

ORIGINAL ARTICLE

Chrononutrition Patterns and Nutritional Status Among Working and Non-Working Women Aged 20-60 Years: A Cross-Sectional Study from Surat, India

Shilpee Agrawal^{*1} , Umaymah Mohmad Degia¹

¹Department of Food and Nutrition, Faculty of Science, Vanita Vishram Women's University, AthwaGate, Surat - 395001, Gujarat, India

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ABSTRACT

Chrononutrition aligns eating patterns with circadian rhythms and is crucial for metabolic regulation. This study assessed the association between chrononutrition patterns and nutritional status among working and non-working women in Surat, Gujarat. A community-based cross-sectional study involved 400 women aged 20–60 years (200 working, 200 non-working). Data were collected using a structured, pre-tested questionnaire on demographics, anthropometric indices (BMI, WHR), dietary intake, physical activity, and chronotype. Data were analyzed using SPSS 25.0, with $p < 0.05$ considered statistically significant. Younger women (26–30 years) were more prevalent in the working group, while older women (56–60 years) were predominantly non-working. Non-working women had significantly higher BMI ($27.6 \pm 6.8 \text{ kg/m}^2$ vs. $25 \pm 5.5 \text{ kg/m}^2$, $p < 0.05$) and waist circumference ($85.9 \pm 18.1 \text{ cm}$ vs. $77.7 \pm 17.6 \text{ cm}$, $p < 0.05$), with 48.5% exhibiting central obesity (WC $> 88 \text{ cm}$) compared to 28.5% of working women. Most participants identified as intermediate chronotypes; however, the working group had a higher percentage of evening chronotypes (18% vs. 16%), while non-working women were more likely to be morning types (29% vs. 25.5%). Both groups had inadequate energy and protein intake but exceeded fat intake, reflecting poor dietary quality. Among working women, chronotype significantly associated with BMI ($p = 0.029$), fat intake ($p = 0.035$), and wake-up timing ($p = 0.04$). In non-working women, significant associations were found with waist circumference ($p = 0.023$), energy intake ($p = 0.01$), and morning tiredness ($p = 0.00$). Overall, chronotype influences nutritional status and dietary patterns, particularly in non-working women, who showed higher levels of central obesity and disrupted eating rhythms. These findings underscore the necessity for targeted dietary and lifestyle interventions aligned with chronotype to mitigate metabolic risks among sedentary women.

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*Corresponding author

E-mail: shilpeeg21@gmail.com (Dr. Shilpee Agrawal)

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1. INTRODUCTION

The intricate relationship between nutrition, biological rhythms, and health has gained significant attention in recent years, leading to the emerging field of chrononutrition. This approach goes beyond traditional dietary guidelines by considering the timing of food intake concerning the body's internal circadian rhythms. The core principle of chrononutrition stems from chronobiology, which studies the circadian rhythms regulating physiological processes such as metabolism, hormonal balance, sleep-wake cycles, and energy homeostasis. Disruptions to these rhythms, especially from misaligned eating patterns, are linked to various metabolic and psychological disorders (Almoosawi et al., 2016; Garaulet & Gómez-Abellán, 2014).

Despite growing global awareness, there is still a significant research gap regarding how chrononutrition patterns differ across demographic subgroups, particularly among women with varying occupational statuses. Working and non-working women represent distinct lifestyle categories, characterized by differences in stress levels, time constraints, sleep patterns, and dietary habits—all of which can significantly impact nutritional status and circadian alignment. For example, working women often have irregular meal timings and greater exposure to artificial light, leading to circadian misalignment and increased risks of obesity, insulin resistance, and cardiovascular disease (Dashti et al., 2018, Meléndez-Fernández et al., 2023). In contrast, while non-working women may experience lower occupational stress, they may face challenges such as sedentary behaviour or irregular routines that disrupt circadian eating patterns.

The global burden of non-communicable diseases (NCDs) among women is rising, significantly affected by poor dietary habits and lifestyle disruptions. According to the World Health Organization (2021), cardiovascular diseases, diabetes, and obesity are leading causes of death among women, often worsened by irregular meal timing and insufficient sleep. Recent NFHS-5 (2021) data in India show increasing rates of overweight and anemia among women, with urban women particularly vulnerable due to lifestyle factors. Moreover, social roles and caregiving responsibilities often limit women's ability, especially those who work, to manage their health behaviour, including meal schedules (Rattani, 2012).

Unlike traditional nutritional studies that primarily focus on dietary quantity and quality, chronotype-based research provides deeper insights into how individual biological timing affects metabolic outcomes. Emerging studies suggest that women with evening chronotypes are more likely to engage in late-night eating, experience reduced sleep duration, and have poorer diet quality—factors that collectively contribute to metabolic dysregulation (Kianersi et al., 2023; Vitale & Weydahl, 2017a). These challenges are intensified for working women with shift work or long hours, making circadian-aligned eating a crucial

area for intervention. Recent evidence highlights the benefits of time-restricted feeding and early eating windows for women, showing improvements in insulin sensitivity, body composition, and appetite regulation (Liu et al., 2024; Chaix et al., 2019). Customizing these strategies to individual chronotypes and occupational routines could yield sustainable health benefits, particularly for Indian women balancing professional and domestic responsibilities. This cross-sectional study aims to investigate and compare chrononutrition behaviors and nutritional status in working versus non-working women aged 20–60 years in Surat, India—a region undergoing rapid urbanization and lifestyle changes. By employing a chronotype-sensitive approach, the study seeks to clarify how circadian-aligned dietary patterns is associated with nutritional health, offering valuable insights for public health strategies, workplace wellness programs, and personalized dietary counselling.

