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CHRONONUTRITION : THE IMPACT OF MEAL TIMING ON THE NUTRITIONAL STATUS OF ADULTS (19-40 year olds)

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Abstract : Chrononutrition explores the impact of meal timing on nutritional status and overall health and, has emerged as a vital area in understanding dietary behaviors among young adults. This cross-sectional study was undertaken to assess the chrononutrition patterns, their effect on nutritional status and sleep quality, usual meal times for 3 main meals, meal skipping behaviors, barriers to timely meals, and perceived health effects related to irregular eating. A questionnaire was prepared and data was collected through interview method, among the Urban and Rural residents of Hyderabad,Telangana. A total of 100 adults between the ages of 19 and 40 were assessed for their meal timing, and nutritional status using both self-reported data and anthropometric measurements. Among the participants ,72% were early breakfast eaters, with 51% having a healthy BMI compared to 49.2% of late breakfast eaters. Early breakfast timing showed a statistically significant association with healthier BMI profiles and better sleep quality (68.1%). The study identified busy schedules (69.2%) and lack of appetite (73.1%) as significant barriers to meal skipping. Despite widespread use of meal-planning strategies such as fixed routines, family meals, and meal prepping, no significant relationship was found between these strategies and reported health conditions. Urban participants exhibited a higher prevalence of morning chronotypes (70%) and greater sleep quality than rural participants (53% morning chronotypes). Given the strong link between early meal timing and better health outcomes, community-level education and interventions addressing meal timing and barriers like busy schedules are vital to improve chrononutrition and reduce metabolic risks.

***IndexTerms* - Chrononutrition , BMI , Barriers , Meal skipping , Chronotype**

INTRODUCTION

1.1 Global Prevalence of ChronoNutrition

Cultural norms significantly shape meal timing, creating diverse patterns across the globe. In Western countries like the United States and Canada, structured meal schedules are common, with breakfast (7–9 AM), lunch (12–2 PM), and dinner (6–8 PM) aligning with work and school routines. However, urban lifestyles and shift work are increasing irregular eating, with approximately 25% of U.S. adults skipping breakfast or eating late due to time constraints. This shift disrupts circadian alignment, contributing to higher obesity rates among irregular eaters.(Deshmukh-Taskar, P. R., et al., 2010)

East Asian countries like Japan and South Korea traditionally follow structured meal schedules, with breakfast around 6–8 AM and dinner by 7 PM, aligning closely with circadian rhythms. Japan's emphasis on balanced, portion-controlled meals supports metabolic health. However, urbanization is driving irregular eating among younger populations, with late-night snacking in cities like Seoul linked to a 15% increased risk of diabetes among shift workers.(Tanaka, S., et al., 2017)

In South Asia, particularly India, rural communities adhere to early meal times (breakfast 7–9 AM, dinner 7–9 PM) due to agricultural lifestyles. In contrast, urban professionals often eat late, with dinner after 9 PM, driven by long work hours and social gatherings. Studies in India show that late diners have a higher prevalence of insulin resistance, underscoring the metabolic risks of mistimed meals.(Misra, A., et al., 2014)

Religious practices introduce unique chrononutrition dynamics. In the Middle East, Ramadan fasting involves abstaining from food from dawn to dusk, with meals (iftar and suhoor) consumed late at night or early morning. While fasting may improve metabolic markers, late-night iftar meals high in carbohydrates can negate these benefits. In non-fasting periods, countries like Saudi Arabia maintain late dinner schedules (9–11 PM), linked to increased risks of glucose dysregulation.(Al-Rawi, N., et al., 2020)

In Mediterranean countries, late meal timing is a cultural hallmark. In Spain, lunch is often consumed between 2–4 PM, and dinner may occur as late as 9–11 PM, reflecting social traditions and warmer climates that encourage evening activities. While the Mediterranean diet's nutrient density may mitigate some risks, late dinners are associated with a 20% higher risk of metabolic syndrome, particularly when eaten close to bedtime. This highlights a tension between cultural practices and chrononutrition principles. (Baron, K. G., et al., 2011). The health consequences of chrononutrition are significant. Regular, circadian-aligned eating improves insulin sensitivity and weight management, while late or irregular meals increase risks of obesity and diabetes. A Spanish study found that dinner after 10 PM was associated with a 23% higher obesity risk. These findings highlight the need for public health strategies to promote optimal meal timing, tailored to cultural and economic contexts.(Garaulet, M., et al., 2013)

In Sub-Saharan Africa, meal timing is heavily influenced by economic factors. Rural populations in countries like Nigeria and Kenya often eat irregularly, with one or two meals daily, typically in the late morning or evening, due to food scarcity or labor demands. Urban areas, however, are adopting Westernized schedules, with breakfast, lunch, and dinner becoming more common among middle-class populations. Late-night eating is emerging in cities like Lagos, correlating with rising obesity rates.(Vorster, H. H., et al., 2011)

Latin America presents a complex picture of meal timing. In Mexico, the main meal (comida) is typically eaten between 2–4 PM, followed by a lighter dinner around 8–10 PM. This delayed schedule, similar to Mediterranean patterns, may disrupt circadian rhythms, with studies linking late dinners to higher BMI. In Brazil, irregular eating is prevalent among low-income groups due to food insecurity, while urban elites adopt structured but sometimes late meal times, influenced by globalized lifestyles.(Romieu, I., et al., 2017)

The global rise of irregular eating is driven by modern lifestyles. Shift work, prevalent in industries like healthcare and transportation, forces millions to eat at night, disrupting circadian rhythms. A meta-analysis found that irregular meal timing increases the risk of type 2 diabetes by 25%. Adolescents worldwide, influenced by social media and academic pressures, are also prone to skipping meals or eating late, exacerbating health risks.(Pot, G. K., et al., 2016). A study in China found that 30% of urban youth consume snacks after 10 PM, correlating with rising obesity rates. These trends challenge chrononutrition principles, as late eating disrupts sleep and metabolism, necessitating innovative interventions.(Zhang, Y., et al., 2021)

Gender also influences meal timing. In patriarchal societies like Pakistan, women often eat later due to household responsibilities, increasing their risk of metabolic disorders. A study found that women eating after 10 PM had a 15% higher prevalence of insulin resistance compared to men. (Ahmed, F., et al., 2020)

Beyond metabolic health, chrononutrition impacts mental well-being. Late-night eating is linked to poor sleep quality, increasing risks of anxiety and depression. In Australia, studies show that irregular meal timing among young adults correlates with higher stress levels, emphasizing the holistic implications of meal timing.(Cain, S. W., et al., 2019). In Germany and India, vegan diets aligned with circadian rhythms enhance metabolic benefits, but late-night plant-based meals can negate these advantages. A study in India found that late-eating vegans had higher BMI, underscoring the importance of timing in dietary interventions.(Singh, P. N., et al., 2019)

1.2 Prevalence of ChronoNutrition in India

The replacement of traditional home-cooked meals with ready-to-eat, processed foods has contributed to an increased risk of chronic diseases in urban India. (Rathi et al., 2017). Meal timing in India is heavily influenced by social and occupational factors, with urban populations increasingly adopting late and irregular eating patterns (Panda et al., 2023).

Chrononutrition, by aligning food intake with circadian rhythms, can influence metabolic health, with irregular meal timing linked to obesity and insulin resistance.(Das et al., 2022).

Young adults aged 19–25 in India, particularly in urban areas, frequently engage in late eating due to academic, social, or early-career demands. A 2017 study on Kolkata adolescents (aged 14–16, with implications for young adults) found, Many adolescents reported irregular meal patterns, with 59% skipping meals and 30% consuming energy-dense snacks late in the evening (Rathi et al., 2017). Young adults (18–25 years) often skip breakfast and consume late-night snacks, with 32% reporting more than six unhealthy snacks daily, often after 9 PM" (Winpenny et al., 2022) .

Urban Indian youth aged 19–25 consume 20% of their daily calories after 8 PM, often due to work or socializing (Sharma et al., 2023). Rural adolescents maintain earlier meal times, with dinners typically before 8 PM (Kumar et al., 2020). Urban adults aged 30–40 frequently eat dinner after 9 PM, with 35% consuming meals post-work or during family gatherings (Kaur & Kalra, 2022). 45% of urban Indian professionals aged 30–40 eat dinner after 10 PM, driven by office hours and social obligations (Gupta et al., 2025).

Late-night snacking is rampant among Indian college students, with 40% eating after 10 PM due to study schedules or social events.The burgeoning fast food environment and sedentary lifestyles were often held responsible for late-night eating among urban middle-class youth (Kaur & Kalra, 2022). Young adults (18–19 years) at university or college had significantly more irregular meal eating patterns and were heavy snackers (Winpenny et al., 2022).Almost 59% of urban Indian youth aged 19–25 skip meals irregularly, replacing them with energy-dense snacks (Sharma et al., 2023).

Late eating is less prevalent in rural areas, where traditional lifestyles promote earlier meals. Rural adults aged 30–40 consume dinner by 7:30 PM, aligning with agricultural routines and family dining norms (Panda et al., 2023). Rural Indian adults with regular meal timing show lower BMI and better glycemic control (Kumar et al., 2020).

In Kerala and Tamil Nadu, 60% of adults aged 30–40 eat dinner before 8 PM, reflecting cultural norms (Gupta et al., 2025).In Delhi , 50% of young adults aged 19–25 eat after 9 PM due to nightlife and work" (Sharma et al., 2023) . Women aged 30–39 show higher adherence to regular meal timing, with 65% eating breakfast before 9 AM (Verma et al., 2025). Whereas , Men aged 30–39 show a stronger tendency toward uncontrolled eating and meal skipping, particularly in urban areas (Verma et al., 2025).

1.3 Meal Timing and it's Impact on Body composition

The interplay between meal timing, circadian rhythms, genetic predispositions, and lifestyle factors has been increasingly studied, particularly in the context of obesity and metabolic disorders. In India, where dietary patterns are shaped by cultural, socioeconomic, and regional diversity, understanding meal timing's impact on body composition is vital, especially given the rising prevalence of obesity and non- communicable diseases (Prabhakar et al., 2020).

