IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

STUDY ON THE ASSOCIATION OF DIET DIVERSITY SCORES WITH CIRCADIAN RHYTHM AND INDIAN DIABETES RISK SCORE AMONG MNC EMPLOYEES (AGED 23–40 YEARS) RESIDING IN PAYING GUEST (PG) ACCOMMODATIONS IN MUMBAI, MAHARASHTRA

[1]Dolly Jitendra Shah , [2]Dr. Nisha Bellare

[1]Masters in specillized Dietetics , [2] PHD,

[1] Speciallized Dietetics ,

[1]S.N.D.T Women's University, Mumbai Maharashtra

Abstract:

Background:

The increasing burden of non-communicable diseases, particularly type 2 diabetes mellitus, among young adults is a growing global and national concern. Rapid urbanization, sedentary occupational patterns, irregular dietary habits, and circadian rhythm disruptions have significantly contributed to rising metabolic risk, especially among employees in multinational corporations (MNCs). Individuals residing in paying guest (PG) accommodations are further exposed to unhealthy dietary environments and irregular lifestyles. While dietary diversity, chronotype, and diabetes risk are independently studied, limited research has explored their combined interaction. Therefore, this study aimed to examine the relationship between dietary diversity, circadian rhythm (chronotype), and diabetes risk among young MNC employees.

Objectives:

To assess the sociodemographic and anthropometric profile of participants; to evaluate dietary intake and dietary diversity scores; to determine chronotype using the Morningness–Eveningness Questionnaire; to assess diabetes risk using the Indian Diabetes Risk Score (IDRS); and to analyze the association between dietary diversity, chronotype, and diabetes risk among MNC employees residing in PG accommodations.

Methodology:

A cross-sectional observational study was conducted among 195 participants (97 males and 98 females) aged 23–40 years, employed in MNCs and residing in PG accommodations in Mumbai. Participants were selected using convenience sampling. Data collection included demographic details, anthropometric measurements (height, weight, BMI, waist and hip circumference), dietary assessment through 24-hour recall and semi-quantitative Food Frequency Questionnaire, dietary diversity scoring, chronotype assessment using the Morningness–Eveningness Questionnaire (MEQ), and diabetes risk evaluation using the Indian Diabetes Risk Score (IDRS). Statistical analysis was performed to examine associations between study variables.

Results: The Intermediate chronotype was most prevalent (26.2%). Working hours were significantly associated with chronotype ($p = 0.042$), with "Definite Evening" types disproportionately working 10–12 hours daily. Central adiposity (waist-to-hip ratio) differed significantly across groups ($p = 0.023$), peaking in Intermediate types. Regarding diet, evening types showed significantly lower consumption of cereals ($p = 0.011$) and legumes/nuts ($p = 0.005$). Critically, "Definite Evening" types recorded the highest estimated diabetes risk (mean IDRS: 42.61 ± 13.89), and a significant negative correlation was found between MEQ and IDRS scores ($r = -0.212$, $p = 0.003$), indicating that morningness is associated with lower risk. High sedentary behaviour in evening types ($p = 0.049$) was identified as a primary risk driver.

Conclusion: Evening chronotype is independently associated with higher estimated diabetes risk and poorer intake of foundational food groups among young professionals. These findings suggest that integrating chronotype screening into workplace wellness programs could be a cost-effective strategy for early T2DM mitigation in urban India.

***Index Terms* - Chronotype, Morningness–Eveningness Questionnaire, Dietary Diversity Score, Indian Diabetes Risk Score, Circadian Rhythm, MNC Employees, Type 2 Diabetes**

