

Sleep patterns among women across age, BMI, and physical activity using smartwatches

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INTRODUCTION

→ **Sleep disturbances**, including increased wake after sleep onset (WASO), frequent awakenings, and lower sleep efficiency, are common among women, particularly in midlife.^{1,2} **Sleep disturbances are influenced by body mass index (BMI), physical activity, and age**,^{3,4} and often intensify during the menopausal transition due to hormonal and behavioural changes.^{1,2}

Sleep efficiency declines from age 40, with WASO and total awake time rising notably between age 45 and 54 years.⁴ Women with higher BMI and lower activity have more fragmented, shorter sleep than healthier, active peers.³ While healthy BMI and regular activity support better sleep, they do not fully prevent midlife sleep disturbances.⁴

Widespread smartwatch use enables large-scale, real-world assessment of sleep and activity.^{5,6} **This study used Samsung Galaxy Watch data to explore associations between sleep, BMI, physical activity, and age in a diverse sample of women aged 20–65 years.**

METHODS

→ This cross-sectional analysis included **192,500 women aged 20–65 years (38,500 in each country)** from the United States, South Korea, Germany, United Kingdom, and France, each with at least one night of valid Samsung Galaxy Watch sleep data collected between 1st and 28th March 2024. On average, participants contributed 20 nights of sleep data. Women with underweight BMI were excluded. Women were stratified by BMI (**healthy weight: 18.5–24.9 kg/m²; overweight: 25.0–29.9 kg/m²; obese: ≥30 kg/m²**), physical activity (**average daily steps: sedentary <5,000; low active 5,000–7,499; somewhat active 7,500–9,999; active 10,000–12,499; highly active ≥12,500**), and age (5-year intervals). Sleep parameters included **total sleep time (TST)**, defined as the total number of minutes spent in any sleep stage; **total sleep period duration (TSPD)**, defined as the number of minutes between sleep onset and final wake-up; **sleep efficiency (TST/TSPD*100)**; and **WASO**, defined as the number of minutes spent awake after falling asleep and before final wake-up. To improve data quality, outliers in wake stage duration between two sleep episodes above the median + 1.5×IQR (160 min) were excluded. Descriptive statistics were used to examine trends across groups.

RESULTS

- The average BMI was **27.6 kg/m²**, with **29%** of participants classified as having obesity (BMI ≥30).
- Women averaged **6,817 steps/day**, with **67%** classified as sedentary or low active; just **4.9%** met the highly active threshold (>12,500 steps/day).
- On average, women experienced **48.3 minutes of WASO (median 39 minutes)**, a **TST of 391.2 minutes**, a mean **TSPD of 439.4 minutes**, and **sleep efficiency of 89.3%**.
- Age-related differences in sleep patterns became more pronounced in the transition from the 40;45 age group, with the steepest differences observed between the 45;50 and 50;55 groups.
- Descriptive trends suggest that women with lower BMI and higher physical activity levels tended to have higher sleep efficiency (**Figures 1 and 2**) and lower WASO (**Figures 5 and 6**), even though their sleep duration appeared slightly shorter (**Figures 3 and 4**). Error bars represent standard error of the mean (SEM).

