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Community Section

Association of Selected Non Communicable Diseases with Sleep Behaviour among the Rural Geriatric Population in the Northern Districts of Tamil Nadu, India: A Cross-sectional Study

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ABSTRACT

Introduction: Non Communicable Diseases (NCDs) and sleep disturbances are significant health concerns, especially among the elderly. Understanding the association between behavioural factors, NCDs and sleep quality in rural geriatric populations is crucial for developing effective interventions.

Aim: To estimate the prevalence of selected NCDs and to assess the relationship between these NCDs and sleep behaviour among the rural geriatric population in the northern districts of Tamil Nadu, India.

Materials and Methods: A cross-sectional study was conducted from July 2018 to May 2020 among 7,200 elderly individuals (≥ 60 years), selected using multistage stratified random sampling from the Chengalpattu, Kancheepuram and Thiruvannamalai districts. Data on socio-demographic variables, behavioural factors (e.g., smoking, tobacco chewing, alcohol use), sleep patterns and NCDs (e.g., hypertension, diabetes, depression) were collected using validated tools. Statistical analyses, including Chi-square tests and logistic regression, were performed to identify associations.

Results: The prevalence of poor sleep was found to be 4,580 (64%), with a higher proportion among females {Odds Ratio (OR)=1.25, p-value <0.001} and unmarried individuals (OR=1.36, p-value <0.001). A total of 2,728 (37.9%) study participants had hypertension, 1,284 (17.8%) had diabetes and 4,043 (56.2%) had depression. Depression was significantly associated with poor sleep (OR=1.52, p-value <0.001), while 1,758 (38.4%) participants with poor sleep reported hypertension and 17.8% reported diabetes. No significant associations were found between these NCDs and sleep quality.

Conclusion: The present study emphasises that the rural elderly population has an elevated risk of inadequate sleep. Poor sleep was significantly predicted by depression, highlighting the necessity for integrated mental health interventions for the elderly. Targeted behavioural and psychological therapies to address sleep issues may enhance the overall well-being and quality of life of this vulnerable population.

Keywords: Depression, Elderly, Hypertension, Old age, Sleep pattern

INTRODUCTION

In India, the elderly population accounts for approximately 10% of the entire population. This percentage is expected to double, reaching 20.8% by 2050, with the southern and western regions of India having the largest proportion of older individuals [1].

The prevalence of chronic diseases is increasing in many nations and this trend is expected to continue for a variety of reasons. For example, life expectancy is rising in most countries, resulting in a larger number of individuals belonging to older age groups, thereby increasing their chances of developing various chronic diseases. Furthermore, people's lifestyles and behavioural patterns are rapidly changing, leading to the emergence of chronic diseases [2].

The most prevalent NCDs include cardiovascular conditions (such as strokes and heart attacks), diabetes, chronic respiratory disorders (like asthma and chronic obstructive pulmonary disease) and cancer. Every year, 41 million individuals die from NCDs, accounting for 71% of all deaths worldwide [3].

Metabolic risk factors lead to four key metabolic changes that increase the likelihood of developing NCDs: high blood pressure, obesity, elevated blood glucose levels (hyperglycaemia) and high levels of fat in the blood (hyperlipidaemia). Ageing correlates with changes in sleep, resulting in more complex sleep patterns, reduced duration, increased nocturnal awakenings and frequent daytime napping [4]. Older individuals are more vulnerable to sleep disorders compared to younger ones due to hormonal changes, co-morbidities and psychosocial stressors [5].

Poor sleep has been linked to an elevated risk of both infectious and non-infectious disorders, multimorbidity and mortality [6,7]. Sufficient, quality sleep is crucial for human health, well-being and healthy ageing [8,9]. Although there have been numerous studies on the prevalence of NCDs, research on the relationship between NCDs and sleep habits in rural elderly populations is limited.

The present study focuses on rural Tamil Nadu due to several region-specific factors that can significantly influence health outcomes, particularly in the elderly population. Health disparities between urban and rural areas in India are well-documented, with rural regions often experiencing poorer health outcomes due to limited access to healthcare services, lower health literacy and socioeconomic disadvantages. These factors can impact the diagnosis and management of NCDs, thereby affecting sleep quality [10].

The study aimed to estimate the prevalence of selected NCDs such as diabetes, hypertension and depression and also to assess the relationship between selected NCDs and sleep behaviour among the rural geriatric population in the northern districts of Tamil Nadu.

