



Hot Nights, Sleepy Days: *Temperature & Daytime Sleepiness* in Johannesburg Adults (2017–2018)

Authors:

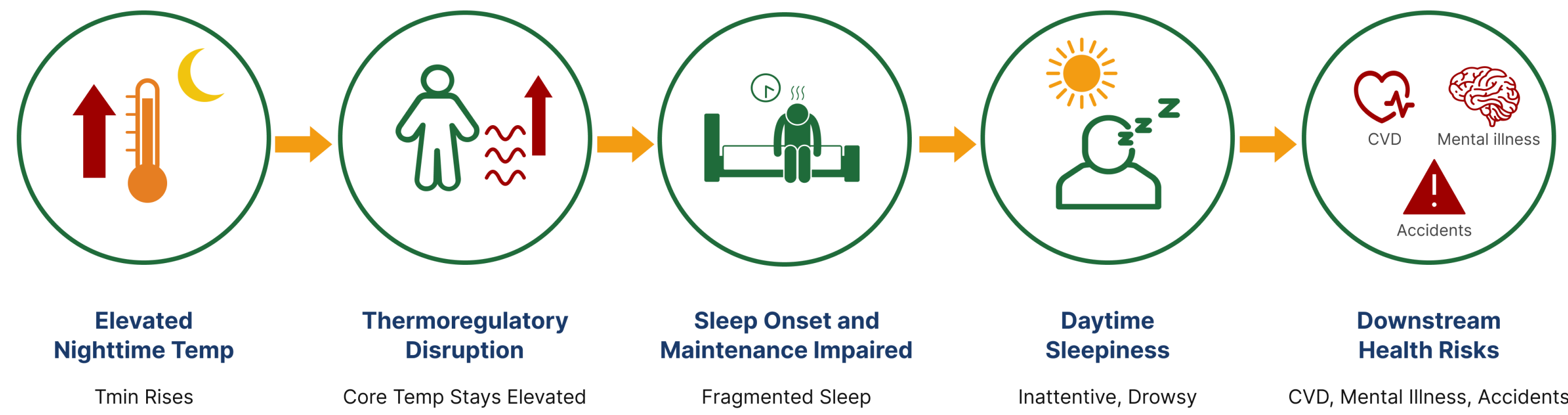
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Background & Aim

Heat - Sleep - Daytime Sleepiness Pathway

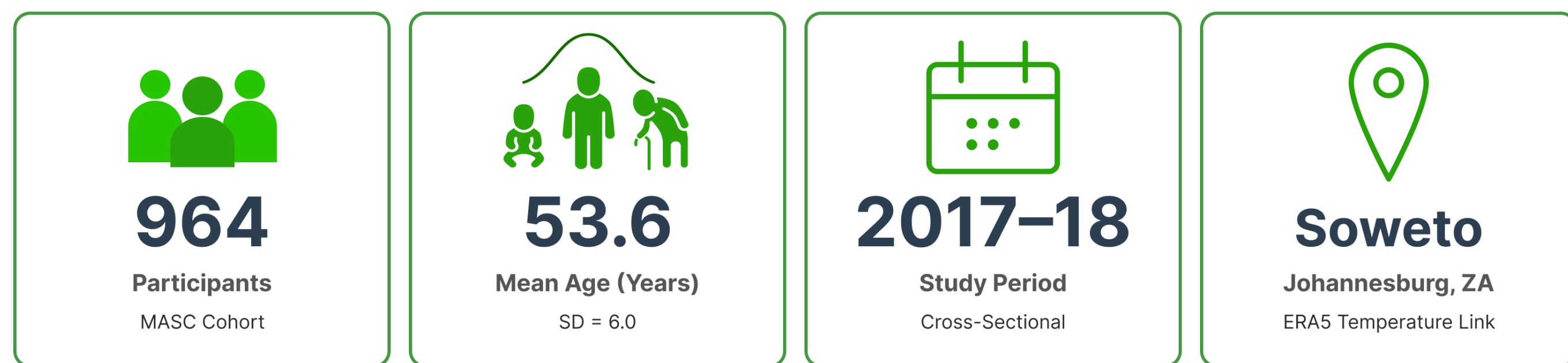


A recognised plausible pathway linking climate change to human health (Chevance 2024; Minor 2022)

