

Insomnia symptoms, sleep quality and reported living conditions at Kindu Central Prison: first prison-based evidence from the Democratic Republic of the Congo

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Abstract

Background

Sleep disturbance is common in custodial settings, but prison-based evidence from the Democratic Republic of the Congo is absent. We estimated the prevalence of clinically significant insomnia symptoms and poor sleep quality at Kindu Central Prison and examined their associations with the cumulative burden of reported living conditions. A cross-sectional study was conducted from 6 April to 30 September 2023 among 404 incarcerated adults recruited by non-probability sampling. Insomnia symptoms were assessed with the Insomnia Severity Index (ISI), sleep quality with the Pittsburgh Sleep Quality Index (PSQI), and prevalence ratios with modified Poisson regression using robust variance.

Results

Clinically significant insomnia symptoms ($ISI \geq 15$) were present in 194 of 404 participants (48.0%; 95% confidence interval [CI], 43.2%–52.9%), and 294 of 401 participants (73.3%; 95% CI, 68.8%–77.4%) had poor sleep quality ($PSQI > 5$). Each additional reported adverse condition was associated with a higher prevalence of clinically significant insomnia symptoms (adjusted prevalence ratio [aPR], 1.18; 95% CI, 1.10–1.27) and poor sleep quality (aPR, 1.06; 95% CI, 1.02–1.10). Compared with participants reporting 0–2 conditions, those reporting at least five had higher prevalence of both outcomes ($ISI \geq 15$: aPR, 2.27; 95% CI, 1.59–3.22; $PSQI > 5$: aPR, 1.39; 95% CI, 1.16–1.67). Higher perceived social support was associated with lower prevalence of both outcomes in extended models.

Conclusions

Sleep problems were frequent among participants at Kindu Central Prison and were associated with the cumulative burden of reported living conditions. The cross-sectional design precludes causal inference, but the findings support assessing sleep alongside locally feasible improvements in material conditions and prospective evaluation of prison-based sleep interventions.

Background

Sleep disturbance is common in prison populations, yet it remains an underexamined component of prison health. A recent systematic review found wide prevalence ranges for both insomnia (26.2%–72.5%) and poor sleep quality (42.8%–88.2%) across correctional settings (Sheppard and Hogan, 2022). This variation partly reflects differences in study populations and measurement instruments, but it may also indicate that sleep health is shaped by the conditions in which people are detained. Insomnia and poor sleep quality are related but distinct constructs: the former concerns the severity and consequences of insomnia symptoms, whereas the latter encompasses a broader assessment of sleep duration, efficiency, disturbances, and daytime functioning (Bastien et al., 2001; Buysse et al., 1989).

Prison-based studies describe several environmental and institutional factors that may compromise sleep (Sheppard and Hogan, 2022). Restricted movement, limited daytime activity, noise, inadequate lighting, insufficient bedding, poor access to water, food insecurity, interpersonal tension, and loss of autonomy may coexist within the same institution. International standards specify that sleeping accommodation, lighting, sanitation, clothing, and bedding should meet basic health requirements (United Nations General Assembly, 2015). Nevertheless, empirical studies have often examined selected demographic, clinical, or behavioural factors rather than the combined burden of adverse detention conditions. Examining these conditions separately may underestimate the way multiple material and relational disadvantages accumulate within a shared living environment.

Evidence from African prisons remains limited and is concentrated mainly in Nigeria and Ethiopia. In a Nigerian maximum-security prison, 45.7% of participants had insomnia (Fakorede et al., 2021). A separate Nigerian study reported that inappropriate sleeping materials and night-time noise were common, while 47.3% of participants had poor sleep quality (Fakorede et al., 2023). Studies conducted in Ethiopian correctional facilities found poor sleep quality in 53.9%, 77.1% and 60.2% of participants, with associations reported for previous incarceration, education, psychological symptoms, physical activity and substance use (Abdu and Hajure, 2020; Getachew et al., 2020; Naser et al., 2025).

