 2024). They are believed to be integral to synaptic plasticity, while research suggests that they are vital to procedural and declarative memory. K-complexes are delta waves and are known as the longest and most distinct brain waves, lasting approximately one second. They help in memory consolidation and maintenance of sleep. N2 NREM is also the stage with the most effect on motor memory consolidation (Schmid et al., 2020), which is especially important for patients, athletes and children.

N3 NREM: also known as Slow Wave Sleep (SWS), is the deepest stage of sleep and the hardest to wake up from. Its electronic signaling is delta waves with lower frequencies and higher amplitudes. It approximately takes 25% of the total sleep time and is mostly present in the first half of a night's sleep. Waking up during that stage could lead to sleep inertia, a form of mental fogginess. N3 NREM plays a crucial role in tissue regrowth, building muscle and bone, and strengthening the immune system. It is also the stage that night terrors, sleepwalking and bedwetting occur.

REM: it is associated with dreaming and rapid eye movement, but the muscles are atonic. It's not a restful stage, with its electrical signaling, beta waves, being similar to those of wakefulness. Its length increases each cycle, starting from 10 minutes on the first cycle and going up to an hour in the last one. Because of the constant increase in duration, it is more dominant in the second half of sleep and takes about 25% of our sleep time. The brain is highly active during REM, with an increase in brain metabolism up to 20%. (National

Heart, Lung, and Blood Institute, 2022; Patel et al., 2024; Stickgold, 2009). Even though sleep offers different benefits depending on the stage, both halves of a full night's sleep are equally important, if we want to fully capitalize on their benefits to health.

Effects of poor sleep quality on health

Despite the numerous benefits provided by the different sleep stages, poor sleep quality can undermine these advantages and pose significant risk to overall health. Deviations from the recommended 7-8 hours per night can lead to a host of adverse outcomes. Short sleepers (< 7 hours per night) have a 12% greater risk of mortality, while long sleepers (>8 hours per night) face 30% higher risk compared to those maintaining optimal sleep durations (Cappuccio et al., 2010). Long sleep duration is particularly linked to elevated levels of inflammatory markers such as C-reactive protein (CRP) and interleukin-6 (IL-6), while experimental sleep deprivation studies suggest no such association for short sleep duration (Irwin et al., 2016), showing a negative impact of poor sleep on the immune system.

Metabolic health is another domain where poor sleep exerts profound effects, with the elevation of inflammatory markers, such as CRP, being suggested as an intentional mediator of the relationship between sleep deprivation and prediabetes (Iyegha et al., 2019). Short sleep duration (<6 hours per night) significantly increases the risk of insulin resistance and diabetes (Singh et al., 2022). Additionally, short sleep has been significantly associated with obesity risk, while long sleep duration appears to have no effect on future obesity among adults (Wu et al., 2014).

The cardiovascular system is particularly sensitive to disruptions in sleep. Both insufficient and excessive sleep are associated with an increased risk of cardiovascular disease (CVD) mortality. However, the impact of long sleep appears to be greater, especially in elderly individuals with poor sleep quality (Suzuki et al., 2009). These findings highlight the need for balanced sleep durations to mitigate cardiovascular risks and promote heart health.

Physical performance is one of the domains most visibly affected by poor sleep. Poor sleep quality negatively impacts aerobic exercise, speed/power endurance, strength, endurance, and skill performance, essentials for both athletic performance and everyday activities (Craven et al., 2022). For athletes these declines can mean the difference between success and failure in competitive events. Similarly, for the general population, reduced physical capacity may impair the ability to perform daily tasks, potentially increasing the risk of accidents and injuries.

Cognitive health is also deeply influenced by sleep quality. Obstructive sleep apnea (OSA), a condition closely associated with poor sleep, has been linked to cognitive impairments in young and middle-aged adults and is a significant contributor to the development of mild cognitive impairment (MCI) and Alzheimer's disease (AD) in older adults (Bubu et al., 2020). Mechanisms such as intermittent hypoxia, sleep fragmentation, reduced slow-wave sleep (SWS), and intrathoracic pressure swings are proposed as drivers of these neurodegenerative changes.

Sleep also plays a crucial role in social interactions. Poor sleep reduces facial and vocal expressivity, leading to monotonic speech, altered acoustic properties, and diminished positive affect, which can negatively influence how individuals are perceived and their ability to engage socially (Beattie et al., 2015). These changes may exacerbate feelings of isolation or misunderstanding, further compounding emotional changes. Additionally, sleep deprivation impairs emotional regulation, increasing negative emotions and diminishing positive ones, as observed in both clinical and subclinical populations (Baglioni et al., 2010).

