Sleep Health: Journal of the National Sleep Foundation 10 (2024) 643–650

Contents lists available at ScienceDirect

Sleep Health: Journal of the National Sleep Foundation

journal homepage: www.sleephealthjournal.org

Employment, income, and sleep in South Africa: An actor-partner interdependence model approach

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ARTICLE INFO

Article history:
Received 24 September 2023
Received in revised form 20 June 2024
Accepted 7 July 2024

Keywords:
Employment
Income
Gender
Sleep
South Africa

ABSTRACT

Objective: We analyze the relationship between employment status, income, and sleep in South Africa to address two research questions: (1) How does employment status influence the sleep quantity of the individual and their partner? (2) How does income impact the sleep quantity of the individual and their partner?

Method: Using data from 1600 Black African couples in the South African Time Use Study, we employ the Actor-Partner Interdependence Model to investigate the relationship between employment status, income, and sleep in couples. We categorize nighttime sleep into three categories: recommended sleep (7-9 hours), short sleep (< 7 hours), and long sleep (> 9 hours).

Results: Employed individuals were more likely to get the recommended amount of sleep and less likely to experience long sleep. However, men whose wives are employed are almost twice as likely as men whose wives are unemployed to experience short sleep, and they experience 47% lower risk of long sleep. Men with a medium level of income have a higher risk of short sleep than those with low income, while those in the highest income category are more likely to get the recommended amount of sleep.

Conclusion: These results highlight the intricate dynamics between managing employment demands and securing economic stability for both men and women in the context of high unemployment and shifting gender norms.

Introduction

Optimal sleep is crucial for maintaining overall physical, mental, and social well-being. Both short and long sleep have been shown to increase risk of obesity, diabetes, hypertension, and cardiovascular disease.[1] The amount of sleep required varies across the lifespan, but in general, adults aged 26-64 are recommended to get 7 to 9 hours of sleep, with 6 and 10 hours being the extreme limits.[2] Both short sleep (< 7 hours) and long sleep (> 9 hours) have negative implications for physical and mental health.[3] In addition, economic precarity through unemployment[4] and low income[5] can contribute to both short and long sleep. However, most research on sleep health is from Western contexts,[6–14] leaving a significant knowledge gap for non-Western contexts, such as South Africa, where precarious employment and unemployment have remained high for decades.[15] To address this gap, we use data from the South African Time Use Study to investigate the association among employment, income, and sleep within couples using a novel methodological approach to model partner interdependence. Specifically, we address the following questions: (1) How does employment status influence the sleep quantity of individuals and the partners? (2) How does income impact the sleep quantity of the individual and their spouse?

This work is important in several ways. First, given economic precarity and increasing social inequality in many countries of the Global South,[15] it is essential that we fully understand the impact of employment and income on well-being. Second, while research on sleep has been growing,[16-20] our knowledge of gender differences in sleep patterns remains limited, particularly in the context of the Global South. Moreover, time use data has been underutilized to advance this work. Finally, recent findings from meta-analyses suggest different patterns of associations between socioeconomic status and sleep quantity in African populations, compared to Western countries.[21] This underscores the need for more research to examine the correlates of sleep in order to inform interventions to improve health and well-being.

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https://doi.org/10.1016/j.sleh.2024.07.006

South African context

South Africa offers an ideal context for exploring the impact of employment on individual and partner sleep patterns. The nation grapples with persistent high unemployment rates, exceeding 20% for over a decade, with an official rate currently at 32.9%.[22] According to the Quarterly Labour Fouce Survey, the number of unemployed South Africans has surged from 4.9 million in 2013 to 7.9 million in 2023. Furthermore, the proportion of participants in these surveys experiencing long-term unemployment has risen from 65.5% in 2013 to 77.2% in 2023.[22] Research on gender roles underscores the enduring dominance of the male breadwinner model in shaping masculinity and fatherhood within Black African families.[23,24] At the same time, the post-apartheid era has ushered in significant changes in traditional gender roles due to more educational opportunities for women, the need for women to work to ensure a livelihood, and efforts to enact a raft of rights targeting women.[25] Despite these shifts, a gendered division of household labor persists. Women devote more time than men to domestic and care work, even when women are engaged in paid employment. men, regardless of their employment status, allocate less time to unpaid work than women.[26] Sleep research has gained prominence, particularly in relation to chronic health conditions like HIV and tnoncommunicable diseases,[27] obesity,[28] and concerns about perceived safety.[29] However, research on the socioeconomic correlates of sleep health in South Africa is lacking.