To our knowledge, this is the first prison-based study of sleep health conducted in the Democratic Republic of the Congo. We examined sleep among incarcerated people at Kindu Central Prison. The primary objective was to assess the association between the cumulative number of adverse detention conditions and clinically significant insomnia symptoms. The secondary objective was to examine whether the same cumulative exposure was associated with poor overall sleep quality, while accounting for individual characteristics, detention-related factors and psychoactive substance use. We hypothesised that a greater cumulative burden of adverse detention conditions would be associated with a higher prevalence of both outcomes.

Methods

Study design and setting

We conducted a cross-sectional study at Kindu Central Prison, Maniema Province, Democratic Republic of the Congo, from 6 April to 30 September 2023. Two senior academic assistants in neuropsychiatry collected the data under academic supervision.

Study population and recruitment

The prison population changed through admissions, releases and transfers, and no complete, stable sampling frame was available. We therefore used non-probability sampling. People incarcerated at Kindu Central Prison were eligible when present and accessible during a recruitment visit and willing to participate; recruitment was not restricted by detention status. The proportion of the prison population

enrolled could not be calculated because the number eligible and present varied over the six-month period. The initial sample comprised 408 participants.

Data collection and measures

Individual interviews used a structured paper questionnaire and were conducted under conditions intended to protect privacy. Responses were later entered into KoboToolbox.

The primary outcome, clinically significant insomnia symptoms, was defined as an Insomnia Severity Index (ISI) score ≥ 15 (Bastien et al., 2001; Morin et al., 2011). The seven items yield a score of 0–28; conventional bands are 0–7, 8–14, 15–21 and 22–28. The threshold was not interpreted as a diagnosis of insomnia disorder. Poor sleep quality, the secondary outcome, was defined as a Pittsburgh Sleep Quality Index (PSQI) global score > 5 (Buysse et al., 1989). Its seven components cover subjective quality, latency, duration, habitual efficiency, disturbances, sleep medication and daytime dysfunction, yielding a score of 0–21. This threshold was not considered a diagnosis of a specific sleep disorder. Binary outcomes were used in the main analyses; continuous scores were used in sensitivity analyses.

The principal exposure was an unweighted sum of seven reported conditions: conflict with another incarcerated person; no outdoor access; no water for washing; one meal daily or irregular food access; no lighting; no mattress; and no blanket. Each was coded 0/1, producing a score from 0 to 7. The score was analysed continuously and grouped as 0–2, 3–4 and ≥ 5 for interpretation; these groups are not clinical thresholds. A secondary model entered all seven conditions simultaneously.

Cannabis, tobacco and alcohol use were recorded as separate binary variables. Among users, the Cannabis Abuse Screening Test, Fagerström Test for Nicotine Dependence and Fast Alcohol Consumption Evaluation were scored using their published rules (Dewost et al., 2006; Heatherton et al., 1991; Legleye et al., 2007). Their risk categories were descriptive because few participants occupied the higher categories. Perceived social support was measured with the 12-item Multidimensional Scale of Perceived Social Support (MSPSS); the mean item score (range 1–7) was analysed continuously, without imposing a locally unvalidated cut-off (Denis et al., 2015; Zimet et al., 1988).

Data preparation

We checked the 408 observations for completeness and consistency. Four records, each belonging to one of four pairs with exceptionally high similarity across independent variable groups, were excluded using the same prespecified rule for each pair: retain the first-entered record. The analytical sample was 404. ISI, PSQI, CAST, Fagerström, FACE and MSPSS scores were recalculated from item responses. ISI was available for all participants; PSQI was calculable for 401. Three bedtime responses recorded as ranges precluded calculation of habitual sleep efficiency. These participants remained in analyses not requiring global PSQI. When reported sleep duration exceeded time in bed, efficiency was capped at 100% for PSQI component scoring; source responses were retained.