The human body operates on a circadian rhythm, a roughly 24-hour cycle regulated by the suprachiasmatic nucleus (SCN) in the hypothalamus, synchronizing metabolic processes with environmental cues like light and food intake. Meal timing acts as a zeitgeber, capable of aligning or disrupting peripheral clocks in organs such as the liver, adipose tissue, and pancreas. Indian adults consuming their largest meal after 8 p.m. had higher body fat percentages compared to those eating earlier, despite similar caloric intake. This suggests that late meal timing can disrupt circadian alignment, promoting fat accumulation. (Singh R et al., 2019)
Late meal timing may increase hunger hormones like ghrelin while reducing satiety hormones like leptin, leading to overeating and fat storage. Research indicates that night shift workers in India showed higher BMI and visceral fat accumulation compared to day workers, linked to irregular meal timing (Gupta, N., et al., 2021). Late-night eating, prevalent in India due to work hours and social gatherings, is linked to adverse body composition outcomes. College students consuming meals after 9 p.m. had higher visceral fat and lower lean mass compared to those eating before 7 p.m., despite similar caloric intake (Rao S et al., 2020). Chronotype influences these effects, evening chronotypes had a 10% higher fat mass percentage compared to morning chronotypes with similar caloric intake (Kumar et al., 2022).
Meal frequency, or the number of eating occasions per day, influences body composition. In India, dietary habits vary, with some populations consuming three large meals daily, while others adopt frequent snacking.

adolescents consuming five smaller meals daily had lower body fat percentages and higher lean mass compared to those consuming three larger meals, even with controlled caloric intake (Sharma et al., 2022). However, frequent snacking on high-calorie, ultra-processed foods in urban India can increase adiposity. Frequent consumption of calorie-dense snacks between meals was associated with higher BMI and waist circumference (Deshmukh et al., 2020).

Genetic polymorphisms, such as those in the PERILIPIN1 (PLIN1) gene, modulate meal timing's effects on body composition South Indian adults with specific PLIN1 variants were more likely to gain fat mass with late meal timing (Nair et al., 2021).

Breakfast skipping, common among urban Indian youth, is linked to poor body composition. Breakfast skippers had higher BMI and fat mass compared to those consuming a balanced breakfast before 9 a.m. (Ghosh et al., 2021). Rural adults consuming dinner before 7 p.m. had lower BMI compared to urban adults eating after 9 p.m (Pandey et al., 2023). For young adults, irregular meal timings, such as skipping breakfast or consuming high-calorie meals at night, correlate with a 1.5–2-fold increased risk of obesity (Almoosawi et al., 2016).

A meta-analysis on meal frequency noted that higher meal frequency (4-6 meals/day) was associated with reduced fat mass and increased fat-free mass, though results were influenced by a single study (Hutchison et al., 2015). Late eating increases ghrelin and decreases leptin, promoting hunger and fat accumulation (Mishra et al., 2022).

1.4 Chrono Nutrition and Sleep Cycle

Early meal intake, aligned with the body's biological morning, supports circadian alignment, promoting timely melatonin onset and better sleep quality. Individuals consuming dinner before 7 p.m. reported improved sleep onset latency and higher sleep efficiency compared to those eating after 9 p.m (Singh et al., 2019). Conversely, late meal intake disrupts circadian rhythms by delaying melatonin secretion and increasing nighttime alertness. Late-night eating (after 10 p.m.) was associated with reduced REM sleep duration and increased sleep fragmentation in Indian adults . Such disruptions impair sleep quality, potentially exacerbating insomnia and daytime fatigue. (Gupta et al 2021).

Early meal intake, particularly consuming the last meal of the day before 7 p.m., aligns food intake with the body's circadian peak in metabolic activity, promoting better sleep quality.Rural adults eating dinner before 6:30 p.m. had longer sleep duration (7.2 hours vs. 6.1 hours) and fewer awakenings compared to urban adults eating after 8 p.m. Early meals reduce digestive activity during sleep, minimizing disruptions to NREM sleep stages. (Pandey et al 2023). Early meal timing also enhances melatonin production by avoiding interference with the evening decline in core body temperature, a critical sleep initiator. A study from Delhi stated that participants consuming breakfast before 8 a.m. and dinner before 7 p.m. showed earlier melatonin onset and improved sleep quality scores (Kumar et al 2022).

Indian adults practicing TRE with an eating window from 9 a.m. to 5 p.m. reported a 15% improvement in sleep quality and reduced nighttime awakenings over 8 weeks (Jain et al 2023). However, TRE's effectiveness depends on the eating window's timing. Early TRE (e.g., 8 a.m. to 4 p.m.) is more beneficial than late TRE (e.g., 12 p.m. to 8 p.m.). Early TRE participants had better sleep efficiency and longer REM sleep compared to late TRE participants (Verma et al 2021).Rural adults eating dinner before 6:30 p.m. slept 7.2 hours on average with fewer wake-ups compared to urban adults eating after 8 p.m., who averaged 6.1 hours (Pandey et al., 2023).

Indian IT professionals consuming meals after 10 p.m. experienced a 20% reduction in slow-wave sleep and increased wake-after-sleep-onset (WASO). Late meals elevate nighttime glucose and insulin levels, increasing arousal and disrupting sleep consolidation (Sharma et al 2021). Late consumption of carbohydrate-heavy meals was linked to a 30-minute delay in sleep onset and reduced sleep efficiency (Deshmukh et al 2020).Some people are genetically more sensitive to late-night eating's sleep disruptions.Individuals with certain CLOCK gene variants had worse sleep quality with late meals compared to those without (Nair et al., 2021). Cultural practices of late-night eating during festivals reduced sleep duration by an average of 1 hour (Bhatia et al., 2021)

1.5 Late night eating and it's effect on mental health

Night Eating Syndrome (NES) is a recognized eating disorder characterized by excessive food consumption after the evening meal or during nocturnal awakenings. NES is distinct from other eating disorders due to its circadian component and is strongly associated with mental health issues, including depression andanxiety (Kaur et al. 2020). The mean eating duration among Indian students ranged from 14.1 to 16.2 hours, often extending into late-night hours due to study sessions (Gupta et al 2020).

The total prevalence of mental health problems evaluated by SDQ in female Iranian adolescents was 17.8%, with late-night snacking patterns contributing to emotional disorders. The consumption of high-glycaemic foods late at night, common in Indian urban settings, leads to rapid blood glucose fluctuations, triggering counter-regulatory hormones like cortisol, which can exacerbate depressive symptoms (Rabbani et al.2019). High dietary glycaemic load could lower plasma glucose to concentrations that trigger the secretion of autonomic counter-regulatory hormones, causing changes in anxiety, irritability, and hunger (Yoshida et al., 2018).

A UK-based study by (El Ansari et al.2025) concluded that the participants from Lebanon were found to have higher stress levels compared to participants from the UK, and this contributed to a lower adherence to a Mediterranean diet with late-night eating exacerbating anxiety symptoms. Irregular meal timing, including late-night eating, is associated with increased risk of mood disorders (Au & Reece 2017).Aligning mealtimes with circadian rhythms improves neurotransmitter balance and emotional resilience, while late-night eating disrupts these processes (Al moosawi et al., 2019).

Female adolescents in high scores of ‘snacking and convenience’ eating patterns were more likely to have indicators of emotional disorders (Farhangi et al. 2018). The interplay between late-night eating, sleep disruption, and anxiety is particularly pronounced among Indian university students, where cultural emphasis on academic performance drives late-night study sessions accompanied by snacking (El Ansari et al., 2025).

1.6 Barriers to consistent Meal Times

1.6a. Social Commitments

Late dinners, common in Indian households due to social gatherings or family routines, disrupt circadian alignment. Indian families frequently consume dinner after 9 p.m. due to cultural practices of eating together, leading to irregular meal timing.This practice is especially prevalent during festivals or religious events, where meals are delayed to accommodate communal activities (Sharma et al., 2023). Urban Indian adults attending social events reported a 2-hour delay in dinner timing, contributing to inconsistent meal schedules (Deshmukh et al., 2020). Social and cultural factors also play a role, as late-night social gatherings or dining traditions disrupt circadian-aligned eating (Gill & Panda, 2015).

1.6b. Busy Schedule

The rise of gig economy jobs, such as ride-sharing or freelance work, exacerbates meal timing challenges. Gig workers often lack designated break times, leading to sporadic eating habits (Tran et al., 2020). Parenting responsibilities further complicate meal consistency, as caregivers often prioritize feeding their children over maintaining their own meal schedules (Berge et al., 2018).
Indian IT professionals working night shifts consumed meals at irregular times, with 60% eating after 11 p.m., leading to circadian misalignment (Gupta et al., 2021).Rural Indian farmers often skip breakfast or delay meals due to early morning fieldwork, resulting in inconsistent eating patterns (Pandey et al., 2023). Globally, shift work poses similar challenges.Night shift workers had a 40% higher likelihood of irregular meal timing compared to day workers, contributing to metabolic disturbances (McHill et al., 2017).

1.6c.Socio economic Factors

The rise of gig economy jobs, such as ride-sharing or freelance work, exacerbates meal timing challenges. Gig workers often lack designated break times, leading to sporadic eating habits (Tran et al., 2020). Parenting responsibilities further complicate meal consistency, as caregivers often prioritize feeding their children over maintaining their own meal schedules (Berge et al., 2018). Socioeconomic factors, including limited access to healthy food options or time for meal preparation, further exacerbate these challenges (Gupta et al., 2019).

Addressing these barriers requires multifaceted interventions, including education, workplace policies, and accessible meal planning resources (Almoosawi et al., 2016).

Socioeconomic factors, including income, education, and access to food, significantly influence meal timing consistency. Low-income families consumed meals at inconsistent times due to limited foodavailability and reliance on daily wages (Bhatia et al., 2021). In contrast, higher-income groups in India face barriers related to lifestyle. Urban professionals often prioritize work over meal schedules, leading to skipped or delayed meals. Affluent Indian adults in metropolitan cities skipped breakfast 30% more frequently due to time constraints, affecting meal timing consistency (Ghosh et al., 2021).In UK lowerincome individuals had less predictable meal schedules due to financial constraints and irregular work hours (Pot, G et al., 2016).