(Un)employment, income, and sleep

Unemployment not only leads to financial difficulties, but also has adverse effects on individuals' physical and mental health, social life, and family life. Unemployed individuals are more likely to experience both short and long sleep than their employed counterparts and are at a higher risk of poor-quality sleep.[4] Conversely, employment is generally associated with fewer sleep problems, although this association varies depending on the type of employment. For instance, short sleep has increased among full-time workers over the past three decades, even after accounting for sociodemographic factors, which seems to be due to the increase in overtime work and stress.[30] On the other hand, some may resort to sleep as a means of coping with work-related stressors. Additionally, shift work schedules can disrupt sleep quantity and quality; in particular, those working night shifts tend to experience more daytime fatigue and longer sleep.[31]

The connection between income and sleep is complex, and extant research results have had unequivocal findings.[5,14] While lower income is typically associated with shorter sleep duration,[32] there is notable variation in sleep quantity in both low-income and high-income groups.[5] Some studies suggest that high-income individuals choose to sleep less due to the perceived high cost of sleep time.[33] Other studies suggest that low-income individuals may sacrifice sleep in favor of pursuing additional training or education to improve their income prospects, or due to stress associated with low-paying jobs, which often involve long hours, nonstandard schedules, or night shifts, all of which contribute to short sleep.[32] Other research argues that the relative income, not the absolute income, affects both the quantity and quality of sleep.[14]

Gendered patterns add more complexity to the association between employment, income, and sleep. Research from the US shows that, even after accounting for their employment and parental roles,[18,34] women report more sleep interruptions due to caregiving. Work based on 23 European countries revealed that women's sleep quality was influenced by both childcare and their partner's unemployment, while men were mainly affected by their own unemployment and financial issues.[7] In one of the only studies in a non-Western context, women in paid employment woke up earlier and slept less than males in South Africa.[27] In terms of partner effects, in single-earner couples, women's employment disrupts men's sleep, whereas in dual-earner couples, women report longer sleep duration than their spouses.[35] The same study also found that higher income correlates with better sleep quality in women.

Conceptual framework

We utilize social exchange theory to consider the intersection of gender, work, and couple dynamics. Based in Becker's seminal work on intrahousehold resource allocation,[36] social exchange theory posits that individuals engage in rational decision making based on reciprocity and interdependence, aiming to maximize rewards and minimize costs. The allocation of sleep quantity and sleep quality[37–39,13] within couples is clearly interdependent. However, the actual allocation of time, including time for sleep, is influenced by gendered expectations about domestic responsibilities and paid work.[40-42] For example, gender norms that place men as the primary breadwinners and women as responsible for domestic responsibilities affect men's sleep[7] and how each partner perceives the other's sleep needs.[43]

Following prior research,[35] we consider employment status and income as having different associations with sleep quantity due to distinct mechanisms. While the impact of income on sleep is likely explained by stress resulting from a cost-benefit analysis of time substitution,[33] the influence of employment status may stem from both stress and the actual reduction of available time. Therefore, our analysis aims to distinguish the gendered impacts of employment status and income on sleep, as elaborated in the following hypotheses:

1. Employed women are more likely to experience short sleep than unemployed women, whereas employed men are more likely than unemployed men to get the recommended amount of sleep.
2. Women with an employed partner are more likely to get the recommended amount of sleep than women with an unemployed partner, but men with an employed partner are more likely to experience short sleep than men with an unemployed partner.
3. Men with higher incomes are more likely than men with lower incomes to experience short sleep.
4. Women whose partners earn higher incomes are more likely to get the recommended amount of sleep compared to women whose partners earn lower incomes.

Data and methods

This analysis draws on the 2010 South African Time Use dataset, collected by Statistics South Africa[a] and publicly available through the DataFirst portal (https://www.datafirst.uct.ac.za/). The data include a nationally representative sample of 39,018 respondents aged 15-64, providing the most recent publicly available time use data in South Africa. Two respondents were selected from each household to complete a time diary; they recorded their activities over a 24-hour period from 4 AM the preceding day until 4 AM on the interview day. These activities were recorded in half-hour increments and categorized based on an activity classification system. For this analysis, we built a couple-level dataset by identifying the husband/wife dyads in each household. We limited the sample to age 20-59 for either partner, given the protracted period of school completion at younger ages and pension eligibility at age 60. Further, we focus this analysis on Black couples, given the disproportionately high unemployment rates among Black Africans. This yielded a final N of 1600 dyads and 3200 individuals.