The connection between sleep and mental health is equally significant. Insomnia, for instance, doubles the risk of developing depression in nondepressed individuals, Underscoring the importance of early treatment programs as preventative strategies in mental healthcare (Baglioni et al., 2011). Poor sleep is also associated with lower quality of life, particularly among individuals experiencing anxiety and depression, as self-reported in measures like the EuroQol-5 Dimension (EQ-5D) Questionnaire (Lee et al., 2021).

Taken together, these studies illustrate the extensive influence of sleep on physical, cognitive, emotional, and metabolic health, as well as its broader implications for quality of life and mortality. The consistent association between poor sleep and adverse outcomes across diverse domains emphasizes the need for interventions aimed to improve sleep quality and duration to enhance overall health and well-being.

Napping and differences with sleep

While poor sleep quality can have severe health consequences, shorter sleep periods, like naps, offer a potential solution to these negative impacts on overall health and well-being. Napping is a short period of sleep that usually occurs during daytime. Because of its duration (20-90 minutes), instead of having multiple sleep cycles just like in a full night's sleep, only one sleep cycle or even only the first two stages (N1 and N2) occur. Having shorter naps (20-30 minutes), makes it difficult to go into deep sleep, due to lack of time, with sleep becoming lighter and easier to wake up from, avoiding sleep inertia.

With sleep deprivation being a major issue (Liu et al., 2016), napping could be a promising solution, by at least partially resolving many of the negative impacts that sleep deprivation has on health. Even with a short 30-minute nap, urinary catecholamine and salivary IL-6 levels altered by sleep loss were restored back to baseline levels, helping with improvement of neuroendocrine stress, immune recovery and potentially long-term cardiovascular health (Faraut et al., 2015). Napping also has significant benefits to cognitive function, vigilance and domains of motor (Schmid et al., 2020), declarative and procedural memory (Leong et al., 2022).

Although napping has a positive association with those factors, the duration of napping must be taken into account, with longer naps possibly having a negative impact on memory and cognitive functions, even leading to higher chances of dementia. Naps that are longer than 30, 45 and 60 minutes could respectively have a 35%, 41% and 40% increased risk of cognitive impairment (Fang et al., 2023). Apart from its association with memory, naps with duration longer than an hour have showed increased risk of obesity (Cai et al., 2023), cardiovascular diseases and mortality (Sun et al., 2022).

The literature about the association of longer naps and cognitive function/memory is mixed. Even though, as said before, longer naps are associated with dementia, the beneficial effects of naps on these factors are mostly shown in studies that longer naps were conducted (Leong et al., 2022). Nevertheless, studies have shown that memory reprocessing and memory consolidation are triggered even with small episodes of napping or relaxation (LAHL et al., 2008; Wang et al., 2021). Based on these findings, having short naps, up to 30 minutes, should be beneficial to cognitive function, many aspects of memory and overall well-being.

The effect of heavy blankets on sleep quality

A potential intervention for enhancing the restorative effects of napping and overall sleep is the use of heavy blankets. A study conducted with young healthy adults has indicated that the use of weighted blankets increases salivary melatonin levels prior to sleep (Meth et al., 2023). Melatonin is a hormone produced by the pineal gland at night and is responsible for promoting sleep anticipation. As people age, melatonin levels decrease, leading to poorer sleep quality (Zisapel, 2018). The ability of weighted blankets to increase pre-sleep melatonin levels could potentially encourage a more consistent bedtime and therefore increase the restorative effects of sleep, especially in older adults.

The most studied and visible influence of the usage of weighted blankets on sleep is their ability to reduce anxiety. In a study conducted by Eva Hjort Telhede and colleagues (2021), they used weighted blankets for the nursing home residents, which resulted in positive effects on sleep quality, activity levels and psychological behavior. The residents slept faster, longer and calmer than before, with less wake ups and the effects continued after the study period. This improvement in sleep quality led to reduction of sleeping pills, risen activity levels, higher independence and social activity, clearer expression of needs and reduction in anxiety and aggressive behavior. The researchers suggest that the answer to these improvements may lie in the ability of deep pressure to calm the sympathetic nervous system's overactivity (Hjort Telhede et al., 2022). Similar results were also found in colleague students, where the usage of weighted blankets improved sleep quality and reduced anxiety (Clapp, 2019). Increase in sleep quality and activity levels, combined with reduction in anxiety and depression were also seen in patients with psychiatric disorders (Ekholm et al., 2020). Based on the existent literature, weighted blankets have a significant influence on anxiety, activity levels and emotional/behavioral state of the user.

