Diet Quality and Affordability of Healthy Diets among Workers of Selected Garments Industries in Bangladesh

A Thesis in Nutrition and Food Science Submitted to the University of Dhaka in Partial Fulfillment of the Requirements for the Degree of Master of Philosophy (M. Phil)

Submitted by

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Dedicated…

"To the bravery of those who dare to make a difference."

DECLARATION

I hereby declare that the content of this M. Phil dissertation is my original work and has not previously been submitted for a degree at this or any other University. To the best of my knowledge, it contains no material previously published or written by other people except where due references have been made.

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CERTIFICATION

This M. Phil thesis, entitled "Diet Quality and Affordability of Healthy Diets among Workers of Selected Garment Industries in Bangladesh," is an original piece of research submitted by Shazia Afrin. Dr. Md. Ruhul Amin, Professor, Institute of Nutrition and Food Science, University of Dhaka, supervised the research, which was submitted to the M. Phil Examination Committee for evaluation.

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This M. Phil thesis, entitled "Diet Quality and Affordability of Healthy Diets among Workers of Selected Garment Industries in Bangladesh," is an original piece of research submitted by Shazia Afrin. Dr. Khaleda Islam, Professor, Institute of Nutrition and Food Science, University of Dhaka, co-supervised the research, which was submitted to the M. Phil Examination Committee for evaluation.

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ABSTRACT

Background: The ready-made garment (RMG) sector is key to Bangladesh's economy, significantly contributing to Gross Domestic Product (GDP) and foreign exchange earnings. However, RMG workers, predominantly women, face critical challenges related to health, nutrition, and productivity. Despite their socio-economic importance, research on diet quality and the affordability of nutritious diets by RMG workers remains limited. This study aimed to evaluate the diet quality as well as the affordability of healthy diets among RMG workers of selected garment industries in Bangladesh.

Methods: This study used baseline survey data from the "Strengthening Workers' Access to Pertinent Nutrition Opportunities" (SWAPNO) project, funded by the Global Alliance for Improved Nutrition (GAIN). A secondary analysis was conducted on cross-sectional data collected from 801 RMG workers (333 males and 468 females) employed in two apparel industries in Dhaka and Mymensingh. Participants were selected using convenience sampling. Data on socio-demographic characteristics, dietary intake (assessed using the 24-hour recall method), nutrient adequacy, and micronutrient intake expressed as a percentage of the Estimated Average Requirement (EAR) were evaluated, along with anthropometric measurements. Nutritional status was assessed using body mass index (BMI) classified according to both World Health Organization and Asian-specific criteria. The affordability of a healthy diet was evaluated, and statistical analyses were performed to examine associations between diet quality, nutritional status, mean probability of adequacy (MPA), and relevant socioeconomic factors.

Results: Among the 801 RMG workers studied, 58.4% were female, and 90.3% were aged 18 to 34 years. Female workers generally had lower educational attainment and income levels compared to males. The dietary analysis showed a heavy reliance on calorie-dense foods, particularly rice, with a low intake of fruits, vegetables, and pulses. Macronutrient distribution indicated excessive carbohydrate intake (67.0% of total energy), while fat intake was often below ideal levels in 43.4% of participants (less than 15% of total energy). Calcium consumption among RMG workers was alarmingly low, with most consuming less than 50% of the Estimated Average Requirement (EAR). Similarly, intakes of iron, zinc, riboflavin, and vitamin A are at or below the EAR,

indicating a high risk of inadequacies. While niacin and folate exceeded the EAR, vitamin C intake was highly variable. A dual burden of malnutrition was observed, with 7.4% of workers underweight and 21.5% overweight or obese based on Global WHO BMI standards, while it was 44% overweight or obese based on WHO Asian BMI standards. The logistic regression analysis showed that the mean probability of adequacy (MPA) for micronutrients was significantly higher among RMG workers in Mymensingh (AOR 1.68, $p = 0.004$) and among those aged 25 to 34 years (AOR 1.40, $p = 0.049$), while other socio-economic factors had no significant effect. Regarding the affordability of healthy diet, this study found that most workers could afford energy-sufficient diets; however, 68% of the workers were unable to afford a healthy diet due to economic constraints. Logistic regression analysis further showed that higher income (BDT > 13,000), smaller household size, and the presence of multiple earning members were significantly associated with better affordability of a healthy diet.

Conclusion: This study highlights significant nutritional challenges among RMG workers in Bangladesh, marked by widespread micronutrient inadequacy and a dual burden of malnutrition, particularly among female workers. Economic barriers remain a critical impediment to accessing healthy diets. These findings underscore the urgent need for targeted interventions to improve diet quality, address micronutrient inadequacies, and promote balanced macronutrient intake while addressing affordability constraints.

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LIST OF ABBREVIATIONS AND ACRONYMS

AOR	Adjusted Odds Ratios
ASF	Animal Source Food
BBS	Bangladesh Bureau of Statistics
BDT	Bangladeshi taka
BGMEA	Bangladesh Garment Manufacturers and Exporters Association
BMI	Body Mass Index
CAPI	Computer-Assisted Program Interface
CI	Confidence Interval
COR	Crude Odds Ratios
CoRD	Cost of Recommended Diet
COVID-19	Coronavirus Disease of 2019
CPD	Continuing Professional Development
CVD	Cardiovascular Disease
DDS	Dietary Diversity Score
DES	Dietary Energy Supply
DF	Degrees of Freedom
DGLV	Dark Green Leafy Vegetables
DM	Diabetes Mellitus
EAR	Estimated Average Requirement
EBP	Evidence-Based Practice
EPB	Export Promotion Bureau
FAO	Food and Agriculture Organization
FBG	Fasting Blood Glucose
FCS	Food Consumption Score
FH	Family History
GAIN	Global Alliance for Improved Nutrition
GDP	Gross Domestic Product
HIES	Household Income and Expenditure Survey
ICMR	Indian Council of Medical Research
ILO	International Labour Organization
IQR	Inter Quartile Range

LCU	Local Currency Unit
MDD-W	Minimum Dietary Diversity for Women
MDM	Mid-Day Meal
MPA	Mean Probability of Adequacy
NCDs	Non-Communicable Diseases
NGO	Non-Governmental Organization
NIN	National Institute of Nutrition
OR	Odds Ratio
PA	Probability of Adequacy
PPP	Purchasing Power Parity
RDA	Recommended Daily Allowance
RE	Retinol Equivalent
RMG	Ready-Made Garments
RNI	Recommended Nutrient Intake
SD	Standard Deviation
SOFI	State of Food and Nutrition Security
SWAPNO	Strengthening Workers Access to Pertinent Nutrition Opportunities
Tk.	Taka
UNICEF	United Nations International Children's Emergency Fund
USD	U.S. Dollar
WFP	World Food Programme
WHO	World Health Organization

CHAPTER 1
INTRODUCTION

1.1 Background

Bangladesh's economic progress over the past few decades has been significantly driven by its ready-made garment (RMG) industry, which operates under the globally recognized slogan "Made in Bangladesh." Since its emergence in the late 1970s, the RMG sector has grown to become the country's largest export-earning industry, playing a pivotal role in national development and contributing substantially to foreign currency reserves (Islam et al., 2016). In the fiscal year 2017–18, the industry generated export earnings of USD 30.61 billion, reflecting an increase of over 8% from the previous year. It accounted for 83.5% of total national exports and contributed 11.23% to the gross domestic product (GDP) (EPB, 2018; BBS, 2018). Since 2009, Bangladesh has been the world's second-largest exporter of RMGs after China.

The RMG sector has expanded from just 12 factories in 1978 (Hossen, 2017) to over 4,600 by 2020, employing approximately 5.1 million workers—of whom around 65% are women (BGMEA, 2020). In the 2019–20 fiscal year, the sector earned USD 27.9 billion in exports, comprising 84% of total exports and contributing 9.24% to GDP (BGMEA, 2020). Despite its vital role in economic growth and employment generation, the RMG industry faces numerous challenges, including low wages, unsafe working conditions, and limited protection of workers' rights, especially for women. The prevailing minimum wage is often insufficient for workers to afford necessities such as food, housing, healthcare, and transportation (Hasnain et al., 2014).

The health and nutritional status of RMG workers are closely linked to their productivity and economic well-being (Hasnain et al., 2014; Faruquee et al., 2014; Ahmed, 2014; Islam et al., 2008). Research by Ahmed (2014) highlights that many female garment workers earn inadequate wages, making it difficult to access nutritious and fresh food, which contributes to malnutrition and a range of health issues such as gastrointestinal disorders, decreased appetite, and foodborne illnesses. Uddin (2015), citing Myrdal (1968), emphasized the cyclical relationship between undernutrition and low labor productivity, noting that undernourished workers are less productive and, as a result, continue to receive

low wages. This vicious cycle undermines both individual well-being and the broader development goals of the sector. Improving the health and nutrition of RMG workers is therefore essential to increasing their productivity and ensuring their effective participation in global markets.

Previous studies have examined various aspects of RMG workers' well-being in Bangladesh, including their socioeconomic status, food habits, food insecurity, health conditions, and the impact of workplace nutrition interventions. However, there remains a critical gap in research on the quality of diets consumed by RMG workers and the affordability of healthy, nutritious foods within this population.

As Bangladesh continues its transition from an agrarian to an industrial economy, the RMG sector has emerged as a cornerstone of development (Mia & Akter, 2019). The sector's rapid growth has been facilitated by low labor costs, minimal technological requirements, and a large pool of available female laborers with limited alternative employment options (Akram, 2014; Jahan, 2012). Many of these workers have limited education, skills, and socioeconomic resources and often migrate from rural areas. This makes them particularly vulnerable to exploitation and health risks (Kabir et al., 2019).

Despite the protection promised by the International Labour Organization (ILO) Convention 155 (1981), which guarantees the right to a safe and healthy working environment, many factory owners in Bangladesh fail to implement necessary safety and health measures (Hasnain et al., 2014). Consequently, workers often experience poor nutritional status and limited access to healthcare. Factory workers are also vulnerable to arbitrary employer practices, intense global market demands, and weak enforcement of labor rights. Due to harsh working environments, long hours, and inadequate incomes, workers frequently face barriers to maintaining good health. A study by Akhter et al. (2010) reported that 85% of female factory workers in 2010 suffered from malnutrition and related health issues.

A study by Solinap et al. (2019) reviewed several studies assessing the health of factory workers, including eight cross-sectional studies and one case-control study, covering a total of 4,566 participants, the majority of whom were women. The largest of these studies involved 1,211 female workers aged 14–19, revealing widespread undernutrition, poor anthropometric indicators, and inadequate nutrient intake. Additionally, the prevalence of

non-communicable diseases (NCDs) such as general and central obesity, vitamin D deficiency, and anemia is alarmingly high in this population (Hasnain et al., 2014; Bhowmik et al., 2015; Islam et al., 2008; Mahmood et al., 2017).

Ensuring a healthy and supportive environment is essential to improving the health and nutritional outcomes of RMG workers. Access to adequate and affordable food, in both terms of quantity and quality, is critical not only for individual well-being but also for enhancing productivity. Macronutrients (energy and protein) and essential micronutrients play vital roles in immunity, cognitive function, motor development, and overall work performance. However, current dietary practices often overlook micronutrient intake, which is crucial for preventing deficiency-related diseases. Therefore, understanding the dietary patterns, nutrient intake, existing nutrient gaps, and the economic feasibility of maintaining a healthy diet among RMG workers is essential for designing effective nutrition interventions and promoting sustainable workforce development in Bangladesh.

1.2 Problem statement

Over the past three decades, the RMG sector has grown exponentially, becoming Bangladesh's most dynamic industry and the second-largest global exporter of garments after China. In the fiscal year 2013–14, the industry generated nearly US$24.5 billion in export earnings, accounting for 80% of the country's total export revenue and employing approximately 4.2 million people, of whom 80% were women (Hossain, 2019). As Bangladesh progresses toward graduation from the Least Developed Countries (LDC) category, with aspirations for economic and technological advancement by 2021, the RMG sector aims to double its export value to US$50 billion. Achieving this target requires a healthy, skilled, and productive workforce.

However, the sector continues to depend heavily on a labor-intensive workforce, especially in Dhaka, Chattogram, and Narayanganj (Uddin, 2015). Compared to other garment-producing countries, where entry-level wages are $101 in Vietnam, $135 in India, and $217 in China, in Bangladesh, the minimum wage is less than USD 25 (approximately BDT 2,750) per month, which falls below the international poverty line of USD 1.25 (approximately BDT 110) per day. This inadequate income severely restricts workers' ability to afford a nutritious diet, forcing many to subsist on monotonous, calorie-dense but nutrient-poor meals consisting primarily of rice, low-quality grains, minimal

vegetables, and small amounts of animal-source foods (Uddin, 2015). Such dietary patterns contribute significantly to malnutrition and poor health among workers and their families. The consequences of undernutrition are profound, including diminished physical and mental productivity, increased vulnerability to illness, and fewer working days, all of which lead to potential underperformance and less national economic progress. These issues are exacerbated by the workers' socioeconomic disadvantages, such as rural origins, poverty, lack of education and bargaining power, and persistent gender inequality (Uddin, 2015).

Food consumption among low-income groups, including RMG workers, is closely tied to their limited purchasing power. According to Chowdhury (2019), most workers allocate only Tk.51–60 (approximately $0.42–0.49) per person per day for meals, with 30% spending Tk.61–70 ($0.50–0.57), 18% spending less than Tk.50 ($0.41), and only 8% spending more than Tk.70 ($0.57) daily. Women's wages are approximately 20% lower than men's overall, and remain about 8% lower even among narrowly defined production workers; this wage gap is statistically significant and persists despite controlling for precisely measured skills, indicating systemic gender-based pay inequality within the garment sector (Menzel & Woodruff, 2021). Many prioritize sending remittances to rural families, paying rent, and covering educational expenses before allocating funds for food. Delayed wages further exacerbate this situation, particularly affecting unskilled and junior workers.

Despite the critical role of nutrition in workforce productivity and national development, no prior study in Bangladesh has systematically examined the relationships between food group consumption patterns, macro- and micronutrient intake, nutrient adequacy, affordability of a healthy diet, and nutritional status among RMG workers. This study addresses this gap by assessing these factors to provide a comprehensive understanding of workers' dietary intake, nutritional adequacy, and ability to afford a healthy diet.

1.3 Significance of the study

The RMG sector in Bangladesh plays a pivotal role in employment generation, foreign exchange earnings, and poverty reduction. According to Shahajada et al. (2019), this sector holds greater potential than any other industry in contributing to national economic growth. Over the past 25 years, the RMG industry has witnessed remarkable expansion,

directly employing around 4 million workers. Its contribution to total exports rose from 3.89% in 1983–84 to 83.9% in recent years, while its share in the GDP increased from 2.74% in 1990–91 to 12.26% in 2017–18. These figures underscore the RMG sector's centrality to Bangladesh's economic development.

Driven by aspirations for a better life, millions of workers, mostly women, migrate from rural areas to urban garment hubs. However, their daily diets remain basic and nutritionally inadequate, primarily composed of rice and lacking essential nutrients (Dipti et al., 2008). Studies have shown that most RMG workers consume insufficient calories and follow an unbalanced diet dominated by carbohydrates. Khan and Ahmed (2005) reported that 82% of workers expend more energy than they consume, while 86% work 8–10 hours a day, limiting opportunities for rest and physical well-being.

A more recent assessment by the Global Alliance for Improved Nutrition (GAIN, 2017) revealed that the diets of RMG workers in five factories in Dhaka and Gazipur fell significantly short of recommended intake levels—fulfilling only 75% of energy, 68% of vitamin B6, 63% of thiamin, 53% of riboflavin, and 21% of vitamin D needs. Furthermore, only 55% of female RMG workers met the Minimum Dietary Diversity for Women (MDD-W) threshold of consuming more than four food groups, an indicator of micronutrient adequacy (FAO, 2016). These inadequate dietary practices, coupled with harsh working conditions, are associated with poor nutritional status, weakened physical condition, increased absenteeism, and diminished productivity (Grimani et al., 2019; Haque et al., 2008).

Given the central economic role of the RMG sector and the vulnerability of its labor force, this study is significant in its aim to assess the dietary patterns, nutrient profiles, and nutritional status of female RMG workers in Bangladesh. It identifies the gaps between actual nutrient intake and recommended dietary requirements and assesses the contribution of different food groups to nutrient intake in typical meals. Additionally, this study explores the affordability of purchasing nutritious foods and the socio-economic factors that influence dietary choices. By addressing these critical issues, the research offers valuable insights for developing targeted interventions to improve the health, well-being, and productivity of RMG workers, thereby supporting sustainable growth in the industry.

1.4 Research questions

1. To what extent do garment workers consume a nutritious and balanced diet?
2. Does the daily diet of RMG workers meet their recommended nutritional requirements?
3. Are garment workers able to afford a nutritionally adequate and healthy diet?
4. What socio-economic factors influence garment workers' access to a healthy and balanced diet?

1.5 Objective of the study

1.5.1 General objective

The overall objective of the study was to assess the quality of diets and the affordability of healthy diets among workers in selected garments industries in Bangladesh.

1.5.2 Specific objectives

The specific objectives were:

1. To assess the RMG worker's diet quality.
2. To evaluate the food consumption patterns of RMG workers.
3. To examine the affordability of a healthy diet by the RMG workers.
4. To determine the nutritional status of the workers.
5. To explore the factors associated with micronutrient adequacy and affordability.

1.6 Hypothesis of the study

1. The diet quality of RMG workers is inadequate, characterized by low dietary diversity and failure to meet recommended dietary guidelines.
2. The food consumption patterns of RMG workers are insufficient, with deficient consumption of nutrient-rich food groups.
3. The majority of RMG workers are unable to afford a healthy diet due to low wages and high non-food expenditures.
4. The nutritional status of RMG workers is suboptimal, characterized by a high prevalence of malnutrition and micronutrient inadequacies.
5. Job location, age, income level, and the number of earning household members are positively associated with micronutrient adequacy and the affordability of a healthy diet.

CHAPTER 2
LITERATURE REVIEW

Understanding diet quality and the affordability of healthy diets is essential for addressing the nutritional challenges faced by industrial workers, particularly in low- and middle-income countries. This literature review examines existing research on dietary quality, cost, and the influence of socioeconomic and occupational factors, with a specific focus on garment industry workers in Bangladesh.

2.1 Socioeconomic status of the RMG workers

2.1.1 Socio-demographic characteristics of the workers

Several studies have explored the age distribution and gender composition of RMG workers in Bangladesh. Afroz (2018) found that 84% of workers in Dhaka are aged 15 to 29, with an average age of 23.7 years, and 60% of the workforce is female. Uddin (2018) reported an average age of 24.6 years, with 76% under 30. Das (2017) noted that 63% of female workers are aged 23 to 33, with 4% under 13, indicating child labor violations. Research on family size reveals that 64% of workers' families have 4 to 6 members (Afroz, 2018), while Uddin (2018) found that 34% have 4 members. Das and Das (2017) also reported that 33% of workers in Dhaka have families of 4 members. This higher percentage is likely due to the broader family-size category used in Afroz's study, as well as socio-cultural norms favoring medium-sized families, and typical household dependency structures among workers. Chowdhury and Ullah (2010) found that 32.45% of workers in Chittagong have families with more than 5 members.

Earning capacity is typically modest, with most families relying on one or two income earners. Uddin (2018) reported that 65.2% of families have two earners, while 28.8% have only one. Chowdhury and Ullah (2010) noted that 70.86% of female workers' families in Chittagong depend on one or two earners, often relying heavily on the income of female workers. These families struggle, with 80% living below the poverty line. Marital status also plays a key role in the workers' responsibilities. Afroz (2018) found that about half of the workforce is married, and Uddin (2018) reported that 71.6% of workers balance work

and family duties. Chittagong, Chowdhury, and Ullah (2010) found that 53% of female workers are married, 36.42% unmarried, and smaller percentages divorced or widowed.

Regarding education, most workers have only primary or secondary education. Afroz (2018) reported that 46% of workers have primary education, 41.67% have secondary education, and only 5.42% hold higher qualifications. Uddin (2018) found similar trends, with 51.2% having secondary education and 4.8% with no formal schooling. Das and Das (2017) noted that 28% are uneducated, and 49% completed primary school. Education is key to improving job performance and reducing gender disparities (Mahmud & Ahmed, 2005). Chowdhury and Ullah (2010) found that only 2.65% of workers are illiterate.

In Dhaka, Sikdar (2014) found that 55% of RMG workers live in houses, 36.25% in mess accommodations, and 3.75% in slums. Hasnain et al. (2014) reported that 65% of female workers live away from their families, and 58.33% reside in overcrowded "kacha" houses in urban slums. With rapid urbanization and increasing slum settlements, the urban population is expected to surpass the rural population, despite stagnant health services for the urban poor. Inadequate and congested living conditions continue to pose significant challenges for RMG workers, potentially affecting their health, safety, and overall well-being.

2.1.2 Income and overtime of the RMG workers

Income levels and overtime hours significantly impact the livelihood and dietary choices of RMG workers. According to Moazzem (2019), the minimum wage for RMG workers in Bangladesh was set at BDT 8,000 for entry-level workers (Grade VII) in August 2018, as shown in Table 2.1. This adjustment represents a nominal increase of approximately 50.9% compared to the previous minimum wage of BDT 5,300 announced in 2013 for the same grade. However, the rate of real wage growth over time remains modest. Since the last wage revision in December 2013, the basic wage for workers has increased annually by only 5%. Taking this into account, the estimated monthly wage for Grade VII workers by the end of 2018 would be BDT 6,460.

Consequently, when comparing the actual wage received in 2018 to the proposed wage structure, the effective wage increase amounts to only 23.8%. Similar trends are observed across other wage grades, with total wage growth of 21.1% for Grade VI, 19.6% for Grade V, 17.2% for Grade IV, 14.4% for Grade III, 7.8% for Grade II, and 7.5% for Grade I.

Based on this calculation, although the basic salary under the 2018 wage structure has increased slightly, it still falls short when adjusted for roles and inflation, and remains lower than the effective wage received by workers in 2018.

In terms of allowances, there have been varied adjustments: medical allowances increased by 140%, transport allowances by 75%, and food allowances by 38.7%. Despite these changes, the overall proposed subsidy increases have been deemed insufficient to ensure a sustainable livelihood for workers (Moazzem & Arfanuzzaman, 2018).

Overtime plays an essential role in the total earnings of workers, as many employers require their employees to put in extra hours. On average, each worker usually needs to work an additional 2 to 4 hours each day. As per the Bangladesh Labor Act 2006 (Amendment of 2013), the maximum permissible overtime is 2 hours, and the legal weekly working hours stand at 60 (Ministry of Labor and Employment, 2006). Even though overtime helps employees stay financially stable, it gets harder to maintain after a full day of scheduled work that lasts for 10 to 12 hours. According to the Bangladesh Labor Act of 2006, adult workers generally should not exceed an 8-hour workday (Ministry of Labor and Employment, 2006). Workers often seek overtime opportunities to boost their earnings, yet wages remain relatively low.

Table 2.1 Monthly wage of the RMG workers in 2018

Grade	Basic wage	House rent (50% of basic)	Medical allowance	Transport allowance	Food allowance	Gross wage (BDT)
Grade I	10440	5220	600	350	900	17510
Grade II	8520	4260	600	350	900	14630
Grade III	5160	2580	600	350	900	9590
Grade IV	4930	2465	600	350	900	9245
Grade V	4670	2335	600	350	900	8855
Grade VI	4370	2185	600	350	900	8405
Grade VII	4100	2050	600	350	900	8000
Trainee	-	-	-	-	-	5975

Note: Grade I: Pattern Master, Chief Quality Controller; Grade II: Mechanic, Electrician, Cutting Master; Grade III: Sample Machinist, Senior Machine Operator; Grade IV: Sewing Machine Operator, Quality Inspector, Cutter, Packer, Line Leader; Grade V: Junior Machine Operator, Junior Cutter, Junior Marker; Grade VI: Operator of General Sewing/Button Machines; Grade VII: Assistant Sewing Machine Operator, Assistant Dry Washing Man, Line Iron Man. BDT: Bangladeshi Taka. ***Source:*** MoLE (2018)

Providing specific data on working hours and overtime compensation, Uddin (2018) conducted a survey involving 250 workers from 47 garment factories located in areas such as Savar, Ashulia, and Uttara, and found that 18.8% of respondents did not work overtime. Notably, 25.6% of workers worked over 60 hours per month, earning between BDT 1000-1500, 1500-2000, 2000-2500, and more than 2500. Additionally, 16.8% worked overtime for 51-60 hours per month, with corresponding salaries falling within similar ranges. Furthermore, 14.4% worked overtime for 41-50 hours per month, earning similar incomes. Similarly, 13.6% worked overtime for 31-40 hours per month, with respective income brackets. 9.3% of respondents worked overtime for 21-30 hours monthly, earning incomes ranging from 500-1000, 1000-1500, and 1500-2000 BDT.