I. INTRODUCTION

In recent decades, the health scale globally has undergone tremendous change. Diseases that could once boast the dubious honor of being the leading cause of death were overtaken, stealthily and silently, by the phenomenon of non-communicable diseases. These illnesses, majorly looking at diabetes mellitus, are now a worldwide concern and the growth rate is increasing rapidly. According to the IDF Diabetes Atlas, there are currently 537 million adults suffering from diabetes across the globe, with the figures expected to flare up to 783 million cases in 2045 (Magliano et al. , 2021). Younger adults aged 23-40 are increasingly being diagnosed with metabolic disorders, usually regarded as the disease of middle-age or old age patients (Strati et al., 2024; Molnár et al., 2025). Young-onset type 2 diabetes is characterized by a significantly increased risk of complications and premature mortality compared to older ages of disease onset (Luk et al., 2025). The WHO estimates that by 2022, there had been 14% of adults suffering from diabetes across the globe with annual incidence growth (WHO, 2024). Recent studies from South India have found that there is a growing incidence of young-onset diabetes, with sedentary lifestyles playing a major role (Harihar et al., 2025). Moreover, young adults living in eastern and central parts of India suffer greatly from the problem of metabolic syndrome and associated risk factors (Dash et al., 2025). Urban environment is one such risk factor: densely populated, fast-paced cities like Mumbai, known for their stressful environment, lack of exercise, irregular sleep, and poor nutrition pose a threat to residents; health and wellbeing (Goel et al., 2024). The first groups of interest in relation to this problem include both workers employed in multinational corporations (MNCs) and people living in paying guest (PG) accommodations. The former group faces a number of problems due to the MNC work culture that, while bringing money into pockets, adversely affects people health and wellbeing. Firstly, working at a desk is an activity that involves almost complete immobility. Secondly, MNC jobs imply attending various back-to-back meetings that prevent people from having lunch and taking regular meal-breaks. Lastly, constant job stress leaves the nervous system in a chronically heightened state, which in turn leads to increased stress levels. Additionally, living in PG places people at risk of sedentary lifestyle: unable to cook, they resort to eating outside and skipping meals when possible. The combination of both sedentary occupation and lack of healthy cooking options creates conditions that allow diabetes risk to develop and grow.

Early identification of metabolic risk is crucial when dealing with young adults with high diabetes susceptibility. As mentioned above, this risk can potentially be assessed via the use of special tests, such as the Indian Diabetes Risk Score (IDRS). Besides diet and physical activity, there is one other aspect of modern urban life that scientists keep discovering more and more information about: the phenomenon of circadian rhythm disruptions. Indeed, it turns out that every single cell in humans; bodies follows a special rhythm, based on a 24-hour cycle of wakefulness and sleeping, hormone secretion, metabolism and glucose regulation (Peng et al., 2022). Specifically, circadian rhythm disturbances have been shown to increase insulin insensitivity, disrupt glucocorticoid and melatonin

levels, and make a person less tolerant of glucose intake (Metab J, 2024). A large longitudinal study found that women with
evening chronotypes, predisposed to working and staying awake at night time, faced the risk of
type 2 diabetes if their lifestyle included unhealthy habits (Kianersi et al., 2023). Thus, the present study is justified. Indeed, MNC employees aged 23-40 and living in PG accommodations in Mumbai form a high-risk group that can benefit greatly from targeted interventions. All three of these variables (DDS, IDRS, and circadian rhythm) can be modified. This is the reason why this study aims to evaluate the relationship of Dietary Diversity Score with Circadian Rhythm and Indian Diabetes Risk Score among MNC employees
aged 23-40 residing in PG accommodation in Mumbai, Maharashtra.

II RESEARCH METHODOLOGY

This cross-sectional observational study was conducted over three months among 195 employees (97 males, 98 females; aged 23–40 years) of two multinational companies in Mumbai, residing in paying guest accommodations, recruited via convenience sampling following ethical approval from the Inter System Biomedical Ethics Committee (ISBEC) and written informed consent. Eligible participants had been employed in an MNC for at least six months, while those living with family, working from home or night shifts, or having known metabolic conditions were excluded. Data were collected using a structured case record form covering demographic characteristics, anthropometric measurements (height, weight, BMI classified per Asia-Pacific cut-offs, waist and hip circumference, waist-to-hip ratio), and dietary intake, assessed through a 72-item semi-quantitative Food Frequency Questionnaire and a three-day 24-hour dietary recall (two weekdays, one weekend day), with nutrient values derived from the Indian Food Composition Tables (2017) and compared against ICMR-RDA standards. Dietary diversity was evaluated using the FAO Individual Dietary Diversity Score (IDDS), based on nine food groups from the 24-hour recall and classified as low, medium, or high diversity. Chronotype was assessed using the 19-item Horne and Östberg Morningness–Eveningness Questionnaire (MEQ), classifying participants into five chronotype categories (Definite Morning to Definite Evening), while diabetes risk was estimated using the validated Indian Diabetes Risk Score (IDRS), incorporating age, waist circumference, physical activity, and family history, and stratified into low, moderate, and high-risk categories. Data were analysed using SPSS version 21, with descriptive statistics (mean, frequency, standard deviation) and inferential tests (chi-square, ANOVA, t-test) used to assess associations between chronotype, anthropometric, dietary, and diabetes risk variables.