MATERIALS AND METHODS

The present cross-sectional study was conducted from July 2018 to May 2020 using a multistage stratified random sampling method.

Three districts in Tamil Nadu—Chengalpattu, Kancheepuram and Thiruvannamalai—were chosen randomly, with one rural Primary Health Centre (PHC) in each district, serving a population of 90,000 to 100,000. A complete enumeration sampling strategy was employed, with 2,400 participants selected from each district, resulting in a total sample size of 7,200. The villages within each selected PHC were listed and the required villages were chosen using the lottery method. Elderly participants from these selected villages were then randomly interviewed until the target sample size was achieved. Data collection commenced after obtaining Institutional Ethical Committee clearance (SRM/IEC/968) and informed consent from participants.

Inclusion criteria: The present study included elderly individuals aged 60 years and older who had lived in the area for at least one year.

Exclusion criteria: Individuals who were unwilling to participate in the study or to give consent were excluded.

Study Procedure

Data were collected from rural blocks by 60 trained data collectors (20 community medicine interns in each district). Data collectors received prior training before starting the data collection process. The training programme covered the study's objectives, target population, inclusion and exclusion criteria and ethical considerations. The standardised administration of the questionnaire was clearly explained, along with the standardised procedures for conducting physical measurements (e.g., blood pressure, height and weight for Body Mass Index (BMI) assessment) to reduce variability between observers. Protocols for handling participant questions or concerns and effective probing techniques to obtain thorough responses without introducing bias were also included.

The data collection process, which involved interviews lasting approximately 30 to 35 minutes each, was coordinated and supervised by the project coordinator. Each data collector covered 8 to 10 households per day. The collected data were then entered by a data entry operator and analysed by a statistical analyst.

Study tool: After being examined in a small pilot study involving 30 participants to validate its efficacy, a detailed face-to-face interview schedule and semi-structured questions were utilised. The socio-demographic profile evaluation included questions about age, sex, occupation and Socioeconomic Status (SES), which was assessed using the Modified BG Prasad scale. Occupations were categorised as follows:

Professionals: This group included doctors, senior administrative officers, senior lecturers and others involved in policy execution and decision-making processes.

Semi-professionals: This category included individuals working in fields such as engineering, teaching and insurance inspection, which required a college degree or post-secondary education.

Skilled workers: These individuals performed complex tasks that necessitated extended training to develop specific competencies, including carpenters, masons, mechanics and professional drivers.

Semi-skilled workers: This group included industrial labourers, laboratory assistants and store owners who required some degree of training.

Unskilled labourers: Examples of this group are watchmen and domestic staff, who carry out jobs that do not need formal schooling or specialised training [11].

The health behaviour assessment included details such as alcohol use, smoking, tobacco use and sleep patterns. Physical health was evaluated through a general examination, followed by screening for chronic diseases and morbidities using previously available medical information. Participants were asked to assess their sleep quality and based on their responses, they were categorised as having either good sleep or poor sleep. Depression was assessed using the Geriatric Depression Scale-15 (GDS short version) [12]. Each of the 15 items was scored as 1 point, yielding a maximum possible score of 15. A score of 0-4 indicates no depression, 5-8 indicates mild depression, 9-11 indicates moderate depression, while 12-15 indicates severe depression.

The present study screened participants for diabetes and hypertension. Diabetes screening was conducted using Random Blood Sugar (RBS) levels measured with an ACCU-CHEK GUIDE monitor. Participants with RBS levels of 200 mg/dL or higher were classified as diabetic, those with levels between 140 and 199 mg/dL were classified as pre-diabetic and those with levels below 140 mg/dL were considered normal [13]. A sphygmomanometer was used to measure blood pressure as part of the hypertension screening process. Individuals were classified as hypertensive if their blood pressure exceeded 140/90 mmHg [14].

Body Mass Index (BMI) was calculated for all participants based on their anthropometric measurements and classified according to the Asian classification as follows:

- <18.5 kg/m^2 - underweight
- 18.5-22.99 kg/m^2 - normal
- ≥23 kg/m^2 - overweight
- ≥25 kg/m^2 - obesity [15].

