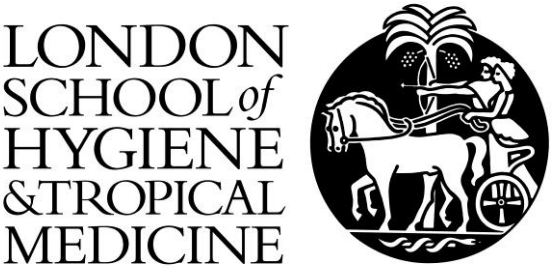

Snacks and nutrition during the complementary feeding period: a cross-sectional study among children 12-23 months of age in Kathmandu Valley, Nepal

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DECLARATION OF OWN WORK

I, Alissa Madeline Pries, confirm that the work presented in this thesis is my own. Where information has been gathered from other sources, I confirm that this has been indicated in the thesis.

Signature: Date: February 25, 2019

Abstract

Availability and consumption of processed foods has grown rapidly in low- and middle-income countries (LMIC), among both adults and children. While snacks provide energy during the nutritionally vital complementary feeding period, consumption of unhealthy snack foods and beverages (USFB), typically energy-dense and nutrient-poor, is concerning given young children's high nutritional requirements and limited gastric capacity. However, there is limited information on the contribution of such foods to dietary intakes and the potential nutritional consequences among young children in LMIC. This thesis describes a cross-sectional study in Kathmandu Valley, Nepal that assessed dietary intakes of a representative sample of 12-23-month-old children (n=745) and examined the association between high consumption of USFB and nutritional status. We found that USFB contributed on average 5.2% of total energy intakes (% TEI) from non-breastmilk foods among the lowest tercile of USFB consumers and 46.9% TEI among the highest tercile. Nearly 9/10 of USFB were commercial products, with biscuits (10.8%), candy/chocolate (3.5%), and savoury snacks (3.4%) providing the largest % TEI. Compared to low USFB consumers, high USFB consumers had lower dietary intakes of 12 nutrients and were at greater risk of inadequate intakes for 8 nutrients. In a model adjusted for other covariates of undernutrition, mean length-for-age (LAZ) was 0.29 standard deviations lower among high USFB consumers than low consumers (p=0.003). No associations were found between high USFB consumption and stunting prevalence or iron status. The prevalence of overweight/obesity was low. Findings from this study indicate that high USFB consumption among young children is associated with increased risk of inadequate micronutrient intakes, which may contribute to poor growth outcomes. In LMIC contexts where the nutrient density of complementary feeding diets is low, addressing the increased availability of inexpensive, packaged products in LMIC food systems should be a priority for policies and programs aiming to safeguard child nutrition.

Acknowledgements

This thesis would not have been possible without the support of many wonderful individuals over the last four years.

Thank you to those who supported me at LSHTM. Many, many thanks to my supervisors, Elaine Ferguson and Suzanne Filteau. From hours pondering 'What is a snack, exactly?' at the start of this journey to the final review of each thesis chapter, your guidance and encouragement have been invaluable. Thank you to my LSHTM advisory committee member, Andrea Rehman, for your statistical guidance and advice. And thank you to Helen Harris-Fry, for generously sharing experiences and resources from your own dietary research in Nepal. I have learned so much from each of you and will always be grateful for your contributions to my skills and knowledge as a researcher.

Thank you to the team at HKI ARCH Nepal – Nisha, Babita, Atul, Anushka, Pratik, Sonia, Rama, and Dale. Your commitment and support for each part of this study – from FGD to recruitment to survey supervision to conversion factors – were indispensable to this research. A heartfelt thank you to the survey data collection team – it was a privilege and joy to work with all of you. Thank you to Kenda for serving as an informal mentor for the PhD experience – quite handy that you also did your LSHTM doctoral research in Nepal. Thank you all for providing so many laughs and smiles throughout my year in Nepal - it was a lot of work, but also a lot of fun. And also a lot of biscuits.

Thank you to the wider HKI team in Asia and at headquarters – Elizabeth, Mary, Sandy, Mackenzie, Ame, Gary, Kenda, and Rolf. Thank you for all your support along the way. Thank you to the BMGF for funding provided for this research.

Thank you to my friends. Thanks for all the laughs, meals, excursions, and lifting of my spirit throughout this PhD – I feel lucky to have such an inspiring and loving group of friends spread across this globe. Thank you to Paxton, for cheering me on all along but especially through the final stretch when I needed it the most.

Thank you to my family – to whom this thesis is dedicated. Thank you to my mom – who taught me strength, to explore the world, and the power of a to-do list. Your endless love supports me every day. Thank you to my brother – who taught me love of the outdoors and what good beer should taste like. These two things proved very helpful when I needed a break from this thesis. And thank you, Dad – you taught me patience, curiosity, and to 'follow my bliss'. Though you've left this world, the unwavering care you always provided motivates me each day to make you proud.

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Abbreviations

24HR	24-hour recall
AGP	α-1 acid glycoprotein
AIC	Akaike information criterion
ANOVA	analysis of variance
ARCH	Assessment and Research on Child Feeding
ASEAN	Association of Southeast Asian Nations
BMI	body mass index
BMIZ	body mass index z-score
BMGF	Bill & Melinda Gates Foundation
CI	confidence interval
CRP	C-reactive protein
DHS	Demographic and Health Survey
EAR	Estimated Average Requirement
EHG	Environmental Health Group
ELISA	enzyme-linked immunosorbent assay
FAO	Food and Agriculture Organization
FCHV	female community health volunteer
FCT	food composition table
FGD	focus group discussions
FSA	Food Standards Agency
GPS	Global Positioning System
HFIAS	Household Food Insecurity Access Scale
HKI	Helen Keller International
ICC	intra-cluster correlation
IDA	iron deficiency anemia
INFOODS	International Network of Food Data Systems
IQR	interquartile ranges
IYCF	infant and young child feeding
LAZ	length-for-age z-score
LMIC	low- and middle-income countries

LSHTM	London School of Hygiene and Tropical Medicine
MAD	minimum acceptable diet
MDD	minimum dietary diversity
MICS	multiple indicator cluster survey
MMF	minimum meal frequency
MRDR	modified relative dose response
MSG	monosodium glutamate
NBF	non-breastmilk foods
NHRC	Nepal Health Research Council
NPR	Nepali rupee
ODK	Open Data Kit
PC-SIDE	PC Software for Intake Distribution Estimation
PPS	probability proportional to size
SES	socio-economic status
SD	standard deviation
SSB	sugar-sweetened beverages
sTfR	soluble transferrin receptor
TEI	total energy intake
TEM	technical error measurement
UK	United Kingdom
USDA	United States Department of Agriculture
USFB	unhealthy snack foods and beverages
VIF	variance inflation factors
WHO	World Health Organization
WAZ	weight-for-age z-score
WLZ	weight-for-length z-score

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Chapter 1: Introduction

BACKGROUND

The global food system has been marked by increased production and availability of processed foods,[1] with increasing consumption of these foods occurring across low- and middle- income countries (LMIC) in recent decades.[1–6] In conjunction, 'nutrition transitions' have been identified in many LMIC - as nations experience economic growth, diet patterns tend to move away from traditional diets and move towards westernized diets, with higher intakes of added sugars, unhealthy fats, and refined carbohydrates.[5] Coupled with reduced physical activity, this shift in diet patterns increases the risk of overweight/obesity in countries also burdened with high rates of undernutrition,[7] commonly referred to as the 'double burden' of malnutrition.