To provide insight into the wage structure and gender disparities among garment workers in Dhaka, Afroz (2018) conducted a comprehensive survey of over 240 workers from various locations in Dhaka city. The study revealed that 24% of workers' initial salaries

range from TK 3000 to 4000, approximately 67% start with salaries between TK 4001 to 5000, and the remaining 11% earn above TK 5000. The average starting salary is TK 3127.64. Additionally, the study found that the minimum and maximum monthly starting salaries are TK 3000 and TK 7000, respectively. It was noted that among male workers, 26% begin with salaries below TK 5000, 57% fall within the TK 4001 to TK 5000 range, and 17% earn more than TK 5000, while only about 5% of female workers start with salaries exceeding TK 5000.

To assess the impact of wage amendments and gender contributions among garment workers, Das (2017) conducted a detailed study focusing on income distribution in the Dhaka Metropolitan Area. The study revealed that 23% of respondents had a monthly income between BDT 4,000 and 6,000, while 46% reported earning between BDT 6,000 and 8,000. Most of their interviewees are in this range, while the second-highest percentage of income is 8000-10000 BDT, and this ratio is 30%. Only 1% of the respondents' income is 10000-12000 BDT. Their average income is 7,200 Taka. Based on the above, this study found that their income levels have risen with the latest amendments to the wages of clothing workers in 2013. According to the amendment, their minimum wage was declared to be BDT 5,300. Therefore, we can see the reflection of the amendment here because most respondents fall within the BDT 6000-8000 range based on their monthly total income. Another interesting fact from this survey was that female employees contributed 41% of the contribution level, so the family exhausted its total household income. This proves that women have contributed significantly to their families and the country's economy.

To highlight wage disparities and the economic challenges faced by female garment workers, several studies have examined salary distributions and living conditions in major industrial cities of Bangladesh. In a study conducted by Sikdar (2014) on the female garments of Dhaka City, it was observed that the labor market in Bangladesh is very cheap, and the survey proves this fact. Nearly 69% of female workers earn a monthly salary of 3000 to 7000 TK, while almost 31% of women receive more than 7,000 TK per month. The average monthly salary is estimated to be 6,455.94 TK (only US$78.83). Wages and benefits play a vital role in determining garment workers' economic status and living conditions. According to Chowdhury and Ullah's (2010) survey of 151 individuals from 29 garment factories across various locations in the Chittagong Metropolitan area, it was

found that 71.52% of female employees receive a monthly salary of Tk. 4,000 or less. This amount falls short of meeting the needs of a typical family consisting of 3-4 members. Only 18% of female workers earn more than Tk. 5,000 per month.

2.1.3 Workers' livelihood expenses

To better understand the financial pressures faced by RMG workers, Moazzem and Arfanuzzaman (2018) analyzed their expenditure patterns and changes in cost of living over time. Answer from Perplexity: pplx.ai/share. As indicated in Table 2.2, the cost of living for these workers has been notable over time, accompanied by shifts in the proportion of expenditures allocated to both food and non-food items.

Following the livelihood needs approach, the study identified many issues, including:

a. The rise in non-food costs has significantly increased workers' overall living expenses;
b. Lack of necessary facilities (such as schools/colleges, hospitals, etc.) also leads to an increase in workers' living costs;
c. Workers, regardless of their professional level, still strive to meet their basic needs;
d. The increase in family members puts pressure on workers to pay extra fees and
e. Changes in non-food costs have different effects on workers in different regions.

The research findings indicated that despite notable wage increases for workers, approximately 52.2% continued to reside in shared living spaces. Furthermore, 86% of workers utilize communal bathrooms, while 85% share kitchen facilities. A portion of workers, totaling 17%, need more beds and sleep on the floor, while 16% do not have ceiling fans in their accommodations. A significant proportion of workers, amounting to 32.2%, resort to personal loans, necessitating monthly repayments.

Table 2.2 Changes in workers' living costs between 2013 and 2018

Cost	**2013 (in BDT)**	**2018 (in BDT)**	**Yearly % change between 2013 and 2018**
Food cost	5180	8125	11.4
Non-food cost	5173	11142	23.1
Total cost	10353	19267	17.2
Non-food cost (with installment)	-	14310	-
Total cost (with installment)	-	22435	-
The ratio of food and non-food costs	50:50	42:58	-
The ratio of food and non-food costs (with installment)	-	36:64	-

Note: BDT: Bangladeshi Taka

Source: Adapted from Moazzem and Arfanuzzaman (2018);

To examine the housing expenditure burden faced by female garment workers despite poor living conditions, Das and Das (2017) conducted a comprehensive survey in Dhaka city that revealed concerning patterns in accommodation costs relative to income. It was found that the expenditure of 106 workers was in the range of 2000-3000 BDT, which is 71% of the total sample. According to housing expenditure, another 27% of the respondents are between 3000-4000 BDT. Very few of them fall within the BDT 1000-2000 range. There are no workers who have lodging costs above BDT 4000. Although most of these female workers live in highly unsanitary slums, this does not reduce their housing costs. If they want to live in a hotel or any other convenient housing, they must pay almost the same rent.

It can be seen from the survey that 29% of female workers have food costs in the range of 5000-8000 Tk, while most respondents (56%) have food costs in the range of 8000-11000 Tk. And the remainder of the worker's food cost lies between BDT 11000-14000. Their average food expenditure is 9060 BDT. From there, it can be understood that their average

food expenditure is moderately high compared to other expenditures. Under the current inflation situation, food prices are increasing day by day. Therefore, they cannot match food costs with rising prices to ensure adequate nutrition.

The survey found that 63% of the respondents' clothing expenditure was between 0-500 Tk, while 27% of the respondents' clothing expenditure was between 500-1000 Tk. 7% and 3% of workers' clothing expenditure is between 1,000-1500 Tk and 1500-2500 Tk. Their average clothing expenditure is 515 Tk, which is relatively low. RMG female workers allocate minimal medical expenses. A significant proportion of respondents spend relatively little on medical facilities each month, with 29% allocating 0–500 Tk, 41% spending 500–1000 Tk, 15% spending 1000–1500 Tk, and 10% spending 1500–2000 Tk. The rest of them are between BDT 2000-3000. Their average medical cost is BDT 865. The average education cost of RMG female workers' children is 750 Tk, which is lower than other costs. This may be because they have received many benefits from NGOs that provide children's education at a meager cost or free of charge. There are also government schools that offer education at minimal cost.

To assess improvements and ongoing challenges in workplace hygiene and sanitation, Farhana et al. (2015) investigated access to sanitation and clean water among garment workers in Bangladesh. Approximately 80% of clothing and textile workers have gained access to sanitation facilities. However, the main challenge lies in the shared toilets, with about 20-30 people using a single toilet, leading to unsanitary conditions. Ideally, there should be at least one toilet for every 10 people. Water supply is another major issue; considerable effort has been made to provide clean water. About 61.1% of workers have access to drinking water, but there isn't enough for their bathrooms and toilets, and workers express dissatisfaction with the quality of drinking water. Therefore, it is crucial to resolve their clean water supply issues. Currently, factory management provides them with the safe drinking water they have access to.

Despite the presence of doctors in most factories, healthcare services for garment workers remain limited, with many companies only able to provide basic medical assistance and minimal medicines. Sikdar et al. (2014) in their study found that nearly 90% of people in the industry have doctors. However, they are only used for primary assistance, and 10% of companies in the industry still do not have any doctors. Companies can only provide workers with small amounts of medicine. The study revealed that female workers incurred

an average monthly medical expense of 497.5 Taka. In contrast, as per the 2010 Wage Board's recommended salary structure for RMG workers, they were only entitled to a medical allowance of 200 Taka. Nearly 96% of workers had to cover monthly medical costs ranging from 0 to 1,000 Taka.

2.1.4 Family savings

Family savings among RMG workers in Bangladesh remain limited due to low household incomes and high living costs, making it challenging for many families to set aside money for future needs. According to Moazzem and Arfanuzzaman (2018), the majority of RMG workers in Bangladesh face difficulties in saving money due to their already limited household incomes. Their findings indicate that approximately 56.5% of workers, mostly married, are able to save part of their family income, with higher-grade workers saving more than those in lower grades. However, these savings are generally allocated to essential expenditures such as securing basic housing or purchasing necessary household assets. Despite the presence of multiple income earners within some households, over 44% of workers are unable to save any money at all.

The concept of expenditure savings refers to income conserved through minimal or prudent spending, often managed informally by housewives engaging in small-scale activities such as agriculture or fishing. However, this form of saving is largely inaccessible to RMG workers due to their demanding factory schedules, which leave little time for additional income-generating activities. As a result, many rely on overtime work to supplement their income, which further reduces opportunities for personal or family engagement.

Despite the importance of savings for financial security, evidence indicates that most RMG workers in Bangladesh have little to no capacity to save after covering their basic needs. Uddin (2018) reports that only 1.2% of surveyed households had savings not exceeding BDT 500, 2.0% had between BDT 500–1000, 3.2% between BDT 1000–1500, 1.6% between BDT 1500–2000, and merely 0.8% reported savings of BDT 2000 or more. Similarly, a study by Das and Das (2017) found that 61% of respondents were unable to save any money after covering their expenses. Among the remaining respondents, 24% managed to save a small portion ranging from BDT 1–500, while 9%, 5%, and 1% saved between BDT 500–1000, 1000–2000, and 2000–3000, respectively. The average savings

amount reported was only BDT 228, highlighting the extremely limited capacity for financial security among RMG workers.

2.2 Nutrition and health status of RMG workers

In developing countries like Bangladesh, the meager income of most people has driven health care to low priority. Women's health is a lot lower than that of the general population because women are more likely to bear poverty than men. Malnutrition is widespread among the mass population. According to Riaduzzaman (2017), nutrition and poverty are closely related. Many fundamental aspects of poverty, such as hunger, inadequate health care, unsanitary living conditions, unstable living pressures, and stress, often damage the nutritional status of people. Therefore, poverty almost always means being deprived of total nutritional capacity, avoiding premature death, living a life without avoidable morbidity, and having energy for work and leisure.

Therefore, the study of poverty is the same as the study of the nutritional status of people. Among the socially and economically deprived people all over the world, the prevalence of the undernourishment value theory coexists with a series of interrelated factors, which together constitute the so-called "poverty syndrome." Its main attributes are:

a. The income level is insufficient to meet basic food, clothing, and housing needs.
b. A diet that is quantitatively and qualitatively insufficient
c. The environment is harsh, and obtaining safe water and sanitation facilities is difficult.
d. Poor access to medical care facilities, and
e. Large family size and high illiteracy rate, especially in females.

According to Kabir et al. (2019), research indicates that RMG employees are susceptible to various physical health challenges resulting from their work environment and the nature of their occupational duties. Numerous studies have identified significant health issues among these workers, primarily stemming from their daily tasks. These health problems encompass respiratory issues, skin ailments, musculoskeletal disorders, hearing impairment, and cardiovascular conditions. Additionally, commonplace ailments such as back and joint pain, coughs, colds, headaches, and eye disorders leading to blindness, hepatitis, fevers, diarrhea, and stomach discomfort have been reported, collectively rendering the health of RMG workers delicate. Contributing factors to these illnesses

include poor nutrition, inadequate dietary balance, poverty, unfavorable workplace conditions, and exposure to chemical hazards such as dust and various raw materials.

Additionally, inadequate nutrient intake, often resulting from lower wages among garment workers, limits their ability to afford nutritious food, exacerbating health issues such as underweight, anemia, and iron deficiency (Makurat et al., 2016; Hasnain et al., 2014). Solinap et al. (2019) conducted a cross-sectional study, the first of its kind, analyzing the health status of 1906 Bangladeshi RMG and TM factory workers. This study revealed that only 11.9% of workers underwent the EBP test, possibly due to the relatively young age of participants (≥ 18 years). Surprisingly, among workers aged 21 to 25, the EBP ratio was higher. Workers aged 21 to 30 accounted for 52.7% of EBP cases, indicating a notable prevalence rate likely influenced by occupational and lifestyle factors.

RMG workers often face inadequate calorie intake and an imbalanced diet dominated by carbohydrates, leading to poor nutritional quality. Research shows that 82.0% of workers expend more energy than they consume, highlighting a significant energy deficit. Most workers (86.0%) work 8–10-hour shifts, while a smaller portion (14.0%) work up to 12 hours, leaving little room for physical activity (Khan and Ahmed, 2005). Despite these challenges, a study by Solinap et al. (2019) found that 65.3% of workers maintained a normal BMI, with only 1.9% classified as obese among those aged 18–64. However, regression analysis indicated that higher BMI was associated with elevated fasting blood glucose (FBG) and blood pressure (EBP), suggesting increased risks of hypertension and diabetes among obese workers. These findings align with earlier research involving 791 male factory workers, which also found a strong link between obesity, hypertension, and diabetes mellitus (Bhowmik et al., 2015).

The nutritional profile of Bangladeshi women reveals a dual challenge of undernutrition and overweight, with significant variations influenced by geographic location and educational attainment, as documented in Riaduzzaman (2017). The study reveals that Bangladeshi women have an average weight of approximately 40.90 kg, which falls below the average weight of women in many other developing countries, indicating prolonged food scarcity. The average height of Bangladeshi women is 151 cm, surpassing the critical threshold of 141 cm. However, a portion of women (16%) fall below 145 cm. Research reveals that 34% of women suffer from chronic malnutrition, reflected in a body mass index (BMI) lower than 18.5. Additionally, one out of ten women is overweight or obese,

with a BMI of 25 or higher. A woman's nutritional status is closely linked to her place of residence and level of education; for instance, 37% of rural women are categorized as underweight (< 18.5), compared to only 25% of urban women.

Among all regions, Sylhet exhibits the highest percentage of underweight women (48%), whereas Khulna has the lowest proportion (29%). Despite a lack of growth in height among Bangladeshi women with children under 5 years old, there has been some improvement in maternal nutritional status from 1996 to 1997, as indicated by BMI measurements. The percentage of mothers falling below the BMI threshold of 18.5 declined from 52% in 1996-97 to 38% in 2004, marking a 27% decrease in less than a decade. Factors contributing to poor health among Bangladeshi women include malnutrition, inadequate environmental sanitation, limited access to medical services, and, notably, negative societal attitudes towards women's health.

There is a vital link between maternal and child health, which is often overlooked in the workplace. A mother's nutritional status and health level will affect her workplace performance and her ability to raise a healthy child. For example, malnourished women give birth to underweight babies who cannot fully reach their growth potential, and maternal malnutrition and anemia cause 50% of children's developmental delays (UNICEF, 2016).

Several literature studies have shown that the nutritional status of adult RMG workers in Bangladesh is suboptimal. A cross-sectional study conducted at two garment factories in Dhaka City in 2012-13 found that about 43.33% of RMG female workers aged 18-35 were underweight (BMI <18.5 kg/m2) (Hasnain et al., 2014). The average BMI in another similar study was reported to be 21.9 kg/m² (Mahmud et al., 2014). Another study conducted in 2008 among adult female RMG workers in Mirpur, Dhaka, found that the prevalence rate of short stature (average height 149.8 cm) and low BMI (average 21.6 kg/m2) was pretty higher among them (Islam et al., 2008).

Nutritional assessments revealed widespread undernutrition and anemia among garment workers, with significant disparities in BMI and hemoglobin levels. In a study conducted by Sharmin et al. (2001), 402 subjects reported that 305 (76%) had a BMI value between 18.5 and 24.9. There were at least 97 individuals (24%) who were malnourished (BMI <18.5). It was found that about 11% of the respondents had blood hemoglobin levels below

10.0 g/dl. 6% of the respondents showed normal hemoglobin status (> 14.0g/dl), mild (11.0-11.99 g/dl) anemia was 28.6%, and moderate (10.0-10.99 g/dl) anemia was 12%. The average hemoglobin level of the respondents was 11.94±1.53 g/dl, ranging from 6.28 to 16.33 g/dl.

Women face disproportionately severe anemia among garment workers compared to men. In their research, Solinap et al. (2019) found that among 506 workers who underwent serum hemoglobin testing, 414 were men and 91 were women. Out of 1236 workers tested for anemia, 897 were men, and 339 were women, resulting in a 19.1% prevalence of anemia. The average age of workers diagnosed with anemia was 27.25±7.4 years, ranging from 18 to 65 years. Notably, 48.5% of women and 10.3% of men were identified as having mild to severe anemia. Mild cases constituted the majority of anemia instances (68.9% of total cases), with significantly different proportions between men and women (7.9% and 30.7%, OR 5.2, 95% CI [3.91-6.83], $p < 0.001$). Moreover, women were more likely than men to have moderate anemia (12.9% vs. 1.9%; OR 7.26, 95% CI [4.54-11.62], $p <0.001$) and severe anemia (5.3% vs. 0.5%; OR 11.6, 95% CI [4.94–27.24], $p <0.001$). Anemia prevalence was highest among workers aged 21 to 25. Additionally, tuberculosis infections were reported by 1% of the study population, with an average age of 30.5±7.2 years (range 17-64 years). Most tuberculosis patients were male (16 males to 3 females), and none of the family history (FH) patients reported tuberculosis.

In Bangladesh, one-third of adolescent girls are underweight (UNICEF, 2015). Similar to the overall population, it is believed that nearly half of women workers in garment factories suffer from malnutrition and anemia (GAIN, 2014). Due to the direct link between maternal and infant health, improving maternal and infant health and nutrition presents significant opportunities for garment factories and contributes to the well-being of children. For instance, providing appropriate food and nutrition consultation, especially for pregnant and nursing women, can have a direct and positive impact on the health and well-being of workers and their young children. However, currently, these opportunities are largely underutilized. For example, it is uncommon for factories to offer hot meals at the workplace (Minimum Wage Gazette, 2013). Instead, they typically only provide space for workers to eat home-cooked food. Furthermore, female clothing workers need better access to information about nutritious food (BSR and GAIN, 2015).

Low wages and limited access to healthy food cause the poor nutritional status of women workers in the RMG sector, which directly affects the health of their children. Risky workplaces in factories and inadequate water, sanitation facilities, and hygiene standards pose a further risk to the health of workers and their children. For example, clean toilets in the workplace and limited opportunities for water and soap for handwashing can exacerbate water-related preventable diseases. This may enhance the health of female RMG workers, who are often at risk for suffering from infections and communicable diseases, insufficient pre-and post-natal care, and the risk of reproductive infections and diseases (BSR HER, 2010).

Diabetes Mellitus (DM) stands as the fifth leading cause of death in Bangladesh, as reported by the World Health Organization (2015). In a study conducted by Solinap et al. (2019), 8.0% of workers (5.9% of women and 8.6% of men) met the diagnostic criteria for DM. Nationally, 9.2% of men aged 25 years and older and 9.9% of women have diabetes (WHO, 2015). While the prevalence of DM among workers is slightly lower than the national average, it is concerning that this study also discovered a similar prevalence among individuals aged 18 to 24. The Demographic and Health Survey revealed an overall diabetes prevalence of 9.9% in urban areas, with prediabetes affecting 24.0% of the population (Akter, Rahman, Abe et al., 2014). In the same age group examined, the prevalence of DM in Solinap et al.'s study was 16.6%, possibly influenced by reduced subject numbers and increased sedentary behavior. Notably, 22.2% of workers exhibited prediabetic Fasting Blood Glucose (FBG) levels. These findings underscore the urgency of implementing diabetes education and prevention initiatives for occupational health at-risk groups (WHO, 2015).

A descriptive cross-sectional study was conducted among 360 female workers in the garment industry across Dhaka, Gazipur, and Narayanganj during 2016-17 to explore their health issues. The research revealed that 88%, 75%, and 55% of participants experienced headaches, hand pain, and respiratory problems, respectively, attributed to the nature of their work, posture, and exposure to dust and chemicals. Additionally, 69% reported symptoms of depression. Uncomfortable seating (79%) and noise (75%) were identified as primary physical health hazards, while psychological distress mainly stemmed from fear of accidents (75%) (Mahmud, Mahmud, and Jahan, 2018).

In their research, Hasnain et al. (2014) illustrated that most participants (53.67%) exhibited multiple symptoms. Among these, symptoms such as anorexia, nausea, fever, stomach pain, burning urination, and dysmenorrhea were reported by 22.33%, 14.33%, 11.67%, 11.33%, 10.67%, and 10.33% of participants, respectively. Additionally, 8% experienced cough, 7.67% reported headaches, 7% complained of lower abdominal pain, 5.67% had runny noses, 4.33% suffered from diarrhea, 4% experienced vomiting, 3% reported increased menstrual periods, and 2.33% had leg pain. Upon examination, 31% of participants were diagnosed with anemia, while no other signs of deficiency were identified.

2.3 Effects of low wages on worker's nutrition

RMG was the primary export commodity in the past 25 years and the main source of foreign exchange. Bangladesh's textile and apparel industry has expanded vigorously and has maintained its maturity by ranking second in the global apparel industry and occupying a 5% market share in the production and export of ready-to-wear garments in 2012. RMG's exports increased from 40,000 US dollars in 1978 to 6.4 billion US dollars in 1979. In 2004-05. The industry also provides employment opportunities for nearly 2 million workers, mostly women, in rural areas (Elahi et al., 2019). Figure 2.1 presents data from the Export Promotion Bureau, compiled by BGMEA, illustrating the steady growth of Bangladesh's RMG exports and their increasing share in the country's total exports from 1995-96 to 2017-18. The chart highlights the pivotal role of the RMG sector in driving national export performance over this period.

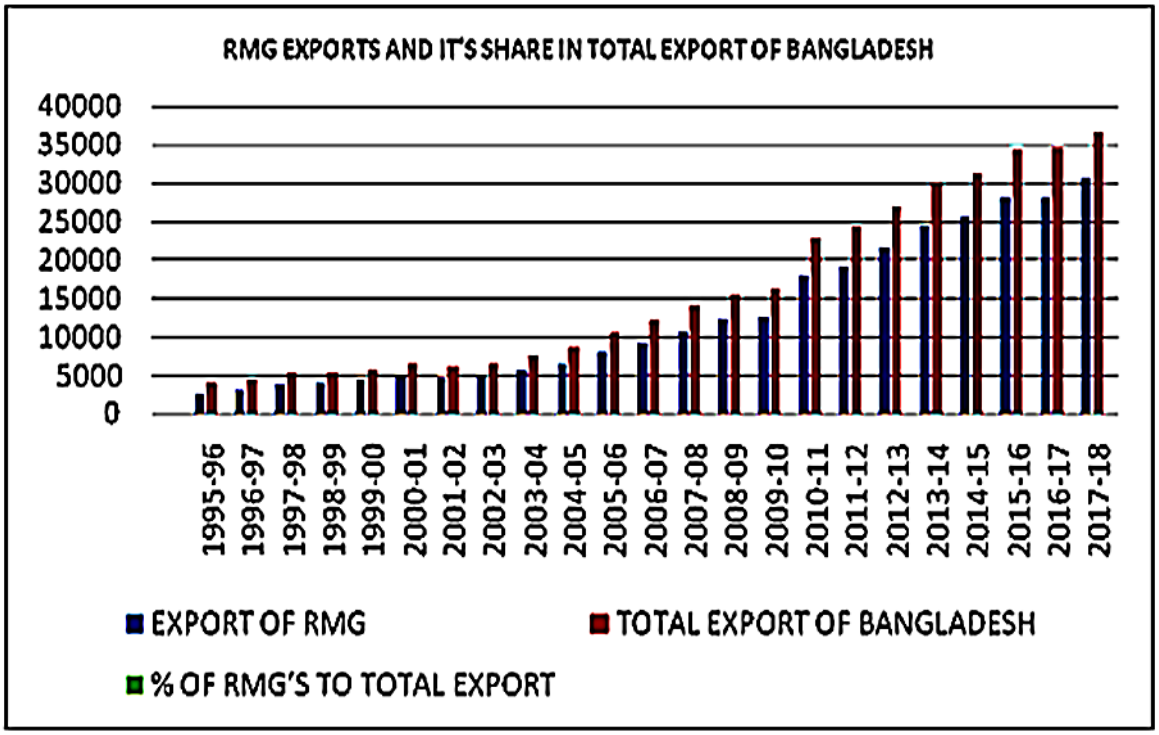

Figure 2.1 RMG Exports vs Total Exports Bangladesh (BGMEA, 2018)

Ensuring appropriate wages is widely acknowledged as crucial for enhancing workers' capabilities. A sufficient quality of wages plays a pivotal role in securing the basic necessities required for the physical well-being of laborers. Conversely, inadequate wages lead to shortages of essential provisions such as food, shelter, and medical care, rendering workers unable to sustain their employment and resulting in decreased labor productivity. In Bangladesh's RMG sector, wages are notably the lowest among significant manufacturing nations in Asia, both in terms of current USD and PPP USD. Even when productivity differences among competing countries are considered, wages remain disproportionately low, as indicated in Table 2.3. Workers in this sector earn less than one US dollar per day, falling below the international poverty line income of 1.25 US dollars. Furthermore, workers are deprived of other benefits and amenities, including bonuses, insurance coverage, financial assistance for illnesses, and a conducive working environment (Financial Express, 2010).