1.6 d.Psychological factors

Psychological factors, such as stress and eating behaviors, contribute to inconsistent meal timing.Stressinduced eating disrupts circadian rhythms and affects metabolic health. College students under exam stress reported skipping meals or eating late, with 50% consuming snacks after 10 p.m (Rao et al., 2020). Emotional eaters in Bangalore consumed 25% more late-night snacks, leading to irregular meal timing (Kumar et al., 2022). Stress-related eating led to a 30% increase in late-night meal consumption, disrupting circadian meal timing (St-Onge et al., 2017).

1.6 e.Food deliveries

Access to late-night food delivery services increased dinner timing by 1.5 hours among urban adults (Singhmet al., 2020). Rural households without refrigeration consumed perishable foods immediately, disrupting regular meal schedules (Verma et al., 2021). Urban residents with access to 24-hour food outlets had a 20% higher likelihood of late-night eating compared to rural residents (Hutchison et al., 2015).

Use of food delivery apps after 9 p.m. was associated with a 30% increase in irregular meal timing among Indian youth (Mishra et al., 2022). Rural Indian adults without access to digital clocks relied on environmental cues, leading to inconsistent meal times (Nair et al., 2021). In the US increased screen time was linked to a 1-hour delay in dinner timing, disrupting circadian meal schedules (Vujović et al., 2022).

1.6 f.Gender Discrimination

Gender roles in India significantly influence meal timing, particularly for women. Women often prioritize family meals over their own schedules, leading to delayed eating. Indian women in joint families ate 1-2 hours later than other family members to accommodate household duties (Jain et al., 2023).Women were 25% more likely to have irregular meal timing due to caregiving responsibilities (Gill et al., 2015). Parents in urban India delayed dinner to match children's schedules, leading to inconsistent meal timing (Anand et al., 2023).

Only 30% of Indian adults were aware of the link between meal timing and health outcomes, leading to inconsistent eating patterns (Gupta et al., 2024). Rural adults with limited education were 40% less likely to follow consistent meal timing due to lack of awareness (Pandey et al., 2023). In Canada ,individuals with low nutritional literacy had a 25% higher rate of irregular meal timing (Anderson et al., 2018).

1.7 Consequences of Meal Skipping and Late eating

Meal skipping, defined as the omission of one or more traditional meals (breakfast, lunch, or dinner), and late eating, often involving meals or snacks consumed close to bedtime, have become common, particularly among young adults, adolescents, and individuals with irregular work hours. Meal skipping is particularly prevalent among young adults, with studies indicating that up to 87% of this population may skip at least one main meal daily, with breakfast being the most frequently omitted (Pendergast et al., 2018). The regular omission of meals has been associated with poorer diet quality, characterized by reduced intake of essential nutrients such as fiber, vitamins, and minerals (Zeballos & Todd, 2020).

1.7 a.Diabetes risk

Skipping or delaying meals misaligns circadian rhythms, affecting melatonin, cortisol, and insulin secretion. Misaligned meal timing disrupts serotonin and dopamine rhythms, impairs glucose metabolism, and increases systemic inflammation (Almoosawi et al ., 2019).Meal skipping patterns were associated with higher fasting glucose levels and increased risk of metabolic syndrome (Farhangi et al 2018).

1.7 b.Mental health risks

Skipping or delaying meals misaligns circadian rhythms, affecting melatonin, cortisol, and insulin secretion. Misaligned meal timing disrupts serotonin and dopamine rhythms, impairs glucose metabolism, and increases systemic inflammation (Almoosawi et al ., 2019).Meal skipping patterns were associated with higher fasting glucose levels and increased risk of metabolic syndrome (Farhangi et al 2018). Breakfast skipping among adolescents was linked to higher stress, anxiety, and weight gain (Gupta et al., 2020).Delayed breakfast timing triggers blood glucose fluctuations, increasing irritability, anxiety, and insulin resistance (Firth et al 2020).Irregular meal timing, including delayed breakfast, was associated with a 17.8% prevalence of emotional disorders and increased BMI among adolescents (Rabbani et al 2019). Skipping lunch was associated with increased stress, anxiety, and impaired glucose metabolism among university students (El Ansari et al. 2025). Skipping lunch among Indian adolescents was linked to irritability, poor mood regulation, and elevated fasting glucose (Gupta et al 2020). The psychological and cognitive consequences of meal skipping and late eating are equally significant. Skipping meals, particularly due to food insecurity or restrictive eating practices, has been shown to increase perceived stress and mental distress (Kelly et al., 2023).Irregular eating patterns can impact productivity and cognitive performance, particularly in academic and workplace settings, where consistent nutrition is essential for optimal functioning (Calland et al., 2022).

1.7 c.Emotional Disruptions

Late dinner, often consumed after 9 PM, is a significant risk factor for health issues due to its impact on circadian rhythms.Late-night eating, including delayed dinner, delays melatonin onset, disrupts serotonin rhythms, and impairs glucose metabolism (Almoosawi et al. 2019). Late dinner was associated with increased emotional disorders and weight gain among adolescents.This behavior disrupts sleep, increases cortisol, and contributes to obesity and mental health issues (Rabbani et al 2019). Irregular meal timing was associated with a 17.8% prevalence of emotional disorders among adolescents. Skipping or delaying meals disrupts serotonin production, exacerbating depressive symptoms, while cortisol spikes increase anxiety, particularly in India's high-stress academic environments. (Rabbani et al., 2019).

1.7 d. Digestive issues

Late-night eating has been linked to digestive issues, including acid reflux and impaired gastric emptying, which can further compromise health (Bhardwaj, 2021). Late-night eating, particularly when combined with short sleep duration, was associated with reduced appetite regulation and increased risk of overeating the following day (Tahara & Shibata, 2018).

1.8 Factors influencing Chrononutrition

Several factors influence the adoption of chrononutrition practices among young adults, including lifestyle, cultural norms, and environmental cues. Urbanization and technology-driven schedules often lead to delayed meal timings, particularly among students and professionals (Yoshida et al., 2019).

Gender differences also play a role, with women more likely to skip meals due to time constraints or body image concerns (Krishnan et al., 2020).

The consequences of disrupted meal timings are far-reaching, encompassing metabolic, psychological, and social dimensions. Metabolically, irregular eating is linked to a 1.8-fold increased risk of type 2 diabetes and cardiovascular disease (Scheer et al., 2013).

Psychologically, misaligned meal timings contribute to mood disorders and cognitive impairments, with a 15% increase in anxiety symptoms reported among late-night eaters (St-Onge et al., 2017). Socially, irregular meal schedules can disrupt family or communal dining, reducing social cohesion (Gill & Panda, 2015).

Adherence to chrononutrition principles, such as consuming meals during daylight hours, is associated with improved nutrient absorption and reduced chronic disease risk (Garaulet et al., 2013). These factors and consequences underscore the importance of promoting chrononutrition as a public health strategy (Almoosawi et al., 2016).

RESEARCH METHODOLOGY

4.1 Sample and Study Design

The present study is an institutional cross-sectional survey carried out to know the influence of meal timing in the nutritional assessment of adults of the age group 19 - 40 years. The sample selection was done through convenience Sampling and prior informed consent (Annexure-III) was obtained from all participants before data collection.

4.2 Study Location

The study was conducted in Hyderabad, where participants from urban and rural areas were taken into account for data collection.

4.3 Pilot Study

A pilot study was done on 15 samples. It was selected to test the present study tools for its validity, clarity, applicability, and the time required to complete it. All required and necessary modifications of the tools were done, and the adults who participated in the pilot study were excluded from the study sample.

4.4 Sample Size and Selection Criteria

A total of 110 subjects were selected for the study. After initial data screening , 100 participants' data was included in the final analysis due to completeness and consistency.

- **Inclusion Criteria :** Inclusion criteria were healthy adults of age group 19-40 years of both genders.
- **Exclusion Criteria :** Exclusion criteria were adults below the age of 19 , and those diagnosed with Hypertension , Cholesterol & Diabetes Mellitus.

4.5 Tools and Techniques for Data Collection

Based on the study's objectives, an online questionnaire was prepared, and a pilot study was conducted. Necessary modifications were made, and a new structured questionnaire (Annexure I) was created. Data Collection was done through the questionnaire using the interview method.

4.5.1 The Pre-Structured Questionnaire was broadly classified into 5 heads as follows

a) ***Socio - demographic details*** of subjects like name , age , residence , occupation was taken.

b) ***Anthropometrical measures :*** Height & weight were noted and BMI was calculated as per the Asian classification

Nutritional status	BMI (kg/m^2)
Underweight	<18.5
Normal	18.5 - 22.9
Overweight	23 - 24.9
Obese I	25 - 29.9
Obese II	>30

Table 1: Asian BMI classification

c) ***Meal Timing & Dietary Habits:*** Participants were classified as early eaters and late eaters, based on the meal times they reported.

d) ***Sleep Cycle & Quality :*** Sleep quality of participants was assessed , the average hours of sleep a person got every night was recorded and analysed with respect to the meal times they reported.

Rating	Sleep Quality Description
1	Very poor
2	Poor
3	Fair
4	Good
5	Excellent

Table 2: Subjective sleep quality rating

e) ***Frequency of Late-night eating & its consequences :*** Late eating frequency of the participants was recorded and analysed for the kind of health outcomes the participants faced like weight gain, mood instability , brain fog , fatigue etc.

f) ***Barriers to consistent eating patterns :*** Obstacles in consistent meals were recorded, with the most prevalent barriers . The primary barriers included busy schedules, lack of appetite, academic pressure, social commitments, and intentional meal skipping. The frequency of meal skipping associated with each of these obstacles was assessed to understand their impact.

4.6 STATISTICAL ANALYSIS

A) ***Descriptive analysis*** was done by calculating frequencies , proportions , mean ,standard deviations.

Mean: It is the average for a certain collection of figures or data which also measures the central tendency of the data.

Mean = Sum of observations / Total number of observations

Standard Deviation: It is described as a variance/deviation from the average mean of the values or data. The conclusion drawn from a lower standard deviation is that the results are fairly near to the average. Higher values, on the other hand, indicate a significant deviation from the mean.