[a] Statistics South Africa ensures that all data are deidentified (https://www.statssa.gov.za/?page_id=785). Therefore no additional IRB clearance is required.

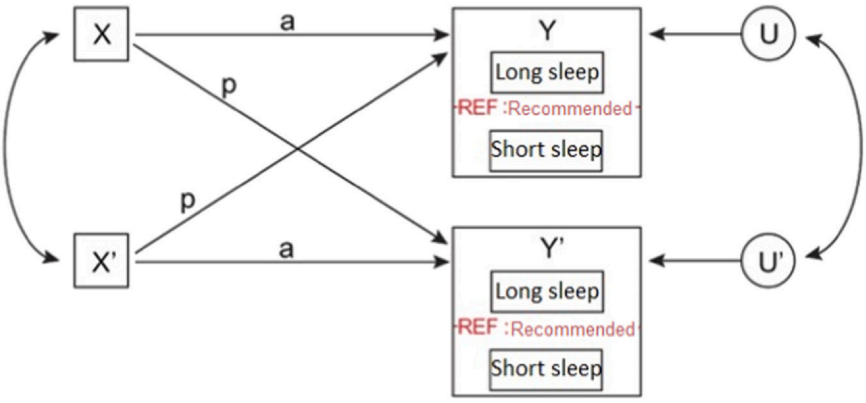

Fig. 1. Conceptual diagram of the multinomial logit model within actor-partner interdependence model (APIM). X: Husband's employment, Y: Husband's sleep hours, U: Residual (unexplained) portion of husband, X′: Wife's employment, Y′: Wife's sleep hours, U′: Residual (unexplained) portion of wife, a: actor effect, p: partner effect[44]

Analytical methods

We applied the Actor-Partner Interdependence Model (APIM), a multilevel modeling strategy commonly used in couple-level analysis, treating the dyad, rather than the individual, as the unit of analysis. This approach minimizes bias and is ideal for studying interdependence within interpersonal relationships.[44] Fig. 1 illustrates the pathways of effects operationalized through multinomial logistic regression. To investigate this relationship, we used STATA17 and the "xtmlogit" package for analysis.

The husband's employment status and income exert actor effects on his sleep hours, while his wife's employment status and her income influence his sleep hours as a partner effect. The same effects holds for the wife's side.

Measures

Recommended sleep duration varies with age, but according to the National Sleep Foundation,[2] adults aged 26-64 should ideally get 7 to 9 hours of sleep, with 6 and 10 hours being the extreme limits. Our primary outcome variable is a three-category sleep outcome variable: recommended (7-9 hours), short (< 7 hours), and long (> 9 hours). Sleep duration is the sum of hours slept between 4 AM the previous day and wake-up time, and hours slept from bedtime on the interview day until 4 AM. We assume the bedtime on the previous day is the same as the interview day. Only nighttime sleep is included. It is worth noting that sleep duration may be overestimated since "lying in bed" descriptions could be coded as sleep.[45]

Our main exposure variables are employment status and income. We followed the STATS SA classification for "employed" and "unemployed" and combine "not economically active" with the unemployed category for two reasons. First, prolonged high unemployment situations usually discourage job seekers *from actively looking for work or trying to start a business*, a criterion for being treated as "unemployed." Therefore, these discouraged job seekers are treated as "not economically active." Second, because of this restriction, the unemployment category is only 7%, leading to small cell sizes. For the income variable, we collapsed the 14 original categories into three: low income (< R1001 monthly), medium income (R1001-R4500 monthly), and high income (> R4501 monthly).

Five covariates, varying between the actor and the partner, as well as the primary exposure and outcome variables, were included: work time, domestic work time, leisure time, age, and the day recorded in the time diary. Other types of time use, such as nap time, education, self-care, and miscellaneous activities, were not included in our model. Therefore, the sum of work time, domestic work time, leisure time, and sleep time can be less than 24 hours. We transformed these time variables into binary format. If the time spent on an activity equaled or exceeded the average time spent on that activity, it was coded as 1; otherwise, it was coded as 0. This binary can improve model efficiency by providing a clearer signal to the model about the duration of certain activities relative to the average, rather than focusing on exact time spent, which might introduce unnecessary complexity. The day of data capture was coded as 1 for weekend and 0 for weekday because sleep duration on weekends differs from weekdays. Three other control variables—urban residence, the number of children under age 7, and the province—were considered constant for both actors and partners. Therefore, we did not distinguish between actors and partners.

