

Comparing Diabetic incidence, glycemic control, and complications in geriatric population: A comparative analysis of retired daytime and shift workers

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KEYWORDS

Shift work, type 2 diabetes, glycemic control, retirees, diabetic complications, occupational health, elderly diabetes.

ABSTRACT

Objective: This study investigates the impact of prior daytime versus shift work on the incidence, glycemic control, and complications of type 2 diabetes mellitus (T2DM) in retirees, aiming to identify long-term effects and inform tailored interventions.

Methods: A six-month retrospective cohort study was conducted in Erode, India, involving 101 retired individuals aged 60 years or older with T2DM. Participants were classified based on prior work schedules (daytime or shift work). Glycemic control (HbA1c levels), diabetes duration, and complications (neuropathy, retinopathy, nephropathy, cardiovascular issues) were assessed via questionnaire. The data were analyzed by independent t-test using SPSS software.

Results: Among the 101 participants, 54 were daytime workers and 47 were shift workers. Shift workers exhibited significantly higher HbA1c levels ($8.96 \pm 1.593\%$) compared to daytime workers ($6.90 \pm 1.012\%$; $p < 0.001$). Night shift workers demonstrated the poorest glycemic control ($9.56 \pm 0.934\%$). The average diabetes duration was longer in shift workers (12.04 years) than in daytime workers (10.33 years). Shift workers also reported higher rates of diabetic complications, particularly neuropathy and cardiovascular issues, compared to daytime workers. A greater proportion of shift workers (68.09%) had poorly controlled diabetes compared to daytime workers (9.26%).

Conclusion: Shift work, particularly night shifts, was associated with worse glycemic control, longer diabetes duration, and increased complications in retirees, highlighting the long-term metabolic impacts of disrupted circadian rhythms. Targeted healthcare strategies and lifestyle interventions are essential to mitigate these adverse outcomes in retired shift workers.

INTRODUCTION

Diabetes is a chronic metabolic disease brought on by either insufficient insulin production by the pancreas or inefficient insulin utilization by the body.¹ Between 1990 and 2019, India saw a significant increase in the incidence of age-standardized diabetes (199.14 to 317.02 every 100,000) and rates of mortality (22.30 to 27.35 every 100,000).² The prevalence of diabetes was highest among older adults, especially those over 60, due to factors such as the aging population, the rapid urbanization of society, health, and lifestyle choices that prioritized western diets, and a lack of physical activity.³ In 2019, diabetes was the primary cause of around 1.5 million fatalities, with 48% of the overall diabetes-related mortality occurring in individuals under the age of 70. Diabetes contributed to an additional 460,000 deaths from renal disease.¹

Recent changes in lifestyle, such as overeating, inactivity, and lack of sleep, have been the primary cause of the rise in the occurrence of Type 2 Diabetes (T2DM). Sleep is a dynamic and active process that is especially beneficial to immune defense and disease resistance. Patients with T2DM sleep less than the general population. Deprivation of specific sleep stages may be harmful, as evidenced by the recent sharp rise in the prevalence of T2DM and obesity and the strong correlation between T2DM and sleep cycles.⁴ The body's circadian rhythm is upset by shift work, which is defined by erratic or rotating work patterns. This can result in metabolic issues and an increased risk of developing chronic illnesses like T2DM.⁵

The long-term implications of shift work after retirement, particularly in the senior population, have received little attention, despite many studies on the link between T2DM and shift work within the working-age population.⁶ For a number of reasons, it is essential to comprehend how daytime and shift employment differ in their consequences on diabetic outcomes after retirement. Based on their previous work patterns, it might offer insights into customized interventions or preventive measures aimed at retired people.⁷

The purpose of this study is to investigate the prevalence of type 2 T2DM, and glycemic control, including diabetic complications in retired people who had worked shift or day jobs in the past. By contrasting these two groups, we hope to clarify whether shift employment throughout those active working years significantly affects the prevalence of T2DM and how it is managed in retirement. This study may open the door for more focused interventions to lessen the effect of shift work on T2DM among retirees, enhancing their general health and well-being, by thoroughly comparing the incidence rates of T2DM, glycemic control strategies, and the number of complications with retired daytime as well as shift workers.

1. MATERIALS AND METHODS

This six-month retrospective cohort study in Erode, India, examined the impact of past work schedules—daytime versus shift work—on diabetic outcomes in retirees with type 2 diabetes mellitus (T2DM). The study aimed to compare glycemic control (HbA1c levels), diabetes incidence, and complications such as neuropathy, retinopathy, nephropathy, and cardiovascular issues. Although the sample size was initially calculated at 152 using RAOSOFT software with a 5% margin of error and a 95% confidence interval, recruitment limitations resulted in 101 participants.