Table 2.3 Comparison of wages of selected Asian countries

Country	Monthly prevailing wage* Local Currency Unit (LCU) in 2011	Monthly prevailing the wage in current US$	Monthly real wage 2011 (in 2011 currency converted to US$ PPP)
Bangladesh	4.062	52	91
Cambodia	70**	70	126
India	4.422	70	170
Indonesia	1.287.471	114	187
Vietnam	2.306.667	109	255
Philippines	7.668	175	233
China	1.363	223	325
Thailand	7.026	221	337

* Excluding overtime but including certain fringe benefits

** Wages in Cambodia are denominated in US dollars

Source: WRC 2013. Cited in CPD report, 2013

According to Uddin (2015), the insufficient income of these individuals leads them to consume low-quality cereals, rice, limited vegetables, few beans, and minimal amounts of fish, if any, on a daily basis. Dairy products, meat, and milk are only consumed sporadically and in small portions. Consequently, malnutrition is prevalent among RMG workers and their children, resulting in various health issues. Persistent poverty, inadequate nutrition, and gender disparities contribute to widespread malnutrition in this demographic, leading to decreased productivity and reduced workforce contribution. This situation poses a potential barrier to the development and expansion of the RMG industry. Fogel (1991, 1992, 1994a, 1994b) underscored the crucial role of nutrition in health, longevity, and human-machine power, particularly during youth. The nutritional status during childhood has been observed to manifest in individuals' height, weight, and body mass index.

By the time individuals reach 30 months of age, nutritional deficiencies have become deeply ingrained (Larrea, Freire, and Lutter, 2001). RMG workers often struggle to earn sufficient income to afford an adequate calorie intake for productivity. This relationship, first explored by Leibenstein (1957) and known as the efficiency wage hypothesis, has been a subject of theoretical inquiry. However, empirically testing this relationship presents numerous challenges, including unobservable differences among workers, measurement inaccuracies, and issues related to observation. Strauss and Thomas (1998) note that interpreting the link between increased calorie consumption and enhanced productivity becomes complicated if more efficient workers, who may naturally be more muscular and consume more calories, are included in the analysis (p. 806).

Economists have investigated the potential link between labor productivity and nutrition for many years. The Efficiency Wage Hypothesis literature, proposed by Liebenstein in 1957, highlights the correlation between calorie consumption and labor productivity improvement, especially among individuals with low incomes. This assumption is significantly important for the labor market, yet it has faced limited empirical testing. Sukhatme (1977) critically analyzed the methodology used to evaluate the relationship between inadequate income and malnutrition. He described malnutrition as a state characterized by insufficient energy intake, using three distinct terms to represent its harmful effects on the body: malnutrition, undernutrition, and protein malnutrition.

Numerous factors reflect an individual's nutritional status throughout their life cycle, with nutrition serving as a vital indicator of both health and the socioeconomic condition of a society. Poverty is widely recognized as the primary driver of poor nutrition, with nutritional status often tied to both the quality and quantity of food consumption, influenced by household income. In low- and middle-income countries in East Asia, an estimated 35.3% of children under five years old suffer from stunting, 3.6% from severe wasting, and 20.7% from underweight (Black et al., 2008). Escalating food prices have led to reduced calorie consumption and increased instances of nutritional deficiencies. Bliss and Stern (1978b) extensively discussed the nutrition literature, which connects nutrient demand to activity levels, and nutrient requirements depend on activity levels and intake affects weight and productivity, emphasizing that measures like weight-for-height alone are insufficient to assess nutritional status.

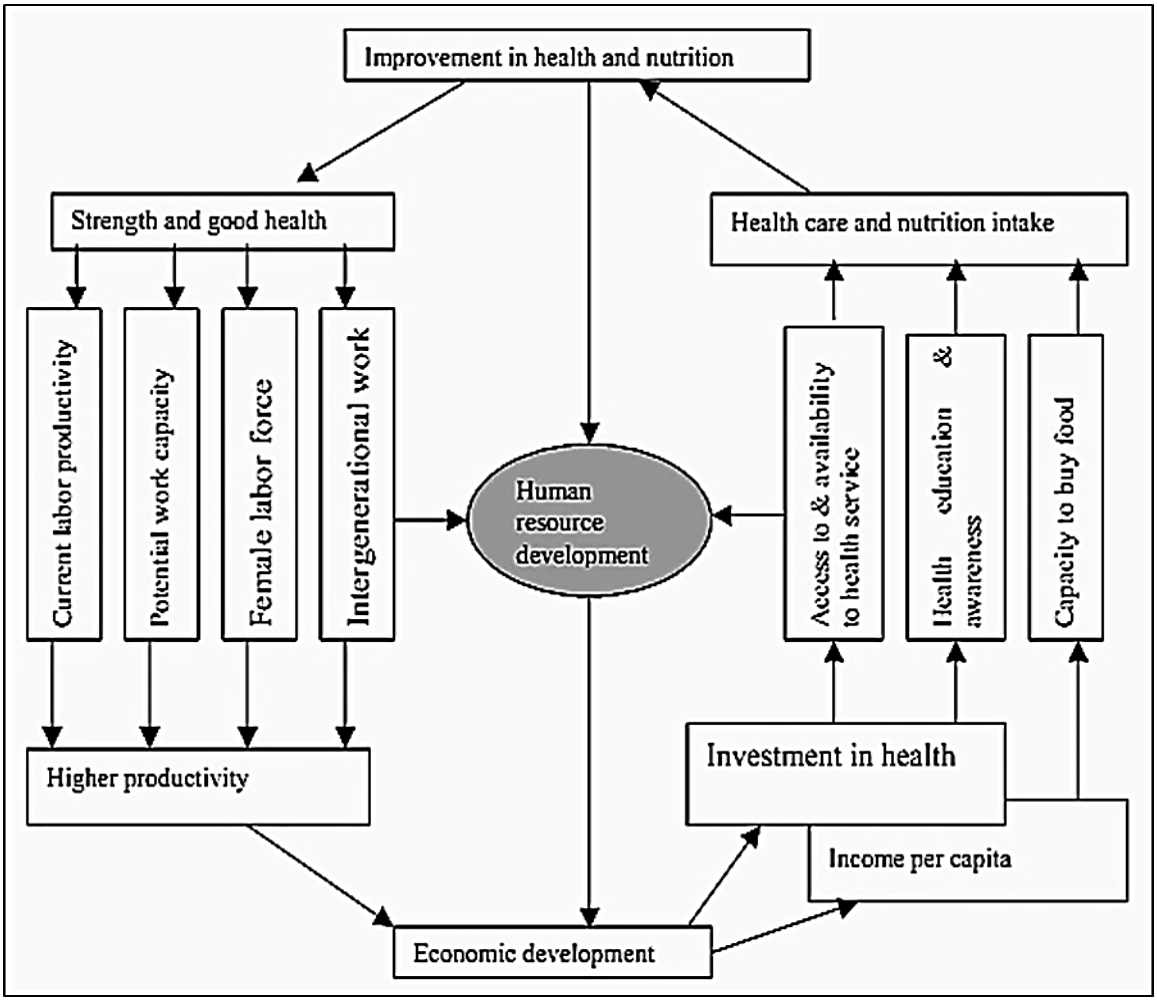

Figure 2.2 Linkage between health-nutrition and human resource development (Source: Akhter and Wohab, 2006)

Akhter and Wohab (2006) established a correlation between health, nutrition, human resource development, and financial development. However, it's important to note that this relationship is not straightforward or linear; instead, it appears to be cyclical with no distinct starting point or initial stage (see Figure 2.2).

The diagram illustrates that individuals' well-being and nutritional status impact workers' productivity by influencing their potential and actual work capacity, as well as the level of support for female and intergenerational labor. Increased work productivity contributes to economic development, leading to higher per capita income and more significant investment in the healthcare and nutrition sectors, particularly in public health. At the individual level, economic growth enhances people's ability to access healthcare services and purchase nutritious foods. Similarly, at the national level, economic development

prompts increased investment in the healthcare sector, leading to widespread availability and accessibility of healthcare services. This, in turn, results in better health outcomes and increased access to healthcare for the population.

Table 2.4 Reason for choosing evening markets

Reasons	**No. of respondents**	**Percentages (%)**
Cheap price and affordable	159	96
Free of transport and carrying cost	151	92
Scope of bargaining	139	84
Fresh vegetables and seasonal fruits	56	34
Availability of small fishes in bhaga	86	52
Availability of dry fish	53	32
Availability of chicken byproducts (liver, throat, skin, kidney, etc.) in kg.	23	14
Formalin/ preservative-free	36	22

Note: Percentage may not sum to 100 percent because of multiple responses

Source: Field survey (2019)

Low-income garment workers in Bangladesh must carefully manage their limited budgets, prioritizing essential expenses like remittances, housing, and education before allocating what remains to food. Wage delays intensify financial strain, particularly for singles, unskilled, and junior workers at the start of each month. Most respondents spend Tk. 51–70 per person per day on meals, with 44% allocating Tk. 51–60, 30% spending Tk. 61–70, 18% less than Tk. 50, and only 8% more than Tk. 70 (Chowdhury, 2019). To stretch their budgets, nearly all workers rely on evening markets in semi-urban and urban garment districts, where street vendors sell lower-quality but affordable produce. The vast majority (96%) prefer these markets for their low prices, with 92% and 84% citing the absence of extra transport costs and opportunities to bargain as additional benefits (Table 2.4).

An understanding of per capita dietary energy supply provides valuable insights into food consumption patterns and overall food security across South Asian countries. Uddin (2015), drawing on Food and Agriculture Organization (FAO) data, compares the average daily caloric availability in the region, highlighting significant differences between countries and underscoring the persistent challenges of ensuring adequate nutrition for all populations

Table 2.5 Total dietary energy supply in South Asian countries

Countries	**Kcal/capita/day**
Bangladesh	2200
Pakistan	2320
Sri Lanka	2390
Nepal	2430
India	2470
Maldives	2600
South Asia	2424

Source: FAO RAP, Bangkok, 2007

Based on data from 2002-2004, Table 2.5 presents the dietary energy supply across different South Asian countries. The Maldives recorded the highest national per-capita dietary energy supply at 2600 kcal/day, while Bangladesh reported the lowest at 2200 kcal/day. Additionally, Uddin (2015) discusses how the proportion of food groups as a percentage of the total dietary calorie supply serves as an indicator of dietary expansion and diversification in South Asian nations, as depicted in Figure 2.3.

The data indicates that Bangladesh relies the most on grains for its dietary energy supply (DES Cer %), with up to 80% of its energy derived from this source, reflecting a high level of neediness. Nepal follows closely with 72%. Conversely, the lowest DES Cer % is found in the Maldives at 39%. A significant trend of increased sugar intake, characteristic of changing dietary habits in Asia, is observed, reaching around 12% in India, Sri Lanka,

Pakistan, and the Maldives, compared to only 3% in Bangladesh and less than 2% in Nepal. Sri Lanka tops the list regarding edible oil consumption, accounting for 12.9% of total energy intake, primarily from coconut oil, followed by India (10.8%, various types) and Pakistan (9.7%, mainly palm oil).

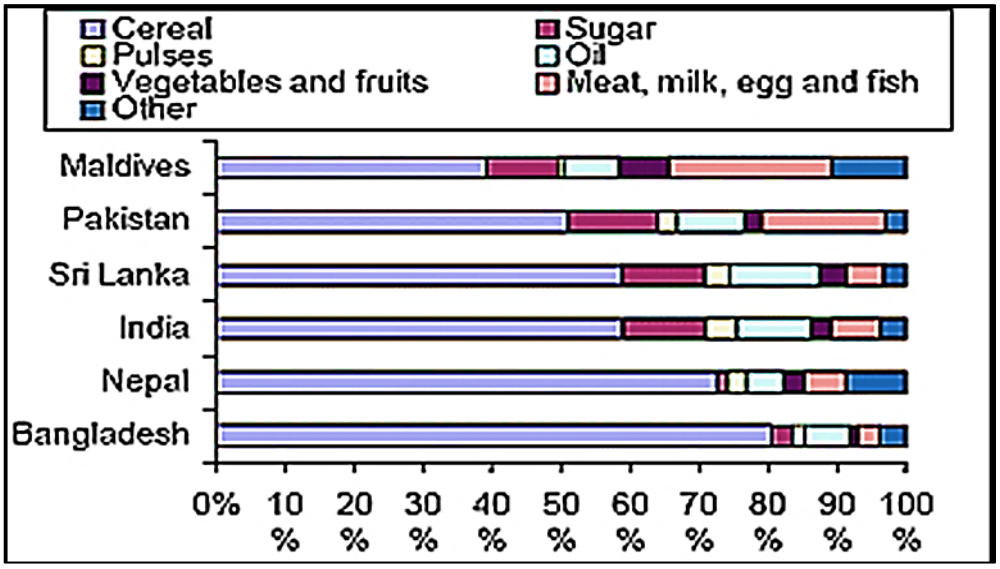

Figure 2.3 Share of food group as a percentage of total dietary calorie supply in South Asian countries, 2005 (Source: Uddin, 2015)

When comparing dietary habits across regions, it's notable that the Maldives and Pakistan consume the highest proportions of animal-based foods, accounting for 23.6% and 17.7% of total energy intake, respectively, whereas the contribution of animal-based foods to diets in Bangladesh is minimal at 3.1%. In the Maldives, 7.3% of total calories come from fruits and vegetables, a relatively higher percentage compared to Pakistan (2.6%) and Bangladesh (under 2%). This highlights the limited diversity in diets in Nepal and Bangladesh compared to other countries. The nutritional quality of the diets of garment workers was found to be subpar, with workers typically unable to afford fish or meat for more than three days per week, indicating insufficient income to support a decent standard of living.

2.4 Food and nutrition consumption pattern of the RMG workers

Dreaming of a better life, thousands of workers from villages gathered in the workers' barracks in the cities surrounding the clothing industry. The daily diet of factory workers in Bangladesh is simple; rice dominates and is likely to lack essential nutrients. Therefore, there is a risk of nutrient deficiency when eating this diet (Dipti S.S. et al., 2008). Rice is the main food in Bangladesh's diet and is the main source of energy. It is also the main source of several nutrients, such as carbohydrates, protein, and iron, and it contributes relatively little vitamin A, calcium, and vitamin C (Hassan and Ahmad, 1990).

According to their research (Islam, Halima & Shaheen, 2025), dietary guideline adherence among garment workers was generally low, particularly for fruits (4.1%), milk (5%), and vegetables (6%–7%). Women exhibited higher adherence to cereals, while men demonstrated greater adherence to fruits, animal-source foods, and milk. Nearly all participants met the recommended protein intake guideline. The food consumption pattern of garment workers' averages per capita was highest for cereals and cereal products, which is followed by vegetables and tubers. The rice consumption is 443g per day, which is almost 52.37% of the total daily food intake. Milk and dairy products, eggs, and meat are only occasionally consumed in small amounts. Fruit intake is mainly seasonal, including jackfruit, bananas, guava, mangoes, blackberries, and other cheap fruits produced locally. The least consumed foods are vegetables, sugar, fish, cooking oil, beans, etc (Chowdhury, 2019) (Table 2.6).

Table 2.6 Average per capita per day food intake of garment workers

Items	Average per Capita per Day Food Intake (grams)	Percentages of Total Consumption (%)
Rice and rice products	443.6	52.3
Wheat and other Cereals	27.1	3.2
Potato, starchy root, and tubers	55.2	6.5
Pulse	24.9	2.9
Sugar/ Gur	7.5	0.9
Edible Oil	17.2	2.3
Vegetables	162.1	19.1
Fruits	13.5	1.6
Fish, dried fish, and Meat	40.05	4.7
Eggs	6.04	0.7
Milk and milk products	23	2.72
Spices and condiments	10.9	1.29
Miscellaneous (tea, soft drinks, snacks, betel leaf, etc.)	15.9	1.88
Total Food Consumed	847	100

Source: Field survey (2019)

The dietary patterns of RMG workers are influenced by both economic limitations and cultural practices, leading to a strong dependence on staple foods and a restricted consumption of nutrient-dense items. In this context, Akter, Zubair, and Haque (2017) assessed the workers' dietary intake using a food frequency questionnaire. 100% of the worker intake rice alongside their daily meal. 60% of them took fish in 4-6 days in seven days, and 80% of the workers consumed potato and pulse in 4-6 days out of every week alongside their meal. 100% of laborers take meat, milk, or milk-based food products once or less per month. 20% of workers took vegetables daily along with their meals, while 80% took 4-6 days per week.

Similar to the findings of Akter, Zubair, and Haque (2017), the study by Saha, Farzana, and Begum (2014) highlights a pattern of limited dietary diversity among RMG workers,

based on participants' recall of food intake in the last seven days, reported that 90% (n = 97) of the respondents had three meals a day, with no snacks between meals. Between meals, only 9.3% (n = 10) of people eat snacks once in a day. More than half of the respondents did not drink milk or eat meat in the earlier week, which is 60% (n = 65) and 57% (n = 62), respectively. In the past 7 days, a good number of respondents intake fish (n = 59, 55%), beans (n = 56, 52%), and fruits/vegetables (n = 68, 63%) > 6 times.

It has been examined that dietary intake between urban and rural residents, the total food intake was notably higher in urban areas compared to rural areas. The consumption of most individual foods by urban households is also higher than that of rural households, including wheat, beans, vegetables and fruits, milk, eggs, chicken, fish, etc. However, rice and potato consumption in rural households is higher. Also, the per capita calorie intake is 2210 Kcal/d, and the calorie intake in rural areas is marginally higher than in urban areas (2240 Kcal/d and 2131 Kcal/d, respectively).

2.5 Calorie intake and energy expenditure pattern of RMG workers

Nutrition and a balanced diet are essential for the well-being and productivity of workers, contributing significantly to optimal performance. Adequate nutrition, neither deficient nor excessive, is essential for ensuring the highest level of welfare. Nutrition encompasses the role of food, nutrients, and their interplay with health and disease, emphasizing the importance of balance and interaction. Workers require nutritious meals to maintain good health and enhance productivity. A proper diet can boost work efficiency and morale while also reducing healthcare expenses (Jaiswal A, 2012). Sultana et al. (2014) conducted a study analyzing the average energy intake, energy expenditure, and energy balance across different age groups of participants, as detailed in Table 2.7. Their findings revealed that energy intake across all age groups was lower than energy expenditure, resulting in a negative energy balance. The deficit in energy ranged between 261.73 and 410.96 calories.

Table 2.7 Average Daily Per Capita Consumption of Food Items in Bangladesh, 2010 and 2016.

Food Item	2016 (grams)			2010 (grams)		
	National	Rural	Urban	National	Rural	Urban
Total	975.53	974.32	978.74	999.99	1005.16	985.49
Rice	367.19	386.09	316.70	416.01	441.61	344.20
Wheat	19.83	17.44	26.22	26.00	23.30	33.60
Potato	64.83	65.89	62.01	70.30	71.50	67.70
Pulses	15.60	15.12	16.88	14.30	13.23	17.20
Vegetables	167.30	164.78	174.06	166.08	170.04	154.95
Edible Oil	26.25	25.70	29.57	20.51	18.28	26.60
Onion	31.04	29.75	34.50	22.00	20.20	27.80
Beef	7.54	6.54	10.22	6.84	4.70	12.50
Mutton	0.55	0.48	0.76	0.60	0.50	0.89
Chicken/duck	17.33	15.30	22.73	11.22	9.01	17.42
Eggs	13.58	12.73	15.85	7.20	5.80	10.90
Fish	62.58	60.59	67.91	49.50	45.80	59.91
Milk and milk products	27.31	26.29	30.04	33.72	31.78	39.16
Fruits	35.78	32.24	45.23	44.70	42.60	50.40
Sugar/Gur	6.90	6.65	7.57	8.40	7.40	11.30
Food taken outside	30.77	27.51	39.47	29.83	28.00	34.97
Miscellaneous foods	80.62	81.23	79.00	72.78	71.41	76.99

Sources: HIES, 2010 and HIES, 2016

According to the ICMR Recommendation (ICMR, 2009), adult women aged 18-30 years the recommended daily calorie intake for adult women aged 18–30 years ranges from 1856 to 1982 kilocalories, depending on body weight and activity level. However, the survey findings indicate that the average daily caloric intake among female workers in this age group was consistently below these recommendations. Specifically, the recorded average intakes were 1738.17 ± 266.0 kcal, 1704.29 ± 297.53 kcal, and 1891.21 ± 286.20 kcal, respectively. These figures suggest a widespread deficiency in energy intake relative to physiological needs. Such inadequate intake may not sustain optimal work performance for several hours and could potentially lead to reduced productivity (Christie, 2002) (Table 2.8).

Table 2.8 Mean energy intake, energy expenditure, and balance (Kilocalories) by the age of the participants

Age Groups (Years)	Resting Metabolic Energy	Energy Intake	Energy Expenditure	Energy Balance
18- 20	1205.3 ± 5 6.4	1738.2 ± 266.0	2109.2 ± 98.8	-371.1
21- 25	1208.7 ± 47.8	1704.3 ± 297.5	2115.3 ± 83.6	-410.9
26-30	1230.3 ± 39.9	1891.2 ± 286.2	2152.9 ± 69.9	-261.7

Source: Field survey (2019) (Bangladesh)

2.6 Nutrient inadequacy among RMG workers

The dietary patterns of adolescent female garment workers in Dhaka reflect a heavy reliance on cereal-based staples, with limited diversity in protein and micronutrient sources, as demonstrated by Khan and Ahmed's (2005) analysis of 1,211 workers across 17 factories. Their food intake analysis revealed a consistent dietary pattern among the subjects, which primarily consisted of cereals. Cereals not only contributed significantly to their energy intake but also provided 56% of their protein, 34% of their iron, and 12% of their calcium. Animal-based foods contributed 28% of the protein intake, while pulses accounted for only 9%. Dairy products and poultry were sources of 29% of preformed

vitamin A, 45% of calcium, and 21% of protein. Dark green leafy vegetables (DGLV) supplied 68% of carotene, 24% of calcium, and 39% of iron. Fruits contributed approximately 16% of the carotene intake (Table 2.9).

Similar dietary patterns have been observed among rickshaw drivers in Bangladesh (Ahmed and Khandker, 1997). Low-income populations in this area typically consume grain-based diets, a pattern also observed among Indian manual workers, where energy intake is often insufficient (Bansal & Mehta, 1985; Premakumari et al., 1986; Kaur & Sood, 1988).