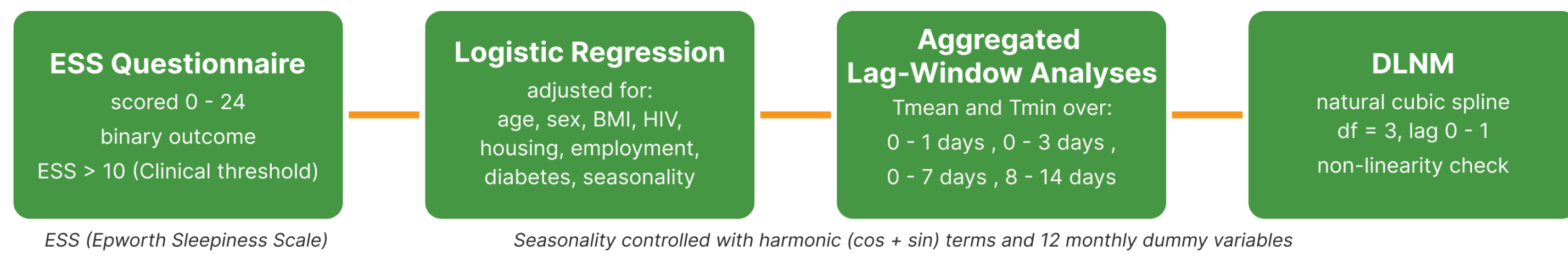
Aim: To investigate the association between mean ambient temperature, minimum temperature and excessive daytime sleepiness in middle-aged Johannesburg adults.

Methods

Study Design & Population



Statistical Analysis Pipeline



Cross-sectional secondary data analysis. ESS completed on the day of research center visit. **↑ in ESS score indicates ↑ in daytime sleepiness³.** ERA5 mean ambient temperature (Tmean) and minimum temperature (Tmin [nighttime temp proxy]) linked to visit date and center geolocation. WBGT used for sensitivity analysis. Sex was investigated as an effect modifier.

Preliminary Results

Of n=964 participants, 154 (16%) had excessive daytime sleepiness (ESS>10). **Each 1 °C rise in Tmin (lag 0-1, M2 harmonic season-adjusted) is associated with a 9% increase in odds of excessive daytime sleepiness (ESS>10) (aOR 1.09, 95% CI 1.01-1.18, p=0.045).** The same exposure expressed as Tmean showed no effect (aOR 1.03, 95% CI 0.95-1.11, p=0.533) when M2 adjusted. Lag 0–1 Tmin: median 9.8°C (IQR: 5.3–13.2°C; range: –0.9–17.4°C). WBGT showed no effect.