III. RESULTS AND DISCUSSION

3.1 : Baseline Demographic Characteristics of MNC Employees by MEQ Chronotype Category (N = 195)

table 3.1: mean baseline demographic characteristics of mnc employees by meq chronotype category (n = 195)

Characteristic	Definite Evening (n=23)	Moderate Evening (n=22)	Intermediate (n=51)	Moderate Morning (n=47)	Definite Morning (n=52)	p-value
Gender, n (%)						
Male	9 (39.1%)	16 (72.7%)	27 (52.9%)	21 (44.7%)	24 (46.2%)	0.156
Female	14 (60.9%)	6 (27.3%)	24 (47.1%)	26 (55.3%)	28 (53.8%)	
Marital Status, n (%)						
Single	14 (60.9%)	16 (72.7%)	34 (66.7%)	29 (61.7%)	37 (71.2%)	0.377
Married	7 (30.4%)	5 (22.7%)	15 (29.4%)	18 (38.3%)	15 (28.8%)	
Divorced	2 (8.7%)	1 (4.5%)	2 (3.9%)	0 (0%)	0 (0%)	
Highest Qualification, n (%)						

HSC	0 (0%)	1 (4.5%)	1 (2.0%)	4 (8.5%)	3 (5.8%)	0.386
Graduate	12 (52.2%)	12 (54.5%)	28 (54.9%)	22 (46.8%)	35 (67.3%)	
Post-Graduate	11 (47.8%)	9 (40.9%)	22 (43.1%)	21 (44.7%)	14 (26.9%)	
Nature of Work, n (%)						
Desk-based	12(52.2%)	15 (68.2%)	27 (52.9%)	27 (57.4%)	26 (50.0%)	0.706
Field-based	5 (21.7%)	4 (18.2%)	6 (11.8%)	7 (14.9%)	11 (21.2%)	
Hybrid/Mixed	6 (26.1%)	3 (13.6%)	18 (35.3%)	13 (27.7%)	15 (28.8%)	
Total Working Hours/Day, n (%)						
<=8 hours	1 (4.3%)	2 (9.1%)	7 (13.7%)	4 (8.5%)	7 (13.5%)	**0.042***
9-10 hours	8 (34.8%)	5 (22.7%)	33 (64.7%)	23 (48.9%)	21 (40.4%)	
10-12 hours	10(43.5%)	12 (54.5%)	9 (17.6%)	14 (29.8%)	20 (38.5%)	
>12 hours	4 (17.4%)	3 (13.6%)	2 (3.9%)	6 (12.8%)	4 (7.7%)	
Duration of Living Away from Home, n (%)						
<6 months	2 (8.7%)	5 (22.7%)	3 (5.9%)	5 (10.6%)	4 (7.7%)	0.008**
6-12 months	1 (4.3%)	6 (27.3%)	16 (31.4%)	10 (21.3%)	6 (11.5%)	
1-2 years	12(52.2%)	9 (40.9%)	11 (21.6%)	12 (25.5%)	15 (28.8%)	
>2 years	8 (34.8%)	2 (9.1%)	21 (41.2%)	20 (42.6%)	27 (51.9%)	
Monthly Income, n (%)						
<Rs.30,000	0 (0%)	1 (4.5%)	7 (13.7%)	3 (6.4%)	9 (17.3%)	0.185
Rs.30,000-50,000	6 (26.1%)	5 (22.7%)	19 (37.3%)	18 (38.3%)	18 (34.6%)	
Rs.50,000-70,000	10(43.5%)	12 (54.5%)	14 (27.5%)	19 (40.4%)	13 (25.0%)	
>Rs.70,000	7 (30.4%)	4 (18.2%)	11 (21.6%)	7 (14.9%)	12 (23.1%)	