Table 2.9 Sources of different nutrients for adolescent female factory workers in urban areas of Bangladesh

Nutrients	Contributory food group†							
	Cereals	**Roots and tubers**	**Pulses**	**DGLV**	**Other vegetables**	**Fruits**	**Fish**	**Dairy and poultry**
Carbohydrate	89.2	5.0	2.6	0.6	0.8	1.1	0.0	0.4
Protein	56.1	2.8	8.7	2.3	1.8	0.4	6.7	21.2
Fats‡	4.9	2.3	0.7	0.3	1.4	0.4	9.1	13.5
Calcium	12.1	2.7	3.7	23.9	6.7	0.9	4.5	45.5
Iron	34.4	4.5	6.0	38.9	4.7	1.7	3.9	5.6
Vitamin A	0.0	0.0	0.0	0.0	0.0	0.0	70.6	29.4
Carotenes	0.0	0.3	0.6	67.9	13.6	15.6	1.0	0.0
Vitamin C	0.0	27.3	0.0	6.5	22.2	33.3	0.0	10.6

Note: † Percentage of total intake contributed by each food group.
‡ Remaining 67.2 percent was supplied by cooking fats.
DGLV: dark green leafy vegetables.
Source: Khan et al (2005)

This study also revealed that most subjects had nutrient intake levels below the Recommended Dietary Allowance (RDA). For instance, over 80% of subjects consuming vitamin A did not meet the RDA. Vegetables serve as the primary source of carotene, a precursor of vitamin A, with more than 80% of intake coming from this source. Additionally, 71% of preformed vitamin A is derived from fish, predominantly freshwater species. While vegetables contribute approximately 82% of carotene intake, only 16% is obtained from fruits. Research suggests that the bioavailability of carotene in vegetables may be lower than previously believed (West and Eilander, 2001).

Table 2.10 Consumption of energy and nutrients among adolescent female factory workers in urban Bangladesh

Nutrients	Mean	SD	Median	Percent of RDA†*			
				< 50%	50-74%	75-99%	≥ 100%
Energy (MJ/day)	5.48	1.46	5.21	8.5	44.7	28.4	18.4
Carbohydrates (g)	244	77.4	228.9	n.a.	n.a.	n.a.	n.a.
Proteins (g/day)	31.7	10.6	31.2	52.9	42.4	4.7	0.0
Fats (g/day)	23.2	5.6	22.6	1.8	2.8	40.7	54.8
Calcium (mg/day)	212.0	205.6	128.6	75.8	9.4	6.4	8.4
Iron (mg/day)	7.9	7.1	5	88.6	5.8	2.3	3.3
Vitamin A (µg, RE/day) ‡	308.9	432.9	140.9	69.7	8.0	4.0	18.3
Thiamin (mg/day)	0.8	0.2	0.8	9.8	37.9	30.3	22.0
Riboflavin (mg/day)	0.4	0.3	0.3	85.1	10.0	3.7	1.2
Niacin (mg/day)	12.7	4.1	12.1	7.1	26.5	30.3	36.1
Vitamin C (mg/day)	32.9	46.9	20.0	50.9	20.6	11.8	16.7

Note: *Energy intake was compared with energy expenditure computed by activity pattern analysis. †RDA: recommended dietary allowance for the Indian people made by the Indian Council of Medical Research. ‡Calculated using factors recommended by IVACG.
RE = Retinol equivalent. n.a. = Recommended intake level not available
Source: West and Eilander (2001)

Like vitamin A, most iron intake comes from plant-based sources. However, the iron intake of 97% of the girls did not meet the recommended levels, with only 9% of iron coming from animal sources, representing a small fraction of the total intake. Adequate consumption of vitamin C can enhance the absorption of non-heme iron from plant sources, yet only 17% of girls consume vitamin C. These girls, who are still experiencing growth potential and are not fully mature, require calcium for skeletal system development

and maturity (IVACG, 2002). However, the average calcium intake falls significantly below the Recommended Dietary Allowance (RDA), with only 8% of girls meeting the RDA for calcium intake.

2.7 Nutritional knowledge among the RMG workers

Awareness of micronutrient deficiencies is a key factor influencing the nutritional health of RMG workers, yet studies indicate that knowledge in this area is often very limited. A critical aspect of the nutritional challenges faced by adolescent female RMG workers is their limited awareness of micronutrient deficiencies and related health risks. Akter, Zubair, and Haque (2017) carried out a cross-sectional study among 100 adolescent female workers in Dhaka and Tangail. This study shows the interviewees' understanding of various micronutrient deficiencies. 70% of workers do not understand vitamin A deficiency and their dietary needs. 89% of workers know nothing about iodine deficiency, and 95% lack a good idea about iron deficiency anemia, which is the most common disease in developing countries in the world.

Table 2.11 Relationship between knowledge and nutritional status

Knowledge		**No. of the respondent**	**Percentage (%)**
About Vitamin A deficiency	Know	21	21
	Partially know	9	9
	Don’t know	70	70
About iodine deficiency	Know	4	4
	Partially know	7	7
	Don’t know	89	89
About iron deficiency	Know	3	3
	Partially know	2	2
	Don’t know	95	95

Source: Akter, Zubair, and Haque (2017)

That is why it is necessary to implement nutrition education programs to change their knowledge and perception of food. The nutrition education programmer aims to change

employees' nutrition and lifestyle by increasing their understanding of healthy habits. Nutrition education can play a role at multiple levels, including:

1. Change attitudes towards specific behaviors;
2. Dealing with normative beliefs (i.e., perception norms);
3. Revise beliefs about self-control and the ability to change.

Interventions are usually carried out through teamwork, such as collaborative menu planning, distribution of educational materials, interactive information meetings, and workshops; another method is one-on-one consultation. Employee nutrition programs frequently advocate for making healthier dietary choices. Various systematic reviews have determined that nutrition education alone can effectively influence knowledge and behavior to a certain degree. In order to make more measurable and continuous changes in the eating habits of employees, it is essential to go beyond the scope of nutrition education and focus on obtaining affordable, healthy food at work (Anderson, 2009; Geaney et al., 2013 and Mhurchu et al., 2010).

2.8 Food security status of RMG workers

Adequate nutrition is crucial for maintaining women's health and enhancing their ability to work, which also impacts the health of their offspring (Branca et al., 2015). Malnutrition is linked to various adverse health outcomes, including cognitive decline, decreased productivity, and weakened immune response, leading to heightened susceptibility to infections (Black et al., 2013). Bangladesh's apparel industry offers comparatively lower monthly wages than many other major garment-producing countries. In Vietnam, monthly salaries range from US$107 to US$156 (approximately BDT 11,770 to BDT 17,160), while in Pakistan they range from US$116 to US$125 (approximately BDT 12,760 to BDT 13,750). In Indonesia, wages vary between US$104 and US$266 (approximately BDT 11,440 to BDT 29,260), and in the Philippines from US$180 to US$321 (approximately BDT 19,800 to BDT 35,310). Similarly, in China, monthly salaries range from US$155 to US$321 (approximately BDT 17,050 to BDT 35,310) (Sheng, 2016)

As per the Bangladesh Ministry of Labor and Employment (2018), the current wage scale for garment workers ranges from Tk. 8000 (US$94.21) to Tk. 18257 (US$193.79) per month, including provisions for rent, medical expenses, transportation, and food (US$1 = 84.91 Taka). Despite this, meeting basic necessities such as securing three meals a day

(Sharmin et al., 2019), accessing minimal healthcare and medical services, and obtaining sanitary living conditions remain significant challenges for these workers (Ahmed and Raihan, 2014). The inadequacy of their wages also contributes to their inability to maintain a decent diet, positively affecting their overall nutrition. A survey revealed that 43.33% of female garment factory workers in Bangladesh are underweight (BMI ≤ 18.5 kg/m2), and 53.67% of them experience various health issues (Hasnain et al., 2014).

Satisfying the basic need for food is essential for all living organisms to sustain their life cycles. Ensuring food security is a crucial developmental goal for numerous developing nations, including Bangladesh (Parvin and Ahsan, 2013). Globally, food security remains a pressing issue, with approximately one in nine individuals (805 million) facing hunger daily (FAO, 2014a). Moreover, the hidden peril of micronutrient deficiency, affecting 2 billion people worldwide, poses a significant challenge (FAO et al., 2014). In Bangladesh, the situation regarding food insecurity is particularly dire due to factors such as overpopulation and the diminishing ratio of land to inhabitants (Shaheen and Islam, 2012), accentuating the critical need for food security measures.

The Food and Agriculture Organization (FAO, 2009) defines food security as the condition where "all individuals have the means, both physical and economic, to access sufficient, safe, and nutritious food at all times, meeting their dietary requirements and preferences for a healthy and active life." This definition underscores the multifaceted nature of food security, encompassing elements of food production, distribution, and consumption while also considering the stability of food availability over time (WFP, 2004). Thus, food security comprises four primary dimensions: food supply, access, utilization, and stability (FAO, 2008).

Food security can only be fully realized when all individuals, especially women, have adequate access to nutritious food. For working women, ensuring proper nutrition is even more critical due to their dual responsibilities at work and home. However, many women employed in the garment industry suffer from poor dietary intake and nutritional deficiencies. > Despite the sector’s significant contribution to the national economy, there is still a lack of comprehensive understanding of the working and living conditions of female workers. Important questions regarding their backgrounds and work environments remain largely unexplored and require empirical investigation (Haque et al., 2008).

Dietary patterns in Bangladesh reflect broader food security challenges, with significant differences in consumption habits between food-secure and food-insecure populations, particularly in their reliance on rice versus nutrient-dense foods. In a study conducted by Sharmin et al., (2020), it was found that women lacking food security had a significantly higher average intake of dry rice [0.18 (SD 0.38), P = 0.005] compared to their food-secure counterparts. Participants with food security consumed lentils more frequently [1.43 (SD 0.49)] than those experiencing food insecurity [1.30 (SD 0.46), P = 0.020]. Among food-insecure adults, the average intake of beef was higher [0.23 (SD 0.42) servings per day], whereas individuals with food security consumed more chicken. Additionally, the average fish intake among food-secure participants was lower, and no notable difference was observed in the average egg intake between the two groups (Table 2.12).

Table 2.12 Frequency of dietary intake of cereal, potato, lentil, meat, fish, and egg between food secure and insecure groups

Food Group	Food secure mean (SD)	Food insecure mean (SD)	P-value
Cereals			
Steamed rice	2.87 (0.34)	2.88 (0.33)	0.791
Puffed rice	0.12 (0.33)	0.16 (0.37)	0.268
Dried rice	0.08 (0.28)	0.18 (0.38)	0.005*
Ruti	0.43 (0.50)	0.43 (0.50)	0.903
Potato	0.79 (0.98)	0.98 (1.00)	0.067
Lentil	1.43 (0.49)	1.30 (0.46)	0.020*
Meat items			
Beef	0.16 (0.37)	0.23 (0.42)	0.107
Chicken	0.31 (0.46)	0.26 (0.44)	0.290
Fish items			
Yellowtail Mullet	0.20 (0.40)	0.21 (0.40)	0.937
Olive Barb	0.18 (0.38)	0.26 (0.44)	0.066
Pangus	0.24 (0.44)	0.19 (0.39)	0.277
Tilapia	0.19 (0.39)	0.23 (0.42)	0.325
Hen egg	0.38 (0.48)	0.39 (0.48)	0.789

Note: *p < 0.05; SD = Standard Definition***, *Source:*** Sharmin et al., (2020)

Building on these concerns, Sharmin, Hamid, and Muda (2019) assessed the food insecurity status among women garment factory workers and revealed alarming levels of

vulnerability. The study found that 71.9% of households within this population experienced food insecurity. Among these, 48.4% of mothers reported facing personal food insecurity, while 47.2% experienced personal hunger. Furthermore, child hunger was also present, with a prevalence rate of 14.7%. These findings emphasize the significant nutritional challenges faced by female garment workers and draw attention to the urgent need for targeted interventions to improve their food security and overall well-being.

Table 2.13 Simple and multiple logistic regression of factors associated with food insecurity among women garment factory workers

Factors	**n (%)**	**Simple Crude OR (95%CI)**	**logistic regression P-value**	**Multiple Adjusted OR (95% CI)**	**Logistic Wald Statistics (df)**	**Regression P-value**
Agriculture farming						
No (Ref)	163(37.6)					
Yes	271(62.4)	0.94(0.61, 1.45)	0.795			
Household size	434(100)	1.95(1.48, 2.57)	<0.001	2.02(1.52, 2.69)	23.86(1)	<0.001
Household Head						
Husband (Ref)	359(82.7)					
Respondent	75(17.3)	0.48(0.25, 0.91)	0.025	0.42(0.21, 0.82)	6.26(1)	0.012
Total income						
Tk.5000-Tk.7999(Ref.)						
Tk.8000-Tk.10999	0.74(0.47, 1.14)	0.175				
Tk.11000-Tk.13999	1.67(0.46, 6.07)	0.429				
Doing overtime						
No (Ref)	22 (5.1)					
Yes	412 (94.9)	1.04 (0.39, 2.73)	0.929			
Job satisfaction						
Neutral (Ref)	180 (41.5)					
Good	254 (58.5)	0.51(0.33, 0.78)	0.002	0.50(0.3, 0.79)	8.89(1)	0.003

Note: OR = Odd Ratio, CI = Confidence Interval, df = degrees of freedom
Source: Akter, et al. (2018)

In a simple logistic regression analysis, it was determined that in agricultural settings, where the head of the household served as the respondent, total income (Tk. 8000-Tk.

10999) and high job satisfaction were significantly associated with food insecurity ($p < 0.25$). Results from a multiple logistic regression analysis indicated that larger households were more likely to experience food insecurity compared to smaller households (OR_adj 2.02, 95% CI, 1.52-2.69, $P < 0.001$). Additionally, female garment factory workers serving as heads of households were found to be less susceptible to food insecurity (OR_adj 0.42, 95% CI, 0.21-0.82, $P = 0.012$). Furthermore, respondents who expressed satisfaction with their work were also less likely to experience food insecurity (OR_adj 0.50, 95% CI, 0.32-0.79, $P = 0.003$) (Table 2.13).

Building on the predictors of food insecurity identified in logistic regression analyses, Zaman et al. (2015) further contextualized these findings by examining daily calorie consumption patterns among female garment workers. Their study revealed that more than one-third of the respondents (33.33%) had a lower calorie intake than the optimal level, while more than a quarter (26.67%) of female garment workers had a calorie intake intake is lower than the optimal level. At the same time, one-fifth of female garment workers consume calories at the optimal level and above the optimal level. Therefore, two-fifths (40%) of female clothing workers received the best calories above the optimal level, but the vast majority (60%) of worker's calorie intake was much lower than the maximum (Table 2. 14).

Table 2.14 Distribution of the respondents according to their calorie intake

Categories	**Respondents**		**Mean**	**SD**
	Number	**Percent**		
Much below optimum (upto1800 kcal/capita/day)	24	26.67	2025.34	436.41
Below optimum (>1800-2122 kcal/capita/day)	30	33.33		
Optimum (>2122-2444 kcal/capita/day)	18	20		
Above optimum (> 2444 kcal/capita/day)	18	20		
Total	90	100		

Source: Zaman et al. (2015)

The workforce nutrition plan is an essential part of solving the problem of malnutrition. The joint efforts of the private and public sectors can improve the health of the global

workforce and significantly reduce the burden of global malnutrition in various environments. Workplaces are a unique setting for nutrition interventions: they can repeatedly interact with a fixed audience, a closed environment that can be modified, and a significant return on investment potential, making labor nutrition a potential sustainable investment.

Nutrition is very much crucial for better health and a good life. Previous studies focused only on examining the socio-demographic factors, energy intake patterns, health vulnerability, health and nutritional status, food habits, and dietary intake of the RMG workers. This study, to the best of our knowledge, it will be the first study to assess the dietary pattern, socio demographic factors related to healthier dietary behaviors, the effects of the food cost on the nutritional status of workers, food diversity, nutrient profile, nutrient inadequacy, impact of low wages, and find out problem nutrient, that causes the deficiency and health-related diseases.

2.9 Affordability of healthy diets among RMG workers

Diet quality is widely recognized as a dietary pattern that reflects the diversity among major food groups in relation to recommended dietary guidelines (Wirt A, Collins CE, 2009). Consequently, high diet quality is associated with more favorable nutrient intake profiles and a reduced risk of diet-related noncommunicable diseases (National Health and Medical Research Council, 2017). Currently, over 2.5 billion individuals globally experience some form of malnutrition, with 800 million facing undernutrition, 2 billion adults categorized as overweight or obese (WHO, 2017), and more than 2 billion individuals suffering from micronutrient deficiencies (Ramakrishnan U, 2002). Poor diet quality has emerged as the primary cause of morbidity and mortality worldwide (Forouzanfar MH, Alexander L, Anderson HR, et al., 2015).

The latest State of Food and Nutrition Security (SOFI) report highlights that access to food and healthy diets remains a primary global concern. Food consumption patterns and diet quality influence the critical relationship between food security and nutrition; however, healthy diets remain unaffordable for many individuals. Based on price data from 170 countries in 2017, the report reveals that a healthy diet costs 60% more than a diet that provides only essential nutrients and five times more than a diet that meets energy needs solely through starchy staples. It is estimated that around 3 billion people globally cannot

afford a healthy diet. In Africa and South Asia, around 57% of the population cannot afford a healthy diet. Many countries in these regions are not on course to meet the global nutrition targets established for 2025 (Dizon, Felipe; Wang, Zetianyu; Mulmi, Prajula, 2021). Specifically, Afghanistan, Bhutan, India, and the Maldives are projected to meet none of the eight targets, while Nepal and Sri Lanka are on track to meet one target, and Bangladesh and Pakistan are on track to meet two targets (2020 Global Nutrition Report, 2020).

Diet quality is identified as a crucial link between food security and nutrition in State of Food Security and Nutrition in the World report (FAO, 2020). The report highlights that the inability to afford a healthy diet is closely associated with food insecurity and various forms of malnutrition. Although there is a substantial body of research addressing nutrition and food security issues, empirical evidence regarding the affordability of healthy diets in low and middle-income countries still needs to be explored. Recent studies suggest that the costs associated with more nutritious foods and achieving nutrient adequacy are beyond the financial reach of the world's poorest populations (e.g., Chastre et al., 2007; Busquet, 2010; Bachewe et al., 2017; Masters et al., 2018; Dizon et al., 2019; Heady and Alderman, 2019; Hirvonen et al., 2019; Mahrt et al., 2019). Consequently, global advancements toward meeting the targets set by SDG 2 for hunger, food security, and nutrition have stagnated (FAO, 2020).

The concept of healthy eating constraints is becoming increasingly significant in the context of development. It is widely recognized that more than merely meeting caloric requirements is required. While this objective has largely been achieved, it does not necessarily equate to a healthy diet. Understanding the limitations of a healthy diet is crucial for policymakers to gauge the extent of food security risk. Moreover, the broader food system context is essential, as enhancing food production alone is insufficient; there must also be improved access to healthy diets (Dizon, Felipe; Wang, Zetianyu; Mulmi, Prajula, 2021). Existing research enhances our comprehension of the relationship between the affordability of healthy diets and various forms of malnutrition. However, the affordability and causal factors of healthier foods can differ significantly between countries and even within a country, depending on season, geography, and local food systems (Mekonnen et al., 2021).

Table 2.15 Daily calorie intake comparison by food groups

Desirable Dietary Patterns (DDP), 2013 (2430 kcal), BD			EAT- Lancet Commission, 2019 (2500 kcal)			Recommended Dietary Allowance (RDA), India 2020		
Food Items	**g/day (Possible range)**	**% of Total Energy**	**Food Items**	**g/day (Possible range)**	**% of Total Energy**	**Food Items**	**g/day (Possible range)**	**% of Total Energy**
Whole grains	400	56	**Whole grains**	232	32	**Whole grains and bajra**	360	53
Rice	350	49						
Wheat and other	50	7						
Pulse	50	6.5	**Pulse**	75(0-100)	11	**Pulse/Meat (Protein sources)**	120	11
Protein sources	260	10.5	**Protein sources**	334	12			
Fish	60	3	**Fish**	28 (0-100)				
Meat	40	2	**Meat (Beef and lamb)**	14 (0-28)	1			
			Meat (Chicken and other poultry)	29 (0-58)	2			
Eggs	30	2	**Eggs**	13 (0-25)	1			
Milk and milk products	130	3.5	**Milk and milk products**	250(0-500)	6	**Milk**	300	3
Fruits	100	3	**Fruits**	200 (100-300)	5	**Fruits**	150	4

Vegetables	**Leafy**	100	2	**Vegetables**		300 (200-600)	3	**Vegetables**	**Leafy**	100	2
	Others	200	2						**Others**	200	2
Potato		100	4	**Tubers and starchy vegetables**		50 (0-100)	2	**Potato and Cassava**		100	4
Oil		30	11	**Fat/oil**	**Unsaturated**	40(20-80)	14	**Fat/oil**		30	9
					Saturated	11.8(0-11.8)	4				
Sugar/ molasses		20	3	**Sugar**		31 (0-31)	5	**-**		-	-
Nuts		-	-	**Nuts**		50 (0-75)	12	**Nuts and seeds**		30	6
Spices		20	2	**-**		-	-	**Spices**		10	-

Source: DDP, 2013; EAT- Lancet Commission, 2019; RDA, India 2020

In this study, we define "healthy" diets as those that adhere to dietary recommendations designed to ensure nutrient adequacy (i.e., both caloric and nutrient requirements) and promote long-term health. This includes Desirable Dietary Patterns (DDP) for Bangladeshi individuals and reference diets intended to support health and environmental sustainability, such as the EAT-Lancet reference diet and the Recommended Dietary Allowances (RDA) 2020 for India. It is important to note that the EAT-Lancet diet is a forward-looking, sustainable diet (within global planetary boundaries) predicated on the assumption that global food systems have advanced to achieve higher productivity and reduced food loss and waste.

Examining the food consumption patterns of RMG workers in terms of energy sufficiency, nutrient adequacy, and healthy diets provides insights into the affordability of nutritious diets. Analyzing diet costs helps researchers and policymakers identify economic barriers to healthy eating, especially for low-income populations, and assess the feasibility of recommended dietary patterns. Factors such as food prices, local economic conditions, and dietary preferences influence diet costs.

In summary, previous studies on RMG workers in Bangladesh have primarily focused on socio-demographic characteristics, income and expenditure patterns, nutritional and health

status, and food security. These studies provide important insights into workers' living standards and vulnerabilities, highlighting issues such as low wages, inadequate dietary intake, and varying levels of food insecurity. However, most of this research has examined these dimensions separately, without establishing a direct link between diet quality and the economic capacity to afford a healthy diet. Furthermore, many of the studies were limited by small sample sizes, particularly in assessing dietary intake and affordability.

In this context, the present study is particularly important to address a critical gap in the existing literature by integrating diet quality with the affordability of a healthy diet among RMG workers. It offers a more comprehensive understanding of whether workers' income levels are sufficient to sustain healthy diets. The findings of this study can contribute significantly to the research field by assessing nutrition within low-income populations and by generating evidence that can inform policy interventions aimed at improving both dietary quality and economic access to healthy food among industrial workers in Bangladesh.

CHAPTER 3
METHODOLOGY

3.1 Data source

Dietary and socio-demographic data were extracted from the baseline survey of the "Strengthening Workers' Access to Pertinent Nutrition Opportunities" (SWAPNO) project, funded by the Global Alliance for Improved Nutrition (GAIN). Based on the existing evidence supporting the effectiveness of worksite nutrition programs in enhancing dietary behaviors and nutritional status among workers, GAIN Bangladesh aimed to expand its Mid-Day Meal Programme to additional factories in Dhaka and Mymensingh. Affordability was assessed by comparing workers' food expenditures with the cost of three diet types: an energy-sufficient diet, a nutrient-adequate diet, and a healthy diet. The cost of these three recommended diets (CoRD) was determined following the methodology proposed by Islam et al. (2023).

3.2 Study design and study population

A cross-sectional survey design was adopted to collect sociodemographic and dietary data from RMG workers in two industries located in Dhaka and Mymensingh from September to October 2021. Numerous RMG factories operate in both areas. The selected industries were chosen due to their distinctly different locations to evaluate the impact of living environments on health and nutrition. Primary data was gathered using a mixed-method approach, incorporating both quantitative and qualitative methods to collect data from various levels, including RMG workers, in factories that provide MDM (Mid-Day Meal). The quantitative data were collected through face-to-face interviews on a sample basis. The study population comprised workers from selected garment factories, including both females and males.