$s = \sqrt{[\Sigma(x_i - \bar{x})^2 / n - 1]}$

B) Chi-square Test:

The chi-square test was employed to assess the relationship between the frequency of the most skipped meal and the type of nutrition information searched by users. It was used to determine if categorical data shows dependency or if the two classifications are independent.

Formula:

> $\chi^2 = \Sigma (O_i - E_i)^2 / E_i$

Where:

O_i = observed

E_i = expected frequency

C) ANOVA (Analysis of Variance):

ANOVA is employed to assess whether there are any statistically significant differences between the means of three or more independent groups. In the context of this study, it can be used to examine whether the mean dietary habits or the perceived accuracy of nutrition information differ significantly across users influenced by multiple social media platforms or influencer types. ANOVA helps determine whether any observed differences in group means are due to true effects or simply due to random chance.

It works by comparing the variance between group means to the variance within the groups.

Formula:

> F = Variance between groups / Variance within groups

Where:

Variance between groups = variation due to the interaction between the different groups (e.g., different influencers or platforms)

Variance within groups = variation within each group (individual differences not explained by the group factor)

If the F-value is significantly greater than 1, it suggests that at least one group mean is different from the others.

D) Logistic Regression:

Ordinal Logistic Regression is employed to examine the relationship between one or more independent variables (predictors) and an ordinal dependent variable—i.e., a variable that has categories with a natural order but unknown spacing between them (e.g., never, rarely, sometimes, often, always).

In the context of this study, it can be used to determine how factors such as age, time spent on social media, or platform used predict the frequency of dietary changes or the level of trust in online nutrition content.

Formula:

> $\log(P(Y \leq j) / P(Y > j)) = \alpha j - \beta_1 X_1 - \beta_2 X_2 - \ldots - \beta_k X_k$

Where:

$P(Y \leq j)$ = cumulative probability of the outcome variable being in category j or below

$P(Y > j)$ = probability of the outcome being above category j

αj = intercept for each cumulative logit

$\beta_1, \beta_2, \ldots, \beta_k$ = regression coefficients for predictor variables $X_1, X_2, \ldots, X_k$

The methodology section outline the plan and method that how the study is conducted. This includes Universe of the study, sample of the study,Data and Sources of Data, study's variables and analytical framework. The detailsare as follows;

IV. RESULTS AND DISCUSSION

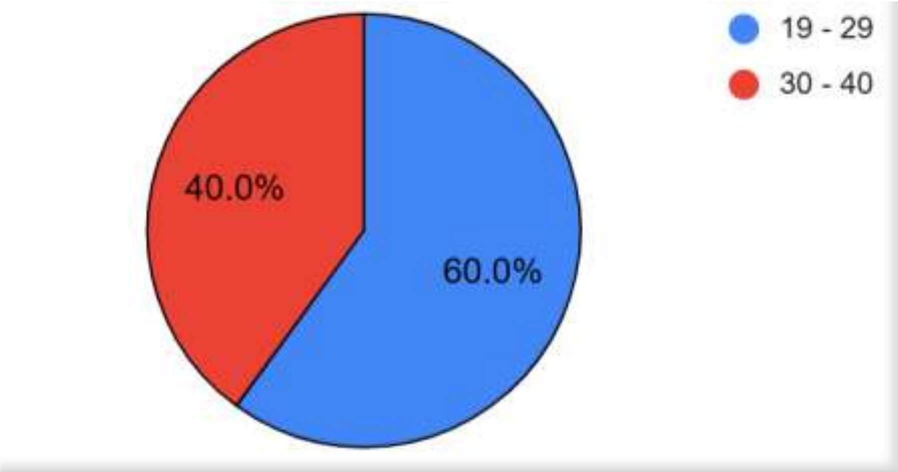

Fig 1 :Age of Respondents

The above pie chart represents that (60.0%) of the subjects participated in the study of 19-29 and (40%) of 30-40 years. The calculated average age is 28.4±5.39 years.

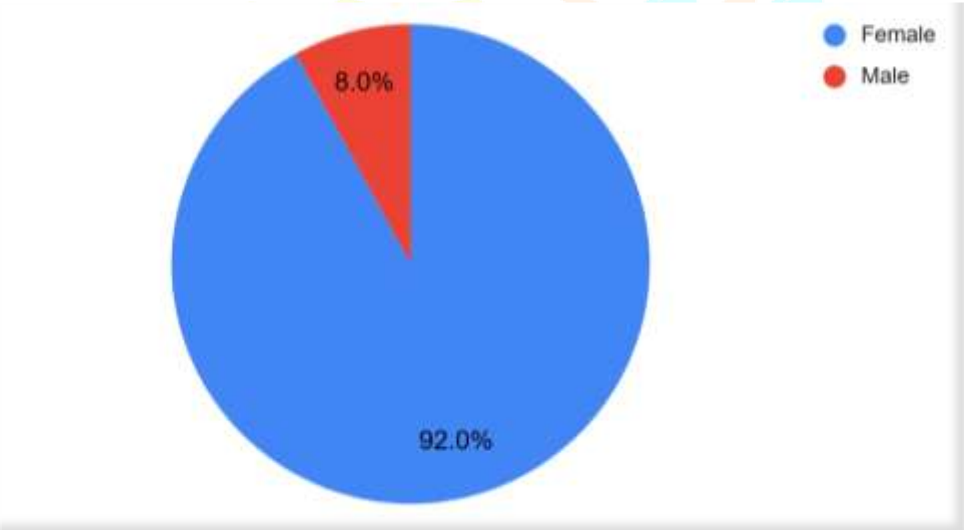

Fig 2 : Gender of Respondents

It can be inferred from the above figure that the majority of the subjects in the study were females (92.0%) , while males constitute only (8.0%).

Table 3: BMI of the Respondents

Residence	BMI Category	(n)	(%)
Urban	< 18.5 (Underweight)	7	9.7
	18.5 - 22.9 (Normal)	22	37.5
	23 - 24.9 (Overweight)	14	26.4
	25 - 29.9 (Obese I)	8	15.1
	> 30 (Obese II)	2	3.8
	Total	53	100

Rural	< 18.5 (Underweight)	11	23.4
	18.5 - 22.9 (Normal)	25	53.2
	23 - 24.9 (Overweight)	9	19.1
	25 - 29.9 (Obese I)	9	19.1
	> 30 (Obese II)	3	6.4
	Total	47	100

As per the Asian BMI classification, BMI of the subjects was categorized as shown in the Table. The distribution shows that nearly half (47%) of the total subjects had a normal BMI, while about 18% were underweight. The remaining population was either overweight (23%) or obese (12%), as illustrated in the Table.

By residence, underweight was more common among rural subjects (23.4%) compared to urban (13.2%), whereas normal BMI was higher in rural (53.2%) than urban (41.5%) participants. Overweight and obesity combined were more prevalent in urban (45.3%) than rural (25.5%) groups. The mean BMI estimated using category midpoints was 24.6 ± 4.7 kg/m².

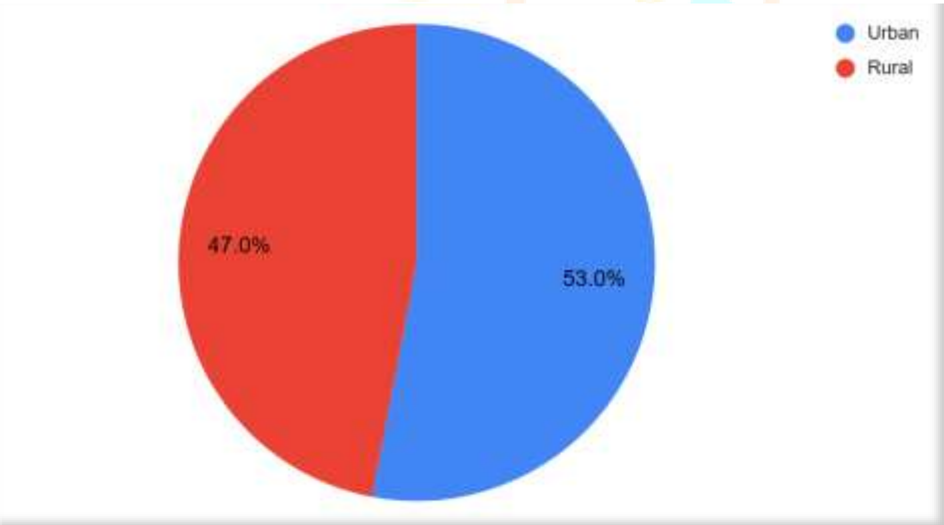

Fig 3: Residence of the Respondents

The above chart indicates 53.3% of individuals live in urban areas, while 46.7% reside in rural locations.

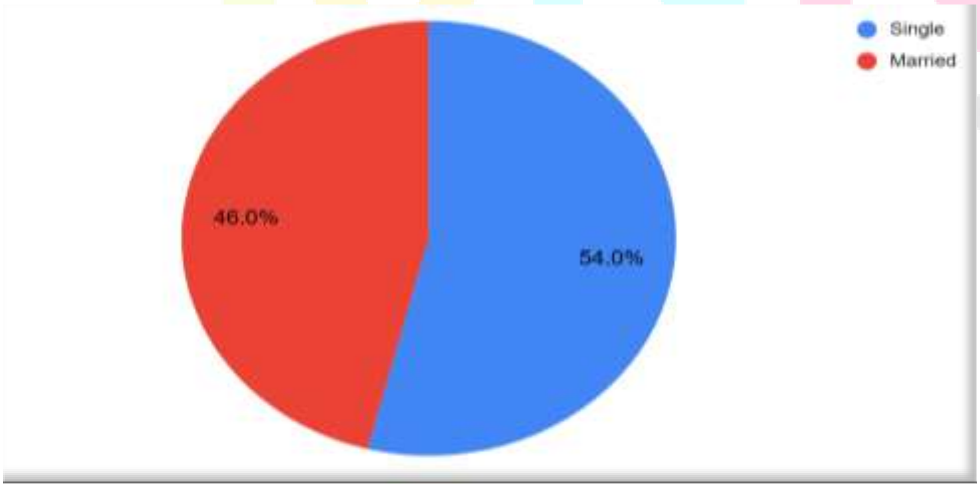

Fig 4: Marital Status of Respondents

Marital status analysis shows 46.0% of individuals are married, with the remaining 54.0% being single.