These studies provide evidence that the positive effects of weighted blankets on sleep quality as well as on physiological, emotional, social and overall well-being are extended beyond age groups or diagnostic conditions, offering potential benefits to a wide range of individuals.

Methodology

Participants

Sample size and selection:

This study included 20 healthy young adults; each assigned a unique participant ID for consistent tracking across sessions. The inclusion criteria were: young adults without known sleep disorders or other conditions that might interfere with sleep. The exclusion criteria were: participants that were underage had a history of diagnosed sleep disorders or other medical conditions affecting sleep.

Informed consent and ethics:

Participants signed an informed consent form prior to the study, and the protocol was approved by the institutional Ethics Committee (2329/1-11/7.2.2024) to ensure compliance with ethical research standards.

Study design

Design and Randomization:

The study employed a randomized controlled crossover design. Each participant used both the weighted blanket (7 kg) and the control blanket in random order to minimize order effects. Participants were aware that they would be using different blankets during the study but were unaware of the differences in weight or the purpose of each blanket. This partial blinding minimized expectancy effects. The control blanket was identical in appearance and material to the weighted blanket but lacked internal weight. This ensured consistent tactile and thermal sensations. Sessions were spaced one week apart, converted at the same time and day of the week for each participant to minimize circadian and behavior variability. The environment was at a temperature of 22° C, with dimmed low light and had white noise using an ionizer to mask external sounds. To assure participants of the cleanliness of the room, protective and disposable sheets were placed over the bedding for each session to maintain hygiene and participant comfort. Additionally, the scale used for weight measurement was cleaned in front of participants. For the pre-nap routine, participants were instructed to avoid caffeine consumption before their appointments.

Procedure

Baseline assessments

Physical measurements were conducted, with height being measured by a standard measuring tape and weight/body composition with the use of a Tanita bioimpedance scale. During that first session participants completed a comprehensive baseline questionnaire set, including:

1. Demographic information: basic details like age height weight etc., to verify eligibility and establish baseline metrics.
2. SF-36 health survey:
3. Pittsburgh sleep quality index (PSQI):
4. Beck depression inventory (BDI)

5. The Perceived Stress Scale (PSS)
6. Athens insomnia scale

Pre-nap procedure:

At the beginning of each session EEG electrodes were applied to monitor sleep quality during the nap. Then, participants reported their current sleepiness levels by answering the Relaxation State Questioner (RSQ). Last there were the physiological measurements. Heart rate and blood pressure was measured with an automative blood pressure monitor, followed by hand grip strength, measured with an electronic handgrip dynamometer, to assess baseline muscle function.

Napping session:

Participants were instructed to lie in any comfortable position and relax. The blanket (weighted or control) was placed over them and the EEG recording began once they were settled. The session lasted 30 minutes, during which participants were undisturbed unless they used the provided alarm button to signal any urgent needs.

Post-nap procedure:

After the 30-minute session, EEG recording was stopped, and post-nap measurements were taken for heart rate, blood pressure, and handgrip strength. Participants then completed the Relaxation State Questioner (RSQ) again. EEG electrodes were removed, and participants were allowed to leave.

Data collection

The EEG data were automatically transferred to a secure database immediately after pressing “stop” recording. The baseline questioner responses were also automatically transferred after completion. Other data, such as physiological measurements and Relaxation State Questioner (RSQ) responses, were manually entered into an excel file using participants ID number to ensure confidentiality. All data were securely stored in a password-protected system accessible only to authorized personnel, ensuring participants privacy. Data sharing with third parties was not permitted.

Measurements and tools

Body composition scale: are scales which use bioelectrical impedance analysis (BIA) technology. By sending a low-level electrical signal through the body, they can estimate body composition. These scales are able to measure body fat percentage, muscle mass, bone mass, body water percentage etc.

Handgrip strength: measures the force generated by squeezing an object. It is often used as an indicator for overall muscle strength and physical health, as it can reflect recovery and nutritional status, or risk of chronic diseases. Usually, an electronic handgrip dynamometer is used for this evaluation. It is a device that consists of a grip sensor connected to a digital display, where the applied force is shown in kilos (kg). The use of this device ensures consistency and accuracy in data collection.