Commercially produced snack foods and sugar-sweetened beverages (SSB) have become common in children's diets across high income countries[8–15] and are increasingly consumed among infants and young children in LMIC contexts.[16–19] While snacks in addition to meals can be an important source of energy and nutrients for young children, contributing to the World Health Organization's (WHO) indicator of minimum acceptable diet (MAD),[20] consumption of processed snack foods and beverages among young children in LMIC is concerning. In the first two years of life, a child's nutritional needs are very high to support their rapid growth and development,[21] and at six months of age it becomes necessary to introduce nutrient-dense complementary foods, while continuing to breastfeed. This period commonly corresponds to growth faltering in young children, and ensuring a nutritious diet during the complementary feeding period is vital for preventing childhood malnutrition.[20]

Commercially produced snack food products are often energy-dense, nutrient-poor, and high in salt or sugar[3,22–24] and trans fats,[25] making them inappropriate for infant and young child feeding (IYCF).[26] There is potential for high consumption of such foods to contribute to both child under- and over-nutrition. Early in life, overconsumption of foods high in energy density but low in nutrient density could

displace consumption of other nutritious foods, including breastmilk,[27] thereby potentially leading to inadequate intakes of micronutrients. Previous studies among school-age children and in high-income settings[12,28–35] have shown an association between consumption of snack foods/beverages and displaced consumption of other nutrient-rich foods and/or reduced nutrient intakes. While one United States study among 2 and 5 year olds found an association between SSB consumption and linear growth faltering,[36] potentially related to resulting micronutrient deficiencies, it is not established if diet displacement translates into micronutrient deficiencies.[37,38] What also remains unknown is the role that unhealthy snack foods play in the diets of infants and young children, particularly in LMIC. In such settings, nutrient density of diets during the complementary feeding period can be limited[27,39] and thus high consumption of energy-dense and nutrient-poor foods may have a greater negative impact than in contexts where young children's overall diets are more nutritionally adequate.

High consumption of unhealthy snack foods and beverages has been linked to increased risk of overweight/obesity through several mechanisms. In addition to contributing to weight gain and overweight/obesity through high energy and fat intakes,[40–43] several other mechanisms serve as pathways to overnutrition. Evidence shows that satiety levels when consuming SSB[44–46] are lower than when consuming non-sweetened beverages, thereby resulting in excessive caloric intakes. Additionally, consumption of sugary/salty foods early in life has also been shown to establish dietary preferences that remain throughout childhood and into adulthood,[47,48] potentially forming lifelong unhealthy eating patterns and increasing the risk of overnutrition and related chronic disease into adulthood. The contribution of unhealthy snack foods to childhood overnutrition has been shown in North America and Europe,[49–53] South America,[54–56] and East Asia.[57] However, this literature pertains to school-age children and is generally limited in LMIC contexts. Globally, 40 million children are overweight/obese, with the majority of these children living in developing countries and LMIC have the fastest rate of increase of overweight among this age group.[58]

CONTEXT: INFANT AND YOUNG CHILDREN NUTRITION IN NEPAL

Growth status

Despite improvements over the last 20 years, undernutrition among children in Nepal remains high. Overall, 36% and 10% of children under 5 years of age are stunted and wasted, respectively.[59] Poor linear growth among Nepali children varies across geographical zones and socio-economic status (SES), with stunting rates trending lower in urban areas and among higher wealth groups. However, stunting still remains prevalent within these groups. As of 2016, 17% of children under five years of age in the highest wealth group and 32% in urban areas were stunted.[59] In the country's most populous area of Kathmandu Valley, 19% of children under 5 years are stunted.[60] Overnutrition among children remains low, with only 1.2% of all children and 1.5% of urban children below five years experiencing overweight/obese (weight-for-height z-score > 2).[59] However, overweight/obesity among adults is rising - increasing from 9% to 22% among women of reproductive age between 2006 and 2016.[59]

Micronutrient status

Micronutrient deficiencies among children in Nepal are also prevalent. As of 2016, 19% of all children under five were anaemic, with rates higher among children 6-23 months of age (33%).[61] Diet likely plays a substantial role in anaemia in Kathmandu Valley, where non-diet contributors to anaemia are less prevalent than in rural areas - 80% of urban Nepal children under five years are regularly dewormed and most malaria is found in the rural Terai region.[62] The recent 2016 national micronutrient status survey found 22% of children 6-23 months of age to have iron deficiency anaemia.[61] This same national survey found 21% of all children and 12% of urban children 6-59 months to be zinc deficient, based on low serum zinc concentrations.[61] Prevalence of vitamin A deficiency was found to be low among children under five years of age both nationally and among urban populations, at 4% and 2%,

respectively, based on modified relative dose response (MRDR).[61] While reported vitamin A supplementation coverage is high at 86%,[59] vitamin A status may be a concern among some Nepali children. In a study among 6-8 year olds, an age group beyond the target population for supplementation, though 9% were found to have serum retinol concentrations indicative of vitamin A deficiency (<0.70 mmol/L), over half (55%) were found to be marginally deficient (<1.05 mmol/L), with researchers hypothesizing that low levels of β-carotene indicated limited consumption of foods rich in vitamin A.[63] A recent study among infants 2-12 months of age reported that while 15% of infants were vitamin A-deficient based on serum retinol concentrations, 65% were marginally deficient.[64]

IYCF practices and diets

Breastfeeding is prevalent in Nepal - nearly all children have ever been breastfed and two-thirds of infants under six months of age are exclusively breastfed.[59] The median duration of exclusive breastfeeding is higher among rural as compared to urban infants (4.5 vs. 3.9 months), and also among poorer households as compared to the wealthiest.[59] Despite common breastfeeding, pre-lacteal feeding is common; approximately 27% of Nepali children residing in urban areas have been fed something other than breast milk in the first three days after birth.[59] Prevalent use of breastmilk-substitutes for pre-lacteal feeding has been noted in Kathmandu Valley,[65] however, use of breastmilk-substitutes for general infant and young child feeding is low at 3.0% of children below two years of age.[59]