Statistical analysis

Categorical variables are reported as n (%), with denominators when they differ from 404. Continuous variables are reported as mean (standard deviation) or median (interquartile range), according to distribution. Outcome prevalence was estimated with Wilson 95% confidence intervals. Spearman correlation quantified the relation between continuous ISI and PSQI scores. Pearson chi-square or Fisher exact tests were used for categorical comparisons.

Crude and adjusted prevalence ratios (PRs) were estimated using Poisson regression with robust variance because both outcomes were common (Barros and Hirakata, 2003; Zou, 2004). Covariates were added in blocks: age, sex, pre-incarceration place of origin and education; detention status and duration; cumulative condition score; and cannabis, tobacco and alcohol use. This fourth model was the main adjusted model. An extended model added mean MSPSS. Age was modelled per 10 years; education as primary or less, secondary (reference), or higher; detention status as pretrial or sentenced; and duration as one year or at least two years. ISI models included 404 participants and PSQI models 401.

The cumulative score was modelled per additional condition and in categories, with 0–2 as reference. A quadratic term assessed departure from linearity. A secondary mutually adjusted model replaced the score with its seven components. Sensitivity analyses used robust linear regression for continuous ISI and PSQI scores. Interactions of the cumulative score with tobacco and cannabis use were exploratory. Collinearity was assessed using variance inflation factors. We report adjusted PRs or regression coefficients with 95% confidence intervals and two-sided p-values. Analyses used Python 3.12.

Use of generative artificial intelligence

ChatGPT (OpenAI) was used to support English-language editing and improve the clarity of the manuscript. The authors reviewed the final text and take full responsibility for its content.

Results

Participant selection

The initial database contained 408 records. Four observations were removed after the data-consistency assessment, leaving 404 participants in the analytical sample (Fig. 1). ISI scores were available for all 404 participants. Global PSQI scores were calculated for 401 participants; three records were retained in the study but excluded from analyses requiring the global PSQI score because bedtime was not reported with sufficient precision.

Participant characteristics

The median age was 31 years (interquartile range [IQR], 26–40), and 357 participants (88.4%) were male. Three quarters came from urban settings, 279 (69.1%) had secondary education, and 216 (53.5%) were serving a sentence. Median detention duration was 1 year (IQR, 1–2), while 136 of 403 participants (33.7%) reported a previous incarceration (Table 1).

Detention conditions, substance use and sleep

Adverse material conditions were common. Mattress deprivation affected 294 participants (72.8%), limited or irregular food access 293 (72.5%), absence of lighting 259 (64.1%), and absence of a blanket 258 (63.9%). The median cumulative score was 3 conditions (IQR, 2–4). Tobacco use was reported by 140 participants (34.7%), cannabis use by 79 (19.6%), and alcohol use by 20 (5.0%). Seventy-eight of the 79 cannabis users also reported tobacco use.

Clinically significant insomnia symptoms were present in 194 of 404 participants (48.0%; 95% CI, 43.2%–52.9%), while 294 of 401 participants had poor sleep quality (73.3%; 95% CI, 68.8%–77.4%) (Table 1). ISI and PSQI scores were strongly correlated (Spearman's $\rho = 0.753$; $p < 0.001$). Among the 193 participants with complete data who had ISI ≥ 15 , 191 (99.0%) also had PSQI > 5 . However, poor sleep quality was also identified in 103 of 208 participants (49.5%) with ISI < 15 .