Figure 1. Sleep efficiency by age and BMI

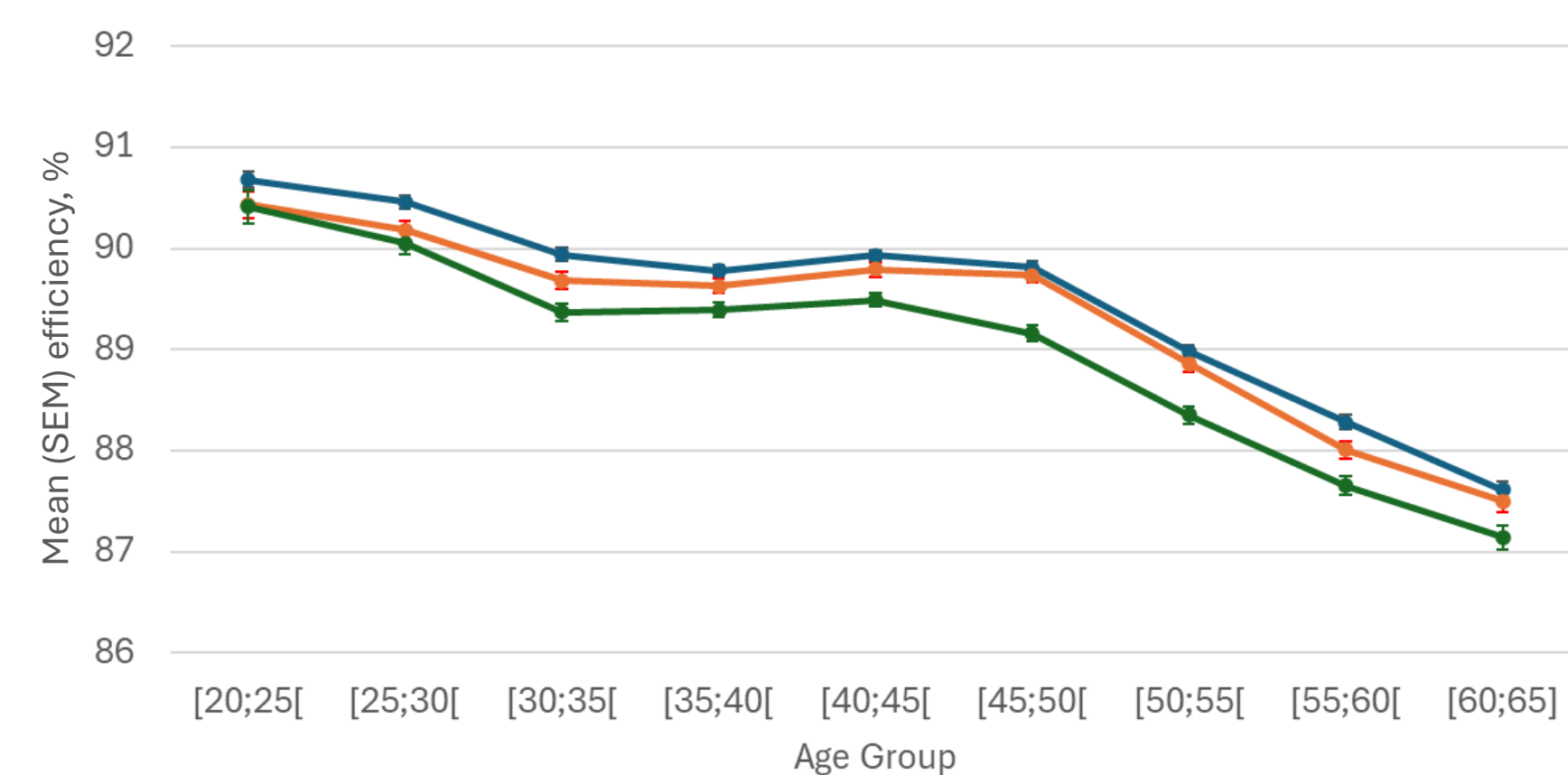


Figure 2. Sleep efficiency by age and daily activity level (steps/day)