3.3 Sample size determination

Determining an appropriate sample size is essential for any field study. In this survey, data were collected from 801 RMG workers across two sites. Convenience sampling was used to recruit participants from different floors and sections based on accessibility and availability. Despite being non-random, the large sample size and broad coverage across

shifts, floors, and roles make the data reasonably representative, and this approach is justified given the practical constraints of factory operations.

This study recalculated the sample size from equation 1, following Isreal (2013). The equation assists in getting a 95% confidence level and a proportion of 0.5%.

$$\mathbf{n} = \frac{\mathbf{N}}{\mathbf{1+N\,(e)^2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(1)}$$

Where:

n = sample size,

N = population size, and

e = the level of precision.

Thus, applying this formula as illustrated in equations '2' and '3' will give a minimum sample size of 382 respondents.

$$\mathbf{n} = \frac{\mathbf{8500}}{\mathbf{1+8500\,(0.05)^2}} = 382\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(2)}$$

$$\mathbf{n} = \frac{\mathbf{9000}}{\mathbf{1+9000\,(0.05)^2}} = 382\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(3)}$$

List of factories and number of workers					
Sl.	**Factory name**	**Addresses**	**No. of workers**	**Sample sizes planned**	**Sample sizes achieved**
1.	Snowtex Outerwear Ltd	Dhamrai, Savar, Dhaka	8,500	400	401
2.	Square Fashion Ltd	Bhaluka, Mymensingh	9,000	400	400
Total			17,500	800	801

Snowtex Outerwear Ltd. comprises about 8500 workers, while Square Fashion Ltd. consists of 9000 workers, in combination adding up to 17500 workers in total. Therefore, to get a 95% confidence level with a 5% error, a total of 382 subjects per industry is the lowest acceptable number for the study. A total of 764 subjects (382 x 2) are required for this study. Since the baseline survey collected data from 801 workers using structured

surveys, this study took all the 801 subjects from the baseline survey, 401 workers from Snowtex Outerwear Ltd, and 400 workers from Square Fashion Ltd. to constitute its analytical samples. Convenience sampling techniques were used to select the required number of workers on every floor and section of garments. In every production line, the first worker was identified as the starting unit, and after a certain gap, usually 20 workers, the second worker was selected, and so on. At the end of the survey, 801 workers' data were collected due to their availability and responsiveness.

3.4 Formulation of Questionnaire

The baseline survey questionnaire was developed to collect data on socio-demographic characteristics, including sex, age, income, education, family size, expenditures, anthropometrics, health, water, hygiene and sanitation, food budget, and access to the commodity market. The questionnaire was reviewed by experts to ensure content validity and pre-tested with a small group of RMG workers to confirm clarity, relevance, and appropriateness of the questions.

3.4.1 Data collection procedure

Data was collected through direct (face-to-face) interviews, following appropriate safety measures in accordance with COVID-19 policies. Two validated structured questionnaires were used to gather socio-economic and dietary intake data from the workers. Interviews were taken in the factory premises with no presence of industry officials at any level. This approach was strictly adhered to collect unbiased data from the workers. The data were recorded using a computer-assisted program interface (CAPI) with CSEntry Pro, a survey management tool developed by the U.S. Census Bureau. The socioeconomic characteristics included sex, age, income, education, family size, and expenditures. For dietary data collection, a single 24-hour recall was administered to 801 subjects. Among them, 10%, or 80 workers, were selected randomly and interviewed one week later to obtain two nonconsecutive 24-hour dietary recalls (Gibson & Ferguson, 2008). Dietary assessments were conducted at their workplace. To improve accuracy, food samples from each factory were weighed to determine the amount consumed by the respondents during their mid-day meal provision.

3.4.2 Dietary intake assessment

After the interview, the dietary data were cleaned and transformed, and the conversion factor, yield factor, and retention factor were applied where applicable to calculate the raw food intake by the workers. Details on the quantities of raw ingredients used for the preparation of food, cooking methods, the total quantity of cooked food, and its subsequent consumption by factory workers had been obtained from both the workers and those who were responsible for food preparation and distribution in the factories for better estimation. Afterward, using the following equation, the raw food quantities consumed by the workers were estimated from the cooked food consumed.

Intakes of the raw food by the individual = (Quantity of raw food in the preparation/ Total cooked quantity of food) × Individual intake of cooked food

Then, the nutrient composition of the foods consumed by the individuals was computed using the Food Composition Table for Bangladesh (Shaheen et al. 2013) and the Desirable dietary pattern for Bangladesh (Nahar et al., 2013).

3.4.3 Assessment of the probability of nutrient adequacy

We calculated the probability of adequacy for each micronutrient using harmonized average requirements (Allen et al., 2020). Following the Institute of Medicine guidelines, coefficients of variation and standard deviations for each micronutrient were determined (IOM, 2000). The zinc requirements assumed semirefined diets, reflecting the typical consumption of both unrefined and semirefined food ingredients by rural populations in Bangladesh. For iron, we applied a moderate absorption efficiency of 10% bioavailability, utilizing the full probability method to evaluate adequacy (Allen et al., 2020). Calcium adequacy was assessed based on the method by Foote et al. (2004), which compares intake levels to the adequate intake (AI). Calcium probability of adequacy was assigned as follows: 0% for intakes below one-fourth of the AI, 25% for intakes between one-fourth and one-half of the AI, 50% for intakes between one-half and three-fourths of the AI, 75% for intakes between three-fourths and the AI, and 100% for intakes exceeding the AI. The mean probability of adequacy (MPA) for micronutrient intake was computed by averaging the probabilities of adequacy (PAs) for 11 micronutrients: vitamin A, thiamin, riboflavin, niacin, vitamin B-6, vitamin B-12, folate, vitamin C, calcium, iron, and zinc. The resulting value for PA ranged from 0 to 100%, and an overall mean probability of adequacy (MPA)

was calculated by averaging the PA across the ten nutrients. The prevalence of inadequacy was defined by considering MPA below 50% (MPA < 0.5) (Román-Viñas et al., 2009). This threshold denotes consumption of 50% to 75% of AI for an individual, which helps prevent micronutrient deficiencies.

3.4.4 Affordability of diet

The cost of a diet is the minimum amount of money required to buy all the food products that are in the diet. There are three types of diets. They are: 1. "Energy sufficient" diets, which provide adequate calories for energy balance at a given level of physical activity and body size, using only the least-cost starchy staple. 2."Nutrient adequate" diets that provide not only adequate calories but also adequate levels of all essential nutrients. 3. "Healthy" diets meet a set of dietary recommendations intended to provide nutrient adequacy and long-term health.

The cost of every diet differs from each other as they include different types of food products with a wide range of prices. They are given below:

Table 3.1 Comparative Daily Costs of Recommended Diet Types in Bangladesh (BDT Adjusted Prices)

Name of the Diet	**Bangladesh adjusted price BDT/day**
Energy sufficient diet	19.0
Nutrient adequate diet	37.1
Healthy diet	85.0

Source: (Islam et al., 2023)

The per capita food costs per day of each respondent are then categorized as Yes (code=1) if they exceed the costs of each diet; otherwise, they are labeled as No (code=0).

3.4.5 Anthropometric assessments

RMG workers were weighed using electronic balances (TANITA KD 182) with closer to 0.1 kg. Workers' height was measured using a non-extensible, inflexible measuring tape with an accuracy of 0.1 cm.

3.5 Implementation arrangements

3.5.1 Pre-testing of the survey questionnaire

The research team conducted the pre-test of the draft questionnaire on some garment workers in project areas (who were not selected for the survey). The purpose of the pre-testing is to check the language, wording, translation, consistency, and integrity of the questionnaire. At the same time, an opportunity was provided to test the software and the Tablet PC for data collection in case of mobile data collection. It also provided practical training to the enumerators in administering the questionnaire.

3.5.2 Program development for tablet PC

The mobile data collection program using the CSPro Android program was developed, which facilitates data entry, editing, and export to other applications. The entry page was developed with the facilities of a logical check, mandatory fill-up, offline save, etc. The collected data was stored in Dropbox. Necessary data cleaning and processing were done after downloading from Dropbox with a user-friendly CSPro version.

3.5.3 Training

Two training programs were organized – one on garment worker data collection and one on qualitative operation for investigators and supervisors, as well as facilitators and moderators. The training had two parts: one on questionnaire training with paper questionnaires and another on using a tablet PC for the given questionnaire. A field practice for participants was organized near the garment factory with a follow-up session. During the practice interviews, they had been observed by the training staff. After the feedback session, the second part started with using a Tablet PC. They are oriented on logging in, filling out questionnaire pages, storing, and submitting. Another field practice was organized with a Tablet PC following a feedback session.

3.6 Quality control checking

The quality control team, which consisted of senior research team members, performed quality control checks to ensure the quality and reliability of collected data. They performed physical verifications to see whether the investigators completed the questionnaires by interviewing the intended respondents in the selected garment factories, asking them the eligible questions, and filling out the questionnaires correctly on the spot. Physical verification was performed both in the presence and absence of the interviewing

team members. Up to five percent of respondents were revisited and interviewed by the Supervisor's Quality Control Officers or Research Officers to monitor the validity of their collected information.

3.7 Data processing

All selected samples were given the value level and level name according to the questionnaire at first. The width and the type of data were adjusted according to the analysis. The decimals were put accordingly. New variables were created by recoding them into different variables for analysis. The whole set of cases was deleted if key variables were found missing. The frequency of each variable was checked. The normality of the data was checked using a box plot, histogram, and statistical tests. If the data were not standard, then extreme values were deleted, and the normality of the data was rechecked. The dietary data were found to be skewed; extreme values were deleted in this case.

3.8 Statistical analysis

The data were initially cleaned using the CSEntry Pro software. All survey data were then exported through the software's interface in three formats: Excel (.csv), SPSS (.sav), and STATA (.dta). Both descriptive and inferential statistical analyses were conducted using SPSS and STATA. Mean differences in dietary intake between groups were assessed using independent sample t-tests for normally distributed data, while the Mann-Whitney U test was applied for non-normally distributed data. Given the skewed nature of food and nutrient intake data, daily intake by gender is presented as medians with interquartile ranges (IQR), specifically the 25th percentiles and 75th percentiles. Multiple logistic regression analysis was performed to examine the influence of socio-economic factors on the Mean Probability of Adequacy (MPA) among workers. A p-value of less than 0.05 was considered statistically significant for all tests.

3.9 Ethical approval

The nature and purpose of the study were explained in detail to all study participants, and written informed consent was obtained from all the study respondents upon agreeing to participate in the study. Ethical approval was obtained from the Institutional Review Board (IRB) of the Institute of Health Economics, University of Dhaka (Ref. No. IHE/IRB/DU/03/2023/Final).

CHAPTER 4

RESULTS

The study aimed to evaluate the dietary quality and nutritional status of RMG workers, recognizing that poor health and nutrition may hinder worker productivity and pose challenges to the growth of the RMG sector. Specifically, the research sought to assess the adequacy of nutrient intake among workers relative to established dietary requirements for adults, while also examining the affordability of nutritious food options within their purchasing capacity. In addition, the study explored variations in nutrient intake across gender and between workdays and non-workdays to better understand dietary behaviors under different conditions. It further investigated whether the typical diet of RMG workers aligns with global dietary standards or meets their desired nutritional goals.

The results are organized into the following subsections: (1) socio-demographic characteristics of RMG workers; (2) diet quality comparisons by gender and day type (workday vs. non-workday); (3) macronutrient energy contribution; (4) diet affordability; and (5) nutritional status of RMG workers.

4.1 Socio-demographic characteristics of the study subjects

Table 4.1 presents the socio-economic and health-related characteristics of the study population. A total of 801 RMG workers participated in the survey, of whom 58.4% were female. The majority of participants (90.3%) were young adults aged 18 to 34 years, with over half of the female workers (52.6%) falling within the 18–24 age group. Notable gender differences were observed in educational attainment: a higher proportion of females had completed only primary education (22.4%), whereas a larger percentage of males had attained secondary education (31.2%). Most workers (40.3%) reported a monthly income between BDT 9,000 and 11,000, followed by 29.6% earning more than BDT 13,000. Statistically significant gender differences were also found in living arrangements, household composition, and the number of income-earning household members. The majority of workers (83.0%) lived with family members, predominantly in households with either two members (44.2%) or three to five members (45.7%), and over half (54.9%) reported having more than one earning member in the household.

Table 4.1 Socio-demographic characteristics of study subjects (n= 801)

Variables	Overall (n=801) %	Male (n=333) %	Female (n=468) %	p-value
Industry location				
Dhaka	50.1	34.8	60.9	< 0.001*
Mymensingh	49.9	65.2	39.9	
Age in years				
18-24	43.4	30.6	52.6	< 0.001*
25-34	46.9	56.8	40.0	
≥ 35	9.6	12.6	7.5	
Education				
Up to Primary	17.0	9.3	22.4	< 0.001*
Secondary Incomplete	35.7	31.2	38.9	
SSC passed	21.7	25.8	18.8	
HSC or Higher	25.6	33.6	19.9	
Personal monthly income (BDT)				
<9,000	13.6	8.4	17.3	< 0.001*
9,000-11,000	40.3	33.6	45.1	
11,001-13,000	16.5	16.2	16.7	
>13,000	29.6	41.7	20.9	
Living status of the workers				
Mess or others	17.0	30.0	7.7	< 0.001*
In own Household	83.0	70.0	92.3	
Household members				
≤ 2	44.2	46.8	42.3	0.340
3-5	45.7	42.6	47.9	
≥ 6	10.1	10.5	9.8	
Household earning members				
Single	35.3	55.9	20.7	< 0.001*
Double	54.9	36.9	67.7	

≥ 3	9.7	7.2	11.5	

Note: SSC – Secondary School Certificate, HSC – Higher Secondary Certificate, BDT – Bangladeshi Taka

Values are considered statistically significant at $p < 0.05$.

4.2 Diet quality

4.2.1 Food group consumption pattern among RMG workers

Table 4.2 Food group consumption pattern among RMG workers (grams/day)

Food Groups	Male Median (IQR) N=333	Female Median (IQR) N=468	p-value
Cereals	369.6 (369.6, 422.7)	369.6 (354.5, 384.6)	< 0.001*
Rice	369.6 (333.3, 371.6)	369.6 (285.5, 369.6)	< 0.001*
Wheat	0.0 (0.0, 46.9)	0.0 (0.0, 30.0)	0.974
Potato	59.6 (26.0, 97.4)	55.0 (26.0, 89.7)	0.318
Vegetables	159.0 (90.8, 255.1)	156.6 (95.6, 236.9)	0.811
Non-leafy Vegetables	124.9 (57.0, 191.4)	111.3 (57.6, 188.7)	0.680
Leafy vegetables	0.0 (0.0, 46.2)	0.0 (0.0, 54.0)	0.970
Pulses	18.0 (12.4, 39.0)	15.0 (7.5, 25.5)	< 0.001*
Masoor	18.0 (11.3, 30.0)	15.0 (2.4, 24.6)	0.002*
Nuts and Seeds	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.225
Milk and milk products	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.041*
Edible oils	20.0 (16.0, 30.0)	18.0 (15.0, 25.0)	0.038*
Soyabean	20.0 (15.0, 30.0)	18.0 (15.0, 24.5)	0.053
Animal source food (ASF)	130.0 (93.0, 191.0)	130.4 (80.0, 181.5)	0.122
Beef	0.0 (0.0, 35.0)	0.0 (0.0, 0.0)	0.004*
Chicken	0.0 (0.0, 50.0)	0.0 (0.0, 41.8)	0.708
Eggs	0.0 (0.0, 38.0)	30.0 (0.0, 39.2)	0.081
Fish	58.9 (24.8, 100.0)	53.4 (22.5, 99.7)	0.403

Condiments and spices	52.0 (36.0, 69.0)	51.5 (36.0, 71.9)	0.557
Onion	35.0 (23.0, 48.7)	37.2 (25.1, 57.0)	0.022*
Chilies	11.0 (8.2, 15.0)	10.0 (7.6, 13.8)	0.135
Fruits	0.0 (0.0, 45.5)	0.0 (0.0, 55.0)	0.439
Sugar	0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	< 0.001*
Miscellaneous	0.0 (0.0, 25.0)	0.0 (0.0, 4.5)	< 0.001*

Note: IQR = Interquartile range; p values from independent sample t-test/Mann-Whitney U test

*Values are considered statistically significant at $p < 0.05$.

Table 4.2 reveals gender variations in dietary intake, particularly in staple cereals, pulses, edible oils, and select animal-source foods. Males consumed more cereals overall, with a median intake of 369.6 grams, compared to females, who also consumed 369.6 grams but with a narrower interquartile range (IQR) of 354.5 to 384.6 grams, leading to a statistically significant difference ($p < 0.001$). Rice intake was similar between genders but showed a significant difference in consumption patterns ($p = 0.001$). Pulses, including Masoor, were consumed more by males than females ($p < 0.001$ and $p = 0.002$, respectively). Edible oils and soybean oil consumption were slightly higher in males, with a significant difference observed for edible oils overall ($p = 0.038$). Beef consumption was significantly higher in males ($p = 0.004$), while egg consumption was more prevalent among females, though not significantly so ($p = 0.081$). Additionally, sugar intake was significantly different between genders ($p < 0.001$), as was the intake of miscellaneous foods ($p < 0.001$).

RMG workers' food group consumption patterns differ between working and non-working days due to factors such as time constraints, fatigue, and access to food, changes in activity levels, and the mid-day meal provided by the factory. Table 4.3 compares the average daily intake of various food groups between working and non-working days among a sample of 801 garment workers. Rice consumption was significantly higher on working days ($p = 0.003$), while wheat consumption decreased ($p = 0.010$). Potato intake increased significantly on working days ($p = 0.012$), along with vegetable consumption, particularly non-leafy vegetables ($p < 0.001$). Pulse consumption, especially masoor, was substantially higher during working days ($p < 0.001$).

Conversely, animal source food consumption decreased significantly on working days ($p < 0.001$), with notable reductions in beef and chicken consumption ($p=0.026$ and $p=0.012$, respectively), although egg consumption increased ($p < 0.001$). Fish consumption remained relatively stable between working and non-working days ($p = 0.325$). Consumption of condiments and spices, particularly onion, decreased significantly on working days ($p < 0.001$). Nuts, seeds, milk products, fruits, and sugar were consumed in minimal quantities regardless of working status, though statistical differences were observed for nuts and seeds ($p = 0.007$), milk products ($p = 0.018$), and sugar ($p = 0.013$). These findings suggest that work schedules significantly influence dietary patterns among RMG workers, potentially impacting their nutritional status.

Table 4.3 Food group consumption pattern among RMG workers based on their working and non-working days (Grams/day)

Food Groups		Non-working Days Median (IQR) N = 128	Working Days Median (IQR) N = 670	p-value
Cereals		369.6 (314.4, 391.2)	369.6 (369.6, 394.6)	0.076
	Rice	369.6 (254.1, 369.6)	369.6 (346.5, 369.6)	0.003*
	Wheat	0.0 (0.0, 50.0)	0.0 (0.0, 30.0)	0.010*
Potato		39.0 (0.0, 90.3)	59.6 (27.0, 93.2)	0.012*
Vegetables		109.4 (44.5, 203.6)	166.9 (99.1, 252.5)	< 0.001*
	Non-leafy Vegetables	68.1 (0.0, 131.0)	135.2 (65.0, 195.8)	< 0.001*
	Leafy vegetables	0.0 (0.0, 64.4)	0.0 (0.0, 46.5)	0.280
Pulses		7.2 (0.0, 24.8)	18.0 (12.4, 33.0)	< 0.001*
	Masoor	0.0 (0.0, 15.0)	18.0 (12.4, 26.9)	<0.001*
Nuts and Seeds		0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.007*
Milk and milk products		0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.018*
Edible oils		19.0 (12.5, 24.0)	19.0 (16.0, 28.0)	0.067
	Soyabean	19.0 (12.5, 24.0)	18.0 (15.6, 27.0)	0.102
Animal source food (ASF)		167.7 (107.0, 262.5)	125.0 (86.3, 174.7)	< 0.001*
	Beef	0.0 (0.0, 38.0)	0.0 (0.0, 0.0)	0.026*
	Chicken	0.0 (0.0, 103.6)	0.0 (0.0, 35.0)	0.012*
	Eggs	0.0 (0.0, 25.0)	33.1 (0.0, 39.2)	< 0.001*
Fish		60.8 (17.6, 117.0)	55.0 (24.0, 97.0)	0.325
Condiments and spices		60.2 (41.1, 83.6)	50.2 (35.2, 67.0)	< 0.001*
	Onion	43.5 (28.5, 65.3)	35.7 (23.2, 48.7)	< 0.001*
	Chilies	10.0 (6.2, 14.8)	10.9 (8.2, 14.0)	0.040*
Fruits		0.0 (0.0, 58.5)	0.0 (0.0, 51.8)	0.113
Sugar		0.0 (0.0, 0.0)	0.0 (0.0, 0.0)	0.013*
Miscellaneous		0.0 (0.0, 30.0)	0.0 (0.0, 15.0)	0.001*

Note: ASF = Animal source food, IQR= Inter quartile range; p values from independent sample t-test/Mann-Whitney U test; *Values are considered statistically significant at $p < 0.05$.

Table 4.4 presents the average daily intake of various food groups, and compares these intakes with the Household Income and Expenditure Survey (HIES) 2022 data and the desirable dietary pattern recommendations by BIRDEM 2013.

Table 4.4 Comparison of overall group consumption with HIES 2022 and Desirable dietary pattern by BIRDEM 2013 (Grams/day)

Food Groups	**Overall Median (IQR) N=801**	**HIES 2022**	**Desirable dietary pattern Recommendation in g per day (BIRDEM 2013)**
Cereals	369.6 (369.6, 394.3)	-	-
Rice	369.6 (311.6, 369.6)	328.9	350
Wheat	0.0 (0.0, 33.5)	22.9	50
Potato	57.0 (26.0, 93.2)	-	100
Vegetables	157.6 (95.0, 246.7)	201.9	-
Non-leafy Vegetables	118.5 (57.0, 191.4)	-	200
Leafy vegetables	0.0 (0.0, 49.7)	-	100
Pulses	18.0 (11.0, 30.6)	17.1	50
Masoor	16.2 (8.1, 25.0)	-	-
Nuts and Seeds	0.0 (0.0, 0.0)	-	-
Milk and milk products	0.0 (0.0, 0.0)	34.1	130
Edible oils	19.0 (15.0, 26.0)	-	30
Soyabean	18.0 (15.0, 26.0)	-	-
Animal source food (ASF)	130.0 (88.0, 186.6)	-	40
Beef	0.0 (0.0, 0.0)	40.0	-
Chicken	0.0 (0.0, 45.0)		-
Eggs	19.0 (0.0, 39.2)	12.7	30
Fish	55.0 (24.0, 100.0)	67.8	60
Condiments and spices	51.8 (36.0, 71.0)	-	-

Onion	36.0 (24.0, 51.0)	-	-
Chilies	10.9 (8.0, 14.6)	-	-
Fruits	0.0 (0.0, 54.0)	95.4	100
Sugar	0.0 (0.0, 0.0)	-	-
Miscellaneous	0.0 (0.0, 16.0)	-	-

Note: IQR=Interquartile range, ASF = Animal source food, HIES = Household Income and Expenditure Survey, BIRDEM=Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders.

The median cereal intake was 369.6 grams per day, with rice being the primary component, slightly above the HIES figure but below the recommended 350 grams for rice. Wheat consumption was negligible, far below the recommended 50 grams. Vegetable intake was lower than the HIES figure, with non-leafy vegetables being the dominant type, though still below the recommended 200 grams. Pulse consumption was close to the HIES figure but fell short of the recommended 50 grams. Notably, there was minimal consumption of nuts, seeds, and milk products, which are significantly below recommended levels. Edible oil intake was around 19 grams, slightly below the recommended 30 grams. Animal-source food consumption was higher than recommended, with eggs and fish being the primary sources. Fruit consumption was negligible, far below the recommended 100 grams. Overall, the dietary patterns of RMG workers deviate from both national expenditure data and health recommendations, highlighting potential nutritional deficiencies.

4.2.2 Energy and macro-nutrient intake

Significant gender-based differences in nutrient intake are revealed in Table 4.5.