Table 1
Participant characteristics, reported living conditions,
substance use and sleep outcomes

Characteristic	Value
Age, years	31 [26–40]
Male sex	357/404 (88.4%)
Urban origin	303/404 (75.0%)
Primary education or less	33/404 (8.2%)
Secondary education	279/404 (69.1%)
Higher education	92/404 (22.8%)
Serving a sentence	216/404 (53.5%)
Pretrial detention	188/404 (46.5%)
Detention duration, years	1 [1–2]
Previous incarceration	136/403 (33.7%)
Conflicts with other incarcerated people	25/404 (6.2%)
No outdoor access	10/404 (2.5%)
No water for washing	99/404 (24.5%)
One meal/day or irregular food access	293/404 (72.5%)
No lighting	259/404 (64.1%)
No mattress	294/404 (72.8%)
No blanket	258/404 (63.9%)
Cumulative adverse-condition score	3 [2–4]
Cannabis use	79/404 (19.6%)
Tobacco use	140/404 (34.7%)
Alcohol use	20/404 (5.0%)
ISI score	14 [7–16]
ISI ≥ 15	194/404 (48.0%)
PSQI score	13 [5–16]
PSQI > 5	294/401 (73.3%)

Data are n/N (%) or median [IQR]. ISI, Insomnia Severity Index; PSQI, Pittsburgh Sleep Quality Index.

Cumulative adverse detention conditions

The prevalence of both sleep outcomes increased with the cumulative number of reported adverse living conditions (Fig. 2). Clinically significant insomnia symptoms were present in 25.6% of participants reporting 0–2 adverse conditions, compared with 54.0% among those reporting 3–4 conditions and 66.7% among those reporting five or more. Poor sleep quality was identified in 59.2%, 77.0%, and 85.2% of participants in the corresponding categories.

Adjusted associations

In the main adjusted model, each additional adverse detention condition was associated with a higher prevalence of clinically significant insomnia symptoms (adjusted prevalence ratio [aPR], 1.18; 95% CI, 1.10–1.27; $p < 0.001$) and poor sleep quality (aPR, 1.06; 95% CI, 1.02–1.10; $p = 0.006$) (Table 2). Age and primary education or less were independently associated with both outcomes. Female sex and tobacco use were associated with clinically significant insomnia symptoms but not with poor sleep quality. Cannabis and alcohol use showed no clear independent association with either outcome.

Table 2
Main adjusted models for clinically significant insomnia symptoms and poor sleep quality

Variable	Category/unit	ISI ≥ 15			PSQI > 5		
		aPR	95% CI	p	aPR	95% CI	p
Age	per 10 years	1.25	1.14–1.38	< 0.001	1.11	1.05–1.17	< 0.001
Sex	Female	1.41	1.05–1.88	0.022	0.97	0.79–1.20	0.773
Origin	Rural	1.13	0.92–1.39	0.256	1.02	0.90–1.16	0.756
Education	Primary or less	1.35	1.09–1.67	0.006	1.21	1.05–1.39	0.009
Education	Higher	1.01	0.74–1.38	0.947	1.07	0.91–1.25	0.433
Detention status	Pretrial	0.92	0.73–1.17	0.516	0.95	0.82–1.09	0.438
Detention duration	≥ 2 years	1.14	0.93–1.42	0.213	1.00	0.87–1.15	0.957
Adverse-condition score	per condition	1.18	1.10–1.27	< 0.001	1.06	1.02–1.10	0.006
Cannabis use	Yes	1.00	0.79–1.27	0.973	0.95	0.82–1.10	0.482
Tobacco use	Yes	1.32	1.03–1.69	0.031	1.10	0.96–1.27	0.181
Alcohol use	Yes	0.98	0.65–1.48	0.927	0.77	0.53–1.10	0.149

Poisson regression with robust variance. Reference categories: male sex, urban origin, secondary education, sentenced status, detention duration of 1 year, and no use of each substance. aPR, adjusted prevalence ratio; CI, confidence interval.

When the cumulative exposure score was analysed categorically, the adjusted prevalence of clinically significant insomnia symptoms was 1.85 times higher among participants reporting 3–4 adverse conditions than among those reporting 0–2 conditions (aPR, 1.85; 95% CI, 1.33–2.56). For participants reporting five or more conditions, the corresponding aPR was 2.27 (95% CI, 1.59–3.22). The adjusted prevalence of poor sleep quality was also higher in the 3–4-condition group (aPR, 1.25; 95% CI, 1.06–1.48) and the ≥ 5-condition group (aPR, 1.39; 95% CI, 1.16–1.67) (Table 2).

