

Date of Notification: 30.05.2025

Notification No.: F.NO. COE/Ph.D./(Notification)/579/2025

Candidate's Name: Tarushi Tanwar

Supervisor's Name: Dr. Zubia Veqar

Name of Department: Centre for Physiotherapy and Rehabilitation Sciences

Thesis Title: Studies on Understanding the Relationship Between Poor Balance and Sleep in Sedentary Young Adult Population

Keywords: balance, polysomnography, postural control, sleep, young adults.

ABSTRACT

Scientific studies have largely concentrated on examining the frequency and consequences of impaired sleep, as well as its correlation with physical and mental health-related variables, in both young and elderly populations, predominantly among Caucasians. Empirical investigations have shown the impact of several individual interventions, including sleep hygiene, cognitive behavioral therapy, mindfulness meditation, stress reduction techniques, and physical activity, on sleep patterns. However, the majority of these studies have focused on middle-aged adults who have been experiencing sleep-related problems and other diseases. A dearth of research exists in the literature on the effects of non-pharmacological, exercise-based interventions on objective electrophysiological sleep parameters, polysomnography, PC, balance, and cortisol levels in young adults (YA). Given the significance of sleep in YAs and the challenges they encounter, it is crucial to investigate alternative therapies in order to get the best possible physical and mental well-being.

Study 1 aimed at comprehensively investigating the prevalence of sleep disturbances and their predictors among YAs, examining their association with stress, anxiety, depression, fatigue, physical activity, posture, and postural control (PC). This includes quantitatively analyzing posture alignment and key PC variables (such as center of pressure, limits of stability, and modified clinical test of sensory integration of balance) across different conditions, as well as exploring gender-based differences in sleep-related variables, psychological factors, and physical health metrics. The objectives of study 2 involved investigating the effects of two exercise-based interventions—progressive muscle relaxation and sensorimotor training—on polysomnography parameters, PC variables (including center of pressure, limits of stability,

and modified clinical test of sensory integration of balance), dynamic balance, and salivary cortisol levels (morning and night) in sedentary male YAs with poor sleep and balance.

All participants in the YA age group who fulfilled the eligibility criteria and were willing to participate in the study were included. Questionnaires were used to assess sleep quality, sleep-related parameters (sleep health, sleep-related beliefs and attitudes, sleep hygiene, daytime sleepiness), stress, fatigue, anxiety, depression, and physical activity. HUMAC, a premium computerized balance system, was utilized to evaluate PC, and for postural assessment, Digimizer software was used. Polysomnography, the current gold standard for objective sleep assessment was used. Dynamic balance assessment was done using the FMS YBT KitTM. The diurnal cortisol level analysis was done using the Human Cortisol ELISA Kit (BT lab). For study 2, participants were randomized into either one of the three (two intervention and one control) study groups - Group A (G_A), Group B (G_B), or Group C (G_C). G_A received progressive muscle relaxation (PMR) along with Sleep Hygiene Education (SHE), G_B received sensorimotor training (SMT) with SHE, and G_C was the control group that received SHE only.

Our study offered valuable insights into factors influencing SQ, establishing a relationship with psychological, postural, and PC variables in YAs. Our findings reported widespread sleep disturbances among YAs. The fact that our participants, on average, considered their SQ as good, despite the PSQI scores suggesting otherwise, indicates possible normalization of poor sleep in this age group. We identified sleep-related beliefs and attitudes, as well as perceived stress and anxiety, as significant predictors of SQ. PC variables in YAs, including the CoP and limit of stability indices, yielded valuable insights that add to the understanding of balance control within this population. Ankle angle emerged as a significant predictor for SQ, indicating the potential of body biomechanics regulation for improving sleep health in YAs. Additionally, gender-specific differences were prevalent in the study, with females reporting a greater degree of fatigue and males exhibiting a larger forward shoulder angle, among other findings. These results underscore the importance of considering gender during assessment and intervention designs to manage sleep, fatigue, and postural imbalances.

To the best of our knowledge, no research so far has studied the effects of interventions such as PMR and SMT on objective sleep measures, diurnal cortisol levels, balance, and PC variables among YAs with poor sleep and balance. The present research made substantial strides in investigating and understanding the effects of two exercise-based interventions, PMR and SMT, on PSG parameters and salivary cortisol levels in YAs with sleep and balance discrepancies. Additionally, the observed outcomes highlight the potential of these two

interventions to influence dynamic balance as well as static and dynamic PC. PMR demonstrated several significant influences on PSG parameters, notably on WK%, N3% (slow wave) sleep, N1% (light) sleep, and SE%, with a potential benefit observed in REM% sleep, thus elaborating the potential effectiveness of PMR in improving sleep in YAs. This expands on current sleep research and sheds light on the complex and multi-faceted nature of sleep, reinforcing the need for individual-oriented and targeted interventions. In parallel with PMR, SMT also offered promising roles in modulating sleep variables, with SE%, SOL, WK%, N3%, and to some extent, N1% and REM% sleep showing favorable changes. This indicates that six weeks of SMT might help improve sleep in YAs with poor balance and sleep, although further research is imperative to emphasize the specific impacts of SMT in this context. Regarding salivary cortisol levels, PMR and SMT exhibited similar impacts in terms of their effect. Though not comprehensive, both techniques caused a decrease in salivary cortisol levels, with PMR demonstrating a statistically significant decrease in night cortisol concentration. The statistical results reflected appreciable improvements in both dynamic balance as well as static and dynamic PC in both the PMR and SMT groups. Given these outcome measures, both interventions could potentially play an essential role in rehabilitative and preventive strategies related to balance and PC. In conclusion, this study fills a gap in the existing literature by exploring the complex interplay between sleep, cortisol, and balance and PC outcomes with PMR and SMT, new and less explored intervention techniques in YAs.