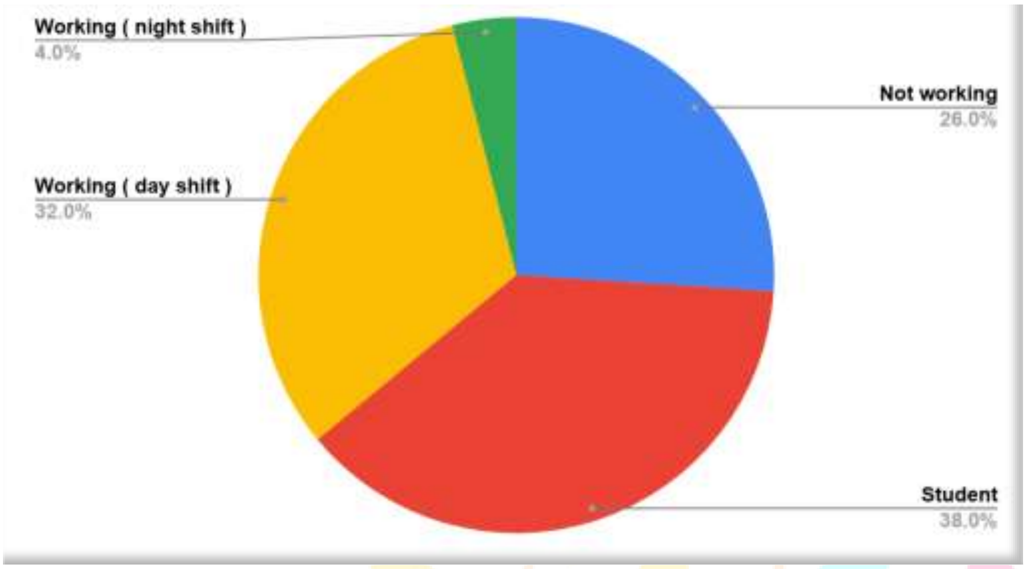

Fig 5 : Occupation of Respondents

The occupational breakdown highlights students as the largest group (38%), followed by day workers (32%), unemployed/not working (26%), and night-shift workers (4%).

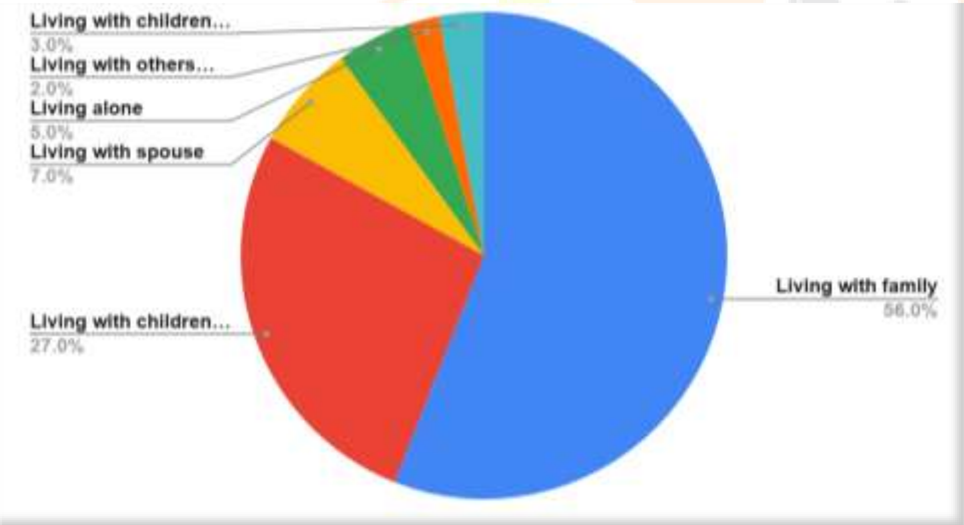

Fig 6 : Living arrangement of Respondents

The above pie chart shows that 56% of participants live with family , 27% with their children & spouse , 7% with spouse , 5% alone , 3% with children and others , and 25 with only others.

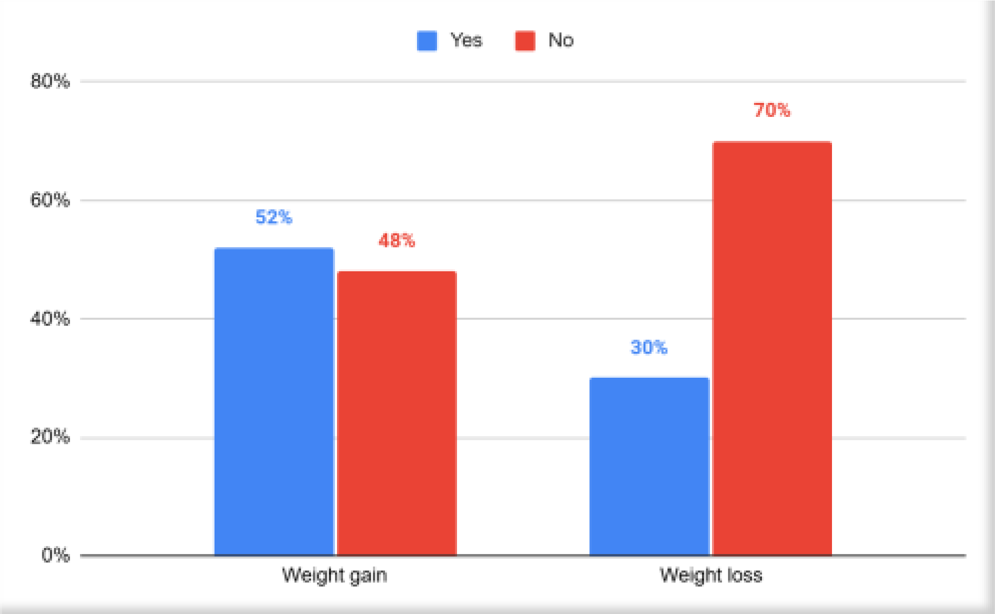

Fig 7: Participants who experienced weight gain & weight loss in the past 6 months

The above bar charts show that more than half (52%) of participants reported weight gain in the past six months, while only 30% experienced weight loss. This indicates that weight gain is more common than weight loss among the group

Table 4: Meal Timings (Breakfast , Lunch , Dinner) of Respondents

Meal	**Residence**	**Early (n)**	**Early (%)**	**Late (n)**	**Late (%)**	**Total participants (n)**
Breakfast	Urban	41	77.4%	12	22.6%	53
	Rural	38	80.9%	9	19.1%	47
Lunch	Urban	46	88.0%	7	13.25	53
	Rural	42	89.4%	5	10.6%	47
Dinner	Urban	7	13.2%	46	86.8%	53
	Rural	6	12.8%	41	87.25%	47

The above table summarizes the meal timing patterns of urban (53) and rural (47) residents separately. It shows that the majority of both urban (77.4%)and rural (80.9%) participants eat breakfast early. Similarly, lunch is predominantly consumed early by 86.8% of urban and 89.4% of rural participants.
In contrast, dinner timing differs significantly, with the majority in both groups (around 87%) eating late.