While continued breastfeeding during the first two years of life is common across Nepal, other IYCF indicators indicate sub-optimal complementary feeding practices. Only 36% of breastfed and 23% of non-breastfed children 6-23 months of age in Nepal consume a minimally acceptable diet[59] as defined by the WHO.[20] While nearly three-quarters (71%) of all Nepali children 6-23 months of age achieve minimum meal frequency (MMF) (consumption of the recommended number of meals and snacks in a day), only 47% achieve minimum dietary diversity (MDD) (consumption of 4 or more food groups in a day).[59] A recent study in a peri-urban area of

Kathmandu Valley found higher rates of MMF as compared to MDD over time among young children 9-24 months of age.[66] These results indicate that while many children may consume the recommended frequency of meals and snacks, the quality of diets during the complementary feeding period may be inadequate. Complementary feeding diets of urban children appear better than national averages, however, one-third of urban young children are still not achieving recommended complementary feeding practices.[59] A recent study assessing dietary intakes across one year (from 12-23 months of age) in a district of Kathmandu Valley, Nepal found very low probability of adequacy for most micronutrients, including zinc, calcium, iron, and vitamin A, throughout this complementary feeding period.[39]

Snack food consumption is prevalent among young children in Nepal. A survey across 16 districts of the country found 52% of children 9-11 months and 64% 21-23 months of age had consumed savoury/sweet snacks in the previous day.[67] In a 2014 Kathmandu Valley study, 57% and 43% of children 6-23 months of age were consuming commercially produced biscuits/cookies and sweets/candy, respectively.[19] Three-quarters of children (74%) consumed a commercial snack food product in the previous day, and nearly all children (91%) had consumed a product in the previous week.[19] Snack food product consumption was higher than consumption of dark green leafy vegetables (35%), orange-fleshed fruits (1%) and vegetables (8%), and eggs (24%).

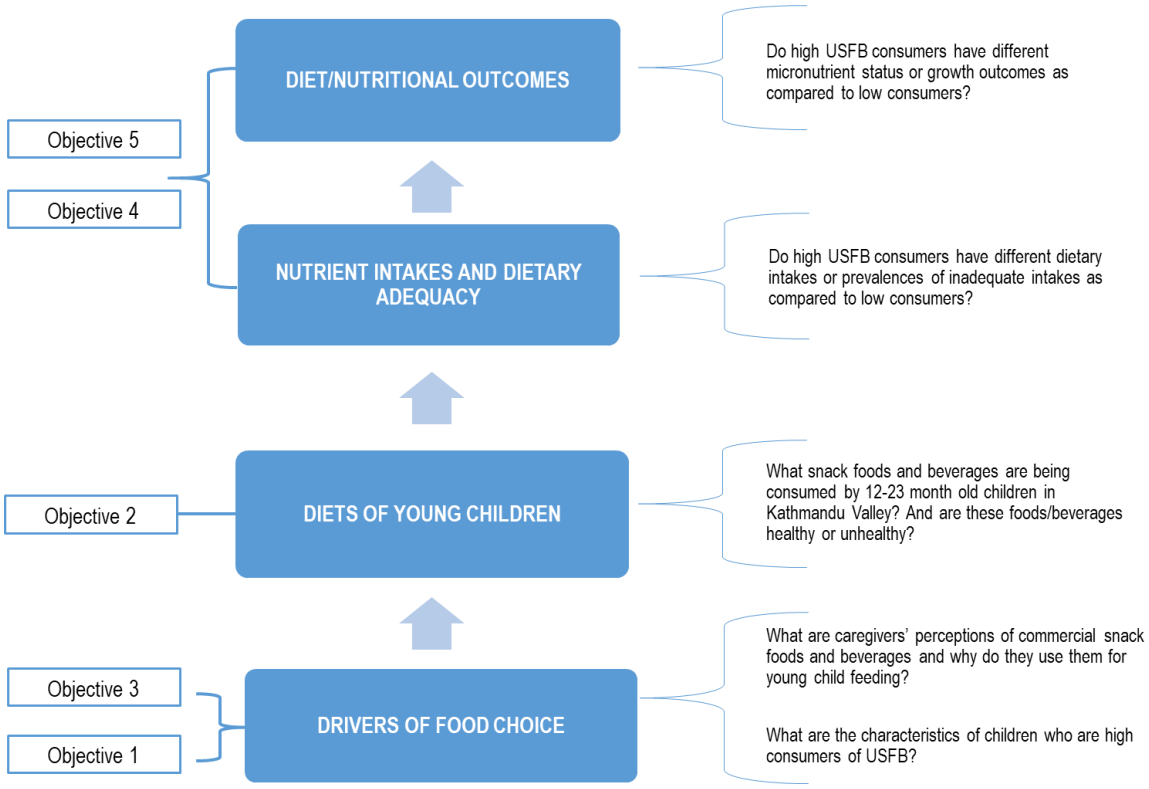
AIMS AND OBJECTIVES

In urban Nepal, where child undernutrition and dietary inadequacy during the complementary feeding period are prevalent, but snack food and beverage consumption is high,[19] a greater understanding of the role of unhealthy snack foods and beverages (USFB -- detailed definition provided on pages 70-71) in young children's diets is needed. The aim of this thesis was to investigate whether high consumption of USFB is associated with over- or undernutrition among young children 12-23 months of age. The primary objectives of this thesis were as follows:

1. To describe perceptions of commercial snack foods and beverages among caregivers in Kathmandu Valley and reasons for their use in young child feeding
2. To assess the nutrient profiles and describe the consumption patterns of USFB consumed by children 12-23 months of age in Kathmandu Valley
3. To investigate the socio-economic characteristics associated with high consumption of USFB among 12-23 month old children in Kathmandu Valley, Nepal
4. To describe the nutritional status (anthropometric, dietary, and iron statuses) of Kathmandu Valley children 12-23 months of age
5. To assess associations between high consumption of USFB and nutrient intakes, dietary adequacy, iron status, and growth status of Kathmandu Valley children 12-23 months of age

Figure 1.1 illustrates the conceptual framework for the objectives investigated by this thesis. These five objectives aimed to provide a comprehensive understanding of the pathway by which USFB are used for IYCF in Nepal, from exploration of caregiver food choices through to their diet/nutritional outcomes.

