



University of  
**Southern  
Queensland**

**THE EFFECT OF MATERNAL EMPLOYMENT ON  
CHILDREN'S DIETARY HABITS, PHYSICAL  
ACTIVITY, AND SEDENTARY BEHAVIOUR**

A Thesis submitted by

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## **ABSTRACT**

Maternal employment could affect children in two ways: reducing time on household activities centred on children's diet, physical activity and sedentary behaviour; and increasing family income which may change food habits, facilitate organized physical activity or affect sedentary behaviour. In higher-income countries, research suggests that maternal employment negatively affects children's diets and physical activity, whereas sedentary behaviour increases. However, little is known about this relationship outside the higher-income countries. Hence, this Ph.D. research aims to examine the patterns of diet, physical activity, and sedentary behaviour of children (6-18 years) of mothers differing in employment status. One systematic review and three empirical research were conducted. The systematic literature review concluded that employed mother's children had poorer dietary patterns and increased sedentary behaviour; however, their children were more physically active. Findings also suggest that research related to maternal employment and children's lifestyle variables are scarce in upper and lower-middle-income countries. Using semi-structured interviews [n=22], Study 2 explored mothers' experiences, views, influences, and barriers concerning children's diet and activity patterns. This qualitative study shows how mothers' time for family, income, and the overarching socio-cultural environment influence children's diet, physical activity, and sedentary behaviour in urban Bangladesh. These findings demonstrate that although employed mothers were aware of their children's diet, and activity patterns, they often felt compromised regarding their children's diet and activity behaviours. Using cross-sectional survey data, the Study 3 examined dietary patterns and physical activity, and Study 4 examined sedentary behaviours of children and adolescents. The cross-sectional survey (Study 3) found insufficient fruits, vegetables and protein consumption, low skipping breakfast but daily milk intake among children and adolescents. Low-to-Moderate Intensity Physical Activity (LMPA) was common among children and adolescents. Study 4 highlighted high prevalence of sedentary behaviour during COVID-19 lockdowns, with boys and adolescents being more sedentary than girls and younger children. A child's sex and age seemed to be important determining factors of diet and activity patterns. Together, the four studies provide new perspectives on diet and activity behaviours of children and adolescents of employed mothers in the context of LMICs (Lower-middle income countries). The qualitative study found that maternal employment influences children's diet and activity patterns, although, cross-sectional studies found no association of children's diet, physical

activity and sedentary behaviour with maternal employment status, suggesting the need for further quantitative research using a large-scale cross-sectional survey data.

## CERTIFICATION OF THESIS

I Sabiha Afrin declare that the PhD Thesis entitled “*The effect of maternal employment on children’s dietary habits, physical activity, and sedentary behaviour*” is not more than 100,000 words in length including quotes and exclusive of tables, figures, appendices, bibliography, references, and footnotes. This Thesis is the work of Sabiha Afrin except where otherwise acknowledged, with the majority of the contribution to the papers presented as a Thesis by Publication undertaken by the student. The work is original and has not previously been submitted for any other award, except where acknowledged.

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## STATEMENT OF CONTRIBUTION

This thesis includes four research papers, which have been completed almost entirely by the candidate, Sabiha Afrin (School of Health and Medical Science, Centre for Health Research, University of Southern Queensland). The candidate served as the study's principal investigator and is the first author of all the articles. She also recruited study participants and oversaw data collection, analysis, and interpretation. The following people also contributed to each of the studies (unless otherwise specified):

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**Paper 1: Afrin, S.**, Mullens, A.B., Chakrabarty, S., Bhoumik, L., Biddle, S. J.H. (2021). Dietary habits, physical activity, and sedentary behaviour of children of working mothers: a systematic review. *Preventive Medicine reports*, 24, <https://doi.org/10.1016/j.pmedr.2021.101607>

The candidate contributed 80% to the planning, concept development, analysis, drafting, and revising of the final submission; Amy Mullens, Sayan Chakrabarty, Lupa Bhoumik and Stuart J. H. Biddle contributed the other 20% to the concept development, analysis, editing and providing important technical inputs.

**Paper 2: Afrin, S.**, Mullens, A. B., Sarker, M.G.F., & Biddle, S. J.H. (2022). Diet, physical activity, and sedentary behaviour of children of employed and not-employed mothers: A qualitative exploration in Bangladesh. Submitted to the journal PLoS ONE.

The candidate contributed 70% to the planning, concept development, analysis, drafting and revising of the final submission; Amy Mullens and Stuart J. H. Biddle (25%), and Sarker

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**Paper 4: Afrin, S., Mullens, A.B., Chakrabarty, S., Biddle, S. J.H. (2022).** Sedentary behaviour of children during the COVID-19 pandemic and their association with maternal employment in Bangladesh: A cross-sectional study. Submitted to the journal “PloS ONE”. Now under revision.

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**DEDICATION**  
**TO MY LOVING PARENTS**



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## **ABBREVIATIONS**

DP	Dietary patterns
PA	Physical activity
SB	Sedentary behaviour
HICs	High income countries
LMICs	Low-to-middle-income countries
UMIC	Upper-middle-income countries
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
METs	Metabolic equivalent task
WHO	World Health Organization
BMI	Body Mass Index
LMPA	Low-to-Moderate Intensity Physical Activity
MVPA	Moderate-to-Vigorous Intensity Physical Activity
TV	Television

# CHAPTER 1: INTRODUCTION

## 1.1. Overview of chapter

The purpose of this chapter is to define key concepts and provide a rationale for the research conducted in this thesis. Concepts of dietary patterns, physical activity and sedentary behaviour are defined, and the evidence of health effects of these lifestyle behaviours on children and adolescents is reviewed. The status of dietary patterns (DP), physical activity (PA) and sedentary behaviour (SB) of children and adolescents (6-18 years) in low-to-middle-income countries (LMICs) and their associations with maternal employment is also reviewed. At the beginning, a definition of children that we consider for this thesis is provided.

## 1.2. Children and adolescents

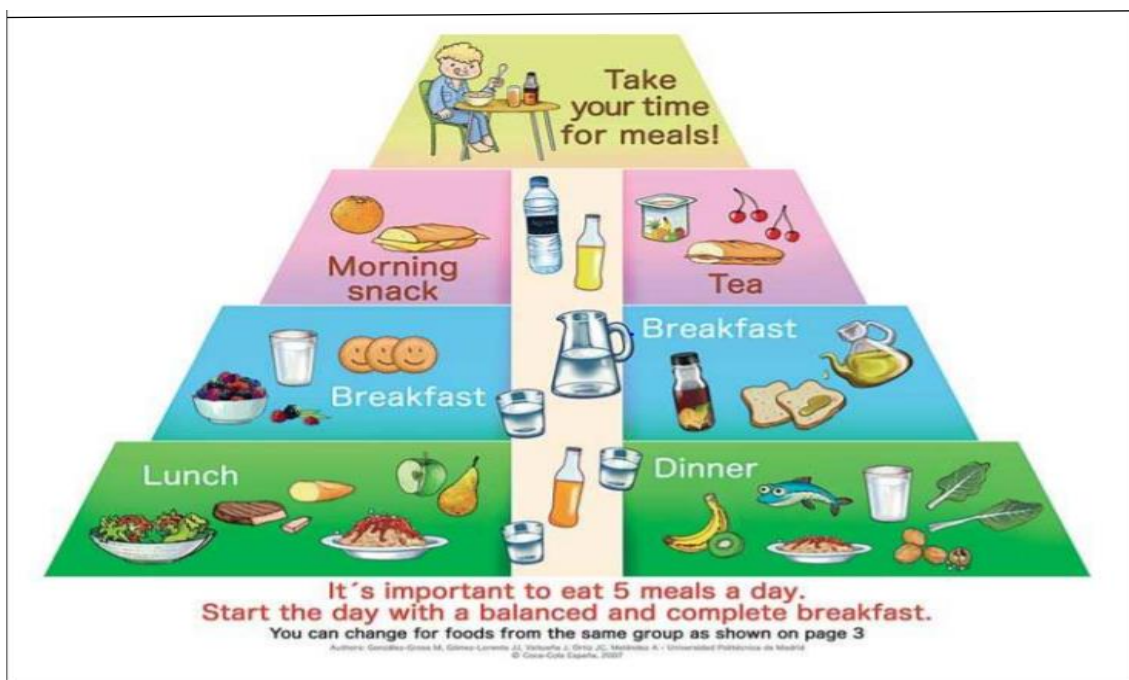
UNICEF (2019) defines children as individuals below the age of 18 years, which is consistent with the National Child Policy (2011) of Bangladesh. However, this definition varies across different laws. The Children Act of 1974 considers a person under 16 years old as a child. In this thesis, we will refer to individuals aged 6-18 years as children. Further, children (aged 6-18 years) were divided into two groups- 'children' (6-12 years) and 'adolescents' (13-18 years). Because children and adolescents undergo distinct physical and mental developmental stages. Dividing them into two separate age groups, 'children' and 'adolescents', while studying diet, physical activity, and sedentary behaviour, offers the ability to capture age-specific trends and behaviours, as well as to conduct a precise analysis of how age impacts these health behaviours. This division also contributes to a better understanding of how these health behaviours evolve over time. Additionally, interventions and precise recommendations to meet the specific needs of each group can lead to more effective results.

## 1.3. Dietary patterns, physical activity, and sedentary behaviour: a brief review

### Dietary patterns

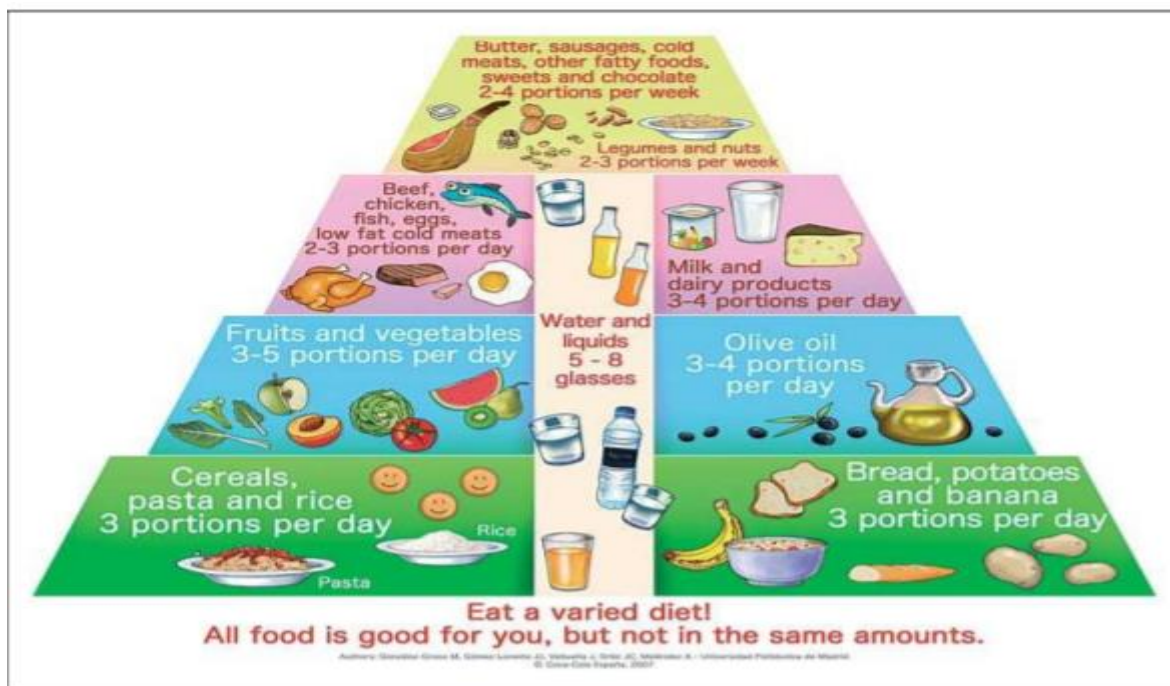
There is no clear consensus about the definition of dietary patterns. Generally, the quantity, variety, or combination of different foods and beverage in a diet and the frequency with which they are habitually consumed is defined as dietary patterns (Michels & Schulze, 2005). Hu (2002) defined dietary patterns as a comprehensive picture of food and nutrient consumption (Hu, 2002). Numerous factors influence people's food choices, but socioeconomic and demographic aspects are among the most important and have received the

most focus (Mello et al., 2020; Mertens et al., 2018). Dietary patterns might be different between regions depending on the typical products, food culture, traditions, and geographical and ecological environment. Even the dietary practices within the same country can vary significantly, as well as differ substantially among individuals. Again, a particular combination of foods that is suitable for adults may not be good for children or adolescents. The nutritional needs and daily activity plan of children are different from adults. González-Gross et al., (2008) propose the ‘Healthy Lifestyle Pyramid’ which is specifically developed for children and adolescents considering recent knowledge and evidence of daily dietary intake, physical activity, and food guide [Figure 1.1(a) and Figure 1.1(b)]. Authors have assumed that following these guidelines will benefit children by reducing the poor health risk factors and promoting healthy growth into adulthood.



**Figure 1.1 (a)** Face of the pyramid: daily food intake [Source: González-Gross et al.,2008]





**Figure 1.1 (b)** Face of the pyramid: food guide for children and adolescents [Source: González-Gross et al.,2008]

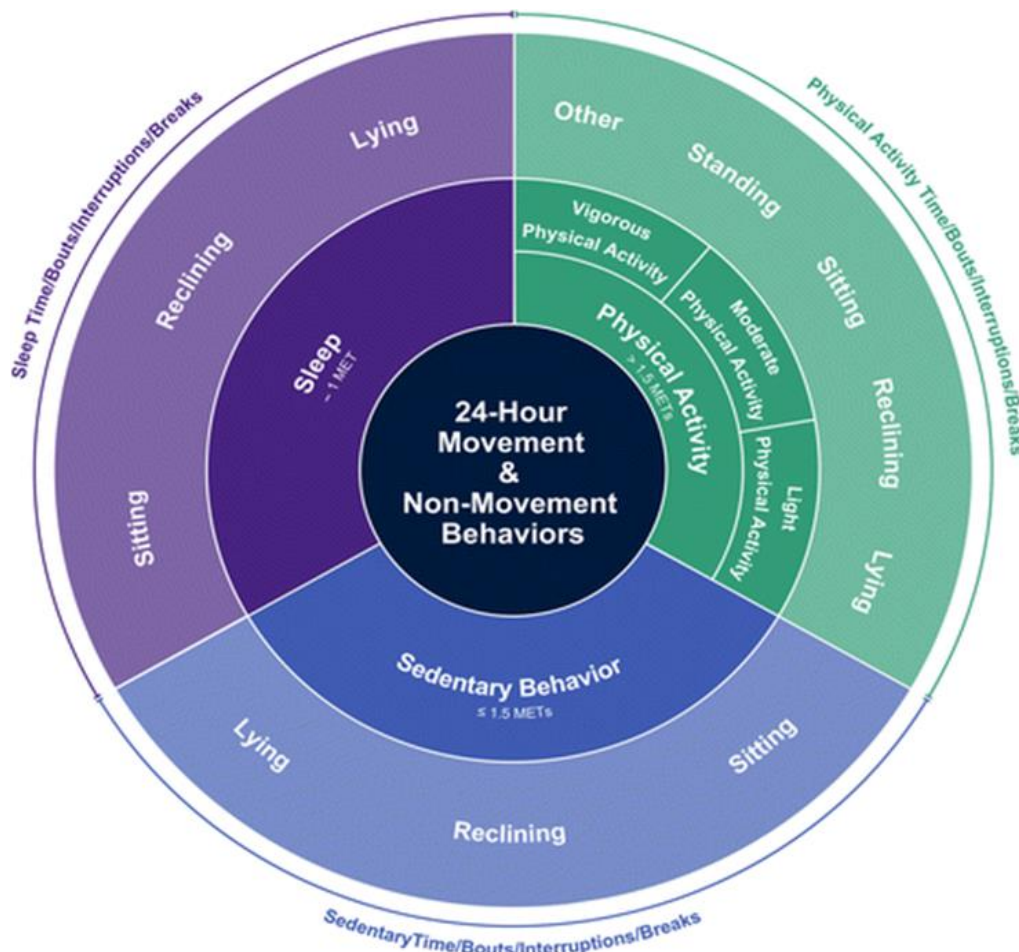
**Physical activity:** Any movement of the body that involves skeletal muscles and requires energy expenditure is referred to as physical activity (Caspersen et al., 1985; Miles, 2007; WHO 2020). Physical activity is a compound, multi-dimensional action. According to the World Health Organisation’s (2020) guideline, it may occur in different modes such as, household (caregiving, household chores), transport (e.g., walking or cycling to work) and/or leisure-time activities (e.g., dancing, swimming) (WHO, 2020). Physical activity can be further classified in terms of the frequency, duration, and intensity of the activity. Frequency and duration refer to how often and how long an activity is performed. Intensity refers to how hard a person is working or the rate of energy expenditure that an activity demands.

Physical activity stimulates the body's cardiorespiratory, musculoskeletal, and metabolic systems over time and become more productive resulting in higher physical fitness (Miles, 2007). Inadequate physical activity has several adverse health outcomes including lower life expectancy. Worldwide, insufficient physical activity causes 6-10% of the major non-communicable diseases of coronary heart disease, type 2 diabetes, and breast and colon cancers (Lee et al., 2012). The global economic burden of insufficient physical activity is enormous, including US\$53.8 billion for health care costs and US\$13.7 billion in productivity loss due to death related to physical inactivity (Ding et al., 2016). Additionally, the lack of physical activity is the fourth leading cause of deaths in the world (Kohl et al.,

2012). Lack of physical activity is therefore identified as an emerging and critical public health concern over the past decades (Lee et al., 2012).

**Sedentary behaviour:** Sedentary behaviour refers to any waking behaviour characterized by a prolonged time spent in sitting, reclining, or lying posture with an energy expenditure  $\leq 1.5$  metabolic equivalent task (METs) (Tremblay et al., 2017). There are some differences between physical inactivity and sedentary behaviour (Ng & Popkin, 2012; Tremblay et al., 2017). The former refers to performing insufficient moderate-to-vigorous physical activity (MVPA) to meet physical activity recommendations, whereas sedentary behaviour includes behaviours which cause little or no movement while not standing (e.g., sitting at a desk; travelling in a car, bus or rickshaw, reading; writing; working on a computer; sitting, or lying down while watching television or playing electronic games). Figure 1.2 is a representation of the overall conceptual model of terminology based on movement, organised around a 24-hour cycle (Tremblay et al., 2017). The movements are collapsed into two components. The primary areas of behaviour that use energy expenditure are represented by the inner circle. The outer circle uses posture to represent general categorizations.

Increasing evidence has shown that the amount of time spent in front of a computer screen or TV goes up systematically with age, and this has a negative impact on health-related quality of life (Stiglic & Viner, 2019) and a wide-ranging adverse impact on health, including cardiovascular disease, type 2 diabetes mellitus, overweight and obesity, high blood pressure, cancer, and all-cause mortality (Ekelund et al., 2018; Park et al., 2020).



**Figure 1.2** A conceptual model of movement-based terminology [Source: (Tremblay et al., 2017).]

#### 1.4. Children and adolescents' health behaviours

Adequate dietary intake is important to all and is of vital importance to children's growth and development. Both excessive and inadequate dietary intake or nutrients may have detrimental influence on children's health and create susceptibility to diet-related diseases, such as hypertension, obesity, osteoporosis, type 2 diabetes mellitus, obesity, and some aspects of mental health in adulthood (Das & Horton, 2012; Lee et al., 2012; Raynor et al., 2012). A recent study used data of 195 countries from 1990-2017 and concluded that, suboptimal dietary intakes is the one of the independent risk factors responsible for more deaths in the world than any other causes (Afshin et al., 2019).

An active lifestyle offers significant health benefit and mitigates health risk. It is recommended that children and adolescents should participate in at least an average of 60 minutes of moderate to vigorous-intensity physical activity daily, across the week (Bull et al.,

2020; WHO, 2020). Health outcomes of physical activity for children and adolescents include improved physical fitness (cardiorespiratory and muscular fitness), cardiometabolic health (blood pressure, dyslipidaemia, glucose, and insulin resistance), bone health, cognitive outcomes (academic performance, executive function), mental health (reduced symptoms of depression), and reduced adiposity (WHO, 2020). On the contrary, sedentary behaviour is associated with adverse health outcomes of children and adolescents including adiposity and metabolic risk (Ekelund et al., 2006), poor fitness and chronic diseases in later life (Biddle et al., 2010; Hancox et al., 2004), as well as shorter sleep duration (Saunders et al., 2022). Again, negative health effects of sedentary behaviours are distinct from those related to insufficient physical activity (Raynor et al., 2012). Yet, children and adolescents are not following the recommended healthy eating (Savidge et al., 2007; UNICEF, 2020), physical activity patterns (Guthold et al., 2019; Strong et al., 2005), or sedentary behaviour (WHO, 2020). It was found that 81% of adolescents across the world have insufficient physical activity and prolonged sedentary behaviour and did not meet the 2010 WHO recommendations (Guthold et al., 2019). According to the authors (Guthold et al., 2019), 77.5% of South Asian girls and 72.1% of boys do not meet recommended physical activity guidelines. Trend data did not show any global improvement during the past decade (Rodriguez-Ayllon et al., 2019).

### **1.5. Measures of dietary patterns, physical activity, and sedentary behaviour**

The measurement of health behaviours such as dietary intake, physical activity, and sedentary behaviour is a necessary but difficult undertaking in research settings. Measuring dietary intake can be difficult because it depends on heterogeneous factors, such as eating habits, occasions, preferences, and tastes, variety, and varying food storage facilities and equipment accessible to different people (Espinel, Paola, & King, 2009).

Typically, diet, physical activity, and sedentary behaviour have been assessed using some form of self-report instrument, including a food diary for diet. More recently, body-worn devices can detect these behaviours, including certain nutrition and energy intake patterns (Farooq & Sazonov, 2016), movement (Troiano et al., 2008), and posture (Atkin et al., 2012; Chastin & Granat, 2010). Both types of approaches have advantages and disadvantages.

It is challenging to evaluate all kinds of sedentary behaviour simultaneously since they manifest in various contexts (such as leisure, work, and transportation) and as various types

(such as computer work, TV watching, and video game play). Available methods of measuring physical activity and sedentary behaviour comprise self-report, parental report, and observation, as well as wearable technology. Accelerometers and wearable cameras are more valid and reliable instrument compared to self-report to measure sedentary behaviour (Atkin et al., 2012). Though, the use of these instruments is very frequent in the studies of physical activity and sedentary behaviour, they cannot provide information on the motives for these behaviours. An overview of the instruments and methods that are commonly used to measure the dietary patterns, physical activity and sedentary behaviour research in children and adolescents are shown in Table 1.1.

**Table 1.1: Measures of health behaviour in children and adolescents: strengths and limitations**

Type of measures	Instrument	Methods	Strengths	Limitations	
<b>Dietary patterns</b>					
(Self-) Reported Assessment methods (Fontana et al., 2020; Thompson & Subar, 2017)	1. Self-reported	Questionnaire (e.g., 24-h diet recalls, food frequency questionnaire)	Keep records of foods within a certain period	Minimal burden on respondents  Validated methods available  Provide information on number of servings, portion size, cooking method, and brand name of commercial products  Relatively simple, cost-effective, and time-efficient	Recall bias  Underreporting is common  Require a high level of motivation of respondents  Time consuming for participants
	2. Ecological Momentary Assessment	Use of diaries (at specific duration of times) to record more information	Repeated real-time assessments of data over a certain period	Suitable for large-scale epidemiological studies	Time consuming

Type of measures	Instrument	Methods	Strengths	Limitations
(EMA) (Kwasnicka et al., 2021; Martin et al., 2012; Maugeri & Barchitta, 2019; Moskowitz & Young, 2006)	about diet and location characteristics (e.g., Photographic food records)		Real-time assessments  Accuracy of information/ eliminate bias associated with retrospective recall  The repeated sampling allows to define current behaviours and experiences Ensure data quality and reduce missing data	There is no check on the accuracy of the data
Devises-based measures	Electronic sensor/ wearable device for food intake (Farooq & Sazonov, 2016; Fontana et al., 2020)	A wearable device	A wearable device that consists of a sensor can detect food intake even when the user is physically active and/or talking	Automatic detection of food intake  Potential for the collection of longitudinal dietary intake data.

Type of measures	Instrument	Methods	Strengths	Limitations
			<p>Need for participant literacy or cognizance of food choices</p> <p>Significantly reduce participant burden and negate some of the pitfalls of self-report.</p>	
<b>Physical activity</b>				
(Self-) Reported measures (Loprinzi & Cardinal, 2011)	1.Self-reported, proxy report from parents and teachers	Questionnaires	Keep records of physical activity within a certain period	<p>Provide information on the type and context</p> <p>Able to measure physical activity in a large sample</p> <p>Interpretation, recall, and social desirability biases.</p> <p>Overestimate the time and intensity of physical activity.</p> <p>Low reliability and validity in some cases</p>



Type of measures	Instrument	Methods	Strengths	Limitations
2. Ecological Momentary Assessment (EMA) (Dunton, 2017; Kwasnicka et al., 2021)	Smartphones etc	Gather self-reported real-time information	<p>Time-intensive approach.</p> <p>Provides information on behaviours, contexts, emotional states, beliefs, attitudes, and perceptions.</p> <p>Reduce recall errors and biases and enhance ecological validity.</p> <p>Collects more proximal to the time and place that behaviour is occurring.</p> <p>Collect data quickly from large sample</p>	Not suitable for younger children
Devises-based measures	A wearable device (e.g., heart rate, accelerometry, pedometers, direct	Tracking the participant's heart rate during physical	Provide information on frequency, intensity, and	May introduce measurement error

<b>Type of measures</b>	<b>Instrument</b>	<b>Methods</b>	<b>Strengths</b>	<b>Limitations</b>	
(Loprinzi & Cardinal, 2011)	observation, doubly labelled water)	activity/ accelerometers record the frequency and magnitude of the body's acceleration during movement/ estimates the number of steps taken over a given period.	duration of physical activity.  Relatively inexpensive and unobtrusive.	Time-consuming and labour-intensive process	
<b>Sedentary behaviour</b>					
(Self-) Reported measures (Atkin et al., 2012; Kwasnicka et al., 2021)	1.Self-reported, proxy report from parents and teachers	Questionnaires	Keep records of sedentary behaviours (time spent watching TV, computer use, playing electronic games etc.) within a certain period	Provides information on type, duration, and context of activity (e.g., physical location, social environment) Ability to measure large samples	Requires validation against 'objective' measures  Recall bias is common  Not suitable for younger children  Social desirability biases

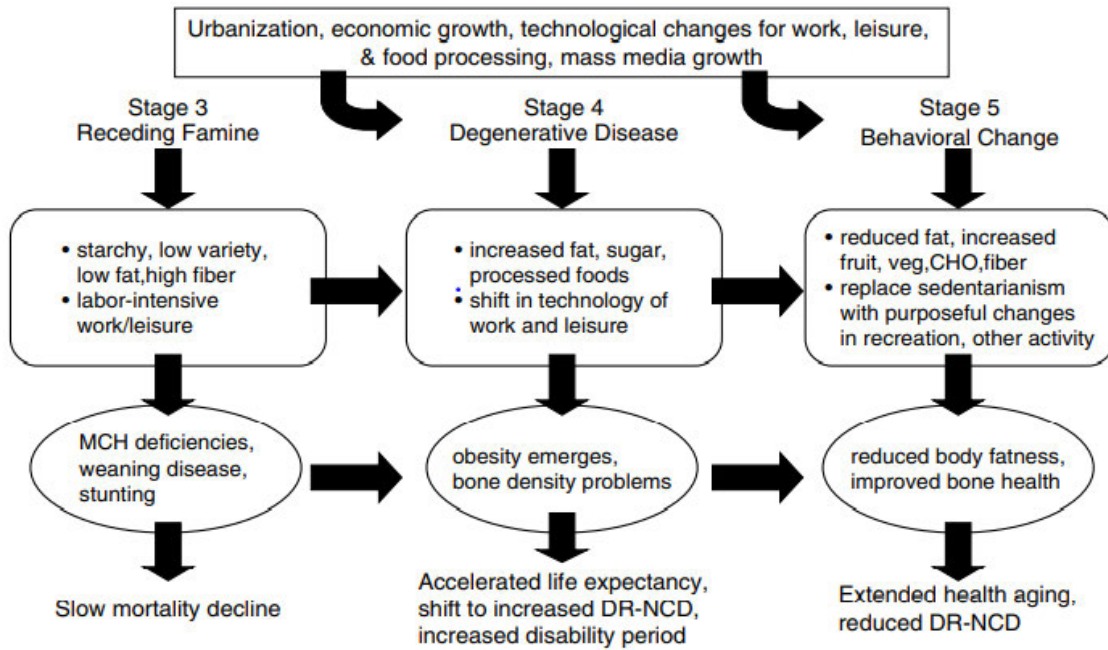
<b>Type of measures</b>	<b>Instrument</b>	<b>Methods</b>	<b>Strengths</b>	<b>Limitations</b>
2.Ecological Momentary Assessment (EMA)	Devices (e.g., mobile phones)	Gather self-reported real-time information	Allow insights into the context of behaviours, including where and with whom they are occurring	Low validity and unknown reliability Cost can be low to high, depending on devices used Burdensome to participants, prompts can disrupt the actual activity of interest, difficult to gather total sedentary behaviour
Devises-based measures (Atkin et al., 2012)	A wearable device (Heart rate monitoring, accelerometer, pedometers, direct observation, doubly labelled water)		Provide information on frequency, intensity, and duration of physical activity.  Relatively inexpensive and unobtrusive.	It may introduce measurement error Wearing the device may be difficult Time-consuming and labour-intensive process

## **1.6. Dietary and activity patterns of children and adolescents in low- and middle-income countries (LMICs)**

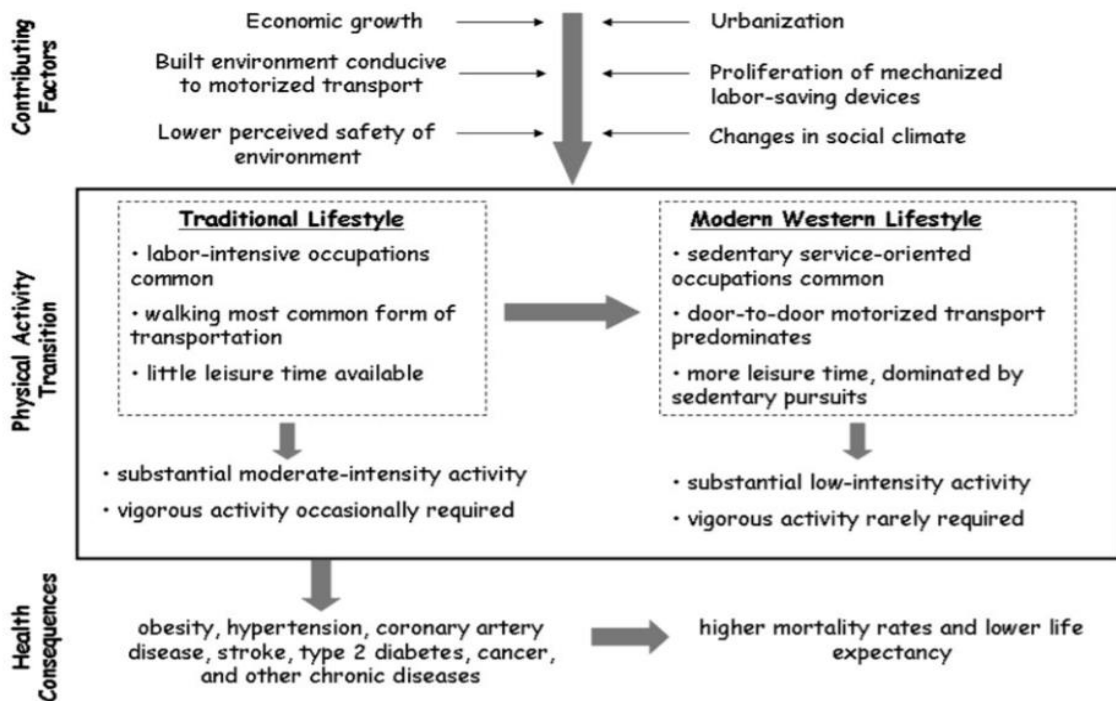
According to the United Nations (2020), worldwide, the number of children and adolescents (aged 0-14 years) comprised 1.98 billion in 2020, and this number has been projected to reach 2.6 billion by 2050. In LMICs children and adolescents comprise 31% of the total population (United Nations, 2017). However, health and health-related behaviours of young people in LMICs have not been considered a priority and largely been under studied (Goodburn & Ross, 2000; Hallal et al., 2012). Important health problems and risk factors for disease in later life emerge during adolescence, yet the health of young people often gets less attention as they are considered healthy (Gore et al., 2011). Compared to within high-income countries, young adults in LMICs are largely neglected or receive less priority than other age groups in terms of public health investments, and efforts to improve health (Goodburn & Ross, 2000; Gore et al. 2011). Many LMICs are passing through the phases of urbanization and globalization which are assumed to bring change in the dietary structure as well as general lifestyle (Hovhannisyanyan & Devadoss, 2018; Regmi & Dyck, 2001). The new dietary habits reflect western patterns, reduced demand for grains and fat, and exhibit a strong preference towards meat or fish, egg, seafood, dairy products, and highly processed foods and drinks (Hovhannisyanyan & Devadoss, 2018; Pingali, 2007). Since, dietary habits are developed at a young age, these transformations are most apparent with younger generations and form the habits for adulthood (Mendez & Popkin, 2004). The dietary changes have been accompanied by an increase in sedentary lifestyles that discourage physical activities. Since children and adolescents represent a major proportion of the total population with potential for primary prevention of many health problems, understanding the lifestyle behaviours and the associated factors of young adults in the context of LMICs is acknowledged recently (DiPietro et al., 2020).

In developing countries, the health behaviours have undergone a rapid change in the last two decades of the 20th century. Popkin and his colleagues (Popkin, 2002; Popkin & Gordon-Larsen, 2004) have explained the ‘nutrition transition’ (Figure 1.3) and how changes related to lifestyle, particularly diet and activity levels, have taken place in the societies analogous with the increasing prevalence of obesity and chronic disease. The nutrition transition emphasized how the modern societies seemed to be shifting their diet and activity patterns from a ‘conventional’ or traditional diet to a diet high in saturated fats, sugar, and refined foods but low in fibre (frequently termed as ‘Western diet’) and on lifestyles characterized by

lower levels of physical activity (Popkin & Gordon-Larsen, 2004). These changes are reflected in nutritional outcomes, such as changes in average stature, body composition, and morbidity (Popkin & Gordon-Larsen, 2004). In addition to nutrition, changes have affected levels of physical activity too. Katzmarzyk and Mason (2009) present a physical activity transition model that describes the underlying causes and health effects related to the changes shown by lower physical activity and greater sedentary behaviour (Figure 1.4). The model explains how influences of economic transition and urbanization cause lifestyles to shift from being strongly dependent on physical activity to less physical activity and greater sedentary behaviour. The model also explains the consequences of reallocation of patterns and levels of physical activity, which may result in rising rates of chronic diseases, greater overall mortality rates, and decreased life expectancy (Katzmarzyk & Mason, 2009). Both models explain the important aspects of diet and physical activity patterns that nations deal with during the periods of economic development. According to the model, economic transition, rapid changes in urban environments, technological advancement, industrialization, and material prosperity accelerate the transitions from high active to more sedentary lifestyles, and from 'traditional' to westernised diets. In recent years, studies have found high sedentary behaviour along with low level of physical activity of children in LMICs (Khan & Burton, 2016; Melkevik et al., 2010; Mushtaq et al., 2011; Paudel et al., 2014; Ravikiran et al., 2013; Thapa et al., 2019).



**Figure 1.3** Stages of the nutrition transition. Here, NR-NCD: nutrition-related noncommunicable diseases; CHO: carbohydrate and MCH: maternal and child health. [Source: Popkin & Gordon, 2004]

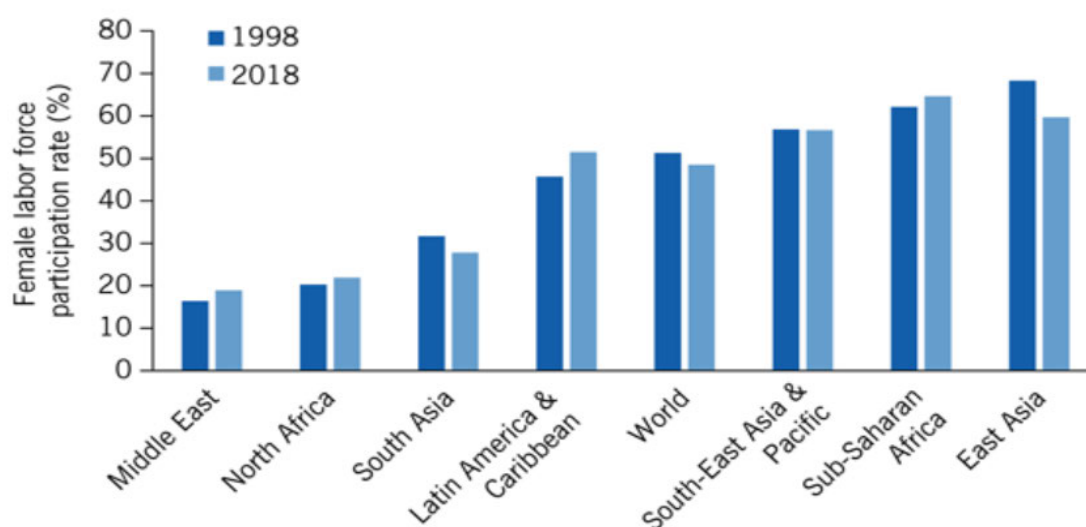


**Figure 1.4** Model of contributing factors and health outcomes associated with the physical activity transition [Source: Katzmarzyk & Mason, 2009]

## 1.7. Rationale for the research project

### 1.7.1. Status of maternal employment in LMICs and in Bangladesh

Female labour force participation is driven by a wide range of factors which include economic growth, education, social norms, and other factors (Verick, 2018). Globally, there has been a visible shift in female labour force participation over the past three decades. Across the globe, female labour force participation rate (age group 15+) has declined from 51.2% in 1990 to 47.3% in 2019 (ILO, 2019) (Figure 1.5). In LMICs countries, women's participation in the labour market is crucial as it is a driver of economic growth (Verick, 2018). However, conservative social attitudes are a hindrance to women's work outside the home in the Middle East, North Africa, and South Asian countries (Gaddis & Klasen, 2014). Marital status is also a significant factor that influence women's decisions regarding labour market participation, because reproductive and care burden are considered an important role primarily for women (Mahmud & Bidisha, 2018). Despite these constraints, 45% women in LMICs have joined in the labour market (The World Bank, 2022).



**Figure 1.5:** Regional estimates of female labour force participation rates (adult population 15 and older) [Source: ILO Statistical Database, ILOSTAT. Available at: <http://www.ilo.org/ilostat>]

In Bangladesh, women's participation rate in the labour force has been changing over the past few decades despite various socio-economic and demographic constraints, such as, lack of opportunity of schooling, and early marriage. The proportionate change of female participation rate in the labour force is higher than that of males over the last decade. At the

national level, women's participation in the labour force has grown from 26.6% in 1990 to 34.5% in 2020 (World Bank, 2022).

### **1.7.2. Dietary pattern, physical activity and sedentary behaviour among children and adolescents and association with maternal employment**

Globally, female labour force participation draws attention to the relationship between maternal employment and children's wellbeing as maternal employment may provide a significant key factor that influences the diet, physical activities and sedentary behaviours of children. Existing research have identified maternal employment as a potential factor that influences children's health behaviours as a whole (Anderson et al., 2003; Anderson, 2012; Baten & Böhm, 2010; Datar et al., 2014). Literature confirms that children of working mothers demonstrate a trend for being overweight due to changing food intake, and patterns of physical activity and sedentary behaviour (Anderson et al., 2003; Anderson, 2012; Baten & Böhm, 2010; Datar et al., 2014).