2. METHODOLOGY

2.1 Study design and setting

A community based cross-sectional study was conducted to assess chrononutrition patterns and nutritional status among working and non-working women aged 20 to 60 years in Surat, Gujarat, India. The study was carried out from November 2024 to January 2025.

2.2 Study population

The target population comprised adult women aged 20 to 60 who were either employed (working part-time or full-time) or non-working (homemakers or unemployed). Exclusion criteria included pregnant or lactating women, individuals with chronic illnesses (such as diabetes or cardiovascular disease), those on specialized diets, and individuals unable to participate, in order to minimize confounding factors.

2.3 Sample size and sampling technique

A sample size of 400 women was calculated using Slovin's formula to ensure statistical validity at a 95% confidence level and a margin of error of $\pm 5\%$. The participants were equally divided into two groups: working women ($n = 200$) and non-working women ($n = 200$). A non-probability purposive sampling method was employed to select working and non-working women aged 20–60 years in Surat, Gujarat. This method specifically targeted individuals relevant to the study objectives. Recruitment took place through workplaces, community centers, and residential areas. This approach was practical and suitable given the constraints of time and resources, as well as the requirement for voluntary participation. Informed consent was obtained from all participants. The following operational definitions were used: *Working Women*: Women who are engaged in either formal or informal employment outside the home for financial compensation; *Non-Working Women*: Women

who are homemakers or unemployed, not participating in paid work; *Chrononutrition*: The study of the timing of food intake in relation to the body's circadian rhythms.

2.4 Data collection

A pre-tested and structured questionnaire was used to collect data through face-to-face interviews, ensuring clarity and minimizing biases from both the interviewer and participants. Additionally, google forms were employed to record information, facilitating subsequent tasks. The questionnaire consisted of three main components:

Demographic data: This included information such as age, education level, occupation, marital status, family structure, number of children, food preferences, and religious affiliation. This section was based on standard demographic items used in public health surveys.

Nutritional assessment: This section comprised two main components: anthropometric measurements and dietary assessment. Anthropometric data were collected using standardized procedures recommended by the World Health Organization (WHO, 2008). Height and weight were measured using a stadiometer, a non-stretchable measuring tape, and an analog weighing scale. Waist and hip circumferences were measured with a non-elastic measuring tape to assess central adiposity. From these measurements, Body Mass Index (BMI) and Waist-Hip Ratio (WHR) were calculated. The BMI classification adhered to the WHO cut-offs, while WHR was interpreted based on the Indian Consensus Guidelines for assessing abdominal obesity as presented in **Table 1** and **Table 2**, respectively. Dietary assessment employed the 24-hour dietary recall method, which focused on food types and portion sizes. The data were analyzed in accordance with the ICMR Dietary Guidelines for Indians (2024) and compared against the Recommended Dietary Allowances (RDA, 2024) to evaluate nutrient adequacy.

Table 1. Cut-Off for Waist-Hip Ratio

Group	Waist-Hip Ratio (WHR)
Normal	<0.90
At risk	>0.90

Table 2. Classification of Body Mass Index

Classification	WHO Body Mass Index (kg/m ²)
Underweight	<18.5
Normal weight	18.5 – 24.9
Overweight	25.0 – 29.9
Obese I	30.0 – 34.9
Obese II	35.0 – 39.9
Obese III	>40.0

Chrononutrition assessment: This section covered Chronotype Assessment, Daily Routine, and Physical Activity. The chrononutrition assessment involved evaluating chronotype, daily routine, and physical activity. Chronotype was determined using the Reduced Morningness–Eveningness Questionnaire (rMEQ), a validated 5-item tool (Adan & Almirall, 1991) that classifies individuals as morning, intermediate, or evening types. Chrononutrition variables—including meal timing, sleep-wake patterns, exercise habits, and alignment with biological rhythms—were gathered using a structured 24-hour timeline. This timeline also estimated Physical Activity Level (PAL) using the factorial method based on reported daily activities. PALs were categorized as light, moderate, or heavy following WHO/FAO/UNU guidelines. This comprehensive approach enabled efficient data collection in a single session, capturing detailed chronobiological and lifestyle information.

2.5 Statistical analysis

Data analysis was conducted using Microsoft Excel and SPSS 25.0. Descriptive statistics, including frequency, percentage, mean and standard deviation, were used to summarize continuous variables (e.g., Body Mass Index, nutrient intake). Chi-square tests were used to examine associations between categorical variables, particularly between chronotype and nutritional status indicators such as BMI classification and waist-hip ratio categories. The independent variable in these analyses was chronotype, while dependent variables included BMI category, WHR, and nutrient intake measures. A p-value of <0.05 was considered statistically significant.

2.6 Ethical considerations

The study followed ethical standards by obtaining informed written consent from all the recruited participants. Confidentiality as well as anonymity were maintained throughout the research, and participants retained the right to withdraw at any point without consequence. Data were anonymized before analysis to ensure privacy and ethical compliance

3. RESULTS AND DISCUSSION

3.1 Participants' demographic characteristics

Table 3 presents demographic data indicating that most employed women (35.5%) are aged 26 to 30, while most non-working women (15.5%) are aged 56 to 60. This suggests that younger women dominate the workforce, while older women are more likely to be unemployed due to familial or socioeconomic factors (Mussida & Patimo, 2021; Blau & Winkler, 2017). Educational trends show that 57.5% of employed women have a bachelor's degree, with most postgraduate degree holders also employed, indicating that higher education enhances job opportunities. In contrast, non-working women are more likely

to have only a secondary education (23%), aligning with research linking lower educational attainment to reduced access to employment (Kromydas, 2020). Occupational statistics reveal that hospital and corporate jobs (both at 27.5%) are the most common among working women, while all non-working women are homemakers. This aligns with previous studies highlighting healthcare as a prevalent and accessible sector for women, influenced by traditional gender norms (Karaçam Yılmaz et al., 2023; Tabassum & Nayak, 2021). Marital status shows a significant difference: 82.5% of non-working women are married compared to 53% of employed women. This suggests that marriage and caregiving responsibilities contribute to women's exit from formal work, a trend supported by national data indicating that 44.5% of women's absence from the labor force is due to household chores (Sarkar, 2023).