Table 4.5 Energy and macronutrient intake among RMG workers (N=801)

Macronutrients	**Overall Median (IQR) N=801**	**Male Median (IQR) N=333**	**Female Median (IQR) N=468**	**p-value**
Energy (kcal)	1949.0 (1843.2, 2112.8)	2030.0 (1913.1, 2196.1)	1901.0 (1804.7, 2029.7)	< 0.001*
Protein (g)	65.1 (59.5, 72.1)	68.2 (63.2, 75.3)	62.7 (57.3, 69.3)	< 0.001*
Fat (g)	33.0 (29.1, 38.3)	34.5 (30.5, 39.6)	32.1 (28.3, 36.6)	< 0.001*

Carbohydrate (g)	327.7 (314.1, 347.3)	339.4 (324.3, 366.0)	320.0 (309.0, 334.8)	< 0.001*

Note: IQR = Interquartile range, p-values from Mann-Whitney U test

*Values are considered statistically significant at $p < 0.05$.

Males exhibit higher median values for energy, protein, fat, and carbohydrate compared to females, as evidenced by the lower p-values ($p < 0.001$). Specifically, males have a median energy intake of 2030.0 kcal compared to females with 1901.0 kcal. Similarly, males consume more protein (68.2 g) compared to females (62.7 g), higher fat intake (34.5 g) compared to females (32.1 g), and increased carbohydrate intake (339.4 g) compared to females (320.0 g).

The analysis also reveals that (Table 4.6) there are no significant variations in energy intake between non-working and working days, as indicated by a p-value of 0.586. However, significant differences are observed in protein, fat, and carbohydrate intake. Specifically, individuals consume higher amounts of protein (67.9 g) and fat (34.8 g) during non-working days compared to working days, with p-values of 0.000 and 0.032, respectively. Conversely, carbohydrate intake is lower during non-working days (322.1 g) compared to working days (328.3 g), with a p-value of 0.040.

Table 4.6 Energy and nutrient intake among RMG workers based on a working day basis (N=801)

Macronutrients	**Non-working Days Median (IQR) N = 128**	**Working Days Median (IQR) N = 670**	**p-value**
Energy (kcal)	1955.2 (1817.0, 2175.9)	1948.4 (1852.4, 2102.2)	0.586
Protein (g)	67.9 (61.3, 78.3)	64.6 (59.4, 71.3)	< 0.001*
Fat (g	34.8 (30.2, 40.2)	32.9 (29.0, 37.3)	0.032*
Carbohydrate (g)	322.1 (307.2, 346.7)	328.3 (315.3, 347.3)	0.040*

Note: IQR= Inter quartile range, p values from Mann-Whitney U test

*Values are considered statistically significant at $p < 0.05$.

4.2.3 Distribution of energy from macronutrients

The distribution of macronutrient intake among the population is presented in Table 4.7, highlighting the proportions of total energy obtained from carbohydrates, protein, and fat. The provided data delves into the macronutrient composition of the surveyed population, expressed as the percent share of total energy intake.

This data reveals that carbohydrates comprise the majority of energy intake at 67%, with a significant portion (66%) exceeding the recommended upper limit. Protein contributes 13.74% of total energy, primarily falling within the recommended range of 5% to 15%. Fat accounts for 16.67% of total energy, with the majority (54.9%) aligning with recommended intake levels. However, 43.4% of the population exceeds the upper-fat intake limit. The WHO/FAO guidelines recommend that a balanced diet should consist of 55-65% of total energy from carbohydrates, 10-15% from protein, and 20-30% from fat. However, the RMG workers in this study were found to exceed the recommended carbohydrate range and fall below the ideal fat intake levels.

Table 4.7 Percent of the population distribution of energy from macronutrients

Macronutrients	**Percent share of total energy**	**Ranges of intake, % (ICMR, 2020)**	**% Population**	**Male (n=333) %**	**Female (n=468) %**	**p-value**
Carbohydrates	67.0	<45%	0.4	0.0	0.6	0.291
		45%-65%	33.6	34.8	32.7	
		>65%	66	65.2	66.7	
Protein	13.7	<5%	0	0.0	0.0	0.386
		5%-15%	77.2	78.7	76.1	
		>15%	22.8	21.3	23.9	
Fat	16.7	<15%	43.4	44.1	42.9	0.388

		15%-35%	54.9	55.0	54.9	
		>35%	1.6	0.9	2.1	

Note: p-values from the Mann-Whitney U test

Significant differences exist in macronutrient intake between non-working and working days among RMG (Table 4.8). On non-working days, 50.0% have > 65% carbohydrate intake, while the majority (69.1%) fall within this range on working days. Conversely, on non-working days, 50.0% have < 45% carbohydrate intake, compared to 30.5% on working days. Protein intake also differs significantly, with 60.2% on non-working days falling into the 5%-15% range, compared to 80.4% on working days. Fat intake distribution is notably different, with 66.4% on non-working days falling into the 15% - 35% range, compared to 52.7% on working days (p-values = 0.000 for carbohydrates and protein, 0.009 for fat).

Table 4.8 Percent of the population distribution of energy from macronutrients based on a workday basis (N=801)

Macronutrients	**Ranges of intake, % (ICMR, 2020**	**Non-working days (n=128) %**	**Working days (n=670) %**	**p-value**
Carbohydrates	< 45	0.0	0.4	< 0.001*
	45%-65%	50.0	30.5	
	> 65%	50.0	69.1	
Protein	< 5%	0.0	0.0	< 0.001*
	5%-15%	60.2	80.4	
	> 15%	39.8	19.6	
Fat	< 15%	31.3	45.8	0.009*
	15%-35%	66.4	52.7	
	> 35%	2.3	1.5	

Note: ICMR = Indian Council of Medical Research, p-values from the Mann-Whitney U test.

*Values are considered statistically significant at $p < 0.05$.

4.2.4 Micronutrient intake of RMG workers

A comprehensive overview of nutrient intake among male and female RMG workers across both working and non-working days is provided in Tables 4.9 and 4.10. Nutritional data, along with p-values, reveal differences between genders in various dietary components, as shown in Table 4.9.

Calcium intake does not show a statistically significant difference between males (311.0 mg) and females (325.9 mg), with a p-value of 0.277. However, significant gender differences are observed in iron, magnesium, phosphorus, potassium, sodium, zinc, copper, retinol, vitamin E, niacin, vitamin B6, folate, and vitamin C, with p-values below 0.05. For example, males have a higher iron intake (10.0 mg) compared to females (8.8 mg), while females have a higher magnesium intake (334.3 mg) than males (320.4 mg). The amount of thiamine consumed is fairly similar between genders, with a p-value of 0.081. It is important to note that varying nutritional intakes are influenced by gender, and therefore, dietary needs should be considered based on sex.

Table 4.9 Median (IQR) micronutrient intake among RMG workers

Nutrients	**Overall (N = 801)**	**Male (N = 333)**	**Female (N = 468)**	**p-value**
Calcium (mg)	319.7 (233.0, 418.5)	311.0 (228.8, 417.0)	325.9 (236.9, 421.8)	0.277
Iron (mg)	9.3 (8.3, 10.8)	10.0 (8.8, 11.6)	8.8 (8.0, 10.0)	< 0.001*
Magnesium (mg)	326.6 (296.8, 368.9)	334.3 (303.6, 384.2)	320.4 (291.7, 359.2)	< 0.001*
Phosphorus (mg)	1000.2 (915.8, 1112.1)	1037.0 (941.6, 1155.5)	975.8 (897.4, 1078.2)	< 0.001*
Potassium (mg)	1847.0 (1694.5, 2074.8)	1914.9 (1750.3, 2174.7)	1802.9 (1647.8, 2019.3)	< 0.001*
Sodium (mg)	187.9 (163.0, 228.5)	198.0 (173.5, 243.0)	180.5 (155.8, 219.7)	< 0.001*

Zinc (mg)	10.4 (9.7, 11.5)	10.8 (10.1, 12.1)	10.2 (9.5, 11.1)	< 0.001*
Copper (mg)	2.0 (1.9, 2.2)	2.1 (1.9, 2.3)	2.0 (1.8, 2.2)	< 0.001*
Vitamin A, RAE (mcg)	171.1 (148.0, 206.1)	162.8 (139.7, 196.3)	178.6 (151.3, 213.8)	0.004*
Retinol (mcg)	48.7 (31.8, 57.4)	46.6 (28.6, 54.6)	51.5 (34.2, 59.5)	< 0.001*
Vitamin E (mg)	1.3 (1.2, 1.4)	1.3 (1.2, 1.4)	1.3 (1.2, 1.4)	< 0.001*
Thiamine(mg)	0.7 (0.7, 0.8)	0.7 (0.7, 0.8)	0.7 (0.7, 0.8)	0.081
Riboflavin (mg)	17.0 (15.9, 18.0)	17.3 (16.0, 18.3)	16.8 (15.7, 17.8)	0.246
Niacin EQ (mg)	1.6 (1.4, 1.8)	1.7 (1.5, 1.8)	1.5 (1.4, 1.7)	< 0.001*
Vitamin B6 (mg)	322.4 (306.0, 344.3)	332.8 (322.2, 361.0)	308.9 (301.0, 338.4)	< 0.001*
Folate (mcg)	62.3 (49.7, 76.4)	63.4 (50.7, 77.2)	60.8 (49.0, 75.6)	< 0.001*
Vitamin C (mg)	4.5 (4.2, 4.9)	4.6 (4.3, 5.0)	4.5 (4.1, 4.8)	0.054
Vitamin B12 (mcg)	1.7 (1.3, 2.2)	1.7 (1.2, 2.2)	1.7 (1.3, 2.2)	0.238

Note: RAE = Retinol Activity Equivalents, EQ = Equivalent, IQR = Interquartile range, p-values from Mann-Whitney U test.
*Values are considered statistically significant at $p < 0.05$

Significant differences were noted in several nutrients when comparing non-working and working days (Table 4.10). Calcium intake was slightly higher on non-working days (339.8 mg) than on working days (313.7 mg), with a p-value of 0.045. Phosphorus intake also showed a significant decrease on working days ($p = 0.003$), along with riboflavin and niacin ($p = 0.015$ and 0.003, respectively). Although iron, magnesium, potassium, and sodium intake did not show statistically significant differences, there were marked variations in folate (higher on working days, $p = 0.011$) and vitamin B12 (lower on working days, $p = 0.007$).

Table 4.10 Median (IQR) micronutrient intake among RMG workers based on a working day basis

Nutrients	Non-working Days Median (IQR) N = 128	Working Days Median (IQR) N = 670	p-value
Calcium (mg)	339.8 (241.8, 473.2)	313.7 (229.4, 412.7)	0.045*
Iron (mg)	9.7 (8.2, 11.5)	9.2 (8.3, 10.7)	0.133
Magnesium (mg)	330.4 (295.7, 376.3)	325.5 (297.3, 368.1)	0.416
Phosphorus (mg)	1048.9 (932.8, 1202.8)	991.4 (913.8, 1100.8)	0.003*
Potassium (mg)	1884.2 (1692.6, 2151.7)	1844.8 (1696.8, 2063.8)	0.311
Sodium (mg)	191.4 (167.6, 255.6)	187.3 (162.9, 223.9)	0.062
Zinc (mg)	10.6 (9.6, 12.2)	10.4 (9.7, 11.5)	0.202
Copper (mg)	2.0 (1.8, 2.2)	2.0 (1.9, 2.2)	0.428
Vitamin A, RAE (mcg)	170.4 (140.9, 218.5)	171.3 (148.1, 204.2)	0.847
Retinol (mcg)	47.6 (32.1, 60.2)	49.3 (31.1, 57.2)	0.847
Vitamin E (mg)	1.3 (1.2, 1.4)	1.3 (1.2, 1.4)	0.173
Thiamine(mg)	0.8 (0.7, 0.9)	0.7 (0.7, 0.8)	0.262
Riboflavin (mg)	17.5 (16.0, 19.0)	17.0 (15.9, 17.8)	0.015*
Niacin EQ (mg)	1.6 (1.4, 1.9)	1.6 (1.4, 1.7)	0.003*
Vitamin B6 (mg)	315.7 (302.9, 339.9)	324.5 (306.5, 345.7)	0.021*
Folate (mcg)	58.4 (43.0, 78.9)	62.5 (50.8, 75.6)	0.011*
Vitamin C (mg)	4.5 (4.1, 5.0)	4.5 (4.2, 4.9)	0.072
Vitamin B12 (mcg)	1.9 (1.3, 2.5)	1.7 (1.3, 2.1)	0.007*

Note: RAE = Retinol Activity Equivalents, EQ = Equivalent, IQR = Interquartile range, p-values from Mann-Whitney U test.
*Values are considered statistically significant at $p < 0.05$

4.2.5 Contribution of food groups to selected micronutrients

The bar chart shows the percentage contribution of various food groups to the nutrient intake of 468 female participants. Cereals are the most significant contributors to carbohydrate (84.6%) and overall energy (64.5%) intake. For protein, fish, meat, and eggs

makeup 38.3% of the total, while cereals also play a significant role, providing 40.5%. Edible oils and fats lead to fat intake at 61.4%, and vegetables are the main source of vitamin A, contributing 50.3%. Fish, meat, and eggs are the top sources of iron (22.6%), calcium (41.0%), and folate (35.1%). This data emphasizes the major food sources for essential nutrients, indicating that cereals are the main contributors to energy and carbohydrate intake, while animal-based foods play an important role in supplying protein, calcium, and iron.

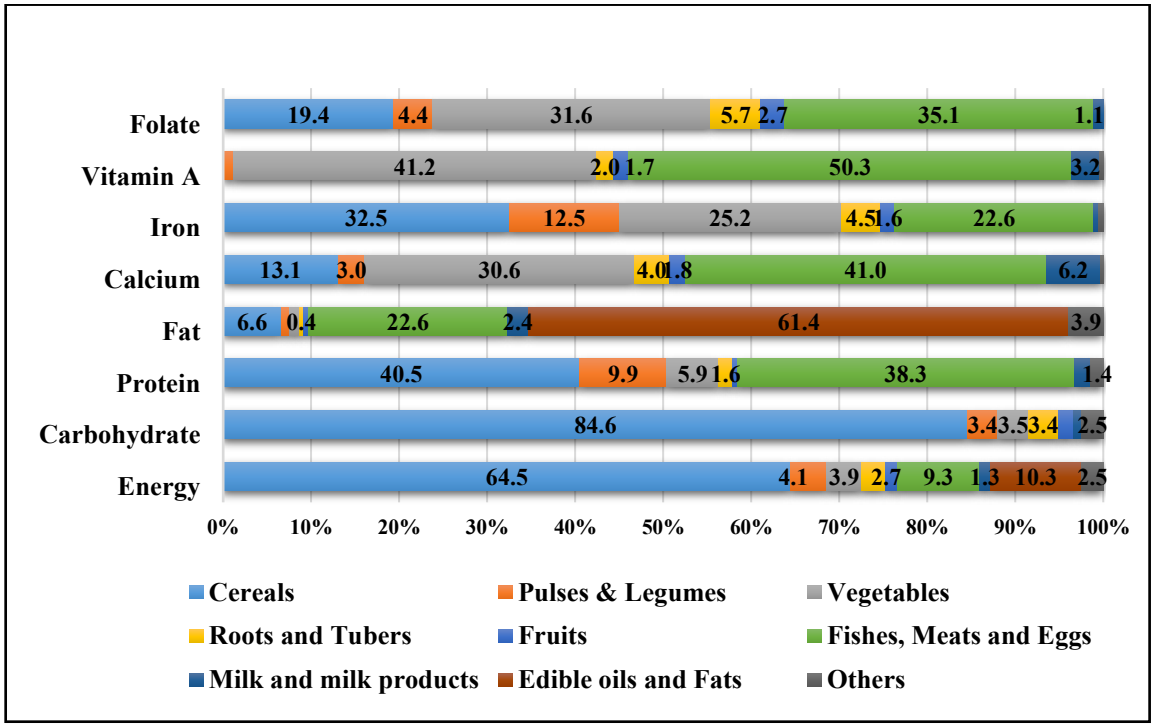

Figure 4.1 Food group's supply to the daily intake of selected macro and micronutrients for female workers

This pattern was also similar among the male RMG workers (Figure 4.2). Cereals provide the largest share of carbohydrates (83.7%) and energy (63.6%). For protein intake, fish, meat, and eggs account for 38.3%, followed by cereals (39.3%). Edible oils and fats are the main source of fat (59.9%). Vegetables are the primary contributors to vitamin A (48.7%), while fish, meat, and eggs significantly contribute to calcium (40.8%), iron (22.0%), and folate (34.8%) intake.

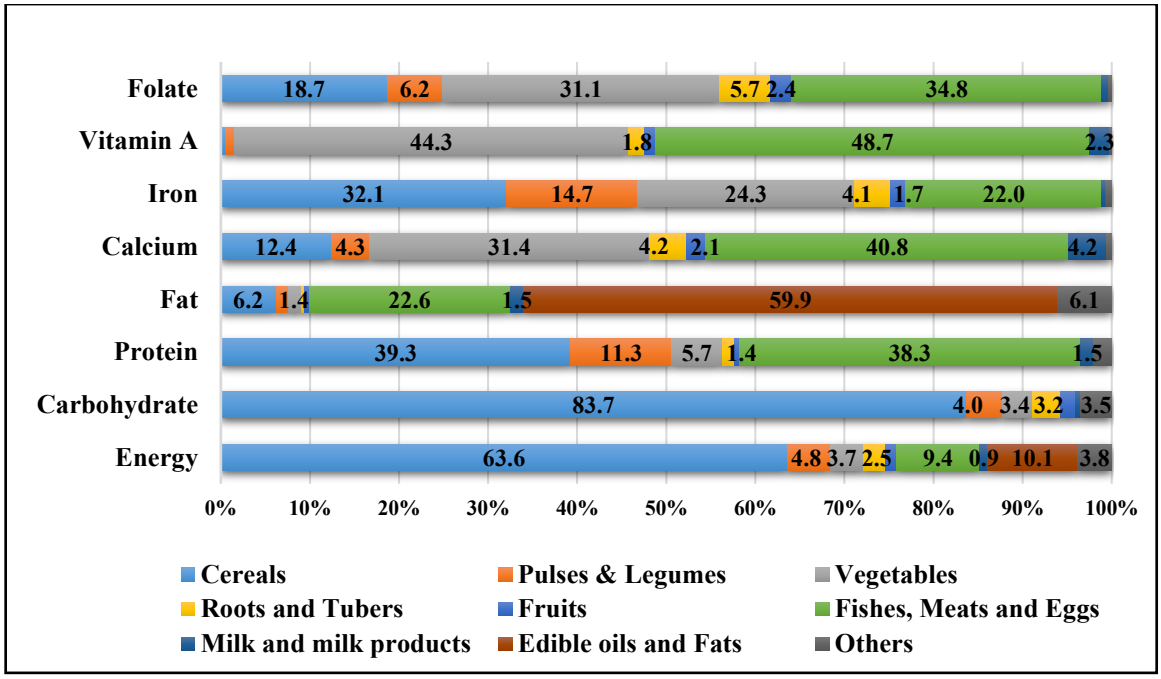

Figure 4.2 The food group's supply of the daily intake of selected macro and micronutrients for male workers

4.2.6 Nutrient adequacy

The adequacy ratio for each micronutrient was calculated by dividing its individual intake by the age and sex-specific requirement of that nutrient. The probability of adequacy was calculated based on that ratio and summarized in Figure 4.3 by sex group.

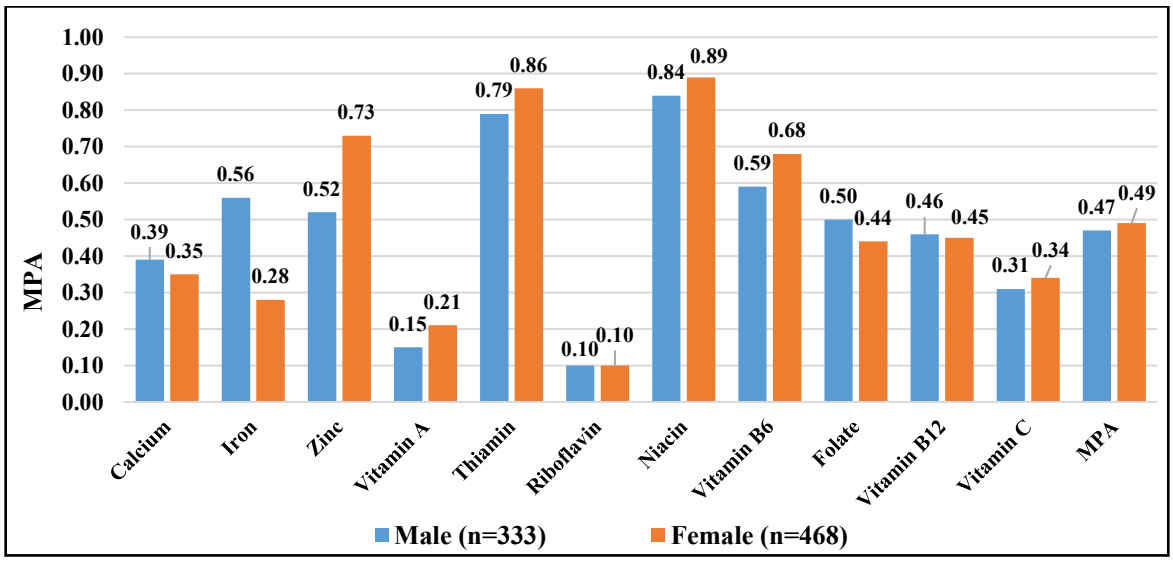

Figure 4.3 The micro-nutrient adequacy ratio of the RMG workers

The highest probability of adequacy achieved by the RMG workers was niacin (male: 0.84 vs. female: 0.89), whereas most minor was achieved for riboflavin (0.10 for both sexes), and vitamin A was the second last (male: 0.15 vs. female: 0.21). The mean probability of adequacy (MPA) was found to be less than 0.50, which means more than 50% of the workers had consumed a diet inadequate in micronutrient content. It was found that female workers consumed an adequate diet in terms of micronutrients compared to their counterparts, except for iron, calcium, folate, and vitamin B12.

Table 4.11 Multiple logistic regression of the effect of socio-economic factors on the mean probability of adequacy (MPA) among the study population

Variables	(%) (MPA > 0.5)	COR (95% CI)	p-value	AOR (95% CI)	p-value
Industry Name					
Dhaka	42.3	1 (Ref.)	-	1 (Ref.)	-
Mymensingh	57.7	1.77 (1.34, 2.35)	<0.001*	1.68 (1.18, 2.41)	0.004*
Sex					
Male	41.5	1 (Ref.)	-	1 (Ref.)	-
Female	58.5	1.01 (0.76, 1.34)	0.963	1.20 (0.86, 1.68)	0.280
Age in Years					
18 to 24	40.4	1 (Ref.)	-	1 (Ref.)	-
25 to 34	50.3	1.30 (0.97, 1.74)	0.083	1.40 (1.00, 1.95)	0.049*
≥ 35	9.3	1.08 (0.66, 1.78)	0.759	1.14 (0.65, 1.99)	0.649
Living status					
Mess or Others	17.3	1 (Ref.)	-	1 (Ref.)	-
In Own Household	82.7	0.96 (0.66, 1.39)	0.821	1.11 (0.65, 1.90)	0.710
Educational status					
Up to Primary	16.8	1 (Ref.)	-	1 (Ref.)	-
Secondary Incomplete	32.7	0.88 (0.58, 1.32)	0.529	0.93 (0.61, 1.43)	0.748
SSC Passed	20.9	0.95 (0.61, 1.50)	0.836	1.05 (0.64, 1.71)	0.843
HSC or Higher	29.7	1.37 (0.89, 2.12)	0.157	1.39 (0.86, 2.23)	0.175
Personal income (BDT)					
<9,000	13.2	1 (Ref.)	-	1 (Ref.)	-
9,000 to 11,000	36.5	0.89 (0.57, 1.38)	0.601	0.91 (0.58, 1.43)	0.670
11,001 to 13,000	16.2	1.03(0.62, 1.71)	0.918	0.93 (0.54, 1.60)	0.794
>13,000	34.1	1.40 (0.88, 2.20)	0.153	1.06 (0.62, 1.79)	0.837
Household size					
≤ 2	45.3	1 (Ref.)	-	1 (Ref.)	-
3 to 5	44.5	0.91 (0.68, 1.22)	0.527	0.90 (0.62, 1.29)	0.561
≥ 6	10.2	0.96 (0.59, 1.56)	0.880	0.83 (0.46, 1.48)	0.528
Number of household earning members					
Single	34.3	1 (Ref.)	-	1 (Ref.)	-
Double	54.7	1.04 (0.77, 1.41)	0.780	1.21 (0.81, 1.81)	0.353
≥ 3	11.0	1.33 (0.81, 2.20)	0.265	1.75 (0.93, 3.30)	0.081

Note: MPA = mean probability of adequacy, COR = Crude Odd Ratios, AOR = Adjusted Odd Ratios, CI – Confidence Interval
*Values are considered statistically significant at $p < 0.05$

The results of multiple logistic regression analysis, presented in Table 4.11, evaluate the influence of socio-economic factors on the mean probability of adequacy (MPA) among the study population. The analysis revealed that workers from Mymensingh had significantly higher odds of achieving adequate micronutrient intake (MPA > 0.5) compared to those in Dhaka, with an adjusted odds ratio (AOR) of 1.68 (95% CI: 1.18, 2.41; p = 0.004). While females exhibited a higher proportion of adequate micronutrient intake than males (58.5% vs. 41.5%), the association was not statistically significant (AOR = 1.20, 95% CI: 0.86, 1.68; p = 0.280). Age was a significant predictor, with individuals aged 25–34 years showing increased odds of adequate micronutrient intake compared to those aged 18–24 years (AOR = 1.40, 95% CI: 1.00, 1.95; p = 0.049), while no significant association was found for those aged 35 years and above. Other socio-economic variables, including living status, educational attainment, personal income, household size, and number of earning members in the household, did not demonstrate statistically significant associations with MPA in the adjusted model.