Evidence suggests that two major consequences of mothers' employment on the family are the 'income effect' (working mothers are contributing financially to the family), and the 'time effect' (they have less time to spend with family members) (Datar et al, 2014). Employed mothers divide their time between work and other activities, including the household. Hence, maternal employment is likely to influence children's welfare as working mothers may spend less time on household activities centred around children, such as children's diet and physical activity (Cawley & Liu, 2012; Bianchi, 2000). Maternal employment increases the demand for processed foods that require shorter preparation times (Regmi & Dyck, 2001) and hence increase the consumption of non-homemade food (Cawley & Liu,2012). Other changes in food intake patterns due to maternal employment include preference for unhealthy and lower nutrient foods (Klesges et al., 1991), consumption fast food meals, skipping meals (e.g., breakfast), or consuming fewer family meals. The frequency of meals and snacks can also either improve or worsen because of increases in household income on the one hand and decrease supervision on the other (Cawley & Liu,2012; Fertig et al., 2009). When mothers work outside of the home, children spend more time with a carer and this may give rise to an increase in sedentary behaviour (Fertig et al., 2009). It is possible that increased family income may facilitate the purchase of fresh and better-quality food, hire substitute care for children as well as availability and accessibility to some physical activities (Brown et al., 2010). Equally, higher purchasing power may influence families to purchase processed



ready-to-eat or ready-to-cook foods which often contain higher saturated fat, sugar, and sodium than foods prepared at home (Poti et al., 2015). In high income countries, the relationship between maternal employment and children's health outcomes in terms of overweight and obesity exhibits a trend for being overweight due to changing food and activity patterns (Anderson et al, 2003; Anderson, 2012; Baten & Böhm, 2010; Datar et al., 2014) while evidence about the relationship between maternal employment status and children's dietary pattern, physical activity and sedentary behaviour in LMICs is largely inconsistent. Family-related policies to support women's employment are well established in the developed countries but are seen to be very poor in LMICs. Even, many developing countries do not follow the ILO standard of 14 weeks duration of maternity leave to support the newborn (Cerise et al., 2013).

Bangladesh provides an optimal setting for research on this topic because of an increasing proportion of mothers who work, and evidence of childhood and adolescent overweight and obesity, especially in urban areas of Bangladesh (Biswas et al, 2017; Bulbul & Hoque, 2014; Khan et al., 2013; Tariqujjaman et al., 2022). In recent years, rate of overweight and sedentary behaviour among school-going children in Bangladesh is very high (Khan et al., 2013; Khan & Burton, 2016). Negative attitudes towards physical activity were also found among young people in Bangladesh (Burton et al., 2020). However, no studies have looked at the association of these lifestyle variables of Bangladeshi children and adolescents with maternal employment status.

## **1.8.Theoretical framework**

Participation in the labour force often imposes double workloads on women, as they are responsible for both household tasks and childcare (Ferrant et al., 2014). An individual's decision is influenced by mainly two resource constraints: a) financial constraint and ii) time constraint. Parents' satisfaction or utility significantly depends on health of their children, assuming that parents are altruistic. The Human Capital Theory and Unitary Household Model provide the complex interplay between maternal employment, household decisions, resource constrains and child health behaviours.

### **1.8.1. Human Capital Theory:**

This theory underscores the role of age, sex, and socioeconomic factors, such as parental education and income, in shaping children's food habits, physical activity, and sedentary

behaviours. These factors impact the opportunities for physical activity, and exposure to sedentary activities in children (Biddle, 2011).

The increase in women's earnings expands the set of possible consumption outcomes and they allocate resources towards physical activity and proper nutrition as an investment in building capital for their child's future health and well-being (Bailey et al., 2013).

### **1.8.2. Unitary Household Model:**

According to the fundamental unitary household model (Becker, 1981), household decisions and behaviours are often made collectively by the household as a single unit, rather than by individual family members. Following Becker's (1981) framework, we have developed a unitary model to explain the relationship between maternal employment and the health behaviours (food habits, physical activity, and sedentary behaviour) of children.

Becker (1981) addresses, as cited in Debela et al., (2020), the effect of an increase in women's income on investments in child human capital in his fundamental unitary household model. This investment decisions occur repeatedly over multiple periods.

According to Debela et al. (2020), during each period, the household wants to maximize utility through consumption and by enhancing the human capital stock of each child.

Assuming that the time that a mother does not spend on the job is dedicated to childcare. The stock of human capital of each child increases when the mother allocates more time and monetary investment to childcare. According to Debela et al. (2020), the return on investments in human capital, in terms of money and time affects the set of employment opportunities, wage and investment in children. This influence works in two ways: i) an income effect and ii) a substitution (time allocation) effect. The income effect results from the increase in family income, which expands the range of available choices. The substitution effect arises as mothers substitute time for work to childcare. When a mother allocates her time to income-generating activities, she may have less time for childcare but gains monetary income, which can be used for healthy food and other healthy activities. Conversely, prioritizing childcare might result in missed income opportunities. This represents a trade-off of time between work and leisure choices, assuming leisure complements childcare time while substituting for work time. The opportunity cost of time spent on childcare is the foregone income from not working, while the opportunity cost of work is the reduced time available for childcare. Time has a direct role in the production of child human capital. The household faces a trade-off between mother spending time with her children, increasing the

utility from child human capital and mother spending time in the labour market, increasing utility from consumption and monetary investments in children. The direction of the combined effect depends on the shape of the utility function and the degree of substitutability between maternal time and monetary inputs in the production of child human capital.

### **1.9. Aim of the research**

This PhD research aims to address key gaps in our understanding of the relationships between maternal employment and children's health behaviours in respect of dietary patterns, physical activity, and sedentary behaviour in a sample of Bangladeshi children and adolescents. This research project will be carried out through four studies to address this aim and associated research gaps. A brief summary of each study is as follows:

**Objective 1:** to map and identify research gaps in the existing literature related to dietary habits, physical activity, and sedentary behaviour of children of working mothers. This is addressed using a systematic review (Study 1).

**Objective 2:** to gain a deeper understanding of mothers' experiences, views, underlying influences, as well as barriers, concerning their children's diet, physical activity, and sedentary behaviour and its links to maternal employment status within Bangladeshi urban families. Qualitative interview and thematic analysis were utilized to conduct this (Study 2).

**Objective 3:** to examine the differences in patterns of dietary intake and physical activity among Bangladeshi children and adolescents (6-18 years) whose mothers are employed. This was addressed using a quantitative cross-sectional survey considering the socio-economic and demographic characteristics and other factors identified in the qualitative study as well as those identified from the literature review (Study 3).

**Objective 4:** to identify the common types and prevalence of sedentary behaviour of children and adolescents during the COVID-19 pandemic in Bangladesh, and to examine the differences by maternal employment status (Study 4).

### **1.10. Overview of thesis**

This thesis consists of 6 chapters. This introductory chapter provides the context of the thesis by highlighting the gaps in the current evidence base on dietary patterns, physical activity, and sedentary behaviour of children and adolescents (6-18 years old) in Bangladesh. Chapters 2-5 comprise the four studies described above. Chapter 6 provides an overall discussion and

conclusion of key findings from this research. This is done in the context of the current evidence and considers how the results can inform strategies to benefit Bangladeshi mothers and their children. It also describes the strengths and limitations of the research.

The studies presented in this thesis have been disseminated through conference presentations and published papers.

## CHAPTER 2: LITERATURE REVIEW

### **Study 1: Dietary habits, physical activity, and sedentary behaviour of children of employed mothers: A systematic review**

This systematic literature review was peer-reviewed and was published in Preventive Medicine Reports on 22 October 2021.

<https://doi.org/10.1016/j.pmedr.2021.101607>

#### **2.1. Introduction**

Systematic literature reviews are particularly important in areas where research emerges rapidly, current evidence is not consistent and new research has the potential to alter policy or practise decisions. The systematic literature review is a scientific and highly informative way to systematically collect, review, and synthesize research findings on a particular topic (Paul et al., 2021). This review was conducted to examine the state of the current literature examining the effects of maternal employment on young people's dietary patterns, physical activity, and sedentary behaviour. Because, globally women employment trend is rising (WDI, 2017) and given this situation, studies have been evaluating the role of maternal employment status on children's wellbeing as mothers are considered the principal caregivers of children. Evidence from High income countries (HICs) confirms that children of employed mothers demonstrate a change in food intake, physical activity and sedentary behaviour patterns (Baten & Böhm, 2010; Datar et al., 2014; Anderson et al, 2003; Anderson, 2012) while findings of studies linked to LMICs are mixed. Therefore, this systematic review aimed to map and identify the research gap in the existing literature related to dietary habits, physical activity and sedentary behaviour of children of employed mothers.

In this thesis, this systematic review is of primary importance as it was instrumental in shaping and informing the direction of the research described in later chapters.



## Dietary habits, physical activity, and sedentary behaviour of children of employed mothers: A systematic review

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Sedentary behaviour (SB)

### ABSTRACT

Since approximately 40% of the global workforce are women, a comprehensive understanding of association of maternal employment with child dietary patterns, physical activity and sedentary behaviour needs more focus. This systematic review aims to identify the association between maternal employment and dietary patterns (DP), physical activity (PA) and sedentary behaviour (SB) of children and adolescents (6 to 18 years). Searches were performed using electronic databases and manual searches. Peer reviewed journal articles, conference papers, theses at masters/doctoral levels in English were included. A total 42 studies met selection criteria, which indicated associations between maternal employment and at least one of the domains of interest: DP, PA and/or SB. Using individual samples of analysis, it was found that, 9 samples of DP, 11 samples of PA and 12 samples of SB were positively correlated with maternal employment, whereas 25 samples of DP, 5 samples of PA and 5 samples of SB showed an opposite association. Results suggest that PA and SB were positively related with maternal employment, whereas DP had an inverse relationship. Findings from this review provide evidence that children of employed mothers had poorer DP and greater prevalence of SB, however, their children are more physically active. Future interventions need to create a positive environment at the workplace and for families to support employed mothers and improve children's dietary patterns and decrease sedentary behaviours. Future studies should prioritise the domains of DP, PA and SB that have been studied inadequately and have inconsistent results.

### 1. Introduction

Two important worldwide trends can be identified in recent years: increasing prevalence of childhood overweight/obesity and increasing participation of women in the paid labour force. Childhood obesity is an emerging salient public health challenge of the 21st century (WHO, 2020). Childhood obesity is risky as it has strong associations with likelihood of adult obesity, which has led to the increasing risk of morbidity, including non-communicable diseases (NCDs) such as cardiovascular disease, type 2 diabetes mellitus, some cancers, poor skeletal health, and some aspects of mental health (Biddle et al., 2004; Das

and Horton, 2012; Lee et al., 2012; Wolin et al., 2010).

According to World Development Indicator (World Bank, 2020), worldwide female employment rate increased substantially in the last century. Employment creates a double burden for women as they often take the family responsibilities of unpaid household tasks and childcare due to traditional division of labour. Balancing with daily multiple roles and responsibilities, employment may impact upon the wellbeing of children if, as hypothesized, employed mothers spend less time on household activities centred on children, such as children's diet and physical activity (Bianchi, 2000; Cawley and Liu, 2012). However, employment may contribute to greater economic opportunities and

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resources, which may also enhance health and wellbeing (Waddell and Burton, 2006).

Literature from the USA (Datar et al., 2014; Anderson et al., 2003), U.K. (Hawkins et al., 2008), Canada (Chia, 2008) and Germany (Baten and Böhm, 2010) have demonstrated that children of employed mothers demonstrate a trend towards being overweight due to changes in food intake patterns (e.g., homemade food vs meals from outside, more processed food and 'junk' food), reduced physical activity and increased sedentary behaviour. The latter is defined as sitting or lying with low energy expenditure during waking hours (Tremblay et al., 2017). Poorer health behaviours among children (e.g., unhealthy dietary patterns, physical inactivity, sedentary behaviours) serve as gateways towards poorer health trajectories and increased health comorbidities in adulthood, including being overweight and obese (Mu et al., 2017). Childhood adiposity as well as physical inactivity and sedentary behaviour among children; represent key modifiable risk factors, to enhance both current and future health outcomes (Raynor et al., 2012).

There has been a visible shift in women's employment in low to middle-income countries (LMIC) over the past two decades (Dodzin and Vamvakidis, 2004; Lopez-Arana et al., 2013). The increase in women's participation in the labour force parallels the increasing prevalence of overweight among children (BMI Z-score > 2), which is believed to occur as a result of the country's nutrition transitions (referred to as characteristic changes in food and physical activity patterns that occur as a result of macro-level changes in economic development, globalization and urbanization) (Lopez-Arana et al., 2013). While the literature confirms that children of working mothers in developed countries demonstrate a trend for being overweight (Datar et al., 2014; Anderson et al., 2003; Baten and Böhm, 2010), research related to dietary patterns, physical activity and sedentary behaviour of children in LMICs are scarce to confirm any definite relationship. Thus, the relationships between maternal employment and children's dietary patterns, physical activity and sedentary behaviour are largely unexplored in LMIC.

No systematic review has investigated how dietary patterns, physical activity and sedentary behaviours (in combination) among children are related to maternal employment. Some previous research that has been identified investigated the association of maternal employment with child obesity and discussed solely one or two of these behaviours as influencing factors towards overweight and obesity (Duch et al., 2013; Mech et al., 2016; Hoyos Gillerio and Jago, 2010; Shrewsbury and Wardle, 2008). However, not only single behaviours, but the combination of multiple risk behaviours ultimately determines the risk of being overweight or obese. It is already identified that consumption of energy dense foods, low levels of physical activity and high levels of recreational screen use (e.g., TV watching and computer use) are key behavioural determinants of overweight and obesity in children and adolescents (Barnett et al., 2018; Rennie et al., 2005). Dietary and physical activity habits are developed at early stages of life (Savage et al., 2007) and have been tracked into adulthood (Kelder et al., 1994; Tammelin et al., 2014), suggesting the importance of increasing our understanding of the roots and development of these behaviours in children. The relationships among maternal employment and these three key behavioural variables remains largely unknown. Since approximately 40% of the global workforce are women (World Bank, 2020), a comprehensive understanding of association of maternal employment with child dietary patterns, physical activity and sedentary behaviour needs more focus considering its short- and long-term impacts on health and wellbeing trajectories over the life course.

This systematic review aims to identify the association between the dietary habits, physical activity and sedentary behaviour of children, with the employment status of mothers. Our main research question is, therefore, 'does the employment status of mothers with children aged 6–18 years affect children's dietary habits, physical activity and sedentary behaviour?'

## 2. Methods

The research protocol of this study is registered in PROSPERO, an international prospective register of systematic reviews (registration number: CRD42020145438).

### 2.1. Search strategy

The review followed the protocol of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2009). Literature searches were conducted using the bibliographic databases of Scopus, PubMed, Science Direct, JSTOR, Google Scholar and ProQuest. For the primary search, no restriction was imposed on publication type, or study design, however, only English language papers were considered. Initial search was applied to title, abstract and key words. For working mothers and physical activity, the following search terms were used: (physical activity OR physical inactivity OR exercise OR sedentary behaviour) AND (maternal work OR working mother OR maternal employ\* OR working women) AND ('child' OR 'adolescent' OR 'youth' OR 'juvenile'). For diet, 'dietary pattern OR dietary intake OR food intake OR dietary habits OR feeding behaviour' were used instead of 'physical activity' or 'sedentary behaviour'. Additional literature and document searches were undertaken via backward searching through the key words identified from the literature review and the secondary literature search of the reference lists of all full text articles selected in the primary search. The search strategies are presented in Supplementary Material.

### 2.2. Inclusion criteria

Studies were incorporated in the present review if they (i) reported on maternal employment status, and dietary patterns (DP), physical activity (PA), or sedentary behaviour (SB) of children aged 6 to 18 years; (ii) were written in English; (iii) published as a peer reviewed journal article, conference paper, or thesis at masters or doctoral level. All research methods, designs, as well as measurement instruments were included. Studies were not considered for inclusion in the systematic review if: (i) the population of the study was only adults, (ii) had obesity or overweight as the focal point of research outcomes, (iii) published as a literature review, (iv) did not provide information about the age of the study population, (v) full text was not available and (iii) was not written in English.

### 2.3. Study selection and data extraction

All studies identified by database search and additional searches were screened for eligibility based on title, abstract and full text by two independent reviewers (SA and LB). Any disagreements were resolved by discussion with the other reviewers/authors.

The data for each included study were extracted by the first author using a standardized extraction form and verified by other authors. Data were extracted on: (1) characteristic of publication [title of the article, author(s), year, country/data source, study design], (2) sample characteristics [sample size, age/age group, employment status/working hours], (3) primary and secondary outcomes as well as measurement methods used for dietary patterns, physical activity and sedentary behaviour. A narrative synthesis of results of included studies was provided. The number of studies included in the systematic literature review were too diverse in outcome as well as measurement to pool data to conduct a meta-analysis.

### 2.4. Coding associations with dietary outcome, physical activity and sedentary behaviour

Studies with significant associations identified between maternal employment and domains of dietary patterns, physical activity and

sedentary behaviour were not discussed unless three or more studies were available (for each category) (Sallis et al., 2000). Conceptually similar domains were combined if there were not enough studies to examine the domains individually. For example, 'snack food including fast food & junk food' domain combined fast food, junk food and processed food. Domains relating to physical activity in included studies were too diverse to report on separately, thus conceptually similar domains were aggregated as moderate to vigorous intensity physical activity (MVPA).

Studies with significant associations between maternal employment and variables (dietary patterns, physical activity and sedentary behaviour) were included in the 'Related to maternal employment' column of Table 2; and associations were classified and coded as: positive association (+), negative association (-). Studies reporting no significant associations were entered in the "Unrelated to maternal employment" column. The coding process was completed following the rules used by Sallis et al. (2000). Studies with low risk of bias scores are presented in bold numbers in the Table 2. Included studies typically used univariate tests for assessing the statistical significance of associations. However, even if multivariate tests were conducted, univariate tests were reported for consistency across studies to ensure meaningful comparisons of key findings.

#### 2.5. Summary codes

Numbers in the second and the fourth columns of Table 2 refer to the study numbers in Table 1. Studies that examined multiple domains of dietary patterns, physical activity or sedentary behaviour, multiple associations with maternal employment were recorded. The column 'number of samples' includes the number of samples that have been studied for each identified domain. The 'Summary' column contains a code to summarize the state of the domain for that variable. After assessing all the studies, calculating the percentages of findings supporting the overall association, each domain was classified as no association (0%–33 % of studies supporting the association), indeterminate/inconsistent (34%–59 % of studies supporting the association) and positive or negative association (60%–100 % of studies supporting the association) and coded as '0', '?' and '+/-' respectively. These rules for classifying variables strength of evidence and direction of association are in accordance with Sallis et al. (2000).

#### 2.6. Risk of bias

Risk of bias of the included studies was assessed using a modified version of Cochrane Collaboration tool adopted for observational studies following Higgins et al. (2011), and the JBI Critical Appraisal Checklist was used for the qualitative study. The adapted tool of Cochrane Collaboration has been used in prior studies (Poitras et al., 2016; Prince et al., 2017; Castro et al., 2018). The tool for observational studies focused on six potential sources of bias: selection bias (sampling method), performance bias (measurement of maternal employment), detection bias (measurement of DP, PA, SB), attrition bias (completeness of outcome data), selective reporting bias (selective outcome reporting), and other bias (control for confounding). Each type of bias was marked as "high", "low", or "unclear" according to pre-specified criteria. The comprehensive explanation of these criteria is provided in the supplementary document. One reviewer [SA] assessed the risk of bias score while the other reviewers verified these by assessing randomly selected 2 studies each and discussed any conflicting results (initially 83% consistency was attained between reviewers). Further disagreements were resolved through team discussion. The overall risk of bias score was determined by summing the total number of criteria marked as 'low risk of bias', 'high risk of bias' and 'unclear risk of bias' according to the pre-established criteria. The JBI Critical Appraisal Checklist was used to assess the quality of the qualitative study based on study methodology. The corresponding score (out of 10 with 10 the highest) and the JBI

Level of Evidence of Meaning (range from 1 to 5 with 5 the lowest) was applied. (Detail documents are available in supplementary files).

### 3. Results

The search of bibliographic databases yielded 14,306 potentially relevant citations, with a further 88 identified through the secondary backward reference searching. Full text papers were reviewed for 108 studies, of which 68 were excluded. A further two papers were identified from reviewing reference lists of included papers, providing a total of 42 papers for the review, as shown in Fig. 1. The papers were published between 1984 and 2020, with 95.2% published in 2000s (see Fig. 2). Most studies were peer-reviewed journal articles (85.7%), with others being these (9.5%), conference papers (2.3%), and working papers (2.3%). Results showed an association of maternal employment with all three variables of dietary patterns, physical activity and sedentary behaviour in 9.5% papers, while 59.5% of studies focused on any one of the three variables. The remaining studies (30.9%) included a combination of two variables (dietary pattern-physical activity; dietary pattern-sedentary behaviour or physical activity- sedentary behaviour). This review identified 10 domains for dietary patterns, two for physical activity and four for sedentary behaviour.

#### 3.1. Maternal employment and dietary patterns

Among the 42 studies included in the review 26 assessed dietary patterns, with 11 assessing dietary patterns using standard dietary pattern questionnaires, three with 24 h dietary recall, two studies used 3-day food diaries, four used food frequency questionnaires (FFQ), two used a healthy eating index (HEI), two used a youth and adolescent food frequency questionnaire (YAQ) and Global school based student health survey (GSHS) questionnaire, and 2-day food diary each were used by one study. Ten studies used self-reporting or parent reporting measures to assess dietary patterns. The review identified ten domains of dietary patterns, and eight were studied three or more times. Snack's food including fast food & junk food was the most assessed domain of dietary pattern used in 9 studies followed by family meals assessed in 8 studies. Four studies (Bauer et al., 2012; Datar et al., 2014; Gaina et al., 2009; Meyer, 2016) among nine reported an increase in snack food consumption when the mother was in full-time employment, three studies (Brown et al., 2010; Sweeting and West, 2005; Taylor et al., 2012) reported no association, and two studies (Adbi et al., 2017; Pearson et al., 2009) reported a negative association with employment status of the mother. Family meal (eating together and meals with family members) had a negative relationship with maternal employment in seven (Anderson, 2012; Bauer et al., 2012; Chang and Lee, 2012; Chang, 2012; Gwozdz et al., 2013; Nadia, 2012; Neumark-Sztainer et al., 2003) out of eight papers, with one (Nie and Sousa-Poza, 2014) showing no association. Maternal employment was negatively associated with children's fruit and vegetables consumption in five studies (Bauer et al., 2012; Datar et al., 2014; Meyer, 2016; Nadia, 2012; Sethi et al., 2014) and one study (Taylor et al., 2012) reported no association. Maternal employment was negatively associated with children's juice, soda, and soft/sports drinks consumption in one sample (Nadia, 2012), positively in one sample (Datar et al., 2014) and no association in another study (Taylor et al., 2012). Healthy eating habits was negatively related to maternal employment in three studies (Bauer et al., 2012; Nadia, 2012; Sweeting and West, 2005) and positively related in one study (Honajee et al., 2012). Five studies (Chowhan and Stewart, 2014; Fitzsimons and Pongiglione, 2019; Gaina et al., 2009; Nadia, 2012; Shuhaimi and Muniandy, 2012) reported a negative relationship with maternal employment for eating meals regularly.

Dietary quality showed a positive relationship with maternal employment in one study (Touliatos et al., 1984), a negative relationship in two studies (Ben-Shalom, 2010; Li et al., 2012) and was unrelated in another study (Taylor et al., 2012). Maternal employment was



**Table 1**  
Characteristics of included studies, along with the results of the study quality assessment for each study (n = 42).

Study	Type of country	Study design	Sample size, source of data, recruitment method	Empirical method / Theoretical framework	Measure of maternal employment	Measure of dietary patterns (DP)	Measure of physical activity (PA)	Measure of sedentary behaviour (SB)	Association with maternal employment	Risk of bias
Brown et al., 2010 <sup>(1)</sup> Australia	HIC	Cross sectional	6–7 years (n = 4464) Child cohort of the second wave of the Longitudinal Study of Australian Children (LSAC)	Path model (multiple regression analysis)	Full-time employment = < 34 h per week, part-time = 1–34 h per week. Part-time employed 44%	Interview with 24 h diary of consumption	Interview with 24 h dairy (Walk for travel or fun', 'ride bike, trike etc for travel or fun', 'other exercise (e.g., swim, dance, run about)	Interview with 24 h dairy on watching TV, video, DVD or movie	Mother's part time working status is negatively associated to television viewing and snack food consumption.	Low risk of bias
Vazquez-Nava et al., 2013 <sup>(2)</sup> Mexico	UMIC	Cross sectional study.	6–12 years (n = 897) Randomly selection	Logistic regression	Self-reported employment status. Employed mother = 38.8%.	Interview on dietary habits	Interview on sports practice.	Interview on play minutes per session / week and TV watching, video games.	Maternal employment had positive association with sedentary lifestyle	High risk of bias
Adbi et al., 2017 <sup>(3)</sup> India	LMIC	Cross-sectional study	13–17 years (n = 1416) Data collected from three public schools.	Simple chi-square test and multinomial logistic regression	Self-reported employment status	Self-administered GSHS questionnaire	-	-	Adolescents' junk food intake was negatively related to working mothers	Low risk of bias
Sethi et al. (2014) <sup>(4)</sup> India	LMIC	Observational study	7–9 years (n = 100) Data collected from two govt. schools.	Descriptive statistics	Self-reported employment status. Working mother = 70%	Interview with 24 h dietary recall method	-	-	Children food intake had negative association with working mothers	High risk of bias
Park et al. (2014) <sup>(5)</sup> South Korea	HIC	Qualitative	10–16 years (n = 26) Data collected from 26 schools.	Thematic analysis (5 principal themes)	Self-reported employment status	In-depth interviews and focus group discussions	-	-	Eating out and minimal breakfast is positively related to maternal employment.	Low risk of bias
Neumark-Sztainer Det al. (2002) <sup>(6)</sup> USA	HIC	Cross-sectional	11–18 years (n = 4746) Data collected from 31 schools.	Cross tabulations, log-linear modelling, and linear regressions.	Self-reported employment status	Survey with YAQ	-	-	Maternal employment was negatively associated with family meal patterns.	High risk of bias
Honajee et al., 2012 <sup>(7)</sup> Mauritius	UMIC	Cross-sectional	2–11 years (n = 289)	Chi square test and factor analysis.	Self-reported as Professional worker	Self-reported FFQ	-	-	Healthier eating of children was significantly and positively associated to maternal employment.	Unclear risk of bias
Fitzsimons and Pongiglione, 2019 <sup>(8)</sup> UK	HIC	Longitudinal cohort study	9 months – 14 years (n = 7, 894)	OLS and FE linear probability models	Self-reported employed if work in the last week or had a job and did not work in the past week for reasons other than parental leave. Part-time employment = 1 and 34 h, full-time = 35 h or more.	Interview about regularity of breakfast on every weekday	-	Interview on TV watching (exceeding three hours per weekday)	Children of employed (both part- and full time) mother watch more TV and less likely to have regular breakfast.	High risk of bias
Cho, 2017 South Korea <sup>(9)</sup>	HIC	Cross sectional study	14.2 years (n = 1,873) Stratified multi-stage	OLS regression, logistic regression	Mothers reported their daily start and end times at work. Average	-	Interview on average hours per week in vigorous exercise	Watching TV/video/ DVD and playing electronic (computer	Longer working hours of mothers was positively associated to TV/Video/	Low risk of bias

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Table 1 (continued)

Study	Type of country	Study design	Sample size, source of data, recruitment method	Empirical method / Theoretical framework	Measure of maternal employment	Measure of dietary patterns (DP)	Measure of physical activity (PA)	Measure of sedentary behaviour (SB)	Association with maternal employment	Risk of bias
			sampling technique.	models and Sensitivity test	work hours per week calculated as $[(\text{weekday work hours} \times 5) + (\text{Weekend work hours} \times 2)]/7$			or video) game per day average time	DVD viewing, electronic game playing and inversely to physical activity.	
Maher et al., 2017 <sup>(10)</sup> USA	HIC	Longitudinal study	8–12 years (n = 191) Students were recruited from school.	Linear regression model and Hochberg Procedure (to reduce Type I error)	Self-reported	-	Accelerometer measures MVPA	Accelerometer	Maternal employment status did not increase child physical activity or sedentary behaviour.	Low risk of bias
Chowhan and Stewart, 2014 <sup>(11)</sup> Canada	HIC	Cross-sectional study	12–17 years (n = 3591)	Linear probability model, FE and instrumental variable models.	Weeks employed in the previous year and the usual hours worked during each of those weeks	Interview on eating habits (eating breakfast every day) and allowance	Interview on Sports, gym class, dance, gymnastics, karate or other groups or lessons	Interview on average daily hours spend watching TV	More working hours of mother was positively related to TV viewing and negatively related to eating breakfast daily. More weeks worked by the mother was negatively related to TV viewing and positively related to physical activity.	High risk of bias
Ham et al., 2013 <sup>(12)</sup> South Korea	HIC	Cross sectional study.	10.01 years (n = 370) Data collected from students at elementary schools.	One-way analysis of variance tests, chi-square tests and multinomial logistic regression	Self-reported. Employed mother = 53.5%	Self-reported eating behaviour	Self-reported exercise	Self-reported screen time (time spent on TV/video/computer/video games)	Children of working mothers had significant positive association with screen time.	High risk of bias
Ziol-Guest et al., 2013 <sup>(13)</sup> USA	HIC	Longitudinal study	13 or 14 years (n = 4192)	OLS regressions and logistic regressions.	Weekly working hours	-	-	Interview on TV watching (Average number of hours)	More maternal working hours are positively associated with hours of TV watching.	Low risk of bias
Touliatos et al., 1984 <sup>(14)</sup> USA	HIC	Cross-sectional study.	10–13 years (n = 99) Data collected from school.	Factor analysis	Self-reported. Employed mother = 66%	Interviewed with 24 h recalls of dietary intake	-	-	Maternal employment and child dietary quality had positive association	High risk of bias
Gaina et al., 2009 <sup>(15)</sup> Japan	HIC	Cross-sectional study	12–13 years (n = 10453). Data collected from high school children.	t-test and $\chi^2$ analyses (or Fisher's exact test), Binominal logistic regression	Self-reported. Full time employed mother = 50.7%; part time = 32.7%	Self-reported eating meals regularity, meals speed and amount	Self-reported physical activity measured in hours per week	Self-reported TV watching time and room tenure	Mothers' employment has no effect on breakfast. Children of full-time employed mothers skip dinner. Children of part-time employed mothers snacked more, eat dinner regularly and eat larger meal portions compared with children of full-time employed mothers. Children non-employed mothers eat faster.	High risk of bias
	HIC	Longitudinal study	0–12 years (n = 1127)	Individual FE and IV regressions		-	-	Self-reported time use survey on 24-hour	Full-time employed mothers had negative	Low risk of bias

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Table 1 (continued)

Study	Type of country	Study design	Sample size, source of data, recruitment method	Empirical method / Theoretical framework	Measure of maternal employment	Measure of dietary patterns (DP)	Measure of physical activity (PA)	Measure of sedentary behaviour (SB)	Association with maternal employment	Risk of bias
Hsin and Felfe, 2014 <sup>(16)</sup> USA					Average weekly hours worked. Employed mother = 78%			periods (watching TV listening music, and unspecified leisure activities)	association with children's unstructured activities (watching television, listening to music, and unspecified leisure activities)	
Bauer et al., 2012 <sup>(17)</sup> USA	HIC	Cross sectional study	Adolescent recruited from middle and high schools. n = 2893.	Linear regression models, generalized estimating equations	Working full-time; working part-time; stay-at-home caregiver; currently unemployed but actively seeking work; and not working for pay. Full-time employed mothers = 46%	Interview on family meal with questionnaire	-	-	Full-time employment of mothers had negative association with family meals, positive with fast food family meal and negative with fruit and vegetable intake.	Low risk of bias
Li et al., 2012 <sup>(18)</sup> Australia	HIC	Longitudinal (Prospective) study	1–14 years (n = 1629)	Multivariate linear regression models	Not working, working 1–15 h, 16–24 h, 25–34 h or ≥ 35 h (full time) weekly.	Self-reported Semi-quantitative FFQ for dietary intake		-	Increasing working hours of full time employed mothers were negatively associated with diet quality.	High risk of bias
Sweeting and West, 2005 <sup>(19)</sup> Scotland	HIC	Cross-sectional study	11 years (n = 2146) Data collected from school.	Logistic regression	Self-reported as full-time home maker, part-time work, full-time work and unemployed	Self-reported Questionnaires on healthy eating habits		-	The likelihood of less healthy eating is lower for the children of part-time mothers. Unhealthy snacking was not associated to maternal employment.	High risk of bias
Morrissey et al., 2011 <sup>(20)</sup> USA	HIC	Observational study.	3rd, 5th and 6th grade (N = 990)	RE and within-child FE regressions.	Self-reported		Physical activity monitor (seven consecutive days during a typical school week)	Interview on watching TV	Grade 3 children of employed mother watched an average of 15.2 h of television per week and spent about one-fifth of their time in moderate or vigorous physical activity. 5th and 6th grade children of employed mother had poorer food choices and more sedentary activity relative to younger age.	High risk of bias
Chia, 2008 <sup>(21)</sup> Canada	HIC	Cross sectional study	6–11 years (n = 4107).	OLS regression. Reduced form equation	Average number of hours of paid worked per week		Interview on organized and non-organized sports	Interview on watching TV and videos	Weekly hours worked by the mother was positively associated with probability of watching more hours of television or video programs per day. Mother's weekly working hours is positive and statistically significant with regular	High risk of bias

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Table 1 (continued)

Study	Type of country	Study design	Sample size, source of data, recruitment method	Empirical method / Theoretical framework	Measure of maternal employment	Measure of dietary patterns (DP)	Measure of physical activity (PA)	Measure of sedentary behaviour (SB)	Association with maternal employment	Risk of bias
Chang and Lee, 2012 <sup>(22)</sup> South Korea	HIC	Cross sectional study	10 or older (n = 14228)	Two-part regression model of time (The first part regression used Probit and the second part was estimated OLS	Local unemployment rates as instrumental variables	Self-reported Two-day time diaries	Self-reported two-day time diaries on supervising or playing with children	—	participation in organized sporting activities. Mothers employment had negative association with family meals, and supervision of children's physical activity	Low risk of bias
Chang, 2012 <sup>(23)</sup> USA	HIC	Cross sectional study	12–17 years (n = 637) Stratified random sampling, Survey data	Multivariate multilevel linear regression	Average number of working hours per week.	Family dinner	—	TV watching	Children's TV-watching hours were not associated with Primary Care Givers' employment status	High risk of bias
Nadia (2012) <sup>(24)</sup> USA	HIC	Cross sectional study	Fifth grade (average age of children is about 10 years). Data (survey) collected from school.	Ordered Probit.	Number of hours worked per week. Full time employment = >20 h per week	Number of glasses of juice drink, number of times soda pop/sport drinks/fruit drinks drank, number of times green salad, carrots, other vegetables, fruits, and fast food eaten in last week.	Number of days per week of 20 min exercise.	TV watching	Maternal full-time employment was positively associated to watching TV and negatively to number of times child drank juice, ate carrots, other vegetables, fruits, and number of times child ate dinner regularly.	High risk of bias
Shuhaimi and Muniandy, 2012 <sup>(25)</sup> Malaysia	UMIC	Cross sectional survey	4–6 years (n = 142) Data collected from 7 Kindergarten.	Two-way ANNOVA, Pearson rank correlation.	Self-reported as unemployed and employed.	Self-reported children's three-days food intake record	—	—	Negative association was found between maternal working hours and child's energy, protein and fat intake; breakfast eating	Low risk of bias
Aniza I et al. (2009) <sup>(26)</sup> Malaysia	UMIC	Cross sectional study	14 and 16 years (n = 519) Data collected from secondary school students	Bivariate analysis and logistic regression	Self-reported employment status	—	Self-reported PA using International Physical Activity Questionnaire (IPAQ).	—	Maternal employment had positive association with physical activity	Low risk of bias
Martin et al., 2018 <sup>(27)</sup> USA	HIC	Longitudinal study	12–18 years (n = 10,518)	FE and cross-sectional model.	Hours a week does s/he work for pay	—	Self-reported number of times they engaged in various leisure activities during the past week	Self-reported weekly hours of watching television, videos and playing video or computer games.	Positive association of screen time with mothers' work hours and mothers' unemployment.	High risk of bias
Meyer, 2016 <sup>(28)</sup> Germany	HIC	Cross-sectional study.	9–12 (n = 2447)	OLS, linear probability model, 2SLS and IV estimate.	Self-reported employment status	Self-report on combined measure of eating raw and cooked vegetables.	Self-reported frequency of physical activity (exercise) 3 times per week	Self-reported hours of watching TV/ playing video games per day.	Maternal full-time employment has positive relation to unhealthy dietary habits (lower consumption of fruits and vegetables, and a higher consumption of soda drinks and processed food) and	High risk of bias

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Table 1 (continued)

Study	Type of country	Study design	Sample size, source of data, recruitment method	Empirical method / Theoretical framework	Measure of maternal employment	Measure of dietary patterns (DP)	Measure of physical activity (PA)	Measure of sedentary behaviour (SB)	Association with maternal employment	Risk of bias
Nie and Sousa-Poza, 2014 <sup>(29)</sup> China	UMIC	Longitudinal study	3–17 years (n = 2618) Multistage random cluster sampling method	OLS and quantile regressions.	Hours worked during the past week	Self-reported dietary patterns: meals at home and caloric intake	Time spend on physical exercise (gymnastics, track, swimming and ball games) and other sports before or after school (measured in minutes per week).	Self-reported total time spent watching TV, doing homework, and reading and writing (measured in minutes per week).	watching TV, playing video games and activity behaviour. Maternal working status is not significantly associated with caloric intake, meals at home, physical exercises, and/or sedentary activities.	High risk of bias
Anderson, 2012 <sup>(30)</sup> USA	HIC	Longitudinal study	Kindergarten to eighth grade.	Probit model	Working hours per week.	Regularity and frequency of eating meals at home, fast food, and eat snacks at school	Self-reported amount of time spent in physically activity (Days/week with vigorous exercise).	Family rules and actual amounts of television viewing (h/week)	Positive association of maternal employment on children's organized activities and more working hours were negatively correlated with regular family meals, regular meal-times, and rules about television watching.	High risk of bias
Taylor et al., 2012 <sup>(31)</sup> Australia	HIC	Cross sectional study.	5–15 years (n = 614). Random sampling.	Univariate/multivariate logistic regression 1	Full-time or part-time employment was determined according to a cut-off of 35 h per week.	Data collected via telephone monitoring system on fruit and vegetables, processed meat; fast food; potatoes; juice; water; and soft/sport drink	Telephone interview (CATI) on physical activity included the time spent per day doing organised sport. Proxy interviews for persons under the age of 16.	CATI on reading for pleasure; studying or doing homework; sleeping; and participating in screen-based activities (watching TV, videos or playing video or computer games)	No significant relationship was found between diet quality and maternal employment.	High risk of bias
Koca et al., 2017 <sup>(32)</sup> Turkey	UMIC	Cross sectional study	6–18 years (n = 7116) Random sampling.	Multiple linear regression analysis	Self-reported. Working mother 39.5%	Self-reported semi-quantitative FFQ	Self-reported out-of-school physical activity (activity by the child either alone, in sports clubs, or with family or friends)	-	Children of working mothers are more active.	Low risk of bias
Ben-Shalom, 2010 <sup>(33)</sup> USA	HIC	Cross sectional study	0–18 years +	Becker's model of household production (Becker 1965)	Full-time employment ≥ 35 h worked per week	Parents interview on the HEI and important nutrients	The number of days per week the child gets rapid exercise.	Parents interview on Tv watching hours/week	In married couple family's food-intake quality decrease with maternal employment, but this association is weaker for single mother families (first study) and children are more likely to get rapid exercise when their mothers work more hours per week (second study).	High risk of bias
Gwozdz et al., 2013 <sup>(34)</sup>		Cross sectional study	5–9 years (n = 7000)	Multiple regression and	Self-reported employment. Full-time				Maternal employment had negative association	Low risk of bias

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Table 1 (continued)

Study	Type of country	Study design	Sample size, source of data, recruitment method	Empirical method / Theoretical framework	Measure of maternal employment	Measure of dietary patterns (DP)	Measure of physical activity (PA)	Measure of sedentary behaviour (SB)	Association with maternal employment	Risk of bias
Belgium, Cyprus, Estonia, Germany, Hungary, Italy, Spain and Sweden	Both HIC & UMIC (Estonia)		Data collected from 390 kindergartens and school.	quantile regression.	employment $\geq$ 35 h worked per week; part time employment < 35 h per week and not in paid employment.	Self-administered Youth Healthy Eating Index	Uniaxial accelerometry (Non structured activities)		with children's calorie intake and positive to physical activity	
Datar et al. (2014) <sup>(65)</sup> USA	HIC	Longitudinal study	5th & 8th grade student (n = 20,020)	OLS and IV estimate.	Self-reported hours of work per week.	Interview with food consumption questionnaire	Self-reported regular and vigorous exercise (min 20 min/day/week)	Television viewing	Maternal employment was positively associated with consumption of soda, fast food, physical activity and sedentary behaviour and negatively related to fruits, vegetables and milk consumption.	Low risk of bias
Parker, 2007 <sup>(66)</sup> USA	HIC	Cross sectional study	5–18 years (N = 260)	Cronbach's Alpha, Pearson correlations and one-way ANOVA.	Self-reported employment status as full time, part time, and not employed	-	Daily step count using pedometer	-	Association of maternal employment and children's physical activity was not statistically significant.	High risk of bias
Raheeq and Arshad (2020) <sup>(67)</sup> Pakistan	LMIC	Cross sectional study	5–10 years (n = 250)	Tabular analysis	Self-reported as working and stay at home mothers	-	-	TV watching	Children of working mothers follow the rules about the time duration of watching television more compared to the children of home-maker mothers.	High risk of bias
Ferrari et al. (2016) <sup>(68)</sup> Brazil	UMIC	Cross sectional study	10 years (n = 328)	Multilevel linear regression model	Self-reported employment as none, less than part time, part time, or full time	FFQ	MVPA using an Actigraph GT3X + accelerometer	TV, video game, and computer time	Children MVPA was negatively associated with maternal employment (mothers who worked part time or less had less MVPA than children whose mothers worked full time).	High risk of bias
Pearson et al. (2009) <sup>(69)</sup> Australia	HIC	Longitudinal	12–15 years (n = 1884)	Logistic regression and multinomial logistic regression model	Maternal employment = full-time, part-time or not in paid employment	Online survey by FFQ	-	-	Girls of part time employed mothers or not in paid employment had an inverse association with their snack and fast-food consumption.	Low risk of bias
Wijtzes et al. (2014) <sup>(60)</sup> Netherlands	HIC	Cross sectional study	6 years (n = 4726)	multiple logistic regression	Employment = no paid job, paid job, part-time [ $<$ 36 h /week], paid job full time [ $>$ 36 hours/week]		Parent-reported children's sports participation (yes, no) and outdoor play.		Children's sports participation was negatively associated with maternal unemployment.	Low risk of bias
Lopoo (2007) <sup>(41)</sup> USA	HIC	Longitudinal	15 years (n = ) the 1996 Survey of Income and Program Participation	Logit and fixed-effects logit models	Mother worked $\leq$ 30 h and mother worked $>$ 30 h.	-	Self-reported after school activities (sports, lesson)	-	A positive relationship between maternal work hours and sports participation.	Low risk of bias

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Table 1 (continued)

Study	Type of country	Study design	Sample size, source of data, recruitment method	Empirical method / Theoretical framework	Measure of maternal employment	Measure of dietary patterns (DP)	Measure of physical activity (PA)	Measure of sedentary behaviour (SB)	Association with maternal employment	Risk of bias
Richards and Duckett (1994) <sup>(42)</sup> USA	HIC	Longitudinal study	10–13 years (n = 295)	Analysis of variance	Not employed, employed part time (1–34 h/week, employed full time (35 or more hours/week).		Self-reported sports and chores.	Self-reported classroom, homework, TV, socializing, general leisure (e.g., games, reading, extracurricular activities).	Full-time maternal employment was associated with more time doing homework with mothers, less time playing sports, more time watching TV and less time in general leisure and less time in general leisure, while part-time employment was associated with more time doing sports with parents.	High risk of bias

OLS: Ordinary Least Square; FE: Fixed Effect; IV: Instrumental Variable; RE: Random Effect; 2SLS: Two Stage Least Square.

negatively associated with children's energy/calorie, protein, and fat intake in two samples (Gwozdz et al., 2013; Shuhaimi and Muniandy, 2012), and unrelated in one sample (Nie and Sousa-Poza, 2014). The effect of intensity of maternal employment on children's DP was reported in 8 studies (Bauer et al., 2012; Datar et al., 2014; Fitzsimons and Pongiglione, 2019; Gaina et al., 2009; Li et al., 2012; Meyer, 2016; Nadia, 2012; Sweeting and West, 2005). Four studies (Bauer et al., 2012; Datar et al., 2014; Gaina et al., 2009; Meyer, 2016) reported a positive association of full-time maternal employment with consumption of soda and fast food whereas another four studies found three domains (eating meals regularly, fruits and vegetables consumption, dietary quality) to be negatively associated with full-time maternal employment (Fitzsimons and Pongiglione, 2019; Bauer et al., 2012; Gaina et al., 2009; Meyer, 2016). Dietary patterns and maternal part-time employment were reported in three studies (Fitzsimons and Pongiglione, 2019; Gaina et al., 2009; Sweeting and West, 2005) -positively associated with two domains (snacking and eating dinner regularly) in one study (Gaina et al., 2009) and negatively in two domains (eating breakfast regularly and healthy eating) in two studies (Fitzsimons and Pongiglione, 2019; Sweeting and West, 2005).