3.2 Anthropometric measurements by employment status

Table 4 shows considerable body composition disparities between working and non-working women. Non-working women had a higher average weight (67.4 ± 16.1 kg) and BMI (27.6 ± 6.8 kg/m²) than working women (61.8 ± 12.8 kg; BMI 25 ± 5.5 kg/m²), putting them closer to the obese group due to lower physical activity levels (Rao et al., 2010a). Non-working women had a larger waist circumference (85.9 ± 18.1 cm) compared to working women (77.7 ± 17.6 cm), indicating increased metabolic risk (Dote-Montero et al., 2023a), (Katagiri et al., 2014). While both groups had appropriate waist-hip ratios, non-working women had a slightly higher average (0.85 ± 0.13 vs. 0.82 ± 0.10). These findings reflect lifestyle differences in diet and exercise levels.

3.3 Body Mass Index (BMI) classification by employment status

Figure 1 illustrates significant differences in BMI distribution between working and non-working women. A larger proportion of working women (53%) fell within the normal BMI range, whereas non-working women exhibited higher rates of overweight (29%) and obesity (31.5% across all classes). The prevalence of obesity (Class I–III) was markedly higher among non-working women, with only 35% maintaining a normal BMI. These findings indicate that non-working women are more likely to be overweight or obese, potentially attributable to lower levels of physical activity and a more sedentary lifestyle. This trend aligns with the research conducted by Gouda & Kumar (2014), which associated elevated obesity rates among non-working women with lifestyle factors. The data underscore the significance of daily structure and activity in sustaining a healthy body weight.

3.4 Waist circumference (cm) classification by employment status

Figure 2 shows the differences in waist circumference between working and non-working women, a crucial indicator of central obesity. Among working women, 54.5% had normal waist measurements (64–80 cm), whereas 28.5% were classified as high risk (>88 cm). In comparison, only 37.5% of non-working women had normal waistlines, with nearly half (48.5%) in the high-risk category. These results indicate a higher prevalence of abdominal obesity among non-working women, likely due to sedentary lifestyles and lower levels of physical activity. Central obesity is associated with an increased risk of metabolic disorders, underscoring the importance of preventive lifestyle interventions. National data from NFHS-5 also reported higher odds of abdominal obesity among non-working urban women, which aligns with the trends observed in this study.

3.5 Waist-Hip ratio classification by employment status

Figure 3 illustrates that 82.5% (n=165) of working women exhibited a normal waist-to-hip ratio (WHR) (<0.90), in contrast to 74.5% (n=149)** of non-working women. A greater proportion of non-working women, 25.5% (n=51), fell into the **at-risk category (>0.90), indicating an increased vulnerability to central obesity. This trend may be linked to lower physical activity levels and sedentary lifestyles among non-working women. Supporting evidence from NFHS-5 data (Chaudhary & Sharma, 2023) reinforces this association. These findings underscore the necessity for targeted interventions to address central obesity in non-working women.

3.6 Dietary profile of working and non-working women

Table 5 indicates that both working and non-working women had intakes of calories, protein, and carbohydrates that were lower than recommended levels, while fat intake exceeded the RDA. Working women consumed an average of 1350.6 ± 370 kcal, and non-working women consumed 1420.7 ± 447.9 kcal, both of which fall short of energy requirements. Protein intake was insufficient for both groups, with working women averaging 36.4 ± 10.8 g and non-working women averaging 39 ± 12.2 g; carbohydrate intake was also inadequate. In contrast, fat intake was high, with working women consuming 54.7 ± 17.2 g and non-working women consuming 57.5 ± 19.3 g. These findings suggest that both groups have imbalanced diets characterized by protein deficiency and excess fat, which aligns with earlier research (Joglekar & Kundle, 2013). The results underscore the need for nutrition education and improved meal planning, regardless of employment status.

Table 3. Demographic Characteristics of Working and Non-Working Women

Value	Category	Working women n=200 (%)	Non-Working Women n=200 (%)
Age (in Years)	15-20	-	-
	21-25	43 (21.5)	16 (8)
	26-30	71 (35.5)	42 (21)
	31-35	33 (16.5)	28 (14)
	36-40	11 (5.5)	21 (10.5)
	41-45	21 (10.5)	22 (11)
	46-50	10 (5)	15 (7.5)
	51-55	10 (5)	25 (12.5)
	56-60	1 (0.5)	31 (15.5)
Educational Qualification	Lower Primary (class 1 to 4)	3 (1.5)	38 (19)
	Upper Primary (class 5 to 7)	2 (1)	27 (13.5)
	Secondary (class 8 to 10)	1 (0.5)	46 (23)
	Higer Secondary (class 11 and 12)	15 (7.5)	32 (16)
	Undergraduate (Bachelors)	115 (57.5)	52 (26)
	Postgraduate (Masters)	60 (30)	5 (2.5)
	Doctoral (Ph.D.)	4 (2)	-
Occupation	Home-Maker	-	200 (100)
	Teacher / Professor	40 (20)	-
	Healthcare Worker (Nurses, Midwives, Community health worker, Doctor, Pharmacist etc.)	55 (27.5)	-
	Corporate Jobs (Human Resources, Sales, Finance, Marketing, Accounting, CEO, etc.)	55 (27.5)	-
	Self-Employed	25 (12.5)	-
	Work from Home (Tutor, Online job, Sell Homemade Products)	25 (12.5)	-

Values are presented as frequency and percentage (n, %). “-” indicates no participants in that category.