Excessive daytime sleepiness per +1 °C

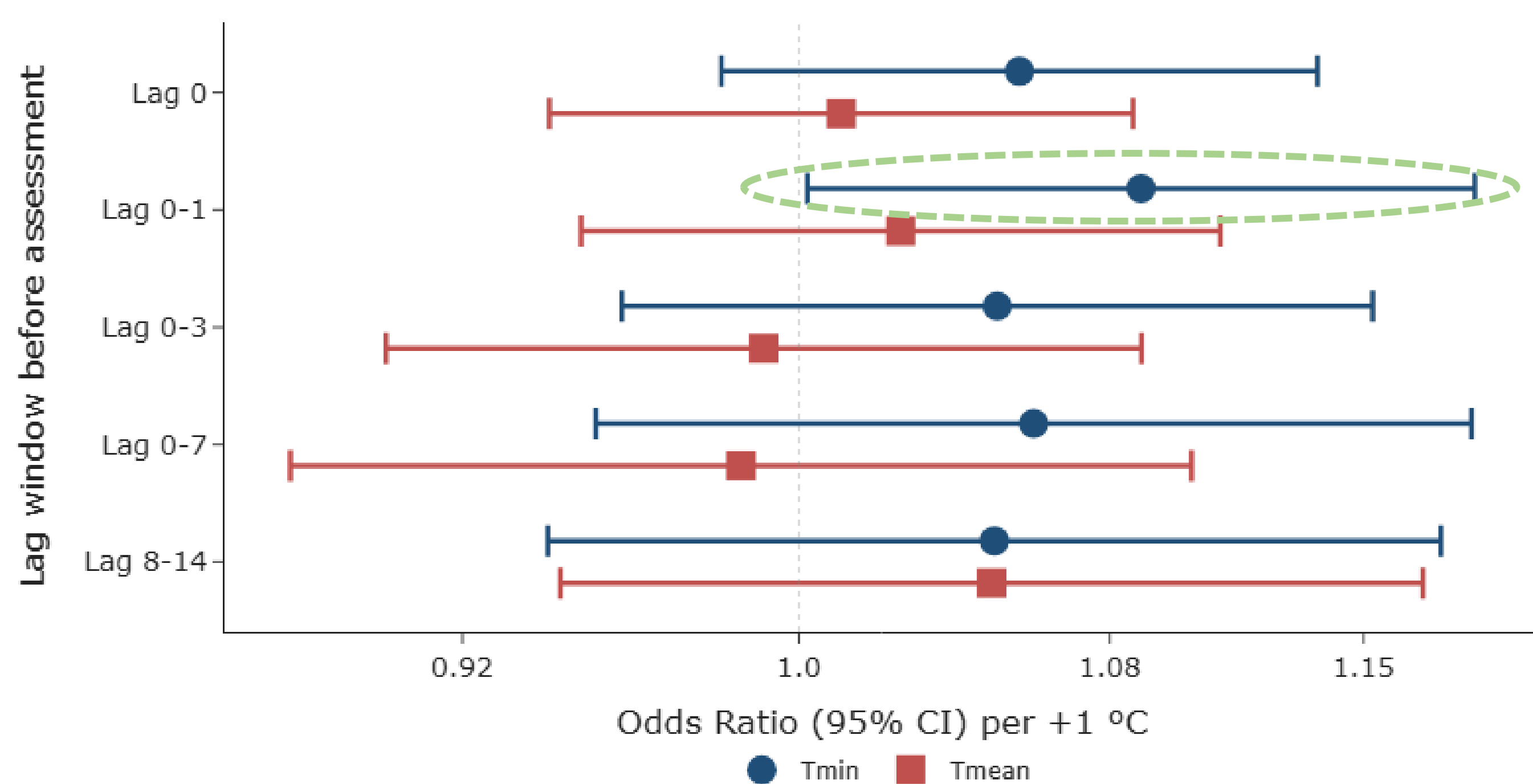


Figure 1. The odds of excessive daytime sleepiness (per 1 °C rise) modelled over five separate lag windows, with minimum temperature and daily mean ambient temperature. n=964 participants, 154 cases ESS>10

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Conflict of Interests: Authors at WITS hold indirect fossil-fuel investments via institutional pension funds

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Preliminary Results

Stratification by sex: Results seem to be driven by males in the sample: per 1 °C rise in Tmin males have a 14% higher risk of excessive daytime sleepiness (aOR 1.14, 95% CI 1.00-1.30, p=0.049) compared to females. This interaction was significant for men at Tmin at lag 0 (p=0.041) and lag 0-1 (p=0.062), but not for Tmean at any lag.