The study sample comprised 195 MNC employees, with a near-equal gender distribution: 97 males (49.7%) and 98 females (50.3%). The Intermediate chronotype (n=51, 26.2%) represented the largest group, followed by the Definite Morning Type (n=52, 26.7%), Moderate Morning Type (n=47, 24.1%), Definite Evening Type (n=23, 11.8%), and Moderate Evening Type (n=22, 11.3%).

Working hours per day showed a statistically significant association with MEQ chronotype (chi2=21.64, p=0.042). Evening-type participants (Category 1) were disproportionately represented in the 10-12 hours category (43.5%), whereas Intermediate-type participants predominantly worked 9-10 hours per day (64.7%). Duration of living away from home was also significantly associated with chronotype (chi2=26.96, p=0.008). Definite Evening types more frequently reported living away from home for 1-2 years (52.2%), while Definite Morning types were more likely to have lived away for over two years (51.9%).

The significant association observed between working hours per day and chronotype (p=0.042) aligns with research suggesting that evening-type individuals are more likely to work longer hours or irregular schedules

The significant association between duration of living away from home and chronotype (p=0.008) is noteworthy. Participants who had been living away from home for more than two years were more likely to belong to Morning-type categories, whereas Evening types were more concentrated in the 1-2 year bracket.

3.2 Anthropomtric Measurements of the Study Sample

Anthropometric parameters were compared across MEQ chronotype categories using one-way ANOVA to determine whether chronotype was associated with any differences in body composition indicators. Table 4.2 presents the mean values and standard deviations for age, weight, height, BMI, waist circumference, hip circumference, and waist-to-hip ratio for each category.

table 3.2: mean anthropometric measurements of the study sample by meq chronotype category (n = 195)

Variable	Definite Evening (n=23)	Moderate Evening (n=22)	Intermediate (n=51)	Moderate Morning (n=47)	Definite Morning (n=52)	F-value	p-value
Age (years)	28.96 +/- 3.69	27.45 +/- 3.29	27.47 +/- 2.72	28.68 +/- 3.36	28.19 +/- 2.74	1.65	0.164
Weight (kg)	72.49 +/- 9.41	72.20 +/- 10.64	70.72 +/- 10.14	69.60 +/- 11.57	71.80 +/- 8.75	0.51	0.728
Height (cm)	165.93 +/- 5.91	169.53 +/- 6.22	167.40 +/- 6.52	167.25 +/- 7.14	167.77 +/- 5.95	0.94	0.444
BMI (kg/m2)	26.28 +/- 2.87	25.15 +/- 3.74	25.21 +/- 3.07	24.90 +/- 4.07	25.51 +/- 2.92	0.72	0.580
Waist circumference (cm)	87.36 +/- 7.37	87.69 +/- 7.07	86.77 +/- 6.90	84.94 +/- 7.96	85.95 +/- 5.75	0.89	0.470
Hip circumference (cm)	107.33 +/- 6.64	107.33 +/- 7.87	105.21 +/- 6.63	106.03 +/- 7.45	106.31 +/- 6.02	0.58	0.675
Waist to hip ratio	0.808 +/- 0.057	0.815 +/- 0.028	0.827 +/- 0.042	0.800 +/- 0.042	0.805 +/- 0.039	2.91	**0.023***

No statistically significant differences were observed across MEQ chronotype categories for age (F=1.65, p=0.164), weight (F=0.51, p=0.728), height (F=0.94, p=0.444), BMI (F=0.72, p=0.580), waist circumference (F=0.89, p=0.470), or hip circumference (F=0.58, p=0.675). The mean BMI of the sample ranged from 24.90 kg/m2 (**Moderate Morning)** to 26.28 kg/m2 (**Definite Evening)** , with all group means within the normal to pre-obesity range by Asian cut-off values.