In brief, 28 samples reported negative, 9 samples positive, and 9 samples reported no association between children's dietary patterns and maternal employment. Overall, the associations between maternal employment and children's dietary patterns showed more adverse than favourable directions.

### 3.2. Maternal employment and physical activity

Nineteen studies (Anderson, 2012; Aniza and Fairuz, 2009; Ben-Shalom, 2010; Chang and Lee, 2012; Chia, 2008; Cho, 2017; Datar et al., 2014; Ferrari et al., 2016; Gwozdz et al., 2013; Koca et al., 2017; Lopoo, 2007; Maher et al., 2017; Meyer, 2016; Morrissey et al., 2011; Nie and Sousa-Poza, 2014; Parker, 2007; Richards and Duckett, 1994; Vazquez-Nava et al., 2013; Wijtzes et al., 2014) reported an association between children's physical activity and maternal employment. Of these 19 studies, over 50% used self-reported methods, 21% used interview and 26.3% used device-based methods to measure physical activity. Three domains of physical activity, MVPA, sports participation and playing with children, were identified, with first two domains studied three or more times. Maternal employment was positively related to children's MVPA in ten samples (Anderson, 2012; Aniza and Fairuz, 2009; Ben-Shalom, 2010; Chia, 2008; Cho, 2017; Datar et al., 2014; Gwozdz et al., 2013; Koca et al., 2017; Morrissey et al., 2011; Meyer, 2016), negatively in three samples (Ferrari et al., 2016; Maher et al., 2017; Vazquez-Nava et al., 2013) and unrelated in two samples (Nie and Sousa-Poza, 2014; Parker, 2007). Maternal employment was positively related to children's sports participation in one sample (Lopoo, 2007) and negatively in two samples (Richards and Duckett, 1994; Wijtzes et al., 2014). The effect of intensity of maternal employment on children's physical activity was reported in 3 studies (Ben-Shalom, 2010; Ferrari et al., 2016; Richards and Duckett, 1994). One study (Ben-Shalom, 2010) reported a positive association of MVPA with full-time maternal employment whereas part-time maternal employment showed negative association with MVPA in one study (Ferrari et al., 2016). Children's sports participation was reported negative association in one study (Richards and Duckett, 1994) when mother works full-time. Same study (Richards and Duckett, 1994) reported positive association between maternal part-time employment and playing with children.

Briefly, 11 samples reported positive association whereas 5 samples observed negative association with maternal employment. Overall, working mothers were more likely to have active children.

### 3.3. Maternal employment and sedentary behaviour

Twenty studies (Anderson, 2012; Brown et al., 2010; Chang, 2012; Chia, 2008; Cho, 2017; Chowhan and Stewart, 2014; Datar et al., 2014;

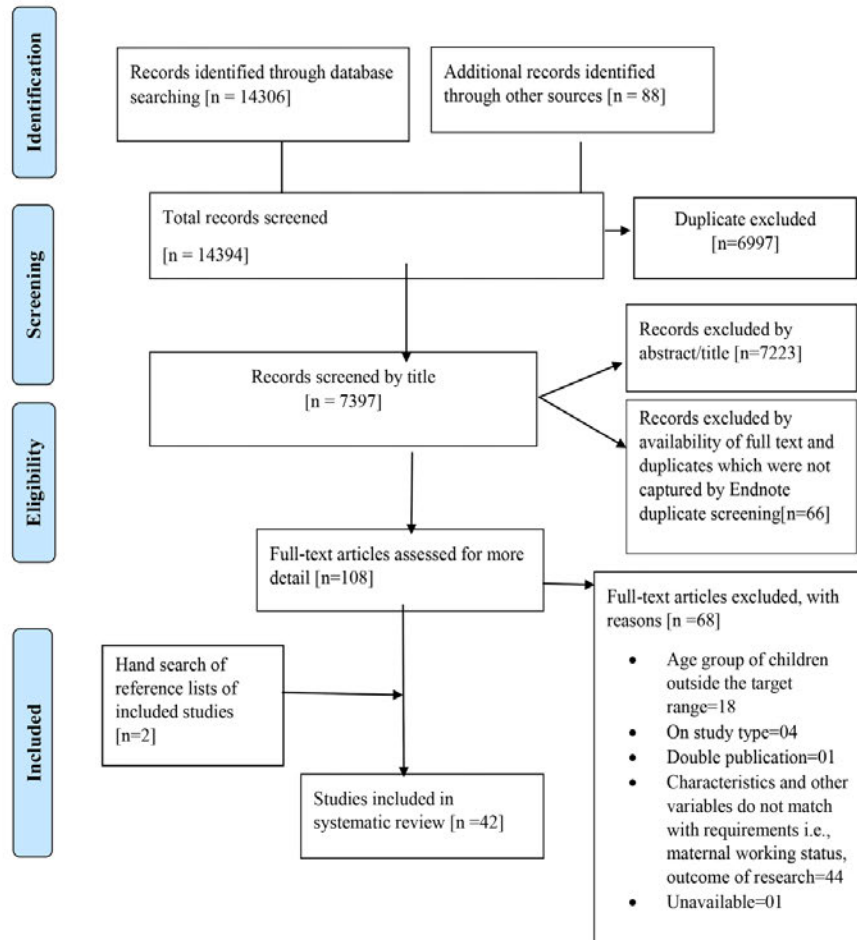


Fig. 1. PRISMA flow diagram for selection of studies.

Fitzsimons and Pongiglione, 2019; Ham et al., 2013; Hsin and Felfe; 2014; Maher et al., 2017; Martin et al., 2018; Meyer, 2016; Morrissey et al., 2011; Nadia, 2012; Nie and Sousa-Poza, 2014; Raheeq and Arshad, 2020; Richards and Duckett, 1994; Vazquez-Nava et al., 2013; Zioli-Guest et al., 2013) reported an association between sedentary behaviour and maternal employment. Four domains of sedentary behaviour were identified, with three domains studied three or more times. Watching Television (TV) was the most assessed sedentary behaviour (n = 13). Among the studies assessed TV watching, eight reported a positive association (Datar et al., 2014; Chia, 2008; Chowhan and Stewart, 2014; Fitzsimons and Pongiglione, 2019; Morrissey et al., 2011; Nadia, 2012; Richards and Duckett, 1994; Zioli-Guest et al., 2013), three reported a negative association (Anderson, 2012; Chowhan and Stewart, 2014; Parker, 2007) and two study reported no association (Chang, 2012; Nie and Sousa-Poza, 2014) with maternal employment. Screen time (TV, DVD, video, movie, playing video or computer games) was the second most assessed sedentary behaviour (n = 6). In these studies, five (Cho, 2017; Ham et al., 2013; Martin et al., 2018; Meyer, 2016; Vazquez-Nava et al., 2013) reported a positive association with screen time and maternal employment and one paper (Brown et al.,

2010) reported a negative association. Average minutes of sedentary behaviour was assessed in three studies, with two (Maher et al., 2017; Nie and Sousa-Poza, 2014) reporting no association and one (Hsin and Felfe, 2014) a negative association with maternal employment. The effect of intensity of maternal employment on children's sedentary behaviour was reported in 5 studies (Brown et al., 2010; Fitzsimons and Pongiglione, 2019; Hsin and Felfe; 2014; Meyer, 2016; Nadia, 2012). Three studies (Fitzsimons and Pongiglione, 2019; Meyer, 2016; Nadia, 2012) reported a positive association of full-time maternal employment with two domains (watching TV and screen time) of sedentary behaviour. TV watching was reported both positive (Fitzsimons and Pongiglione, 2019) and negative (Brown et al., 2010) association with part time maternal employment. Average minutes of sedentary behaviour was negatively related with full-time maternal employment in one study (Hsin and Felfe; 2014).

In sum, 13 samples reported positive, 5 samples negative, and 4 samples reported no association between children sedentary behaviour and maternal employment.



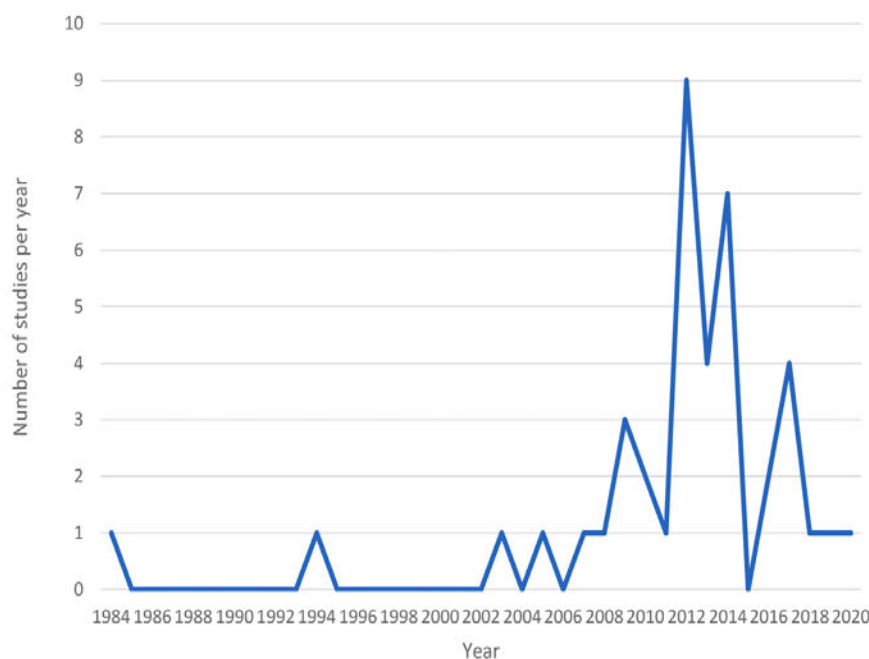


Fig. 2. The number of studies on the association of maternal employment to DP, PA and SB published per year.

### 3.4. Differences in outcome between countries differing in income status

The World Bank's income classification of countries was used in this review. Based on this classification, 32 of 42 reviewed studies were from HIC, 7 from UMIC, and 3 from LMIC. Table 3 summarizes the associations between maternal employment and dietary patterns, physical activity and sedentary behaviour in high-, upper-middle and lower-middle income countries. The association of dietary patterns, physical activity and sedentary behaviour showed an indeterminate relationship with maternal employment in LMIC and UMIC. Twenty-six studies examined dietary patterns in HICs with the majority from the USA ( $n = 16$ ). The association between "healthy dietary patterns of children in HIC" were indeterminate related to maternal employment. Physical activity and sedentary behaviour were found to have positive associations with maternal employment in HIC. Eight out of thirteen studies reported positive associations between children's physical activity and maternal employment. Twenty-one studies reported sedentary behaviour, with 14 positively related to maternal employment.

### 3.5. Risk of bias assessment

Across all studies, 57.1% ( $n = 24$ ) had high risk of bias score. The remaining 40.5% studies ( $n = 17$ ) were classified as low risk of bias score, while 2.4% ( $n = 1$ ) had unclear risk of bias. Concerning each criterion of risk of bias for observational studies, 56.1% of studies ( $n = 23$ ) used probability sampling methods and were hence identified as low risk of bias. The majority of the studies (70.8%) had high risk of performance bias as most cases of 'maternal employment' were measured using non-validated tools. Similar to performance bias, over half of detection bias (51.2%) had high risk for using non-validated measurements for dietary patterns, physical activity and sedentary behaviour. Over one third of studies (41.5%;  $n = 17$ ) did not manage < 20% of missing data and were marked as high risk for attrition bias. One third of studies (34.1%;  $n = 14$ ) did not provide any reasons for missing data and were identified as unclear risk of attrition bias. Reporting bias is low for

two-thirds of the studies (70.7%;  $n = 29$ ) and 17.1% ( $n = 7$ ) had high risk of reporting bias. Nearly two-thirds of studies (63.1%;  $n = 26$ ) reported about the statistical methods to control for potential confounding factors, and hence were coded as low risk of bias; and 22% ( $n = 9$ ) did not provide sufficient information regarding confounding factors. Detailed risk of bias results is available in the supplementary material.

Effect size is measured for individual studies. Effect sizes ranged from  $-0.08$  to 3.8. Majority of studies fail to produce medium to large effect size.

## 4. Discussion

The aim of this systematic review was to determine whether maternal employment was associated with children's health behaviours, specifically dietary patterns, physical activity, and sedentary behaviour. A wide range of domains for these behaviours among children within HIC and LMIC were identified. These domains were assessed using various tools and the association with maternal employment was varied. The review shows that the number of studies on these lifestyle variables among children related to maternal employment has expanded in the last two decades, with two studies between 1980s and 1990s, and all remaining studies published in the 2000s.

Results showed that maternal employment was inversely associated with children's family meals (Anderson, 2012; Bauer et al., 2012; Chang and Lee, 2012; Chang, 2012; Gwozdz et al., 2013; Nadia, 2012; Neumark-Sztainer et al., 2003), fruits and vegetables consumption (Bauer et al., 2012; Datar et al., 2014; Meyer, 2016; Nadia, 2012; Sethi et al., 2014), healthy eating habits (Bauer et al., 2012; Gwozdz et al., 2013; Sweeting and West, 2005), eating meals regularly (Chowhan and Stewart, 2014; Fitzsimons and Pongiglione, 2019; Gaina et al., 2009; Nadia, 2012; Shuhaimi and Muniandy, 2012), and energy/calorie, protein, and fat intake (Gwozdz et al., 2013; Shuhaimi and Muniandy, 2012). In dual income families it is expected that maternal employment may allow families to spend more on healthy foods (Lowery et al., 2019), however, employment is likely to create a time constraint for meal

**Table 2**  
Summary of samples showing the associations between maternal employment and different domains of dietary patterns, physical activity, and sedentary behaviour for children (n = 83).

Domains of Dietary patterns	Related to Maternal employment Study no	Association (+/−)	Unrelated to Maternal employment	Number of samples analysed (n)	Association	Summary code (% of study)
Snacks food including fast food & junk food	15, 17, 28, 35, 39	+	1, 19, 31	n = 9	?	5/9 55.6%
Family meals	6, 17, 22, 23, 24, 30, 34	−	29	n = 8	−	7/8 88%
Fruits & vegetables	4, 17, 24, 28, 35	−	31	n = 6	−	5/6 83.33%
Juice, water, soda, soft/sports drinks	24, 35	− +	31	n = 3	0	1/3 33.3%
Milk and milk products	4, 35	+				
Healthy eating habits	7, 17, 19, 34	+		n = 4	−	3/4 75%
Eating meals (breakfast/dinner) regularly	8, 11, 15, 24, 25	−	15*	n = 6	−	5/6 62.5%
Dietary quality	14, 18, 33	+	31	n = 4	?	2/4 50%
Energy/ calorie, protein & fat intake	25, 34	−	29	n = 3	−	2/3 66.6%
Eating out at restaurants	5	+				
<b>Domains of Physical activity</b>						
MVPA	2, 10, 38, 9, 20, 21, 26, 28, 30, 32, 33, 34, 35	−	29, 36	n = 15	+	10/15 66.6%
Sports participation	40, 42, 41	− +		n = 3	−	2/3 66.6%
Playing with their children	22, 42	− +				
<b>Domains of Sedentary behaviour</b>						
Watching TV	8, 11†, 13, 20, 21, 24, 35, 42, 11, 30, 39	+	25, 31	n = 13	+	8/13 61.5%
Screen time (combining TV, DVD, video or movie, playing video/computer games)	1, 9, 12, 27, 28	− +	2	n = 6	+	4/6 66.7%
Average minutes of sedentary behaviour (i.e., < 100 counts per minute)	16	−	10, 29	n = 3	0	1/3 33.3%
Other sitting activities (reading for pleasure, writing, playing musical instrument)	42	+	29			

\*Eating breakfast shows <sup>0</sup> & dinner shows <sup>−</sup> association.

† Maternal hours worked, and weeks worked had different outcome.

related behaviours (Devine et al., 2003; Jabs et al., 2007). Studies show that employed mothers spent significantly less time in meal preparation (Beshara et al., 2010; Cutler et al., 2003) and consume more meals prepared away from home (Kant and Graubard, 2004). Their children are less likely to eat fruits and vegetables (Hawkins et al., 2009) and more likely to skip meals and have unfixed snacking time (Watanabe et al., 2011). In addition to this, employed mothers have less time to supervise their children, which creates opportunities for poorer diets (Datar et al., 2014). Hence, time pressures for employed mothers may have a greater detrimental effect on children's food intake patterns as reflected in fewer family meals, less consumption of fruits and vegetables, less healthy eating habits, and greater irregularity or 'skipping' of meals (breakfast and dinner). Juice, water, soda, soft/sports drinks were found to have no association with maternal employment (Datar et al., 2014; Nadia, 2012; Taylor et al., 2012). In this review an indeterminate association with maternal employment was found in children's consumption of snack food, including fast food and junk food (Adbi et al., 2017; Brown et al., 2010; Datar et al., 2014; Gaina et al., 2009; Meyer, 2016; Sweeting and West, 2005; Taylor et al., 2012), and dietary quality (Ben-Shalom, 2010; Liet al., 2012; Taylor et al., 2012; Touliatos et al., 1984). Overall, further investigations are needed to determine more definite conclusions for those domains (e.g., milk and milk products, eating out at restaurant) that had indeterminate outcome because of the

small number of studies available. MVPA was positively associated with maternal employment (Anderson, 2012; Aniza and Fairuz, 2009; Ben-Shalom, 2010; Chia, 2008; Cho, 2017; Datar et al., 2014; Gwozdz et al., 2013; Koca et al., 2017; Meyer, 2016; Morrissey et al., 2011) whereas sports participation showed a negative association (Lopoo, 2007; Wijtzes et al., 2014) in the current review. Overall, it is indicated that children of working mothers were sufficiently physically active. This finding may seem somewhat contradictory. Working mothers bear a double or triple burden of responsibilities at home and at work (Bond and Sales, 2001), and thus may lack sufficient remaining time and energy to more fully supervise and actively engage with their children (Cawley and Liu, 2012; Fertig et al., 2009). However, monetary support from employed mothers may lead a better quality of life. There is evidence that higher socioeconomic status (SES) of families provides more opportunities for their children to do more activities, some of which are physical activities (Park and Kim, 2008; Stalsberg and Pedersen, 2010), and they could financially support the enrollment of their children into organized physical activity such as active sports clubs (Datar et al., 2014; Kantomaa et al., 2007).

In terms of TV watching in children as a sedentary behaviour, most studies reported positive associations with maternal employment (Chia, 2008; Chowhan and Stewart, 2014; Datar et al., 2014; Fitzsimons and Pongiglione, 2019; Nadia, 2012; Richards and Duckett, 1994; Sweeting

**Table 3**  
Summary of studies showing the association between maternal employment and dietary patterns, physical activity and sedentary behaviour based on Lower-middle income, Upper-middle income and High-income countries.

Type of country (number of studies from each country)	Study no	Association	Summary code (% of study)		
LMIC (7.1%) (India = 2, Pakistan = 1)	DP	11, 12 <sup>-</sup>			
	PA	-			
	SB	37 <sup>-</sup>			
UMIC (16.7%) (China = 1, Mexico = 1, Malaysia = 2, Mauritius = 1, Turkey = 1, Brazil = 1)	DP	7 <sup>+</sup>	1/3		
		25 <sup>-</sup>	33.3%		
		29 <sup>0</sup>			
	PA	26 <sup>+</sup> , 32 <sup>+</sup>	2/4		
		29 <sup>0</sup> , 38 <sup>-</sup>	50%		
HIC (76.2%) (USA = 16, UK = 1, Canada = 2, Australia = 4, Japan = 1, South Korea = 4, Scotland = 1, Germany = 1, Netherlands = 1, 6 European countries (Belgium, Cyprus, Estonia, Germany, Hungary, Italy, Spain, and Sweden) = 1)	DP	5 <sup>+</sup> , 14 <sup>+</sup> , 15 <sup>+</sup> , 18 <sup>+</sup> , 28 <sup>+</sup> , 35 <sup>+</sup>	15/26		
		6 <sup>-</sup> , 8 <sup>-</sup> , 11 <sup>-</sup> , 15 <sup>-</sup> , 17 <sup>-</sup>	57.7%		
		19 <sup>-</sup> , 22 <sup>-</sup> , 23 <sup>-</sup> , 24 <sup>-</sup> , 28 <sup>-</sup> , 30 <sup>-</sup> , 33 <sup>-</sup> , 34 <sup>-</sup> , 35 <sup>-</sup> , 39 <sup>-</sup> , 1 <sup>0</sup> , 15 <sup>0</sup> , 19 <sup>0</sup> , 29 <sup>0</sup> , 31 <sup>0</sup>			
		PA	9 <sup>+</sup> , 20 <sup>+</sup> , 21 <sup>+</sup> , 28 <sup>+</sup> , 30 <sup>+</sup> , 34 <sup>+</sup> , 35 <sup>+</sup> , 41 <sup>+</sup>	8/13	
			10 <sup>-</sup> , 22 <sup>-</sup> , 40 <sup>-</sup> , 42 <sup>-</sup> , 36 <sup>0</sup>	61.5%	
		SB	2 <sup>+</sup> , 8 <sup>+</sup> , 9 <sup>+</sup> , 11 <sup>+</sup> , 12 <sup>+</sup> , 13 <sup>+</sup> , 16 <sup>+</sup> , 20 <sup>+</sup> , 21 <sup>+</sup> , 24 <sup>+</sup> , 27 <sup>+</sup> , 28 <sup>+</sup> , 35 <sup>+</sup> , 42 <sup>+</sup>	14/21	
				1 <sup>-</sup> , 11 <sup>-</sup> , 16 <sup>-</sup> , 30 <sup>-</sup> , 10 <sup>0</sup> , 23 <sup>0</sup> , 29 <sup>0</sup>	66.6%

and West, 2005; Ziol-Guest et al., 2013). TV viewing has become a preferred leisure time activity of children during unsupervised time (Datar et al., 2014) and the reason may be the unavailability of outdoor facilities or due to safety reasons. Existing literature support positive associations between maternal employment and TV viewing of children (Fertig et al., 2009). Screen time (TV, DVD, video, or movie, playing video/computer games) indicated a positive relationship with maternal employment (Cho, 2017; Ham et al., 2013; Martin et al., 2018; Meyer, 2016). Children and adolescent's increasing exposure to screen-based activities are evident in other reviews (Thomas et al., 2019). Results show that children of employed mothers were physically active, but at the same time, children spent more time on sedentary pursuits. While this may appear contradictory, it has been shown that physical activity can be independent of how much time children spend in sedentary behaviours over the day (Marshall et al., 2004; Pearson et al., 2014; Sallis et al., 2000). For example, a child can indulge in high levels of MVPA but also in sedentary screen time. Within a 24-h day, time can be displaced to lighter forms of physical activity or sleep.

#### 4.1. Strength and limitations of the study

Applying a comprehensive and systematic approach, this review included a detailed summary and critical narrative synthesis of 42 published papers. Additional strengths of the review are the inclusion of all study designs as well as all type of measures of dietary patterns, physical activity and sedentary behaviour. Furthermore, this review

included multiple domains of dietary patterns, physical activity and sedentary behaviour.

This systematic review has some limitations. Although we tried to identify as many studies as possible, we may have inadvertently missed some eligible studies due to limited search strategy and beyond published English language studies. Furthermore, a majority of the studies were cross-sectional, thus conclusions regarding causality of association are not possible. Although device-based measures of physical activity and sedentary behaviour are more reliable, only a small number of studies used them. Most studies used self-report or maternal-report data, hence contributing to the possibility of reporting bias. Risk of bias among included studies were relatively high since many studies did not report on the reliability and validity of measures used to assess maternal employment and dietary patterns, physical activity and sedentary behaviour. The diverse nature of measures and outcomes prevented the use of meta-analysis. Conceptually similar domains were combined which may also narrow down the depth of analysis and generalizability of these findings. Though, multivariate tests are more accurate, use of univariate test for assessing statistical significance is a limitation of this study. Finally, most of the studies are from HIC, hence findings may not be similar in the context of LMIC.

## 5. Conclusion

To our knowledge, this is the first systematic review that summarises the evidence for links between dietary patterns, physical activity, and sedentary behaviour of children with the employment status of their mothers. Findings suggest that maternal employment was associated with poor dietary patterns but more physical activity and more time on sedentary activities. The latter were particularly for TV viewing and other screen-based activities of children. These findings provide an indication of how maternal employment may increase the risk of childhood obesity. We also identified a lack of validated measures of dietary patterns and few studies using device-based assessment of physical activity and sedentary behaviour. The findings of this systematic review have important implications in the context of growing participation of women in the labour force. Considering that the employment and economic activity of women will continue to increase in the future, interventions should support employed mothers with an aim to promote healthier children's dietary patterns and decrease sedentary time. Little can be deduced from the inadequately studied domains (for example-milk and milk products, eating out at restaurant, mothers playing with their children, sitting activities (reading-writing, playing musical instruments)), hence future studies need to focus on these domains of dietary patterns, physical activity and sedentary behaviour. Domains that have inconsistent results also require further testing. In addition to this, future research needs to pay attention to UMIC and LMIC because research related to maternal employment and children's lifestyle variables are scarce in those countries. Moreover, the use of device-based measures of physical activity and sedentary behaviour are needed in order to produce accurate estimates of total time spent in physical activity and sedentary behaviour.

## 6. Financial support

This research did not receive any financial support from any organization.

## 7. Ethics approval

N/A

## 8. Consent

N/A

## 9. Availability of data and materials

Data and other material will be provided as supplementary document.

## Authors contributions

All authors contributed to the planning and design of the systematic review. The corresponding author performed the literature searches, full text screening, data extraction and analysed, and wrote the first draft of the review. The other authors contributed to the screening of the studies for eligibility, to the risk of bias assessment of studies. All authors reviewed, edited, and approved the final draft. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pmed.2021.101607>.

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## **2.2. Links and implications for next study**

To the best of my knowledge, this systematic literature review was the first to provide a comprehensive narration of the population-based literature on the dietary patterns, physical activity and sedentary behaviours in children and adolescents. The systematic literature review has identified that maternal employment was associated with poor dietary habits but more physical activity and more time on sedentary activities. High sedentary behaviours were related to TV watching and other screen-based activities of children. Poor lifestyle behaviours have public health relevance, especially poor diet and activity patterns may be a risk factor for numerous negative health outcome, including cardiometabolic risk, adiposity, depression, and poorer quality of life (Carson et al., 2016; Funtikova et al., 2015; Meyer, 2016; Stiglic & Viner, 2019). In addition to having long-term physical, social, psychological, and economic consequences, poor dietary patterns can affect a child's physical development throughout childhood and adolescence (UNICEF, 2020). Given the original contributions of this systematic review, the understanding in the domain of diet, physical activity and sedentary behaviour among children and adolescents, this study is likely to be a reference for future public health research on these three lifestyle behaviours.

This study was also the first to distinguish between the studies from different income classification of countries (e.g., HICs, UMICs, LMICs). The systematic review highlighted the paucity of studies on maternal employment and dietary patterns, physical activity and sedentary behaviours in upper and lower-middle income countries, 16.7% for UMIC and 7.1% for LMIC, so further research is required to determine how the employment status of mothers affects the dietary habits, physical activity levels, and sedentary behaviour of children and adolescents in these countries. As such, the next study employed a qualitative design semi-structured individual interviews (n=22) to gain a more comprehensive insight into the perspectives, experiences, facilities, and obstacles faced by mothers in Bangladeshi urban families regarding their children's diet, physical activity, and sedentary behaviour, as well as how these are associated with their employment status.

# **CHAPTER 3: DIET, PHYSICAL ACTIVITY, AND SEDENTARY BEHAVIOUR OF CHILDREN OF EMPLOYED AND NOT-EMPLOYED MOTHERS: A QUALITATIVE EXPLORATION**

This paper has been submitted to the journal PLoS ONE. The submitted version of the manuscript is included in this thesis. The manuscript is formatted in accordance with the Vancouver reference guidelines as required by the journal.

## **3.1. Abstract**

### **Background**

Growing economic needs, expansion of educational and employment opportunities, and changing attitudes within the society towards employed women, are some of the influencing factors of increasing female employment in Bangladesh. However, female labour force participation has been negatively associated with being married and having young children here. There is an absence of information about the associations between maternal employment and children's dietary patterns, physical activity, and sedentary behaviour in the context of lower-middle income countries (LMICs). This study aims to comprehensively explore the dietary patterns, physical activity, and sedentary behaviour of children aged 6-18 years of mothers differing in employment status within Bangladeshi urban families.

### **Methods**

A qualitative design and purposive snowball sampling were used. Semi-structured individual telephone interviews were conducted [n=22] with employed and non-employed mothers. Data were analysed using Braun and Clark's thematic analysis. A combination of inductive and deductive techniques was used to generate codes.

### **Results**

The interviews identified 5 emerging themes. Analysis demonstrated that diet, physical activity, and sedentary behaviour were influenced by family food environment, children's preferences, family type, environmental barriers to physical activity, time constraints, and use of screen-based devices at home. Maternal income provides opportunities for non-homemade food and maternal absence has a detrimental impact on physical activity and sedentary behaviours.

## **Conclusion**

Given the scarcity of research on influences of maternal employment on children's dietary patterns, physical activity, and sedentary behaviour in LMICs, this study will add new information and results may serve as a basis for future quantitative research to address the problem of child's feeding, physical inactivity and the use of screen-based devices experienced by working mothers in urban Bangladesh. Findings indicated that interventions aimed at reducing screen time, increasing physical activity, and improving diet quality are needed.

## **3.2. Introduction**

Consistent with global trends, an increasing proportion of the labour force in Bangladesh are women. Growing economic needs, expansion of educational and employment opportunities, and changing attitudes within society towards employed women are associated with increased female employment rates in urban Bangladesh [1]. Female employment has experienced a remarkable transformation during 1980s and 1990s, with the expansion of export oriented ready-made garment (RMG) industries being particularly noteworthy. This sector has generated approximately 4 million employment opportunities, with 80% comprising females [2]. According to World Bank data, labour force participation among women over age 15 has increased from 25% in 1990 to 36% in 2019, although this rate has slowed [3]. Some of the many reasons for these shifts include marital status, which have reduced women's influence regarding labour market activities due to reproductive and care burdens [4,5].

Female participation in the labour force has attracted researchers to explore potential relationships between maternal employment and child health-related behaviour in an effort to understand and enhance health outcomes. Currently, the focus of available studies on maternal employment and childhood obesity has solely focused on dietary patterns, physical activity, or sedentary behaviour, or a combination of these behavioural patterns [6-9]. However, comprehensive studies involving all these factors remain scarce. Few studies have identified within the context of high-income countries [9-12], which may not be applicable within the context of Bangladesh, a lower-middle income country (LMIC) in South Asia.

Studies on maternal employment and children's diet [7,8,11-13] and physical activity [14,15] has shown negative associations. Maternal employment tends to be associated with less favourable physical activity and diet among their children. Sedentary behaviour among children – low energy sitting or reclining outside of sleep hours – has shown an increasing



association with maternal employment in higher income countries, such that maternal employment is associated with greater sedentary behaviour of children [6,8,9]. Little is known about these relationships outside of higher income countries, with research concerning these relationships also being less conclusive, particularly within LMICs [16-18]. This suggests social and cultural contexts may influence these associations [7]. Thus, this study aims to gain a deeper understanding of mothers' experiences, views, influences, and barriers concerning their children's diet, physical activity and sedentary behaviour, associated with maternal employment status within Bangladeshi urban families.

### **3.3. Methods**

#### **3.3.1 Study design**

Due to limited availability of data, we adopted a qualitative approach. Furthermore, the rationale behind employing a qualitative method was to gain a deeper understanding of the effects of maternal employment, thus facilitating the implementation of a quantitative survey. Interviews were chosen as they provide rich and nuanced information about participants' experiences, views and beliefs concerning the research topic [19]. The Ethical Review Committee of the University of Southern Queensland, Australia, approved this study [ref: H20REA147, dated: 20 August 2020]. Informed written consent was obtained from all participants.

#### **3.3.2 Participants and Settings**

Individual interviews were conducted with employed and not-employed mothers. It is worth mentioning that we deliberately used the term 'not-employed'. Generally, employment refers to work for payment, and unemployment means the state when someone is willing and able to work but does not have a paid job. Since all mothers engage in work, whether it is within their homes or at their workplaces, regardless of payment, we refrain from labelling them as unemployed or not working. The term "not-employed," as used here, pertains to working without receiving payment or not being in paid employment. Inclusion criteria for employed mothers were: having at least one child between 6-18 years, being a dual earning family, mother working outside of the home (>20 hours/week) and residing in Sylhet in Bangladesh. Not-employed mothers had identical selection criteria, except the 'working outside' criterion. This city was chosen as it represents a typical urban area of an LMIC. Because this city has experienced significant urbanization with rapidly changing physical infrastructure and socio-demographics. Economic growth in Sylhet is evident in sectors such as trade, education, and

remittances from overseas workers. According to the Bangladesh Population Housing Census (2011)[20], the highest expansion of the urban area in Bangladesh has taken place in Sylhet Division, which is 13.86%. The census also shows that urban population variation during 2001-2011 was the highest in Sylhet Division (48.12%). Considering these circumstances, Sylhet has been chosen as a representative of urban area in LMICS. Purposive and snowball sampling were used to ensure that the participants met the recruiting requirements and to achieve some diversity [21]. Possible participants were approached through telephone or email. Telephone numbers/email addresses were collected via personal and professional networks.

The children of the mothers interviewed were 6–18 years old [mean age 10.5 years, SD=3.50] and 54.5% children were female. Of the 22 mothers, 13 were employed in different occupations, and most were from nuclear families (77%). A majority of the mothers (59%) completed tertiary level education and 13% did not carry out education after primary level (Table 3.1).

**Table 3.1 Demographics of respondents (N=22)**

Characteristics	n (%)	M(SD)
Employment status	Employed as:	
	4 (18.18)	
	Banker	3 (13.64)
	Teacher/lecturer	1(4.55)
	Doctor	1(4.55)
	Nurse	2 (9.09)
	NGO* employee	2 (9.09)
	Cleaner	
	Total employed	13(59.09)
	Not employed	9(40.91)
Age of mothers (years)		36.5 (4.4)
Education	Up to primary or equivalent	3(13.64)
	Up to secondary or equivalent	4(18.18)
	Up to higher secondary or equivalent	2(9.09)

Characteristics		n (%)	M(SD)
	Tertiary level completed	13(59.09)	
Type of family	Nuclear	17(77.27)	
	Extended	5(22.72)	
Number of children	One	1(4.55)	
	Two	17(77.27)	
	More than two	4(18.18)	
Gender of child	Female	12(54.55)	
	Male	10(45.45)	
Proportion of children	Children (6-12 years)	14 (63.64)	
	Adolescents (13-18years)	8(36.36)	
Total family income (BD** Taka) per month	<20,000	4(18.18)	
	20,000-<40,000	4(18.18)	
	40,000-<60,000	13(59.10)	
	60,000 or more	1(4.55)	

\*Non-government organisation \*\* Bangladeshi taka (1000 ~ AU\$ 15.5 and US\$12 as on March 2021)

### 3.3.3 Interview schedule

A semi-structured interview schedule was crafted following a literature review of children's dietary patterns, physical activity and sedentary behaviour. A semi-structured discussion guide allowed the respondents to tell their story and facilitate possibilities of capturing high quality participant data in a flexible manner. Topic guides were extensively revised to ensure acceptability of questions across employed/not-employed mothers. Topics included patterns and contexts of diet, facilities/barriers to physical activity, and motivational/contextual reasons for sedentary behaviour among children and adolescents.