STATISTICAL ANALYSIS

Raw data were cleaned in Excel and then imported into IBM Statistical Package for Social Sciences (SPSS) Statistics for Windows, Version 21.0, for further analysis. Both univariate and multivariate analyses were conducted. Descriptive statistics were employed and results were expressed as frequencies and percentages. Categorical variables were compared using the Pearson Chi-square test. Odds Ratios (OR) and 95% Confidence Intervals (CI) were calculated for all risk factors. A p-value of <0.05 was considered statistically significant.

RESULTS

The sociodemographic details of the participants is represented in [Table/Fig-1]. The majority of participants 5118 (71.1%) belonged to the 60-69 years age group. The study had a larger percentage of female participants, numbering 4371 (60.7%), compared to males at 2829 (39.3%). A high proportion, 5352 (74.4%), were illiterate, indicating a lower level of education among the study participants. A total of 4421 (61.4%) participants were classified in the lower socioeconomic class (Class V), while 1830 (25.4%) were in the lower middle class (Class IV). Additionally, 3031 (42.1%) held unskilled employment and 3056 (42.5%) were unemployed.

Variables		n (%)
Age	60-69 years	5118 (71.1)
	70-79 years	1636 (22.7)
	>80 years	446 (6.2)
Gender	Male	2829 (39.3)
	Female	4371 (60.7)
Marital status	Married	5622 (78.1)
	Unmarried	174 (2.4)
	Divorced	1233 (17.2)
	Widow	171 (2.3)
Education	Illiterate	5352 (74.4)
	Primary	1171 (16.3)
	Middle	429 (6)
	Secondary	216 (3)
	Graduate	32 (0.5)

Employment status	Professional	24 (0.3)
	Semi professional	684 (9.5)
	Skilled	99 (1.3)
	Semi-skilled	306 (4.3)
	Unskilled	3031 (42.1)
	Unemployed	3056 (42.5)
Religion	Hindu	6913 (96)
	Others	287 (4)
Socioeconomic status	I (Upper)	168 (2.3)
	II (Upper-middle)	268 (3.7)
	III (Middle)	513 (7.1)
	IV (Lower-middle)	1830 (25.4)
	V (Lower)	4421 (61.4)

[Table/Fig-1]: Socio-demographic profiles of the study participants.

Over half of the study population (50%) is categorised as either overweight 1485 (20.6%) or obese 2114 (29.4%). The significant prevalence of overweight and obesity requires concern, although the normal weight category includes 2568 participants (35.7%). The underweight category 1033 (14.4%) also represents a significant portion of the population and carries its own health risks. The prevalence of NCDs was as follows: diabetes 1284 (17.8%), hypertension 2728 (37.9%), obesity 2114 (29.4%) and depression 4043 (56.2%). The prevalence of lifestyle risk factors included smoking 567 (7.9%), alcohol consumption 634 (8.8%) and tobacco chewing 970 (13.5%) [Table/Fig-2].

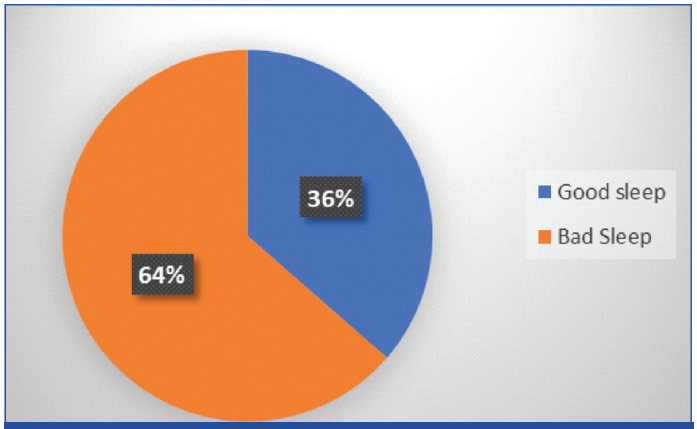
Variables		n (%)
Body mass index	Underweight	1033 (14.4)
	Normal	2568 (35.7)
	Overweight	1485 (20.6)
	Obese	2114 (29.4)
Hypertension	Yes	2728 (37.9)
	No	4472 (62.1)
Depression	Present	4043 (56.2)
	Absent	3157 (43.8)
Diabetes	Yes	1284 (17.8)
	No	5916 (82.2)
Smoking	Yes	567 (7.9)
	No	6633 (92.1)
Tobacco chewing	Yes	970 (13.5)
	No	6230 (86.5)
Alcohol intake	Yes	634 (8.8)
	No	6566 (91.2)

[Table/Fig-2]: Distribution of Non communicable Diseases (NCD) and behavioural addiction of the study participants.