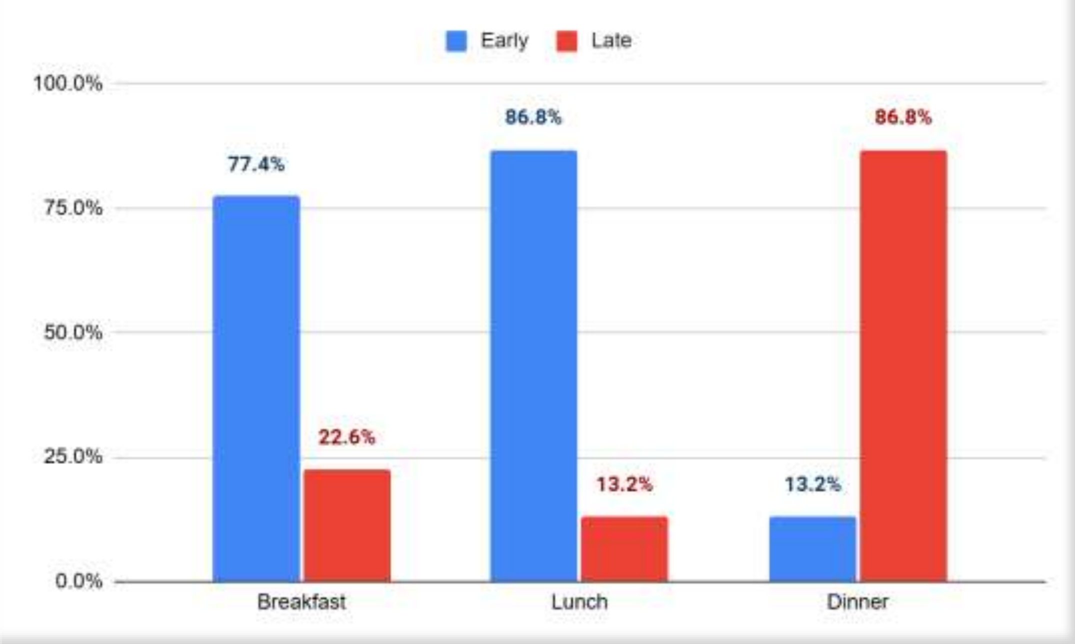

Fig 8 : Urban Residents: Early vs. Late eaters

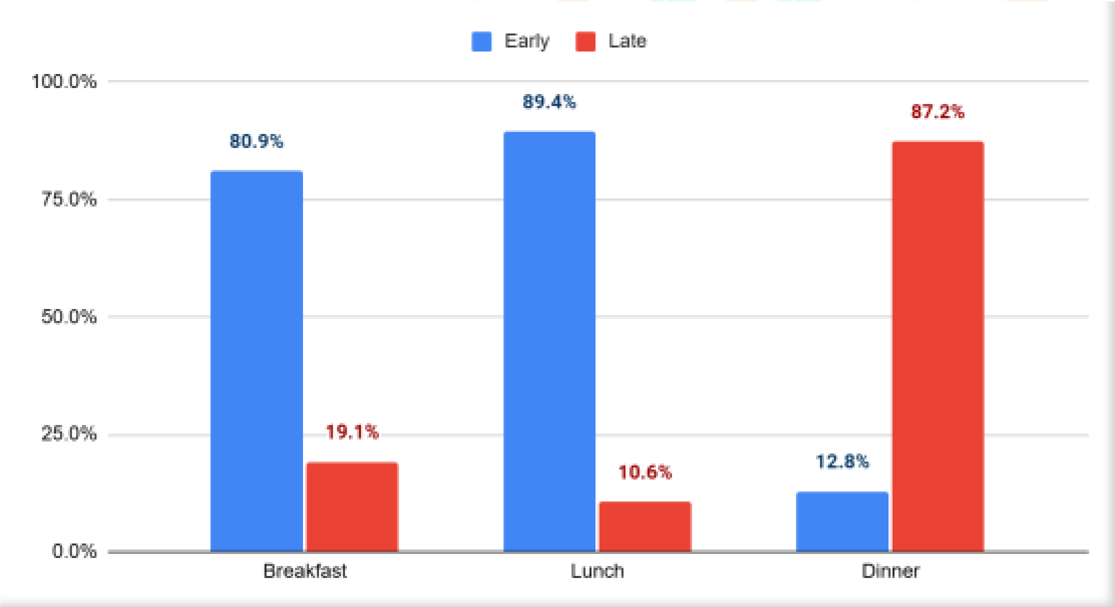

Fig 9: Rural Residents: Early vs. Late eaters

Table 5:Gap between Dinner and bedtime

Gap between dinner and bedtime	Urban (n)	(%)	Rural (n)	(%)
Less than 1 hr	5	9.4%	10	21.3%
1-2 hrs	33	62.3%	22	46.8%
More than 2 hrs	15	28.3%	15	31.9%
Total participants	53	100%	47	100%

The table above shows urban participants mainly have a 1–2 hour gap between dinner and bedtime (62.3%), while rural participants display a more varied pattern, with higher proportions at both less than 1 hour (21.3%) and more than 2 hours (31.9%).

Table 6 : Sleep Quality Rating

Sleep quality rating	Urban (n)	Urban (%)	Rural (n)	Rural (%)
1 = Very poor	2	3.8%	9	19.1%
2 = Poor	4	7.5%	10	21.3%
3 = Fair	9	17.0%	9	19.1%
4 = Good	20	37.7%	11	23.4%
5 = Excellent	18	34.0%	8	17.0%
Total	53	100%	47	100%

This table reveals that urban participants report better sleep quality than rural participants, with over 70% rating their sleep as "Good" or "Excellent" compared to about 40% in the rural group. It also revealed that rural participants have higher rates of "Very Poor" or "Poor" sleep quality (40%) compared to only 11% among urban participants.

Table 7 : Natural Tendency of Respondents

Natural Tendency	Urban (n)	Urban (%)	Rural (n)	Rural (%)
Morning person	37	69.81%	25	53.19%
Evening person	11	20.75%	15	31.91%
Neither in particular	5	9.43%	7	14.89%
Total	53	100%	47	100%

The above table reveals natural tendency (chronotype) differences between urban (and rural respondents. Urban residents show a higher proportion of "Morning person" (70%) compared to rural residents (53%), while rural participants have more "Evening person" responses (32% versus 21% in urban). The "Neither in particular" category is relatively similar in both groups.

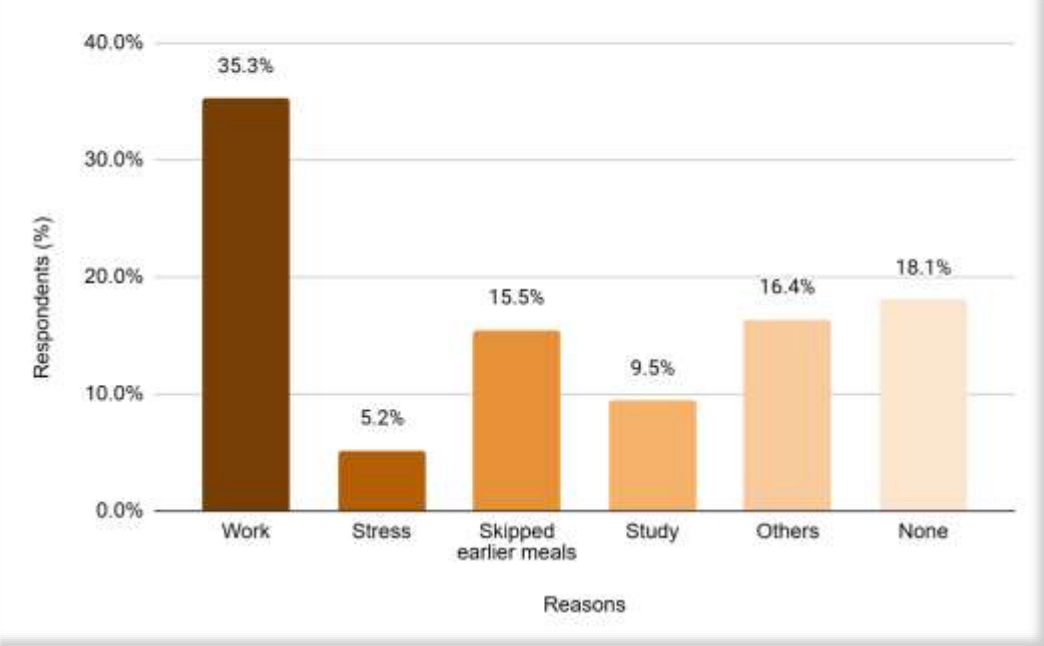

Fig 10 :Reasons for late night eating

The bar chart shows that work is the leading cause of late-night eating, reported by 35.3% of respondents, showing that long hours often delay meals. 15.5% eat late due to skipping earlier meals, while 16.4% cite other personal reasons. 9.5% link it to studying, 5.2% to stress and 18.1% report no reason. Overall, late-night eating is largely driven by busy lifestyles and disrupted daytime routines.

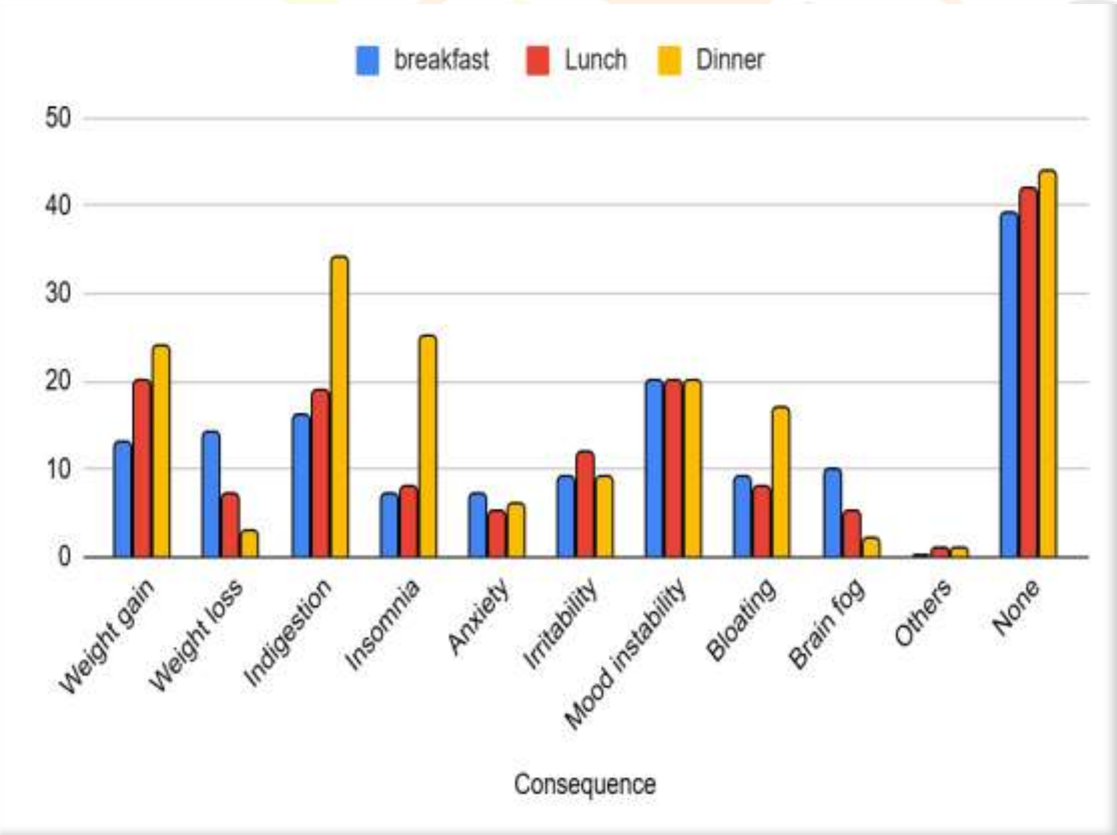

Fig 11 : Consequences of late Meals

The above bar charts show how Late meals impact individuals differently: late breakfast causes mood instability (13.9%), indigestion (11.1%), and weight loss (9.7%) with 27.1% unaffected; late lunch leads to weight gain and mood instability (13.6%) and indigestion (12.9%) with 28.6% unaffected—the least disruptive; late dinner results in the most issues, mainly indigestion (18.4%), insomnia (13.5%), and weight gain (13.0%), with only 23.8% unaffected.

Table 8 :Most Skipped Meal

Meal Skipped	Urban (n)	Urban (%)	Rural (n)	Rural (%)
Breakfast	29	54.7%	19	40.4%
Lunch	11	20.8%	15	31.9%
Dinner	6	11.3%	5	10.6%
None	7	13.2%	8	17.0%

It is inferred from the above table that Breakfast is the most skipped meal in both groups, especially urban (54.7% vs 40.4%).
Lunch skipping is higher in rural (31.9%) than urban (20.8%). Dinner skipping is the least common in both groups.