Sex-specific effect of Tmin on ESS

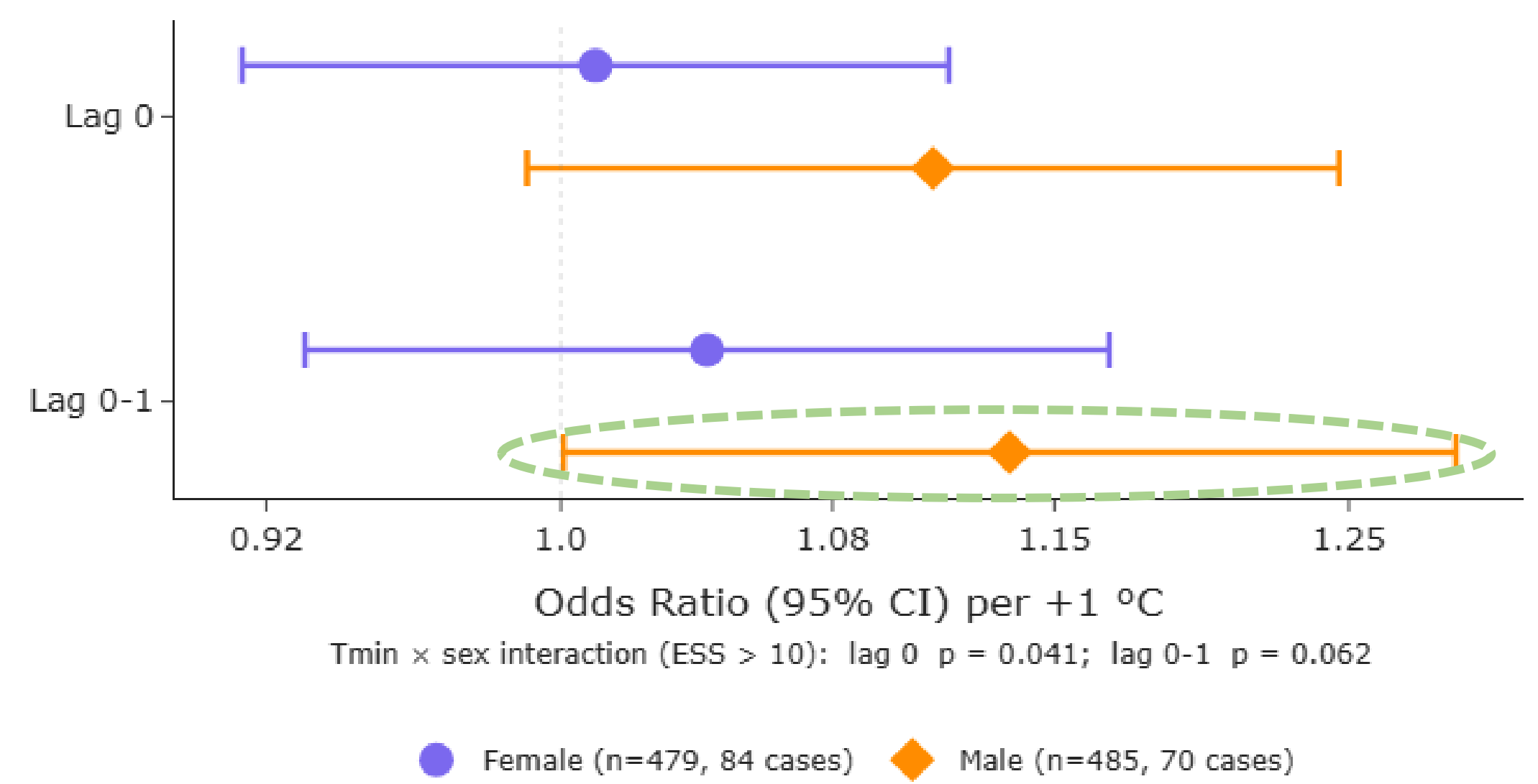


Figure 2. Odds of excessive daytime sleepiness (per 1 °C rise), stratified by sex, at lag 0 and lag 0-1