Waist-to-hip ratio (WHR) was the only anthropometric variable that showed a statistically significant difference across chronotype categories (F=2.91, p=0.023). The Intermediate type recorded the highest mean WHR (0.827 +/- 0.042), followed by Moderate Evening type (Category 2, 0.815 +/- 0.028). The Moderate Morning type had the lowest mean WHR (0.800 +/- 0.042).

The present study did not find statistically significant differences in BMI, weight, height, waist circumference, or hip circumference across MEQ chronotype categories.

3.3 Dietary Diversity Score (DDS) of the Study Sample by MEQ Chronotype Category (N = 195)

Dietary diversity was assessed using the Dietary Diversity Score framework, which evaluates consumption across ten standardised food groups. The overall DDS total score and coded dietary diversity categories were compared across MEQ chronotype groups. Additionally, individual DDS food group consumption was examined via chi-square testing to identify items significantly associated with chronotype. Table 4.5 presents these findings.

table 3.3 : mean dietary diversity score (dds) of the study sample by meq chronotype category (n = 195)

Food Group / DDS Item	Response	Definite Evening (n=23)	Moderate Evening (n=22)	Intermediate (n=51)	Moderate Morning (n=47)	Definite Morning (n=52)	Total (N=195)	χ^2 (df=4)	p-value
DDS Total Score									
DDS Total		**8.87 +/- 2.18**	**9.82 +/- 1.30**	**9.49 +/- 1.50**	**9.57 +/- 1.63**	**9.56 +/- 1.50**		**F=1.15**	**0.336**

Table 3.3 presents the chi-square analysis of 16 DDS food group items across MEQ chronotype categories. The mean DDS total score for the overall sample was 9.49 +/- 1.61 out of a possible 13 groups. No statistically significant difference in DDS total was found across MEQ categories (F=1.15, p=0.336), with scores ranging from 8.87 +/- 2.18 in the Definite Evening type to 9.82 +/- 1.30 in the Moderate Evening type. Similarly, the coded dietary diversity variable did not differ significantly across groups (F=0.70, p=0.594). The Moderate Evening type had the lowest mean coded score (1.45), suggesting relatively higher dietary diversity within that group.

Of the 16 items evaluated, two demonstrated statistically significant associations: cereals (χ^2 = 12.991, p = 0.011) and legumes, nuts, and seeds (χ^2 = 14.696, p = 0.005). Oils and fats were consumed universally (100% across all groups) and therefore excluded from chi-square analysis. The remaining 13 food group items did not reach statistical significance, although several showed clinically relevant trends.

3.4 Morningness-Eveningness Questionnaire (MEQ) Scores and Item-Level Responses by Chronotype Category (N = 195)

table 3.4: mean morningness-eveningness questionnaire (meq) scores and item-level responses by chronotype category (n = 195)

MEQ Item / Variable	Definite Evening (n=23)	Moderate Evening (n=22)	Intermediate (n=51)	Moderate Morning (n=47)	Definite Morning (n=52)	Test Statistic	p-value
MEQ Total Score							
MEQ Total Score	**36.17 +/- 3.95**	**71.68 +/- 1.84**	**53.86 +/- 2.86**	**45.74 +/- 2.42**	**63.40 +/- 3.37**		**<0.001*****

The mean MEQ total score for the overall sample was 54.37 +/- 11.04, reflecting an overall Intermediate to Moderate Morning tendency. The one-way ANOVA demonstrated a highly significant difference in MEQ total scores across all five categories (F=624.83, p<0.001), confirming the validity of the chronotype classification. The Definite Evening type (Category 1) recorded the lowest mean score (36.17 +/- 3.95), and the Moderate Evening type (Category 2) the highest (71.68 +/- 1.84), consistent with the scale's scoring structure. The Definite Morning type (Category 5) averaged 63.40 +/- 3.37, Moderate Morning (Category 4) averaged 45.74 +/- 2.42, and Intermediate (Category 3) averaged 53.86 +/- 2.86.

All 19 items demonstrated highly significant chi-square values ($p < 0.001$), providing strong internal validation of the MEQ's discriminant ability in this Indian MNC-PG-resident population. This consistent pattern confirms that the five chronotype categories represent distinct circadian phenotypes rather than arbitrary classifications, and that the MEQ performs reliably within this urban professional cohort.