Table 1 presents selected descriptive statistics of the sample at the individual and couple levels.

Table 1
Selected sample characteristics

	Men [Std] (N = 1600)	Women [Std] (N = 1600)
Mean total sleep (min)	527.2 [130.58]	548.2 [116.63]
Recommended sleep (7-9 h)	48.13%	45.38%
Short sleep (< 7 h)	13.50%	8.75%
Long sleep (> 9 h)	38.38%	45.88%
Mean total work time (min)	376 [296.27]	153.4 [240.50]
Mean total domestic work time (min)	67.62 [109.69]	319.52 [185.43]
Mean total leisure time (min)	254.93 [197.61]	218.21 [163.23]
Mean age	38.91 [9.3]	34.2 [8.97]
Income		
Low income (< R1001 monthly)	23.25%	40.56%
Medium income (R1001-R4500 monthly)	51.69%	41.13%
High income (> R4501 monthly)	25.06%	18.31%
Couple-level attributes (N = 1600)		
Employment status		
Man employed/woman unemployed	22.78%	
Man unemployed/woman employed	4.22%	
Both employed	16.19%	
Both unemployed	56.81%	
Number of children under 7 y living in the household		
0	50.53%	
1	32.56%	
2	13.91%	
3+	3.00%	
Province		
Western Cape	6.25%	
Eastern Cape	10.75%	
Northern Cape	4.50%	
Free State	11.00%	
KwaZulu-Natal	13.44%	
North West	10.50%	
Gauteng	20.25%	
Mpumalanga	13.06%	
Limpopo	10.25%	
Geography type		
Urban formal	51.88%	
Urban informal	14.50%	
Tribal areas	26.88%	
Rural formal	6.75%	

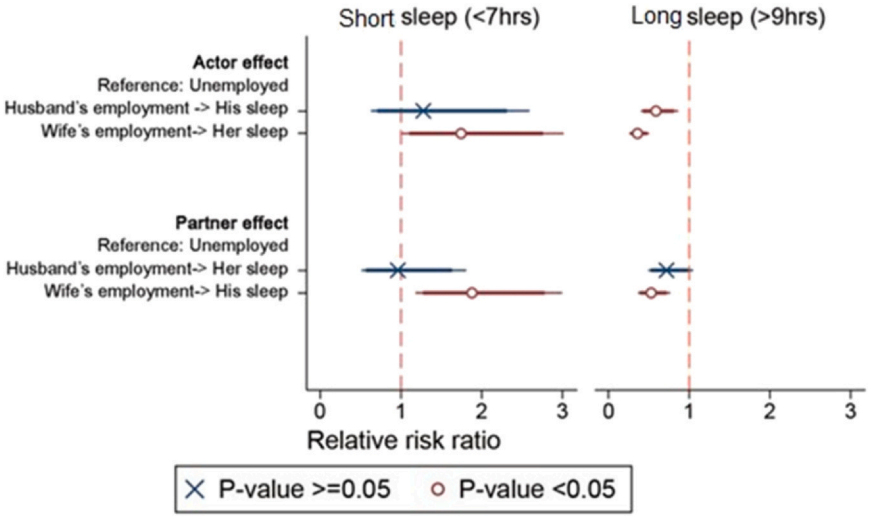

Fig. 2. Actor-partner interdependence model (APIM) of husband-wife dynamics to predict the relative risk of experiencing short sleep or long sleep as a function of employment status (N = 1600). Note: Controls - domestic work hours, paid work hours, leisure hours, age, number of children, urban residence, province

Relative to men, women sleep an average 20 minutes longer, are more likely to have long sleep (> 9 hours), and less likely to have short sleep (< 7 hours). Men and women spend 6 and 2.5 hours, respectively, on outside work, whereas women, on average, spend 5 hours on domestic work while men spend 1 hour. Even though more women are unemployed or not economically active, they take on a disproportionate burden of domestic work. Men spend 37 minutes more in leisure time than women. In terms of monthly income, women are more likely to be in the < R1001 category, whereas men are more likely to be in the "monthly more than > R4501" category. The distribution of couples' employment status shows both unemployed at 56.8%, followed by employed men/unemployed women at 22.8%, both employed at 16.19%, and employed women/unemployed men at 4.2%. About half of the couples do not have children under age 7 living in the household. Twenty percent of the sample resides in Gauteng province, and 50% live in formal settlements in urban areas.