Extended and sensitivity analyses

In a secondary analysis with additional adjustment for perceived social support, each one-point increase in the mean MSPSS score was associated with a lower prevalence of clinically significant insomnia symptoms (aPR, 0.77; 95% CI, 0.70–0.85; $p < 0.001$) and poor sleep quality (aPR, 0.89; 95% CI, 0.84–0.94; $p < 0.001$). The cumulative adverse-condition score remained associated with clinically significant insomnia symptoms (aPR per additional condition, 1.15; 95% CI, 1.07–1.24; $p < 0.001$). Its association with poor sleep quality was attenuated but remained statistically compatible with a small increase in prevalence (aPR, 1.04; 95% CI, 1.00–1.09; $p = 0.044$) (Additional file 1).

When the seven reported living conditions were entered simultaneously into the adjusted models, absence of a blanket was associated with a higher prevalence of clinically significant insomnia symptoms (aPR, 1.65; 95% CI, 1.07–2.54; $p = 0.023$) and poor sleep quality (aPR, 1.29; 95% CI, 1.05–1.59; $p = 0.017$). Estimates for the other individual conditions were closer to the null after mutual adjustment (Additional file 2).

Results were similar when ISI and PSQI were analysed as continuous scores. Each additional reported adverse condition was associated with a 0.87-point higher ISI score (adjusted β , 0.87; 95% CI, 0.55–1.18; $p < 0.001$) and a 0.67-point higher PSQI score (adjusted β , 0.67; 95% CI, 0.36–0.99; $p < 0.001$). The quadratic terms provided no clear evidence of departure from linearity (Additional file 3).

Discussion

Comparison with African and international evidence

The cumulative number of reported adverse conditions was associated with both sleep outcomes. Nearly half of participants met the ISI threshold for clinically significant insomnia symptoms and almost three quarters met the PSQI criterion for poor sleep quality. Each additional condition corresponded to an 18% higher adjusted prevalence of clinically significant insomnia symptoms and a 6% higher prevalence of poor sleep quality. Categorical and continuous-score analyses showed a compatible pattern, and the association persisted when perceived social support was included. The cumulative burden, rather than any single condition, is therefore the principal finding.

The 48.0% prevalence of clinically significant insomnia symptoms was close to the 45.7% reported in a Nigerian maximum-security prison (Fakorede et al., 2021). Poor sleep quality in Kindu (73.3%) was higher than estimates from another Nigerian prison (47.3%), Diredawa (53.9%) and southern Ethiopia (60.2%), but close to Mettu Prison (77.1%) (Abdu and Hajure, 2020; Fakorede et al., 2023; Getachew et al., 2020; Naser et al., 2025). These comparisons do not rank institutions: sampling, sex composition, measures, thresholds, detention regimes and analytical choices differed. International reviews likewise show wide variation (Dewa et al., 2015; Griffiths and Hina, 2022; Sheppard and Hogan, 2022).

ISI and PSQI were strongly related but not interchangeable. Almost every participant with $ISI \geq 15$ and a calculable PSQI also had $PSQI > 5$, while about half below the ISI threshold still had poor sleep quality. This is consistent with the ISI's focus on insomnia severity and consequences and the PSQI's broader

coverage of duration, efficiency, disturbances and daytime dysfunction (Bastien et al., 2001; Buysse et al., 1989). Neither threshold establishes a clinical diagnosis.

The exposure-response pattern across 0–2, 3–4 and ≥ 5 conditions is consistent with prison research linking sleep disturbance to environmental disruption and context-related stress (Dewa et al., 2015; Dewa et al., 2017; Elger, 2003; Elger, 2009; Griffiths and Hina, 2022). Interpersonal tension, uncertainty and limited control may maintain cognitive and autonomic arousal (Riemann et al., 2010). Lighting may affect alertness and circadian signalling (Cajochen, 2007), while inadequate bedding may impair physical and thermal comfort. Irregular meals and restricted outdoor access may disturb daily routines. These mechanisms were not measured and remain explanatory possibilities, not causal findings.