Table 4. Mean Anthropometric Measurements by Employment Status

Sr. No.	Anthropometric Measurements	Working Women (n = 200)	Non-Working Women (n = 200)
1	Height (cm)	157.2 ± 6.7	155.9 ± 7.1
2	Weight (kg)	61.8 ± 12.8	67.4 ± 16.1
3	Body Mass Index (kg/m ²)	25 ± 5.5	27.6 ± 6.8
4	Waist Circumference (cm)	77.7 ± 17.6	85.9 ± 18.1
5	Waist-Hip Ratio	0.82 ± 0.10	0.85 ± 0.13

Values are presented as mean ± SD. BMI = Body Mass Index; SD = Standard Deviation; WC = Waist Circumference; WHR = Waist-Hip Ratio

Table 5. Macronutrient Intake Comparison with RDA in Study Participants

Nutrients	RDA	Working Women n=200		Non-Working Women n=200	
		Mean $\pm$ SD	Comparison ($\pm$)	Mean $\pm$ SD	Comparison ($\pm$)
Energy (Kcal)	1660	1350.6 $\pm$ 370	-309.4	1420.7 $\pm$ 447.9	-239.3
Protein (g/d)	46	36.4 $\pm$ 10.8	-9.6	39 $\pm$ 12.2	-7
Carbohydrate (g/d)	249	174.7 $\pm$ 54.9	-74.3	183.6 $\pm$ 58.6	-65.4
Fat (g/d)	37	54.7 $\pm$ 17.2	+34.7	57.5 $\pm$ 19.3	+37.5

RDA = Recommended Dietary Allowance; SD = Standard Deviation; Kcal = Kilocalories; g/d = grams per day. Values are presented as mean $\pm$ SD. Comparison ($\pm$) indicates the difference between the mean intake and RDA: negative (-) values indicate intake below RDA; positive (+) values indicate intake above RDA.

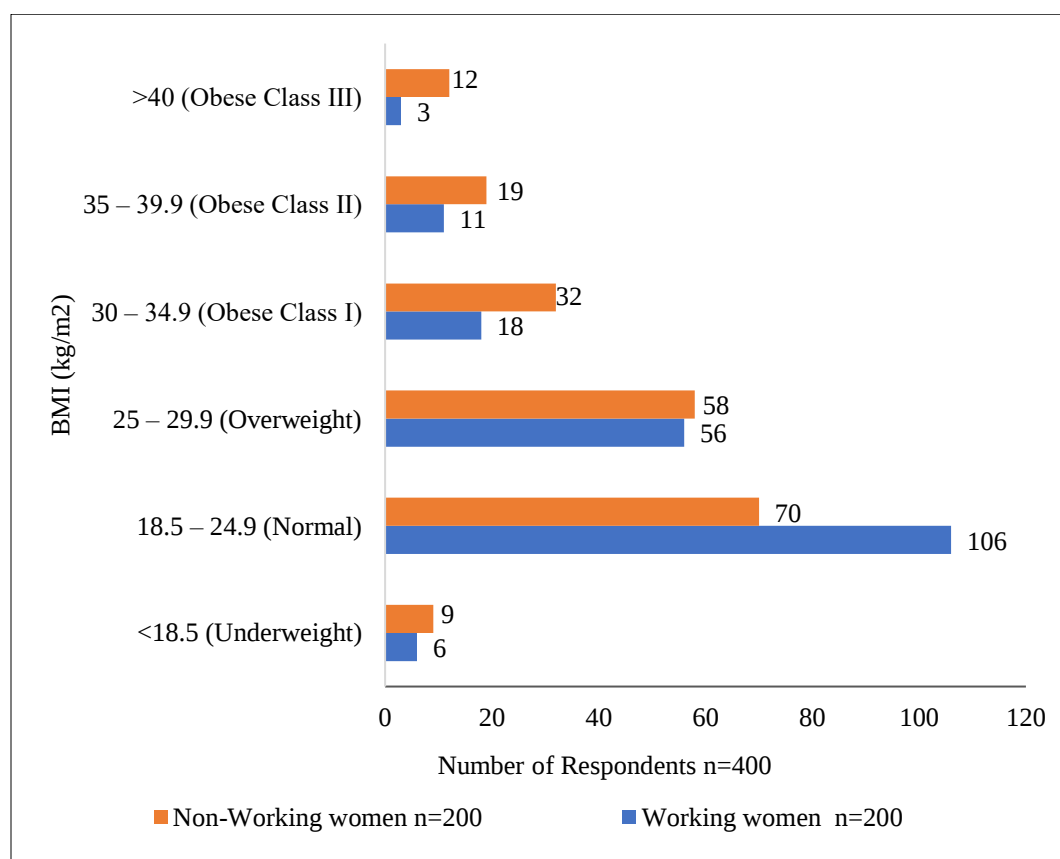


Fig. 1. Body Mass Index (kg/m²) classification of participants (Working and Non-Working Women). Values represent the number of participants. Working women (n = 200); non-working women (n = 200).