3.5 Indian Diabetes Risk Score (IDRS) of the Study Sample by MEQ Chronotype Category (N = 195)

table 3.5: mean indian diabetes risk score (idrs) of the study sample by meq chronotype category (n = 195)

IDRS Component	**Definite Evening (n=23)**	**Moderate Evening (n=22)**	**Inter mediate (n=51)**	**Moderate Morning (n=47)**	**Definite Morning (n=52)**	**F-Statistic**	**& p-value**
Age (years)	28.96 ± 3.69	27.45 ± 3.29	27.47 ± 2.72	28.68 ± 3.36	28.19 ± 2.74	F=1.647	p = 0.164
Waist Circumference Risk Score (Female >90 cm / Male >100 cm; max score = 20 pts)	9.13 ± 5.96	5.45 ± 5.96	6.86 ± 7.07	6.17 ± 7.39	5.96 ± 7.21	F=1.082	p = 0.367
Sedentary Behaviour Score (No exercise & sedentary at work/home; max score = 30 pts)	**21.74 ± 7.17**	15.00 ± 9.64	16.47 ± 8.20	19.79 ± 9.21	17.88 ± 9.97	F=2.428	**p = 0.049***
Family History Score (Both parents diabetic; max score = 20 pts)	10.87 ± 5.96	10.00 ± 5.35	9.02 ± 6.40	10.64 ± 6.39	10.38 ± 5.93	F=0.610	p = 0.656 (NS)
IDRS Total Score (max score = 100 pts)	**42.61 ± 13.89**	**30.45 ± 13.97**	**32.75 ± 13.13**	**37.45 ± 13.26**	**34.23 ± 11.94**	F=3.456	**p = 0.009****

The overall mean IDRS total score for the sample was **35.18 +/- 13.37.** A statistically significant difference in IDRS total scores was observed across MEQ chronotype categories (F=3.46, p=0.009). **The Definite Evening type recorded the highest mean IDRS total score (42.61 +/- 13.89), indicating the greatest estimated diabetes risk**. The Moderate Evening type had the lowest mean IDRS total (30.45 +/- 13.97), followed by the Intermediate type (32.75 +/- 13.13), Definite Morning type (34.23 +/- 11.94), and Moderate Morning type (37.45 +/- 13.26).

Among the IDRS component scores, **the sedentary behaviour score showed a borderline significant difference across categories (F=2.43, p=0.049). The Definite Evening type again recorded the highest mean sedentary score (21.74 +/- 7.17)**, whereas the Moderate Evening type had the lowest (15.00 +/- 9.64). Waist circumference risk score (p=0.367) and family history score (p=0.656) did not differ significantly across chronotype groups.

The finding that MEQ chronotype was significantly associated with IDRS total score (F=3.46, p=0.009), with the Definite Evening type recording the highest mean score (42.61 +/- 13.89), represents one of the most clinically significant findings of this study. The IDRS is a validated non-invasive screening tool developed for the Indian population, with scores of 60 and above indicating high risk for type 2 diabetes mellitus (Mohan et al., 2005). While the group means in the present study fall below this high-risk threshold, the significantly elevated scores in Evening types warrant clinical attention, particularly given the younger age profile of this sample.

3.6 Comparison of Key Variables across DDS Categories

To provide a comprehensive overview, one-way ANOVA was conducted for all key study variables across the three DDS categories. Table 4.11 presents the means, standard deviations, F-values, and significance levels.

table 3.6: comparison of key variables across dds categories (n = 195)