Relaxation State Questionnaire (RSQ): is a self-assessment tool designed to measure an individual’s psychological and physiological state of relaxation. It consists of 10 questions, evaluating stress levels, mental calmness, and physical relaxation based on subjective experiences and feelings. It is a tool commonly used for research settings that study the effects of interventions that promote relaxation. (supplementary 3&4)

Electroencephalography (EEG): is a non-invasive technique used to measure electrical activity in the brain. Brainwaves are detected by sensors placed on the scalp, categorizing them into frequency bands (e.g., alpha, beta, delta). This categorization enables researchers to study brain states during sleep, wakefulness, and cognitive tasks. It is a helpful tool for diagnosing epilepsy, sleep disorders, brain injuries or other brain/neuron related disorders.

Home Sleep Test (HST): is a simplified EEG tool which can be used in a home setting. It consists of 4 sensors connected to a device, which are placed in different areas of the scalp after the use of pilling cream for better connection, and a tablet. The tablet shows instructions for the placement of the sensors in different steps and is responsible for the recording. With the HST, brain activity is measured, categorizing the brain waves into frequency bands like a more complicated EEG would.

Statistical analysis

the statistical analysis was performed using IBM SPSS statistics version 21 (SPSS Inc., Chicago, U.S.A.). Independent samples T-test was used to examine if there are significant differences in baseline characteristics between male and female subjects. A paired T-test was used to compare within subject's differences between the two conditions (control and weighted blanket). A General Linear Model (GLM) Repeated Measures ANOVA was used to assess changes in EEG parameters among the 2 conditions. A Bonferroni post-hoc test was performed to assess individual differences. The significance level was set at $p\_<0,05$.

Results

Table 1: participants' basic characteristics

Variables	Participants (N=20)
Gender	7M/13F
AGE (yrs)	22.05 ± 1.9
HEIGHT (cm)	172.9 ± 10.9
WEIGHT (kg)	69.7 ± 12.2
FAT %	18.8 ± 7.4
MUSCLE MASS (kg)	54.1 ± 12.2
BMI	23.1 ± 1.7
SF-36 (%)	79.8 ± 11.5
Pittsburgh (ΔΠΥ)	7.0 ± 4.0
Beck Depression Inventory (BDI)	5.0 ± 3.7
The Perceived Stress Scale (PSS)	20.2 ± 3.9
Athens Insomnia Scale (AIS-7)	5.1 ± 3

Table 1: shows the basic characteristics for the participants, with no statistically significant differences between subjects, P>.05.

20 young adults with an average age of 22,05 participated in the study. No major sleep disturbances were observed in the questionnaire results.

Table 2: EEG results

Variables	N	Control	7kg	Mean difference (95% C.I); P-value
TST (min)	20	17,9 ± 18,9	13,6 ± 8,6	-4,3 (-14,3 to 5,7); P=0,385
Sleep Efficiency (%)	20	36,7 ± 18,6	37,4 ± 23,0	0,74(-9,3 to 10,8); P=0, 878
Sustained Sleep Efficiency (%)	20	45,0 ± 19,2	43,7 ± 25,9	-1,3(-12,7 to 10,1); P=0, 817
Sleep Latency (min)	20	8,8 ± 7,2	6,2 ± 4,6	-2,7(-6.0 to 0.6); P=0,106
Sleep Latency N1 (min)	19	9,5 ± 6,5	7,1 ± 7,5	-2,4(-5,8 to 1,1); P=0,167
Sleep Latency N2 (min)	15	13,6 ± 9,6	14,8 ± 9,6	1,1(-4,7 to 7,0); P=0,687
Deep Sleep (min)	3	16,9 ± 4,8	19,6 ± 4,9	2,7(-15,4 to 20,8); P=0,582
Wakes (index)	20	4,9 ± 1,8	4,2 ± 1,5	-1(0 to 2); P=0,101

Table 2 presents the mean and standard deviation (SD) of EEG results for both control and intervention group. It also displays the mean difference between the groups, along with the confidence Interval (95% C.I) and the statistical significance (P-value) of the observed differences.