Lag 0-1 effect on ESS across seasonal-adjustments

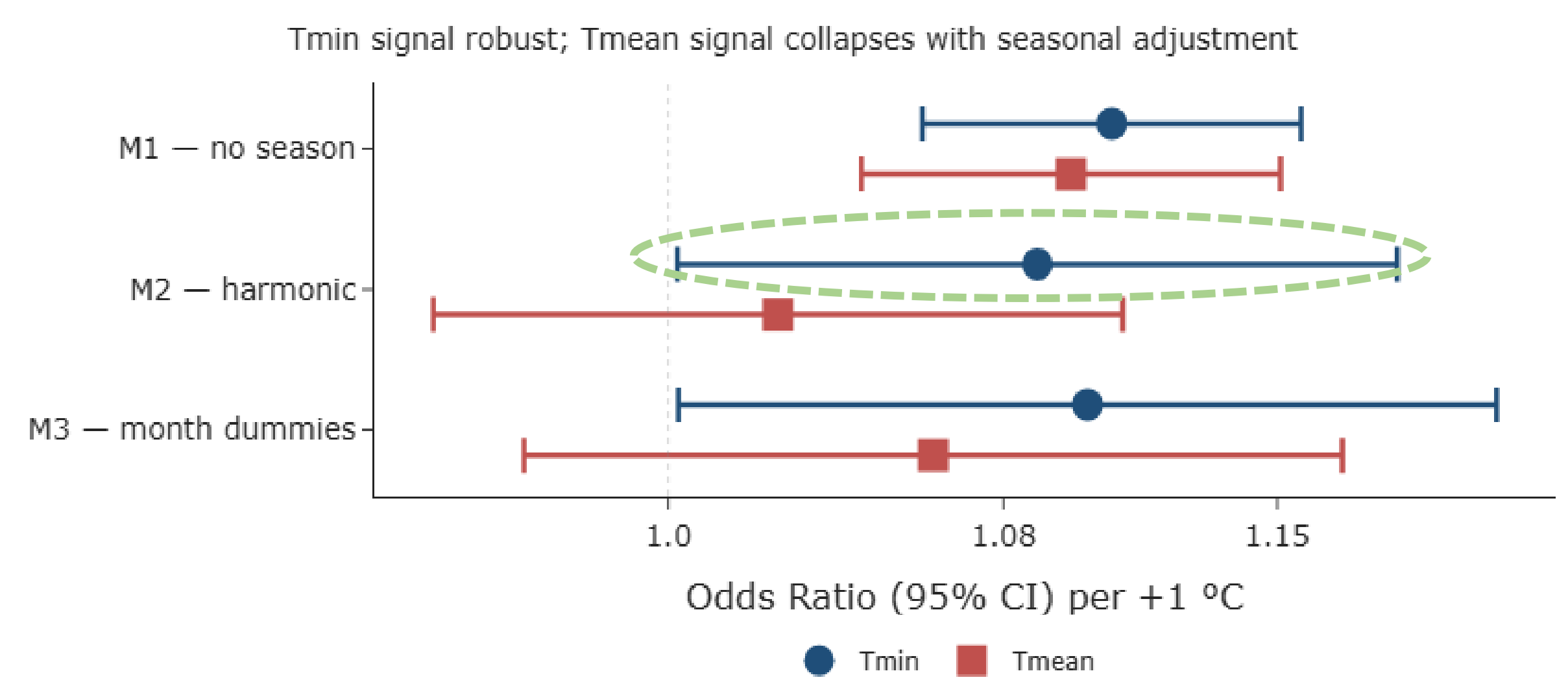


Figure 3. Odds of excessive daytime sleepiness at lag 0-1, adjusted by seasonality. M1 shows the effect with no seasonal adjustment. M2 is with harmonic seasonal adjustment. M3 is with 12-month dummy variables seasonal adjustment.