Variable	High DDS (Code 1) n=120 Mean ± SD	Low DDS (Code 2) n=3 Mean ± SD	Moderate DDS (Code 3) n=72 Mean ± SD	F-value	p-value
Dietary & Scoring Variables					
DDS Total score	10.46 ± 1.04	6.00 ± 2.65	8.03 ± 0.87	147.11	**<0.001***
MEQ Total score	55.23 ± 10.82	38.00 ± 11.36	53.63 ± 10.95	3.95	**0.021***
IDRS Total score	34.00 ± 12.79	40.00 ± 10.00	36.94 ± 14.30	1.29	0.277
Macronutrient Intakes					
Energy intake (kcal/day)	1441.05 ± 246.5	1831.67 ± 380.9	1528.83 ± 274.3	5.41	**0.005****
Protein intake (g/day)	52.19 ± 12.54	66.00 ± 12.17	56.64 ± 16.81	3.26	**0.041***
Carbohydrate intake (g/day)	214.05 ± 35.75	252.33 ± 28.38	225.97 ± 36.05	3.81	**0.024***
Fat intake (g/day)	41.48 ± 12.20	61.67 ± 23.12	44.18 ± 13.86	4.18	**0.017***
IDRS Component Scores					
Waist risk score (max 20 pts)	5.42 ± 6.60	10.00 ± 0.00	8.33 ± 7.32	4.48	**0.013***
Sedentary score (max 30 pts)	18.58 ± 9.10	20.00 ± 10.00	17.22 ± 9.23	0.56	0.571
Family history score (max 20)	9.83 ± 5.34	10.00 ± 0.00	10.56 ± 7.29	0.31	0.731
Age (years)	27.68 ± 2.84	30.00 ± 2.00	28.81 ± 3.41	3.65	0.028*

** p < 0.05; ** p < 0.01; *** p < 0.001. Low DDS group (n=3)*

Among the scoring variables, DDS total score differed highly significantly across coded categories (F = 147.11, p < .001), confirming construct validity of the grouping. MEQ total score differed significantly across DDS categories (F = 3.95, p = .021), with the High DDS group recording the highest mean MEQ score (55.23), suggesting a modest directional association between morning chronotype orientation and higher dietary diversity. IDRS total score did not differ significantly across DDS categories (p = .277). All four macronutrient variables differed significantly across DDS categories (energy: p = .005; protein: p = .041; carbohydrate: p = .024; fat: p = .017), with the Low DDS group (n=3) recording the highest mean intake values across all macronutrients. Given the very small size of the Low DDS group, these comparisons should be interpreted cautiously. Among IDRS components, the waist circumference risk score differed significantly across DDS categories (F = 4.48, p = .013), with the Low DDS group recording the highest mean waist risk score (10.00). Age also differed significantly across DDS groups ($F = 3.65$, $p = .028$).

Discussion

The present study examined circadian chronotype in relation to anthropometric, behavioural, dietary, and diabetes-risk parameters among 195 MNC employees residing in paying-guest accommodations in Mumbai, revealing a chronotype distribution weighted toward morning and intermediate types, consistent with the demands of structured occupational schedules that tend to entrain circadian preference toward earlier timing regardless of underlying biological tendency. Despite this occupational entrainment, clear behavioural and physiological gradients emerged across chronotype categories. Definite Evening types consistently exhibited the least favourable risk profile: they reported longer working hours, shorter duration of independent living, higher smoking prevalence, more frequent alcohol consumption, lower consumption of cereals and legumes/nuts/seeds, the highest Indian Diabetes Risk Score, and the greatest sedentary behaviour sub-score. This convergence of adverse indicators in a single chronotype group lends internal coherence to the findings and mirrors the broader literature associating eveningness with circadian misalignment, irregular meal timing, and elevated metabolic risk, even though several individual associations (e.g., smoking, alcohol) did not reach statistical significance in this sample, likely owing to limited subgroup sizes.

Two findings merit particular emphasis. First, waist-to-hip ratio was the only anthropometric measure to differ significantly by chronotype, underscoring that circadian phenotype may influence the pattern of fat distribution—specifically central adiposity—more than overall adiposity as captured by BMI. Given that WHR is a more sensitive correlate of insulin resistance and cardiometabolic risk than BMI alone, this finding suggests that chronotype-related risk may be under-detected when body composition is assessed using BMI in isolation. Second, the significant elevation in IDRS among Definite Evening types, coupled with the significant negative correlation between MEQ score and IDRS, indicates a graded relationship between morningness and diabetes risk. Notably, this association appears to be driven predominantly by the sedentary behaviour component of the IDRS rather than by waist circumference or family history, pointing to physical inactivity—rather than adiposity or genetic predisposition—as the principal behavioural pathway linking eveningness to elevated diabetes risk in this cohort.