The sleep quality of the study participants, revealing that 2620 (36%) had good sleep, while 4580 (64%) had poor sleep is represented in [Table/Fig-3].

For Chi-square analysis, categories within the variables of age, marital status, educational qualification, employment status, socioeconomic class and BMI were categorised into two groups. The category with the highest frequency was retained as one group, while all remaining categories were combined into a single other group.

Compared to men, women were more likely to report experiencing poor sleep (OR=1.25, p<0.001), indicating that gender influences sleep quality. Among those who reported poor sleep, 76.2% were married (OR=1.33, p<0.001). Compared to literate participants (24.8%), illiterate participants (75.1%) were 1.1 times more likely to experience poor sleep (p=0.041). Participants' age did not significantly affect sleep quality (OR=1.070, p=0.45). Participants belonging to socioeconomic class V had 1.26 times higher odds of poor sleep compared to other socioeconomic classes (OR=1.260, p<0.001) [Table/Fig-4].



[Table/Fig-3]: Pie diagram showing sleep quality of the study participants.

There was no significant association between employment status and sleep (OR=1.037, p=0.45). No statistical association was observed between hypertension (OR=1.06, p=0.25) or diabetes (OR=0.993, p=0.92) and reported sleep quality. Depressed individuals had 1.52 times higher odds of experiencing poor sleep (OR=1.52, p<0.001). Inadequate sleep was observed in individuals who did not engage in smoking (OR=0.733, p<0.001), tobacco chewing (OR=0.854, p=0.02), or alcohol consumption (OR=0.720, p<0.001).

DISCUSSION

The present study examined the sleep quality of the geriatric population and its correlation with NCDs such as diabetes, hypertension and depression. In the present study, 36% of participants reported good sleep, while 64% had poor sleep. This contrasts with the study by Minz S et al., which revealed that 69.5% of participants had good sleep quality and 30.5% experienced poor sleep [16]. This discrepancy may be attributed to differences in the methods used to assess sleep quality.

The majority of participants in the present study, 71.1%, belonged to the 60-69 years age group, followed by 22.7% in the 71-80 years age group. Approximately 60.7% of the participants were female and 39.3% were male. This is similar to a study by Muhammad T et al., which reported 52.39% women and 47.61% male participants [17]. Women reported poorer sleep than men (OR = 1.25, p < 0.001), consistent with a study by Jaisoorya TS et al., which indicated that women had a higher prevalence of sleep problems such as insomnia. It also found that older age and lower education levels increased the likelihood of poor sleep among women [18]. Gender disparities in sleep become apparent following puberty, which could be attributed to hormonal changes (puberty, menstruation, pregnancy, menopause), caregiving responsibilities and higher rates of psychological distress in women [19,20].

In the present study, 61.4% of participants belonged to the lower socioeconomic class (Class V), which is consistent with a study conducted among tribal populations in Tamil Nadu, where 79.1% belonged to the lower class. Another finding consistent across both studies was that 7.8% of participants in the present study were smokers, compared to 12.7% in the tribal study [21]. Participants who were married had greater odds of having trouble sleeping, emphasising the importance of social and emotional support for good sleep. This result aligns with a study conducted in Chennai by Ramesh S et al., who found that older people living in assisted living facilities, many of whom had little family support, experienced higher rates of sleep disorders and insomnia [22].

Of those with insufficient sleep in the present study, 17.8% had hypertension and 38.4% had diabetes. Despite prior research