Absence of a blanket was the only individual condition associated with both outcomes after mutual adjustment. Adequate bedding is included in minimum detention standards (United Nations General Assembly, 2015), but this result does not identify blankets as the dominant determinant. Several conditions were common and correlated, so simultaneous entry redistributed shared information and reduced precision. The cumulative score offers the more stable interpretation.

Higher perceived social support was associated with lower prevalence of both outcomes. A Nigerian study of prison circumstances, family support and sleep did not identify an independent predictor of poor sleep quality (Fakorede et al., 2023); differences in measurement, population and setting may matter. Because support and sleep were measured together, direction cannot be established, and support may partly lie on the pathway between living conditions and sleep. The extended model is an assessment of robustness, not proof of protection or mediation.

Tobacco use was independently associated with clinically significant insomnia symptoms but not poor sleep quality. Nicotine-related arousal is plausible (Jaehne et al., 2012), but smoking frequency, timing and overnight withdrawal were not measured. Cannabis and alcohol showed no clear independent association, yet alcohol use was reported by only 20 participants and 78 of 79 cannabis users also used tobacco. These data cannot exclude substance-specific associations.

Strengths, limitations and implications

This first prison-based study of sleep health in the Democratic Republic of the Congo used two complementary sleep measures, reported outcome-specific denominators and estimated PRs appropriate for common outcomes. Findings were compatible across alternative parameterisations. Non-probability recruitment, a changing prison population and absence of a stable denominator limit assessment of selection and generalisability. Measures were self-reported; detention conditions were not independently observed; and no actigraphy or clinical sleep assessment was available. The French instruments have not been psychometrically validated among incarcerated people in the Democratic Republic of the Congo. Psychological distress, night-time noise, crowding, temperature, illness and medication use were not measured and may have confounded the estimates.

At Kindu Central Prison, sleep assessment can be considered alongside review of modifiable conditions, particularly bedding, lighting, water access, food regularity and outdoor access. Brief cognitive behavioural and multicomponent sleep interventions have been tested in other prisons, although evidence remains limited and context-specific (Dewa et al., 2024; Griffiths and Hina, 2022; Randall et al., 2019). Any programme in Kindu requires adaptation to local resources and prospective evaluation.

Conclusions

Sleep problems were frequent among participants at Kindu Central Prison. A greater cumulative burden of reported adverse living conditions was associated with higher prevalence of clinically significant insomnia symptoms and poor sleep quality. These findings do not establish causation, but they support integrating sleep assessment with locally feasible review of material conditions and prospective evaluation of prison-based interventions.

Declarations

Author Contribution

BLK: Conceptualization, investigation, data curation, project administration, and writing – original draft. ONT: Methodology, data curation, validation, and writing – review and editing. RMM: Methodology, validation, and writing – review and editing. DBB: Investigation, data curation, validation, and writing – review and editing. CKKM: Conceptualization, methodology, formal analysis, supervision, visualization, and writing – review and editing. All authors contributed to interpretation of the findings, reviewed the final manuscript, approved it for submission, and agreed to be accountable for the work.