Results

Fig. 2 illustrates the results from the APIM to predict the relative risk of experiencing sleep deficiency or oversleep as a function of employment status.

In terms of actor effects, employed men are more likely to have recommended sleep and have a 41% lower risk of experiencing long sleep. However, employed women are more likely ((relative risk ratio) RRR = 1.74, 95% CI = [1.01,3.02]) to experience short sleep compared to unemployed women and experience a 64% lower risk of long sleep (RRR = 0.36, 95%CI = [0.26, 0.50]). Partner effects show that men whose wives are employed have a 47% lower risk of experiencing long sleep (RRR = 0.53, 95% CI = [0.37, 0.77]). However, they are nearly twice as likely (RRR = 1.87, 95% CI = [1.18, 3.00]) to experience short sleep compared to men whose wives are unemployed, net of his own employment status. No partner effects are evident for women. Fig. 3 presents the results from models predicting the relative risk of experiencing short sleep or long sleep as a function of income.

Men with high incomes are more likely (RRR = 0.45, 95% CI = [0.27, 0.74]) to obtain the recommended amount of sleep and have a lower risk of long sleep. Men in the medium income bracket face a higher risk (RRR = 2.42, 95% CI = [1.30, 4.49]) of short sleep compared to those in the low-income group. No actor or partner effects are observed for women across any income category. However, women whose partners have high incomes are more likely to get the recommended amount of sleep (RRR = 0.63, 95%CI = [0.40, 0.99]), compared to those with partners in low income brackets. They also face a 37% lower risk of experiencing long sleep. The final set of models considers both partners'

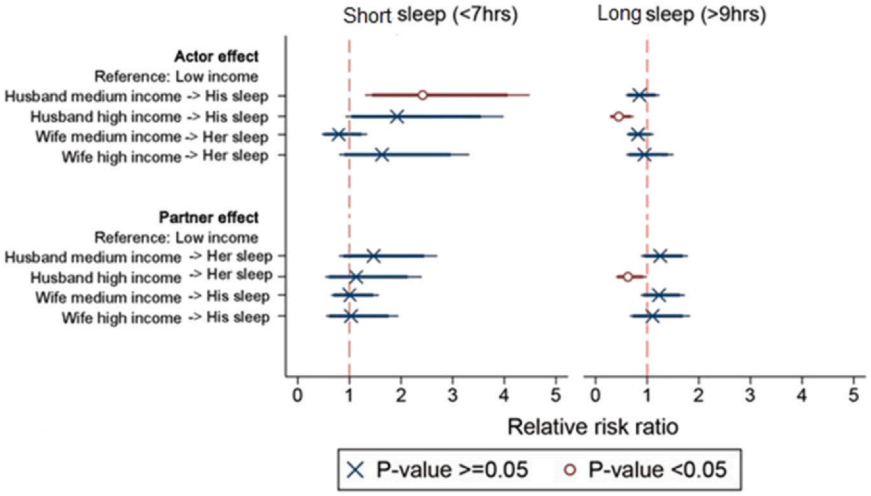

Fig. 3. Actor-partner interdependence model (APIM) of husband-wife dynamics to predict relative risk of experiencing short sleep or long sleep as a function of income (N = 1600). Note: Controls - domestic work hours, paid work hours, leisure hours, age, number of children, province, urban residence, province