Variables		Bad sleep n (%)	Good sleep n (%)	Total n (%)	Chi-square	Odds Ratio (OR) (CI)	p-value
Age	60-79 years	4298 (93.8%)	2456 (93.8%)	6754 (93.8%)	0.30	1.018 (0.834-1.242)	0.862
	>80 years	282 (6.2%)	164 (6.2%)	446 (6.2%)		1	
Gender	Female	2870 (62.7%)	1501 (57.3%)	4371 (60.7%)	20.17	1.251 (1.135-1.380)	<0.001*
	Male	1710 (37.3%)	1119 (42.7%)	2829 (39.3%)		1	
Marital status	Married	3490 (76.2%)	2132 (81.4%)	5622 (78%)	26.06	0.733 (0.650-0.826)	<0.001*
	Unmarried/widowed/divorced	1090 (23.8%)	488 (18.6%)	1578 (22%)		1	
Education	Illiterate	3442 (75.1%)	1910 (73%)	5352 (74.4%)	4.43	1.124 (1.008-1.254)	0.036
	Literate	1138 (24.8%)	710 (27%)	1848 (25.6%)		1	
Employment status	Yes	2651 (57.9%)	1493(57%)	4144 (57.5%)	0.54	1.037 (0.941-1.143)	0.45
	No	1929 (42.1%)	1127 (43%)	3056 (42.5%)		1	
Religion	Hindu	4394 (95.9%)	2519 (96.2%)	6913 (96%)	0.185	0.947 (0.740-1.213)	0.667
	Others	186 (4.1%)	101 (37.8%)	287 (4%)		1	
Socioeconomic status	Class V	2904 (63.4%)	1517 (57.9%)	4421 (61.4%)	21.31	1.260 (1.142-1.390)	<0.001*
	Others	1676 (6.6%)	1103 (42.1%)	2779 (38.6%)		1	
Body mass index	Obese	2298 (50.2%)	1301 (49.7%)	3599 (50%)	0.14	1.018 (0.925-1.121)	0.71
	Non obese	2283 (49.8%)	1318 (50.3%)	3601 (50%)		1	
Hypertension	Yes	1758 (38.4%)	970 (37%)	2728 (37.9%)	1.31	1.060 (0.960-1.170)	0.25
	No	2823 (61.6%)	1649 (63%)	4472 (62.1%)		1	
Diabetes	Yes	815 (17.8%)	469 (17.8%)	1284 (17.8%)	0.013	0.993 (0.876-1.125)	0.92
	No	3765 (82.2%)	2151 (82.2%)	5916 (82.2%)		1	
Smoking	Yes	322 (7%)	245 (9.3%)	567 (7.8%)	12.37	0.733 (0.616-0.872)	0.001*
	No	4258 (93%)	2375 (90.7%)	6633 (92.2%)		1	
Tobacco chewing	Yes	586 (12.8%)	384 (14.7%)	970 (13.5%)	4.95	0.854 (0.744-0.981)	0.029*
	No	3994 (87.2%)	2236 (85.3%)	6230 (86.5%)		1	
Alcohol intake	Yes	358 (7.8%)	276 (10.5%)	634 (8.8%)	15.33	0.720 (0.611-0.849)	<0.001*
	No	4222 (92.2%)	2344 (89.5%)	6566 (91.2%)		1	
Depression	Present	2744 (60%)	1299 (49.6%)	4043 (56.1%)	72.26	1.52 (1.380-1.674)	<0.001*
	Absent	1836 (40%)	1321 (50.4%)	3157 (43.9%)		1	

[Table/Fig-4]: Association of inadequate sleep with socio-demographic details, Non communicable Diseases (NCD) and behavioural addiction.
(*p-value of <0.05 is considered statistically significant)

indicating a bidirectional relationship between these diseases and sleep problems, no significant association was observed in this rural population. This result contrasts with studies conducted in urban environments, including the study by Chobe M et al., where 52% of hypertensive individuals and 34.5% of those with diabetes reported disturbed sleep. Additionally, another Cardiometabolic Risk Reduction in South Asia (CARRS) study demonstrated the substantial influence of diabetes and hypertension on sleep quality [23,24].

Because rural populations often lack access to healthcare facilities, NCDs may go undiagnosed or managed suboptimally, which could obscure their apparent effect on sleep. Furthermore, a rural lifestyle that emphasises physical activity and entails less exposure to environmental stressors such as pollution and noise may mitigate the negative effects of NCDs on sleep quality. This could also be due to underreporting or a lack of awareness in rural areas regarding the connection between sleep disorders and NCDs.

The present study found no significant correlation between BMI categories and sleep quality, although obesity is frequently associated with poor sleep, particularly in conditions such as obstructive sleep apnoea. A meta-analysis investigating the relationship between sleep duration and BMI revealed mixed findings. About half of the studies observed a substantial correlation, suggesting that individuals who slept for shorter periods were more likely to be overweight or obese. Conversely, six studies found an inverse relationship, indicating that lower BMI was linked to longer sleep duration [25].