### 3.3.4 Data collection

The data were collected in between September-October 2020. All interviews were conducted over telephone (due to COVID-safe procedures) by the lead researcher, usually in an interviewee's preferred time. The lead researcher is an employed mother in Bangladesh. Interviews were audio-recorded with the consent of the interviewee. Interviews lasted approximately 30-60 (average 45) minutes. A prepared script was used to introduce the study. Because the interview was semi-structured, there were some specific topics to be covered, however, the researcher was able to delve deeper into the subject by asking supplementary

questions that were not on the interview guide [22]. Interviews were conducted in the local language (Bengali). Throughout the interviews, mothers were encouraged to express their experiences regarding the key constructs. Before each interview, interviewees completed a self-administered demographic questionnaire. Interviews were continued until saturation, at point where pre-determined codes/themes were effectively reflected in the data and further data would not likely result in the identification of new codes or themes [23,24]. Saturation was achieved after interviewing 22 participants.

### **3.3.5 Data analysis**

Thematic analysis [25] was used to analyse the data. Interviews were transcribed verbatim prior to thematic analysis. Thematic analysis involves a series of phases including familiarization with data, generating initial codes, looking for themes, reviewing themes, and defining/naming the themes. Some of the themes of this study were pre-defined, based on topics covered in the interviews. Transcriptions were read and coded by the lead researcher using a combination of inductive and deductive techniques. This enabled a comprehensive immersion of data [26] and avoided inaccurate recollection of conversations [27]. During transcription, care was taken to ensure the anonymity of data. All participants were offered to check the transcript, however only two accepted. Another co-author reviewed the data in the Bengali language and made small changes to the codes and themes. Final themes were crafted after discussion with the research team. This process enabled greater trustworthiness and accurate interpretation of data.

## **3.4 Results**

### **3.4.1 Characteristics of study participants**

Sample [n=22] comprised of 13 employed and 9 not-employed mothers (Table 3.1). Age of participants ranged from 30 to 46 years (mean  $36.5 \pm 4.4$  years). Family income ranged from <20,000 to > 60,000 Bangladeshi taka (BDT) per month (~US\$235-700). Employed mothers worked outside the home for 5 days/week, between 6-12 hours/day.

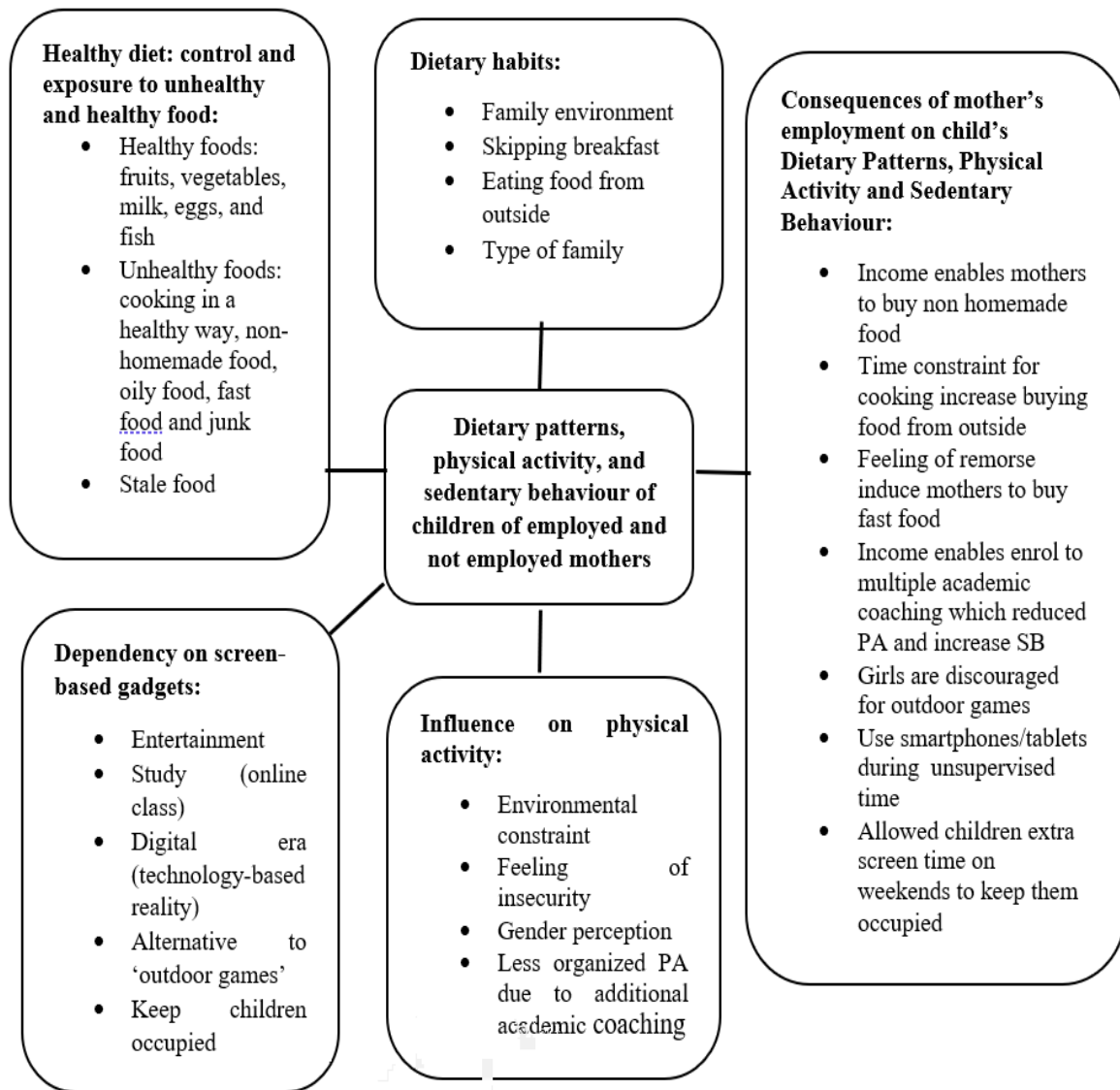
### **3.4.2 Themes**

The evaluation of 22 interview transcripts identified a total of five themes and 13 sub-themes (Table 3.2). The first two themes related to dietary pattern, one based on physical activity, and one on sedentary behaviour (children's screen-based activities). The last theme was concerned with the influence of mother's employment on diet, physical activity, and

sedentary behaviour. Thematic map (Figure 3.1) was developed based on analysis of transcripts.

**Table 3.2 Summary of themes**

<b>Themes</b>	<b>Sub-themes</b>
Theme 1: Child's eating habits	Eating habits of children Nuclear vs extended family Tendency of skipping meals
Theme 2: Healthy diet: control and exposure of unhealthy and healthy food	Exposure at the home Exposure in the community
Theme 3: Influences of environmental constraint on physical activity	Built environment Perceptions of safety within the environment Time pressure due to study
Theme 4: Dependency on screen-based devices	Use of screen-based devices within the home Measures taken to limit screen time Justifications for limiting screen time
Theme 5: Trade-off between time-income and maternal care: the channel through which maternal employment impacts the dietary patterns, physical activity, and sedentary behaviour of their children	Income and time effects Remorseful feelings of employed mothers.



**Figure 3.1** Overall thematic map of dietary habits, physical activity, and sedentary behaviour of children of employed and not employed mothers

### Theme 1: Child's eating habits

Full-time employed mothers mentioned family food environment and children's preferences influenced their food habits. Busy employed mothers offered instant foods (e.g., noodles, frozen food) and non-homemade food to their children, a practise that was not evident among stay-at-home mothers.

When I'm too busy in the hospital, I order food for my children. On the other days, however, I tried to make a balance. (Employed mother of 15-year-old boy)

Most of the mothers perceived that, as a 'good mother', cooking is a family responsibility, although employed mothers mentioned it to be "very tiresome" due to fatigue associated with

the additional demand of paid work and home duties. Only a few employed mothers mentioned they do not cook because they are “too tired to cook after coming from the office” and it reduces time with children. One full-time employed mother stated, “When I am at home, I try to spend time with my children to compensate for my absence.” In contrast, not employed mothers tended to cook more often because “family members do not like it if food is cooked by the domestic housekeeper”. In addition to this, they do not have faith in the hygiene and cleanliness of the paid domestic staff. Reasons were clarified by one respondent as most of them (paid domestic staff) are from families in poverty, live in slum areas, and do not have sufficient knowledge nor consistent practices of good hygiene.

Type of family also has a role in shaping children’s food choice. Grandparents’ food consumption patterns influence children’s dietary intake as they are likely to be the children’s main caregivers in the absence of the mother. Children living with grandparents are more likely to have healthier eating—defined within interviewees as consumption of homemade and traditional (Bangladeshi) dishes (e.g., rice, lentil/pulses, vegetables, fish curry), and no strong preference for processed/fast foods.

Most mothers from nuclear families said they tried to cook according to children’s choices as their children prefer ‘selective foods’ (e.g., chicken for lunch/dinner, fries/burger for afternoon snacks). Compared to children of nuclear families, children of an extended family have less preferences for non-homemade foods.

...I strive to meet my daughter’s preference (e.g., chicken for lunch/dinner, fries/burger for afternoon snacks) in the menu. (Employed mother of 15-year-old girl from nuclear family)

My son eats the same foods as the rest of the family. They used to eat traditional cuisine like fish curry and vegetables with rice, influenced by their grandmother. (Employed mother of 8-year-old boy from extended family)

In comparison to stay-at-home counterparts, employed mothers stated that their children were more likely to skip breakfast. Because both mother and kid are in a rush for work/school, children tend to eat an insufficient portion of food or refuse to eat breakfast. However, interviewees underlined the necessity of establishing habits of eating breakfast at an early age so children could eat independently if the mother is busy.

In the morning both of us are in hurry. She eats alone, and the amount is insufficient like an egg or 3/4 sip of milk. (Employed mother of 11-year-old girl)

Skipping breakfast was not reported by unemployed mothers as they typically never allowed child to go to school without breakfast.

Skipping meal is bad for health. Stomach will remain empty for a long time. So, I always insist her to eat breakfast. (Stay-at-home mother of 10-year-old girl)

## **Theme 2: Control and exposure to unhealthy and healthy food**

The importance of cooking food in a healthy way was also mentioned, “I do not use much oil in cooking”. Employed mothers expressed desires to feed children vegetables/fruits yet felt their children did not eat enough (which was not the case for not employed mothers).

In my absence, kids don't eat vegetables. (Employed mother of 11-year-old girl)

My son eats only some selective vegetables. I try to balance this deficiency giving him more fruits. (Employed mother of 15-year-old boy)

Again, non-homemade, oily food (fries), and fast food /junk food were mentioned as unhealthy food by almost all interviewees. Stale food (e.g., food prepared 2-3 days prior) was also considered unhealthy as it may cause food poisoning. Mothers were aware of healthy and unhealthy foods; however, this was not translated into practice. Many of the foods that children preferred were deemed unhealthy by mothers, yet these foods were frequently purchased by working mothers as a form of compensation for being away from their children for work. In contrast, stay-at-home mothers prefer to encourage their children to eat homemade food.

... I feel guilty as well as some sort of obligation...kids become happy if I bring something for them...pizza, burger what they like. I know these are unhealthy, but their smile is important. (Employed mother of 13-year-old boy)

My daughter likes non-homemade food. But we have been controlling those foods that we considered unhealthy. (Stay-at-home mother of 10-year-old girl)

Physical proximity of snack shops attracted children and employed mothers buy such foods more frequently. “My son got hungry after school. He buys chips/crackers/ice cream, or coke from the snack shop in front of the school” stated by employed mother of 8-year-old boy.



### **Theme 3: Influences of environmental constraint on physical activity**

Environmental barriers to physical activity include the lack of proper playgrounds and playmates, as well as feelings of insecurity due to safety concern. Most interviewees mentioned that their children like to play but not having any playgrounds or parks close by bars their interest. For many children school is the single-most place where they have both playgrounds and playmates.

My son plays in the school. But at home he does not have any place to play.  
(Employed mother of 10-year-old boy)

Interviewees, particularly employed mothers, indicated they feel fearful to let children, especially daughters, to go outside alone. Teenage girls are considered ‘old enough’ to go outside to play. These obstacles make children more constrained, and less interested in playing.

When I'm not home, I forbid my kid from playing outside. (Employed mother of 6-year-old girl)

My elder daughter is not going outside for playing as she is grown-up now. (Stay-at-home mother of 15-year-old girl)

Private academic coaching is an important part of many children’s daily lives in Bangladesh. Almost all mothers mentioned that their child attended additional tutoring after school. Private academic coaching replaces time otherwise available for physical activity. All mothers mentioned that they understood physical activity increases physical fitness, however children have less physical activity because of time constraints, including academic coaching.

I admitted my son to a (children’s) cricket club. But due to pressure of study, he stops going there. (Employed mother of 13-year-old boy)

### **Theme 4: Dependency on screen-based devices**

During the COVID-19 pandemic, online classes and study activities on computer increased screentime of children. Children also used smartphone/tablet for entertainment, particularly watching movies/cartoons on You Tube or playing games. The predominant sedentary behaviours within the home differed depending on age and gender of the child. Older children spent more time on screen-based devices. According to respondents, girls’ sedentary behaviours were listening to music, talking on phone, and watching videos whereas boys spent more time playing games. One interviewee pointed out that environmental barriers

(e.g., no playground/park close by) to outdoor playing are key reasons diverting children towards screen-based activity. She felt screen-based activities are replacing physical activities. Employed mothers said their children use screen-based devices more when mothers are not at home as they cannot monitor them at that time. Employed mothers of children (6-12 years) mentioned they permitted playing games on smartphones/tablets on weekend days to keep children occupied so that they can do household activities without interruption.

...I have many households work at home on weekends. When I am busy with household chores, I let my son play games on phone. (Employed mother of 10-year-old boy)

Restrictions on time and content were identified as key controlling measures for screen time. Mothers said they allow tablet/smartphone for a certain period only. Others mentioned they do not limit time, rather they control the content of what the child watches. Other interviewees expressed disappointment as they feel their rules and restrictions could not sufficiently control their children's use of smartphone/tablet.

My son spends 5-6 hours watching cartoons or playing games in smartphone. If I told him to stop watching, he gives me the device, but after a few minutes' he requests for it. (Stay-at-home mother of 15-year-old boy)

All mothers wanted to control their child's screen time due to adverse effects on health and wellbeing. Employed mothers stated that screen time was connected to time wastage, fixation with device, decreased physical activity, weight gain, and health issues from prolonged sitting.

My daughter watches 'Tiktok' and other videos...nothing useful. (Stay-at-home mother of 10-year-old girl)

My son is gaining weight in an unhealthy manner as he sits whole day with phone. (Employed mother of 17-year-old boy)

Sitting with phone for long time is unhealthy. (Employed mother of 10-year-old girl)

### **Theme 5: Trade-off between time-income and maternal care: the channel through which maternal employment impacts the dietary patterns, physical activity, and sedentary behaviour of their children**

Employed mothers, according to ecological model, are members of two systems: home and work. Workplace characteristics such as work hours and income will be linked to both individual functioning and the quality of family ties. Because mothers spend more time caring for their children, characteristics such as employment status may have played a role in influencing their children's lifestyle behaviours.

One of the most important themes was that mother's employment was clearly seen to be impacting the child's dietary patterns, physical activity, and sedentary behaviour. Even though the mother's income provides additional financial support, it can reduce time devoted to the children (Figure 3.1). Higher family income appears to increase the opportunities for buying prepared food and enrolling children in private academic coaching. Employed mothers mentioned that the decrease in family time was a constraint for cooking and looking after children. After spending 8-10 hours at work, it becomes stressful for mothers to cook food. Mothers mentioned that they typically purchase foods that could be easily prepared (e.g., instant noodles). Income also allowed families to employ a maid / house-help for cooking/domestic support. Children of employed mothers frequently buy snacks and fast food from shops located nearby the school compared to not employed mothers.

Mothers consider financial support as the main benefit of being employed and wanted to spend a proportion of income supporting future career prospects of their children, hence they enrol children in academic coaching opportunities. As stated, this is likely to reduce time for physical activity and may also increase sedentary time. Children prefer to spend more time on smartphone/tablets when they are unsupervised, or when supervised by non-parents. Employed mothers tend to not let their children, particularly girls, play outside for security reasons, as stated.

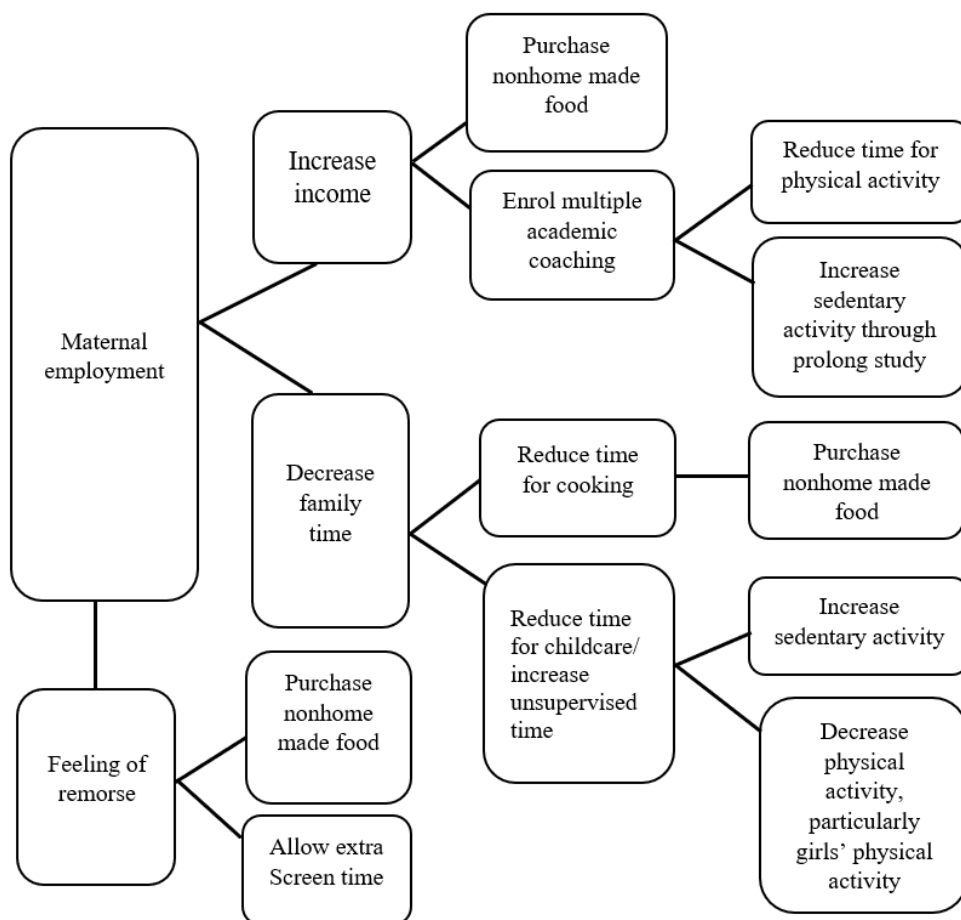
There are many limitations relying solely on one person's (spouse) income. My income supports me to purchase foods that my children prefer... (Employed mother of 15-year-old girl)

My income helps better facilities for my son's study. (Employed mother of 6-year-old boy)

Emotions of employed mothers had an impact on food intake and sedentary activity. Most employed mothers expressed feelings of remorse that their children are deprived of maternal care due to employment. This emotion drives them to do bring foods that their children like, often being fast food bought on the way back home, to allow more time in addition to their allocated time to watch or play games on a smartphone or tablet as compensation. Figure 3.2 provides a schematic presentation of income and time effect of maternal employment.

Sometimes my son wants me to buy drink (coke) for him. Since I am out of the home for a long time, I feel I should take what he wants... It will make him happy...It's difficult to strict to healthy rules for a working mother. (Employed mother of 13-year-old boy)

They continue to view videos on tablet after online class in my absence. (Employed mother of 13-year-old girl)



**Figure 3.2** Income and time effect of maternal employment on children’s dietary patterns, physical activity, and sedentary behaviour

### 3.5 Discussion

This study provides unique insights into the under-investigated experiences of Bangladeshi mothers, who differ in employment status, regarding three key health behaviours (diet, physical activity, and sedentary behaviour) of children using thematic analysis. Income and time availability were two salient issues. Some findings were similar to those of prior studies while others provided new information, in particular about children's physical activity and sedentary behaviour patterns during the COVID-19 pandemic.

In this study, findings related to 'non-homemade food consumption' and 'skipping of breakfast' support previous research showing that maternal working hours appear to be related to greater consumption of less healthy non-homemade food [28], less breakfast with family [7], and skipping breakfast or consumption of fewer meals with children [29]. Other research has shown that working mothers allocate less time for cooking [10] and supervising children's eating [6], which may lead to consumption of non-homemade food and further disruption to family meals, including skipping meals.

Children living in extended families appear more likely to eat homemade and traditional (local) dishes than those living in nuclear families. Family structures and family meals eaten together have been previously identified as important predictors of children's dietary habits in Asian countries [30,31]. According to these authors, extended family members' diets, such as the grandmother's, have a considerable impact on children's food consumption and children ate more traditional/staple foods when eating meals with family. We found similar interactions between the diets of grandparents and children.

Evidence has shown that working mothers spend significantly less time in cooking [10,32] and meal preparation [33], a finding that contrasts with our results in Sylhet. We found most of the mothers still consider cooking as a key responsibility they have for the family. This discrepancy can be explained by the conventional gender norms and the patriarchal social structure of Bangladesh. Such a social structure assigns specific gender norms and domestic responsibilities on females from an early age [5] ; they believe cooking to be "women's work" and "mother's responsibility", regardless of their employment status.

Higher household income may increase the opportunities for pocket money available for the purchase of junk food in school [7], which enables children to buy food from vending

machines and school tuck shops [34]. Another study of Bangladeshi children found most young children receive pocket money from their mother and about two-thirds of them buy foods from shops close to their school [35]. We revealed that the notion of healthy food included good meal preparation. On the contrary, oily, store-bought, stale, and fast/junk food were all viewed as unhealthy.

In the urban area where we sampled, there is a scarcity of playgrounds. Such unfavourable environments constrain physical activity, whereas social cohesion is associated with children's participation in sports and physical activity [36] and neighbourhood environments are a significant predictor of physical activity. Our study found employed mothers were unwilling to allow girls, in particular teenage girls, outside for outdoors games due to social and safety concerns. This confirms the findings by James (2001) [37] based on a study of adolescent women. The author [38] identified that stereotypical gender roles, gender differences in outdoor recreation opportunities, and physical and environmental factors, as well as family expectations to time spent in their bedrooms (listening to music, reading magazines), were the factors associated with adolescent girls' activities, similar to current study result in a Bangladeshi setting.

The importance of attending academic coaching after school was found in other studies in Asian countries [30,38]. In accordance, authors [39] have highlighted the use of afternoon time as the most consistent correlate of active recreation. This 'critical window' of time – after school but before dinner (or it gets dark) – is a key time to promote physical activity [40]. Expectations of Asian parents regarding academic performance have the potential to reduce children's post-school playtime and increase sedentary time associated with prolonged study, confirming findings of the present study in the context of Bangladesh. Academic achievement was given priority over a healthy lifestyle as it is seen to be related to enhanced career opportunities.

We found that mothers believed children's screen-based sedentary time was greater than was previously seen due to the COVID-19 pandemic. Besides watching TV, videos/movies and playing games on smartphones/tablets, participation in online classes and doing homework on computers increases children's screen time, consistent with contemporary COVID-19 findings [41]. Gender differences in screen-based sedentary behaviour were consistent with recent findings [42,43]. Prior studies [7,44,45] also reported insufficient physical activity and more unsupervised time as correlates of sedentary behaviour.

We broadly split the impacts of maternal employment status on children's diet, physical activity and sedentary behaviour into income and time effects. Income allows mothers to buy non-homemade food and enrol children in academic coaching. Attending academic coaching can influence physical activity/sedentary behaviour in a detrimental way. Although previous studies have shown physical activity is largely independent from sedentary behaviour [46,47], this finding indicates that lack of physical activity may increase the likelihood of spending more time in sedentary postures through prolonged study, suggesting a connection between both behaviours. This recognises the negative correlations of sedentary behaviour with exercise and physical activity [48,49] and the '24-hour' model<sup>1</sup> where changes in sedentary time have to be displaced by more active behaviours during waking hours [50]. Our findings match earlier research showing that working mothers' time constraints were associated with pre-prepared meal purchases [9,] and an increase in sedentary behaviour [7,28]. The current study found that the children of employed mothers spent more sedentary time when they were in the care of others or were left unsupervised.

We also found mothers' awareness about children's diet and activity patterns was not always reflected in their behaviour. Employment creates a double burden on women as they often take the family responsibilities and thus may have insufficient time and energy to fully supervise and actively engage with their children [9,28]. Hence, mothers allowed some food or activity for their children which they considered unhealthy. These were intended to make their child happy, but this, at the same time, also promoted opportunities for unhealthy eating and activity habits, suggesting that certain ambivalence feelings among employed mothers were another channel that impacts children's dietary and activity patterns.

This thematic analysis did not find consistent results with all the themes following previous studies. For example, the time allocated to household management (i.e., cooking, cleaning, laundry etc.) by employed women has been decreasing in the last 45 years [51] which is opposite to the finding of mothers' time spending for cooking because of 'mothers' responsibility' and gender role imposed by the society in Bangladesh. Secondly, prior studies

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<sup>1</sup> The '24-hour' model describes the amount of time spent in movement behaviours, including physical activity (light, moderate, vigorous), sedentary behaviour and sleep, across the 24-h day. One can only increase time in one activity by decreasing time in another.

identified physical activity and sedentary behaviour were independent of one another [46,47], however, we found that physical activity and sedentary behaviour were substituted due to lesser prevalence of opportunities for physical activity, and the increased availability of electronic devices and increased parental pressure for prolonged hours of study. Finally, this study found that the substitution effect (time constraint) of employed mothers has a greater significant negative effect than the positive income effect as has been reported earlier in Bangladesh [52]. Employed mothers have less time, energy, and flexibility to take care of their children after work, which contribute to stronger negative time effect. In addition to this, this study identified a feeling of compunction of employed mothers that induced them to compromise with children's food and sedentary activities; this is a new addition to the existing literature.

### **3.5.1 Strength and limitations**

To our knowledge, this is the first study that provides critical insights into how maternal employment status plays important roles collectively in the diet, physical activity and sedentary behaviour of children and adolescents in a LMIC. Since the interviewees covered a wide range of topics, our findings may extrapolate to other similar settings in Bangladesh and possibly to other LMICs with comparable cultural backgrounds. Some limitations should be mentioned, though. Participants were only recruited from one city of Bangladesh. Due to non-random sampling, like-minded people may have been invited. Given the educational level, there is relatively less heterogeneity in the sample. The themes we identified need to be further tested through both quantitative and further qualitative analyses. Other socioeconomic and demographic factors may affect the habits of dietary patterns, physical activity, and sedentary behaviour and should be considered in future studies.

### **3.6 Conclusion**

This study adds to the understanding of the various pathways by which maternal employment may influence the diet, physical activity and sedentary behaviour of children in Bangladesh. These findings demonstrate that regardless of employment status, mothers were aware of their children's diet, and activity patterns, however, employed mothers often felt compromised regarding what is best for their children. In this study, the decline in children's diet appears to be an important consequence of maternal employment. The findings for activity-related behaviours indicated a decrease in physical activity and an increase in



sedentary behaviour of children irrespective of maternal employment status. This happens mainly for online classes and other online activities due to COVID-19. Yet, children of employed mothers spent less time on physical activity and more time on screen-based activities compared to not-employed mothers. Given the paucity of research on the effects of mothers' employment on children's diet and activity patterns in LMICs, this study adds to the growing body of knowledge about how mothers' time for family, income, and the overarching socio-cultural environment influence children's dietary habits, physical activity, and sedentary behaviour in urban Bangladesh. Findings of this study can be used for future interventions to reduce children's screen time, increase of physical activity, and improve the quality of diet. In this regard, mothers can play an important role.

### **Author's contribution**

S.A., A.M., G.F.S. and S.J.H.B. contributed to the planning and design of the study. S.A. performed the literature searches, data collection, and analysis, and wrote the first draft of the paper. A.M., G.F.S. and S.J.H.B. reviewed, edited, and approved the final draft. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

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### **Conflict of interest**

The authors have no financial or non-financial conflict of interest to declare that are relevant to the content of this article.

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### **3.8 Links and implications for next study**

This study was the first to provide an insight into the correlates of dietary patterns, physical activity, and sedentary behaviours of children and adolescents of employed and not-employed mothers in Bangladesh. This comprehensive study enriches our understanding by exploring the concepts and experiences of mothers as well as providing the contextual and environmental factors related to eating habits, physical activity and sedentarism of children of employed and not-employed mothers. The findings are important to understand children's eating habits, physical activity, and sedentary behaviour patterns within the home and in the community and the differences and similarities between employed and not-employed mothers. Better understanding the context in which dietary and activity behaviours in children and adolescents occur is beneficial to policymakers to figure out the future interventions to have the maximum impact. We use qualitative analysis at the beginning as qualitative research is assumed to be the primary tool for data collection and analysis (Atieno, 2009). However, findings of the qualitative approach cannot be extended to a larger population with the same degree of certainty that quantitative analyses can, because the research findings are not tested to discover whether they are statistically significant or due to chance (Atieno, 2009). Quantitative methods allow a reliable and systematic measure of the variables and test hypotheses (Queirós; et al., 2017). Moreover, participants' responses in the qualitative interview were likely subject to social desirability bias. Therefore, the next study conducted a quantitative analysis to understand the association of maternal employment with diet and physical activity patterns of children and make predictions for a larger sample.

# **CHAPTER 4: DOES MATERNAL EMPLOYMENT INFLUENCE DIETARY AND PHYSICAL ACTIVITY PATTERNS OF BANGLADESHI CHILDREN? EVIDENCE FROM A CROSS-SECTIONAL STUDY**

This manuscript is under progress. It will be submitted to either a physical activity or child health/wellbeing journal. The manuscript is formatted in accordance with the Vancouver guidelines.

## **4.1 Abstract**

Studies on the impact of maternal employment on the dietary and physical activity patterns of children in low-and-middle-income countries (LMICs) are scarce. This paper aims to examine the dietary and physical activity patterns of Bangladeshi children and their association with maternal employment status. The survey was conducted between February and September 2021 during the COVID-19 restriction in Bangladesh. Data were collected from three locations in Bangladesh, namely Dhaka, Sylhet, and Mymensingh. On behalf of 304 children (148 female and 156 male) aged 6-18 years ( $M=10.5$ ;  $SD=3.35$ ), mothers completed the Food Frequency Questionnaire (FFQ) and Physical Activity Questionnaire for children (PAQ-C) and adolescents (PAQ-A). Logistic regressions were used to identify factors associated with dietary and physical activity patterns. Most respondents (57%) reported eating fewer than five servings of fruit and vegetables per day. A minority (8.2%) reported skipping breakfast 3-7 days per week. About half (52.3%) reported drinking milk at least daily. Most of the respondents (96.4%) reported insufficient protein consumption. Additionally, most children (93.8%) were moderately active. Findings revealed insufficient fruit, vegetable and protein consumption among children and adolescents. Disparities were identified contingent on age, family income, family size, number of siblings, family type and BMI status. However, maternal employment status was not found to be a predictor of diet or physical activity patterns in children and adolescents. Interventions can be aimed at promoting fruit, vegetable, and protein consumption and could potentially target enhancing family supports and attitudes.

**Keywords:** Dietary patterns, Physical activity, Children and adolescents, Maternal employment, Bangladesh.



## 4.2 Introduction

Obesity and overweight were once solely a problem within high-income countries; however, the obesity epidemic has now burgeoned to low- and middle-income countries (LMICs) [1-3]. In LMICs, the prevalence of overweight and obesity among children and adolescents increased from 8% to 13% between 1980 and 2013 [4]. Changes in global nutrition and physical activity patterns, as well as economic development, are thought to be leading contributors to obesity. In LMICs, the 'nutrition transition' has shifted diet away from a traditional pattern of eating to high-fat, high-sugar, high-salt, energy-dense, and low-fiber diet [5] and childhood obesity has risen dramatically as a result of these changes in food patterning, combined with decreased levels of physical activity [6].

Poor dietary patterns and insufficient physical activity among children and adolescents are associated with numerous significant health problems, including metabolic and cardiovascular disease, poor bone mineral density, poor mental health, and reduced academic performance [7,8]. In contrast, healthy eating habits and regular physical activity are critical for healthy growth and cognitive development for children/adolescents [9,10].

Key factors in overweight and obesity include fast-food consumption, physical inactivity patterns, and sedentary screen time, as well as family and home environment, parental education, and maternal employment. Given the increased awareness of connections between diet, activity patterns and obesity among youth, maternal employment status has been receiving greater attention [11,12]. The associations between maternal work and children's dietary and activity patterns have been extensively studied in high-income countries, with findings indicating diet and activity patterns among children/adolescents are strongly associated with maternal employment status [12-14]. However, little is known about whether these relationships are evident in LMICs, with only 7% of studies based in LMICs [15].

Employed mothers tend to have less time for their children after balancing many roles and responsibilities at home and work [11,16,17]. In recent decades, the female employment rate has risen in conjunction with economic progress in Bangladesh. According to the World Bank, women's labour force participation has increased from 26.6% in 1990 to 34.5% in 2020 [18]. Several studies have addressed the associations of maternal employment with the prevalence of isolated health and behavioural factors including nutritional status [19, 20],

childhood diarrhea [21], behavioural problems and cognitive deficits [22,23], and obesity [1,24,25] among children/adolescents in Bangladesh; but with little or no information about other risk factors such as poor dietary and physical activity patterns. Thus, this study aims to examine patterns and correlates of diet and physical activity in a group of Bangladeshi children and adolescents and the association of these behavioural patterns with maternal employment status.

### **4.3 Materials and Methods**

Participants were children and adolescents aged 6-18 years. Mothers were recruited as proxy respondents to provide information about their children's dietary patterns and physical activity, as mothers are typically the primary caregivers and are responsible for their children's feeding and general well-being. The survey was conducted between February and September 2021 during the country-wide lockdown due to the COVID-19 pandemic in Bangladesh. Since data was collected during the lockdown, we employed an online data collection platform to ensure COVID safety. Participant email addresses were collected from the researcher's networks in three selected locations in Bangladesh, namely Dhaka, Sylhet, and Mymensingh; and these referrals helped to recruit more participants using snowball sampling. The primary investigator sent an email with an information sheet and consent form, explaining the study context and inviting participation. The link to online measures of dietary patterns and physical activity was emailed to those who consented to participate. We used the online survey platform of the host university for the survey. The ethics committee of the host University approved this study [H20REA147 dated 20/08/2020].

#### **4.3.1 Sample**

Employed and not-employed mothers were eligible to participate in the survey. Mothers with a 6–18-year-old child who did not have a chronic medical problem and who lived in any of the selected cities were eligible for recruitment. With young children more reliant on their mother's care, only the youngest child was considered for this study if a mother had more than one child between the age of 6-18. We choose children of 6-18 years age, because it is a critical period in child's development, where habits are being formed [26], influenced by a combination of family, and societal factors and set a base for future behaviours [27].

By using 95% CI (two-sided), 5% margin of error and 50% standard deviation (if p is unknown, its value is assumed to be 50% or 0.5) [28], the sample size determined 385 participants were suitable for this study. Further, we considered a 10% nonresponse rate,

resulting in a desired sample size of  $(385+10\%) = 423.5 \sim 424$ . Detailed sample size determination is provided in Appendix C.

#### **4.3.2 Measures**

This study used a structured 7-day recall Food Frequency Questionnaire (FFQ) to collect information on the dietary patterns of children and adolescents. This scale has previously been validated and used in Asian countries [29,30]. A validated 7-day recall instrument, the Physical Activity Questionnaire for children (PAQ-C) and adolescents (PAQ-A), was used to assess children's levels of physical activity [31]. The survey instruments were available in both English and Bengali (the local language) and took approximately 40–45 minutes to complete. The questionnaire covered demographic data (gender, age); family-based factors (mother's employment status, number of siblings, number of family members, family type, monthly income); 7-day physical activity; and 7-day food items. The study tools and procedures were pre-tested with ten mothers in Sylhet and then slightly modified based on pilot feedback.

#### **Dietary Patterns**

The FFQ instrument contains questions about major food types, including fruit and vegetable (FV), sugar-sweetened beverages, fast-foods, snacks and sweets, and staple foods. Mothers were asked how often their children ate these foods in the previous week. A six-point scale was given for each food item, ranging from 1 (Never) to 6 (More than 3 a day). For this study, the frequency of each dietary behaviour was categorized into "high" or "low" following Bangladesh national dietary guidelines [32] and World Health Organization guidelines [33].

#### **Meeting Recommendations of Fruit and Vegetable Consumption**

The recommended fruit and vegetable intake was reported contingent of age, sex and maternal employment status. Following WHO guidelines, the total frequency of fruit and vegetable consumption per day was calculated by adding the responses of consumption of specific fruit and vegetables per day [33]. The total frequency of FV consumption/day was dichotomized as follows:

High FV consumption if portions  $\geq 5$  times/day and Low FV consumption if portions  $< 5$  times/day.

#### **Fast-Food Consumption**

This variable was constructed from responses to eating several fast-foods including burgers, fries, instant foods, sandwiches, and others (e.g., ready to eat frozen food) in the past seven

days. The composite weekly frequency of eating fast-food was constructed from the weekly frequency of eating each category of fast-food item. Following the recommendation [32], this variable was then dichotomized as follows:

High = 'More than thrice a day' and 'twice a day, 'once a day' and '3-4 days a week'.

Low = 'Never', '1-2 days a week'.

### **Beverage Consumption**

The beverage variable (consistent with the fast-food variable) was built from responses to nine different sugar-sweetened beverages. This variable was then dichotomized as follows:

High = 'More than thrice a day' and 'twice a day', 'once a day' and '3-4 days a week'

Low = 'Never', '1-2 days a week'.

### **Protein Consumption**

This variable was calculated based on weekly consumption of fish, fowl, red meat, and eggs, and dichotomized as follows:

High = 'More than thrice a day', 'twice a day' and 'once a day'

Low = 'Never', '1-2 days a week', '3-4 days a week.'

### **Milk Consumption**

Considering the multiple health benefits of drinking milk, regular milk consumption was isolated from other beverages and protein variables and assessed separately. This variable was dichotomized as:

High = 'More than thrice a day', 'twice a day' and 'once a day'

Low = 'Never', '1-2 days a week', '3-4 days a week'.

### **Skipping Breakfast**

Research shows that children and adolescents who eat breakfast on most days of the week have better short- and long-term health benefits [34,35] compared with those who skip breakfast. We constructed this variable as a high frequency of skipping breakfast and a low frequency of skipping breakfast (weekly). This variable was evaluated using a single question that asked respondents how frequently their children skipped breakfast over the previous week. As a result, the 'skip breakfast' variable was created in a dichotomous fashion as follows:

High = '3-4 days a week', '4-5 days a week', and '7 days a week'

Low = 'Never', '1-2 days a week'.

### **Physical Activity**

The frequency of various types of physical activity over a week was rated on a 5-point scale, with the lowest score signifying the least amount of physical activity and a score of 5 indicating high physical activity. Based on the score, we created the Low to Moderate Physical Activity (LMPA) variable [36]. Moderate-to-vigorous intensity physical activity (MVPA) was not found among our sample of children.