The absence of significant differences in macronutrient intake and overall dietary diversity across chronotype groups, despite significant differences in specific food groups (cereals and legumes/nuts/seeds), suggests that the standardised meal environment of PG accommodations may buffer gross nutritional disparities while still permitting selective omission of specific food groups, plausibly through breakfast- or lunch-skipping behaviours characteristic of evening chronotypes. This pattern is consistent with a ceiling effect in the DDS distribution, wherein the relatively homogeneous institutional food environment constrains the detection of chronotype-driven dietary variation at the aggregate level, even as targeted deficits in specific food groups persist. Collectively, these findings suggest that workplace and residential food environments common to the MNC/PG lifestyle may mask, rather than eliminate, chronotype-associated nutritional vulnerabilities, and that diabetes risk in evening-oriented individuals within this population is better explained by circadian-linked sedentarism than by dietary or anthropometric factors alone. These results support the inclusion of chronotype-sensitive screening—particularly around physical activity and central adiposity—in occupational health programmes targeting young, urban, shift-adjacent professional populations.

Conclusion

The study demonstrates that circadian preference significantly influences dietary habits, lifestyle behaviors, and diabetes risk among young MNC employees living in PG accommodations. Evening chronotypes showed higher diabetes risk, greater sedentary behavior, longer working hours, and poorer intake of key food groups, while morning orientation was associated with lower diabetes risk. Dietary diversity positively supported nutrient adequacy, highlighting its importance in improving nutritional quality. Overall, the findings emphasize the need for chronotype-based nutrition and lifestyle interventions to reduce cardiometabolic risk in urban working adults.

REFERENCES

1. Magliano, D. J., & Boyko, E. J. (2021). *IDF Diabetes Atlas* (10th ed.). International Diabetes Federation. https://diabetesatlas.org
2. Molnár, G. A., Kiss, Z., & Wittmann, I. (2025). Young patients with type 2 diabetes have high relative risks for complications. *Frontiers in Endocrinology, 16,* 1638565. https://doi.org/10.3389/fendo.2025.1638565
3. Strati, M., Moustaki, M., Psaltopoulou, T., Vryonidou, A., & Paschou, S. A. (2024). Early onset type 2 diabetes mellitus: An update. *Endocrine, 85*(3), 965–978. https://doi.org/10.1007/s12020-024-03567-2
4. Luk, A. O. Y., Wu, H., Fan, Y., Fan, B., O, C. K., & Chan, J. C. N. (2025). Young-onset type 2 diabetes—Epidemiology, pathophysiology, and management. *Journal of Diabetes Investigation, 16*(7), 1157–1172. https://doi.org/10.1111/jdi.14350
5. World Health Organization. (2024). *Diabetes*. https://www.who.int/news-room/fact-sheets/detail/diabetes
6. Harihar, A., Arun Maiya, G., Shetty, S., et al. (2025). Prevalence of young-onset diabetes and associated physical activity profile in southern India. *Clinical Epidemiology and Global Health, 33*. https://doi.org/10.1016/j.cegh.2025.101000
7. Dash, M., Sadangi, S., Barik, B. S., Barik, M., Hussain, N. A., Hussain, T., et al. (2025). Metabolic syndrome and its associated risk factors and morbidities among young adults in Bhubaneswar: A cross-sectional study. *National Journal of Community Medicine, 16*(3), 261–270.
8. Goel, A., Goel, P., & Goel, S. (2024). The prevalence of metabolic syndrome and its association with waist circumference in middle-aged individuals from urban Mumbai. *Cureus, 16*(9), e69669. https://doi.org/10.7759/cureus.69669
9. Kianersi, S., Liu, Y., Guasch-Ferré, M., Redline, S., Schernhammer, E., & Sun, Q. (2023). Chronotype, unhealthy lifestyle, and diabetes risk in middle-aged US women: A prospective cohort study. *Annals of Internal Medicine, 176*(10), 1330–1339. https://doi.org/10.7326/M23-0727