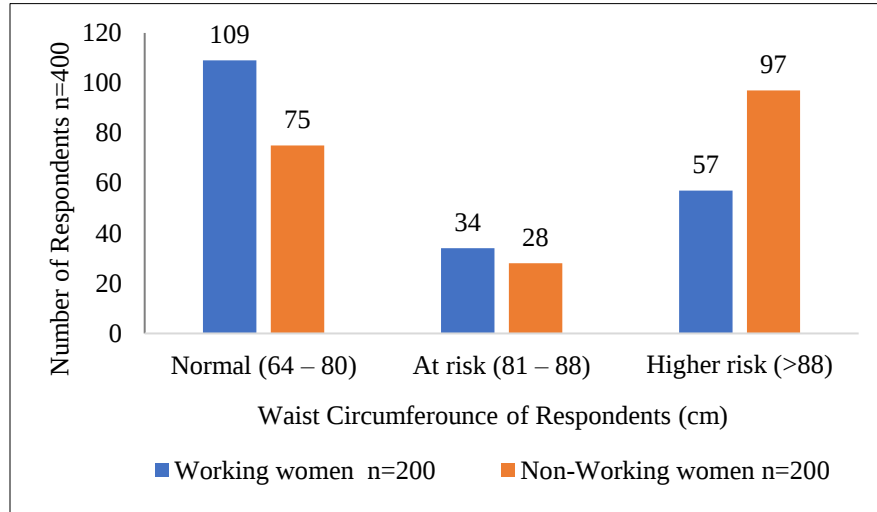


Fig.2 Waist Circumference (cm) of participants. Values represent the number of participants. Working women (n = 200); non-working women (n = 200).

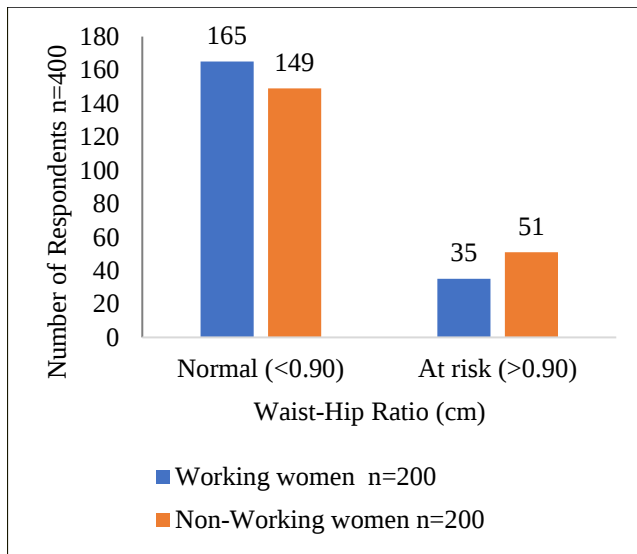


Fig. 3 Waist-Hip Ratio Classification of the participants. Values represent the number of participants. Working women (n = 200); non-working women (n = 200).

3.7 Assessment of chrononutrition patterns

3.7.1 Chronotype classification by employment status

Figure 4 illustrates the distribution of chronotypes as measured by the rMEQ. Most participants were identified as intermediate types (56.5% of working women and 55% of non-working women). Morning chronotypes were slightly more common

among non-working women (29%) compared to working women (25.5%), while evening types were more prevalent among working women (18% vs. 16%). This pattern may indicate that occupational demands influence circadian preferences toward eveningness, aligning with findings from Vitale & Weydahl (2017b). Significant associations were observed between waist circumference and wake-up time in non-working women, and between BMI and preferred wake-up time in working women. These results are consistent with Taslim et al. (2023), highlighting that circadian misalignment can adversely affect metabolic health and underscoring the importance of incorporating chronotype considerations into nutrition and lifestyle interventions for obesity and metabolic risk.

3.7.2 Participants' daily routine

3.7.2.1 Wakeup pattern of working and non-working women

Figure 5 shows that most working women woke between 6:00–7:00 a.m. (21.5%), indicating that their job schedules influenced their routines. In contrast, non-working women had a wider range of wake-up times, with peaks at 5:00–6:00 a.m. (22.5%), 6:00–7:00 a.m. (23%), and 8:00–9:00 a.m. (20%). This variability supports Jones et al. (2019), who noted that non-working adults have more flexible and inconsistent sleep-wake patterns due to the absence of imposed schedules.

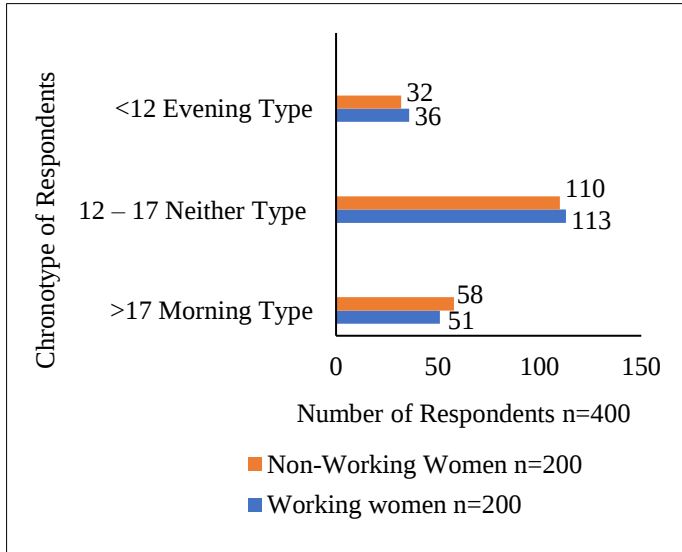


Fig. 4. Chronotype classification Among Working and Non-Working Women. Values represent the number of participants. Working women (n = 200); non-working women (n = 200). Chronotype categories based on rMEQ scoring: <12 = Evening Type, 12–17 = Neither Type, >17 = Morning Type.