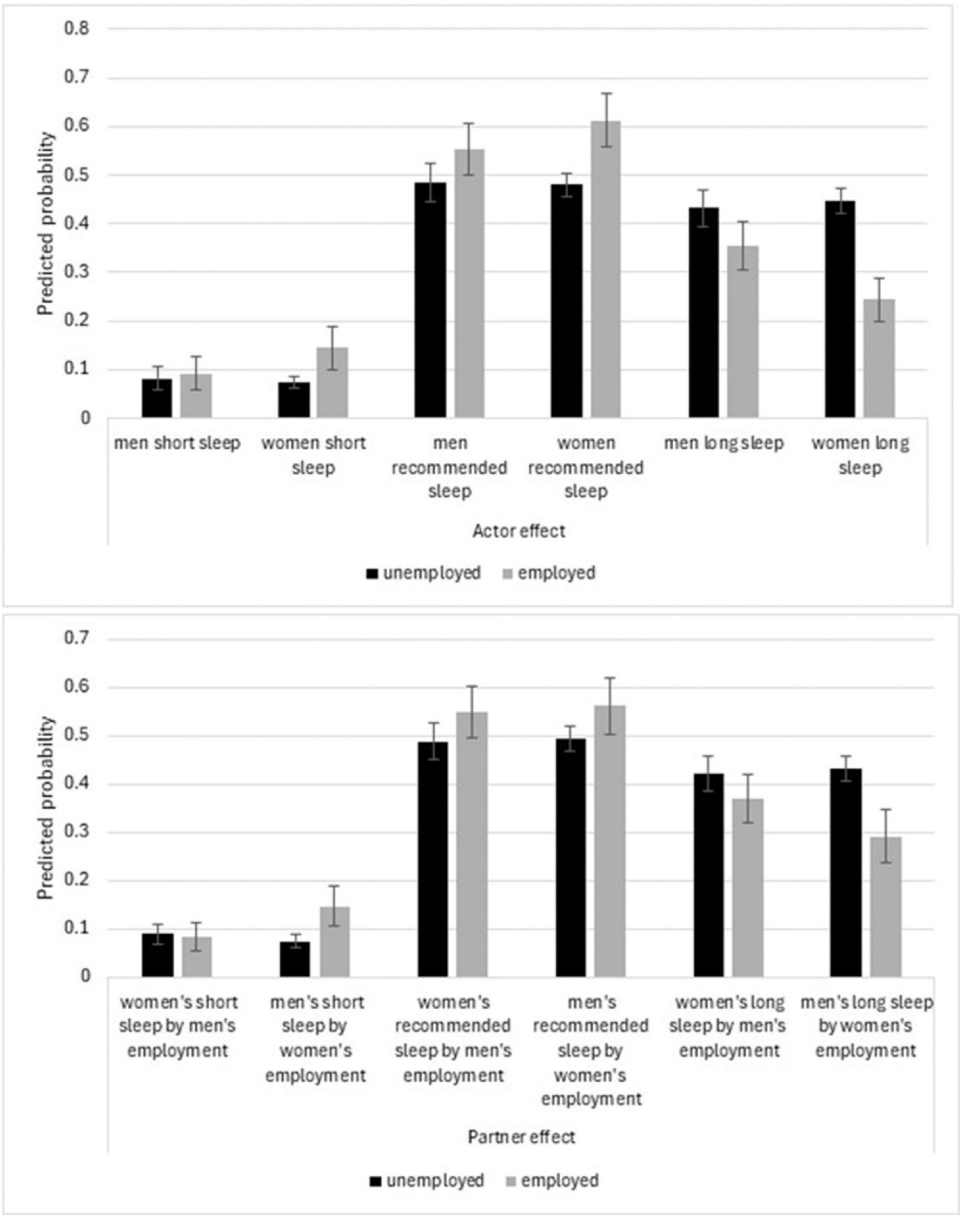

Fig. 4. Predicted probability of being in each sleep category by employment status of actor and partner. Note: Controls - domestic work hours, paid work hours, leisure hours, age, number of children, urban residence, province

employment statuses (Fig. 4) and incomes (Fig. 5). Instead of displaying the results as relative risk ratios, we present them as predicted probabilities to facilitate a more intuitive interpretation.

The predicted probability of experiencing short sleep among employed women is 0.144 (SE = 0.023, 95% CI = [0.10, 0.19]) and is statistically higher than that among unemployed women (0.074, SE = 0.007, 95% CI = [0.06, 0.09]), net of income. However, the predicted probability of achieving recommended sleep for employed men is higher than for unemployed men, although the difference is not statistically significant at the 95% CI. In terms of partner effects, the predicted probability of experiencing short sleep among men with employed partners is 0.146 (SE = 0.021, 95% CI = [0.11, 0.19]), statistically higher than among men with unemployed partners ((predicted probability) PP = 0.074, SE = 0.006, 95% CI = [0.06, 0.09]). Conversely, the predicted probability of achieving recommended sleep for women with employed partners is higher than for women with unemployed partners, but this difference is not statistically significant at the 95% CI.