Participants were retirees aged 60 years or older, diagnosed with T2DM, and undergoing treatment with oral antihyperglycemic drugs. Those included had a history of either daytime work (fixed schedules, 8:00 AM to 5:00 PM) or shift work (irregular or rotating shifts). Shift workers were further categorized by duration into groups of 1-5, 6-10, 11-20, and more than

20 years. Exclusion criteria included individuals with non-T2DM, psychiatric conditions, or pregnancy to avoid confounding factors.

Ethical approval was obtained from the Institutional Ethics Committee, and written informed consent was provided by all participants. Data collection involved a structured questionnaire capturing demographic details, work history, sleep duration, age at diabetes onset, HbA1c levels, and complications. Participants were classified as either daytime or shift workers for comparison.

Glycemic control was assessed through HbA1c levels, and complications, including neuropathy, nephropathy, retinopathy, and cardiovascular diseases, were recorded. Statistical analysis was performed using SPSS software, with independent t-tests employed to compare HbA1c levels between groups. A significance threshold of $p < 0.05$ was applied, and confounding factors were adjusted during the analysis.

The findings highlight the long-term impact of shift work on metabolic health, with shift workers showing worse glycemic control, longer diabetes duration, and higher rates of complications compared to daytime workers. These results underscore the importance of tailored interventions and improved healthcare strategies to manage diabetes in retirees, particularly those with a history of shift work. This evidence provides valuable insights for healthcare planning to enhance the quality of life for elderly individuals affected by T2DM.

2. RESULTS

3.1 Demographics

The study included 101 participants, comprising 54 daytime workers (53%) and 47 shift workers (47%), due to the inability to achieve the initially calculated sample size of 152 within the study duration. The demographic analysis showed that 69 of the participants were male (68%) and 32 were female (32%), with the majority (77.23%) aged between 60 and 70 years. The shift workers consist of 32% of Night shift workers and 68% of Rotating Shift workers. The shift workers mostly (55%) worked for 11 to 20 years on the shift works

	Total	Daytime workers	Shift workers
Overall participants	101	54 (53%)	47 (47%)
Gender			
Male (68%)	69 (68%)	33	36
Female (32%)	32 (32%)	21	11
Age Group			
60-70 years	78	39	39
71-80 years	20	12	8
Above 80 years	3	3	NA

Table 1: The gender and age-wise distribution of participants in this study.

3.2 Glycemic Control (HbA1c Levels):

The average HbA1c levels were significantly higher among shift workers ($8.96 \pm 1.593\%$) compared to daytime workers ($6.90 \pm 1.012\%$) ($p < 0.001$) with Standard deviation (SD). Within the shift worker group, those with a history of night shifts exhibited the highest HbA1c levels with SD ($9.56 \pm 0.934\%$), whereas daytime workers had better glycemic control. The

duration of shift work was positively correlated with poorer glycemic control, particularly in those with 11-20 years of shift work exposure, where HbA1c levels peaked that is 9.30%.

	Daytime workers	Shift workers
Average HbA1c level \pm SD (%)	6.90 \pm 1.012	6.90 \pm 1.012
p-value	<0.001	

Table 2: The average hbA1c levels of participants.

	Rotating Shift	Night Shift
Average HbA1c Level in Shift Workers \pm SD (%)	8.67 \pm 1.763	9.56 \pm 0.934
p-value	0.074	

Table 3: The average HbA1c levels of shift worker participants with a p-value.

3.3 Diabetes Duration:

The average duration of diabetes was longer in shift workers (12.04 years) than in daytime workers (10.33 years). This finding suggests that shift work may contribute to earlier onset or prolonged progression of diabetes, possibly due to the metabolic disturbances caused by circadian rhythm disruption. Especially the rotating shift workers have a longer duration (12.62 years) of diabetes than night shift workers (10.8 years).

	Daytime workers	Shift workers
Average diabetes duration	10.33 years	12.04 years
In years and months	10 years 4 months	12 years and 0.5 months

Table 4: Average Diabetes duration of participants.

3.4 Diabetes Management:

Shift workers demonstrated a higher reliance on combination therapy involving multiple oral antihyperglycemic agents compared to daytime workers, indicating that their diabetes was more challenging to manage. The glycemic index analysis further revealed that a larger proportion of shift workers had poorly controlled diabetes compared to daytime workers, with 68.09% of shift workers showing suboptimal glycemic control versus 9.26% of daytime workers.