Odds of ESS>10 against Tmin at lag 0-1

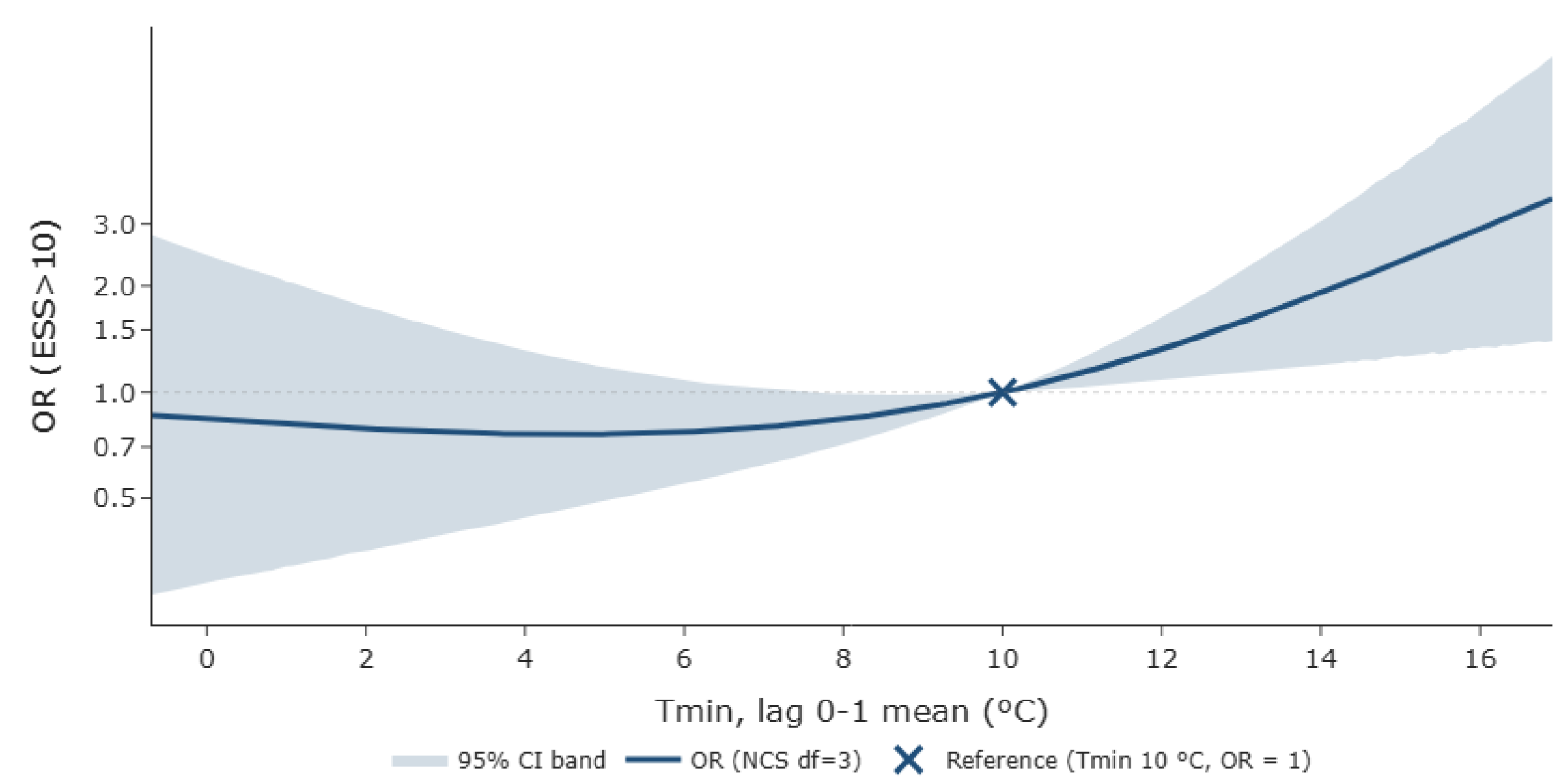


Figure 4. DLNM of ESS > 10 against mean Tmin at lag 0-1, n = 964 (logistic, M2-adjusted; natural cubic spline on exposure.) Likelihood-ratio test vs linear: $\chi^2 = 9.47$, $df = 2$, non-linearity $p = 0.009$.

The DLNM curve departed from linearity; uncertainty was wide at the distribution extremes due to small sample size.

Conclusion

Higher lag0-1 nighttime temperature was significantly associated with daytime sleepiness in middle-aged Johannesburg adults, with stronger effects in men. Mean ambient temperature showed no association, suggesting sleepiness may be linked specifically to impaired overnight thermoregulation rather than general heat exposure.

Limitations & next steps: Cross-sectional design limits causal inference. ESS captures self-reported subjective sleepiness (recall bias). Small sample size reduces statistical power. Future work should use longitudinal designs, objective sleep measures, and assess diurnal temperature range.

Downstream Health Risks of Heat-Induced Sleep Disruption



Sleep health should be considered in all heat-health adaptation strategies (Chevance 2024; Minor 2022)