### Sociodemographic Variables

**Table 4.1** Definitions of sociodemographic variables

Variable name	Description	Type of variable
Maternal employment	Occupation of mothers	Binary Categorical
Age group	Age of child in years	Binary Categorical
BMI of children [1]	Weight in kilograms divided by the square of height in feet	Categorical
Gender	Sex of child	Binary Categorical
Mothers' education	Level of education in years	Categorical
Family type	Type of members living together under the same roof	Binary Categorical
Type of school	Public vs private	Binary Categorical
Number of siblings	Total number of siblings	Categorical
Family size	Total number of members in the family	Categorical
Gross household income/month	Total income per month in Bangladeshi Taka	Categorical

### 4.3.3 Statistical analysis

Pearson's chi-square test was used to determine the associations between children's diet and physical activity with maternal employment and other socioeconomic components. Multiple logistic regression models were used to assess the association of maternal employment and other socioeconomic variables with child's dietary and physical activity patterns. Separate models were used for the alternative binary outcome variables of diet - such as meeting daily

recommended portions of fruit-vegetable, milk consumption, protein consumption, fast-food consumption, skipping breakfast (in a week) - and physical activity. All analyses were conducted using STATA statistical software version 17.0. Descriptive statistics were used to summarize the sample's sociodemographic, physical activity, and dietary variables. Age-group and gender differences were examined using Mann-Whitney tests.

## 4.4 Results

### 4.4.1 Sample characteristics

A total of 424 individuals were invited to participate in the survey, and 371 completed the questionnaire. Sixty-seven replies were disqualified because they failed to include all the required sections. As a result, the analytical sample of the study included 304 mothers (response rate 71.7%), 48.7% of them were mothers of girls, 70.1% were the mother of younger children (6 to 12 years old), 68.8% were engaged in paid work, and 77.9 % belonged to a family that had a monthly income higher than the national average. The mean age of young children was 8.4 (SD=1.98) years and of adolescents was 14.6 (SD=1.79) years. Table 4.2 provides information on the socio-demographic characteristics of mothers and their children.

**Table 4.2** Demographics of the mothers and children (N=304)

<b>Characteristics</b>	<b>Number*</b>	<b>Percentage</b>
Sex of children		
Male	156	51.3
Female	148	48.7
Mean Age of children (in years)	10.5(SD=3.35)	
6-12 years (children)	213	70.1
13-18 years (adolescent)	91	29.9
BMI of children		
Underweight	121	39.80
Normal	134	44.08
Overweight	33	10.86
Obese	16	5.26
Type of School		
Private	257	84.5

Characteristics	Number*	Percentage
Public	47	15.5
Type of Family		
Nuclear	247	81.25
Extended	57	18.75
Number of siblings		
No	69	22.70
1	193	63.49
2	31	10.2
3 or more	11	3.62
Education of mothers		
Less than primary	1	0.3
Primary completed	2	0.7
Secondary completed	13	4.3
Higher secondary completed	11	3.6
Graduation degree and above	277	91.1
Occupation of mothers**		
Not in paid work	95	31.2
In paid work	209	68.8
Monthly gross family income (in BDT)		
***	16	5.3
20,000 and below	51	16.8
20,001- 40,000	48	15.8
40,001- 60,000	60	19.7
60,001- 80,000	41	13.5
80,001-100,000	82	27
Above 100,000		

\*Total for each variable may not be equal to n=304 due to missing values

\*\*Due to small numbers in different categories, all paid work categories were combined to 'In paid work.'

\*\*\* BDT= Bangladeshi taka ;1000 BDT = 9.68 USD (as on 13 January 2023)

#### 4.4.2 Physical activity, fruit and vegetable, beverage, milk, protein consumption and breakfast habits

Significant differences were evident by age group for breakfast consumption, milk consumption and physical activity (Table 4.3). Younger children (6-12 years) skipped breakfast less and engaged more in low-to-moderate intensity physical activity (LMPA) per day compared to older adolescents. Similar results were found for milk consumption (Table 4.3). Younger children drink milk more regularly per day compared to adolescents. There were significant gender differences in daily FV consumption. Girls ate more fruit and vegetables per day compared to boys. Overall protein consumption was very low, with only 3.2% of children and adolescents having a high intake of protein.



**Table 4.3** Distribution of different food consumption/day, skipping breakfast per week and Low-to-Moderate Intensity Physical Activity:

Column-wise proportion is calculated

	Total (n=304)	Boys (n=156)	Girls (n=148)	Children (n=213)	Adolescent (n=91)	Child of employed mothers (n=209)	Child of not- employed mothers (n=95)	$\chi^2$	P value
<b>Frequency of FV consumption/day</b>									
Low	174(57.24)	102 (33.55)	72 (23.68)	116 (38.16)	58 (19.08)	57 (18.75)	117 (38.49)	8.6910	0.003
High	130 (42.76)	54 (17.76)	76 (25.00)	97 (31.91)	33 (10.86)	38 (12.50)	92 (30.26)		
<b>Fast food consumption</b>									
Low	302 (99.34)	154 (50.66)	148 (48.68)	212 (69.74)	90 (29.61)	208 (68.42)	94 (30.92)	0.3294	0.566
High	02 (0.66)	2 (0.66)	0 (0.00)	1 (0.33)	1 (0.33)	1 (0.33)	1 (0.33)		
<b>Beverage consumption</b>									
Low	303 (99.67)	155 (50.99)	148 (48.68)	213(70.07)	90 (29.61)	102 (33.55)	43 (14.14)	0.4560	0.499
High	1(0.33)	1 (0.33)	0(0.00)	0(0.00)	1 (0.33)	107 (35.20)	52 (17.11)		
<b>Protein consumption</b>									
Low	293 (96.38)	148 (48.68)	145 (47.70)	206 (67.76)	87(28.62)	199 (65.46)	95 (31.25)	2.6084	0.106
High	11(3.62)	8 (2.63)	3 (0.99)	7 (2.30)	4(1.32)	10 (3.29)	0 (0.00)		
<b>Milk consumption</b>									
Low	145(47.70)	75(24.67)	70(23.03)	93(30.59)	52(17.11)	102(33.55)	43(14.14)	0.0185	0.892
high	159(52.30)	81(26.64)	78(25.66)	120 (39.47)	39(12.83)	107(35.20)	52(17.11)		
<b>Skip breakfast</b>									
Low	279 (91.78)	144 (47.37)	135 (44.41)	202 (66.45)	77(25.33)	192(63.16)	87(28.62)	0.1199	0.729
high	25(8.12)	12 (3.95)	13 (4.28)	11 (3.62)	14 (4.61)	17(5.59)	8 (2.63)		
<b>Low-to-Moderate Intensity Physical Activity (LMPA)</b>									
Low	19 (6.25)	8 (2.63)	11(3.62)	9(2.96)	10(3.29)	13 (4.28)	6 (1.97)	0.6882	0.407
moderate	295 (93.75)	148 (48.68)	137 (45.07)	204 (67.11)	81(26.64)	196 (64.47)	89 (29.28)		

### 4.4.3 Regression Analysis

To determine which factors are associated with children's sedentary behaviour (recreational, productive, and less productive), binary logistic regression is used to estimate the likelihood that sedentary behaviour is related in the following way:

$$\text{Logit}(P) = \ln \frac{P}{1-P} = \alpha + \beta'X \dots\dots\dots(1)$$

Where  $P$  = the probability of the event occurring;  $\alpha$  is the intercept parameter;  $\beta$  is the vector of slope parameter; and  $X$  is the vector of explanatory variables. The explanatory variable ( $X$ ) describes some selected characteristics. A description of the variables used for the logistic regression analysis is provided in Table 1. If explanatory variables were associated with high sedentary behaviour at a 10% level of significance ( $P < 0.10$ ) in a bivariate analysis, they were considered for multivariate analyses. Pearson's correlation coefficient was used to test the collinearity. The odds ratios (ORs) of variables in logistic regression represent a positive association if  $OR > 1$  and a negative association if  $OR < 1$ . The variables in multivariate analyses were presented as odds ratios, 95% confidence intervals (CI), and level of significance. Marginal effects were calculated for the logistic regression. The VIF was assessed to check for multicollinearity among independent variables, following the method proposed by Midi et al., (2010) [32]. Hosmer-Lemeshow diagnostic test and goodness of fit tests (Pearson chi-square) was performed with respect to the logistic regression results. The statistical package Stata version 16.0 was used in the analyses.

Among different socioeconomic and environmental variables, we observed that diet and physical activity prevalence varied by age group, family income, number of family members, type of family, number of siblings and BMI status. Income groups and type of family were significant moderators in meeting recommended daily fruit and vegetable consumption. Children and adolescents from higher-income families were 19% (OR=1.189; 90% CI: 1.034-1.366) higher than income group BDT 20,000 to meet the recommended daily consumption of >5 portions of fruit and vegetable in this study. There is a 61% decrease in the odds of meeting the recommended daily fruit and vegetable consumption of children and adolescents living in an extended family than living in a nuclear family (OR=0.397; 90% CI: 0.198-0.796).

Age group and family size were significant moderators for skipping breakfast five times a week with odds that adolescents skipped breakfast much more than children (OR=3.22; 90% CI: 1.507-6.889). Children and adolescents living in a family consisting of more than 2-4

members had more than double the odds of skipping breakfast (OR=2.58; 90% CI: 1.073-6.238) than families with 2-4 members.

Age group, family income, and BMI status were found to be significant in daily milk consumption. Being an adolescent was related to lower odds of drinking milk everyday (OR=0.528; 90% CI: 0.330-0.844) compared with children. The odds of drinking milk daily were about 20% higher for children and adolescents from higher income families and had higher BMI status (OR=1.22; 90% CI: 1.070-1.397 and OR=1.292; 90% CI: 1.0081-1.657) than children and adolescents from lower income and BMI status.

The odds for daily protein intake of children and adolescents with higher BMI were about 74% higher (OR=1.742; 90% CI: 1.013-2.994; P=0.092) than the odds for the underweight children and adolescents.

The age group and the number of siblings significantly predicted the physical activity of children and adolescents in this study. The result found that the odds for adolescents were about 63% lower (OR=0.375; 90% CI: 0.125 -0.977; P=0.073) than the odds for children to participate in physical activity. Children with siblings had lower odds (OR=0.537; 90% CI: 0.292-1.096; P=0.088) for participation in physical activity than children without siblings (only child) (Table 4.4)

**Table 4.4: Regression analysis by dietary patterns and physical inactivity**

Dependent variables →	Meet >5 portions of fruit-vegetable/day			Skip breakfast >5 days/week			Milk consumption			Protein consumption			Low to Moderate Intensity Physical Activity		
	Odds ratio	90% CI		Odds ratio	90% CI		Odds ratio	90% CI		Odds ratio	90% CI		Odds ratio	90% CI	
<b>Maternal employment (ref. unpaid working mother)</b>	1.27	0.772	2.092	0.669	0.292	1.529	0.843	0.525	1.352	3.591	0.611	21.113	0.594	0.201	1.757
<b>Sex (ref. male)</b>	1.197	0.775	1.849	1.247	0.587	2.646	0.82	0.538	1.250	0.412	0.128	1.329	0.676	0.282	1.622
<b>Age group (ref. Children)</b>	0.642	0.392	1.05	3.222**	1.507	6.889	0.528**	0.330	0.844	0.945	0.308	2.897	0.375*	0.152	0.922
<b>Income group (ref. 20,000 and below)</b>	1.189**	1.034	1.366	1.253	0.972	1.615	1.222**	1.070	1.397	1.073	0.770	1.495	0.888	0.67	1.177
<b>Family member (ref. 2-4 persons)</b>	1.264	0.703	2.272	2.588*	1.073	6.238	1.684	0.960	2.956	0.619	0.117	3.278	1.588	0.507	4.973
<b>BMI (ref. underweight)</b>	1.084	0.845	1.392	1.062	0.681	1.658	1.292*	1.008	1.657	1.742*	1.013	2.994	1.562	0.83	2.937
<b>Number of siblings (ref: no siblings)</b>	0.811	0.563	1.168	0.963	0.554	1.673	0.929	0.670	1.288	0.742	0.257	2.147	0.537*	0.295	0.977
<b>School type (ref. private school)</b>	0.766	0.404	1.454	1.035	0.373	2.872	0.845	0.463	1.541	1.584	0.389	6.448	1.793	0.427	7.529
<b>Type of family (ref. nuclear family)</b>	0.397**	0.198	0.796	0.408	0.125	1.329	0.855	0.462	1.584	0.621	0.084	4.571	0.864	0.27	2.763

\*\*\*, \*\*, \*: Significant at 1%, 5% and 10%

## 4.5 Discussion

Several studies have investigated the impact of a COVID-19 lockdown on children and adolescents' lifestyles and found that it may lead to a lasting impact on dietary and physical activity patterns [37,38]. Likewise, the current study examined the factors affecting the dietary and physical activity patterns of children and adolescents, differentiating by mothers' employment status during the COVID-19 lockdown in Bangladesh. Major findings in this study indicated that different socioeconomic characteristics, such as children's age, family income, type of family, family size and BMI status were determining factors of dietary patterns and physical activity among children and adolescents. However, mothers' labour market participation was not found to be linked to children's diet and physical activity habits. Many working mothers had flexibility in their work schedules due to remote work opportunities during the lockdown. With changes in routines and increased time spent at home might have shifted the family dynamics that play a significant role in shaping the diet and physical activity patterns of children and adolescents during the lockdown. These factors might have overshadowed the influence of maternal employment status.

To the best of our knowledge, this is the first study that examines the underlying determinants that influence children and adolescent's dietary and physical activity habits while controlling for mothers' employment status during the COVID-19 lockdown in Bangladesh.

This study found a low intake of fruits and vegetables among children and adolescents compared to the WHO's daily recommendations. Family income, and type of family appeared to be significant predictors of daily intake of fruits and vegetables. Approximately two-thirds (64%) did not meet the recommended consumption of daily fruit-vegetables. We found children and adolescents from high income families were more likely to meet the WHO's daily recommendations for fruit and vegetable consumption, compared to those from lower income families. Opposite patterns were found among children and adolescents from extended families. Recent population-based studies in Bangladesh [39] and other LMICs [40] identified low fruit and vegetable consumption among children and adolescents with almost 80% consuming insufficient fruits and vegetables. Mustafa et al. [41] found that poor consumption of fruit and vegetables was less likely among people with higher incomes. People from low-income families frequently find it difficult to consume fruit and vegetables, suggesting economic constraints in this population. The potential causes of lower intakes among the low incomes include the lower demand because of the higher price of these foods compare to energy-dense low-price foods as well as dietary cultural preferences in this region

and social factors related to poverty. More people within an extended family might be a reason for less consumption of fruit and vegetable as fruit and vegetable consumption is related to affordability [42], although further analysis is required to see if extended families could also have additional income earners. As stated earlier, food culture is a more prevalent factor than mere affordability or family structure found in other studies. We observed no significant difference in fruit and vegetable consumption between children of employed and not employed mothers in this study, contrary to earlier research [43].

We found that less than one-fifth of children and adolescents (15.4%) skip breakfast most days of the week, indicating that most have established healthy breakfast consumption habits. Children's and adolescents' breakfast consumption is strongly associated with family structures and family routines [44,45]. During the data collection period of this study, most mothers were working remotely during the COVID-19 lockdown and were not rushed to go to work, which may enable them to have breakfast together with children and might be a reason for less breakfast skipping by children, but further work is required on this. Other pressures (e.g., children at home) may also be in evidence. Aligned with previous research [45,46], this study found breakfast skippers were more likely to be adolescents than younger children. We found that children living in a family with more family members were also more likely to skip breakfast, contrasting the findings of Badrasawi et al. [47]. Authors identified family level variables such as not having someone to prepare food as a determinant of skipping breakfast. Hence, requires further investigation.

Adolescents were less likely to drink milk than younger children while children from higher incomes and higher BMI were more likely to drink milk than children from lower income and lower BMI status. Generally, teenage children have more options of beverages than younger children and tend to consume more carbonated and other drinks such as fruit juice, and fruit-flavoured drinks than milk [48]. Higher income is related to affordability; however, no association was found between milk consumption and BMI in prior research [48].

Bangladesh is one of the countries that provides more than 50% of the proteins from fish sources in the world [49]. According to Global Food Security Index (2022) report, Bangladesh ranked in 80<sup>th</sup> position out of 113 countries in the Global Food Security Index [50], however, the majority of children and adults did not get enough protein [51]. Consistent with existing studies, the current study found that children with higher BMI were more likely

to eat more protein daily. This is consistent with previous studies [52,53] which supported a relationship between high protein intake and higher BMI. The “Early protein hypothesis” explains the reason as high protein intake enhances weight gain and body fat deposition, as well as the risk of obesity and adiposity [54]. Intra-household differences in protein intake were found in a recent study in Bangladesh [51], although we did not find any significant variation suggesting further studies are required.

We did not find moderate-to-vigorous intensity physical activity (MVPA) among study participants. Results showed that Low-to-Moderate Intensity Physical Activity (LMPA) was common among Bangladeshi urban children. Data for this study were collected during the COVID-19 pandemic when children and adolescents were restricted in their outdoor movement due to state-wide lockdowns, and this may explain the decline in physical activity and the reason for not participating in MVPA by children and adolescents.

Recent studies on physical activities during periods of social distancing for COVID-19 found a significant decline in physical activity in children and adolescents [55,56]. Age-related differences found in this study are established correlates of physical activity [46,57,58] including during COVID-19 social distancing [56]. Those studies highlighted that adolescents were less likely to engage in physical activity than young children. Reasons emphasized were less support for physical activity, self-efficacy [57], lack of interest, motivation and family support [59]. Several recent studies found that the screen time of children and adolescents increased dramatically during the pandemic [37,60]. Though physical activity is considered somewhat independent of sedentary behaviour [60], during the lockdown children may have substituted physical activity with sedentarism and taken to video games, electronic devices, and TVs more than ever as they had fewer entertainment options during quarantine [38].

In this study, the number of siblings was a predictor of LMPA. It is usually expected that siblings are supportive of participating in physical activity [62]; however, current findings contrast with this. Findings from earlier research showed that Bangladeshi children had insufficient physical activity, with three of five not taking part in recommended levels [63]. During the pandemic a significant proportion of Bangladeshi people, both adults and children, were physically inactive and had high sedentary behaviours [64]. Since children's health behaviours are significantly influenced by parents' behaviours (i.e., modelling and

support), attitudes, and beliefs [65], less physically active time spent by parents and other elder members of the family may influence the younger members of the family.

We note some limitations in this study. We used the 7 days recall method to collect data on food and physical activity, and the accuracy of such data was entirely dependent on the capacity and memory of the respondents. Self-reported data are prone to over- or under-estimation. The possibility of self-presentation bias also exists. Additionally, our data may have been affected by seasonality and representativeness as it was collected during the lockdown period of COVID-19. Caution should be exercised when attempting to generalize the findings, as the data were collected using non-random sampling and did not apply post-stratification method. Differences in social, cultural, and regional factors, as well as variations in lifestyle, customs, nutritional awareness, or cooking styles may also affect these diet and physical activity patterns and were not examined in this study. Future research should also consider potential explanatory factors for diet and physical activity.

#### **4.6 Conclusion and Policy Implications**

The evidence, especially in LMICs, is mixed on the association or effect of mother's employment on diet and physical activity among children and adolescents [14,66,67]. The current study found maternal employment was not associated with children's dietary and physical activity patterns in Bangladesh. Flexible work opportunities during the lockdown could have allowed mothers to better balance work responsibilities with family activities, potentially overriding the impact of their employment status on children's diet and physical activity routines. However, we found insufficient fruit and vegetable and protein intake among Bangladeshi children and adolescents. In addition to this, diet and physical activity patterns were moderated by many socioeconomic factors such as age, family income, family size, number of siblings, and family type. Findings require critical policy attention because the government of Bangladesh and UN agencies have identified child health and women's participation in economic activities as two of their top priorities. Bangladesh has largely attained self-sufficiency in food in terms of per capita calorie availability at the national level [68]. In addition to this, the indicators of malnutrition have declined over time indicating progress in achieving food and nutrition security. However, there are several emerging factors in Bangladesh such as parental education, household position in the wealth index, that are likely to worsen the child nutrition [69,70]. Diets have remained largely unbalanced with cereals still accounting for the majority portion of dietary energy intake. The National Food



and Nutrition Security Policy (NFNSP) Plan of Action 2021-2030 [68] of Bangladesh aims to establish the per capita energy and nutrient requirements for healthy diets of populations with varying ages, body sizes, gender, physical activity levels, occupations, and physiological status. This study found insufficient intake of fruit and vegetable and protein and less physical activity among Bangladeshi children and adolescents with significant disparities among age groups, family income, family size, number of siblings, family type and BMI status. Our results, therefore, suggest that policy makers should focus on the intake of specific foods that children are deprived of. We found that the national policy [68] is aligned with the findings of our study as it has a specific intervention policy targeting the diet and physical activity of children and adolescents.

The Sustainable Development Goals (3, 5 and 8 in particular)<sup>2</sup> are included in the objectives for Bangladesh to promote the development. Policy makers must appreciate the strategies that enhance maternal labour-force participation because Bangladeshi women play important roles in the food system, and their empowerment enhances both household food security and dietary diversity [71]. Findings of this study do not support the conventional perception that maternal employment has adverse consequences for young people, especially in terms of child food and physical activity habits. Interventions aimed to promote fruit, vegetable, and protein consumption of children and adolescents could potentially target enhancing family supports and attitudes.

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<sup>1</sup> <sup>2</sup> SDG3: Ensure healthy lives and promote well-being for all at all ages. SDG 5: Achieve gender equality and empower all women and girls. SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

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**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** The data (anonymized) presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy restrictions.

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#### **4.8 Links and implications for next study**

Female labour force participation is an important component for economic drive in LMICs, however, it depends on many factors, such as social norms, education levels, fertility rates, and facilities available for childcare. These factors have a complex relationship with female labour force participation, especially for married women. Given these constraints, over the past years the rate of labour force participation among married women has risen in Bangladesh (Mahmud & Bidisha, 2018). Since mothers are the main caregiver of the children, the effects of mothers' employment on children's food intake patterns, and activity patterns are an important policy question as these lifestyle behaviours has short- and long-term impacts on health and wellbeing over the life course (Ekelund et al., 2018; Park et al., 2020). The findings of this research will contribute to existing literature and improve the knowledge by examining the household and maternal characteristics that have an impact on child dietary patterns and physical activity at the individual level in this country.

Several studies have suggested that Bangladesh is experiencing a double burden of overweight among children and adolescents, especially in urban areas (Biswas et al., 2016; Bulbul & Hoque, 2014; Khan, Burton & Trost, 2017). In addition to this, high sedentary behaviour is evident among young population in Bangladesh (Khan, Burton & Trost, 2017). There is limited research in Bangladesh related to maternal employment focusing on the dietary patterns, physical activity and sedentary behaviours of children and adolescents as pathway variables of childhood obesity. As such the next study was conducted a quantitative analysis to explore the nature and context of sedentary behaviour in urban Bangladeshi children and adolescents.

# **CHAPTER 5: SEDENTARY BEHAVIOURS OF CHILDREN DURING THE COVID-19 PANDEMIC AND THEIR ASSOCIATION WITH MATERNAL EMPLOYMENT IN BANGLADESH: A CROSS-SECTIONAL STUDY**

The revised version of this study has been submitted to the journal “PLOS ONE” and is currently under review. The submitted version of the manuscript is included in this thesis. It is formatted in accordance with the Vancouver guidelines as specified in the journal.

## **5.1 Abstract**

### **Background**

To prevent the spread of COVID-19, a country-wide lockdown was instigated in Bangladesh. During the pandemic, Bangladesh had 543 days of school closures, which is likely to have had a substantial impact on young people's lifestyles, including time spent in sedentary behaviour. Existing studies have shown an association between children's sedentary behaviour and maternal employment. However, there are no data on the relationship between sedentary behaviour and maternal employment among Bangladeshi school-aged children during the pandemic. This study investigated the patterns of sedentary behaviour among children aged 6-18 years (M=10; SD=3.12) in Bangladesh, and their relationship with maternal employment status.

### **Methods**

A cross-sectional study with 383 children (50.4% female) was undertaken between February and September 2021. Sedentary behaviours were assessed using the 7-day Adolescent Sedentary Activity Questionnaire (ASAQ). Mothers were the proxy respondents. Logistic regression estimates the association using odds ratios and 95% confidence intervals (CI). Statistical significance was considered at  $p < 0.05$ .

### **Result**

During the pandemic, 81% of children and adolescents had high recreational sedentary behaviour (>2 hours/day), 49% had high ‘productive’ sedentary behaviour (>369 min/day) and 50% had high ‘less productive’ sedentary behaviour (>257 min/day). As expected, multiple logistic regression showed that recreational, productive, and less productive sedentarism were more likely among older children (13-18 years) throughout the week.

During the weekend days, boys were more likely to engage in recreational, productive, and less productive sedentary behaviour than they were during the weekdays. Children sedentary behaviour was not associated with maternal employment status. A potential explanation could be most mothers could work from home at the beginning of the pandemic, leading to a better balance between work responsibilities and family activities, and notable influence on their children's screen time.

## **Conclusion**

Young and older children in Bangladesh exhibited high levels of sedentary behaviour during COVID-19 lockdowns. Age and sex were the determining factors of high levels of sedentary behaviour. Effective interventions targeting schools and parents need to consider minimizing the sedentary behaviour of children and adolescents.

## **5.2 Introduction**

Any waking behaviour that requires  $\leq 1.5$  metabolic equivalents (METs) of energy expenditure in a sitting, reclining, or resting posture is referred to as sedentary behaviour [1]. In practical terms, it is low energy sitting. There is a growing concern about children's sedentary behaviour as several chronic health issues in children, including cardiometabolic risk factors, obesity, and a lack of physical fitness have been linked to sedentarism [2-4], and the behaviours may track into adulthood [5]. Regular physical activity, on the other hand, has proven to be important for children's and adolescents' healthy growth and development [6]. Since physical activity is somewhat independent of sedentary behaviour [1,7]; it is possible that even children who meet physical activity recommendations are unaware of the health risks associated with excessive sedentary behaviour [8,9]. According to guidelines, children and adolescents recreational screen time should not be more than 2 hours daily [10,11]. Despite this, young people spend more time in low energy sitting than is recommended [9,12,13].

Globally, 166 countries required school closures during the COVID-19 pandemic, affecting over 1.5 billion young people (over 80% of enrolled students) [14]. Bangladesh mandated school closures from March 2020. During this period, schools provided students with remote learning opportunities. Evidence has shown that this change has had a significant impact on children's lifestyles [15]. Restrictions on going outside and to school have an impact on the activity patterns of children and adolescents. A scoping review of 130 papers showed that 52.3% of children and adolescents use more than the recommended 2 hours per day of

recreational screen time, averaging 3.6 hours per day [16]. The COVID-19 restrictions may have worsened the situation of young people's sedentary behaviour [15]. Research revealed a considerable rise in screen time and sedentary behaviour among young individuals during the pandemic [15], with an increase estimated at 20-66% [17,18]. According to a survey on Chinese children and adolescents aged 6-17 years old conducted before (January 2020) and after (March 2020) the COVID-19 pandemic lockdown, overall screen time increased by almost 30 hours per week, with a 23.6% rise in total high screen time (>2 hours/day) [18]. Another study of 211 American parents of children aged 5-13 years old found that children spent 90 minutes/day sitting for remote learning/online school activities and >8 hours /day sitting for leisure activities [19]. However, it is logical to assume that not all sedentary behaviours are necessarily 'bad'. The literature has tended to investigate prolonged periods of low energy sitting from a health viewpoint, with much evidence suggesting negative outcomes if sedentary time is high. But some sedentary behaviours, such as reading or studying, could be perceived as being 'productive' use of time, or even necessary. Differentiating what might be seen as 'productive' and 'less productive' behaviours might be fruitful.

Prior research highlighted maternal employment as one possible determinant of children's sedentary behaviour. For example, Fitzsimons and Pongiglione [20] found more sedentary behaviour among children whose mothers were employed. Datar et al., (2014) [21] demonstrated deterioration in sedentarism among children whose mothers work more. Mothers' time allocation to their children's activities may be influenced by their employment. More working hours of mothers can be associated with more sedentary time of children as children spend more time with nonparental caregivers or are unsupervised, which may influence their behaviour patterns, such as choosing to spend time in sedentary behaviour [22]. Despite evidence suggesting that there are plausible mechanisms through which maternal employment could be associated with child sedentary behaviour, few studies examine this relationship in low-to-middle-income countries (LMICs), where a high proportion of the young population is engaged in sedentary behaviour [13]. Further, the COVID-19 pandemic may make the situation far worse because of measures such as lockdowns and school closures. For example, in Bangladesh, the pandemic has affected around 38 million students as schools were closed for 543 days [23,24]. Thus, the objective of this study is to identify the common types of what could be considered recreational,

productive (purposeful) and less productive sedentary behaviours among Bangladeshi children during the pandemic and examine the differences by maternal employment status.

### **5.3 Methods**

Cross-sectional data for this study were collected from three locations in Bangladesh: Dhaka, Sylhet, and Mymensingh between February-September 2021, during the first country-wide COVID-19 lockdown in Bangladesh. During the data collection period, 198 of 242 days were under lockdown.

#### **5.3.1. Sampling design**

The representative sample is based on research questions. In selecting the sample, we consider mothers, the proxy respondents, of children and adolescents (6-18 years old). We consider this age group because, over 80% of adolescents worldwide did not meet the recommended levels of daily physical activity [25]. While Bangladeshi children and adolescents had a relatively lower prevalence of insufficient physical activity than the global trend, it was still high at 66% [25]. Additionally, studies examining changes in sedentary behaviour over time suggest that sedentary behaviour increases with age [26,27]. Hence, we are targeting children aged 6 to 18 years. Mothers were included in the survey if they (i) have a child aged 6 to 18 years, did not have a chronic medical condition, (ii) currently reside in any of the selected cities, and (iii) working and non-working women from all walks of society. By using 95% CI (two-sided), 5% margin of error and 50% standard deviation, the sample size determined 385 participants were suitable for this study. Further, we considered a 10% nonresponse rate, resulting in a desired sample size of  $(385+10\%) = 423.5 \sim 424$ . The sample size calculation for this study is given in supporting information S1.

#### **5.3.2. Participants and settings**

Participants were recruited from principal researcher networks and their referrals. The list of participants included 712 people. Due to the need for physical distancing, participants were sent an email containing a consent form and survey information sheet to ascertain whether they were interested in participating. Mothers who provided written consent to participate received the survey questionnaire via paper mail, e-mail, or WhatsApp attachment, depending on their preference, and returned it the same way seven days later. The survey was available in English and Bengali (the local language).

A total of 590 mothers agreed to participate in the survey. Among them, 417 mothers completed the questionnaire, with 32 responses were excluded for failure to complete the required sections (characteristics of excluded responders are given in the S2 Table), and two responses were disqualified for reporting sitting time exceeding 24 hours. The analytical sample included 383 participants (65% response rate). The Ethics Committee of the host university approved the study [ref: H20REA147] on 20 August 2020.

### **5.3.3. Outcome measures: sedentary behaviour**

Mothers completed the Adolescent Sedentary Activity Questionnaire (ASAQ) over seven days. The ASAQ is a reliable and valid tool for assessing sedentary behaviour, and has been used successfully in Bangladesh [13,25]. Mothers reported the duration (in minutes) of different sedentary activities children spent on typical weekdays and weekend days. We divided the days of the week since research suggests differences in children's sedentary time on weekdays and weekends [26]. Participants' reports of children's sedentary behaviour were classified into three categories: (1) recreational sedentary behaviour, including viewing television/video, using computer/internet for fun, and playing video games; (2) productive sedentary behaviour, including classroom sitting (online), doing homework not on the computer, using computer for homework, private lessons (tutor), reading for leisure, travel by car/bus/motorcycle/rickshaw, doing crafts/hobbies, and playing/practicing a musical instrument; and (3) less productive sedentary behaviour, including watching TV/videos/cinema, playing video games, using computer for fun, sitting with friends and talking on phone. The weighted average of 7 days sitting time was used to calculate total daily sedentary time:

$[\text{school-day sedentary time} \times 5] + [\text{weekend-day sedentary time} \times 2]/7$ .

### **5.3.4. Statistical analysis**

The characteristics of children were summarized using descriptive statistics. Maternal employment status was categorised as mothers 'in paid employment' and 'not in paid employment'. Children were divided into two groups: younger children (6-12 years) and older children (13-18 years) as evidence shows sedentary behaviour changes with age [27,28]. To determine which factors are associated with children's sedentary behaviour (recreational, productive, and less productive), binary logistic regression is used to estimate the likelihood that sedentary behaviour is related in the following way:



$$\text{Logit}(P) = \ln \frac{P}{1-P} = \alpha + \beta'X$$

Where  $P$  = the probability of the event occurring;  $\alpha$  is the intercept parameter;  $\beta$  is the vector of slope parameter; and  $X$  is the vector of explanatory variables. The explanatory variable ( $X$ ) describes some selected characteristics. A description of the variables used for the logistic regression analysis is provided in Table 5.1. If explanatory variables were associated with high sedentary behaviour at a 10% level of significance ( $P < 0.10$ ) in a bivariate analysis, they were considered for multiple regression. Pearson's correlation coefficient was used to test the collinearity. The odds ratios (ORs) of variables in logistic regression represent a positive association if  $OR > 1$  and a negative association if  $OR < 1$ . The variables in multiple regression analyses were presented as odds ratios, 95% confidence intervals (CI), and level of significance. Hosmer-Lemeshow diagnostic test was performed to check model fitness. The VIF was assessed to check for multicollinearity among independent variables, following the method proposed by Midi et al., (2010) [29]. Marginal effects were calculated for the logistic regression. The statistical package Stata version 16.0 was used in the analyses.

**Table 5.1** Variable definitions used for econometric analysis.

Variable name	Variable description	Type of variable	
Recreational sedentary behaviour	Time watching TV, watching videos /cinema / playing video games, and using computer for fun.	Binary	High vs Low
Productive sedentary behaviour	Time for Classroom sitting (online), doing homework not on the computer, using computer for homework, private lessons (tutor), reading for leisure, travel (car /bus/motorcycle/ rickshaw), doing crafts or hobbies and playing/practicing musical instrument.	Binary	High vs low
Less productive sedentary behaviour	Time for watch TV, watching videos/cinema/playing video games, using computer for fun, sitting around (chat	Binary	High Vs low

	with friends/on the phone/ chilling/relax).		
Maternal employment status	Occupation of mothers	Binary Categorical	In paid employment vs not in paid employment
Age group	Age of child in years	Binary Categorical	Younger children vs older children
Gender	Sex of child	Binary Categorical	Male vs female
Own smartphones	Child owns a smartphone	Binary Categorical	Yes vs no

#### 5.4 Results

A total of 383 participants were studied, including 278 children (6-12 years) and 105 adolescents (13-18 years). Among them, 37.3% were the offspring of employed mothers, and the sample was approximately equal by sex (50.39% female). The proportion of employed mothers in the sample (37%) is comparable to the employment rate in women in Bangladesh (World Bank, 2023). The average age was 10 years (SD = 3.12). Daily sedentary behaviour accounted for around 11 hours of waking time. Of the 383 children, 80.68% had a high level of recreational sedentary behaviour according to guidelines (i.e., >2 hours/day) (Table 5.2).

**Table 5.2** Proportion of children of employed and not employed mothers engaged in different types of sedentary behaviour across 7 days.

	Not Employed (239)	Employed (142)	Total	P value
<b>Recreational sedentary behaviour/day</b>				
Low ( $\leq 2$ h/day)	48 (12.6%)	26 (6.82%)	74 (19.42%)	P = 0.672
High (> 2h/day)	191 (50.13%)	116 (30.45%)	307 (80.58%)	
<b>Productive sedentary behaviour /day</b>				
Low( $\leq 240$ min/day)	129 (33.86%)	67 (17.59%)	196 (51.44%)	P= 0.200

High(>241min/day)	110 (28.87%)	75 (19.69%)	185(48.56%)	
<b>Less productive sedentary behaviour /day</b>				
Low (≤280min/day)	131 (34.38%)	61 (16.01%)	192 (50.39%)	P= 0.025
High(>280min/day)	108 (28.35%)	81 (21.26%)	189 (49.61%)	
<b>Age group</b>				
6-12 years	194 (50.92%)	79 (20.73%)	273 (71.65%)	P = 0.000
13-18 years	45 (11.81%)	63 (16.54%)	108 (28.35%)	
<b>Sex</b>				
Boy	104 (27.3%)	83 (21.78%)	187 (49.08%)	P=0.005
Girl	135 (35.43%)	59 (15.49%)	194(50.92%)	

#### 5.4.1. Recreational sedentary behaviour

The results of testing associations with children's sedentary behaviours are shown in Tables 5.3 and 5.4 for weekdays and weekend days, respectively. To investigate relationships between binary recreational sedentary behaviour (high vs. low) and each of the explanatory variables (i.e., Maternal employment status, Age group, Sex, and Own smartphones), recreational sedentary behaviour was considered high if daily sedentary time was more than 2 hours, based on current guidelines [10,11]. Multiple regression estimate shows a positive association between children's recreational sedentary behaviour and maternal employment. The estimated odds ratio of the maternal employment status is 1.219 on weekdays. This means, on weekdays that the odds of recreational sedentary behaviour of children having mothers in paid employment is higher by 21%, although this is not significant.

Sex significantly predicted the recreational sedentary behaviour of children. Multiple regression analysis showed that during weekdays, boys were 0.31 times less likely to be high in recreational sedentary behaviour (OR=0.31, 95% CI=0.185-0.518, p=000) compared to girls (Table 5.3). However, on weekend days boys were 1.8 times more (OR=1.81, 95% CI=1.07-3.07, p=0.027) likely to take part in recreational sedentary behaviour (Table 5.4).

#### 5.4.2 Productive sedentary behaviour

'Productive' sedentary behaviour was dichotomized into low and high levels around the median [30,31]. On weekdays, productive sedentary behaviour was low if ≤480minutes/day and high if >480 minutes/day. On weekends it was low if ≤ 240 minutes/day and high if >240

minutes/day. The estimated odds ratio for the age group was 2.21 on weekdays (Table 5.3), while on weekend days, it was 2.35 (Table 5.4). This suggests that the odds of productive sedentary behaviour were higher by more than half (55% and 57%) for older children both on weekdays and weekends. The estimated odds ratio for sex was 1.83 on weekend days suggesting the likelihood (odds) of productive sedentary behaviour of a boy was higher by a factor of 1.83 on weekend days. There was no significant predictor of productive sedentary on weekdays.

**Table 5.3** Logistic regression results of bivariate regression estimates for the probability of sedentary behaviour on Weekdays.