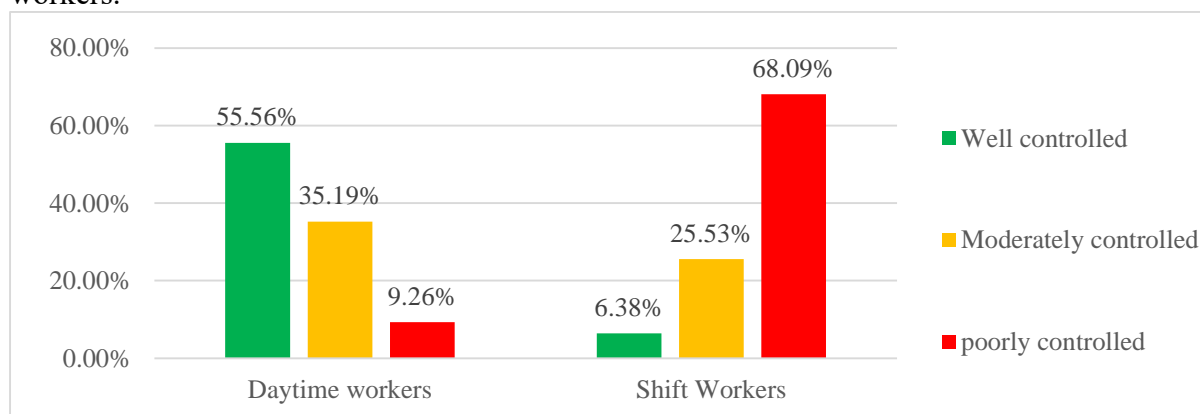


Figure 1: The glycemic index based on their HbA1c range.

3.5 Diabetic Complications:

In our study around 48% of participants have diabetic complications. Diabetic complications were more prevalent among shift workers, and shift workers developed more complications, particularly neuropathy and cardiovascular issues along with neuropathy, retinopathy & nephropathy, compared to daytime workers. In contrast, daytime workers exhibited significantly fewer complications, with neuropathy affecting only 5 and retinopathy 4. Retinopathy and nephropathy were also more frequently reported in the shift worker group,

underscoring the cumulative adverse effects of disrupted circadian rhythms and irregular work schedules.