Table 3: Physical and RSQ within group results

	CONTROL			7kg		
Variables	**Pre (95% CI)**	**Post (95% CI)**	**P Value*; Effect size-d (Δ%)**	**Pre (95% CI)**	**Post (95% CI)**	**P-Value*; Effect size-d (Δ%)**
N	20	20	-	20	20	-
RSQ	33,8 ± 4,7	39,3 ± 4,3	P=<0.001; -1.221 (17,8% ± 17,6)	31,4 ± 3,1	36,7 ± 4,5	P=<0.001; 1.371 (31,9% ± 65,3)
Systolic Pressure (mmHg)	117,6 ± 11	111,0 ± 17,8	P=0.05; -0.446 (-5,6% ± 12,7)	118,3 ± 14,3	114,6 ± 13,6	P= 0.04; 0.265 (-4,9% ± 10,5)
Diastolic Pressure (mmHg)	66,7 ± 11,5	63,9 ± 7,3	P=0.327; -0.29 (-2,5% ± 12,4)	65,8 ± 6,9	64,9 ± 7,2	P=0.327; 0.127 (-0,9% ± 6,3)
Heart Rate (Bits/min)	70,1 ± 13,2	65,3 ± 10,8	P=0.002; -0.398 (-6,1% ±7,5)	66,8 ± 10,6	62,8 ± 9,7	P=0.006; 0.393 (-7,2% ± 11)
Handgrip Strength (Kg)	33,3 ± 8,0	30,9 ± 7,0	P=0.019; -0.319 (38,7% ± 20,1)	33,4 ± 8,9	29,9 ± 7,2	P=0.005; 0.432 (-9,2% ± 12,9)

Table 3 displays the results for the physical tests (Systolic pressure, Diastolic Pressure, heart rate and handgrip test) and the Relaxation State Questionnaire (RSQ). It divides the results into pre and post intervention for both the control and the 7kg weighted blanket group, presenting the means, confidence Interval (95% C.I), standard deviation (±SD), as well as the statistical significance (P-value), effect size-d and Δ% of those observed differences. The differences are based on the time variable (Pre-post) not between the two groups.

Table 4: Physical and RSQ between group results

Between group difference in change			
Outcome	**Estimate**	**95% CI**	**P-value**
RSQ	-0.3	-3.4 to -2.9	.88
Systolic Pressure (mmHg)	3.0	-5.8 to 11.7	0.51
Diastolic Pressure (mmHg)	1.8	-4.3 to 7.9	0.56
Heart Rate (Bits/min)	0.7	-4.1 to 5.5	.78
Handgrip Strength (Kg)	-0.8	-3.4 to 1.9	0.57

Table 4: presents the between group difference in change results for the physical tests (Systolic pressure, Diastolic Pressure, heart rate and handgrip test) and the Relaxation State Questionnaire (RSQ). It displays the differences between the 7kg intervention compared to the Control blanket, by showing the Estimate, confidence Interval (95% C.I) and the statistical significance (P-value).

Discussion

This randomized control trial demonstrated beneficial effects of a 7kg weighted blanket on sleep latency and the number of awakenings (wakes) in healthy individuals. Using a home-sleep test EEG system, we were able to objectively assess the impact of the 7kg weighted blanket on the participants' naps compared to the control condition. The EEG results (table 2) show that when the participants used the weighted blanket, they were able to sleep 2.7 minutes faster than when with the use of the control blanket [-2,7(-6.0 to 0.6); P=0,106]. In addition to reduced sleep latency, participants experienced less awakenings during their nap. The number of awakenings ranged from the same as the control group to 2 less wakes, with an average of 1 less wake using the weighted blanket [-1(0 to 2); P=0,101].

These findings align with a study conducted on children diagnosed with an ADHD, where the intervention of a ball weighted blanket led to a reduction in sleep latency and awakenings, demonstrating its effectiveness on whole night sleep and different populations (Hvolby & Bilenberg, 2011).

The rest of the EEG parameters (TST, Sleep Efficiency, Sustained Sleep Efficiency, Sleep Latency N1, Sleep Latency N2, Deep Sleep) showed minimal differences between the 2 groups. Although, none of the EEG results reached statistical significance ($p>0.05$), potentially due to a Type II error, the observed reduction of 2,7 minutes on sleep latency and up to 2 fewer awakenings is worth noting. Given that the intervention was tested on a 30-minute nap and not a full night's sleep, it makes these effects even more meaningful, as every minute of a short nap is valuable.

Apart from the EEG findings on sleep parameters, the weighted blanket also influenced physiological and subjective measures (table 3&4). Within both control and 7kg conditions, statistically significant differences were observed in most parameters. Specifically, there was an increase in the RSQ score [con: P=<0.001; -1.221 (17,8% ± 17,6); 7kg: P=<0.001; 1.371 (31,9% ± 65,3)] and a reduction in Systolic Pressure [con: P=0.05; -0.446 (-5,6% ± 12,7); 7kg: P= 0.04; 0.265 (-4,9% ± 10,5)] , Heart rate [con: P=0.002; -0.398 (-6,1% ±7,5); 7kg: P=0.006; 0.393 (-7,2% ± 11)], and Handgrip strength [con: P=0.019; -0.319 (38,7% ± 20,1); 7kg: P=0.005; 0.432 (-9,2% ± 12,9)] in both conditions after the 30-minute nap compared to their pre-nap measurements. Diastolic pressure was the only parameter that didn't show significant difference in either group [con: P=0.327; -0.29 (-2,5% ± 12,4); 7kg: P=0.327; 0.127 (-0,9% ± 6,3)].