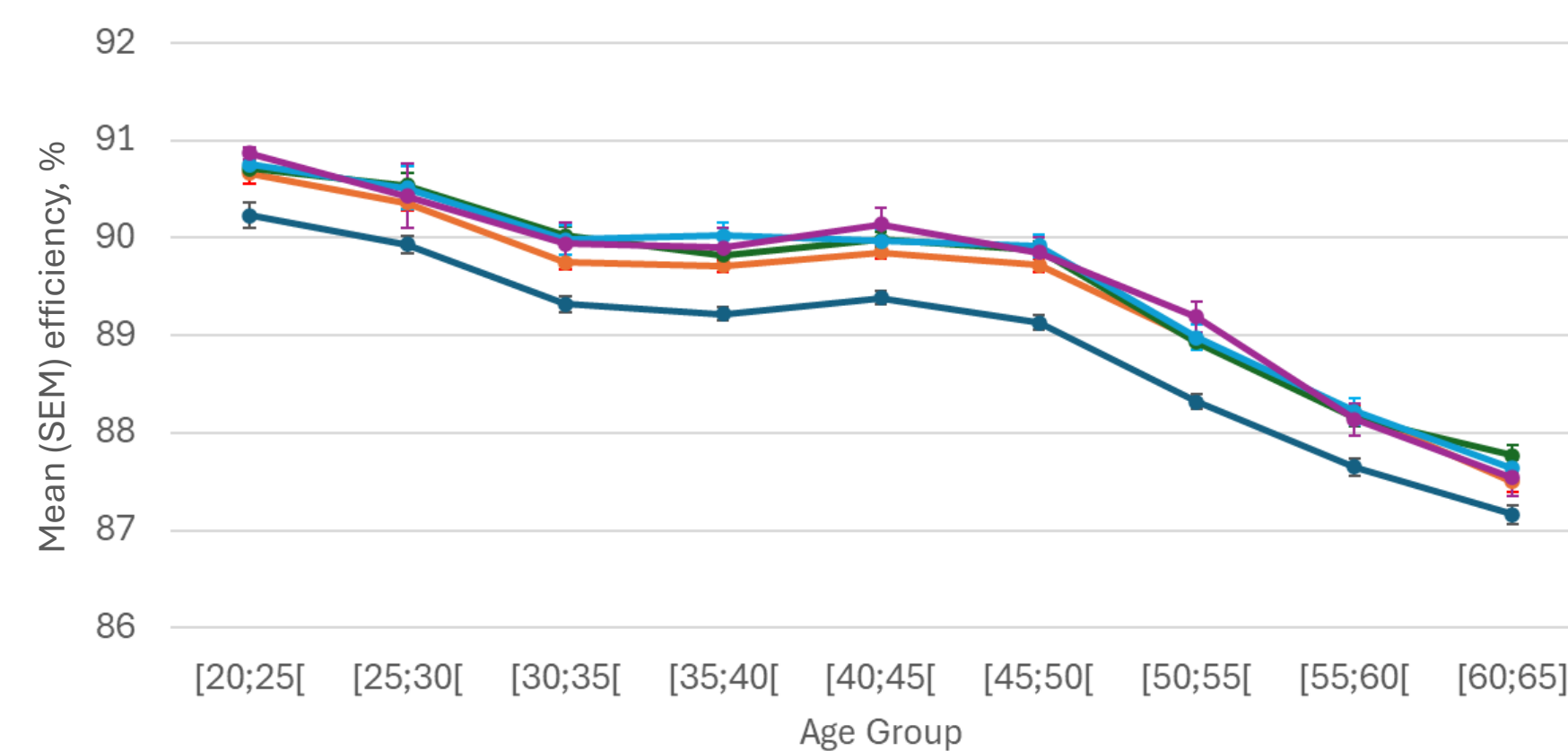


Figure 3. Sleep duration by age and BMI