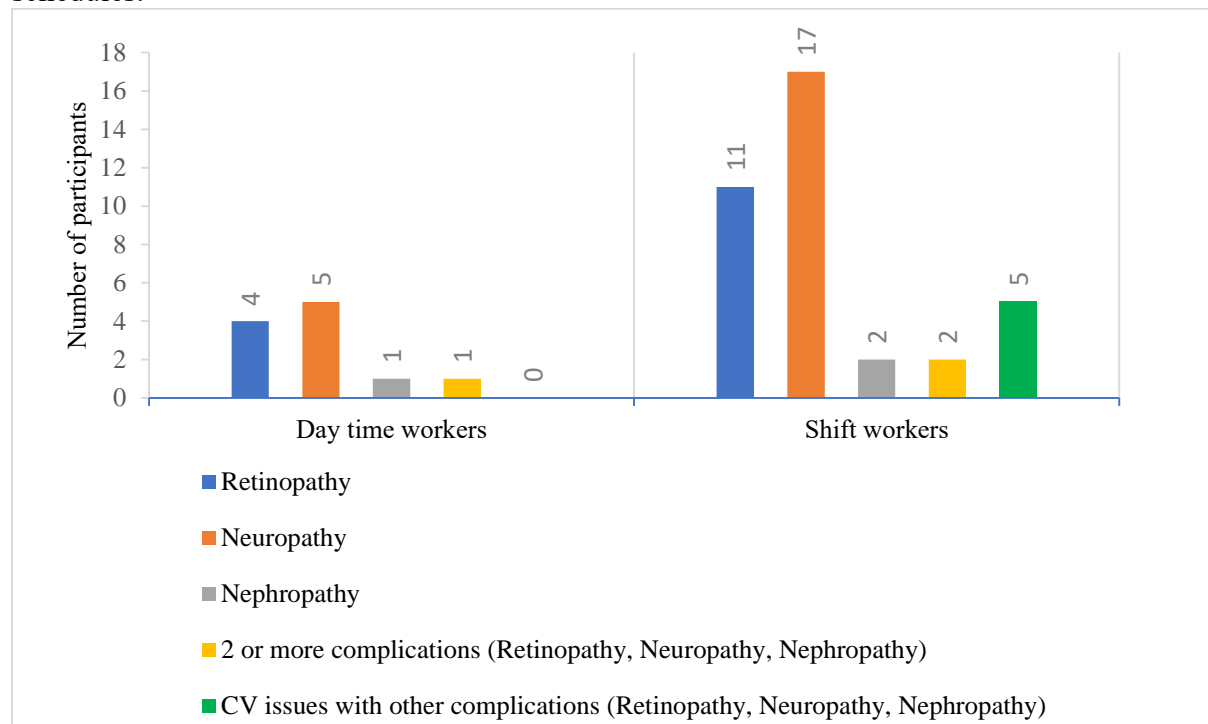


Figure 2: Number of diabetic complications among the participants.

3. DISCUSSION

The study incorporated 101 participants, with a gender distribution of 68% male and 32% female. The majority of participants (77.23%) were in the 60-70-year age group, with fewer participants in older age brackets. This distribution aligns with the study's focus on retired individuals and allows for a robust analysis of diabetes in the early retirement years. A study by Das U et.al., (2023)³ also focused on elderly populations in India, finding that diabetes prevalence was highest among older adults, particularly those above 60 years

The distribution between daytime workers (53%) and shift workers (47%) is relatively balanced, allowing for a fair comparison between these two groups in terms of diabetic outcomes. This distribution is similar to the study by Guo Y et.al., (2013)⁸, which examined the effects of shift work diabetes in retired workers.

Among shift workers, rotating shifts (68%) were more common than fixed night shifts (32%). This distribution reflects the typical work patterns in many industries and allows for analysis of how different shift types impact diabetes management. Shan Z et.al., (2018)⁹ also differentiated between rotating night shifts and other work patterns in their study on shift work and diabetes risk.

The majority of shift workers (55%) had worked shifts for 11-20 years, with 28% working shifts for over 20 years. This long-term exposure to shift work allows for analysis of cumulative effects on diabetes management. Potential correlation between the duration of shift work and glycemic control. Notably, individuals with 11-20 years of shift work experience showed the highest average HbA1c levels, indicating poorer glycemic control.

Vetter et.al., (2018)¹⁰ found that longer exposure to night shift work was associated with a higher risk of type 2 diabetes, particularly pronounced after 10 years of shift work. They observed a 15% higher risk of type 2 diabetes for every 5 years of shift work exposure. The

slight decrease in HbA1c levels for those with over 20 years of shift work might be attributed to survivorship bias or improved adaptation to shift work over time

Shift workers, particularly those on rotating shifts, had a longer average duration of diabetes compared to daytime workers. These findings are consistent with a large-scale study by Pan et.al., (2011)⁶, which found that longer durations of rotating night shift work were associated with an increased risk of type 2 diabetes

The difference in HbA1c levels between daytime and shift workers is statistically significant ($p < 0.001$). Shift workers have a substantially higher average HbA1c level compared to daytime workers. The difference in HbA1c levels between rotating shift and night shift workers is not statistically significant at the 0.05 level, the p-value of 0.074 suggests a potential difference that might be confirmed with a larger sample size or longer study duration. Ihab Mohammadi El Tayeb et.al., (2014)¹¹ found that shift work was associated with poor glycemic control in patients with type 2 diabetes. They reported that HbA1c levels were significantly higher in shift workers than in non-shift workers.

A higher proportion of daytime workers had well-controlled diabetes compared to shift workers. Conversely, a much larger percentage of shift workers had poorly controlled diabetes, suggesting that shift work may negatively impact glycemic control. This aligns with findings from Albishri MA et al., (2021)¹², who found that shift workers with diabetes had worse glycemic control compared to daytime workers.

Shift workers more frequently required combination therapy (multiple drugs) for diabetes management compared to daytime workers. This suggests that shift workers may have more difficult-to-control diabetes. Knutsson A. and Kempe A.'s (2014)⁷ review noted that shift workers often require more intensive diabetes management.

In this study, we noted that 48% of participants have diabetic complications. This high prevalence of complications underscores the importance of effective diabetes management. The relationship between poor glycemic control and complications is well-established in the literature, as discussed by Fowler (2008)¹³.

Shift workers develop more complications, particularly neuropathy and cardiovascular issues, compared to daytime workers. Ihab Mohammadi El Tayeb et.al., (2014)¹¹ study shows a higher frequency of microvascular complications (diabetic retinopathy and diabetic nephropathy) among the shift work group than the daytime group.