4.2.7 Micronutrient intake as percent of EAR

The distribution of micronutrient consumption among 801 RMG workers is illustrated in Figure 4.4 as a percentage of the Estimated Average Requirement (EAR).

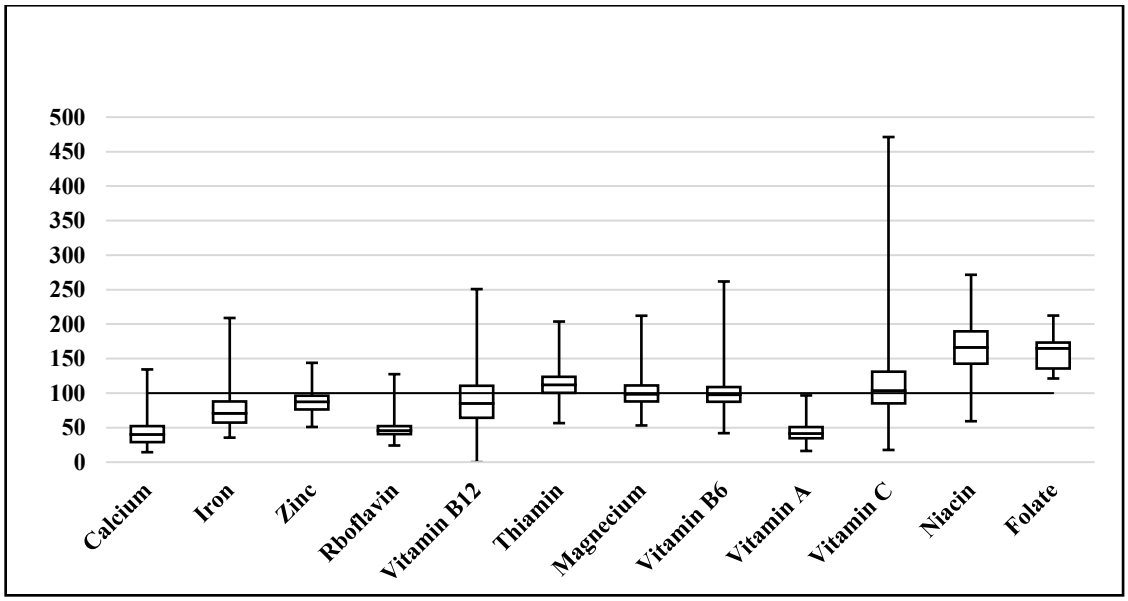

Figure 4.4 Micronutrient intake as percent of EAR by RMG workers (N = 801)

The results indicate considerable variability in micronutrient intake among RMG workers, with a substantial proportion failing to meet the Estimated Average Requirement (EAR) for several essential nutrients. Calcium intake is notably inadequate, with the median intake falling well below 50% of the EAR. Similarly, micronutrients such as iron, zinc, riboflavin, and vitamin A show median intakes at or below the EAR, suggesting a widespread risk of deficiency. In contrast, nutrients such as niacin and folate exhibit median intakes above the EAR for some individuals, indicating relatively better adequacy. The distribution of vitamin C intake is highly dispersed, with some individuals consuming levels far exceeding the EAR, reflecting marked dietary variability. Overall, the data indicate that, while certain micronutrient intakes are adequate or even high, there are significant deficiencies in dietary consumption of essential nutrients, which may affect workers' health and productivity.

4.3. Nutritional Status

The nutritional status of RMG workers, as measured by Body Mass Index (BMI), provides significant insight into their general health and well-being.

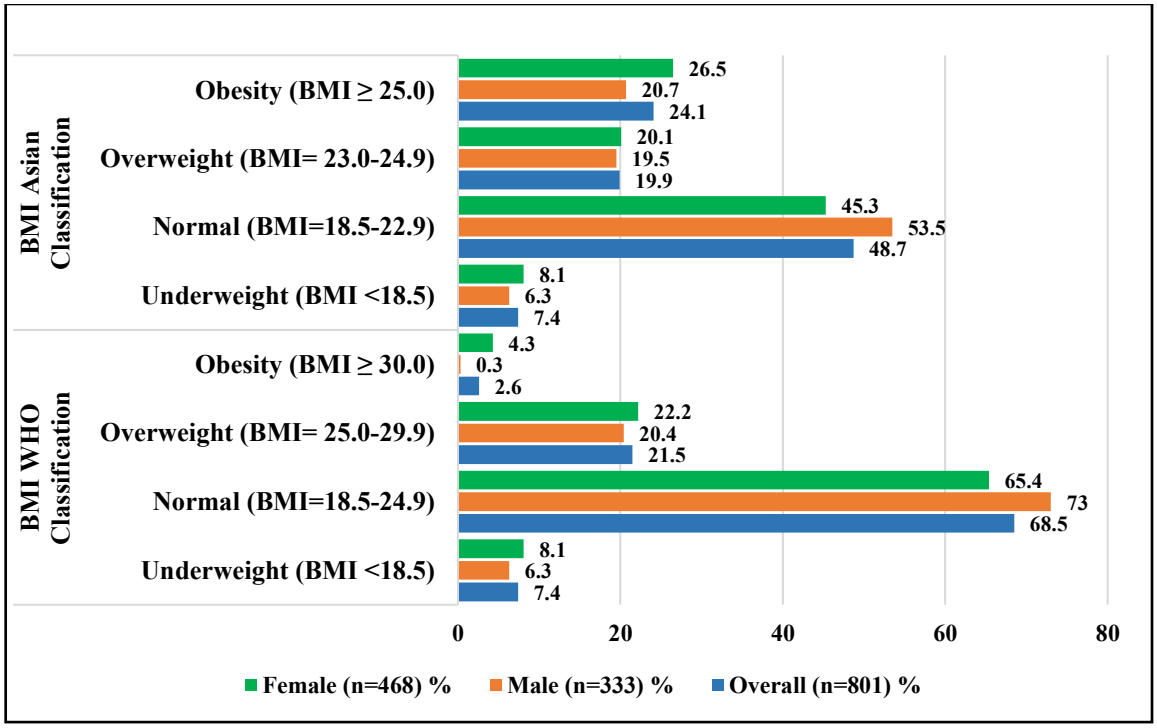

Figure 4.5 Nutritional status of RMG workers as per BMI

BMI is a simple weight-for-height index that is often used to describe humans as being underweight, overweight, or obese. Figure 4.3 provides the distribution of individuals

across different BMI (Body Mass Index) categories based on both the WHO and Asian classifications. The WHO classification categorizes individuals into Underweight (BMI < 18.5), Normal (BMI=18.5-24.9), Overweight (BMI=25.0-29.9), and Obesity (BMI ≥ 30.0). In this sample, the majority fall within the Normal category (68.5%), followed by Overweight (21.5%), Underweight (7.4%), and Obesity (2.6%) according to the WHO criteria. When applying the Asian classification, the BMI ranges are adjusted, with categories including Underweight (BMI < 18.5), Normal (BMI=18.5-22.9), Overweight (BMI=23.0-24.9), and Obesity (BMI ≥ 25.0). The highest percentage falls within the Normal category (48.7%), followed by Obesity (24.1%), Overweight (19.9%), and Underweight (7.4%). Overall, the findings indicate that while most individuals fall within the normal BMI range under both classifications, the Asian criteria reveal a higher proportion of overweight and obesity, suggesting an increased risk of weight-related health issues in this population.

4.4 Affordability of a healthy diet

Table 4.12 shows the prevalence of several types of diets in Dhaka and Mymensingh, Bangladesh, using adjusted criteria for energy sufficiency, nutritional adequacy, and overall wellness.

Table 4.12 Affordability status of diets among RMG workers

Types of Diet		**Dhaka (n=401)**	**Mymensingh (n=400)**
Energy Sufficient Diet (Bangladesh adjusted)	No	0.5	0.3
	Yes	99.5	99.8
Nutrient Adequate Diet (Bangladesh adjusted)	No	2.7	5.5
	Yes	97.3	94.5
Healthy Diet (Bangladesh adjusted)	No	68.1	67.0
	Yes	31.9	33.0

In Dhaka, 99.5% of respondents have an energy-sufficient diet, compared to 99.8% in Mymensingh. Regarding nutrient adequacy, 97.3% of respondents in Dhaka meet the requirements, against 94.5% in Mymensingh. However, in terms of keeping a healthy diet, both areas have a higher number of respondents who do not match the requirements, with 68.1% in Dhaka and 67.0% in Mymensingh.

The provided data in Table 4.13 illustrates the distribution of diet types among male and female RMG workers in two different garment industries in Dhaka and Mymensingh, Bangladesh, based on adjusted criteria for energy sufficiency, nutrient adequacy, and a healthy diet. In Dhaka, 100% of males and 99.3% of females have an energy-sufficient diet, whereas in Mymensingh, 99.5% of males and 100% of females meet this criterion. Regarding nutrient adequacy, a higher percentage of females in both locations meet the criteria compared to males. Specifically, in Dhaka, 97.9% of females compared to 95.7% of males have a nutrient-adequate diet, while in Mymensingh, 96.7% of females compared to 92.6% of males meet this standard. However, a significant proportion of respondents in both genders and locations do not maintain a healthy diet, with over 60% not meeting the criteria.

Table 4.13 Affordability status of diets among RMG workers based on their gender

Types of Diet		**Dhaka (n=401)**		**Mymensingh (n=400)**	
		Male	**Female**	**Male**	**Female**
Energy Sufficient Diet (Bangladesh adjusted)	No	0.0	0.7	0.5	0.0
	Yes	100	99.3	99.5	100
Nutrient Adequate Diet (Bangladesh adjusted)	No	4.3	2.1	7.4	3.3
	Yes	95.7	97.9	92.6	96.7
Healthy Diet (Bangladesh adjusted)	No	70.7	67.0	66.8	67.2
	Yes	29.3	33.0	33.2	32.8

The findings of a logistic regression analysis are displayed in Table 4.14, where the various sociodemographic factors' corresponding p-values are displayed with the crude odds ratio (COR) and adjusted odds ratio (AOR). Age, sex, income, education, number of earning members, and family size are explored as predictors of an outcome. Workers aged 35 and above showed significantly lower odds of the outcome in crude analysis (COR = 0.54, p = 0.033), but this association became non-significant after adjustment (AOR = 0.65, p = 0.195). While females had slightly higher odds in the crude model (COR = 1.05, p = 0.749), the adjusted model suggested lower odds (AOR = 0.78, p = 0.191), though not statistically significant.

Table 4.14 Factors associated with the affordability of a healthy diet

Variables	COR	p-value	AOR	p-value
Age in years				
18 to 24	1 (Ref.)			
25 to 34	0.79 (0.58, 1.07)	0.127	0.77 (0.53, 1.11)	0.153
≥ 35	0.54 (0.30, 0.95)	0.033*	0.65 (0.34, 1.25)	0.195
Sex				
Male	1 (Ref.)			
Female	1.05 (0.78, 1.42)	0.749	0.78 (0.54, 1.13)	0.191
Personal income of the workers (BDT)				
< 9,000	1 (Ref.)			
9000 to 11,000	1.03 (0.64, 1.67)	0.895	1.06 (0.63, 1.78)	0.822
11001 to 13,000	1.35 (0.78, 2.33)	0.289	1.59 (0.87, 2.91)	0.128
> 13,000	1.51 (0.93, 2.48)	0.099	1.95 (1.12, 3.40)	0.019*
Education				
Up to Primary	1 (Ref.)			
Secondary incomplete	1.44 (0.92, 2.25)	0.113	1.44 (0.88, 2.35)	0.143
SSC passed	1.30 (0.80, 2.13)	0.292	1.12 (0.64, 1.96)	0.684
HSC or higher	1.27 (0.79, 2.05)	0.326	1.02 (0.60, 1.75)	0.936
Number of earning members				
Single	1 (Ref.)			
Double	1.41 (1.02, 1.94)	0.037*	2.73 (1.82, 4.11)	< 0.001*
3 or more	0.86 (0.49, 1.52)	0.598	4.70 (2.20, 10.06)	< 0.001*
Number of family members				
5 or more	1 (Ref.)			
3 to 4	4.89 (3.07, 7.79)	<0.001*	9.50 (5.26, 17.18)	< 0.001*
2 or less	2.02 (1.23, 3.33)	<0.005*	3.14 (1.77, 5.57)	< 0.001*

Note: COR = Crude Odd Ratios, AOR = Adjusted Odd Ratios

*Values are considered statistically significant at $p < 0.05$

Income above BDT 13,000 was a significant predictor in the adjusted model (AOR = 1.95, $p = 0.019$). Households with two (AOR = 2.73, $p < 0.001$) or three or more earning members (AOR = 4.70, $p < 0.001$) had higher odds of the outcome. Smaller family sizes (3–4 members and ≤2 members) were also significantly associated with higher odds (AOR = 9.50 and 3.14, respectively; $p < 0.001$). In contrast, educational attainment and lower income categories were not significantly associated. These results show the impact of income, number of earning members, and family size on the study's outcome

CHAPTER 5
DISCUSSION

The study findings indicate that the diets of RMG workers were largely dependent on calorie-dense staple foods such as rice, with inadequate consumption of fruits, vegetables, and pulses. Carbohydrates accounted for a substantial share of total energy intake, while a considerable proportion of workers consumed less than the recommended level of fat. Micronutrient inadequacies were prevalent, particularly for calcium, iron, zinc, riboflavin, and vitamin A, with most intakes falling below the Estimated Average Requirement (EAR). The mean probability of adequacy (MPA) for micronutrients was significantly higher among workers from Mymensingh and those belonging to the age group of twenty-five to thirty-four years. A dual burden of malnutrition was evident, with the coexistence of underweight and overweight or obesity based on WHO standards, and an even higher prevalence when applying Asian BMI cut-offs. A majority of workers were unable to afford a healthy diet and its affordability was associated with higher income, smaller household size, and the presence of multiple earning members.

5.1 Diet quality of RMG workers

This study assessed the average daily intake of various food groups among male and female garment workers, revealing notable gender differences and patterns in dietary consumption. Males consumed more cereals than females, with rice being the staple food for both groups, while the intake of wheat and other cereals remained minimal. Potato and vegetable consumption was comparable across genders, with non-leafy vegetables being the most frequently consumed subgroup. Males had a higher intake of pulses, particularly masoor dal, whereas females consumed more milk and dairy products. The intake of edible oils and animal-source foods was similar between males and females; however, males consumed more beef, whereas females consumed more chicken and eggs. Fish consumption was slightly higher among males. Fruit intake was somewhat greater in females, while males consumed more sugar and miscellaneous food items. Both genders reported similar use of condiments and spices, with onions being the most commonly consumed.

These findings align with earlier research. Chowdhury (2019) highlighted that garment workers prioritize cereal-based diets, with rice comprising over half (52.37%) of their daily intake at approximately 443 grams, and that consumption of milk, dairy, eggs, and meat was infrequent. Seasonal fruits such as jackfruit, bananas, guavas, and mangoes were identified as popular but limited to seasonal availability, while vegetables, sugar, fish, cooking oil, and legumes were among the least consumed. Dharma et al. (2013) similarly noted that low-income populations often rely on inexpensive, calorie-dense foods like refined grains due to affordability. Sharmin et al. (2020) reported higher lentil consumption among food-secure female workers, highlighting its role as a protein-rich alternative in low-income diets. Arsenault et al. (2013) found that 64% of women in rural Bangladesh consumed lentils daily. Sharmin et al. (2020) also observed that food-insecure female workers preferred beef and fish, influenced by taste preferences and availability in factory canteens, whereas food-secure workers leaned toward chicken.

Our analysis of dietary patterns across working and non-working days further revealed notable variations. Cereal intake, particularly rice, was higher on working days, while pulse and nut consumption increased on non-working days. Non-working days also saw a significant rise in the consumption of animal-source foods, fish, and fruits, indicating a shift toward more diverse and potentially higher-quality diets during leisure periods. Additionally, intake of sugar and miscellaneous items was higher on non-working days.

When compared to national dietary benchmarks, such as the Household Income and Expenditure Survey 2022 (HIES 2023) and dietary guidelines from BIRDEM (2013), several gaps were identified. Rice consumption among garment workers closely matched the recommended daily intake of 350 grams, while wheat intake remained below the recommended 50 grams. Potato intake exceeded the suggested 100 grams per day, whereas total vegetable consumption, both leafy and non-leafy, was insufficient. Pulses were consumed slightly below the recommended 50 grams. Encouragingly, milk and dairy intake exceeded the recommended 130 grams. However, fat and oil intake fell short of the 30-gram recommendation. While the consumption of animal-source foods, such as eggs and fish, generally met or surpassed recommended levels, beef intake was lower than the 40 grams per day recommendation. Spice intake aligned with guidelines, yet fruit consumption remained below the recommended 100 grams per day.

5.1.1 Sharing of energy from macronutrients

The distribution of energy from macronutrients—carbohydrates, proteins, and fats—is crucial for maintaining optimal health, especially for RMG workers who often engage in physically demanding labor for extended hours. An appropriate balance not only supports daily energy needs but also influences productivity and long-term health outcomes. According to Sultana et al. (2014), the estimated energy requirements for female factory workers range from 1,856 to 1,982 kcal depending on age group. However, our study found that average energy intake among female workers consistently fell short of these recommendations across all age groups, with mean values of 1,738.2 kcal (18–20 years), 1,704.3 kcal (21–25 years), and 1,891.2 kcal (26–30 years). Such an insufficient intake likely compromises work performance and may lead to fatigue and reduced labor capacity.

Previous research aligns with our findings. Khatun et al. (2015) reported energy deficits among both male and female garment workers, with females experiencing more pronounced inadequacies in the intake of carbohydrates, proteins, fats, and overall energy. Similarly, Kavitha et al. (2020) observed that adolescent female workers also consumed energy and protein levels below the recommended dietary allowance (RDA), with fat intake showing minimal variation between age groups.

Daily intake percentages for different macronutrients vary due to differing nutritional guidelines, individual needs, and populations. In this study, median energy intake was observed to be higher among males compared to females. A similar gender disparity was evident across all macronutrients, with males consuming greater amounts of protein, fat, and carbohydrates than females, and these differences were statistically significant. Comparisons between working and non-working days revealed slight increases in energy, carbohydrate, and protein intake on non-working days, although these differences were not statistically significant. However, fat intake showed a notable and statistically significant increase on non-working days, indicating variability in dietary behavior based on work schedule.

Macronutrient energy distribution further illustrates dietary imbalances. Most workers (66.9%) consumed carbohydrates within the recommended 45–65% of total energy, though a substantial portion exceeded this range. Protein intake was more balanced, with 77.2% of the population within the 5–15% recommended range, though a higher

percentage consumed excess protein on non-working days (39.8% vs. 19.6% on working days). Fat intake presented the most significant deviation, with 43.4% of workers consuming below the 15% minimum threshold, more commonly on working days (45.8%) than non-working days (31.3%). These patterns indicate that while carbohydrate and protein distribution remain relatively stable, fat intake is particularly sensitive to work schedule and generally insufficient, especially among female workers.

Overall, the findings represent suboptimal macronutrient consumption among RMG workers, with a consistent shortfall in meeting RDAs, particularly among females, which may contribute to reduced energy availability and impaired work capacity.

5.1.2 Micronutrient intake of RMG workers

The findings of this study reveal significant gender-based differences in micronutrient consumption. Male workers exhibited significantly higher intake levels of iron, magnesium, phosphorus, potassium, sodium, zinc, copper, retinol, thiamine, riboflavin, niacin equivalents, vitamin B6, folate, and vitamin B12 compared to their female counterparts. Conversely, female workers had higher intakes of calcium, vitamin A, retinol, and niacin equivalents. These disparities may be attributed to physiological needs, dietary preferences, and sociocultural factors influencing access to and choice of foods.

The study also found variations in nutrient intake between working and non-working days. For instance, calcium intake was significantly higher on non-working days ($p = 0.045$), suggesting that leisure days might allow for more diverse or nutrient-rich food consumption. Although other nutrients such as thiamine, riboflavin, vitamin C, and vitamin E also showed day-specific differences, the associations were not statistically significant. These findings point to the influence of routine, food availability, and time constraints on dietary habits during the workweek.

Calcium intake among the workers was particularly low, with an average of only 319.7 mg/day, substantially below the recommended nutrient intake (RNI) of 1,000 mg/day (Nahar, 2013). Previous studies reported similar patterns, with female RMG workers consuming approximately 75% of their RDA for calcium (Islam et al., 2013). Iron intake also presented a concern. The interquartile range (IQR) for iron consumption was 9.3 mg/day, while the recommended intake for women, considering varying levels of bioavailability, ranges from 19.6 to 58.8 mg/day (Nahar, 2013). The average daily iron

intake for female workers was only 8.8 mg/day, falling below even the lowest recommended value. This deficiency may contribute to the high prevalence of anemia observed in similar populations. For example, Akter et al. (2017) reported that 92% of adolescent female industrial workers were anemic, likely due to insufficient intake of iron-rich foods.

Overall, micronutrient inadequacy was more pronounced among female workers, consistent with earlier studies. Khan and Ahmed (2005) found significant deficiencies in micronutrient intake among 1,211 adolescent girls employed in 17 garment factories in Dhaka. Such inadequate nutrient intake increases vulnerability to a range of health issues, including weakened immunity, anemia, fragile bones, and reduced work efficiency (Mahmood et al., 2017; Islam et al., 2013; Saha et al., 2014; Solinap et al., 2019). Additionally, the average dietary intakes reported in this study fell short of the ICMR-NIN (2020) recommendations, which are essential for sustaining performance in physically demanding jobs. As James et al. (1990) emphasized, inadequate energy and nutrient intake, even for short periods, can significantly impair work capacity.

5.1.3 Contribution of various food groups to specific micronutrients

Dietary patterns observed in this study were predominantly rice-based, with the highest rice intake found in the rice and low diversity and meat and fish patterns. In contrast, the wheat and high diversity pattern was characterized by approximately 500 kcal lower rice consumption per day, accompanied by higher intake of wheat, pulses, and oils. Fruit and vegetable consumption ranged from 100 to 180 kcal/day and remained lowest among individuals following low-diversity diets. Meat and fish contributed more substantially to energy intake in selected patterns, whereas dairy consumption was minimal across all groups. The average daily energy intake was 2934 kcal/capita/day, with the highest intake recorded in the wheat and high diversity pattern (3055 kcal) and the lowest in the rice and low diversity pattern (2813 kcal). Notably, nutrient adequacy was particularly poor among individuals adhering to low-diversity diets, where only 3% and 10% met the recommended fat and protein intake, respectively (Ali et al. 2021).