Interestingly, the HR findings differ from those reported in a study conducted during wisdom tooth surgery, where participants experienced a lower heart rate while using a weighted blanket compared to those in the control group (Chen et al., 2016). This difference may be due to the contrasting conditions of the two studies. In the wisdom tooth surgery setting, the heart rate increased, possible due to procedural stress or pain, with the weighted blanket mitigating the rise. However, during the nap, HR naturally decreased in both groups with a slightly greater reduction observed in the control condition.

Overall, both the control and the intervention groups demonstrated statistically significant differences in most physiological and subjective parameters, indicating increased relaxation. However, when comparing between groups no statistically significant differences in change were observed. The similarity in performance between the groups may be due to how unfamiliar the participants were with the use of a weighted blanket. Also, the choice of healthy individuals as participants led to sleeping with all conditions with no issues, which also affected the lack of difference between the 2 conditions. Although these patterns could be explained by unfamiliarity, potential discomfort with the blanket, and the participants already having good sleep quality, this difference in performance was not reflected in the EEG results, where the weighted blanket showed a more favorable impact.

Conclusion

This study aimed to determine whether weighted blankets can meaningfully enhance nap quality by assessing both subjective and objective nap outcomes. Notable findings were observed using the EEG system, as participants fell asleep faster and experienced less awakenings during the 7kg weighted blanket condition. However, no significant differences were observed between the 2 conditions in the physical and subjective measures. These findings suggest that weighted blankets may contribute to improved sleep quality, which could, in turn, support daily functioning and overall health. Future studies involving different conditions and populations are needed to fully understand the potential benefits of weighted blankets on sleep quality and well-being.

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Appendix

1) Consent form

ΠΑΝΕΠΙΣΤΗΜΙΟ ΘΕΣΣΑΛΙΑΣ
ΤΜΗΜΑ ΕΠΙΣΤΗΜΗΣ ΦΥΣΙΚΗΣ ΑΓΩΓΗΣ ΚΑΙ ΑΘΛΗΤΙΣΜΟΥ

Υπεύθυνη δήλωση Συναίνεσης Δοκιμαζόμενου σε Ερευνητική Εργασία

Σκοπός της ερευνητικής εργασίας: Σκοπός της έρευνας είναι να εξετάσει το βαθμό επίδρασης που μπορεί έχει η χρήση κουβέρτας βαρύτητας στα επίπεδα χαλάρωσης και εγρήγορσης του εγκεφάλου υγειών ατόμων και την επίπτωση που έχει αυτό στα επίπεδα υποκειμενικής αίσθησης της ηρεμίας.

Διαδικασία μετρήσεων: Θα χρειαστεί να πραγματοποιηθεί μία συνάντηση, όπου θα σας ενημερώσουμε για την διαδικασία της έρευνας και στην συνέχεια θα συμπληρώσετε ένα ατομικό ιστορικό υγείας, ένα ερωτηματολόγιο σχετικά με την ποιότητα ζωής, του ύπνου, του άγχους και των διαπροσωπικών επιπέδων χαλάρωσης. Η συμπλήρωση ερωτηματολογίου και ιστορικού θα γίνει μία φορά στην αρχή. Εφόσον πληροίτε τις προϋποθέσεις, μπορείτε να συμμετέχετε στην έρευνα και να ξεκινήσουμε κατευθείαν την μελέτη. Συνολικά θα συμμετάσχετε σε 4 συνεδρίες: Στην 1η επίσκεψη θα σας πάρουμε ιστορικό και στην συνέχεια θα αξιολογηθεί η αρτηριακή πίεση με την χρήση ηλεκτρονικού πιεσόμετρου, θα πάρουμε δείγμα σάλιου για την αξιολόγηση των επιπέδων κορτιζόλης στο σώμα, ενώ καθόλη την διάρκεια της μελέτης μια σειρά από ηλεκτρόδια θα είναι τοποθετημένα στο μέτωπο για την μέτρηση της λειτουργικότητας του εγκεφάλου και ταυτόχρονα θα τοποθετηθεί στο στήθος ένα φορητό σύστημα μέτρησης ηλεκτρικού παλμού για την καταγραφή της μεταβλητότητας του καρδιακού ρυθμού. Θα ξαπλώσετε για 1 ώρα σε ένα κρεββάτι και θα σκεπαστείτε με μια απλή κουβέρτα 1 κιλού. Μετά το τέλος της δοκιμασίας θα μας δώσετε δείγμα σάλιου, θα μετρήσουμε την αρτηριακή σας πίεση, και θα συμπληρώσετε το ερωτηματολόγιο χαλάρωσης. Στην 2^{η}, 3^{η}, και 4^{η} επίσκεψη οι οποίες θα λάβουν χώρα ανά 3 ημέρες θα προβούμε στις ίδιες ακριβώς διαδικασίες με την διαφορά ότι θα ξαπλώσετε με κουβέρτα 7Kg, 9Kg ή 14Kg.