Figure 1.1 Conceptual framework for thesis - objectives



THESIS ROADMAP

This thesis follows a paper-based structure, with seven chapters in total. The first chapter serves as background for the thesis, the third chapter details all study methods, chapters 2 & 4-6 present the four papers prepared for this thesis, and the last chapter synthesizes key thesis findings and interprets these findings in the larger context of young child nutrition. Three of the four papers prepared for this thesis have been accepted for publication in *Maternal and Child Nutrition*, and the remaining paper is under review with *Journal of Nutrition*.

Chapter 1 (presented here) serves as an introduction to this thesis, provides background on the topic and context for the study, and outlines the aim/objectives of this thesis. **Chapter 2** is a systematic review conducted to provide insight on what is already known on this topic and to identify what gaps in the evidence remain to be filled. Specifically, a search of three databases was conducted to identify prior research that quantified the contribution of USFB to total energy intake (TEI) among children under two years of age in a LMIC, and any prior research that explored the

association between consumption of USFB and children's dietary or nutritional outcomes in LMIC. Chapters 4-6 present the primary research results and address the primary objectives for this thesis. While each research paper chapter provides an overview of the methods used, **Chapter 3** provides a comprehensive description of all research methods used in this thesis. This chapter provides explanation of the study design, sampling, tools, data management, and analysis for each of the study's components in detail. **Chapter 4** aims to answer the 'why' behind USFB consumption among young children by presenting qualitative and quantitative results on caregiver's perceptions of USFB and their reasons for using these foods for young child feeding. Specifically, themes from focus groups discussions (FGD) among grandmothers, mothers, and working mothers were triangulated with results from the quantitative survey, which included a module informed by this qualitative formative research. This chapter provides information on drivers for food choice within this urban context that could be used to inform behaviour change interventions and other programmatic efforts. **Chapter 5** is based on results from the quantitative survey and describes the sample of caregivers and children who participated. This chapter also describes children's consumption of USFB, including the contribution of USFB to children's TEI from non-breastmilk foods, the types of foods that were nutrient profiled as USFB, costs of USFB versus healthy snack foods/beverages, and other characteristics of USFB for use in young child feeding. Finally, caregiver/child characteristics associated with high USFB consumption are presented. This chapter provides information that can be used to target interventions aiming to improve diet quality of young children in an urban Nepal context. **Chapter 6** is also based upon results from the quantitative survey and provides answers to objectives 4-5 of this thesis. In this chapter nutritional status of the sample is described and associations between high USFB consumption and dietary and nutritional status outcomes are assessed, including total nutrient intakes, risk of dietary inadequacy, iron status, and linear– length-for-age z-scores (LAZ) – and ponderal growth – weight-for-length z-scores (WLZ). Analyses compare high USFB consumers to low consumers, with the degree of consumption based on TEI from non-breastmilk foods. The findings from this chapter provide information on the role

of unhealthy foods in undernutrition in a context where overweight/obesity is low and locally used complementary foods have a low nutrient density. Finally, **Chapter 7** concludes the thesis by summarizing the key findings from Chapters 2 and 4-6, providing discussion within the larger context, considering the methodological limitations and strengths of this study, and providing recommendations for future research, policy, and programs.

COLLABORATING INSTITUTIONS AND FUNDING

The collaborating institutions for this research included: London School of Hygiene and Tropical Medicine (LSHTM) and Helen Keller International (HKI). Funding for research costs was provided by the Bill & Melinda Gates Foundation (BMGF) as part of HKI's Assessment and Research on Child Feeding (ARCH) project.

ROLE OF THE CANDIDATE

Study design and planning

This study was part of the second phase of Helen Keller International's Assessment and Research on Child Feeding project, which seeks to build the evidence base about the promotion and utilization of commercially produced foods and beverages to inform nutrition policies and programs for infants and young children. Results from the first phase of the ARCH project found high rates of consumption of commercially produced snack foods and SSB among children 6-23 months of age in Kathmandu Valley.[19] During the first phase of the ARCH project (2013-2016), I was the Asia Regional Project Coordinator and managed the data collection, analysis, and write-up of these Nepal findings in 2013-2014. It was through my involvement in this work that I became interested in this topic and in 2015 I collaborated with HKI to include the concept of this present study - looking further into the role of unhealthy snack foods and beverages in young Nepali children's diets and nutritional outcomes - in the funding proposal for the second phase of ARCH (2016 – 2019). Once funding was confirmed for the study in 2015, I enrolled in the PhD project at LSHTM.

I led the overall conceptual design of the research questions and objectives for this study, as well as the protocols and tools for both the qualitative and quantitative components of the study, including the electronic data collection system. My academic supervisors and advisory committee members at LSHTM and HKI also provided feedback on protocol drafts. In addition, staff from the ARCH Nepal project reviewed the protocols, specifically for input regarding logistics of the sampling strategy and translation of the tools.