4. CONCLUSION

This retrospective cohort study aimed to investigate the impact of past daytime and shift work on diabetic incidence, glycemic control, and associated complications in retired individuals. The key findings are:

- Shift workers had higher average HbA1c levels (8.96%) compared to daytime workers (6.90%), especially those who worked night shifts (9.56%)
- The average duration of diabetes was longer in shift workers (12.04 years) compared to daytime workers (10.33 years)
- A higher percentage of shift workers had poorly controlled glycemia (68.09%) compared to daytime workers (9.26%)
- Shift workers developed more diabetic complications, particularly neuropathy and cardiovascular issues, compared to daytime workers

These results suggest that past shift work, especially night shifts, may have long-term detrimental effects on glycemic control and the development of diabetic complications even

after retirement. Tailored interventions targeting retired shift workers' sleep patterns and lifestyle factors could help mitigate these adverse outcomes.

5. LIMITATIONS

The study had a limited sample size of 101 participants, which may not be fully representative of the entire retired population. Additionally, reliance on self-reported data regarding past work history and sleep patterns introduces the possibility of recall bias, potentially affecting the accuracy of the findings. As a retrospective cohort study with a cross-sectional design, the research cannot establish causality between shift work and diabetic outcomes. The six-month duration of the study may have further limited its ability to capture long-term trends or seasonal variations in diabetic control. Conducted in a single region, the study's findings are also limited in generalizability to broader populations. Moreover, the absence of information on participants' diabetic status or glycemic control before retirement makes it difficult to establish a clear cause-and-effect relationship between shift work and diabetic outcomes. To address these limitations, future studies should include larger sample sizes, adopt longitudinal designs, utilize objective sleep assessments, and gather comprehensive data to provide a more definitive understanding of the long-term impacts of shift work on diabetes management and outcomes in retirees.

6. REFERENCES

1. Diabetes. World Health Organization. Accessed January 12, 2024. <https://www.who.int/news-room/fact-sheets/detail/diabetes>.
2. Jha RP, Shri N, Patel P, Dhamnetiya D, Bhattacharyya K, Singh M. Trends in the diabetes incidence and mortality in India from 1990 to 2019: a joinpoint and age-period-cohort analysis. *Journal of Diabetes & Metabolic Disorders*. 2021;20(2):1725-1740.
3. Das U, Kar N. Prevalence and risk factor of diabetes among the elderly people in West Bengal: Evidence-based Lasi 1st Wave. *BMC Endocrine Disorders*. 2023;23(1):170-179.
4. Preston BT, Capellini I, McNamara P, Barton RA, Nunn CL. Parasite resistance and the adaptive significance of sleep. *BMC Evolutionary Biology*. 2009;9(1):7-15.
5. Kecklund G, Axelsson J. Health consequences of shift work and insufficient sleep. *British Medical Journal*. Published online 2016:i5210.
6. Pan A, Schernhammer ES, Sun Q, Hu FB. Rotating night shift work and risk of type 2 diabetes: Two prospective cohort studies in women. *PLoS Medicine*, 2011; 8(12), e1001141.
7. Knutsson A, Kempe A. Shift work and diabetes--a systematic review. *Chronobiology International*. 2014;31(10):1146-1151.
8. Guo Y, Liu Y, Huang X, et al. The effects of shift work on sleeping quality, hypertension and diabetes in retired workers. *PLoS One*. 2013;8(8):e71107.
9. Shan Z, Li Y, Zong G, et al. Rotating night shift work and adherence to unhealthy lifestyle in predicting risk of type 2 diabetes: results from two large US cohorts of female nurses. *British Medical Journal*. 2018; 363:k4641.
10. Vetter C, Dashti HS, Lane JM, et al. Night shift work, genetic risk, and type 2 diabetes in the UK Biobank. *Diabetes Care*. 2018;41(4):762-769.
11. El Tayeb IM, Ramadan BK, eds. Impact of Shift Work on Glycemic Control in Insulin Treated Diabetics Dar El Chefa Hospital, Egypt 2014. *International Journal of Diabetes Research*. 2014;3(2):15-21.
12. Albishri MA, Alsubaie DM, Abugad HA, Abdel Wahab MM. Association between glycemic control and shift working among healthcare workers with diabetes, Dammam, Saudi Arabia: Five years' experience. *Saudi Medical Journal*. 2021;42(12):1296-1301.
13. Fowler MJ. Microvascular and macrovascular complications of diabetes. *Clinical Diabetes*. 2008;26(2):77-82.