Πιθανοί κίνδυνοι: Δεν υπάρχει κίνδυνος τραυματισμού κατά τη διάρκεια των δοκιμασιών.

Προσδοκώμενες ωφέλειες: Από τα αποτελέσματα της παρούσας έρευνας θα προκύψουν τυχόν θετικές επιδράσεις της κουβέρτας βαρύτητας στο εγκεφαλικό σύστημα υγειών ατόμων και την επίπτωση που έχει αυτό στα επίπεδα υποκειμενικής αίσθησης της ηρεμίας.

Δημοσίευση δεδομένων-αποτελεσμάτων: Οι πληροφορίες που θα συλλέξουμε από τις απαντήσεις σας με το ατομικό ιστορικό υγείας είναι κωδικοποιημένες και θα μείνουν απόρρητες. Η συμμετοχή σας στην έρευνα συνεπάγεται ότι συμφωνείτε με τη δημοσίευση των δεδομένων και των αποτελεσμάτων της, με την προϋπόθεση ότι θα είναι ανώνυμα και θα χρησιμοποιηθούν μόνο για τις ανάγκες της παρούσας έρευνας.

Πληροφορίες: Σε όλη τη διάρκεια της έρευνας οι ερευνητές (Δρ. Γεώργιος Σακκάς και Ηλίας Ντούμας) θα είναι στη διάθεση των δοκιμαζομένων για να προσφέρουν οποιουδήποτε είδους πληροφορία είτε αυτή αφορά την έρευνα είτε τη συμπλήρωση των ερωτηματολογίων.

Ελευθερία συναίνεσης: Η συμμετοχή σας στη παρούσα έρευνα είναι εθελοντική και έχετε την δυνατότατα να αρνηθείτε την συμμετοχή σας, καθώς επίσης και να αποχωρήσετε από αυτή οποιαδήποτε στιγμή το επιθυμείτε.

Διάβασα το έντυπο αυτό και κατανοώ τις διαδικασίες που θα εκτελέσω. Συναινώ να συμμετέχω στην έρευνα.

Ημερομηνία: …../…..../……

Ονοματεπώνυμο και υπογραφή συμμετέχοντος

Υπογραφή ερευνητή

Ηλίας Ντούμας

Ονοματεπώνυμο και υπογραφή παρατηρητή

2) Ethical committee approval

ΠΑΝΕΠΙΣΤΗΜΙΟ ΘΕΣΣΑΛΙΑΣ
ΤΜΗΜΑ ΕΠΙΣΤΗΜΗΣ ΦΥΣΙΚΗΣ ΑΓΩΓΗΣ ΚΑΙ ΑΘΛΗΤΙΣΜΟΥ

Εσωτερική Επιτροπή Δεοντολογίας

Τρίκαλα: 7.2.2024
Αριθμ. Πρωτ.: 2329

Βεβαίωση έγκρισης της πρότασης για διεξαγωγή έρευνας με τίτλο: Επίδραση της χρήσης της κουβέρτας βαρύτητας 7 κιλών στα επίπεδα χαλάρωσης και εγρήγορσης

Επιστημονικώς υπεύθυνος-η / επιβλέπων-ουσα: Σακκάς Γεώργιος
Ιδιότητα: Αναπληρωτής Καθηγητής
Ίδρυμα: Πανεπιστήμιο Θεσσαλίας
Τμήμα: ΤΕΦΑΑ

Κύριος ερευνητής-τρια / φοιτητής-τρια: Αντωνίου Νικόλαος
Πρόγραμμα Σπουδών: Προπτυχιακό
Ίδρυμα: Πανεπιστήμιο Θεσσαλίας
Τμήμα: ΤΕΦΑΑ

Η προτεινόμενη έρευνα θα είναι: Διπλωματική εργασία

Τηλ. επικοινωνίας:
Email επικοινωνίας:
Αφαίρεση προσωπικών δεδομένων (Υπηρεσία Βιβλιοθήκης & Πληροφόρησης Πανεπιστημίου Θεσσαλίας)

Η Εσωτερική Επιτροπή Δεοντολογίας του Τ.Ε.Φ.Α.Α., Πανεπιστημίου Θεσσαλίας μετά την υπ. Αριθμ. 1-11/7.2.2024 συνεδρίαση της εγκρίνει τη διεξαγωγή της προτεινόμενης έρευνας.