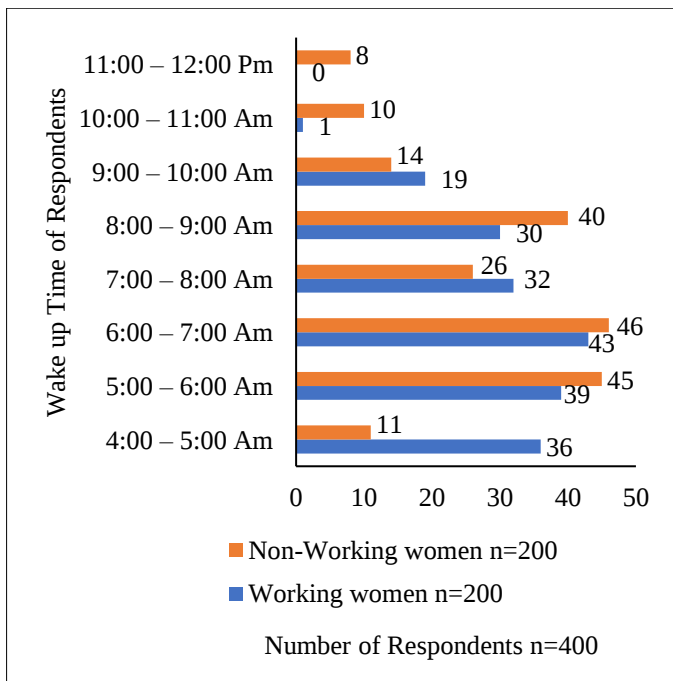


Fig. 5. Wakeup Pattern of Working and Non-Working Women. Values represent the number of participants. Working women (n = 200); non-working women (n = 200). Wake-up times are based on self-reported 24-hour recall data. No significant differences between groups are indicated unless otherwise specified.

3.7.2.2 Sleep duration among working and non-working women

As illustrated in **Figure 6**, 51% of working women reported sleeping only 4–6 hours, compared to 47.5% of non-working women, who averaged 7–9 hours. The shorter sleep durations among working women are likely due to occupational stress and time constraints, while non-working women showed longer but more irregular sleep patterns. These findings align with Brum et al. (2022), who indicated that work-related stress and inconsistent routines negatively impact sleep quantity and quality in employed women.

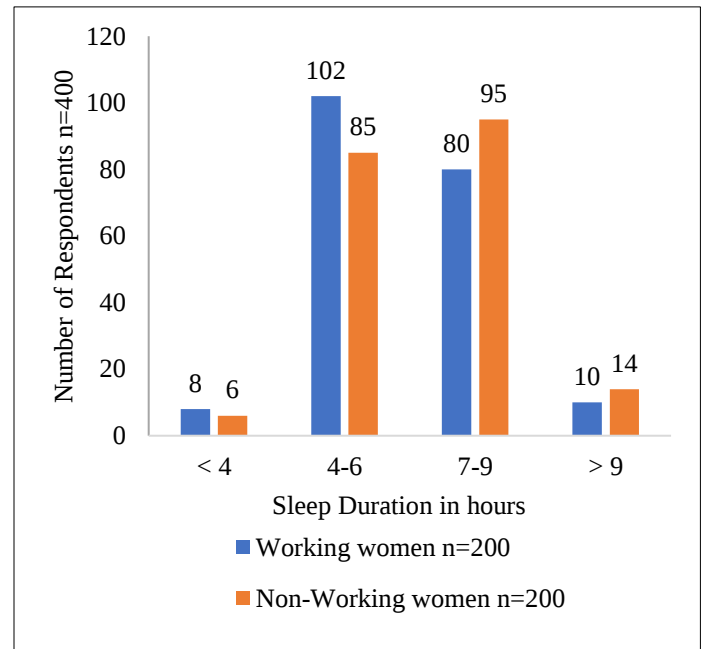


Fig. 6. Sleep Duration Among Working and Non-Working Women. Values represent the number of participants. Working women (n = 200); non-working women (n = 200). Sleep duration categories are based on self-reported hours of sleep in a 24-hour period. No significant differences between groups are indicated unless otherwise specified.

3.7.2.3 Largest meal of the day consumed by participants

Figure 7 shows that lunch was the largest meal for both working (48.5%) and non-working women (56%), while 41% of working women reported dinner as their main meal. This may reflect time constraints that lead to delayed eating among working women (Dote-Montero et al., 2023b), whereas the preference for lunch among non-working women likely results from more flexible routines and access to home-cooked meals (Rao et al., 2010b).

3.7.3 Physical activity patterns of the participants

3.7.3.1 Involvement in physical activity by employment status

Figure 8 reveals that working women participated more in structured physical activity (42.5%) compared to non-working women (32.5%). This aligns with findings by Habib et al. (2012), who noted lower levels of organized exercise among homemakers, which contributes to a higher risk of weight gain and metabolic disorders.