		<b>Bivariate Estimate</b>			
		<b>Odds ratio</b>	<b>95% CI</b>		<b>P value</b>
<b>Recreational sedentary behaviour</b>					
Intercept					
Maternal employment status	Not in paid employment versus in paid employment	1.848	1.111	3.073	0.018
Age group	Children (6-12 years) versus Adolescents (13-18 years)	1.821	1.039	3.192	0.036
Sex	Girl versus Boy	0.283	.170	.469	0.000
Own smartphones	No versus Yes	1.826	1.099	3.036	0.020
<b>Productive sedentary behaviour</b>					
Maternal employment status	Not in paid employment versus in paid employment	1.726	1.126	2.647	0.012
Age group	Children (6-12 years) versus Adolescents (13-18 years)	2.498	1.583	3.942	0.000
Sex	Girl versus Boy	.669	0.441	1.016	0.059
Own smartphones	No versus Yes	1.798	0.358	0.615	0.000
<b>Less productive sedentary behaviour</b>					
Intercept					
Maternal employment status	Not in paid employment versus in paid employment	1.804	1.186	2.745	0.006
Age group	Children (6-12 years) versus Adolescents (13-18 years)	2.024	1.287	3.181	0.002
Sex	Girl versus Boy	0.433	0.287	0.652	0.000
Own smartphones	No versus Yes	1.689	1.112	2.566	0.014

**Table 5.4 Logistic regression results of multivariate regression estimates for the probability of sedentary behaviour on Weekdays.**

		Estimated value			
		Odds ratio	95% CI		P value
<b>Recreational sedentary behaviour</b>					
Intercept		4.73			
Maternal employment status	Not in paid employment versus in paid employment	1.219	.118	12.655	0.868
Age group	Children (6-12 years) versus Adolescents (13-18 years)	1.421	.7819	2.583	0.249
Sex	Girl versus Boy	0.31	0.185	0.518	0.000
Own smartphones	No versus Yes	1.219	0.118	12.655	0.868
<b>Productive sedentary behaviour</b>					
<b>Intercept</b>		0.46			
Maternal employment status	Not in paid employment versus in paid employment	0.34	0.031	3.74	0.381
Age group	Children (6-12 years) versus Adolescents (13-18 years)	2.21	1.37	3.56	0.001
Sex	Girl versus Boy	0.77	0.49	1.19	0.239
Own smartphones	No versus Yes	4.09	0.378	44.34	0.246
<b>Less productive sedentary behaviour</b>					
Intercept		0.93			
Maternal employment status	Not in paid employment versus in paid employment	3.75	.37	37.89	0.263
Age group	Children (6-12 years) versus Adolescents (13-18 years)	1.71	1.06	2.757	0.029
Sex	Girl versus Boy	.49	.32	.74	0.001
Own smartphones	No versus Yes	.38	.04	3.84	0.411

**Table 5.5 Logistic regression results of bivariate regression estimates for the probability of sedentary behaviour on Weekend days**

		<b>Estimated value</b>			
		<b>Odds ratio</b>	<b>95% CI</b>		<b>P value</b>
<b>Recreational screen time</b>					
Intercept					
Maternal employment status	Not in paid employment versus in paid employment	1.121	0.659	1.905	0.672
Age group	Children (6-12 years) versus Adolescents (13-18 years)	1.874	.998	3.518	0.051
Sex	Girl versus Boy	1.918	1.137	3.237	0.015
Own smartphones	No versus Yes	1.109	0.653	1.885	0.700
<b>Productive sedentary behaviour</b>					
Intercept					
Maternal employment status	Not in paid employment versus in paid employment	1.313	0.866	1.990	0.200
Age group	Children (6-12 years) versus Adolescents (13-18 years)	2.525	1.591	4.007	0.000
Sex	Girl versus Boy	1.983	1.320	2.977	0.001
Own smartphones	No versus Yes	1.371	0.905	2.079	0.137
<b>Less productive sedentary behaviour</b>					
Intercept					
Maternal employment status	Not in paid employment versus in paid employment	1.804	1.186	2.745	0.006
Age group	Children (6-12 years) versus Adolescents (13-18 years)	2.023	1.287	3.181	0.002
Sex	Girl versus Boy	0.433	0.287	0.652	0.000
Own smartphones	No versus Yes	1.689	1.112	2.566	0.014

**Table 5.6 Logistic regression results of multivariate regression estimates for the probability of sedentary behaviour on Weekend days**

		<b>Estimated value</b>			
		<b>Odds ratio</b>	<b>95% CI</b>		<b>P value</b>
<b>Recreational sedentary behaviour</b>					
Intercept		2.81			
Maternal employment status	Not in paid employment versus in paid employment	1.053	0.086	12.839	0.968
Age group	Children (6-12 years) versus Adolescents (13-18 years)	1.725	0.9122	3.262	0.093
Sex	Girl versus Boy	1.812	1.069	3.074	0.027
Own smartphones	No versus Yes	0.848	0.069	10.4	0.898
<b>Productive sedentary behaviour</b>					
<b>Intercept</b>		0.552			
Maternal employment status	Not in paid employment versus in paid employment	0.380	0.036	3.966	0.419
Age group	Children (6-12 years) versus Adolescents (13-18 years)	2.35	1.471	3.751	0.001
Sex	Girl versus Boy	1.827	1.207	2.767	0.005
Own smartphones	No versus Yes	2.618	0.250	27.362	0.422
<b>Less productive sedentary behaviour</b>					
Intercept		0.93			
Maternal employment status	Not in paid employment versus in paid employment	3.75	0.37	37.89	0.263
Age group	Children (6-12 years) versus Adolescents (13-18 years)	1.71	1.06	2.757	0.029
Sex	Girl versus Boy	0.49	0.32	0.74	0.001
Own smartphones	No versus Yes	0.38	0.04	3.84	0.411



### 5.4.3. Less productive sedentary behaviour

Following the same procedure as above, less productive sedentary behaviour was dichotomized into low and high levels around the median [30,31]. On weekdays, less productive sedentary behaviour was dichotomized as low ( $\leq 240$  minutes/day) and high ( $>240$  minutes/day). Likewise, on weekend days, less productive sedentary behaviour was dichotomized as low ( $\leq 240$  minutes/day) and high ( $>280$  minutes/day). The estimated odds ratio for the age group was 1.71 on weekdays (Table 5.3), and 1.61 on weekend days (Table 5.4). This suggests that the odds of less productive sedentary behaviour were greater by more than half for adolescents both on weekdays and weekends. The estimated odds ratio for sex was 0.49 on weekdays and 2.21 on weekend days which means that the likelihood (odds) of less productive sedentary behaviour for boys was less by more than 2 times<sup>3</sup> on weekdays and greater by a factor of 2.21 on weekend days.

Table 5.7 presents the marginal effects of sedentary behaviour on the probability that the child is sedentary during both weekdays and weekends as derived from logistic regression. The marginal effects reflect the difference in predicted probability for a unit change in the independent variable of interest. The results show that male children were 20% less likely to be engaged in recreational sedentary behaviour and 17% less likely to be engaged in less productive sedentary behaviour on weekdays. The association between the age group and whether a child was sedentary was statistically significant for productive and less productive sedentary behaviour on weekdays. The results suggest that on weekdays, the probability that the older age group was engaged in productive sedentary behaviour was 18% higher, and in less productive sedentary behaviour, it was 12% higher than that of the younger age group. According to the findings, on weekends, boys' participation in recreational, productive, and less productive sedentary behaviour was higher than that of girls by 9%, 14%, and 20%, respectively. The association between the age group and whether a child was engaged in sedentary behaviour was statistically significant for all three categories of sedentary behaviour on weekend days. The results suggest that on weekdays, the probability that the younger children's participation in recreational, productive and less productive sedentary behaviour was higher than that of adolescents by 7%, 21%, and 11% respectively. There was no statistically significant association between maternal employment status and any type of sedentary behaviour.

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<sup>3</sup>  $1.49=2.04$

**Table 5.7** Marginal effect of recreational, productive, and less productive sedentary behaviour on weekdays and weekend days

Independent variable	Weekdays			Weekend days		
	Recreational sedentary behaviour	Productive sedentary behaviour	Less productive sedentary behaviour	Recreational sedentary behaviour	Productive sedentary behaviour	Less productive sedentary behaviour
Maternal employment	.03 (.20)	-.20 (.18)	.30 (.23)			.06 (.24)
Gender	-.21*** (.04)	-.06 (.05)	-.17*** (.05)	.09** (.04)	.14** (.05)	.20*** (.05)
Age group	.06 (.05)	.19*** (.06)	.13** (.06)	.08*** (.04)	.21*** (.06)	.11** (.06)
Smartphone	.03 (.20)	.31 (.23)	-.20 (.20)			.00 (.24)

Note: (1) Standard errors are in parentheses. (2) \* Significant at 10% level; \*\* Significant at 5% level; \*\*\* Significant at 1% level

## 5.5 Discussion

This study assessed the prevalence and patterns of sedentary behaviour during COVID-19 lockdown, including recreational, productive, and less productive behaviours, and their association with mothers' employment status in a sample of children and adolescents in Bangladesh. Our results showed high prevalence of sedentary behaviour among children and adolescents in Bangladesh, and age group and being a boy were positively associated with different types of sedentary behaviour. However, we found that a mother's employment status had no association with the sedentary behaviour of her children during the lockdown.

According to the findings of this study, children spent 11 hours per day in all types of sedentary behaviours across the week. During the COVID-19 pandemic's school closure days, approximately 81% of children and adolescents engaged in high (>2hours/day) recreational sedentary behaviour, 49% were engaged in high productive sedentary behaviour (>369 min/day) and 50% had high less-productive sedentary behaviour (>257 min/day).

During the restrictions of the pandemic, online lessons became a new element of children's sedentary behaviour worldwide [32]. Our results show that less than half (49%) of the

children engaged in high productive sedentary behaviour (>369 min/day) for the requirement of online learning. The time for productive sedentary behaviour included school-related sedentary time for 4 hours each day, including online classes, and completing school-related tasks. Furthermore, results showed that watching TV, videos/cinema, and playing video games were the most common types of less productive sedentary behaviour among children: over 80% of children and adolescents spent more time on screens than the recommended guidelines. It is difficult to compare results because there rather few studies utilizing similar instruments during the COVID-19 restrictions. According to research conducted before the COVID-19, Khan and Burton [13] showed that 79% of Bangladeshi children and adolescents had high levels of recreational screen time. Our finding suggests that recreational sedentary behaviour may not have changed significantly throughout the pandemic even though studies of sedentary behaviour in young people in other countries reported a considerable rise during the epidemic [18,33]. Consistent with previous studies [13,34], we found that adolescents (13-18 years) are more sedentary than younger children (6-12 years) and sedentary behaviours are common among boys. Parental control over younger children (6-12 years) might be a possible reason of less sedentary behaviours compared to adolescents (13-18 years). Sedentary behaviour due to prolonged study may provide another explanation for why adolescents had more sedentary time. This is consistent with prior studies that due to high expectations of Asian parents for their children's academic achievement, adolescents can have a heavier study load and spend more sedentary time through prolonged study [13,35,36]. The restrictions of going outside during the pandemic and use of screen-based devices for study, communication, and entertainment could also increase sedentary behaviour.

In our multiple regression analysis, some variables, most notably maternal employment status, did not appear to be significantly associated with the child's sedentary behaviour even though previous studies have shown this [21]. While the odds of maternal employment showed a positive association with children's recreational and less productive sedentary behaviour, and a negative association with productive sedentary behaviour on weekdays, these were not significant.

There are two possible avenues through which maternal employment may influence children's sedentary behaviour: income and time. It is claimed that the growing availability and accessibility of electronic devices have contributed to children increased sedentary behaviour [37,38] and working mothers provide more resources for purchasing technological equipment for children. Employed mothers' time constraints may impair caregiving and, as a

result, increases children's sedentary behaviour. However, we observed that the proportion of children engaging in excessive sedentary behaviour is lower for mothers in paid employment compared to the children of mothers not in paid employment (Table 5.2). One possible reason may be that many mothers were able to work remotely during the start of the pandemic, which may have had a significant impact on their ability to control their children's screen time, but the data in LMICs is not clear or well understood in this regard, thus further work on this is recommended.

### **5.5.1. Strength and limitations**

To our knowledge, this is the first study to test the association between maternal employment status and children's and adolescents' sedentary behaviour during the COVID-19 lockdown in Bangladesh. Nevertheless, this research has some limitations. Because this study relied on proxy- and self-reported primary data, we were unable to incorporate numerous socioeconomic characteristics because many respondents did not provide this information. Children and adolescents' sedentary behaviour may be prone to over-reporting [39]. Nonresponse bias was another limitation of this study. As a COVID safe measure, the respondent completed the questionnaire remotely through email, mail, or WhatsApp. This may have affected the response rate. Finally, the cross-sectional nature of the study should be considered when interpreting the findings, because it is not possible to infer causal associations in cross-sectional study design.. Future studies in this field should investigate if the impact of changes in these variables exists over time and thus incorporate prospective designs.

### **5.6 Conclusion**

In conclusion, children and adolescents in Bangladesh spent a prolonged time in sedentary behaviour during the COVID-19 lockdown with males and older (13-18 years) being independent predictors of sedentarism. However, no significant association was found between maternal employment status and sedentary behaviour among Bangladeshi children. The proportion of children engaged in high recreational, productive, and less-productive sedentary behaviour is concerning, given that in Bangladesh access to screen-based devices has expanded dramatically in recent years. Interventions to reduce some sedentary behaviours in children and adolescents should be taken urgently.

**Author's contribution**

S.A., A.M., S.C., A.K. and S.J.H.B. contributed to the planning and design of the study. S.A. performed the literature searches, data collection, and analysis, and wrote the first draft of the paper. A.M., S.C. A.K. and S.J.H.B. reviewed, edited, and approved the final draft. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

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**Conflict of interest**

The authors have no financial or non-financial conflict of interest to declare that are relevant to the content of this article.

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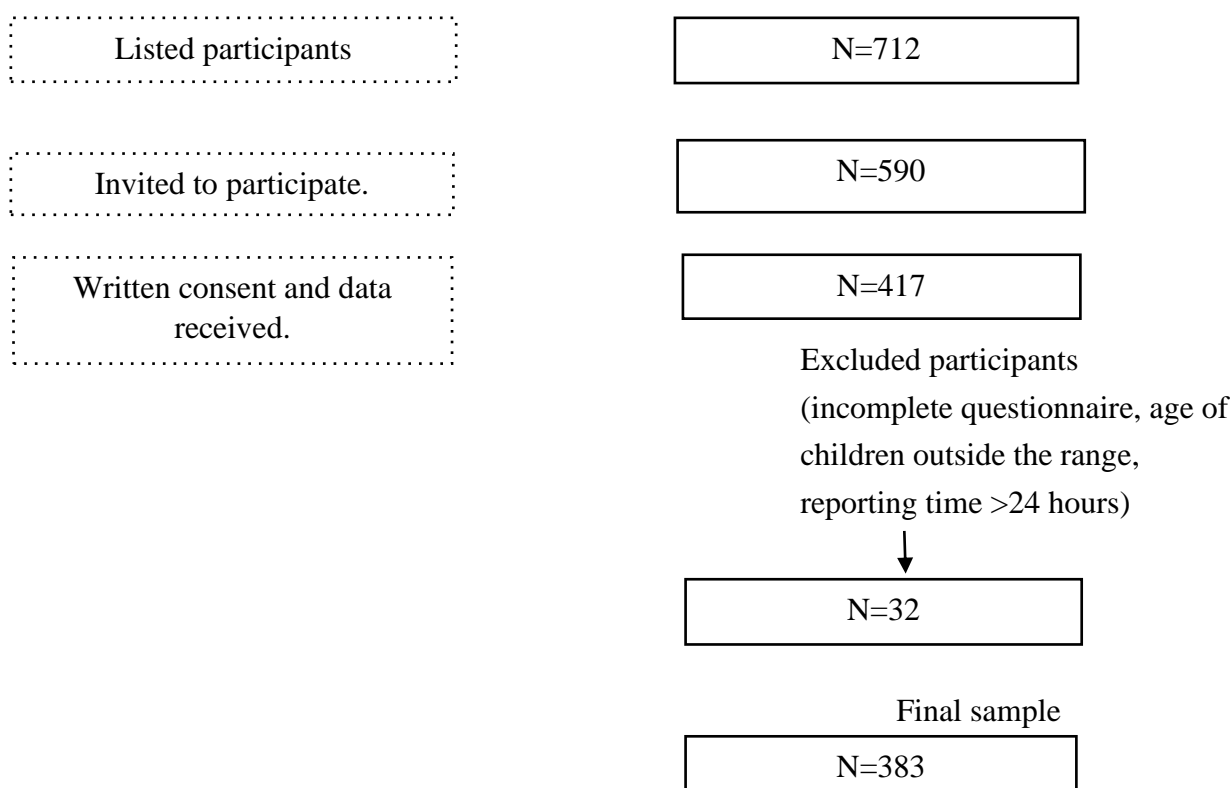
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## SUPPORTING INFORMATION

**S1 Table. Participant selection**



**S2 Table. Characteristics of excluded participants**

Age group	Sex	Maternal employment status	Own smart phone
6-12 years (18)	Male (21)	Employed (10)	Yes (13)
13-18 years (9)	Female (11)	Not employed (11)	No (9)
Outside the range (5)		No information (11)	No information (10)

**S3Table. Descriptive statistics of different sedentary behaviour on weekdays**

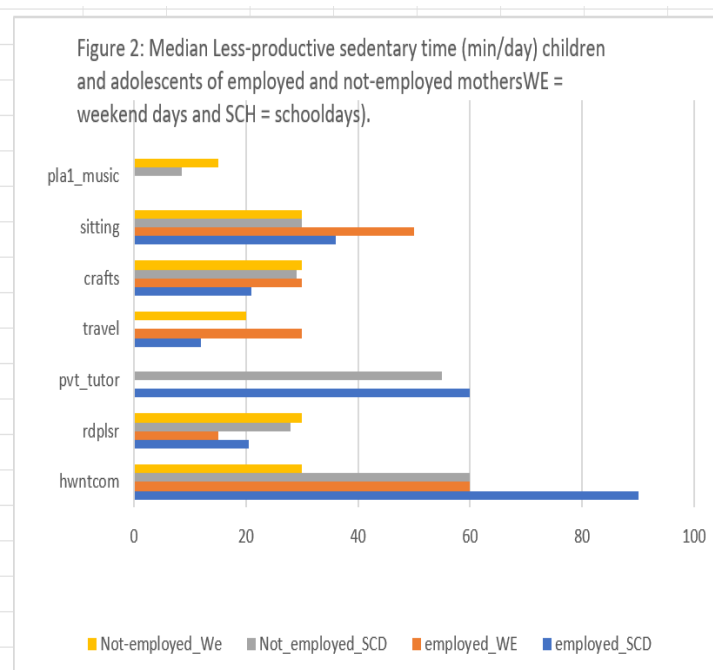
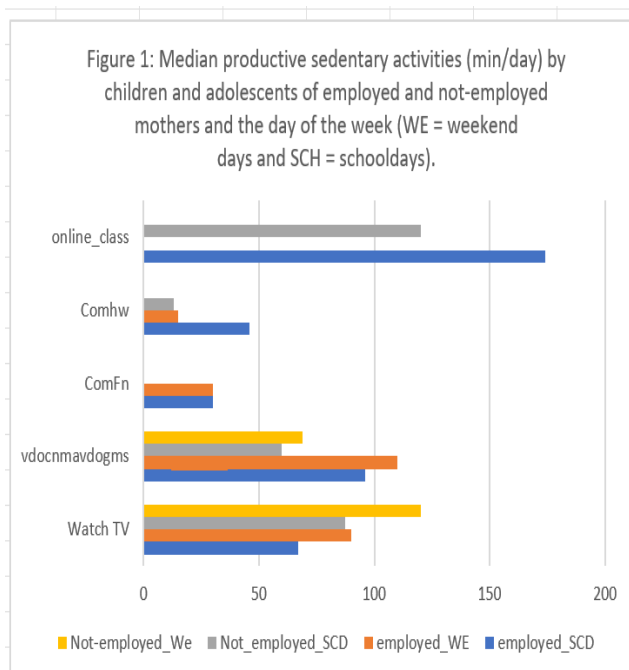
	Weekdays		Weekend days	
	Frequency	Percentage	Frequency	Percentage
Recreational Sedentary Behaviour				
Low	96	25.07	74	19.32
High	287	74.93	309	80.68
Productive Sedentary Behaviour				

	Weekdays		Weekend days	
Low	241	62.92	197	51.44
High	142	37.08	186	48.56
Less productive Sedentary Behaviour				
Low	204	53.26	192	50.13
High	179	46.74	191	49.87

**S4 Table. Summary statistics of different sedentary behaviour (in minutes) on weekdays and weekend days**

	Weekdays			Weekend days		
Variable	Obs	Mean (SD)	Max	Obs	Mean (SD)	Max
<b>Recreational Sedentary Behaviour</b>						
Watching TV	383	438.90 (315.37)	1740	383	222.10 (146.99)	1020
Watching videos /cinema / playing video games	382	421.97 (404.30)	4800	383	188.28 (149.57)	950
Using computer for fun	382	164.20 (246.29)	1900	383	70.91 (92.08)	420
<b>Less productive Sedentary Behaviour</b>						
Watching TV	383	438.90 (315.37)	1740	383	222.10 (146.99)	1020
Watching videos /cinema / playing video games	382	421.97 (404.30)	4800	383	188.28 (149.57)	950
Using computer for fun	382	164.20 (246.29)	1900	383	70.91 (92.08)	420
Sitting around (chat with friends/on the phone/ chilling/relax)	381	229.59 (248.49)	1380	383	113.91 (117.01)	600
<b>Productive Sedentary Behaviour</b>						
Time for Classroom sitting (online)	382	672.31 (410.31)	1950	No online class on weekend days		
Doing homework not on the computer	381	367.24 (298.14)	1560	382	114.43 (120.77)	720
Using computer for homework	382	235.16 (278.72)	1290	383	63.83 (94.07)	506
Private lessons (tutor)	383	287.01	1040	383	62.45	480

Variable	Weekdays			Weekend days		
	Obs	Mean (SD)	Max	Obs	Mean (SD)	Max
		(284.67)			(98.43)	
Reading for leisure	382	168.16 (204.77)	1080	383	74.85 (89.46)	480
Travel (car /bus/motorcycle/ rickshaw)	382	75.15 (111.52)	600	383	68.19 (82.21)	480
Doing crafts or hobbies	382	176.13 (186.74)	1200	383	79.64 (87.75)	480
Playing/ practicing musical instrument	383	134.50 (182.95)	960	383	71.42 (105.24)	810



## **5.8 Links and implications of this study**

Sedentary behaviour has become epidemic worldwide and Bangladesh is no exception. In Bangladesh, children and adolescents display a high level of sedentary behaviour, which has been further exacerbated by COVID-19 lockdowns and remote learning opportunities provided by schools. Paterson et al. (2021) found that these restrictions have had a significant impact on the lifestyle of children, prompting a survey to investigate the prevalence and types of sedentary behaviour during the pandemic. The study adds new classifications of sedentary behaviour, categorizing them into productive, less-productive, and recreational behaviours to better understand the contextual factors. The study found that age and sex were key factors in high levels of sedentary behaviour, highlighting the need for interventions. This information is important in addressing the double burden of weight problem among children in Bangladesh, as previously identified in other studies (Biswas et al., 2016; Bulbul & Hoque, 2014; Khan, Burton & Trost, 2017). This study is one of the first to examine sedentary behaviour among children and adolescents in Bangladesh during the pandemic, adding to the limited body of knowledge. With the increasing accessibility of internet services and screen-based technology in Bangladesh, the study emphasizes the need for parent-and school focused interventions to reduce sedentary behaviour.

## CHAPTER 6: DISCUSSION AND CONCLUSION

This Ph.D. thesis investigates the dietary patterns, physical activity levels, and sedentary behaviour of children and adolescents aged 6 to 18 years of employed mothers. This chapter summarizes the key findings of the four studies that comprise this thesis, interprets and discusses the significance of the research findings in light of the extensive literature, and provides insights regarding diet, physical activity, and sedentary behaviour of children and adolescents. At the outset, a description of the study findings is provided, followed by implications and recommendations for further research. Finally, the study's strengths and shortcomings are discussed, followed by a conclusion section.

### 6.1 Overview of aims and key research findings

The primary goal of this thesis was to examine the way in which mothers' labour-force participation affects the food patterns, physical activity, and sedentary behaviour of children and adolescents aged 6 to 18 years in a Bangladeshi population. To accomplish this purpose, this research was conducted in three stages, with each based on the findings from previous study, as shown in Figure 6.1.

**The first stage** included a systematic literature review (Chapter 2: Study 1: Afrin et al., 2021) to summarize the studies concerning the dietary patterns, physical activity, and sedentary behaviour of employed mothers' children and adolescents, as well as the impact of maternal employment on these three aspects of child and adolescent health-related behaviour. Physical activity and sedentary behaviour were shown to have a positive link with maternal employment, however dietary patterns showed an unfavourable relationship. The children of employed mothers had poorer food habits and higher sedentary behaviour: however, the children of employed mothers were more physically active, according to the review. This study also emphasizes the importance of future research in the domains of food patterns, physical activity, and sedentary behaviour, which have been explored inadequately to date. For instance, children's snack food consumption, particularly fast food and junk food, and dietary quality did not find any definite relationship with maternal employment. Additionally, there was no conclusive link between maternal employment and children's dietary patterns, physical activity, or sedentary behaviour in LMICs and UMICs. The systematic literature review found only 3 studies in LMICs, compared to 32 studies from HICs that explored the relationship between dietary habits, physical activity, and sedentary behaviour and maternal employment in children and adolescents. Overall, further research is essential to arrive at

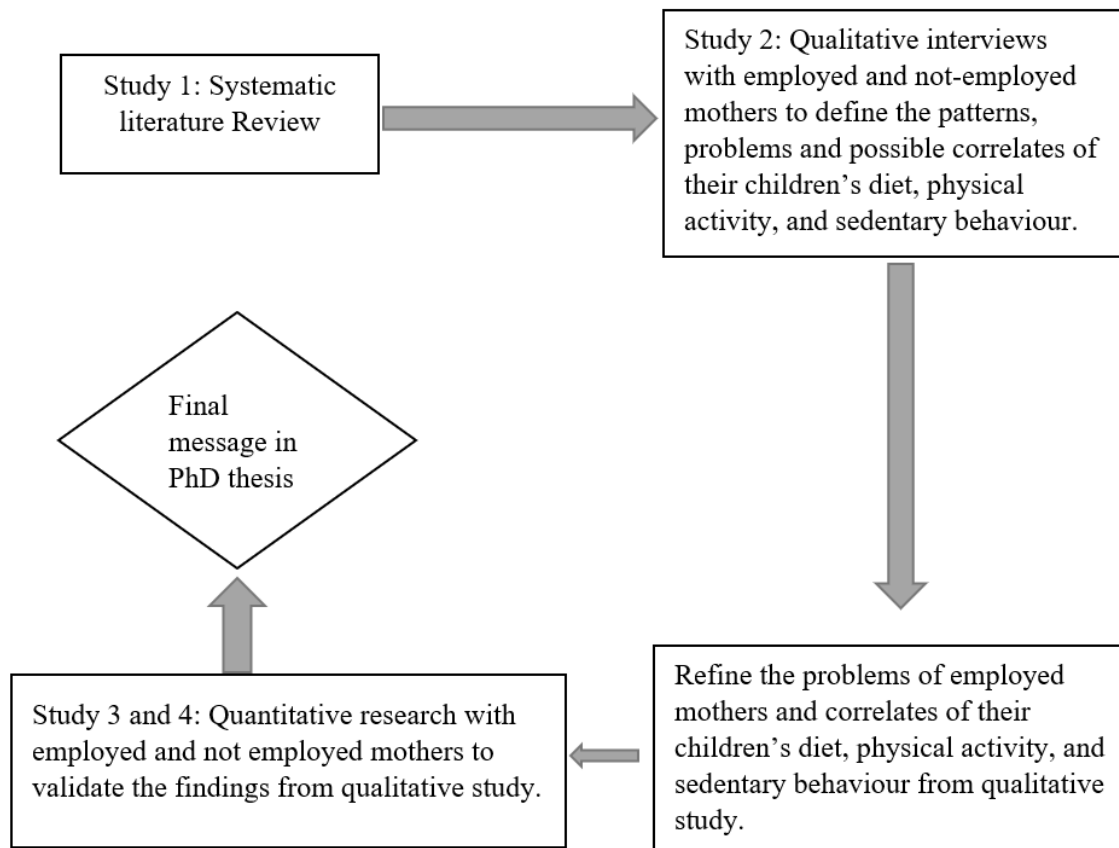
more definitive conclusions about how mother's employment impact children's dietary patterns, physical activity, or sedentary behaviour.

To better understand how mothers, regardless of employment status, perceive children's and adolescents' eating habits, physical activity, and sedentary behaviours in LMIC settings, **the second stage** (Chapter 3: Study 2: Afrin et al., 2023a) of this research included a qualitative study [n=22]. The qualitative findings enrich our understanding of the issues from an individual standpoint. Five themes were identified through qualitative interviews. These themes were child's eating habit; healthy diet: control and exposure of unhealthy and healthy food; influences of environmental constraint on physical activity; dependency on screen-based devices and trade-off between time-income and maternal care: the channel through which maternal employment impacts the dietary patterns, physical activity, and sedentary behaviour of their children. These themes shed light on numerous important elements of how children's and adolescents' dietary habits, physical activity, and sedentary behaviour are related to their mothers' employment status. Initially, we emphasised on the contexts of these behaviours, such as family and other external influences. Children living in extended families, for example, preferred to consume traditional foods inspired by their grandparents. The accessibility of a snack shop was a motivation for purchasing junk food after school. Employed mothers gave their children more pocket money compared to not-employed mothers. Regardless of employment status, mothers expressed difficulties in getting their children to eat vegetables. Breakfast skipping, and eating instant and non-homemade food, was common for the children of employed mothers. Environmental restrictions also limited range of physical activities. The most reported environmental barrier was the lack of children's park or playground. Outdoor physical activity among adolescent girls specifically was hampered by sociocultural factors (e.g., gender role, religion) and parental feelings of apprehension. Children mostly utilised screen-based gadgets for education (e.g., online classes, homework) and enjoyment (e.g., watching movies, cartoons, and playing games). Children of employed mothers have more access to screen-based devices. For instance, when their mother was at work, throughout the week children utilised electronic devices more frequently. On the weekends, employed mothers sometimes allowed their children more time than usual to use their smartphones and tablets to occupy them so that mothers may finish up domestic chores. Mothers considered that restrictions on time and content were the best strategy to reduce children's screen time. Finally, qualitative interviews shed some light on how mothers feel when they trade-off between time, income and maternal care. The major

way that mothers' employment affected their children's eating habits, level of physical activity, and sedentary behaviour was through these factors. Mothers viewed financial assistance as the key advantage of employment since it provided the chance for better foods and educational opportunities. On the other hand, access to fast food and junk food was frequently made possible by the mother's income. Finally, remorseful feelings among employed mothers that their children were deprived of their affection also created the opportunity for non-homemade food and sedentarism.

In order to validate our interpretations of this qualitative data, the **final stage** (Chapters 4 and 5: Studies 3 and 4 [under review]) comprises survey data with a comparable demographic profile. In a sample of Bangladeshi children and adolescents, the studies looked at the patterns and correlates of eating, physical activity, and sedentary behaviour as well as the association between these behavioural patterns and the employment status of mothers. Insufficient consumption of fruits, vegetables, and protein, as well as a preference for moderate physical activity, were found in Study 3 (Chapter 4: Afrin et al., 2023b). The significant determinants of food and physical activity habits were age, family income, and family size, number of siblings, family type, and BMI status. Among children and adolescents, eating habits and physical activity patterns were not predicted by the employment status of the mother. During the pandemic, Study 4 (Chapter 5: Afrin et al., 2023c) identified the common types of recreational, productive (purposeful) and less productive sedentary behaviours among Bangladeshi children during the pandemic and examined differences by maternal employment status. In Bangladesh, both young and older children showed significant levels of sedentary behaviour during COVID-19 lockdowns, based on findings from this study. High levels of sedentary behaviour were associated with age and gender. However, in our study, maternal employment status was not a predictor of sedentary behaviours in children and adolescents.



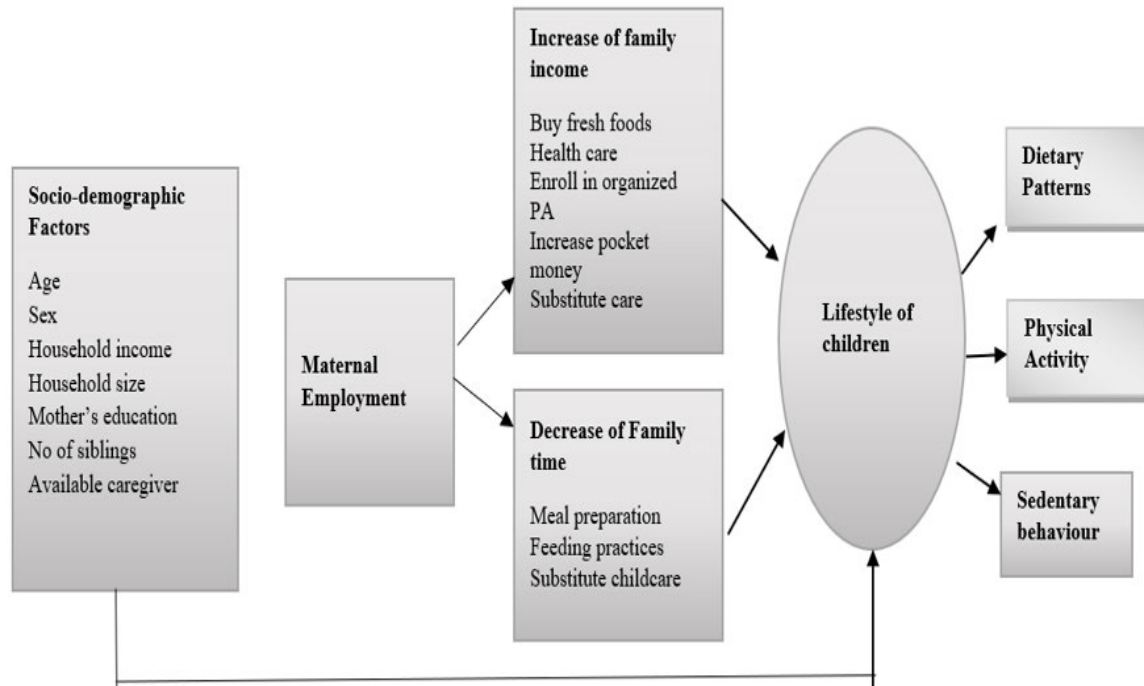


**Figure 6.1** Research stages (stage 1 to stage 3)

## 6.2 Interpretations of findings

The empirical findings of this research showed that maternal work had a conflicting impact on these three lifestyle behaviours in Bangladeshi children and adolescents. Due to the complex and multifaceted nature of these three lifestyle behaviours, as well as the likelihood that the impacts will vary depending on the country or region, it is difficult to determine the impact of maternal labour force participation on children's eating habits, physical activity levels, and sedentary behaviour (Datar et al., 2014). Again, maternal employment has a dual impact: working outside the home tends to reduce a mother's time available to care for her family and children (the time effect/substitution effect); and maternal employment contribute to family income which tends to have a favourable impact on health and behaviour (the income effect). These two areas result in a complex and nuanced interaction that can either directly or indirectly affect the child's lifestyle depending on a number of factors. Figure 6.2

provides a schematic representation of how maternal employment impact child's lifestyle variables.



**Figure 6. 2** Diagram describing the association between mother’s employment, children’s dietary patterns, physical activity and sedentary behaviour [Source: Modified from Ang, Wee, Poh & Ismail (2012)]

The systematic literature review in Chapter 3 revealed that the children of employed mothers had poorer eating habits and more sedentary habits despite having increased physical activity (Afrin et al., 2021). According to Bond and Sales (2001) mothers who work have a double or triple burden of responsibilities at both home and at work, and they may not have the time or energy to care for and connect with their children (Cawley and Liu, 2012; Fertig et al., 2009). Therefore, it is likely that employed mothers cannot prepare home-cooked meals and instead must turn to processed foods and prepared meals (e.g., frozen foods) for greater time efficiency. Additionally, children's sedentary behaviour may be poorer when mothers are unable to socialise or do activities with them. Thus, it is assumed that employed mothers' demanding schedules will have a detrimental effect on their children’s eating habits and sedentary behaviour. However, it was surprising to find that employed mothers' children were

more physically active. This outcome deviates from research by Fertig et al (2022). These authors discovered that parental work was not associated with the physical activity of children. Having a better income as a family may provide more possibilities for children to engage in physical activities, including enrolment in organized physical pursuits such as after-school sports or clubs (Datar et al., 2014; Kantomaa et al., 2007).

The systematic review indicated that research on lifestyle factors for children, adolescents and mothers in upper and lower-middle-income countries is limited. Given that women's economic activity and employment in these countries are much needed and expected to increase in the future, it is unclear how mothers' employment status affects their children's eating habits, physical activity, and sedentary behaviour. Future studies should thus focus on LMICs and UMICs as studies relating to maternal employment, children's lifestyle factors as well as domains of dietary patterns, physical activity, and sedentary behaviour have not been thoroughly addressed and have produced inconsistent results.

A qualitative interview was conducted with 22 mothers who were either employed or not employed to compare and validate our findings from the systematic literature review. The qualitative study identified five major themes, including the child's dietary patterns, healthy-unhealthy food, environmental barriers to physical activity, use of screen-based devices, and the trade-off between time, income, and mother's care (Study 2). In nuclear families, children's dietary preferences were influenced by their tastes as well as parental influence, but in extended families, grandparents had a significant impact since they looked after the children while the mother was away at work. Park and his colleagues (2014) interviewed mothers and schoolteachers and demonstrated that children raised by grandparents often consume traditional meals and practice good dietary habits (Park et al., 2014). Having family support during the parenting process, therefore, appears to help children develop better eating habits. Findings of this study concerning instant or restaurant meals and skipping breakfast among children of employed mothers are validated by earlier studies (Fertig et al. 2009; Kant and Graubard 2004). According to a recent survey, children are increasingly skipping breakfast (Sincovich et al., 2022). A systematic review of 33 countries with 285,626 children and adolescents reported that 10%–30% of them skipped breakfast (Monzani et al., 2019). Maternal employment may intensify breakfast skipping as mother's working hours were associated with increased consumption of unhealthy and non-homemade foods (Kant and Graubard 2004), less breakfast with family (Datar et al. 2014), and skipping breakfast or less eating with children (Fertig et al. 2009). As a result, studies suggested maternal employment

intensified the practice of skipping breakfast (Fertig et al. 2009; Datar et al., 2014). Research has also revealed that working mothers do not have sufficient time to oversee their children's meals or prepare meals (Brown et al. 2010). Contrary to the previous studies, the qualitative study discovered that employed mothers cooked most of the time, despite having limited time (Cawley and Liu 2012). They cooked as a result of social pressures, established gender roles, and practices of being a "good mother" (Dickin et al., 2021) that they picked up early in life (Mahmud & Bidisha 2018). We found that children whose mothers were employed bought food from the school canteen and the stores outside the school. Maternal employment may create such opportunity since children and adolescents from families with greater incomes are more likely to get pocket money (Datar et al. 2014). And about 66% of children used their pocket money to purchase junk food at school (Saha et al., 2013).

According to earlier research (Bower et al., 2008; Davison & Lawson, 2006; Sallis et al., 2000), children and adolescents' active engagement in physical activities was hampered by environmental factors including a lack of a playground and time for outside play. Adolescent girls were not permitted to play outside for social, cultural, and safety concerns. This research is comparable to that by Stride et al. (2018) on young Asian women. The study concluded that because young women are expected to adopt traditional gender roles in the household, they have less time and energy for physical activity. Role of religion and community influence was also included in it (Stride & Flintoff, 2016). We discovered that parents send their children to after-school academic tutoring because they believe education is the key to a better future. This decreases children's physical activity time after school (Atkin et al., 2011) and increases sedentary time as a result of increased study time (Cui et al., 2011). Another factor of increased sedentary behaviour revealed in recent research during the COVID-19 pandemic was remote learning and the usage of screen-based recreation during lockdowns (Hall et al. 2020). Consistent with prior research, our findings suggested that time restrictions of employed mothers is related to the purchasing of ready-to-eat meals (Cawley and Liu 2012) and increased sedentary behaviour of children (Datar et al., 2014; Fertig et al. 2009). When children of employed mothers are often cared for by others or are not supervised by their mother, they spend more time sitting and on sedentary pursuits (Datar et al., 2014).

The current study discovered that mothers' knowledge of their children's eating and behaviour habits was not always reflected in their behaviour. Mothers may not have the time or energy to care for or be as actively involved with their children after handling the simultaneous burdens of work and family life (Cawley and Liu 2012; Fertig et al. 2009). As a result,

mothers allow their children to consume foods and engage in activities that are deemed detrimental to their health. Mothers bring fast-food/junk food that their children like or allow to play games on cell phone/tablet to make children happy, however this might also result in poorer food and activity habits. It has been discovered that some remorseful emotions (e.g., guilt) among employed mothers might influence their children's food and activity patterns.