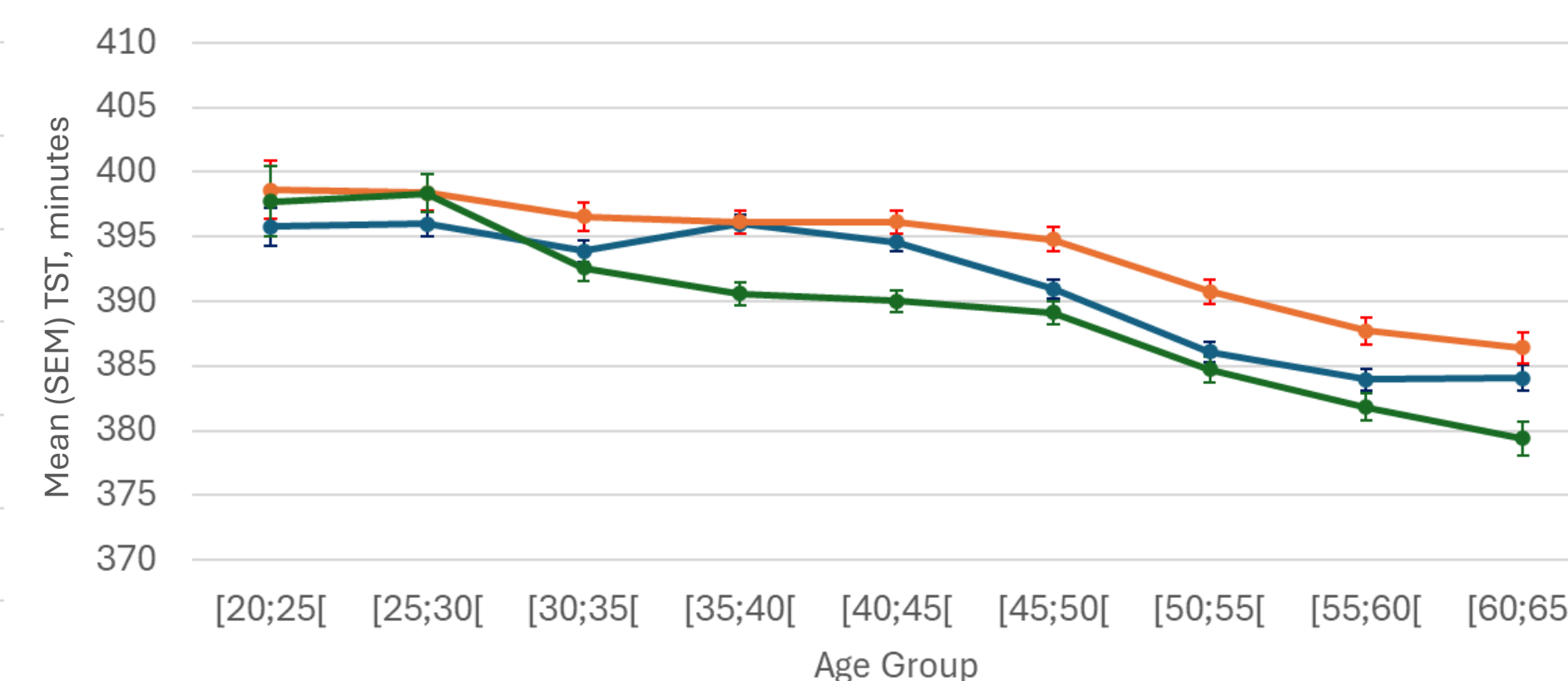


Figure 4. Sleep duration by age and daily activity level (steps/day)