These findings indicate that although overall energy intake among garment workers may appear adequate, dietary diversity and micronutrient adequacy remain limited. Compared to general dietary recommendations and typical population-level patterns in Bangladesh,

this suggests that garment workers are nutritionally more vulnerable, primarily due to their reliance on monotonous, cereal-based diets and limited access to nutrient-dense foods such as fruits, vegetables, and dairy products. This imbalance may have important implications for long-term health and productivity.

A diverse and balanced diet composed of multiple food groups is essential for meeting the nutritional needs of RMG workers and sustaining their productivity and health. The present study assessed the contribution of specific food groups to micronutrient intake, stratified by gender. Among female workers (n = 468), cereals were the predominant source of carbohydrates (84.6%) and contributed 64.5% of total energy intake. Vegetables (41.2%) and fruits (50.3%) served as the primary sources of vitamin A. Iron intake was mainly derived from cereals (32.5%) and animal products (22.6%), while calcium was primarily obtained from milk and dairy products (41.0%) and vegetables (30.6%). Dietary fats were predominantly provided by edible oils and fats (61.4%), and protein sources were largely cereals (40.5%) and animal-derived foods (38.3%). Folate was chiefly contributed by vegetables (35.1%) and cereals (19.4%). These findings underscore the need for a diverse diet to meet essential nutrient requirements among female workers.

Similarly, for male workers (n = 333), cereals contributed 83.7% of carbohydrate intake and 63.6% of total energy. Fruits (48.7%) and vegetables (44.3%) remained the major sources of vitamin A. Iron intake was largely drawn from cereals (32.1%) and vegetables (24.3%), while calcium was primarily sourced from dairy (40.8%) and vegetables (31.4%). Edible oils and fats accounted for 59.9% of dietary fat, while protein came mainly from cereals (39.3%) and animal-based foods (38.3%). Vegetables (34.8%) and cereals (18.7%) were key contributors to folate intake. These results emphasize the critical role of cereals and plant-based foods in providing energy and micronutrients, while animal products remain important sources of essential vitamins and minerals.

5.1.4 Nutrient adequacy

While both male and female workers demonstrated relatively high adequacy for certain nutrients, most notably niacin (male: 0.84; female: 0.89) and thiamin, severe inadequacies were observed for riboflavin (0.10 for both sexes) and vitamin A (male: 0.15; female: 0.21). Gender-specific differences were also evident: males showed higher adequacy for iron, calcium, and folate, whereas females had higher adequacy for zinc and vitamin B6.

These findings highlight the need to address dietary imbalances specific to each group. Consistent with Darina and Ningying (2018), poverty remains a major barrier to adequate nutrition, compelling workers to opt for low-cost, nutrient-poor food. Food insecurity, including concerns over food availability and the affordability of preferred items, further contributes to dietary inadequacies. Such nutritional deficits, particularly among working populations, can lead to serious health consequences, including immune dysfunction, reduced physical capacity, and increased hospitalization risks (Coleman, 2017).

In our study, socio-demographic factors were influencing the likelihood of achieving adequate micronutrient intake (MPA > 0.5). Workers from Mymensingh had significantly higher odds of meeting micronutrient adequacy compared to those from Dhaka (AOR = 1.68, p = 0.004). Although females demonstrated a slightly higher overall micronutrient adequacy, the difference was not statistically significant. Age was also an influential factor, with workers aged 25–34 being more likely to meet adequacy than those aged 18–24 (AOR = 1.40, p = 0.049). Other variables such as education level, income, household size, number of earners, and living arrangements did not show significant associations with micronutrient adequacy.

5.2 Affordability of diet

The affordability of a healthy diet remains a critical concern for RMG workers and has significant implications for their nutritional status and overall well-being. Findings from this study demonstrate that although most RMG workers in Dhaka and Mymensingh have access to energy-sufficient and nutrient-adequate diets, a substantial proportion are unable to afford a truly healthy and balanced diet. This observation is consistent with prior evidence indicating that economic limitations and high food prices are major barriers to achieving dietary diversity among low-income populations (FAO, 2021; Raza et al., 2018).

More than two-thirds of the workers surveyed in both regions failed to meet the criteria for a healthy diet, reflecting a persistent gap between caloric sufficiency and diet quality. This pattern echoes findings from previous research showing that while staple foods such as rice and lentils are widely consumed and affordable, nutrient-dense foods like fruits, vegetables, and protein sources are often inaccessible to low-wage earners (Ahmed et al., 2019). The study's logistic regression analysis reinforces that diet affordability is strongly

shaped by socio-economic factors, particularly income level, number of earning household members, and household size.

Income emerged as a key determinant: workers earning more than BDT 13,000 were nearly twice as likely to afford a healthy diet (AOR = 1.95, $p = 0.019$), in line with evidence linking higher income to improved dietary diversity and nutrition security (Rahman & Mishra, 2020). In contrast, lower-income workers are more likely to prioritize inexpensive, calorie-dense but nutrient-poor foods.

Household earning capacity also significantly influenced diet affordability. Workers from households with two earning members had 2.73 times higher odds, and those with three or more earners had 4.70 times higher odds of affording a healthy diet (both $p < 0.001$), supporting earlier studies suggesting that multiple income sources enhance access to diverse and nutritious foods (Ghosh, 2017). Family size further shaped diet affordability. Smaller households, consisting of three to four members or fewer, were significantly more likely to afford a healthy diet than larger households (AOR = 9.50, $p < 0.001$ for three to four members; AOR = 3.14, $p < 0.001$ for two or fewer members). This is consistent with previous findings that larger households face greater financial strain, often resulting in poorer dietary quality (Banik et al., 2020).

The study emphasizes the substantial impact of income, household size, and the number of earning members on the affordability of a healthy diet among RMG workers.

5.3 Nutritional status

The findings revealed a significant prevalence of overweight and obesity among the workers, especially among females. This result aligns with previous research, such as a study conducted by Justus Liebig University Giessen, which surveyed a factory in Phnom Penh. This study reported that garment workers were not only overweight (31.4%) but also anemic (26.9%), which heightened their risk of exhaustion and fainting. Similarly, the Cambodia Daily report, titled "Finds Garment Worker Malnourish," highlighted the alarming nutritional status of Cambodian garment workers, noting that many consume only half of the recommended daily calorie intake for adults engaged in manual labor. The study found that the average daily calorie intake of these workers was 1,598 calories, falling short of the recommended intake for individuals in the garment industry.

A study by Sharmin et al. (2020) also revealed that a substantial proportion of female garment workers exhibited obesity (BMI ≥ 28 kg/m²) and had waist circumferences at levels that indicated a higher risk of health complications. The study suggested that these risks could be attributed to poor eating habits, which often stem from food insecurity. Food-insecure households are frequently forced to limit their food purchases, resulting in the consumption of high-calorie, low-cost foods. Fatema et al. (2014) also found similar patterns, reporting that male participants had a mean BMI of 22.5 kg/m² and a waist-to-hip ratio (WHR) of 0.86, while female participants had a mean BMI of 23.4 kg/m² and a WHR of 0.81. Both BMI and WHR increased with age in both genders. The prevalence of cardiovascular disease (CVD) risk factors was also elevated, with 23% of individuals classified as overweight (95% CI 19.7-26.3) and 27.9% as obese (95% CI 25.3-30.5).

Our study, which applied both WHO and Asian BMI classifications, found a high proportion of overweight and obese workers. According to WHO criteria, most participants were classified as having a normal BMI (68.5%), followed by overweight (21.5%), underweight (7.4%), and obesity (2.6%). However, when applying the Asian classification, which adjusts BMI ranges, the highest percentage was in the normal BMI category (48.7%), followed by obesity (24.1%), overweight (19.9%), and underweight (7.4%). The substantial prevalence of overweight and obesity, especially under the Asian BMI classification, emphasizes a growing risk of diet-related health issues among RMG workers. These results point to the significant risks associated with obesity in this population, which may be linked to poor dietary habits. Food insecurity, which forces workers to limit their food purchases, often results in the consumption of high-energy but low-cost foods, contributing to weight gain and associated health risks.

Similar findings were reported by Gooding, Walls, & Richmond (2012), who found that food-insecure women had a BMI that was, on average, 0.9 kg/m² higher than their food-secure counterparts. This underscores the need for targeted interventions to address the dietary patterns of RMG workers and to improve food security. Given the prevalence of both underweight and overweight conditions among workers, there is a clear need for workplace health programs that focus on promoting healthy eating and physical activity.

Overall, the findings of this section demonstrate a clear coexistence of undernutrition and overnutrition among RMG workers, reflecting a complex nutritional transition within this population. The presence of both underweight and overweight individuals indicates that

inadequate diet quality, combined with economic constraints and food insecurity. While some workers fail to meet minimum energy and nutrient requirements, others are exposed to excessive consumption of low-cost, energy-dense foods, increasing their risk of non-communicable diseases.

5.4 Strengths and limitations

5.4. 1 Strengths

A significant strength of this study was its large sample size, comprising data from 801 RMG workers. This increases the study's statistical power and supports the generalizability of its findings to similar populations in Bangladesh. Including participants from various age groups, employment durations, and socioeconomic backgrounds further enhances the analysis by ensuring diverse representation.

The study's comprehensive evaluation of dietary intake, covering both macronutrients and micronutrients, provides a thorough assessment of participants' nutritional status. This approach identifies potential imbalances or deficiencies in both energy and essential nutrients, which is crucial for understanding the diets of low-income labor groups.

Additionally, the use of the Probability of Adequacy (PA) method for assessing micronutrient intake adds methodological rigor. The PA method facilitates a more precise estimation of whether individual nutrient intakes meet recommended levels, offering a nuanced perspective on dietary adequacy.

Lastly, the study's identification of gender-based differences in food and nutrient intake is significant. By revealing these disparities, the research informs the development of targeted nutrition policies and interventions, particularly for women who may face greater barriers to adequate nutrition.

5.4.2 Limitations

One limitation of this study was its cross-sectional design, which precludes the establishment of causal relationships between dietary patterns and health outcomes. While associations can be observed, the temporal order of events remains undetermined, making it unclear whether specific dietary behaviors are the causes or results of particular health conditions or nutritional statuses.

A further limitation relates to the dietary assessment method. The study relied on two non-consecutive 24-hour dietary recalls, which may not adequately represent habitual intake, particularly in populations with irregular food access or variable eating patterns. This approach is susceptible to day-to-day fluctuations, potentially compromising the accuracy of long-term dietary behavior estimates.

Additionally, the use of purposive sampling from selected factories restricts the generalizability of the findings. Since the sample was drawn from specific factories, the results may not be representative of the wider RMG workforce across different regions or factory types in Bangladesh. Moreover, the study did not consider seasonal or temporal variations in food availability and consumption, factors that can significantly influence dietary intake over time.

CHAPTER 6

CONCLUSION, SUMMARY OF HYPOTHESIS AND RECOMMENDATIONS

6.1 Conclusion

The study concludes that malnutrition and micronutrient inadequacy coexist among RMG workers in Bangladesh. RMG workers face financial constraints, which limit their ability to afford healthy food and, in turn, negatively impact their nutritional status. The results also reveal that alarming dietary micronutrient inadequacies, particularly among female workers, such as iron, calcium, and vitamins A and D. These inadequacies are exacerbated by a dietary pattern predominantly consisting of cereals and insufficient consumption of fruits, vegetables, and pulses, further aggravating the risk of malnutrition. Additionally, dietary quality fluctuates between working and non-working days, suggesting that work-related constraints restrict dietary diversity.

Regional differences were observed. RMG workers in the Dhaka region were at a higher risk of micronutrient inadequacy than their counterparts in the Mymensingh region. Workers in their 20s and early 30s show better micronutrient adequacy compared to younger workers, and education and income level did not significantly impact micronutrient intake.

Furthermore, the study found high prevalence of overweight and obesity among RMG workers, particularly when using the Asian BMI classification, which raises concerns about the growing risks of obesity-related health issues. This research makes a significant contribution by simultaneously assessing diet quality, affordability, and nutritional status among RMG workers. The findings provide valuable evidence to inform the development of targeted workplace health and nutrition interventions aimed at improving workers' overall health, well-being, and productivity.

6.2 Summary of hypothesis

H1: The diet quality of RMG workers is inadequate, characterized by low dietary diversity and failure to meet recommended dietary guidelines. **(Accepted)**

H2: The food consumption patterns of RMG workers are insufficient, with deficient consumption of nutrient-rich food groups. **(Accepted)**

H3: The majority of RMG workers are unable to afford a healthy diet due to low wages and high non-food expenditures. **(Accepted)**

H4: The nutritional status of RMG workers is suboptimal, characterized by a high prevalence of malnutrition and micronutrient inadequacies. **(Accepted)**

H5: Job location, age, income level, and the number of earning household members are positively associated with micronutrient adequacy and the affordability of a healthy diet. **(Accepted)**

6.2 Recommendations

The study reveals strong links between diet quality, income, and nutrition among RMG workers in Bangladesh; thus, the following recommendations are proposed:

Educational and nutritional interventions for female workers: The study shows that female workers have lower educational attainment and income levels than their male counterparts, which may limit their knowledge of nutrition and healthy food choices. It is recommended that targeted educational programs be implemented to raise awareness on balanced diets, focusing on the need to diversify food choices, particularly the inclusion of fruits, vegetables, and pulses.

Promotion of healthy diets in the workplace: Compared to the general population, RMG workers rely heavily on calorie-dense foods and have lower micronutrient intake. Workplace initiatives should provide healthier food options, such as subsidized fruits, vegetables, pulses, and fortified foods in canteens, and nutrition-based incentives to encourage healthier eating habits.

Addressing the dual burden of malnutrition: The study reveals a dual burden of malnutrition, with workers being both underweight and overweight/obese. A comprehensive nutritional approach is necessary, addressing both undernutrition and overnutrition. Health campaigns promoting balanced energy intake and physical activity should be prioritized to reduce obesity-related risks and support weight management.

Micronutrient supplementation programs: RMG workers, particularly in Mymensingh, face significant micronutrient deficiencies, including calcium, iron, zinc, riboflavin, and vitamin A. It is recommended that government and industry collaborate to provide micronutrient supplementation or fortified foods, particularly for workers at risk of deficiencies.

Improving income and economic access to healthy diets: Despite adequate energy intake, many workers cannot afford a healthy diet. The affordability of nutritious food is influenced by income, household size, and the number of earners. To address this, measures such as wage increases, better working conditions, and financial support programs should be implemented to enhance workers' access to healthier diets.

Implementing these recommendations is expected to improve the nutritional status of RMG workers in Bangladesh, resulting in better health and increased productivity.

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Appendix: Questionnaire of the study

Identification No. of the Schedule | | | |

DIET QUALITY AND AFFORDABILITY OF HEALTHY DIETS AMONG WORKERS OF SELECTED GARMENTS INDUSTRIES IN BANGLADESH

DCI 1: SEMI-STRUCTURED QUESTIONNAIRE

Respondent: Readymade Garments Workers (male/female)

Conducted by: Shazia Afrin

Institute of Nutrition and Food Science (INFS)

University of Dhaka

June, 2020

Informed Consent for Readymade Garments Workers

Salam/Adab, my name is _____. I am from SURCH, a socio-economic based research organization, is located at Chankhar Pool, Dhaka. At present we are conducting a baseline survey on Baseline Survey of Knowledge, Attitude, Practice, Behavior (KAPB), and Food Supply System around nutritious and safe food consumption among Readymade Garments Workers enrolled in factories for SWAPNO Projects, which will identify the nutrient gap in the existing diet of the workers in individual factories. Based on the assessment, standard dietary guidelines for the individual factory should consider the cost and availability of food served at the midday meal to address the dietary gap.

Confidentiality of your information will be maintained strictly. Your name and identity will never be disclosed anywhere by any means, and all the information will be used for research purposes only. Participation in this survey is voluntary, and you can choose not to answer any individual question or all of the questions at any point of survey, even after your consent. You may not get any immediate benefit from this survey; however, SWAPNO Projects will benefit from the results of the survey to develop a nutritious and healthy mid-day meal at the workplace. It will take 30-45 minutes to complete the interview. There is no physical, social or psychological risk on you as well if you like to participate. You will not get any financial benefit for the interview.

I hope that you will participate in this survey since your views are important. At the time or after the interview, if you want to know about any issue regarding this survey, you can contact over following telephone numbers 01_____

Now, if you agree to participate, I would like to ask you some questions about your perception, knowledge, and practice related to nutritious diet and safe food.

RESPONDENT AGREES TO BE INTERVIEWED	1 ↓	RESPONDENT DOES NOT AGREE TO BE INTERVIEWED →	2	END

Respondent's Signature: _____

Witness's Name and Signature: _____

Interviewer's/ Facilitator's Name:
_____

Date _____/_____/_____

A. General Information

Name of the Area (EPZ/Non-EPZ)		Name of the Factory/Industry	
Name of the Respondent			
Name of husband/wife/father			
Name of Interviewer		Sign of interviewer	
Name of Supervisor		Sign of supervisor	
Name of data Editor		Sign of data editor	
Name of data entry operator		Sign of data entry operator	
Date of interview	d d m m y y	Start Time of interview	/ AM/ PM
Form completion status	Completed……..1 Incomplete……..2 Refused……3		

No.	Questions & Filters	Coding Categories	Code	Skip
1	Respondent's age (Year)	_____**Years**		
2	Service designation	Helper	1	
		Assistant Supervisor	2	
		Super visor	3	
		Quality Inspector	4	
		Others_____		
3.	Job section	Cutting	1	
		Sewing	2	
		Finishing	3	
		Quality Inspection	4	
		Others_____		
4.	How many years are you in this job/factory?	_____ Years		
5	How many years are you in this profession?	_____ Years		
6	What is your marital status?	Married	1	
		Unmarried	2	
		Divorced	3	
		Widow	4	

7	Current address:			
8	What is your permanent address?	**Village:** **Upazila:** **District:** **Division:**		

B: SOCIO-DEMOGRAPHIC CHARACTERISTICS

No.	Questions & Filters	Coding Categories	Code	Skip
Household and Respondent Characteristics				
9	Have you ever been to school?	Yes	1	
		No	2	→ 11
10	Which is the highest class that you have passed?	……...(class)		
11	What religion do you follow?	Islam	1	
		Hindu	2	
		Bouddho	3	
		Christian	4	
		Others (specify…)	97	
12	How many members are in your family?	_____		
13	How many earners are in your family?	_____		
14	What is your average monthly income?	Main Salary _____Taka Overtime _____Taka		
15	What is your household's average monthly income?	_____ (BDT)		
16	On an average how many hours did you work?	_____(hour)		
17.1	While working here did you send money or any other things to your home?	Yes No	1 2	
17.2	If yes, on an average how much money/things did you send in a month?	_____(taka)		

C. Food and Non-food Expenditure

Food Expenditure (Last 1 month)

18.	Food Expenditure	Price per unit (taka)	Total Expense	Purchase from: Fair Price/traditional market (1=Yes; 2=NO)		19.	Non-food Expenditure	Price per unit (taka)	Total Expense
18.1	Rice					19.1	House Rent		
18.2	Wheat					19.2	Transport		
18.3	Flour					19.3	Study		
18.4	Pulses/Dal					19.4	Entertainment		
18.5	Cooking oil					19.5	Clothing		
18.6	Leafy vegetables					19.6	Others		
18.7	Vegetables								
18.8	Meat/Egg/Milk								
18.9	Fruits								
18.10	Fish (big)								
18.11	Fish (small)								
18.12	Dry fish								
18.13	Spices								
18.14	Sugar								
18.15	Jaggery								
18.16	Sweets								
18.17	Biscuits								
18.18	Tea-leaves								
18.19	Betel leaves								

18.20	Betel nuts								
18.21	Soft drinks								
18.22	Tea								
18.23	Others (specify)…								
	Total=		Total=				Total=		Total=

D. Dietary Diversity, FIES, 24-h Recall

Dietary Diversity (MDDW, FCS)

	I would like to ask you about all the different foods that you have eaten in the last 7 days. Could you please tell me how many days in the last 7 days you have eaten the following foods?			
	No.	**Questions**	**Ate yesterday? (1= yes; 2=No)**	**How many times in the last 7 days?**
20.1	CEREALS	Rice, Bread, wheat, Sorghum, Semolina, Millet or Corn, Maize, Barley, Whole-grain, Rice flakes any other grains or foods made from these		
20.2	WHITE ROOTS AND TUBERS	Potatoes, white potatoes, white yam, white cassava, Radish or other foods made from roots.		
20.3	DARK GREEN LEAFY VEGETABLES	Alligator weed, Agathi, Amaranth red, Amaranth green, Beet greens leaves, Bottle gourd leaves, Colocasia eaves, dark green, Drumstick leaves, kale, spinach.		
20.4	VITAMIN A RICH VEGETABLES AND TUBERS	Pumpkin, Carrot, Squash, or Sweet potato that are orange inside, Red sweet pepper		

20.5	OTHER VEGETABLES	Tomato, Eggplant, Onion,		
20.6	VITAMIN A RICH FRUITS	Ripe mango, Ripe palm, Black berry, Cantaloupe, Apricot (fresh or dried), Ripe papaya, Dried peach, Wood apple, Pomelo, and 100% fruit juice made from these, dewari, zamburia, water melon etc.		
20.7	OTHER FRUITS	Banana, Dates fruits, Pineapple, jackfruits, lychee, Ripe gaub, Guava, including 100% fruit juice made from these.		
20.8	ORGAN MEAT	Liver, Kidney, Heart or other organ meats or Blood-based foods		
20.9	FLESH MEATS	Beef, Lamb, Goat, Chicken, Duck, other birds,		
20.10	EGGS	Eggs from chicken, duck, guinea fowl or any other egg		
20.11	FISH AND SEAFOOD	Fresh or dried fish or shellfish, Barb, Catfish, Climbing perch, indigenous, Catla, Clown knifefish, Catla, Mrigal, Rohu Fish, Shrimp, Tilapia, fish eggs, Mussel/Clam, Pangas.		
20.12	LEGUMES, AND SEEDS	Dried beans, Dried peas, Lentils, Green gram, Grass pea, Soybean, Seeds or foods made from these hummus,		
20.13	NUTS	Nuts, peanut, almonds, pistachios, cashews, seeds, bean seed, pumpkin seed, jackfruit seed or foods made from these like peanut butter.		
20.14	MILK AND MILK PRODUCTS	milk, Butter, Cheese, Yogurt, Sour cream, Whey, Ice cream or other milk products		
20.15	OIL	Foods containing oil/fat/butter		
20.16	SUGAR	Sugar, gur, molasses (or foods containing these items)		

No.	Questions & Filters	Coding Categories	Code	Skip
21	Yesterday, how was your food?	As usual Festival Sick	1 2 3	
22	What is your health condition, (if women worker)?	Normal Pregnant Lactating N/A	1 2 3 96	
23	Do you take IFA supplements, (if women worker)?	Yes No N/A	1 2 96	

24. Dietary intake by 24-hour recall method (First)

Eating time (Code)	Food Menu Description	Food type (code)	Portions /Serving size	Name of ingredients	Cooked weight	Yield Factor (YF) for Cooked weight (1 for raw weight)	Food Code (FCT)	Final weight (gram)

Code:								
Eating time: 1= Break fast 2= Lunch 3= Dinner 4= Snacks	**Food type:** 1= Raw 2= boiled/mashed 3= fried 4= bhuna/chochori 5= Curry 6= Readymade food							

25. What are your favorite foods?

Food	**Food Name**	**Frequency of eating** 1= Regular 2=Sometimes 3=Occasionally	**If the previous answer is 2/3, what is the reason?**
Leafy vegetables			
Vegetables			
Fish			
Meat			
Pulses			
Fruits			
Roots and tubers			

E: Anthropometry

26.	**Height (cm)**	**Weight (Kg)**	**Weight status** **1=Empty Stomach** **2= After food**	**Measurement of Mid Arm Circumferences (MUAC) (mm)** **[If the worker is pregnant]**	**Measurement status?** **1=Yes** **2=No** **3= Sick** **4= not willing** **5=Other**
1					
2					
3					
Average					