Results from the survey in Chapter 4 found that children and adolescents consume inadequate fruit, vegetables, and protein, although the majority drink milk regularly and do not skip breakfast. While the majority of the children and adolescents were moderately physically active, there was no evidence of vigorous physical activity among the study participants. Age, family income, family size, family type, number of siblings and BMI status were all significant factors in dietary habits and physical activity. In prior research in Bangladesh, children and adolescents from affluent families were more likely than children from low-income families to fulfill WHO recommendations for daily fruit and vegetable intake (Mustafa et al., 2000). Children and adolescents from extended families showed opposing trends. In Bangladesh (Salwa et al., 2021) and other low- and middle-income countries (Darfour-Oduro et al., 2018), nearly four out of every five children and adolescents consume insufficient fruits and vegetables. Reduced intake among low-income individuals might be caused by decreased demand due to the pricing for certain goods, dietary preferences in the region, and poverty-related social factors (Rasmussen et al., 2006). Since fruit and vegetable intake is connected with affordability (Miller et al., 2016), further research is necessary to determine whether large families have additional sources of income, but this may be a reason for reduced fruit and vegetable eating in extended families with more individuals. Comparing children of employed mothers with those who were not, this study found no appreciable difference in the intake of fruits and vegetables between the two groups of mothers, unlike a previous study (Hawkins et al., 2009). Only 15% of children and adolescents reported skipping breakfast on the majority of days of the week, according to the results of the breakfast skipping habit in this research. This demonstrated that most children and adolescents had established good breakfast routines. Breakfast habits are significantly correlated with family dynamics and practices in children and adolescents (Pearson et al., 2009; Sincovich et al., 2022). Survey data were collected during the COVID-19 lockdown, when most mothers worked from home and were less pressured for time. This could have made it possible for them to eat breakfast with their children, which might have reduced breakfast skipping. However, having offspring at home might have created extra obligations,

so further study is required on this. According to the study findings, older children were more likely than younger ones to skip breakfast (Pearson et al., 2009; Sincovich et al., 2022). Younger children were more likely to drink milk than adolescents, whereas children with higher incomes and higher BMI status were more likely to drink milk than those with lower incomes and lower BMI status. Adolescents typically have more beverage options than younger children, and they favour other drinks such as carbonated beverages and flavoured drinks over milk (Forshee & Storey, 2003). Although prior research has not found a link between drinking milk and BMI, but affordability rises with affluence (Forshee & Storey, 2003) and might influence daily milk intake.

More than half of the world's fish-based protein comes from Bangladesh (Ahmed, 2021). Bangladesh ranks 80th on the Global Food Security Index (2022), although the majority of adults and children do not consume sufficient protein (Global Food Security Index 2022, 2022). The current study found that children with higher BMI tend to consume more protein, which aligns with previous studies supporting high protein intake to increased BMI and higher risk of obesity (Febriani et al., 2019; Koletzko et al., 2016). Recent studies in Bangladesh showed differences in protein intake within households (Ahmed et al., 2022), however, this study did not find any significant intra-household variation in protein intake, which emphasizes the need for more research. The study discovered that while low-to-moderate intensity physical activity (LMPA) was common among urban Bangladeshi children and adolescents, moderate-to-vigorous intensity physical activity (MVPA) was lacking. This could be a result of restrictions on outdoor activity due to the COVID-19 pandemic or environmental and social restrictions described earlier.

Consistent with previous research, the current research highlighted high levels of (recreational) screen time among children and adolescents, with over 80% exceeding the recommended daily limit of 2 hours. Since all sedentary behaviours are not 'bad' such as reading or studying, this research considers two additional categories, namely productive and less-productive sedentary behaviour. All types of sedentary behaviours were found high among children and adolescents' behaviour during COVID-19 lockdowns with age and sex being key determining factors. Consistent with previous studies (Chen et al., 2018; Khan & Burton, 2016), result found that adolescents (13-18 years) and boys were more sedentary than younger children (6-12 years) and girls. During the COVID-19 restrictions remote learning become an important element of children and adolescents sedentarism (Musa et al., 2022). Prolonged study due to parental expectation (Cui et al., 2011; Khan & Burton, 2016; Park et

al., 2014) may provide an explanation for why adolescents had more sedentary time. Children's sedentary behaviour was not found to be associated with maternal employment status. This finding contradicts previous study that shows positive association between mothers working hours and children sedentary time (Hatakeyama et al.,2020), because, maternal longer working hours creates time constraints and reduced the time they spent with children (Cawley & Liu, 2012). Mothers less rules and restrictions on children's use of screen-based devices during the COVID-19 may explain the lack of association between children's sedentary behaviour and maternal employment status in this research. Bounova et al. (2016) argued that family factors such as perceived rules, parental modelling, parents' screen related sedentary behaviour, parental concern for screen-based activities and encouragement for physical activity are significant factors in predicting children and adolescent's sedentary time. Knowing that children's online class, study as well as recreations all were screen based as there were no alternatives during the COVID-19 lockdown, mothers may be reluctant in applying control for sedentary behaviours.

### **6.3 Recommendations for future research**

This program of research suggests several areas that should be investigated in relation to the diet, physical activity and sedentary behaviours of children and adolescents in Bangladesh. Measurement, long-term prospective data, and participant representativeness should all be highlighted in future studies. In Bangladesh in 2020, only 39% population live in urban area (World Bank, 2023). Therefore, future research should focus on population-based studies with a more representative samples of children and adolescents from rural areas in addition to urban settings. Long-term prospective studies are advised to comprehend the trajectories of dietary patterns, physical activity and sedentary behaviours of children and adolescents of employed mothers, and to assess associated influencing factors. This is necessary to understand the determinants of causality and the direction associated with dietary habits, physical activity, and sedentary behaviour of children and adolescents.

### **6.4 Policy implications**

Existing research acknowledges the complexity of the health impact of food intake and physical activity in children and adolescents and recognises the multiple factors that influence dietary and activity patterns, including cultural, geographic, socioeconomic, and demographic factors (Datar et al., 2014). While a comprehensive policy recommendation is beyond the scope of this study, it has important policy implications, particularly in light of the changing social and cultural landscape in LMICs and the rising trend of female labour force

participation despite constraints. Given the urgent need for short- and long-term interventions to improve children's health, the findings from this research contribute to existing literature by examining household and maternal characteristics that impact child dietary patterns, physical activity, and sedentary behaviour. Specifically, this study found disparities in diet, physical activity, and sedentary behaviour among children and adolescents in Bangladesh, with insufficient fruit and vegetable and protein intake and less breakfast skipping habit being particularly prevalent. While Bangladesh has made progress in achieving food and nutrition security, there are several emerging factors that are likely to negatively impact child nutrition, and policymakers should focus on specific foods that children are deprived of and take a more nuanced and holistic perspective. Schools may be key settings for children's health promotion, and interventions should encourage healthy eating and exercise at school by making healthy food and sports facilities available. While the national policy in Bangladesh (NFNSPPA, 2021) is aligned with these findings, fundings and monitoring of these policies remain challenges (Biswas, Pervin, et al., 2017).

### **6.5 Strengths and limitations of the research**

The key strength of this research project is the integration of quantitative and qualitative approaches to examine the multiple dimensions of young people's dietary patterns, physical activity and sedentary behaviour and their association to maternal employment status. Combining qualitative and quantitative data helped comprehensively address the research question and obtain more robust evidence. The systematic literature review identified the areas where further studies are needed (e.g., different domains of diet) and highlighted areas of uncertainty where little to no relevant research has been done (e.g., LMICs). The qualitative interviews helped understand the experience of mothers regarding their experience and other thinking related to children's diet and activity patterns within their sociocultural environment and understanding the mental mapping of the respondents (e.g., the income-time trade-off dimension of employed mothers). The integration of these two approaches offers an opportunity to obtain both an in-depth and comprehensive understanding of the subject matter.

A major strength of this research is the focus on a lower middle-income country (LMIC). There is limited research evidence on the effects of maternal employment on diets, physical activity, and sedentary behaviours in LMICs (Asif et al., 2022; Oddo & Ickes, 2018). Most of the studies that have been conducted in LMICs have examined only one or a combination of



two of dietary patterns, physical activity, or sedentary behaviours. We did not find any study that examined how these three lifestyle behaviours of children were affected by maternal employment status. This is yet another strength of this research. Examining only one or two of these behaviours may not be enough to guide effective interventions. This research recruited a moderately large and diverse sample of children and adolescents from three different cities ensuring a balanced representation of gender and age.

Some limitations of this research need consideration. Survey data was collected through an online platform, and it was challenging to maintain a proper probabilistic sampling method due to the unpredictable conditions caused by the COVID-19. It used a non-random convenience sample of children and adolescents from three major cities in Bangladesh. As such, the results of these studies do not represent all children and adolescents of the country and may have limited generalizability. Due to the cross-sectional nature of data, these results should be interpreted with caution. The cross-sectional design does not allow determination of causality. Dietary patterns, physical activity and sedentary behaviour data were self-reported, which is a common and convenient method in large population-based studies; however, the method is susceptible to social desirability and recall bias. Data were collected during the COVID-19 lock down period which may bias findings. This research only assessed individual-level correlates of dietary patterns, physical activity, and sedentary behaviours, hence, other correlates such as environmental and policy level factors were out of scope.

## **6.6 Conclusion**

There is growing evidence that young people's unhealthy dietary habits, low physical activity levels, and sedentary lifestyles have an impact on their short- and long-term health. Unhealthy health behaviours among children serve as gateways towards adverse health outcome and multiple health condition during adulthood. As women's employment is a significant factor in determining children's food intake, level of physical activity, and sedentary behaviour, throughout the world these patterns draw attention to the association between maternal employment and children's health. The mixed-method approach used in this research provides insights into dietary habits, physical activity and sedentary behaviour in children and adolescents in an LMIC setting. Moreover, the findings of this PhD thesis deliver new perspectives on the dietary patterns, physical activity and sedentary behaviour of children and adolescents of employed mothers in LMICs. Overall, we found that children and

adolescents consumed insufficient amounts of fruit and vegetables, protein, skipped less breakfast, drank milk regularly, and engaged in low levels of physical activity and high levels of sedentary behaviour. Age and sex of the child appeared to be key variables in these behaviours. In Bangladesh, children and adolescent's dietary preferences, physical activity, and sedentary behaviour are all influenced by a variety of socioeconomic and environmental variables. Household wealth, family size, siblings, type of family, BMI status, absence of a playground, and social constraints, particularly for girls, are just a few. Though, the qualitative investigation discovered significant effects of maternal employment on dietary, physical activity and sedentary behaviour habits, we discovered that maternal work was not a predictor of diet, physical activity, or sedentary behaviour in children and adolescents from cross-sectional survey research. A comprehensive understanding of children's and adolescent's health behaviours is required to support evidence-based intervention techniques that promote healthy dietary patterns and active lifestyles defined by appropriate physical activity and reduced sedentary behaviour. Therefore, further research is suggested in the settings of LMICs to understand the trajectories of dietary habits, physical activity, and sedentary behaviour of children of employed mothers.

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## **APPENDIX A**

### **STUDY ONE ONLINE SUPPLEMENTARY MATERIAL**

**Table A.1 Online Resource 1 (PRISMA checklist)**

Sub-Section/topic	#	Checklist item	Reported on page #
<b>TITLE</b>			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
<b>ABSTRACT</b>			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	1
<b>INTRODUCTION</b>			
Rationale	3	Describe the rationale for the review in the context of what is already known.	1-3
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	3
<b>METHODS</b>			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	3
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	4
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	4
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	4
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	4-5
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	4-6
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	4-6

Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	6
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	5
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., $I^2$ ) for each meta-analysis.	5-6

Page 1 of 2

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	N/A
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	N/A
<b>RESULTS</b>			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	6-7
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	24-32
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	11
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	N/A
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	N/A
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	N/A
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	N/A
<b>DISCUSSION</b>			

Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	11-13
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	13-14
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	14
<b>FUNDING</b>			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	N/A

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit: [www.prisma-statement.org](http://www.prisma-statement.org).

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## Online Resource 2: (Risk of bias summary)

A composite risk of bias score for each study was then calculated by summing the total number of criteria:

Low risk of bias: When three or more of the six risk of bias criteria were met

High risk of bias: When less than three of the six risk of bias criteria were met

Unclear risk of bias: When four or more criteria presented an unclear risk of bias due to incomplete reporting.

**Table A.2** Risk of bias summary across selected studies

<b>Study</b>	<b>Select ion bias</b>	<b>Perfor manc e bias</b>	<b>Detect ion bias</b>	<b>Attriti on bias</b>	<b>Selecti ve report ing bias</b>	<b>Other bias: Confo undin g</b>	<b>Risk of bias score</b>
Brown, et al. (2010)	Low risk of bias	High risk of bias	High risk of bias	Low risk of bias	Low risk of bias	Low risk of bias	Low risk of bias
Vazquez -Nava et al.(2013 )	Low risk of bias	High risk of bias	High risk of bias	Unclear risk of bias	High risk of bias	Unclea r risk of bias	High risk of bias
Adbi, A et al.(2017 )	Unclea r risk of bias	Unclea r risk of bias	Low risk of bias	Unclear risk of bias	Low risk of bias	Low risk of bias	Low risk of bias
Sethi, D. et al. (2014).	Unclea r risk of bias	High risk of bias	High risk of bias	Unclear risk of bias	Low risk of bias	High risk of bias	High risk of bias
Park, S., et al. (2014)	Qualitative						Low risk of bias
Neumar k-Sztainer , D., et al. (2003)	Unclea r risk of bias	High risk of bias	Low risk of bias	High risk of bias	High risk of bias	Low risk of bias	High risk of bias

<b>Study</b>	<b>Select ion bias</b>	<b>Perfor manc e bias</b>	<b>Detect ion bias</b>	<b>Attriti on bias</b>	<b>Selecti ve report ing bias</b>	<b>Other bias: Confo unding</b>	<b>Risk of bias score</b>
Honajee , K. et al. (2012)	Unclear risk of bias	Unclear risk of bias	Low risk of bias	Unclear risk of bias	High risk of bias	Unclear risk of bias	Unclear risk of bias
Fitzsimons, E. et al. (2019)	Low risk of bias	High risk of bias	Unclear risk of bias	High risk of bias	Low risk of bias	Low risk of bias	High risk of bias
Cho, Y. (2017)	Low risk of bias	Low risk of bias	High risk of bias	Low risk of bias	Low risk of bias	High risk of bias	Low risk of bias
Maher, J. P., et al. (2017)	Unclear risk of bias	Unclear risk of bias	Low risk of bias	High risk of bias	Low risk of bias	Unclear risk of bias	High risk of bias
Chowhan, J., et al. (2014).	Unclear risk of bias	High risk of bias	Low risk of bias	Low risk of bias	Low risk of bias	Low risk of bias	Low risk of bias
Ham, O. K., et al (2013).	High risk of bias	Unclear risk of bias	Low risk of bias	Unclear risk of bias	High risk of bias	Unclear risk of bias	High risk of bias
Ziol-Guest et al., (2013).	Low risk of bias	Low risk of bias	Low risk of bias	Low risk of bias	Unclear risk of bias	Low risk of bias	Low risk of bias
Touliatos, J., et al. (1984)	Unclear risk of bias	High risk of bias	Low risk of bias	Unclear risk of bias	Low risk of bias	High risk of bias	High risk of bias
Gaina, A., et al. (2009).	Unclear risk of bias	High risk of bias	High risk of bias	High risk of bias	High risk of bias	Low risk of bias	High risk of bias
Hsin, A., & Felfe, C. (2014).	Unclear risk of bias	High risk of bias	Low risk of bias	Low risk of bias	Unclear risk of bias	Low risk of bias	Low risk of bias
Bauer, K. W., et al. D. (2012).	Unclear risk of bias	Low risk of bias	Low risk of bias	High risk of bias	Unclear risk of bias	Low risk of bias	Low risk of bias

<b>Study</b>	<b>Select ion bias</b>	<b>Perfor manc e bias</b>	<b>Detect ion bias</b>	<b>Attriti on bias</b>	<b>Selecti ve report ing bias</b>	<b>Other bias: Confo undin g</b>	<b>Risk of bias score</b>
Li, J., et al. (2012).	Low risk of bias	High risk of bias	High risk of bias	High risk of bias	Low risk of bias	Low risk of bias	High risk of bias
Sweetin g, H., & West, P. (2005).	Unclea r risk of bias	Unclea r risk of bias	High risk of bias	High risk of bias	Low risk of bias	Low risk of bias	High risk of bias
Morrissey, T. W., et al. (2011)	Low risk of bias	High risk of bias	Unclear risk of bias	High risk of bias	Low risk of bias	Low risk of bias	High risk of bias
Chia, Y. F. (2008)	High risk of bias	High risk of bias	Low risk of bias	Unclear risk of bias	Low risk of bias	Low risk of bias	High risk of bias
Chang, Y., & Lee, S. (2012).	Low risk of bias	Unclea r risk of bias	High risk of bias	Unclear risk of bias	Low risk of bias	Low risk of bias	Low risk of bias
Chang, Y.-J. (2012).	Low risk of bias	High risk of bias	High risk of bias	Unclear risk of bias	Low risk of bias	Low risk of bias	High risk of bias
Nadia, Y. (2012)	Unclea r risk of bias	High risk of bias	High risk of bias	Unclear risk of bias	Low risk og bias	Low risk of bias	High risk of bias
Shuhai mi, F., et al. (2012)	Low risk of bias	High risk of bias	Low risk of bias	High risk of bias	Low risk of bias	Unclea r risk of bias	Low risk of bias
Aniza, I., et al.(2009 )	Low risk of bias	High risk of bias	Low risk of bias	Low risk of bias	Low risk of bias	Unclea r risk of bias	Low risk of bias
Martin, M. A., et al. (2018)	Low risk of bias	High risk of bias	High risk of bias	High risk of bias	Low risk of bias	Low risk of bias	High risk of bias
Meyer, S. C. (2016)	Unclea r risk of bias	High risk of bias	High risk of bias	Low risk of bias	Unclear risk of bias	Low risk of bias	High risk of bias



<b>Study</b>	<b>Select ion bias</b>	<b>Perfor manc e bias</b>	<b>Detect ion bias</b>	<b>Attriti on bias</b>	<b>Selecti ve report ing bias</b>	<b>Other bias: Confo unding</b>	<b>Risk of bias score</b>
Nie, P., et al.(2014 ).	Low risk of bias	High risk of bias	High risk of bias	High risk of bias	Low risk of bias	Low risk of bias	High risk of bias
Anderson, P. M. (2012)	Unclear risk of bias	Unclear risk of bias	High risk of bias	Unclear risk of bias	High risk of bias	Low risk of bias	High risk of bias
Taylor, A. W., et al. (2012)	Low risk of bias	High risk of bias	High risk of bias	High risk of bias	Low risk of bias	Unclear risk of bias	High risk of bias
Koca, T., et al. (2017)	Low risk of bias	High risk of bias	Low risk of bias	Unclear risk of bias	Low risk of bias	Unclear risk of bias	Low risk of bias
Ben-Shalom, Y. (2010).	Low risk of bias	High risk of bias	High risk of bias	Low risk of bias	High risk of bias	Low risk of bias	High risk of bias
Gwozdz, W., et al. (2013)	Unclear risk of bias	High risk of bias	Low risk of bias	High risk of bias	Low risk of bias	Low risk of bias	Low risk of bias
Datar, A., et al. (2014).	Low risk of bias	High risk of bias	High risk of bias	Low risk of bias	Low risk of bias	Low risk of bias	Low risk of bias
Parker, M. S. (2007)	Unclear risk of bias	High risk of bias	Low risk of bias	High risk of bias	Low risk of bias	Unclear risk of bias	High risk of bias
Raheeq, W. et al. (2020)	Low risk of bias	High risk of bias	High risk of bias	Unclear risk of bias	Unclear risk of bias	High risk of bias	High risk of bias
Ferrari et al. (2016)	Low risk of bias	Unclear risk of bias	Low risk of bias	High risk of bias	Low risk of bias	High risk of bias	High risk of bias
Pearson et al. (2009)	Low risk of bias	Unclear risk of bias	Low risk of bias	High risk of bias	Low risk of bias	Low risk of bias	Low risk of bias
Wijtzes et al. (2014)	Low risk of bias	High risk of bias	High risk of bias	Low risk of bias	Low risk of bias	Low risk of bias	Low risk of bias

<b>Study</b>	<b>Select ion bias</b>	<b>Perfor manc e bias</b>	<b>Detect ion bias</b>	<b>Attriti on bias</b>	<b>Selecti ve report ing bias</b>	<b>Other bias: Confo unding</b>	<b>Risk of bias score</b>
Lopoo et al. (2007)	Low risk of bias	High risk of bias	High risk of bias	Low risk of bias	Low risk of bias	Low risk of bias	Low risk of bias
Richards et al. (1994)	Low risk of bias	High risk of bias	High risk of bias	High risk of bias	Low risk of bias	Low risk of bias	High risk of bias

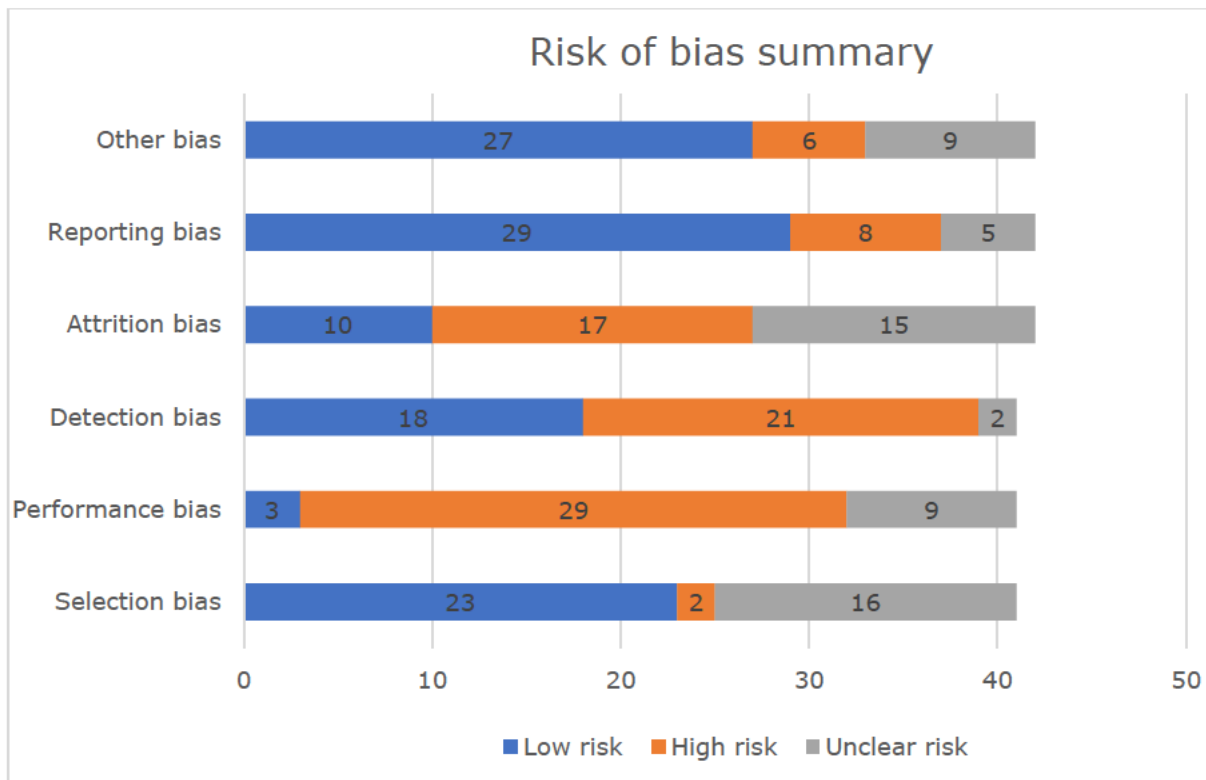
### Summary of Risk of bias score:

High risk of bias: 24 (57.14%); Unclear risk of bias: 01 (2.38%); Low risk of bias: 17 (40.47%)

Table A.3\* Summary of RoB

	<b>Selectio n bias</b>	<b>Performanc e bias</b>	<b>Detection bias</b>	<b>Attrition bias</b>	<b>Selective reporting bias</b>	<b>Other bias</b>
<b>High risk of bias</b>	2 (4.87%)	29 (70.73%)	21 (51.21%)	17 (41.46%)	7 (17.07%)	6 (14.63%)
<b>Low risk of bias</b>	23 (56.09%)	3 (7.31.87%)	18(43.90%)	10(24.39%)	29 (70.73%)	26(63.41%)
<b>Unclear risk of bias</b>	16 (39.02%)	9 (21.95%)	2 (4.87%)	14(34.14%)	5(12.19%)	9 (21.95%)

\*Total studies =41 since one Qual study is not counted here



**Figure A. 1** RoB summary in graph

### Online Resource 3 (Cochrane Collaboration's tool for assessing risk of bias)

**Table A.4** Cochrane Collaboration's tool for assessing risk of bias

Bias domain	Source of bias	Support for judgement	Review authors' judgment (assess as low, unclear or high risk of bias)
Selection bias	Random sequence generation	Describe the method used to generate the allocation sequence in sufficient detail to allow an assessment of whether it should produce comparable groups	
	Allocation concealment	Describe the method used to conceal the allocation sequence in sufficient detail to determine whether intervention allocations could have been foreseen before or during enrolment	
Performance bias	Blinding of participants and personnel*	Describe all measures used, if any, to blind trial participants and researchers from knowledge of which intervention a participant received. Provide any information relating to whether the intended blinding was effective	
Detection bias	Blinding of outcome assessment*	Describe all measures used, if any, to blind outcome assessment from knowledge of which intervention a participant received. Provide any information relating to whether the intended blinding was effective	
Attrition bias	Incomplete outcome data*	Describe the completeness of outcome data for each main outcome, including attrition and exclusions from the analysis. State whether attrition and exclusions were reported, the numbers in each intervention group (compared with total randomised participants), reasons for attrition or exclusions where reported, and any reinclusions in analyses for the review	
Reporting bias	Selective reporting		
Other bias	Anything else, ideally prespecified	State any important concerns about bias not covered in the other domains in the tool	

\*Assessments should be made for each main outcome or class of outcomes.

Ref: Higgins, J., Altman, D., Gotzsche, P., Juni, P., Moher, D., & Oxman, A. et al. (2011). The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. *BMJ*, 343(oct18 2).

<https://doi.org/10.1136/bmj.d592>

**Online Resource 3 (JBI Critical Appraisal Checklist for Qualitative Research)**

**JBI Critical Appraisal Checklist for Qualitative Research**

Reviewer..... Date.....

Author ..... Record Number.....

	Yes	No	Unclear	
Not applicable				
1. Is there congruity between the stated philosophical perspective and the research methodology?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Is there congruity between the research methodology and the research question or objectives?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Is there congruity between the research methodology and the methods used to collect data?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Is there congruity between the research methodology and the representation and analysis of data?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Is there congruity between the research methodology and the interpretation of results?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Is there a statement locating the researcher culturally or theoretically?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Is the influence of the researcher on the research, and vice-versa, addressed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Are participants, and their voices, adequately represented?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Is the research ethical according to current criteria or, for recent studies, and is there evidence of ethical approval by an appropriate body?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Do the conclusions drawn in the research report flow from the analysis, or interpretation, of the data?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Comments:** Low risk of bias

^Reproduced from: JBI (2014a)

**Supplementary material: In/out form for study selection**

**Dietary habits, physical activity and sedentary behaviour of children of working mothers: a systematic review**

**IN/OUT FORM**

Author and  
year

Today's  
date

Study ID  
Number

Reviewer

Question	Yes	Not Clear	No	Further information:
Is the study an <b>observational study / baseline intervention study/longitudinal/prospective study?</b>				State the type of study:
Is the age group of children studied <b>aged 6-18 years?</b>				Age group:
Is the <b>mother's employment status reported?</b>				State the type of work (e.g., full time, part time):

Is a child outcome reported on either dietary intake or physical activity or sedentary behaviour?				State the primary measure(s) reported:		
Question	Yes	Not Clear	No	Further information:		
Does the study measure the association between at least one domain of mother's employment status and one domain of dietary intake, physical activity and sedentary behaviour?						
English language?						
<b>IF THE ANSWER TO ANY OF THE ABOVE IS SHADED BOX, <u>EXCLUDE</u> THE STUDY (FROM THIS INITIAL SCREENING)</b>						
This study is:	Included	<input type="checkbox"/>	Excluded	<input type="checkbox"/>	NOT SURE	<input type="checkbox"/>
	Details:					



Other information

## **APPENDIX B**

### **STUDY TWO SUPPLEMENTARY MATERIAL**

**Semi-structured discussion guide for telephone interview:**

Name of participant (mother)	
<b>Mother characteristics</b>	
Profession	
Age	
Education level	High School:    undergraduate:    Post-graduate:
<b>Child characteristics</b>	
Number of siblings	No sibling:    One sibling:    More than one sibling:
Sex of child:	Boy.....                      Girl.....
Age of children (in years)	
<b>Household characteristics</b>	
Family type	Nuclear.....                      Extended family...
Household income (BD taka per month)	< 20,000 (lower income group) 20,000- < 30,000 (lower middle-income group) 30,000- < 40,000(middle income group) 40,000-<50,000 (upper middle-income group) 50,000 or more

**Dietary Patterns**

**a) Eating patterns**

- i)What do your children usually eat?
- ii) Do your child skip meals?
- iii) What influences your children’s eating habits e.g., taste of foods, family, friends, TV advertisement or anything else?

**b) Perception of healthy eating**

- i)Which foods do you consider as healthy foods? Which are unhealthy?

**c)Food preparation**

- i)Do you cook for your family? Why or why not?

**d) Cost and benefit of earnings**

- i) What kind of benefits your children get from your earning? Are there any disadvantages?

## **Physical activity**

### ***a) Physical activity pattern***

- i) What types of physical activity do your child like most and why?

### ***b) Perceptions of physical activity***

- i) What do you feel about your children's physical activity?

### ***c) Facilities and Barriers to physical activity participation***

- i) What is the benefit of physical activity for your children?
- ii) What are the constraints of physical activity for your children?

## **Sedentary behaviour**

### ***a) Purpose of using screen-based devices***

- i) For what purposes does your child use screen-based devices?

### ***b) Motivational and contextual reasons***

- i) In what situation does your child sit more? When you are at home or at work?

### ***c) Perception of sedentary behaviour***

- i) What's the benefit and effect of sedentary activities for your children?

### ***d) Facilities and barriers for regulating screen time***

- i) What kind of support do you get for controlling your children's screen time?
- ii) What kind of constraints do you feel when controlling your children's screen time?

**Self-reported demographic information (Bengali version):**

অংশগ্রহণকারীর নাম:	
<b>Mother characteristics</b>	
পেশা:	
বয়স:	
শিক্ষাগত যোগ্যতা:	উচ্চ মাধ্যমিকের কম..... উচ্চ মাধ্যমিক..... স্নাতক..... স্নাতকোত্তর.....
<b>Child characteristics</b>	
ভাইবোনের সংখ্যা:	কোন ভাইবোন নেই..... একজন..... একজনের বেশী.....
সন্তানের লিঙ্গ:	ছেলে..... মেয়ে.....
সন্তানের বয়স (বছরে):	
<b>Household characteristics</b>	
পরিবারের ধরন:	একক..... যৌথ.....
পারিবারিক আয় (বাংলাদেশী টাকায়):	<২০০০০ ২০০০০- <৩০০০০ ৩০০০০- <৪০০০০ ৪০০০০ বা তার বেশী



# Consent Form for USQ Research Project

<b>ID</b>	0		
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Please return this form prior to undertaking the interview.

## Project Details

Title of Project: The effect of maternal employment on children’s dietary habits, physical activity and sedentary behaviour

Human Research Ethics Approval Number: H20REA147

## Research Team Contact Details

### Principal Investigator Details

Sabiha Afrin  
 Email: [REDACTED]  
 Telephone:  
 Mobile: [REDACTED]

### Supervisor Details

Professor Stuart J. H. Biddle  
 Email: [REDACTED]  
 Telephone: [REDACTED]  
 Mobile: [REDACTED]

## Statement of Consent

By signing below, you are indicating that you:

- Have read and understood the information document regarding this project. Yes / No
- Have had any questions answered to your satisfaction. Yes / No
- Understand that if you have any additional questions you can contact the research team. Yes / No
- Are over 18 years of age. Yes / No
- Understand that any data collected may be used in future research activities [all future research activities OR only those related to this field]. Yes / No



## Participant Information for USQ Research Project

- Agree to participate in the project.

Yes /   
No

### Project Details

Title of Project: The effect of maternal employment on children’s dietary habits, physical activity and sedentary behaviour

Human Research Ethics Approval Number: H20REA147

### Research Team Contact Details

#### Principal Investigator Details

Sabiha Afrin  
Email: [REDACTED]  
Telephone:  
Mobile: [REDACTED]

#### Supervisor Details

Professor Stuart J. H. Biddle  
Email: [REDACTED]  
Telephone: [REDACTED]  
Mobile: [REDACTED]

### Description

This project is being undertaken as part of Doctor of Philosophy program.

The purpose of this project is to explore the dietary patterns, physical activity, and sedentary behaviour of working mothers with children (aged 6-12 years) in urban families of Bangladesh.

The research team requests your assistance because this data may benefit the working mothers by identifying the constraint(s) related to dietary patterns physical activity and

sedentary behaviour of their children and help the policy makers to design effective strategies and policies for them and for their children.

### **Participation**

Your participation will involve participation in an online survey that will take approximately 15-20 minutes of your time.

Questions will include sociodemographic features of your family, dietary patterns, physical activity and sedentary behaviour of your children.

Your participation in this project is entirely voluntary. If you do not wish to take part, you are not obliged to. If you decide to take part and later change your mind, you are free to withdraw from the project at any stage. You may also request that any data collected about you be withdrawn and confidentially destroyed.

Your decision whether you take part, do not take part, or to take part and then withdraw, will in no way impact your current or future relationship with the University of Southern Queensland.

### **Expected Benefits**

It is expected that this project will not directly benefit you or your child. However, it may benefit indirectly by assisting the policymakers to identify the constraint(s) related to dietary patterns physical activity and sedentary behaviour of children of mothers working outside and help to design effective strategies and policies for them and for their children.

### **Risks**

In participating in this survey, there are no anticipated physical or mental risks beyond normal day-to-day living. However, the potential inconvenience of participants to take part in the research might be giving up time.

### **Privacy and Confidentiality**

All comments and responses will be treated confidentially unless required by law.

Your data will be made available for future research purposes through the mediated access repository. The data will be stored and shared as non-identifiable data.

The project summary of results will be communicated to you in the format of thesis, journal article and conference paper.

Any data collected as a part of this project will be stored securely as per University of Southern Queensland's [Research Data Management policy](#).

### **Consent to Participate**

We would like to ask you to sign a written consent form (enclosed) to confirm your agreement to participate in this project. Please return your signed consent form along



with the questionnaire to a member of the Research Team prior to participating in online survey.

#### **Questions or Further Information about the Project**

Please refer to the Research Team Contact Details at the top of the form to have any questions answered or to request further information about this project.

#### **Concerns or Complaints Regarding the Conduct of the Project**

If you have any concerns or complaints about the ethical conduct of the project, you may contact the University of Southern Queensland Manager of Research Integrity and Ethics on +61 7 4631 1839 or email [researchintegrity@usq.edu.au](mailto:researchintegrity@usq.edu.au). The Manager of Research Integrity and Ethics is not connected with the research project and can facilitate a resolution to your concern in an unbiased manner.

**Thank you for taking the time to help with this research project. Please keep this sheet for your information.**

## **Dietary habits, physical activity and sedentary behaviour of children of urban employed and unemployed mothers in Bangladesh: a qualitative study**

Dear participant, my name is Sabiha Afrin. I am a Ph.D. researcher at the University of Southern Queensland, Australia. Our team conducting a research study that investigates the effect of maternal employment on their children (6-18 years); this includes children's dietary patterns, physical activity and sedentary behaviour. Your participation in this study involves answering some questions through a telephone interview that will take around 30-40 minutes from your time. All the information that I received from you will be treated with strict confidentiality and will be used only for the purpose of research. Your identity will also be kept confidential.

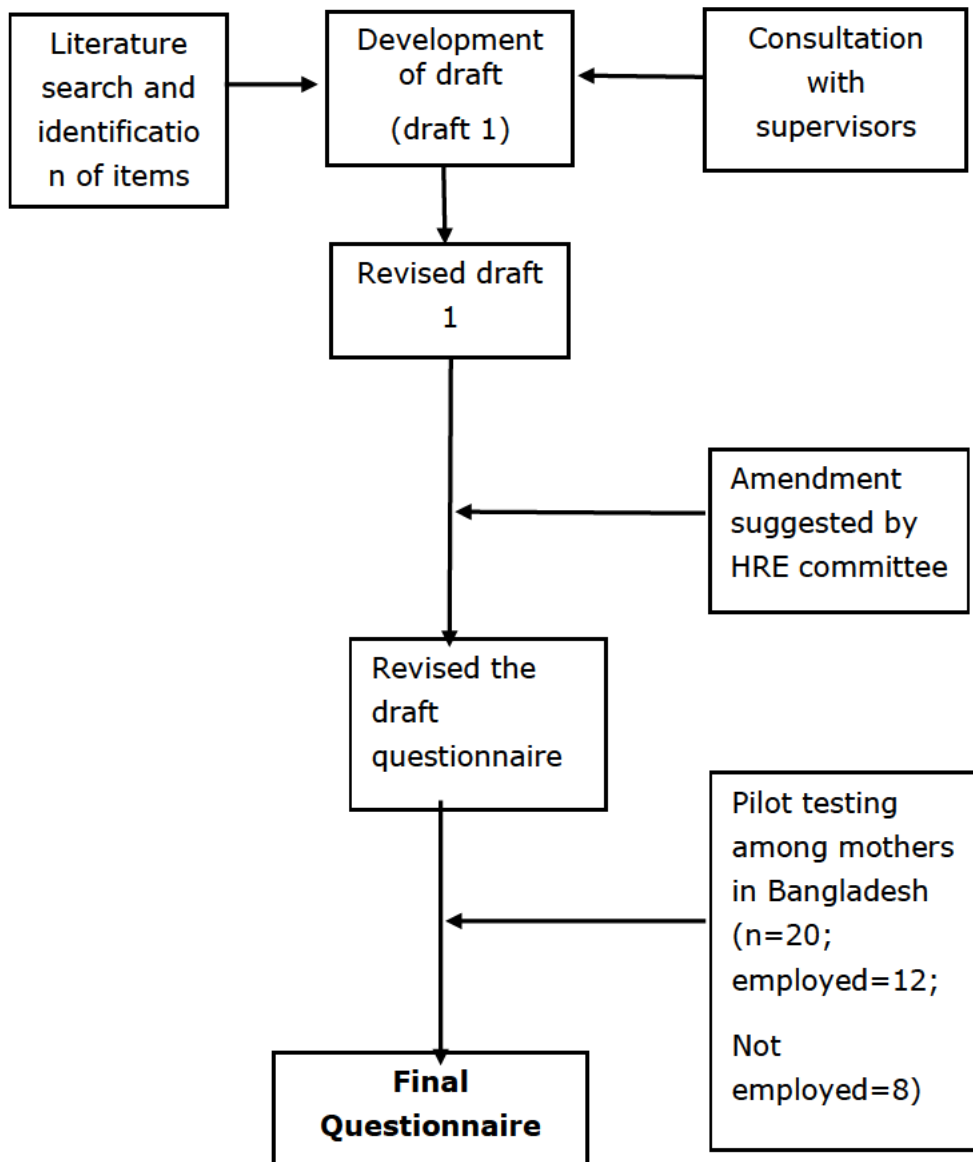
To be eligible to participate in this study, we have a few questions to ask you.

1. Are you a resident of Sylhet city? Yes.....No.....
2. Do you have a child aged between 6-18 years? Yes.....No.....
3. Does the child have any medical problem that may affect his/her normal life?  
Yes.....No.....