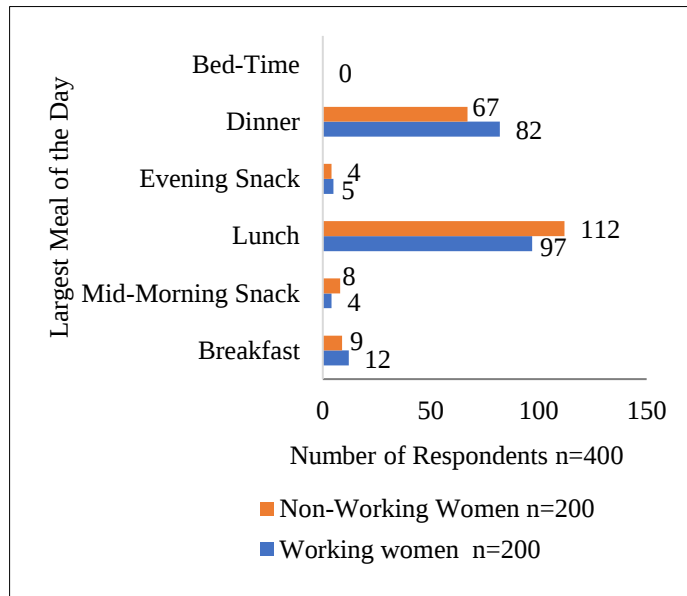


Fig. 7. Largest Meal of the day consumed by Working and Non-Working Women. Values represent the number of participants. Working women (n = 200); non-working women (n = 200). No significant differences between groups are indicated in this figure.

3.7.3.2 Physical activity level (PAL) classification by employment status

Table 6 presents physical activity level (PAL) values based on the factorial method. Working women had a significantly higher mean PAL (1.71 ± 0.28), placing them in the moderate activity category, while non-working women had a lower mean PAL (1.53 ± 0.09), indicating sedentary to light activity levels. The findings suggest that working women generally lead a more physically active lifestyle compared to their non-working counterparts, who tend to have lower activity levels.

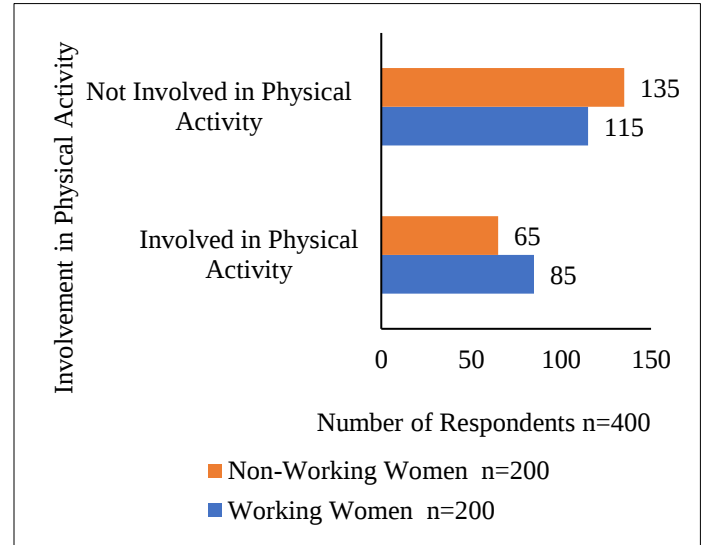


Fig. 8. Involvement in Physical Activity by Employment Status. Values represent the number of participants. Working women (n = 200); non-working women (n = 200). Involvement in physical activity is based on self-report form the 24-hour period. No significant differences between groups are indicated unless otherwise specified.

3.7.4 Relationship between nutritional status and chronotype

To assess the association between nutritional status indicators and chronotype components, Chi-square tests were performed. The results are summarized in **Table 7** and **Table 8**.

3.7.4.1 Relationship between nutritional status indicators and chronotype among working women (N = 200)

Table 7 examines the relationship between Chronotype and Nutritional Status among working women, highlighting important associations. The Waist-Hip Ratio was associated with "Time of tiredness in the evening leading to the need for sleep" ($\chi^2 = 7.840$, $p = 0.09$), although this relationship was only marginally significant. BMI exhibited a significant association with "Feeling best time of the day" ($\chi^2 = 33.63$, $p = 0.02$), suggesting that chronotype might play a role in body weight management. This aligns with earlier research indicating that individuals with a later chronotype might have a higher body mass index and poorer metabolic health outcomes, likely as a consequence of disturbances in their circadian rhythms and late-night eating habits. Fat intake was significantly related to both "Wake-up time on a supposedly free day" ($\chi^2 = 16.52$, $p = 0.03$) and "Morning and evening types of people" ($\chi^2 = 15.95$, $p = 0.04$), reinforcing the connection between disruptions in circadian rhythms and dietary fat intake (Dote-Montero et al., 2023c). However, no statistically significant relationships were observed between chronotype and other factors such as weight, height, and carbohydrate intake among working women.

3.7.4.2 Relationship between nutritional status indicators and chronotype among non-working women (N = 200)

Table 8 illustrates the relationship between chronotype and nutritional status among non-working women, highlighting several significant associations. Waist circumference was significantly associated with both "Wake-up time on a supposedly free day" ($\chi^2 = 17.79$, $p = 0.02$) and "Morning and evening types of individuals" ($\chi^2 = 14.94$, $p = 0.06$). This suggests that women who wake up later may be at an increased risk for abdominal obesity, as prior research has linked delayed wake-up times with larger waist measurements and metabolic issues (Sato & Sato, 2023). Energy intake also exhibited strong associations with various chronotype factors, including "Wake-up time on a supposedly free day" ($\chi^2 = 18.68$, $p = 0.01$), "Tiredness half an hour after waking up" ($\chi^2 = 13.88$, $p = 0.08$), and "Time of tiredness in the evening leading to the need for sleep" ($\chi^2 = 13.39$, $p = 0.09$). Furthermore, protein intake was significantly related to "Tiredness half an hour after waking up" ($\chi^2 = 25.78$, $p = 0.00$), indicating that chronotype may influence patterns of protein consumption.