Data collection and fieldwork

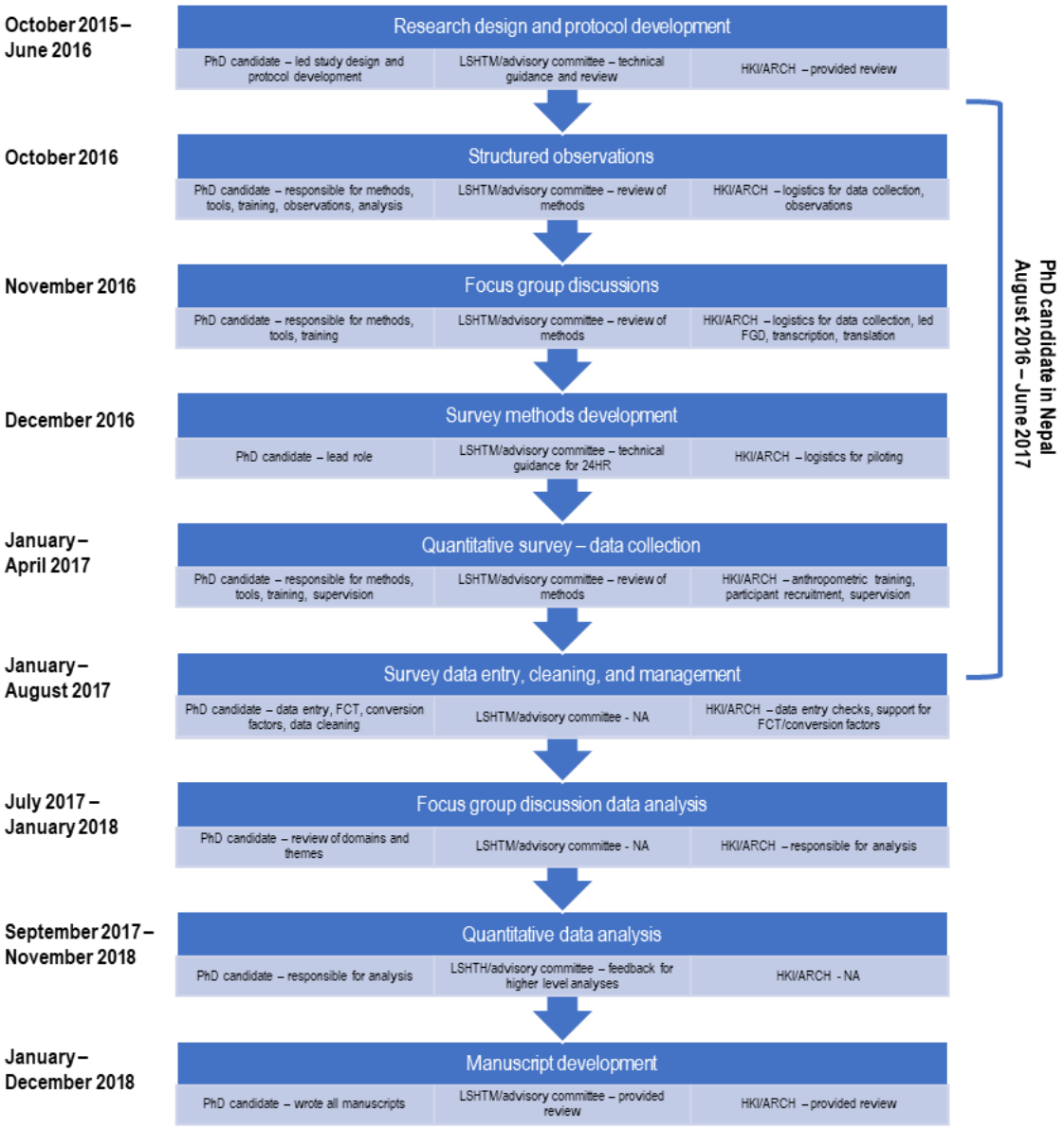
I travelled to Nepal from August 2016 – June 2017 to oversee data collection for this study; during this time, I worked with the ARCH Nepal project team who supported field logistics in Kathmandu Valley. My PhD supervisor made a trip to Nepal to provide technical guidance on the development of methods for the 24HR, and I was then responsible for developing the materials and manuals for these methods. A local research firm recruited candidates for data collection positions, and ARCH Nepal project staff and I interviewed and selected the final pool of candidates for training. I was responsible for training data collectors for both the qualitative formative research and quantitative survey, including development of training materials, leading classroom and practice sessions, and leading pre-testing. An expert staff from HKI Nepal provided training on anthropometric measuring for the nurses, and I led the assessment of technical error measurement to standardize measurers. Supervision of data collection was managed by myself, staff from the ARCH Nepal project, and a staff from the contracted local research firm. Identification of the lab for processing of blood samples and contracting of the laboratory in Germany for blood sample analysis was managed by an ARCH Nepal staff, as well as contracting of Mahidol University and Nottingham University for nutrient composition analysis of food products.

Data entry, analysis and manuscript development

Transcription and translation of focus group discussions was led by ARCH Nepal project staff, and I was responsible for all data entry, cleaning, and management of the quantitative survey data. I wrote each chapter of this thesis, including the four

papers for publication, with co-authors from LSHTM and HKI providing feedback on drafts for finalization. I led analysis of all quantitative data, and an ARCH Nepal project staff led analysis of qualitative data for Chapter 4. A timeline and involvement of LSHTM and HKI staff for these study activities can be found below in Figure 1.2.

Figure 1.2 Study timeline and partner involvement



Chapter 2: Systematic review: contribution of snack food and SSB to diets and nutritional status of children less than two years of age in LMIC

ABSTRACT

While snacks can provide important nutrients for young children during the complementary feeding period, the increasing availability of snack foods and SSB, often energy-dense and nutrient-poor, in LMIC is a concern. Such foods may displace consumption of nutritious foods in contexts where diets are often nutritionally inadequate and the burden of childhood malnutrition is high. This systematic review summarizes literature on the contribution of snack food/SSB consumption to TEI of children below 23 months of age in LMIC and associations between this consumption and nutritional outcomes. It also identifies areas where further research is needed. A systematic search of Embase, Global Health, and MEDLINE for literature published in January 1990 – July 2018 was conducted. This search yielded 8,299 studies, 13 of which met inclusion criteria: 9 studies assessed % TEI from snack foods/SSB, and 4 studies assessed associations between snack food/SSB consumption and nutritional outcomes. Average % TEI from snack foods/SSB ranged from 13-38%. Findings regarding associations with growth were inconclusive, and no studies having assessed associations with nutrient intakes. Variation in measurement of consumption and definitions of snack foods and SSB limited study comparisons. Further research is needed to understand how consumption of energy-dense, nutrient-poor snack foods and SSB influences under- and over-nutrition in young children during the complementary feeding period in settings that are experiencing dietary transitions and the double burden of malnutrition.

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Thesis Title	Snacks and nutrition during the complementary feeding period: a cross-sectional study among children 12-23 months of age in Kathmandu Valley, Nepal		
Primary Supervisor	Elaine Ferguson		

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Stage of publication	**In press**

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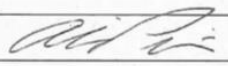
For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	A.P. developed the objectives of the review, the search strategy, and conducted the review - including paper screening and full-text review. S.F. and E.F. reviewed the search strategy prior to the review. A.P. drafted the paper witih feedback from all co-authors.

SECTION E

Student Signature	
Date	31/01/2019

Supervisor Signature	E. Ferguson
Date	31/01/2019

INTRODUCTION

Ensuring a nutritious diet in the first two years of life, both in terms of quantity and quality, is vital for young children's nutrition and health.[21,68] During this period of accelerated growth and development, a child's nutrient requirements are high. It is therefore recommended to introduce appropriate and nutrient-rich complementary foods, including snacks, at six months of age while continuing to breastfeed. The types of snacks fed to young children however, are important to ensure diet quality. Snack food products and SSB are often energy-dense, nutrient-poor, and high in salt or sugar,[3,22–24] making them inappropriate for IYCF.[26]

The growing availability of unhealthy processed foods in many LMIC is a concerning trend.[1] Overconsumption of snack food products and SSB has been shown to contribute to overweight and obesity among children in the United States [50–53] and Latin America.[54–56] Additionally, energy-dense, nutrient-poor foods early in life can displace consumption of other nutritious foods, including breastmilk,[27] potentially increasing a child's risk of inadequate nutrient intakes and contributing to childhood undernutrition. The correlation between consumption of snack foods/SSB and lower consumption of nutrient-rich foods and/or reduced nutrient intakes has been shown in high-income settings.[12,28,29,31–34]

Prevalent consumption of snack foods and SSB among young children has been noted across Africa, Asia, and Latin America.[16–18,69,70] However, the role these foods play in the overall diets of infants and young children in LMIC, as well as their impact on their nutrition, remains unclear. The influence of such foods on diet quality and nutritional outcomes is hypothesized to be different in LMIC, as compared to high-income settings, given the higher burden of undernutrition and limited accessibility of nutrient-dense foods in diets. The purpose of this systematic review was therefore to synthesize available literature on the contribution of snack food and SSB to TEI among children 0-23 months of age in LMIC and associations between consumption of such foods/beverages and nutritional status of young children in these settings, as well as to identify future research needs within this topic area.