## **APPENDIX C**

### **STUDY THREE ONLINE SURVEY MATERIAL**

**Supplementary material C.1: Questionnaire development for the survey**



**Figure C.1** Flow diagram of survey questionnaire development

### Supplementary material C.2: Sample size determination

Sample size will determine using the following formula (assuming that the population is large) (Islam, 2005):

$$n = \frac{Z^2_{\alpha/2} \times p(1 - p)}{d^2}$$

Where,

$n$  = sample size

$Z_{\alpha/2}$  = two-sided normal variate value

$p$  = standard deviation

$d$  = margin of error

By using 95% CI (two-sided), 5% margin of error and 50% standard deviation ( if **p is unknown, its value is assumed to be 50% or 0.5**), a total sample size will be:

**Z = level of confidence (1.96)**

**p = 0.5**

**d = 0.05**

**Calculation:**

$$\begin{aligned} n &= \frac{(1.96)^2(0.5)(1 - 0.5)}{(0.05)^2} \\ &= \frac{(3.8416)(0.5)(0.5)}{0.0025} \\ &= 384.16 \end{aligned}$$

Sample size,  $n=385$

If we consider 10% nonresponse rate the sample size will be  $(385+10\% \text{ of } 385) = 423.5$

**Final sample size = 424**

### Supplementary material C.3: Hosmer-Lemeshow diagnostic test and Pearson chi-square goodness of fit tests result (STATA output)

#### Pearson goodness-of-fit test:

```
. estat gof
```

```
Goodness-of-fit test after logistic model
Variable: meet
```

```
Number of observations = 273
Number of covariate patterns = 191
Pearson chi2(181) = 196.92
Prob > chi2 = 0.1982
```

#### Hosmer-Lemeshow test

```
. estat gof, group(10)
```

```
note: obs collapsed on 10 quantiles of estimated probabilities.
```

```
Goodness-of-fit test after logistic model
Variable: meet
```

```
Number of observations = 273
Number of groups = 10
Hosmer-Lemeshow chi2(8) = 8.28
Prob > chi2 = 0.4070
```

```
. estat gof, group(10) table
```

```
note: obs collapsed on 10 quantiles of estimated probabilities.
```

```
Goodness-of-fit test after logistic model
Variable: meet
```

Table collapsed on quantiles of estimated probabilities

Group	Prob	Obs_1	Exp_1	Obs_0	Exp_0	Total
1	0.2212	5	4.9	23	23.1	28
2	0.2538	6	6.5	21	20.5	27
3	0.3052	7	7.5	20	19.5	27
4	0.3298	10	8.9	18	19.1	28
5	0.3565	9	9.3	18	17.7	27
6	0.3949	13	10.1	14	16.9	27
7	0.4251	12	11.5	16	16.5	28
8	0.4641	8	13.9	23	17.1	31
9	0.5234	16	12.4	9	12.6	25
10	0.6173	13	14.0	12	11.0	25

```
Number of observations = 273
Number of groups = 10
Hosmer-Lemeshow chi2(8) = 8.28
Prob > chi2 = 0.4070
```

```
.
```

Milk consumption

## Pearson goodness-of-fit test:

```
. estat gof
```

```
Goodness-of-fit test after logistic model  
Variable: milk_freq
```

```
Number of observations = 273  
Number of covariate patterns = 191  
Pearson chi2(181) = 191.43  
Prob > chi2 = 0.2833
```

## Hosmer-Lemeshow test

```
. estat gof, group(10)
```

```
note: obs collapsed on 10 quantiles of estimated probabilities.
```

```
Goodness-of-fit test after logistic model  
Variable: milk_freq
```

```
Number of observations = 273  
Number of groups = 10  
Hosmer-Lemeshow chi2(8) = 11.95  
Prob > chi2 = 0.1535
```

```
. estat gof, group(10) table
```

```
note: obs collapsed on 10 quantiles of estimated probabilities.
```

```
Goodness-of-fit test after logistic model  
Variable: milk_freq
```

Table collapsed on quantiles of estimated probabilities

Group	Prob	Obs_1	Exp_1	Obs_0	Exp_0	Total
1	0.3191	5	7.9	23	20.1	28
2	0.3976	16	10.0	11	17.0	27
3	0.4361	8	11.7	20	16.3	28
4	0.4800	12	12.7	16	15.3	28
5	0.5023	14	12.8	12	13.2	26
6	0.5332	14	14.7	14	13.3	28
7	0.5640	18	14.8	9	12.2	27
8	0.6142	16	15.9	11	11.1	27
9	0.6889	17	17.4	10	9.6	27
10	0.8249	18	20.1	9	6.9	27

```
Number of observations = 273  
Number of groups = 10  
Hosmer-Lemeshow chi2(8) = 11.95  
Prob > chi2 = 0.1535
```

## Skip breakfast

### Pearson goodness-of-fit test:

```
. estat gof
```

```
Goodness-of-fit test after logistic model  
Variable: skipbreakfast_numeric
```

```
Number of observations = 273  
Number of covariate patterns = 191  
Pearson chi2(181) = 212.01  
Prob > chi2 = 0.0571
```

### Hosmer-Lemeshow test

```
. estat gof, group(10)  
note: obs collapsed on 10 quantiles of estimated probabilities.
```

```
Goodness-of-fit test after logistic model  
Variable: skipbreakfast_numeric
```

```
Number of observations = 273  
Number of groups = 10  
Hosmer-Lemeshow chi2(8) = 5.71  
Prob > chi2 = 0.6798
```

```
. estat gof, group(10) table  
note: obs collapsed on 10 quantiles of estimated probabilities.
```

```
Goodness-of-fit test after logistic model  
Variable: skipbreakfast_numeric
```

Table collapsed on quantiles of estimated probabilities

Group	Prob	Obs_1	Exp_1	Obs_0	Exp_0	Total
1	0.0251	1	0.6	27	27.4	28
2	0.0326	1	0.8	26	26.2	27
3	0.0450	2	1.0	25	26.0	27
4	0.0532	1	1.4	28	27.6	29
5	0.0604	1	1.6	27	26.4	28
6	0.0730	0	1.7	25	23.3	25
7	0.1146	1	2.6	27	25.4	28
8	0.1409	5	3.4	22	23.6	27
9	0.1792	5	4.5	24	24.5	29
10	0.5363	7	6.3	18	18.7	25

```
Number of observations = 273  
Number of groups = 10  
Hosmer-Lemeshow chi2(8) = 5.71  
Prob > chi2 = 0.6798
```

```
.
```

### Protein consumption:

### Pearson goodness-of-fit test:



```
. estat gof
```

```
Goodness-of-fit test after logistic model  
Variable: proteinv1
```

```
Number of observations = 247  
Number of covariate patterns = 167  
Pearson chi2(158) = 120.95  
Prob > chi2 = 0.9873
```

## Hosmer-Lemeshow test

```
. estat gof, group(10)  
note: obs collapsed on 10 quantiles of estimated probabilities.
```

```
Goodness-of-fit test after logistic model  
Variable: proteinv1
```

```
Number of observations = 247  
Number of groups = 10  
Hosmer-Lemeshow chi2(8) = 5.71  
Prob > chi2 = 0.6796
```

```
. estat gof, group(10) table  
note: obs collapsed on 10 quantiles of estimated probabilities.
```

```
Goodness-of-fit test after logistic model  
Variable: proteinv1
```

Table collapsed on quantiles of estimated probabilities

Group	Prob	Obs_1	Exp_1	Obs_0	Exp_0	Total
1	0.0079	0	0.2	25	24.8	25
2	0.0130	0	0.3	26	25.7	26
3	0.0183	1	0.4	23	23.6	24
4	0.0238	2	0.7	31	32.3	33
5	0.0315	0	0.5	16	15.5	16
6	0.0401	1	1.0	26	26.0	27
7	0.0504	0	1.1	23	21.9	23
8	0.0752	1	1.5	23	22.5	24
9	0.0894	2	2.2	24	23.8	26
10	0.2248	4	3.3	19	19.7	23

```
Number of observations = 247  
Number of groups = 10  
Hosmer-Lemeshow chi2(8) = 5.71  
Prob > chi2 = 0.6796
```

.

## Physical activity

### Pearson goodness-of-fit test

```
. estat gof
```

```
Goodness-of-fit test after logistic model  
Variable: Phy_activity_numeric
```

```
Number of observations = 273  
Number of covariate patterns = 217  
Pearson chi2(206) = 171.26  
Prob > chi2 = 0.9629
```

## Hosmer-Lemeshow test

```
. estat gof, group(10)
```

```
note: obs collapsed on 10 quantiles of estimated probabilities.
```

```
Goodness-of-fit test after logistic model  
Variable: Phy_activity_numeric
```

```
Number of observations = 273  
Number of groups = 10  
Hosmer-Lemeshow chi2(8) = 4.82  
Prob > chi2 = 0.7761
```

```
. estat gof, group(10) table
```

```
note: obs collapsed on 10 quantiles of estimated probabilities.
```

```
Goodness-of-fit test after logistic model  
Variable: Phy_activity_numeric
```

```
Table collapsed on quantiles of estimated probabilities
```

Group	Prob	Obs_1	Exp_1	Obs_0	Exp_0	Total
1	0.8832	25	25.7	6	5.3	31
2	0.9037	22	21.5	2	2.5	24
3	0.9245	24	24.7	3	2.3	27
4	0.9407	29	29.0	2	2.0	31
5	0.9495	23	22.7	1	1.3	24
6	0.9609	28	26.8	0	1.2	28
7	0.9683	26	26.0	1	1.0	27
8	0.9766	25	26.3	2	0.7	27
9	0.9869	27	26.5	0	0.5	27
10	0.9996	27	26.8	0	0.2	27

```
Number of observations = 273  
Number of groups = 10  
Hosmer-Lemeshow chi2(8) = 4.82  
Prob > chi2 = 0.7761
```

Group	Prob	Obs_1	Exp_1	Obs_0	Exp_0	Total
1	0.8832	25	25.7	6	5.3	31
2	0.9037	22	21.5	2	2.5	24
3	0.9245	24	24.7	3	2.3	27
4	0.9407	29	29	2	2	31
5	0.9495	23	22.7	1	1.3	24

6	0.9609	28	26.8	0	1.2	28
7	0.9683	26	26	1	1	27
8	0.9766	25	26.3	2	0.7	27
9	0.9869	27	26.5	0	0.5	27
10	0.9996	27	26.8	0	0.2	27

## Supplementary material C.4: Online Survey Questionnaire (Study 3)

8/19/22, 9:44 AM

UniSQ Survey Tool - A cross sectional study on the dietary intake, physical activity patterns and sedentary behaviour among ...

### A cross sectional study on the dietary intake, physical activity patterns and sedentary behaviour among children of employed and non-employed mothers.

#### Project Details:

The effect of maternal employment on children's dietary habits, physical activity and sedentary behaviour

Human Research Ethics Approval Number: H20REA147

#### Research Team Contact Details:

Sabiha Afrin

Professor Stuart J. H. Biddle

Email:

subject=The%20effect%20of%20maternal%20employment%20on%20children's%20DPA%20and%20SB)

Telephone:

Mobile: +8801717040166

#### Description:

This project is being undertaken as part of Doctor of Philosophy program.

The purpose of this project is to explore the dietary patterns, physical activity, and sedentary behaviour of working mothers with children (aged 6-12 years) in urban families of Dhaka, Mymensingh and Sylhet district, Bangladesh.

The research team requests your assistance because this data may benefit the working mothers by identifying the constraint(s) related to dietary patterns physical activity and sedentary behaviour of their children and help the policymakers to design effective strategies and policies for them and for their children.

#### Participation:

Your participation will involve participation in an interview that will take approximately 30-40 minutes of your time.

The interview will take place at a time and venue that is convenient to you.

Questions will include sociodemographic features of your family, dietary patterns, physical activity and sedentary behaviour of your children.

Your participation in this project is entirely voluntary. If you do not wish to take part, you are not obliged to. If you decide to take part and later change your mind, you are free to withdraw from the project at any stage. You may also request that any data collected about you be withdrawn and confidentially destroyed.

Your decision whether you take part, do not take part, or to take part and then withdraw, will in no way impact your current or future relationship with the University of Southern Queensland.

#### Expected Benefits

It is expected that this project will not directly benefit you or your child. However, it may benefit indirectly by assisting the policymakers to identify the constraint(s) related to dietary patterns physical activity and sedentary behaviour of children of mothers working outside and help to design effective strategies and policies for them and for their children.

#### Risks

In participating in this interview, there are no anticipated physical or mental risks beyond normal day-to-day living. However, the potential inconvenience of participants to take part in the research might be giving up time.

#### Privacy and Confidentiality

All comments and responses will be treated confidentially unless required by law.

Your data will be made available for future research purposes through the mediated access repository. The data will be stored and shared as non-identifiable data.

The project summary of results will be communicated to you in the format of thesis, journal article and conference paper.

<https://surveys.usq.edu.au/index.php/admin/printablesurvey/sa/index/surveyid/442735/lang/en>

1/14

Any data collected as a part of this project will be stored securely as per University of Southern Queensland's [Research Data Management policy](http://policy.usq.edu.au/documents/151987PL) (<http://policy.usq.edu.au/documents/151987PL>).

#### Consent to Participate

We would like to ask you to sign a written consent form (enclosed) to confirm your agreement to participate in this project. Please return your signed consent form to a member of the Research Team prior to participating in your interview.

#### Questions or Further Information about the Project

Please refer to the Research Team Contact Details at the top of the form to have any questions answered or to request further information about this project.

#### Concerns or Complaints Regarding the Conduct of the Project

If you have any concerns or complaints about the ethical conduct of the project, you may contact the University of Southern Queensland Manager of Research Integrity and Ethics on

+61 7 4631 1839 or email [researchintegrity@usq.edu.au](mailto:researchintegrity@usq.edu.au) (<mailto:researchintegrity@usq.edu.au>). The Manager of Research Integrity and Ethics is not connected with the research project and can facilitate a resolution to your concern in an unbiased manner.

There are 33 questions in this survey.

## Sociodemographic questionnaire

Please provide information about your child who is between 6 to 18 years. If all or more than one of your children are in this age group, give the information of the younger ones.

1

Respondent is mother

\*

🗳️ Choose one of the following answers

Please choose **only one** of the following:

Yes

No

2

Respondent is the main caregiver

🗳️ Choose one of the following answers

Please choose **only one** of the following:

Yes

No

3  
Gender of child

\*

❶ Choose one of the following answers  
Please choose **only one** of the following:

Male  
 Female

4 Age of child in years \*

Please write your answer here:

5 Number of siblings \*

Please write your answer here:

6  
Type of school

\*

❶ Choose one of the following answers  
Please choose **only one** of the following:

Private  
 Public

7 Number of family members \*

Please write your answer here:

8

Occupation/Profession of mother

\*

Please write your answer here:

9 Current employment status \*

● Choose one of the following answers

Please choose **only one** of the following:

- Employed full time (32-40 hours per week)
- Employed part time (up to 31 hours per week)
- Not employed

10 Type of family \*

● Choose one of the following answers

Please choose **only one** of the following:

- Nuclear
- Joint

11 your highest level of education \*

● Choose one of the following answers

Please choose **only one** of the following:

- No formal schooling
- Less than primary
- Primary completed
- Secondary completed
- Higher Secondary completed
- Graduation degree and above

12

Total monthly expenditure of family (approximately)

\*

Please write your answer here:

13 Total monthly income of family (approximately)

Please write your answer here:

## Physical Activity Questionnaire (PAQ-C)

We are trying to find out about your child's level of physical activity from the last 7 days (in the last week). This includes sports or dance that make you sweat or make your legs feel tired, or games that make you breathe hard, like tag, skipping, running, climbing, and others. Remember: 1. There is no right and wrong answers — this is not a test. 2. Please answer all the questions as honestly and accurately as you can — this is very important.



14

Physical activity in your spare time: Have your child done any of the following activities in the past 7 days (last week)? If yes, how many times? (Mark only one circle per row.)

\*

Please choose the appropriate response for each item:

	No	1-2 times	3-4 times	5-6 times	7 times or more
Skipping	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Walking for exercise	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bicycling	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Jogging or running	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Dance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Aerobics	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Yoga	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Swimming	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Handball	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Football	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Volleyball	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Basketball	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Badminton	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hokey	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cricket	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kabady	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

15

In the last 7 days, during your physical education (PE) classes, how often were your child very active (playing hard, running, jumping

\*

Choose one of the following answers  
Please choose **only one** of the following:

- Don't do PE
- Hardly ever
- Sometimes
- Quite often
- Always

16 In the last 7 days, what did your child do most of the time at recess? (Check one only.) \*

Choose one of the following answers  
Please choose **only one** of the following:

- Sat down (talking, reading, doing schoolwork) .....
- Stood around or walked around
- Ran or played a little bit
- Ran around and played quite a bit
- Ran and played hard most of the time

17 In the last 7 days, what did your child normally do at lunch (besides eating lunch)? (Check one only.) \*

Choose one of the following answers  
Please choose **only one** of the following:

- Sat down (talking, reading, doing schoolwork)
- Stood around or walked around
- Ran or played a little bit
- Ran around and played quite a bit
- Ran and played hard most of the time

18 In the last 7 days, on how many days right after school, did your child do sports, dance, or play games in which you were very active? (Check one only). \*

🗳️ Choose one of the following answers

Please choose **only one** of the following:

- None
- 1-time last week
- 2 or 3 times last week
- 4 times last week
- 5 times last week

19

In the last 7 days, on how many evenings did your child do sports, dance, or play games in which you were very active? (Check one only.)

\*

🗳️ Choose one of the following answers

Please choose **only one** of the following:

- None
- 1-time last week
- 2 or 3 times last week
- 4 or 5 last week
- 6 or 7 times last week

20 The last weekend, how many times did your child do sports, dance, or play games in which you were very active? (Check one only.) \*

🗳️ Choose one of the following answers

Please choose **only one** of the following:

- None
- 1 time
- 2 — 3 times
- 4 — 5 times
- 6 or more times

21 Which one of the following describes your child best for the last 7 days? Read all five statements before deciding on the one answer that describes your child. \*

● Choose one of the following answers

Please choose **only one** of the following:

- All or most of free time was spent doing things that involve little physical effort
- Sometimes (1 — 2 times last week) did physical things in my free time (e.g. played sports, went running, swimming, bike riding, did aerobics)
- Often (3 — 4 times last week) did physical things in my free time
- Quite often (5 — 6 times last week) did physical things in my free time
- Very often (7 or more times last week) did physical things in my free time

22 Mark how often your child did the physical activity (like playing sports, games, doing dance, or any other physical activity) for each day last week. \*

Please choose the appropriate response for each item:

	None	Little bit	Medium	Often	Very often
<b>Sunday</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Monday</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Tuesday</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Wednesday</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Thursday</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Friday</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Saturday</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

23 Was your child sick last week, or did anything prevent him from doing your normal physical activities? (Check one.) \*

● Choose one of the following answers

Please choose **only one** of the following:

- Yes
- No

24 If you answer 'Yes' in the previous question, Please mention what prevented him?

Please write your answer here:

25

Please write the height and weight of your child.

26

Is there any playground at your child's school?

\*

❶ Choose one of the following answers

Please choose **only one** of the following:

Yes

No

27 Does your child attend any private study coaching? \*

❶ Choose one of the following answers

Please choose **only one** of the following:

Yes

If Yes, how many hours?

No

Make a comment on your choice here:

## Food frequency Questionnaire

We are trying to find out the consumption of foods that your child eat in the last 7 days (in the last week). Please answer the frequency of the following food intake as accurately as possible. Mark only one circle per row.

## 28 :Fruits and Vegetables \*

Please choose the appropriate response for each item:

	Never	1-2 days a week	3-4 days a week	Once a day	Twice a day	More than 3 a day
Apples	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bananas	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Oranges/Tangerines	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Grapes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other fruits(not including fruit juice)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Carrots	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Beans	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cauliflower	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ladies finger/okra	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ridge gourd (Jhinga)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Groud	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Pumpkin	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Leafy vegetables	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Salad (e.g., cucumber, lettuce)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other vegetables (not including potatoes)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

29  
: Sugar-sweetened beverages

\*

Please choose the appropriate response for each item:

	Never	1-2 days a week	3-4 days a week	Once a day	Twice a day	More than 3 a day
100% fruit juice (e.g. orange / apple)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fruit drinks such as Sejan, Pran or Ribena	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Diet soft drinks (e.g. diet coke or Sprite Zero)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Regular soft drinks (e.g. Coke or Pepsi)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Energy/sports drinks (e.g. Speed, Tiger or Red Bull)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Milkshakes/hot chocolate/labani	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Yogurt/curds	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Regular milk	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

30 : Fast food \*

Please choose the appropriate response for each item:

	Never	1-2 days a week	3-4 days a week	Once a day	Twice a day	More than 3 a day
Pizza	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Burger	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fries	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sandwich	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Instant foods (e.g., noodles)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (e.g., frozen foods)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

31

: Snacks and sweets

\*

Please choose the appropriate response for each item:

	Never	1-2 days a week	3-4 days a week	Once a day	Twice a day	More than 3 a day
Crisps (e.g. Sun chips, Mr. twists etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Snacks such as Dal vaja, muri, canacur	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sweets (mishiti)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Chocolate such as dairy milk	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Chocolate biscuits such as Digestive, Oreo	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Regular biscuits (e.g. Fiza, Fulkoli)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cake (such as muffins, donuts)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ice cream	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

32 : Regular food \*

Please choose the appropriate response for each item:

	Never	1-2 days a week	3-4 days a week	Once a day	Twice a day	More than 3 a day
Rice	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Dal	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bread/Roti	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Noodles	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fish	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fowls (chicken, duck)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Red meat (Beef, mutton)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Eggs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



### 33 How often does your child skip breakfast?

❗ Choose one of the following answers

Please choose **only one** of the following:

- কখনোই না
- সপ্তাহে ১-২ দিন
- সপ্তাহে ৩-৪ দিন
- সপ্তাহে ৫-৬ দিন
- সপ্তাহে ৭ দিন

**Thank you for taking the time to help with this research project.**

Submit your survey.

Thank you for completing this survey.

**APPENDIX D**

**STUDY FOUR SURVEY MATERIAL**

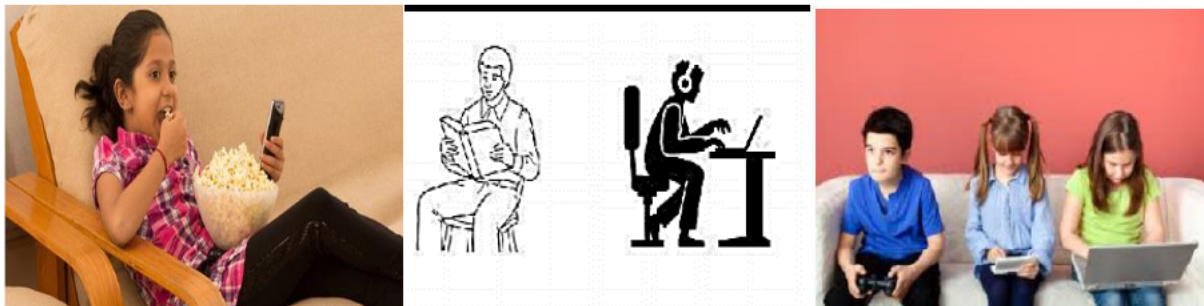
**Supplementary material D.1: Online Resource: Adolescent Sedentary Activity Questionnaire (ASAQ), Consent form and Participant Information for USQ Research Project**



**Project Title: The effect of maternal employment on children's dietary habits, physical activity, and sedentary behaviour**

**Adolescent Sedentary Activity Questionnaire (ASAQ)**

[**Sedentary activities** include works, which cause **LITTLE or NO** movement (e.g., sitting at a desk, travelling in a car /bus or rickshaw, reading, writing, working on a computer, sitting, or lying down while watching television or playing electronic games)]



**Sabiha Afrin**

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[এই কোয়েশ্চনিয়ারটি টি সাত দিনে পূরন করতে হবে।আপনার সন্তান প্রতিদিন প্রশ্নে উল্লেখিত কাজগুলো কতক্ষণ করে তা প্রতি দিনেরটা প্রতিদিন লিখতে হবে। অর্থাৎ কেউ রবিবার থেকে লেখা শুরু করলে পরের শনিবার শেষ হবে। কোয়েশ্চনিয়ারটি পূরন হয়ে গেলে ৭দিন পরে কোয়েশ্চনিয়ার এবং কনসেন্ট ফর্মের ছবি তুলে আমাকে পাঠাতে অনুরোধ করছি।এরপরও কোন প্রশ্ন থাকলে আমাকে জানাবেন।সহযোগিতার জন্য আপনাকে অগ্রীম ধন্যবাদ জানাচ্ছি। ভালো থাকবেন।]

ID	0			
----	---	--	--	--

Please write your identification number in the above box (the same code as in the consent form)

Name of children: \_\_\_\_\_ Age: \_\_\_\_\_

sex: m \_\_\_\_\_ f \_\_\_\_\_ Class/Grade: \_\_\_\_\_

Name of Parent/Guardian: \_\_\_\_\_

Think of a typical school week, Sunday-Thursday, and write down how much approximately your child spend doing the following activities before and after school each day.

Activities	Sunday		Monday		Tuesday		Wednesd ay		Thursda y	
	Hour s	Min	Hour s	Min	Hour s	Min	Hour s	Min	Hour s	Min
Watch TV										
Watching videos/cinema/pla ying video games										
Using computer for fun										
Using computer for homework										
Doing homework not on the computer										
Reading for leisure										
Private lessons (tutor)										
Travel (car /bus/motorcycle/ rickshaw)										
Doing crafts or hobbies										
Sitting around (chat with friends/on the phone/chilling/rela x)										
Playing/practicing musical instrument										
Classroom sitting time(online)										

Think of a typical school weekend, Friday-Saturday, and write down how much approximately your child spend doing the following activities on the weekend.

Activities	Friday		Saturday	
	Hours	Minutes	Hours	Minutes
Watch TV				
Watching videos/cinema/playing video games				
Using computer for fun				
Using computer for homework				
Doing homework not on the computer				
Reading for leisure				
Private lessons (tutor)				
Travel (car /bus/motorcycle/ rickshaw)				
Doing crafts or hobbies				
Sitting around (chat with friends/on the phone/chilling/relax)				
Playing/practicing musical instrument				

**Question: Do your child have his/her own smartphone/tablet?**

i) Yes                       ii) No

**Thank you very much for completing this questionnaire.**

Date:                      /                      /

**Interview results:**

Completed (fully responded)	
Partly completed	
Refused	



# Consent Form for USQ Research Project

<b>ID</b>	0		
-----------	---	--	--

## Consent form

### Project Details

Title of Project: The effect of maternal employment on children’s dietary habits, physical activity and sedentary behaviour

Human Research Ethics Approval Number: H20REA147

### Research Team Contact Details

#### Principal Investigator Details

Sabiha Afrin  
 Email: [REDACTED]  
 Telephone:  
 Mobile: [REDACTED]

#### Supervisor Details

Professor Stuart J. H. Biddle  
 Email: [REDACTED]  
 Telephone: [REDACTED]  
 Mobile: [REDACTED]

### Statement of Consent

By signing below, you are indicating that you:

- Have read and understood the information document regarding this project. Yes / No
- Have had any questions answered to your satisfaction. Yes / No
- Understand that if you have any additional questions you can contact the research team. Yes / No

- Are over 18 years of age. Yes /  No
- Understand that any data collected may be used in future research activities [all future research activities OR only those related to this field]. Yes /  No
- Agree to participate in the project. Yes /  No

Participant Name	<input type="text"/>
Participant Signature	<input type="text"/>
Date	<input type="text"/>
Contact number	<input type="text"/>

**Please return this sheet to a Research Team member prior to undertaking the interview.**



## Participant Information for USQ Research Project

### Project Details

Title of Project: The effect of maternal employment on children’s dietary habits, physical activity and sedentary behaviour

Human Research Ethics Approval Number: H20REA147

### Research Team Contact Details

#### Principal Investigator Details

Sabiha Afrin  
Email: [REDACTED]  
Telephone:  
Mobile: [REDACTED]

#### Supervisor Details

Professor Stuart J. H. Biddle  
Email: [REDACTED]  
Telephone: [REDACTED]  
Mobile: [REDACTED]

### Description

This project is being undertaken as part of Doctor of Philosophy program.

The purpose of this project is to explore the dietary patterns, physical activity, and sedentary behaviour of working mothers with children (aged 6-18 years) in urban families of Bangladesh.

The research team requests your assistance because this data may benefit the working mothers by identifying the constraint(s) related to dietary patterns physical activity and sedentary behaviour of their children and help the policy makers to design effective strategies and policies for them and for their children.



## **Participation**

Your participation will involve participation in an online survey that will take approximately 15-20 minutes of your time.

Questions will include sociodemographic features of your family, dietary patterns, physical activity and sedentary behaviour of your children.

Your participation in this project is entirely voluntary. If you do not wish to take part, you are not obliged to. If you decide to take part and later change your mind, you are free to withdraw from the project at any stage. You may also request that any data collected about you be withdrawn and confidentially destroyed.

Your decision whether you take part, do not take part, or to take part and then withdraw, will in no way impact your current or future relationship with the University of Southern Queensland.

## **Expected Benefits**

It is expected that this project will not directly benefit you or your child. However, it may benefit indirectly by assisting the policymakers to identify the constraint(s) related to dietary patterns physical activity and sedentary behaviour of children of mothers working outside and help to design effective strategies and policies for them and for their children.

## **Risks**

In participating in this survey, there are no anticipated physical or mental risks beyond normal day-to-day living. However, the potential inconvenience of participants to take part in the research might be giving up time.

## **Privacy and Confidentiality**

All comments and responses will be treated confidentially unless required by law.

Your data will be made available for future research purposes through the mediated access repository. The data will be stored and shared as non-identifiable data.

The project summary of results will be communicated to you in the format of thesis, journal article and conference paper.

Any data collected as a part of this project will be stored securely as per University of Southern Queensland's [Research Data Management policy](#).

## **Consent to Participate**

We would like to ask you to sign a written consent form (enclosed) to confirm your agreement to participate in this project. Please return your signed consent form along with the questionnaire to a member of the Research Team prior to participating in online survey.

## **Questions or Further Information about the Project**

Please refer to the Research Team Contact Details at the top of the form to have any questions answered or to request further information about this project.

#### **Concerns or Complaints Regarding the Conduct of the Project**

If you have any concerns or complaints about the ethical conduct of the project, you may contact the University of Southern Queensland Manager of Research Integrity and Ethics on +61 7 4631 1839 or email [researchintegrity@usq.edu.au](mailto:researchintegrity@usq.edu.au). The Manager of Research Integrity and Ethics is not connected with the research project and can facilitate a resolution to your concern in an unbiased manner.

**Thank you for taking the time to help with this research project. Please keep this sheet for your information.**

## Supplementary material D.2: Hosmer-Lemeshow diagnostic test and Pearson chi-square goodness of fit test result (STATA output)

### Weekdays SB

### Productive SB

```
. estat gof
```

```
Goodness-of-fit test after logistic model  
Variable: PSB_HL
```

```
Number of observations = 381  
Number of covariate patterns = 12  
Pearson chi2(7) = 3.30  
Prob > chi2 = 0.8563
```

```
. estat gof, group(10)
```

```
note: obs collapsed on 10 quantiles of estimated probabilities.
```

```
Goodness-of-fit test after logistic model  
Variable: PSB_HL
```

```
Number of observations = 381  
Number of groups = 6  
Hosmer-Lemeshow chi2(4) = 1.05  
Prob > chi2 = 0.9015
```

```
Warning: There are only 6 distinct quantiles because of ties.
```

```
. estat gof, group(10) table
```

```
note: obs collapsed on 10 quantiles of estimated probabilities.
```

```
Goodness-of-fit test after logistic model  
Variable: PSB_HL
```

```
Table collapsed on quantiles of estimated probabilities
```

Group	Prob	Obs_1	Exp_1	Obs_0	Exp_0	Total
2	0.5249	60	59.3	53	53.7	113
5	0.6350	48	50.2	31	28.8	79
6	0.7631	30	30.3	10	9.7	40
7	0.8353	52	50.0	9	11.0	61
8	0.8543	22	21.4	3	3.6	25
10	0.9447	58	58.9	5	4.1	63

```
Number of observations = 381  
Number of groups = 6  
Hosmer-Lemeshow chi2(4) = 1.05  
Prob > chi2 = 0.9015
```

```
Warning: There are only 6 distinct quantiles because of ties.
```

### Less- Productive SB

```
. estat gof
```

```
Goodness-of-fit test after logistic model  
Variable: LPSB_HL
```

```
Number of observations = 381  
Number of covariate patterns = 12  
Pearson chi2(7) = 4.44  
Prob > chi2 = 0.7278
```

```
. estat gof, group(2)
```

```
note: obs collapsed on 2 quantiles of estimated probabilities.
```

```
Goodness-of-fit test after logistic model  
Variable: LPSB_HL
```

```
Number of observations = 381  
Number of groups = 2  
Hosmer-Lemeshow chi2(0) = 0.01  
Prob > chi2 = .
```

```
. estat gof, group(2) table
```

```
note: obs collapsed on 2 quantiles of estimated probabilities.
```

```
Goodness-of-fit test after logistic model  
Variable: LPSB_HL
```

Table collapsed on quantiles of estimated probabilities

Group	Prob	Obs_1	Exp_1	Obs_0	Exp_0	Total
1	0.4625	69	68.6	124	124.4	193
2	0.7783	103	103.4	85	84.6	188

```
Number of observations = 381  
Number of groups = 2  
Hosmer-Lemeshow chi2(0) = 0.01  
Prob > chi2 = .
```

```
. estat gof, group(10)
```

```
note: obs collapsed on 10 quantiles of estimated probabilities.
```

```
Goodness-of-fit test after logistic model  
Variable: LPSB_HL
```

```
Number of observations = 381  
Number of groups = 7  
Hosmer-Lemeshow chi2(5) = 1.66  
Prob > chi2 = 0.8936
```

```
Warning: There are only 7 distinct quantiles because of ties.
```

```
. estat gof, group(10) table
```

```
note: obs collapsed on 10 quantiles of estimated probabilities.
```

```
Goodness-of-fit test after logistic model  
Variable: LPSB_HL
```

Table collapsed on quantiles of estimated probabilities

Group	Prob	Obs_1	Exp_1	Obs_0	Exp_0	Total
3	0.3204	40	36.6	75	78.4	115
4	0.3919	19	21.8	37	34.2	56
5	0.4625	10	10.2	12	11.8	22
7	0.4890	37	38.6	42	40.4	79
8	0.5667	37	37.3	29	28.7	66
9	0.6359	28	26.7	14	15.3	42
10	0.7783	1	0.8	0	0.2	1

```
Number of observations = 381  
Number of groups = 7  
Hosmer-Lemeshow chi2(5) = 1.66  
Prob > chi2 = 0.8936
```

```
Warning: There are only 7 distinct quantiles because of ties.
```

## Recreational SB

```
. estat gof
```

Goodness-of-fit test after logistic model  
Variable: RSB\_h1

```
Number of observations = 381
Number of covariate patterns = 12
Pearson chi2(7) = 11.59
Prob > chi2 = 0.1149
```

```
. estat gof, group(10)
```

note: obs collapsed on 10 quantiles of estimated probabilities.

Goodness-of-fit test after logistic model  
Variable: RSB\_h1

```
Number of observations = 381
Number of groups = 7
Hosmer-Lemeshow chi2(5) = 11.44
Prob > chi2 = 0.0433
```

Warning: There are only 7 distinct quantiles because of ties.

```
. estat gof, group(10) table
```

note: obs collapsed on 10 quantiles of estimated probabilities.

Goodness-of-fit test after logistic model  
Variable: RSB\_h1

Table collapsed on quantiles of estimated probabilities

Group	Prob	Obs_1	Exp_1	Obs_0	Exp_0	Total
2	0.5963	72	67.4	41	45.6	113
3	0.6461	0	1.3	2	0.7	2
4	0.6929	33	38.0	23	18.0	56
5	0.7420	18	16.3	4	5.7	22
7	0.8295	62	65.5	17	13.5	79
8	0.8814	64	59.4	4	8.6	68
10	0.9045	36	37.1	5	3.9	41

```
Number of observations = 381
Number of groups = 7
Hosmer-Lemeshow chi2(5) = 11.44
Prob > chi2 = 0.0433
```

Warning: There are only 7 distinct quantiles because of ties.

## Weekend days Sedentary behaviour

Recreational SB

```
. logistic RSB_hl i.mother_employed Age_grp Gender ownsmartphon
```

```
Logistic regression                               Number of obs =   381
                                                    LR chi2(4)      =   9.17
                                                    Prob > chi2     =  0.0569
Log likelihood = -182.97705                       Pseudo R2      =  0.0245
```

RSB_hl	Odds ratio	Std. err.	z	P> z	[95% conf. interval]	
1.mother_employed	1.053242	1.343781	0.04	0.968	.0864014	12.83912
Age_grp	1.799726	.6045652	1.75	0.080	.9316875	3.476503
Gender	1.805954	.4905708	2.18	0.030	1.060439	3.075585
ownsmartphon	.8482916	1.084767	-0.13	0.898	.0691922	10.4
_cons	2.883302	.5522998	5.53	0.000	1.980804	4.196998

Note: `_cons` estimates baseline odds.

```
. estat gof
```

Goodness-of-fit test after logistic model  
Variable: RSB\_hl

```
Number of observations =   381
Number of covariate patterns =   12
Pearson chi2(7) =   3.97
Prob > chi2 = 0.7835
```

```
. estat gof, group(10)
```

note: obs collapsed on 10 quantiles of estimated probabilities.

Goodness-of-fit test after logistic model  
Variable: RSB\_hl

```
Number of observations =   381
Number of groups =   7
Hosmer-Lemeshow chi2(5) =   1.83
Prob > chi2 = 0.8725
```

Warning: There are only 7 distinct quantiles because of ties.

## Productive SB

```
. logistic PSB_HL i.mother_employed Age_grp Gender ownsmartphon
```

```
Logistic regression
```

```
Number of obs = 381
```

```
LR chi2(4) = 24.96
```

```
Prob > chi2 = 0.0001
```

```
Pseudo R2 = 0.0473
```

```
Log likelihood = -251.44863
```

PSB_HL	Odds ratio	Std. err.	z	P> z	[95% conf. interval]	
1.mother_employed	.3804233	.4550235	-0.81	0.419	.0364877	3.966317
Age_grp	2.329831	.5786563	3.41	0.001	1.431901	3.790845
Gender	1.834807	.3927622	2.84	0.005	1.206092	2.791259
ownsmartphon	2.617504	3.134306	0.80	0.422	.250394	27.36218
_cons	.5533264	.0932176	-3.51	0.000	.3977236	.769806

Note: `_cons` estimates baseline odds.

```
. estat gof
```

Goodness-of-fit test after logistic model

Variable: PSB\_HL

```
Number of observations = 381
```

```
Number of covariate patterns = 12
```

```
Pearson chi2(7) = 12.20
```

```
Prob > chi2 = 0.0942
```

```
. estat gof, group
```

```
option group incorrectly specified
```

```
r(198);
```

```
. estat gof, group(10)
```

note: obs collapsed on 10 quantiles of estimated probabilities.

Goodness-of-fit test after logistic model

Variable: PSB\_HL

```
Number of observations = 381
```

```
Number of groups = 6
```

```
Hosmer-Lemeshow chi2(4) = 6.28
```

```
Prob > chi2 = 0.1790
```

Warning: There are only 6 distinct quantiles because of ties.

```
.
```

## Less-productive SB

```
. logistic LPSB_HL i.mother_employed Age_grp Gender ownsmartphon
```

```
Logistic regression                                Number of obs =   381
                                                    LR chi2(4)      = 25.63
                                                    Prob > chi2     = 0.0000
Log likelihood = -251.26041                        Pseudo R2      = 0.0485
```

LPSB_HL	Odds ratio	Std. err.	z	P> z	[95% conf. interval]	
1.mother_employed	1.278576	1.334163	0.24	0.814	.1653935	9.884046
Age_grp	1.606819	.3964849	1.92	0.055	.9906766	2.606167
Gender	2.288277	.4891797	3.87	0.000	1.505018	3.479168
ownsmartphon	1.009262	1.056821	0.01	0.993	.129626	7.858072
_cons	.5219464	.088345	-3.84	0.000	.3745855	.7272788

Note: **\_cons** estimates baseline odds.

```
. estat gof
```

```
Goodness-of-fit test after logistic model
Variable: LPSB_HL
```

```
Number of observations =   381
Number of covariate patterns =   12
Pearson chi2(7) =   5.27
Prob > chi2 = 0.6273
```

```
. estat gof, group(10)
```

note: obs collapsed on 10 quantiles of estimated probabilities.

```
Goodness-of-fit test after logistic model
Variable: LPSB_HL
```

```
Number of observations =   381
Number of groups =   7
Hosmer-Lemeshow chi2(5) =   3.22
Prob > chi2 = 0.6654
```

Warning: There are only 7 distinct quantiles because of ties.

```
.
```