The timing of meals among non-working women was found to be influenced by their wake-up time, which may affect overall metabolic health. Research by Dote-Montero et al. (2023d) emphasizes that delayed meal consumption due to later wake-up times can lead to prolonged fasting intervals, disruptions in energy balance, and increased susceptibility to metabolic

disorders, underscoring the importance of structured meal timing. Although some differences were observed in other associations, no significant trends were identified for weight, height, or carbohydrate intake.

CONCLUSION

The research highlights how employment status affects nutritional behaviour, body composition, and patterns of chrononutrition. Employed women showed improved weight control and greater levels of physical activity, but they had less sleep and more regular meal schedules, which could affect their metabolic health. On the other hand, unemployed women showed a higher likelihood of obesity and central fat accumulation, probably due to decreased physical activity, later meal times, and more adaptable daily routines. These results emphasize the importance of tailored nutrition and lifestyle strategies that correspond with a person's chronotype and professional commitments. Promoting consistent exercise, organized meal preparation, and a well-rounded macronutrient distribution is vital for lowering the chances of metabolic diseases and obesity in both employed and unemployed women. Furthermore, understanding how circadian rhythms impact metabolism may offer valuable information for enhancing dietary practices and boosting health outcomes among various demographic groups.

Table 6. Physical activity level (PAL) classification by employment status

Classification	PAL Value (FAO/WHO/UNU) (2004)	Working Women n=200 Mean $\pm$ SD	Non-Working Women n=200 Mean $\pm$ SD
Sedentary Activity	1.40 -1.69		
Moderate Activity	1.70 – 1.99	1.71 $\pm$ 0.28	1.53 $\pm$ 0.09
Heavy Activity	2.00 – 2.40		

PAL = Physical Activity Level; SD = Standard Deviation. Classification thresholds based on FAO/WHO/UNU (2004) guidelines. Values are presented as mean $\pm$ SD.

Table 7. Relationship between nutritional status indicators and chronotype among working women (N = 200)

Working Women										
	Wake up time on a supposedly free day		Tiredness of respondents half hour after wakeup time		Time of tiredness of respondents in the evening resulting in need of sleep		“Feeling best” time of the day		Morning and evening types of people	
	Chi Square	P Value	Chi Square	P Value	Chi Square	P Value	Chi Square	P Value	Chi Square	P Value
Weight	28.306	0.247	28.929	0.223	28.892	0.224	27.744	0.271	24.773	0.418
Height	24.151	0.086	12.497	0.709	19.522	0.243	16.070	0.448	23.511	0.101
Waist Circumference	7.582	0.817	10.745	0.551	14.375	0.277	13.014	0.368	9.061	0.698
Waist-Hip Ratio	4.952	0.292	3.280	0.512	7.840	0.098	2.169	0.705	4.177	0.383
BMI	18.470	0.556	10.412	0.960	23.779	0.252	33.631	0.029	20.136	0.449
Energy	0.923	0.921	1.194	0.879	6.533	0.163	1.482	0.830	5.204	0.267
Carbohydrates	8.310	0.404	5.354	0.719	4.409	0.818	9.614	0.293	10.456	0.234
Protein	9.147	0.330	9.662	0.290	3.506	0.899	4.882	0.770	15.951	0.043
Fat	16.526	0.035	4.492	0.810	9.160	0.329	8.695	0.369	13.164	0.106

Values represent Chi-square statistics and associated p-values. BMI = Body Mass Index. WHR = Waist-Hip Ratio. Significant associations ($p \leq 0.05$) are highlighted and marked in bold.

Table 8. Relationship between nutritional status indicators and chronotype among non-working women (n=200)

Non-Working Women										
	Wake up time on a supposedly free day		Tiredness of respondents half hour after wakeup time		Time tiredness of respondents in the evening resulting in need of sleep		“Feeling best” time of the day		Morning and evening types of people	
	Chi Square	P Value	Chi Square	P Value	Chi Square	P Value	Chi Square	P Value	Chi Square	P Value
Weight	25.062	0.402	26.636	0.322	16.515	0.869	21.635	0.601	33.462	0.095
Height	12.921	0.375	14.104	0.294	13.319	0.346	13.806	0.313	13.909	0.307
Waist Circumference	17.798	0.023	5.410	0.713	5.769	0.673	5.121	0.745	14.940	0.060
Waist-Hip Ratio	2.520	0.641	0.895	0.925	3.904	0.419	3.030	0.553	3.569	0.467
BMI	17.153	0.643	22.573	0.310	18.400	0.561	17.0101	0.652	17.718	0.606
Energy	18.687	0.017	13.887	0.085	13.393	0.099	16.423	0.037	18.670	0.017
Carbohydrates	4.033	0.854	11.276	0.187	8.479	0.388	11.907	0.155	12.107	0.147
Protein	9.780	0.281	25.785	0.001	7.474	0.486	12.464	0.132	9.728	0.285
Fat	4.838	0.775	4.572	0.802	3.092	0.928	4.728	0.786	16.036	0.042

Values represent Chi-square statistics and associated p-values. BMI = Body Mass Index. WHR = Waist-Hip Ratio. Significant associations ($p \leq 0.05$) are highlighted and marked in bold.

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DATA AVAILABILITY STATEMENT

The data used in this study is available upon request from the author

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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