Ο Πρόεδρος της
Εσωτερικής Επιτροπής Δεοντολογίας
– ΤΕΦΑΑ

Τσιόκανος Αθανάσιος
Καθηγητής

3) RSQ

Relaxation State Questionnaire (RSQ) – Ερωτηματολόγιο Αίσθηση Χαλάρωσης

Όνομα ___________________________________ Ημερομηνία ___________

Ηλικία ______ Φύλο (κυκλώστε): Α Θ Άλλο ____________________________

Παρακάτω υπάρχουν φράσεις που οι άνθρωποι συνηθίζουν να χρησιμοποιούν για να περιγράψουν την κατάσταση που αισθάνονται. Διαβάστε κάθε φράση και μετά σημειώστε το αντίστοιχο κουτί για την φράση που σας εκφράζει για να δείξετε πως αισθάνεστε **τώρα**, δηλαδή αυτή τη στιγμή. Δεν υπάρχουν σωστές ή λανθασμένες απαντήσεις. Μην ξοδεύετε πολύ ώρα για κάθε μία φράση αλλά δώστε την απάντηση που φαίνεται να ταιριάζει πιο καλά σε αυτό που αισθάνεστε **τώρα**.

Ερωτήσεις	**Διαφωνώ Απόλυτα**	**Διαφωνώ**	**Ούτε Συμφωνώ ούτε Διαφωνώ**	**Συμφωνώ**	**Συμφωνώ Απόλυτα**
1. Νιώθω ότι αναπνέω γρηγορότερα από ότι συνήθως (Α)					
2. Η καρδιά μου χτυπά πιο γρήγορα από ότι συνήθως (Α)					
3. Αισθάνομαι τους μύες μου σφικτούς και σε ένταση (σφιγμένες γροθιές ή τάση στην γνάθο ή συνοφρυωμένο μέτωπο) (Α)					
4. Αισθάνομαι τους μύες μου ανακουφισμένους					
5. Αισθάνομαι τους μύες μου χαλαρούς					
6. Αισθάνομαι πολύ χαλαρά					
7. Αυτή την στιγμή νιώθω εντελώς ήρεμος/η					
8. Νιώθω υπνηλία και κούραση.					
9. Είμαι έτοιμος/η να κοιμηθώ.					
10. Νιώθω αναζωογονημένος/η και ξύπνιος/α (Α)					

Ευχαριστούμε πολύ για τον χρόνο σας

Βαθμολόγηση Ερωτηματολογίου

Ερωτήσεις	Διαφωνώ Απόλυτα	Διαφωνώ	Ούτε Συμφωνώ ούτε Διαφωνώ	Συμφωνώ	Συμφωνώ Απόλυτα
1. Νιώθω ότι αναπνέω γρηγορότερα από ότι συνήθως (Α)	5	4	3	2	1
2. Η καρδιά μου χτυπά πιο γρήγορα από ότι συνήθως (Α)	5	4	3	2	1
3. Αισθάνομαι τους μύες μου σφικτούς και σε ένταση (σφιγμένη γροθιά ή τάση στην γνάθο ή συνοφρυωμένος) (Α)	5	4	3	2	1
4. Αισθάνομαι τους μύες μου ανακουφισμένους	1	2	3	4	5
5. Αισθάνομαι τους μύες μου χαλαρούς	1	2	3	4	5
6. Αισθάνομαι πολύ χαλαρά	1	2	3	4	5
7. Αυτή την στιγμή νιώθω εντελώς ήρεμος/η	1	2	3	4	5
8. Νιώθω υπνηλία και κούραση.	1	2	3	4	5
9. Είμαι έτοιμος/η να κοιμηθώ.	1	2	3	4	5
10. Νιώθω αναζωογονημένος/η και ξύπνιος/α (Α)	5	4	3	2	1

- Muscle Score (Items 3, 4, and 5)
- Cardiovascular Score (Items 1 & 2)
- Generell Relaxation Score (Items 6 & 7)
- Sleepiness Score (Items 8, 9, and 10)

Higher means are equal to more relaxed muscles and more relaxation. For the sleepiness score, higher scores mean more sleepiness.