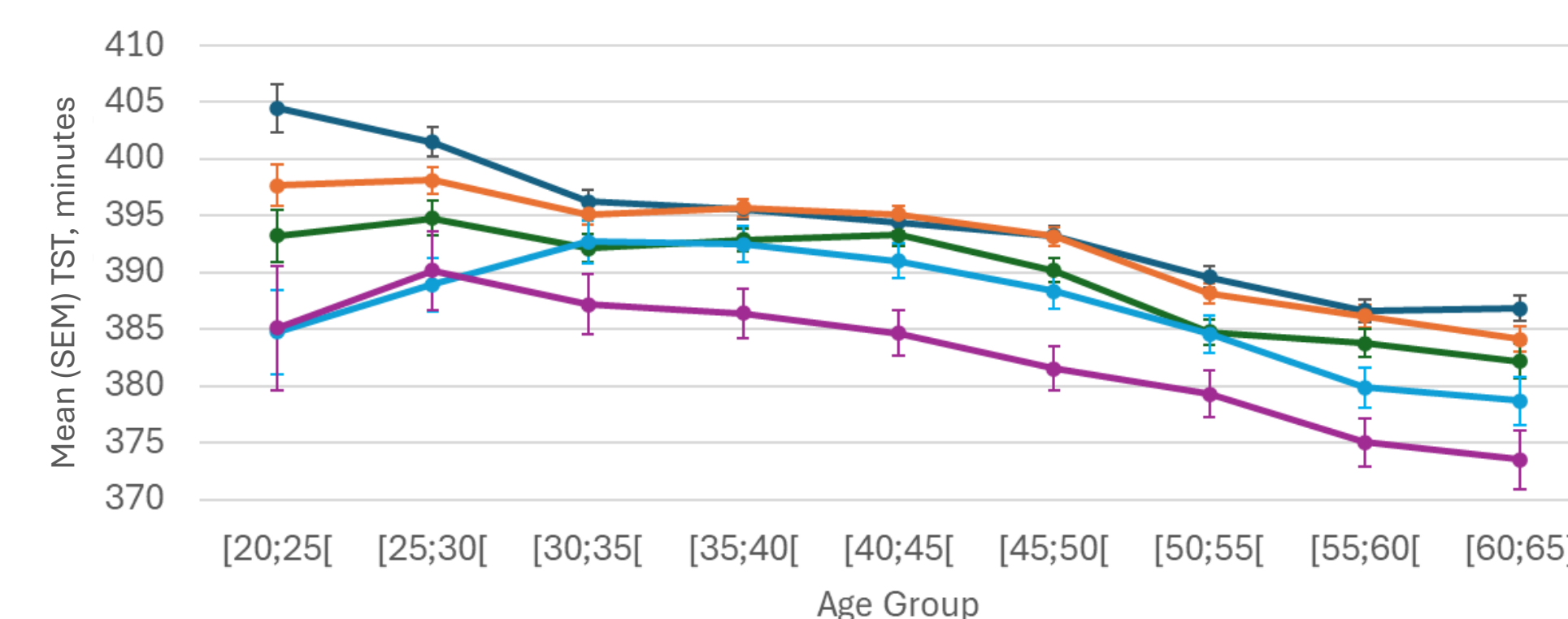


Figure 5. WASO by age and BMI

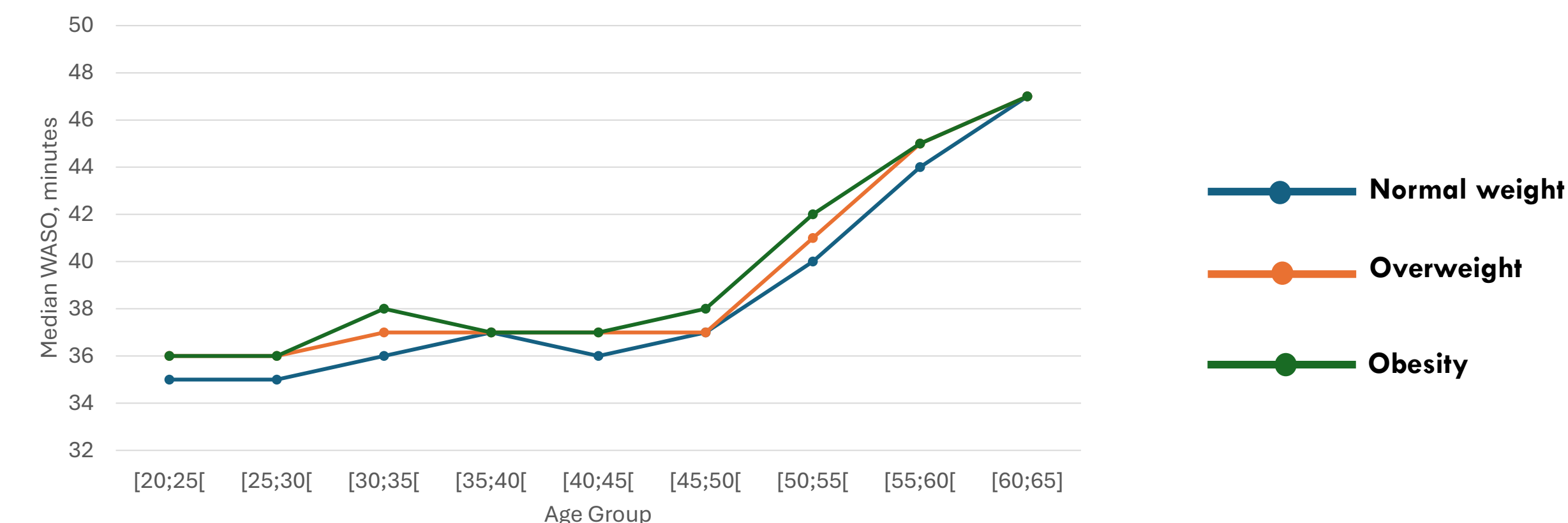
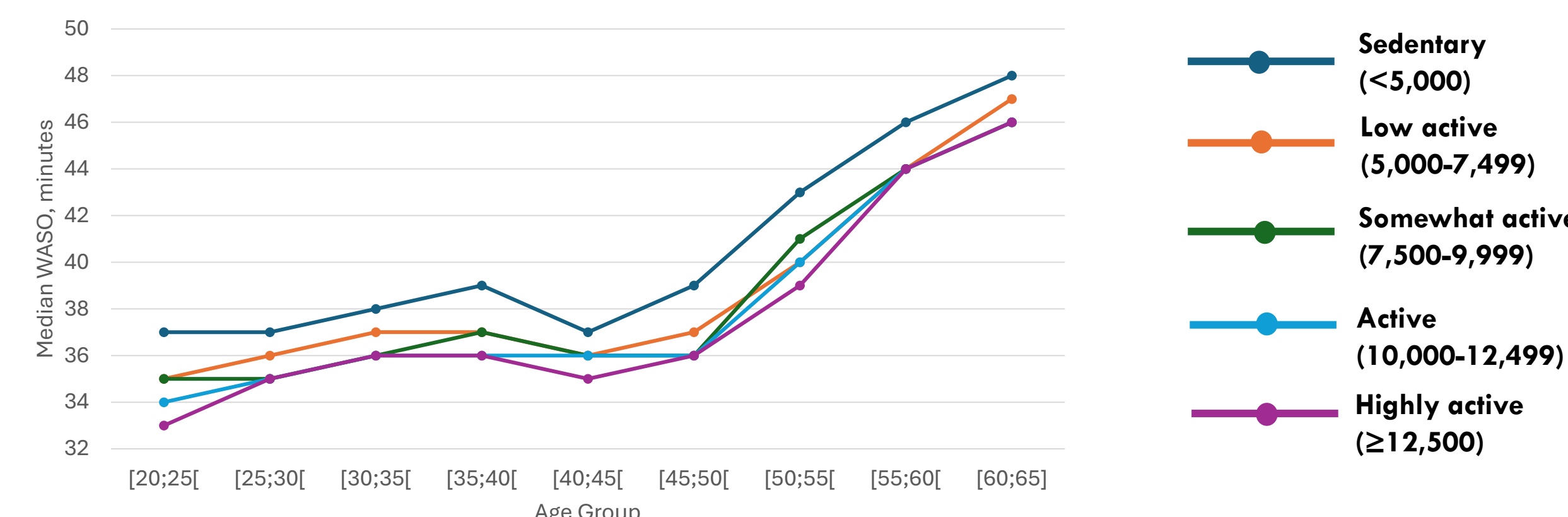


Figure 6. WASO by age and daily activity level (steps/day)



CONCLUSIONS

Sleep efficiency was lower, and WASO higher, in older ages across all BMI and activity groups, suggesting age-related changes as a key contributor to sleep disturbances



Age-related differences in sleep were most evident between age 45 and 55 years, **consistent with the menopausal transition** and reinforcing the need for **early identification and intervention**



Smartwatch-based data offer **a scalable way to monitor sleep and activity patterns**, enabling personalised approaches to address sleep challenges across the lifespan



These data might further help increase the understanding of the role of **exercise intensity and weight changes** in influencing midlife sleep disturbances

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