When we look at income, net of employment, the predicted probability for men experiencing short sleep varies according to income levels: it is 0.13 for medium income (SE = 0.02, 95% CI = [0.09, 0.17]) and 0.13 for high income (SE = 0.03, 95% CI = [0.08, 0.19]), whereas the predicted probability of experiencing short sleep for low-income men is 0.06 (SE = 0.01, 95%CI = [0.05, 0.08]). No significant differences are found for women's income. In terms of partner effects, for women, the predicted probability of achieving recommended sleep is highest when partnered with high-income husbands (PP = 0.58, SE = 0.04, 95% CI = [0.51, 0.65]) and marginally insignificant for women achieving recommended sleep with partners in the lowest income bracket (PP = 0.46, SE = 0.03, 95% CI = [0.41, 0.51]). No partner effects are found for men.

Discussion

Our analysis highlights three key findings pertaining to the hypotheses. First, being employed is likely to reduce the risk of having

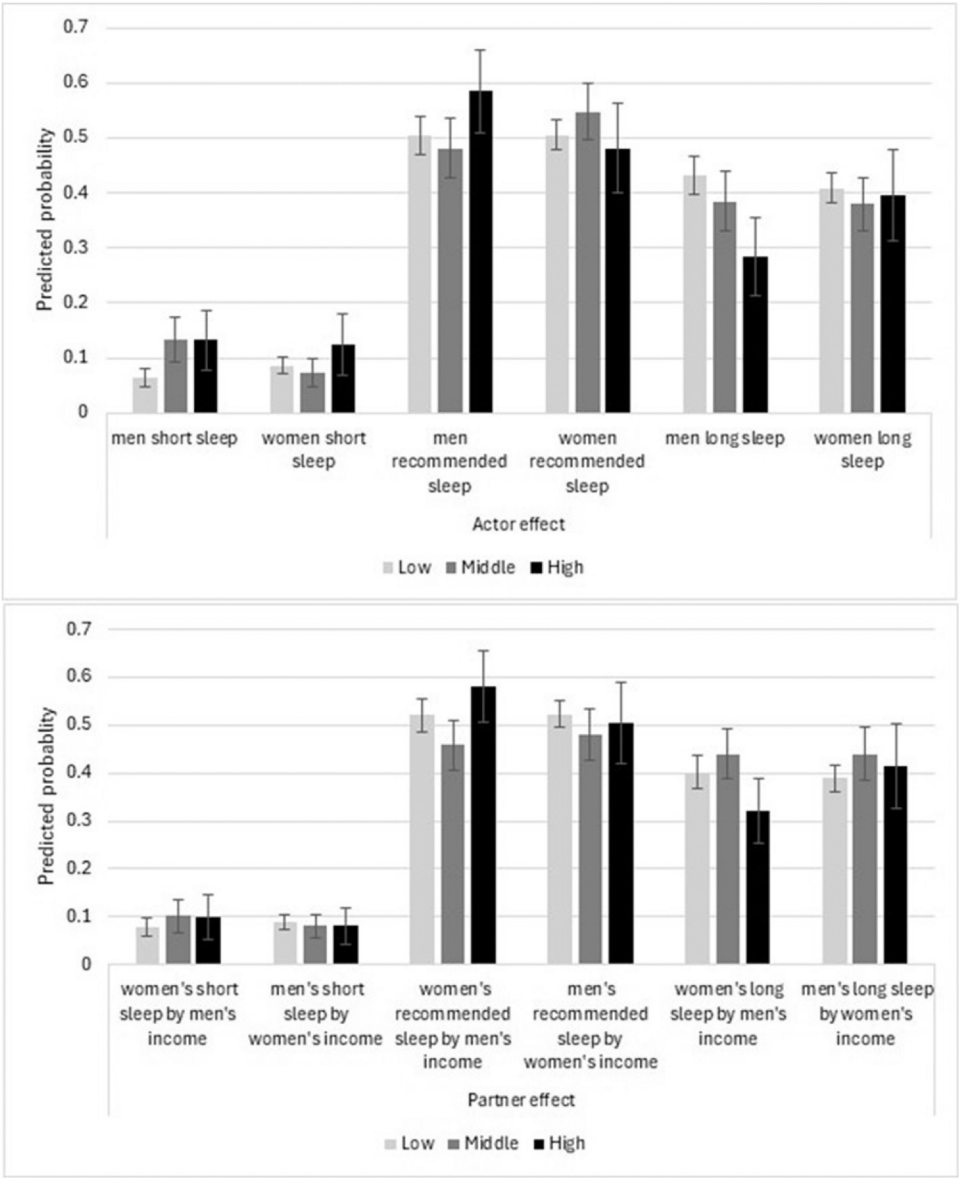

Fig. 5. Predicted probability of being in each sleep category by income level of actor and partner. Note: Controls - domestic work hours, paid work hours, leisure hours, age, number of children, urban residence, province

long sleep for both men and women, but is a risk factor for short sleep only for women (actor effects). Second, in partner effects, women's employment increases risk of short sleep for men but men's employment does not increase risk of short sleep for women. Third, higher income is associated with short sleep only for men as an actor effect. When we explored the effect income and employment in the same model (Fig. 5), we found that, for actor effects, income fully accounts for the greater risk of short sleep among women, but the protective effect of men's income on women's risk of long sleep disappears, suggesting that employment, not income, drives these effects.

These findings suggest that, while there may be some similarity in the effects of income and employment, it would be prudent to consider them as distinct influences on sleep. Our results provide some support for social exchange theory, but they also show that access to sleep is gendered, given that employed women are subject to a "second shift" phenomenon,[46] navigating both sets of responsibilities and losing sleep in the process, as shown by the prevalence of short sleep among employed women. Men's willingness to assume responsibilities for household work has been slow to change,[26,47] similar to the US and other Western countries.[48,49] At the same time, the income effect on sleep is more noticeable for men in both actor and partner effects. Interestingly, our research also shows a heightened risk of short sleep among men with employed wives, prompting further research. Reciprocity, a core dimension of social exchange theory, clearly has limits for explaining gendered time use[46] in relation to sleep quantity at the couple level. For example the results show that employed women's sleep loss can spill over into men's sleep loss, rather than the women's sleep loss (cost) benefiting men's sleep. While men with medium level income