METHODS

Search terms and study selection

A systematic search was conducted across three databases on July 25, 2018: Embase, Global Health, and MEDLINE, using the search terms presented in Figure 2.1. These terms were based on four broad categories: 1) low, lower-middle, or upper-middle income countries based on World Bank classifications (2017), 2) energy-dense, nutrient-poor snack foods and beverages, 3) diet or nutrition, and 4) children. Because definitions for snack foods and SSB are wide ranging, the search strategy identified all studies related to children's diets, which were then screened to identify those that included specific measurement of snack foods/SSB; this included measurement of types of foods (ex. biscuits, candy, soft drinks, etc.) or categories of foods (ultra-processed foods, discretionary foods, snack foods, junk foods, non-core foods, etc.). Titles and abstracts were screened first for exclusion/inclusion, which was followed by full-text screening. All three researchers reviewed search strategy and terms (AP, SF, EF) and screening was conducted by one researcher (AP). Screened studies were included if they met the following criteria: a) they were conducted in a LMIC, and b) the study population included children below two years of age, and c) they assessed the contribution of snack foods and/or SSB to children's TEI (based on kcal) or the association between children's consumption of snacks foods and/or SSB and nutrient intakes/micronutrient status/anthropometric status. Studies were excluded based on the following criteria: a) studies published prior to January 1, 1990 (based on the assumption that availability and use of snack foods/SSB in LMIC has changed in the last 2-3 decades), b) literature was not published in English, c) results published as conference/meeting abstracts only, d) studies that assessed contribution to TEI from added sugars only, or e) studies with a wider age range than children 0-23 months of age that did not present specific data within this age range. References of included studies were also hand-searched to identify relevant studies for inclusion; no additional studies were identified through this process.

Figure 2.1. Search terms for systematic review

1	cambodia or east timor or indonesia or laos or myanmar or philippines or vietnam or bangladesh or bhutan or india or nepal or pakistan or sri lanka or timor-leste or lao or afghanistan or benin or burkina faso or burundi or central african republic or chad or comoros or congo or drc or democratic republic of congo or eritrea or ethiopia or gambia or guinea-bissau or guinea or haiti or north korea or liberia or madagascar or malawi or mali or mozambique or niger or rwanda or senegal or sierra leone or somalia or south sudan or tanzania or togo or uganda or zimbabwe or angola or armenia or bolivia or cabo verde or cameroon or cote d'ivoire or djibouti or egypt or el salvador or georgia or ghana or guatemala or honduras or jordan or kenya or kiribati or kosovo or kyrgyz or lesotho or mauritania or micronesia or moldova or mongolia or morocco or nicaragua or nigeria or papua new guinea or sao tome principe or solomon island* or sudan or swaziland or syria or tajikistan or tunisia or ukraine or uzbekistan or vanuatu or west bank or gaza or yemen or zambia or albania or algeria or american samoa or argentina or azerbaijan or belarus or belize or bosnia herzegovina or botswana or brazil or bulgaria or china or colombia or costa rica or croatia or cuba or dominca or dominican republic or eduador or equatorial guinea or fiji or gabon or grenada or guyana or iran or iraq or jamaica or kazakhstan or lebanon or libya or macedonia or malaysia or maldives or marshall island* or mauritius or mexico or montenegro or namibia or nauru or panama or paraguay or peru or romania or russia or samoa or serbia or south africa or st lucia or st vincent or grenadines or suriname or thailand or tonga or turkey or turkmenistan or tuvalu or venezuela or low income countr* or lower middle income countr* or low middle income countr*
2	snacks/
3	snack* or ultra processed food* or convenience food* or sweet* beverage* or fast food* or chip* or crisp* or cookie* or biscuit* or candy or candies or soft drink* or carbonated beverage* or instant noodle or processed food* or chocolate* or soda* or pepsi or coca cola or cola* or fruit* drink* or lolli* or junk food* or fizzy drink* or high-sugar or high-fat or cake* or doughnut* or donut* or SSB* or sugar sweetened beverage*
4	diet/
5	wasting or wast* or underweight or undernutri* or nutrient* or nutri* or grow* or consum* or nutri* status or anthropo* or stunt* or overweigh* or obes* or diet* intake or diet* adequacy or child* feed* or complementary feed* or micronutri* or anemic or anemia or aneamia
6	child/
7	child* or young child* or babies or baby or infant* or toddler* or kid*
8	2 or 3 or 4
9	6 or 7
10	1 and 5 and 8 and 9