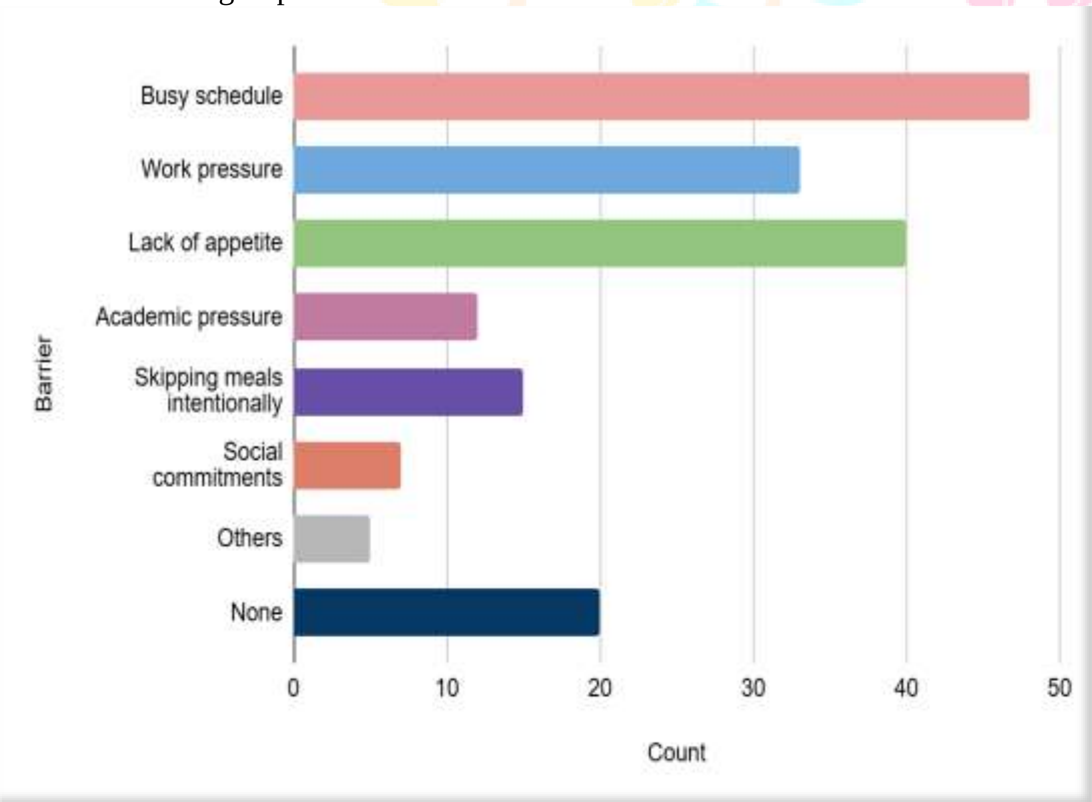

Fig 12 : Barriers to Consistent Eating Schedules

The above chart highlights key barriers to having meals on time. Busy schedules are the most common issue (48%), followed by lack of appetite (40%) and work pressure (33%). Other factors include academic pressure (12%), intentional meal skipping (15%), and social commitments (7%).

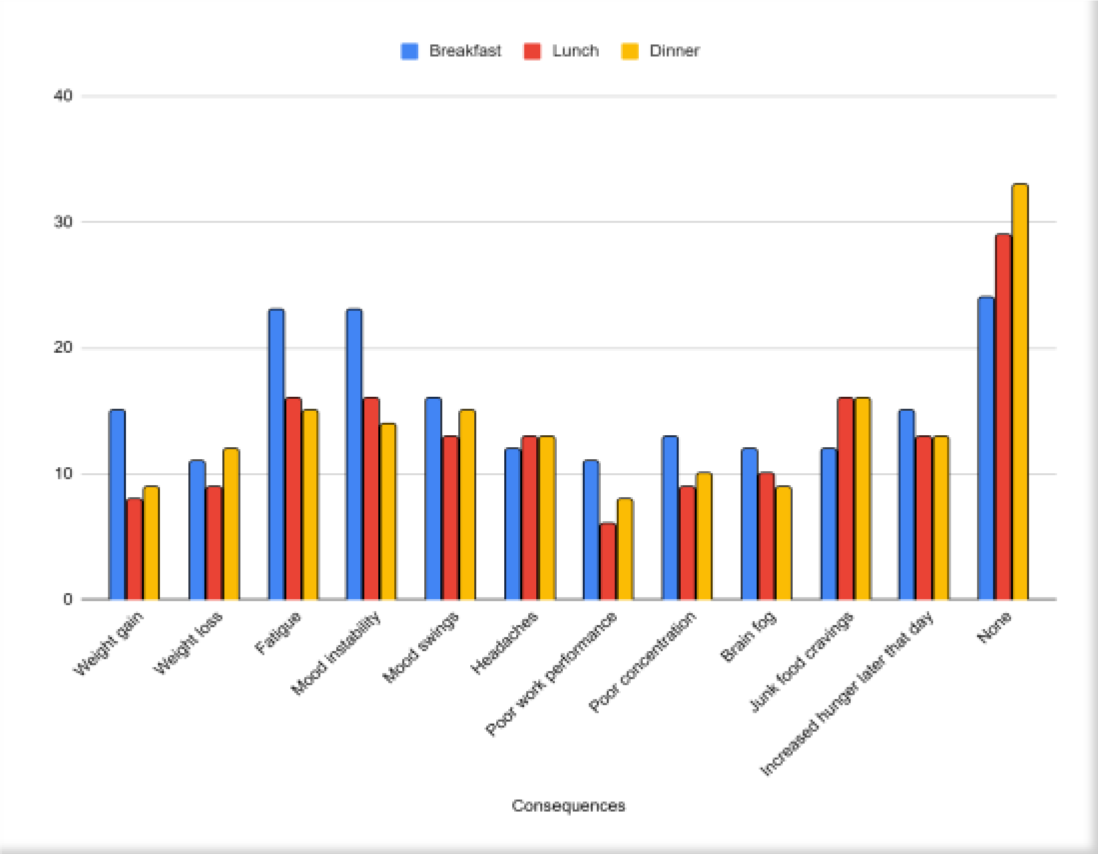

Fig 13: Consequences of Meal Skipping

Skipping breakfast results in the most and strongest negative effects, with 12.3% experiencing fatigue or mood instability, 8.6% mood swings, 8.0% increased hunger or weight gain, and 6.4% brain fog; only 12.8% had no issues. Skipping lunch mainly causes junk food cravings, fatigue, and mood instability (all 10.1%), mood swings and increased hunger (8.2% each); 18.4% experienced no problems. Skipping dinner is least problematic, with 9.6% having junk food cravings, 9.0% fatigue and mood swings, and 19.8% unaffected. Overall, breakfast is the most critical meal for maintaining well-being.

Table 9 :Association Between Early eaters and BMI (*P ≤ 0.05 significant)

Meal timing	N(%)	BMI N(%)	χ^2	P-Value (p<0.05)	Ordinal logistic regression	Regression p-value (p<0.05)	Result
Break fast	41 (41.0 %)	Healthy: 21 (51.2%) Overweight :4 (9.8%) Obese: 16 (39.0%)	6.61	**0.037**	0.77 (0.36–1.66)	0.51	χ^2 **significant** / Reg Insignificant
Lunch	76 (76.0 %)	Healthy: 38 (50.0%) Overweight : 15 (19.7%) Obese: 23 (30.3%)	0.41	0.813	0.91 (0.39–2.15)	0.83	Insignificant
Dinner	55 (55.0 %)	Healthy: 25 (45.5%) Overweight : 10 (18.2%) Obese: 20 (36.4%)	3.25	0.197	0.58 (0.27–1.22)	0.51	Insignificant

The analysis revealed statistically significant relationship, (as per the chi square analysis) between early breakfast eaters and healthy BMI.
A statistically significant association between early breakfast timing and healthier BMI profiles, was shown in a study conducted by author Silva et al (2024).

The analysis revealed no statistically significant relationship between early lunch timing and BMI.
No significant relationship between lunch timing and BMI was also found in the study conducted by author Silva et al (2022).
The analysis revealed no statistically significant relationship between early Dinner timing and BMI either.
No significant relationship between dinner timing and BMI was also found in the study conducted by author Silva et al (2022).

Table 10:Association Between Late eaters and BMI (*P ≤ 0.05 significant)

Meal timing	N(%)	BMI N(%)	χ^2	P-Value (p<0.05)	Ordinal logistic regression (p<0.05)	Regression p-value	Result
Break fast	59 (59.0 %)	Healthy: 29 (49.2%) Overweight :17 (28.8%) Obese: 13 (22.0%)	1.8	0.40	0.85 (0.50–1.20)	0.30	Insignificant

Lunch	24 (24.0 %)	Healthy: 12 (50.0%) Overweight: 6 (25.0%) Obese: 6 (25 .0%)	1.2	0.55	1.10 (0.60–2.05)	0.75	Insignificant
Dinner	45 (45.0 %)	Healthy: 25 (55.6%) Overweight: 11 (24.4%) Obese: 9 (20 .0%)	1.0	0.70	0.90 (0.50–1.60)	0.70	Insignificant

The analysis revealed statistically significant relationship between breakfast timing and BMI.
No statistically significant association between breakfast timing and BMI profiles, was shown in a study conducted by author Kahleova et al (2024).

The analysis revealed no statistically significant relationship between lunch timing and BMI.
No significant relationship between lunch timing and BMI was also found in the study conducted by author Chaix et al (2024).

The analysis revealed no statistically significant relationship between Dinner timing and BMI either.
No significant relationship between dinner timing and BMI was also found in the study conducted by author Garaulet et al (2022).