are more likely to experience short sleep than those in other income categories, likely due to both time substitution and stress from job insecurity, high income earners do not appear to face the same risk and show the highest probability of getting the recommended amount of sleep. Men with low incomes are less likely to experience short sleep than those in other income categories, but they are more likely be at the risk of long sleep. It should also be mentioned that both actor and partner effects of income are more variable than employment effects.

In interpreting these results, it is important to acknowledge the limitations of the analysis. First, sleep data from time diaries are subject to inaccuracies resulting from the process of coding open-ended

responses as sleep. Second, our measure is based on the assumption that bedtime the prior day is the same as the one reported on the interview day. Third, while we recognize that our dataset is dated, this is the most recent time use data available in the African region. Moreover, the unemployment crisis in South Africa has, if anything, worsened over time, so these results are likely conservative estimates. Lastly, we make no claims of causality in our analysis, but rather demonstrate the value of using APIM to unpack the complex set of effects that can play out in the context of dyadic relationships.

Despite these limitations, our findings make a needed contribution to our understanding of gender, work, and family in the Global South. Moreover, our findings align with other time use studies utilizing APIM at the couple level,[35,40-42] and work applying APIM to study gender differences in sleep quantity.[6,35,50] We have addressed important questions about the implications of livelihood constraints on the well-being of individuals and partners in contexts marked by high levels of economic precarity and tensions between competing cultural scripts about gender roles.[51] Specifically, these findings underscore the need to better understand the implications of men's weakening positions as primary breadwinners for both their own health and their partners'. At the same time, we also need to examine how significant increases in women's education and labor force participation play out at the individual and couple level in terms of stress and time allocation.[51] In the era of expanding rights, it is clear that change comes with costs and benefits for both men and women. We hope our work can serve as a starting point for understanding these associations in other Global South contexts undergoing similar social and economic transformations.

Author contributions

SW: Conceptualization, Writing – original draft, Methodology, Data curation, Formal analysis, Visualization. **SM**: Conceptualization, Supervision. All authors: Writing – review & editing.

Declaration of conflicts of interest

The authors declare no competing interests.

Funding

We gratefully acknowledge support from the Eunice Kennedy Shriver National Center for Child Health and Human Development grant P2C-HD041041, Maryland Population Research Center.

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