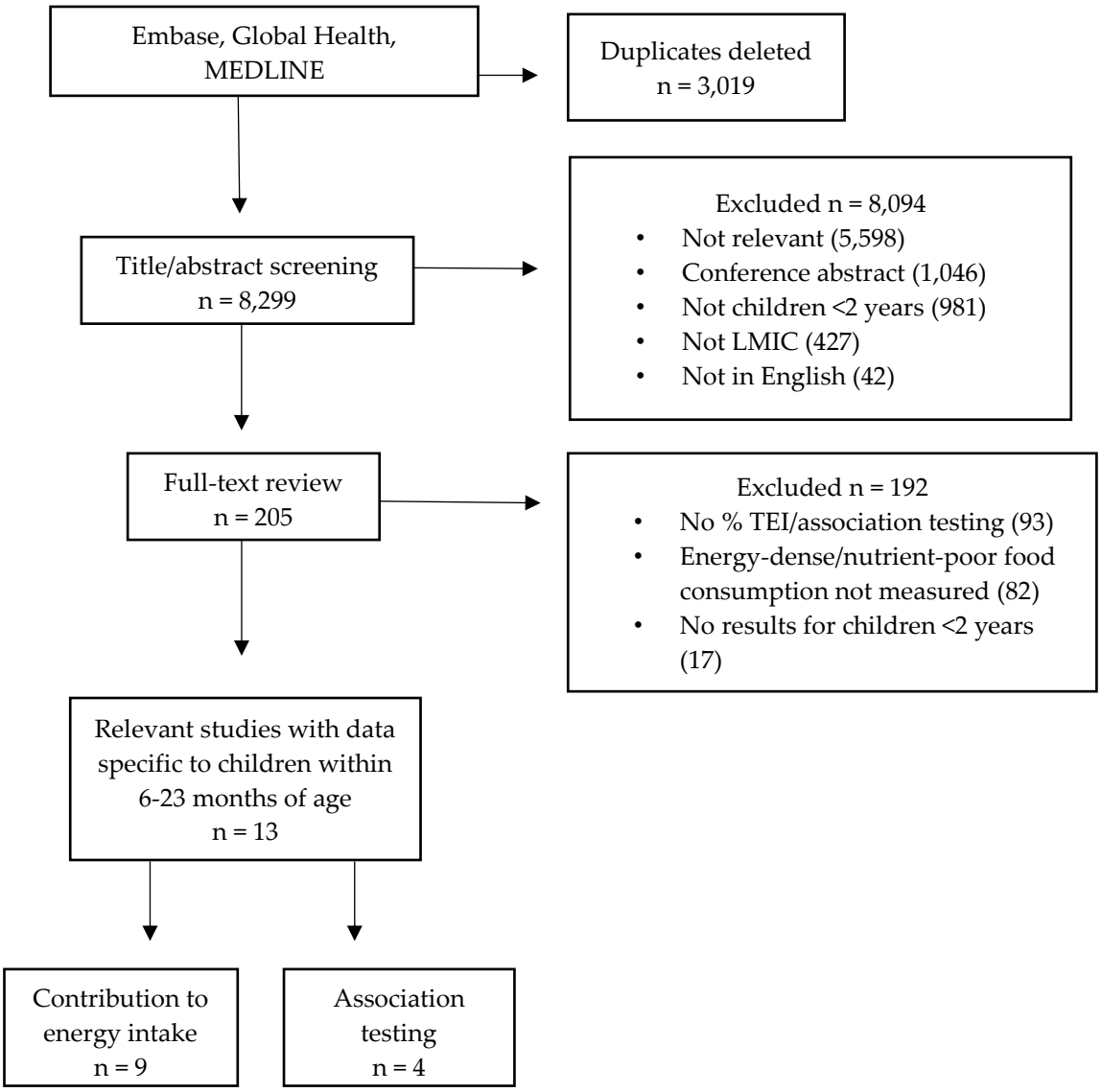
Data extraction and synthesis

For studies presenting data on the proportion of TEI derived from snack foods and/or SSB, the following information was extracted: reference, study population, sample size, location, study design, dietary assessment methods, diet findings, and their definition of snack food/SSB. For studies that tested associations between snack food/SSB consumption and child nutritional status, the following additional information was extracted: the nutritional outcomes tested, and results of the associations tested.

RESULTS

After deletion of 3019 duplicates, this search resulted in 8299 studies. After title/abstract screening, 205 studies were identified as relevant for full-text review. The majority of studies were excluded because the study population did not include children below two years of age. During full-text review, thirty relevant studies were identified with age ranges that included children 0-23 months of age in their samples. Just under half of these studies however, presented data on children specifically within the 0-23 months of age range. A total of 13 studies met the selection criteria; 9 studies detailed the proportion of energy intake derived from snack foods or SSB and 4 examined associations between snack food/SSB consumption and nutritional status (Figure 2.2).

Figure 2.2. Flow diagram of study selection for systematic review



Contribution to energy intake

Nine studies identified in this review assessed the contribution of snack foods/SSB to dietary energy intakes among children within the complementary feeding period. Details of these studies are presented in Table 2.1. Five of these studies were from Latin America, three studies were from east/southeast Asia, and one study was from Egypt.

The reported % TEI ranged from 13.1% among 0-23 month olds in the Amazonas district of Peru[72] to 38.2% among 12-23 month olds in Phnom Penh, Cambodia,[73] with a median of 19.3% TEI across all nine studies. Five studies assessed dietary energy

contribution from both snack foods and SSB.[74–78] Four studies did not specifically indicate if they assessed contributions from SSB in addition to snack foods.[72,73,79,80]

Four studies presented differences in % TEI from snacks/SSB across age groups, with most showing an increase in % TEI from such foods among older children. Across the entire complementary feeding period, Lander et al.[80] and Denney et al.[74] found that % TEI from snack foods and SSB increased with age (27.0% among 6-8 month olds vs. 35.0% among 9-11 month olds vs. 40.0% among 12-23 month olds; and 8.0% among 6-11 month olds vs. 19.6% among 12-23 month olds, respectively). However, a decrease in % TEI from processed snack foods/SBBs with age was shown by Kavle et al.[76] in rural and peri-urban Egypt.

Relationships between consumption and nutritional outcomes

Four studies assessed relationships between consumption of snack foods/SSB and nutritional outcomes among children during the complementary feeding period in LMIC (Table 2.2). Three studies looked at associations with anthropometry, one study looked at the association with anaemia, and no studies reported association testing between snack food/SSB consumption and dietary nutrient intakes. These four studies were conducted in countries that spanned three separate regions, with three conducted in urban/peri-urban locations and one in a rural location.[81] Three studies included consumption of both snack foods and SSB in their analyses, while one study included consumption of snack foods only (not SSB).[82]

For associations between snack food/SSB consumption and anthropometric outcomes, one study assessed differences in mean z-scores[83], one study assessed associations with overweight/obesity, and one study assessed associations with growth delay.[82] Budree et al.[83] found no relationship between snack food/SSB consumption and body-mass index z-score (BMIZ), height-for-age z-score (HAZ) or weight-for-age z-score (WAZ), comparing mean z-scores among 12 month olds who had consumed snack foods/SSB daily to those who consumed these foods less frequently (BMIZ β=-0.01 [95% confidence interval (CI):-0.4-0.4]; HAZ β=0.2 [95 CI:-0.3-0.6]; WAZ β=0.1 [95% CI:-0.5-0.5]). Jimenez-Cruz et al.[84] noted 1.87 higher odds

of overweight/obesity (BMIZ > 2) among 5-24 month olds who consumed high fat snack foods and SSB at least once a week; this relationship was also noted for consumption of SSB only (OR: 1.62; [95% CI: 1.10 – 2.36]) and consumption of high-fat foods only (OR: 1.91; [95% CI: 1.31-2.78]). The study in Iran by Vakili et al.[82] noted a positive association between regular feeding of junk food among 6-24 month olds and growth delays. The definition and measurement of growth delay however, were not presented in the paper. One study[81] assessed the assosiation between consumption of various types of snack foods/SSB – biscuits, sweets, savoury snacks, or soft drinks – and anaemia among 6-12 months of age in rural South Africa, with no statistical differences in proportions of anaemic versus non-anaemic children noted.