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Figures

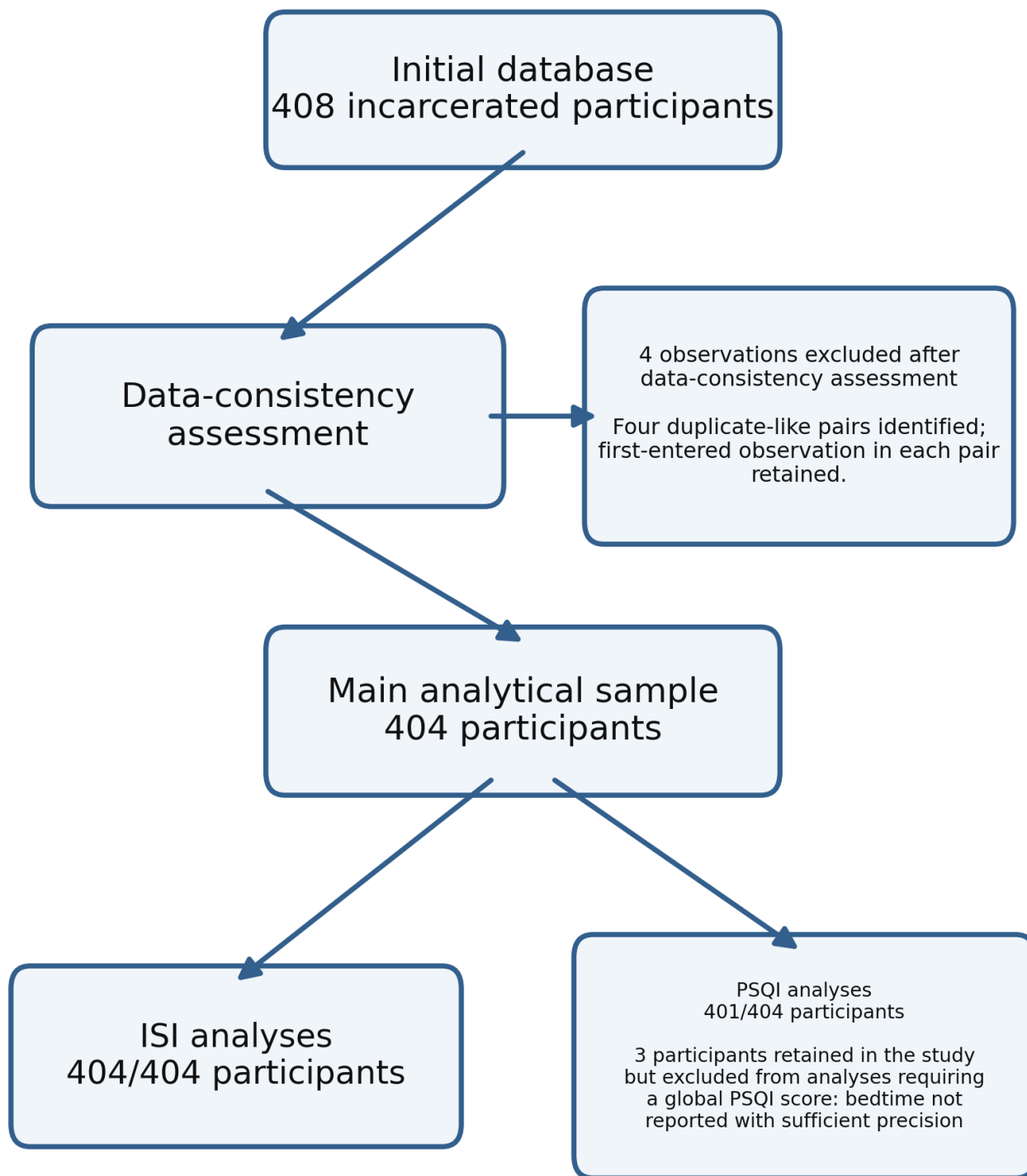


Figure 1

Participant selection flowchart. Four observations were excluded after the data-consistency assessment, leaving 404 participants for ISI analyses and 401 participants with a calculable global PSQI score.