According to the present study, depression was significantly linked to poor sleep quality; 60% of those who did not get enough sleep reported experiencing depression. Participants with depression had significantly greater odds of having poor sleep (OR=1.52, p<0.001). This result aligns with the findings of Rathod KS et al., which indicated that poor sleep was associated with a 1.12-fold increase in the risk of cognitive impairment {Adjusted OR (AOR): 1.12; 95% CI: 1.01, 1.24} and a two-fold increase in the risk of depression (AOR: 2.01; 95% CI: 1.87, 2.15). Social isolation and a lack of psychological support in elderly individuals may contribute to this link [26].

The present findings revealed that among those who had inadequate sleep, only 7% were smokers and 12.8% had the habit of tobacco chewing. This contrasts with a polysomnographic study by Jaehne A et al., where smokers exhibited shorter sleep durations, longer sleep latencies, increased rapid eye movement sleep density and a higher frequency of sleep apnoeas and leg movements compared to non smokers [27]. Another study found that smokers often experience poorer sleep compared to non smokers, with difficulties in both falling and staying asleep, shorter sleep durations, an increased risk of sleep disorders and impaired day-to-day functioning [28]. Additionally, a study by Venkat S et al. identified key factors affecting sleep quality, finding significant associations for smoking (16%, p<0.05) and tobacco chewing (20%, p<0.05) [29]. The low reporting of smoking and tobacco chewing behaviours in our study may explain this discrepancy. Due to social stigma and cultural norms surrounding alcohol and tobacco use, behavioural addictions may go unreported in rural populations. A study on Alcohol Use Disorders (AUDs) conducted in both rural and urban areas of Madhya Pradesh supports this notion; nearly half of the men (49.2%) felt embarrassed by their issues related to alcohol [30]. Furthermore, the physically active lifestyles and strenuous employment common in rural areas may enhance general fatigue, potentially offsetting the sleep-disrupting effects of smoking.

Limited access to healthcare facilities in rural areas often means NCDs are not adequately diagnosed or managed, which can obscure their impact on sleep. Older adults living in rural areas frequently face challenges such as long travel distances, lack of transportation, financial difficulties and fewer available specialists. These issues can hinder consistent diagnosis and proper adherence to treatment.

The present study encompassed a substantial sample size, ensuring robust statistical power and enhancing the applicability of the findings to rural geriatric populations. By assessing a wide range of factors, including behavioural patterns, NCDs, sociodemographic traits and sleep quality, the study provides a thorough understanding of the complex factors that contribute to poor sleep. The implementation of a multistage stratified random sampling methodology further strengthened the study's validity by ensuring representation from diverse rural settings, thereby enhancing the credibility and generalisability of the results.

Limitation(s)

The cross-sectional design of the present study limits the ability to infer causality between sleep quality, NCDs and behavioural factors. Additionally, the reliance on self-reported data for sleep patterns and behavioural habits, such as smoking, alcohol consumption and tobacco chewing, introduces potential biases, including recall bias and social desirability bias. In the present study, sleep quality was assessed based on participants' self-reported perceptions of good or bad sleep, rather than objectively measured sleep duration. This could have contributed to the increased prevalence of reported poor sleep in our study. Furthermore, the study's primary focus on hypertension, diabetes and depression may have excluded other significant NCDs, such as chronic respiratory conditions, that could also influence sleep quality.

CONCLUSION(S)

The present study emphasises that the rural elderly population is at an elevated risk of inadequate sleep, particularly among women and married individuals. Poor sleep quality is associated with low literacy, highlighting the need for targeted interventions. To address this, Information, Education and Communication (IEC) activities that emphasise the importance of sleep hygiene and the identification of sleep-related health issues should be developed in a pictorial format. Additionally, enhancing community engagement through interactive methods such as role plays and participatory learning can facilitate better understanding and promote timely health-seeking behaviour, especially in low-literacy populations.

Poor sleep was found to be significantly predicted by depression, underscoring the necessity of integrated mental health interventions for the elderly. Although diabetes and hypertension were prevalent among participants who had inadequate sleep, no significant association was discovered, indicating that other environmental or behavioural factors might also impact sleep quality. Targeted behavioural and psychological therapies to address sleep problems may improve the general well-being and quality of life of this vulnerable population.

An integrated approach is needed, involving community health workers in the early screening and diagnosis of depression at the primary care level, alongside the provision of group therapy, counselling and peer support to combat social isolation and offer emotional support. Concurrently, it is essential to provide support to family members and caregivers in their caregiving roles for the elderly.

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