Table 11: Association Between Sleep Quality and Regular Eating Schedules

Meal Timing	**N (Early / Late)**	**Good Sleep % (E /L)**	**χ^2 value (p<0.05)**	**ANOVA (p) (p<0.05)**	**Regression Coef (p) (p<0.05)**	**Result**
Breakfast	72 / 28	68.1% / 42.9%	7.02 **(0.0081)**	3.77 **(0.055)**	-0.97 **(0.033)**	**Significant**
Lunch	74 / 26	66.2 % / 50.0%	5.61 (0.23)	3.98 (0.084)	-0.73 (0.067)	Insignificant
Dinner	51 / 49	60.8 % / 61.2%	6.87 **(0.014)**	5.84 **(0.018)**	-1.12 **(0.003)**	**Significant**

Early breakfast timing showed a statistically significant positive association with good sleep.
A significant association between breakfast timing and improved health-related outcomes was seen in the study conducted by author Smith et al. (2017).

Lunch timing was not significantly related to sleep quality.
No significant relationship between lunch timing and health behaviors was reported by authors Johnson and Lee (2015).

Early dinner timing was significantly associated with better sleep outcomes.
Dinner timing as an important factor influencing metabolic health and sleep quality was reported by author Brown et al. (2019).

Table 12: Association Between Late night Eating and Anxiety

Barrier	Meal	N (%)	χ^2 value (p<0.05)	P-Value (p<0.05)	Result
Busy schedule	Breakfast	18 (69.2%)	5.12	**0.023**	**Significant**
	Lunch	15 (68.2%)	4.34	**0.037**	**Significant**
	Dinner	42 (66.7%)	27.04	**0.001**	**Significant**
Lack of appetite	Breakfast	19 (73.1%)	7.34	**0.007**	**Significant**
	Lunch	17 (77.3%)	8.91	**0.003**	**Significant**
	Dinner	36 (57.1%)	8.45	**0.004**	**Significant**
Work pressure	Breakfast	9 (34.6%)	0.05	0.820	Insignificant
	Lunch	12 (54.5%)	2.48	0.115	Insignificant
	Dinner	29 (46.0%)	0.78	0.377	Insignificant
Social Commitments	Breakfast	7 (26.9%)	0.59	0.443	Insignificant
	Lunch	8 (36.4%)	0.04	0.843	Insignificant
	Dinner	17 (27.0%)	3.02	0.082	Insignificant
Skipping meals intentionally	Breakfast	6 (23.1%)	0.70	0.401	Insignificant
	Lunch	7 (31.8%)	3.44	0.064	Insignificant
	Dinner	12 (19.0%)	0.68	0.411	Insignificant
Academic pressure	Breakfast	6 (23.1%)	1.12	0.290	Insignificant
	Lunch	9 (40.9%)	2.78	0.096	Insignificant
	Dinner	19 (30.2%)	1.63	0.202	Insignificant
Others	Breakfast	7 (26.9%)	3.13	0.077	Insignificant
	Lunch	5 (22.7%)	2.38	0.123	Insignificant
	Dinner	8 (12.7%)	1.68	0.194	Insignificant

The analysis revealed a statistically significant relationship between the frequency of late night eating and anxiety levels in adults.

Consuming meals during nighttime hours triggered mood vulnerabilities, emphasizing the importance of synchronized eating and sleep patterns for mental health was also shown in the study conducted by author He et al (2022).

Table 13: Association between Barriers and Meal Skipping

Eating Frequency	Anxiety N(%)	No Anxiety N(%)	P-Value (p<0.05)	χ^2 value (p<0.05)	Result
Frequently	4 (80 %)	21 (22.1%)	**0.014**	8.54	**Significant**
Rarely / Occasionally	1 (20%)	64 (67.4%)			
Never	0 (0%)	10 (10.5%)			

This analysis revealed a significant relationship between the three most common barriers (busy schedule , lack of appetite & work pressure) and irregular meal timings.

Author Felicity J et al (2016) , conducted a study that proved busy schedule as the most common and statisfically significant.

Table 14 :Association between Consistent meal strategies and Early meal intake

Meal	Strategy	Early eaters using strategy (N%)	χ^2 value ($p<0.05$)	P-Value ($p<0.05$)	Result
Breakfast	Following a fixed daily routine	38 (18.7%)	7.72	0.172	Insignificant
	Eating with family	40 (19.7%)			
	Meal prepping in advance	35 (17.2%)			
	Setting reminders or alarms	34 (16.7%)			
	Keeping quick snacks	36 (17.7%)			
	Others	20 (9.9%)			
Lunch	Following a fixed daily routine	30 (18.6%)	4.25	0.512	Insignificant
	Eating with family	31 (19.3%)			
	Meal prepping in advance	28 (17.4%)			
	Setting reminders or alarms	25 (15.5%)			
	Keeping quick snacks	29 (18.0%)			
	Others	18 (11.2%)			
Dinner	Following a fixed daily routine	25 (18.4%)	3.75	0.585	Insignificant
	Eating with family	27 (19.9%)			
	Meal prepping in advance	23 (16.9%)			
	Setting reminders or alarms	22 (16.2%)			
	Keeping quick snacks	24 (17.6%)			
	Others	15(11.0%)			

The analysis revealed no statistically significant relationship between early eating habits and the specific meal strategies used.

No statistically significant relationship between meal timing strategy among adults and noted variable, was found in the meta analysis conducted by author Liu et al (2024).

Table 15: Association Between Skipped Meals and Reported Consequences

Consequences	Breakfast skippers (N%)	Lunch skippers (N%)	Dinner Skippers (N%)	χ^2 value ($p<0.05$)	p-value ($p<0.05$)	Result
Weight gain	24 (14.72%)	23 (12.11%)	18 (11.18%)	1.22	0.544	Insignificant
Weight loss	26 (15.95%)	15 (7.89%)	12 (7.45%)	5.64	0.059	Insignificant
Fatigue	37 (22.70%)	40 (21.05%)	32 (19.88%)	0.90	0.639	Insignificant
Mood Instability	44 (26.99%)	45 (23.68%)	38 (23.60%)	0.24	0.886	Insignificant
Headaches	22 (13.50%)	27 (14.21%)	19 (11.80%)	1.31	0.520	Insignificant
Poor concentration	18 (11.04%)	20 (10.53%)	14 (8.70%)	0.91	0.634	Insignificant
Brain fog	16 (9.82%)	19 (10.0%)	17 (10.56%)	0.17	0.918	Insignificant
Increased hunger later	25 (15.34%)	30 (15.79%)	21 (13.04%)	1.18	0.554	Insignificant
Junk food cravings	25 (15.34%)	31 (16.32%)	22 (13.66%)	0.95	0.623	Insignificant
Poor work performance	15 (9.20%)	18 (9.47%)	14 (8.70%)	0.33	0.846	Insignificant
Mood swings	21 (12.88%)	20 (10.53%)	18 (11.18%)	0.12	0.942	Insignificant
Others	2 (1.23%)	1 (0.53%)	0 (0%)	2.00	0.368	Insignificant
None	17 (10.43%)	22 (11.58%)	38 (23.60%)	11.05	**0.004**	**Significant**

The analysis revealed no statistically significant relationship between the type of meal skipped (breakfast, lunch, or dinner) and the most commonly reported consequences, namely fatigue, mood instability, and mood swings.

No robust statistical link between the specific meal omitted and the resulting adverse effect profile was also shown in the study conducted by author Azemati et al (2020).

Table 16:Association between late meals and reported consequences

Consequences	Breakfast (N%)	Lunch (N%)	Dinner (N%)	χ^2 value ($p<0.05$)	p-value ($p<0.05$)	Result
Weight gain	27 (14.36%)	28 (15.14%)	30 (15.96%)	0.420	0.811	Insignificant
Weight loss	18 (9.57%)	13 (7.03%)	12 (6.38%)	1.483	0.476	Insignificant
Indigestion	32 (17.02%)	31 (16.76%)	34 (18.09%)	0.178	0.915	Insignificant

Brain fog	8 (4.26%)	7 (3.78%)	5 (2.66%)	0.626	0.731	Insignificant
Anxiety	8 (4.26%)	7 (3.78%)	7 (3.72%)	0.042	0.979	Insignificant
Mood instability	28 (14.89%)	28 (15.14%)	27 (14.36%)	0.089	0.957	Insignificant
Insomnia	14 (7.45%)	13 (7.03%)	18 (9.57%)	0.956	0.621	Insignificant
Bloating	11 (5.85%)	13 (7.03%)	14 (7.45%)	0.571	0.752	Insignificant
Irritability	15 (7.98%)	14 (7.57%)	12 (6.38%)	0.390	0.823	Insignificant
Others	2 (1.06%)	1 (0.54%)	1 (0.53%)	0.462	0.793	Insignificant

The analysis revealed no statistically significant relationship between the late meal intake (breakfast, lunch, or dinner) and the most commonly reported consequences, namely weight gain , indigestion , and mood instability.

Author Dashti et al. (2021), conducted a large cohort study that found late eaters had only slightly higher cardiometabolic risk and lower weight loss success compared with early eaters, with overall effects varying and often not statistically significant.

Table 17 : Association between Chronotype and Meal timing

Meal	**Chronotype**	**Early (N%)**	**Late (N%)**	**χ^2 value (p<0.05)**	**p-value (p<0.05)**	**Result**
Breakfast	Morning	28 (37.3%)	17 (22.7%)	9.1	**0.0025**	**Significant**
	Evening	8 (10.7%)	22 (29.3%)			
Lunch	Morning	27 (36.0%)	18 (24.0%)	2.08	0.15	Insignificant
	Evening	13 (17.3%)	17 (22.7%)			
Dinner	Morning	17 (22.7%)	28 (37.3%)	0.79	0.37	Insignificant
	Evening	5 (6.7%)	25 (33.3%)			

The analysis revealed a statistically significant relationship between chronotype and breakfast timing, with morning chronotypes significantly more likely to eat breakfast early, while evening chronotypes tend to eat breakfast late. No statistically significant relationship was found between chronotype and the timing of lunch or dinner.

A statistically significant relationship between chronotype and breakfast timing was also shown in a study conducted by Mazri et al. (2019), which found that evening chronotypes were significantly associated with delayed breakfast timing and that morning types were more likely to consume breakfast early.ssss

I. ACKNOWLEDGMENT

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