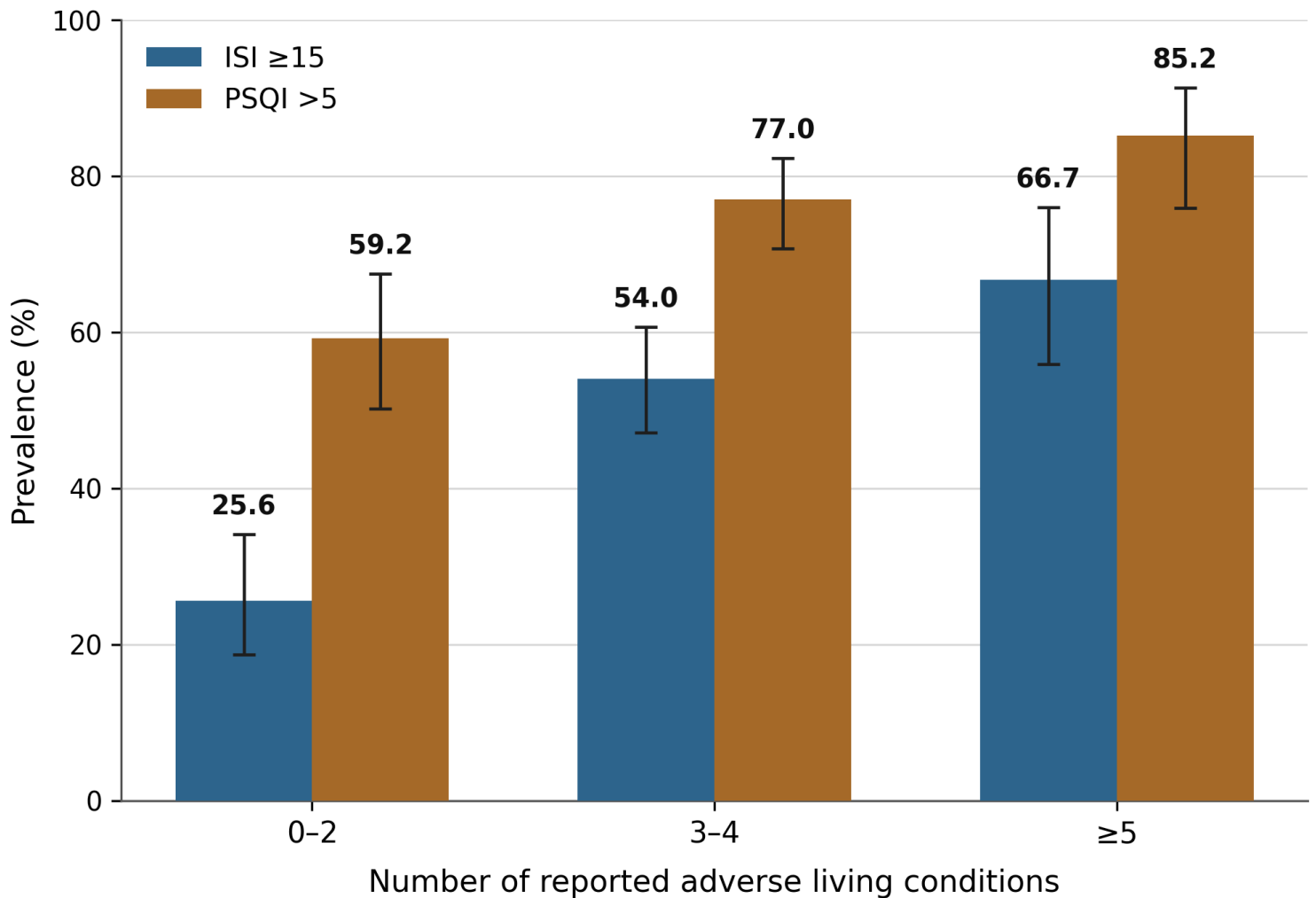


Figure 2

Prevalence of sleep outcomes by cumulative living-condition burden. Error bars represent 95% confidence intervals. Clinically significant insomnia symptoms were defined as ISI ≥ 15 and poor sleep quality as PSQI > 5 .

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Additionalfile1MSPSSadjustedmodels.docx](#)
- [Additionalfile2Individuallivingconditions.docx](#)
- [Additionalfile3Continuousleepscores.docx](#)