DISCUSSION

This review indicates that the % TEI contributed by snack foods and SSB among children in the 0-23 month age range in LMIC ranged from 13% in rural Peru to 38% in urban Cambodia. Evidence regarding the influence of snack food and SSB consumption on children's dietary adequacy and nutritional status in these contexts is however limited. Results from the three studies which explored associations between snack food/SSB consumption and child growth outcomes show mixed findings: one found no significant relationship with z-scores[83], one found a positive relationship with child overweight/obesity[49], and one identified a positive relationship with child growth delays.[82] No studies were identified that assessed associations between snack food/SSB consumption and dietary nutrient intakes and only one assessed child micronutrient status, specifically, anaemia status.

While this review indicates that snack foods/SSB are potentially providing a substantial proportion of dietary energy among young children in LMIC, the low number of studies and their limited geographical distribution limit the ability to understand whether the % TEI from snack foods/SSB differs between urban versus rural populations and across regions, particularly those beyond Latin America and East/Southeast Asia. Of the nine studies that explored % TEI from snack foods/SSB,

four were conducted in urban contexts[73,75,78,80], and one was conducted in a conflict area.[79] Two studies used national datasets[74,77], however, neither disaggregated data among 0-23 month olds by rural/urban area of residence. Kavle et al.[76] and Roche et al.[72] presented findings for rural samples of children, however, the small sample sizes (n=60 and n=32, respectively) likely limit the precision of the % TEI results for these sub-populations and the ability to generalize results. Of all nine studies assessing contributions of energy intake from snack foods and SSB, the majority were from Latin America (specifically Peru, Mexico or Brazil; n=5) and East/Southeast Asia (Cambodia, Indonesia or Mongolia; n=3). There were no studies from South Asia and only one study was conducted in northern Africa (none were conducted in southern or eastern Africa), revealing a dearth of information in contexts where the global burden of undernutrition is highest. Additionally, only three studies assessing % TEI considered variation across age groups, with two noting an increase in % TEI from snack foods/SSB and one noting a decrease, indicating that the function of these foods spanning the complementary feeding period could differ across regions of the world. There is a need for more research to explore the contribution of snack foods and SSB to energy intakes in the diets of infants and young children in LMIC, extending geographic regions, assessing urban versus rural areas, and exploring age trends.

The median % TEI from processed snack foods/SSB for children below 23 months across studies in this review was 19%, with a range of 13-38%. Percent TEI from snack foods/SSB among adolescents in LMIC, as well as among children in high-income settings, have also been noted within this range. Among Malaysian adolescents, 24% of TEI came from snack foods[85] and among Filipino 15 year olds 21% TEI came from snack foods.[86] In high-income settings, 31% and 27% TEI came from snack foods/SSB among 2-6 year olds in Russia and the United States, respectively[86], and 31% of TEI among American children and adolescents 8-18 years of age came from low-nutrient density foods, such as processed snack foods and SSB.[12] While high consumption of snack foods and SSB has often been thought to be a problem specific to school-age children and children in higher socio-economic settings, the findings from this

systematic review suggest that these foods are now making up a significant portion of total dietary intake among infants and young children in low-income settings in some regions of the world.

This systematic review also identified a need for further research to examine the relationship between snack food/SSB and dietary nutrient intake adequacy during the crucial complementary feeding period in LMIC. While no studies in this review explored the relationship between snack food/SSB consumption and micronutrient intakes, based on the average % TEI noted, it is plausible that such consumption patterns are contributing to reduced dietary nutrient intakes among young children in LMIC settings. There is increasing evidence that high intakes of energy-dense, nutrient-poor snack foods/SSB contribute to micronutrient dilution and reduced nutrient intakes among adolescents and adults.[87] In a systematic review of evidence evaluating the nutritional significance of added sugar consumption, Gibson[38] concluded that very high intakes of added sugars (over 20% of energy intake) - particularly when consumed in the form of soft drinks, sugar, and sweets – are correlated with lower intakes of some micronutrients among school-age children in high-income settings. Among US children 8-18 years of age, Kant[12] found that mean intakes of vitamin A, B6 and folate, as well as calcium, magnesium, iron and zinc, all declined with increased consumption of low-nutrient dense foods (candy, baked and dairy desserts, salty snacks, and SSB), with these foods contributing 30% TEI on average in the study sample. Among Australian 16-24 month olds, Webb et al.[34] noted reduced intakes of many nutrients, including calcium, zinc, and vitamin A, among the highest consumers of snack foods/SSB, with these foods contributing 27% TEI on average. Among South African 1-3 year olds, those in the highest quartile of added sugar consumption (based on % TEI) had lower intakes of calcium, iron and zinc, as compared to toddlers with lower % TEI from added sugar.[88] Five studies in this review[73,75,77,79,80] noted % TEI from snack foods/SSB of approximately 20% or higher among children below 23 months of age, suggesting levels of consumption that could contribute to micronutrient dilution. It is also critical to note that this review did not identify any studies that explored the relationship between snack

food/SSB consumption and reduced micronutrient intakes, dietary adequacy, or micronutrient status beyond aneamia. There is a clear need for further research on this pathway, given that young children have high nutrient requirements and the nutrient density of complementary foods in LMIC are often low.[27,89]

Findings regarding the association between snack food/SSB consumption and growth outcomes were limited and mixed among studies in this review. The study by Budree et al.[83] did not find any significant relationships with BMIZ, HAZ, or WAZ. However, the researchers did not assess % TEI from snack foods/SSB and instead based analysis on non-quantitative measurements of snack foods/SSB consumption, which may not be able to precisely estimate consumption levels associated with micronutrient dilution and/or excessive energy intakes and that may be necessary to establish a relationship between consumption and growth outcomes. Additionally, the population in this study was 6-12 months of age; as seen in the studies detailing % TEI from snacks, the contribution of such foods to total dietary intake tends to be higher among older children. It may be that the quantity of snack food/SSB consumption at 6-12 months was not substantial enough to result in an impact on growth outcomes. Jimenez-Cruz et al.[84] found increased odds of overweight/obesity among Mexican 5-24 month olds, while Vakili et al.[82] found a higher prevalence of growth delay among Iranian children 6-24 months of age who ate snacks. The influence of such foods could in theory contribute to either overnutrition, through excessive energy intakes, or to undernutrition, through displaced consumption of nutrient-dense foods, and so the findings from these two studies are not inherently contradictory. However, with only two studies, both of which used varying non-quantitative measurements of snack food/SSB consumption, it is difficult to draw conclusions based on these limited results. The biological/nutritional significance of diet displacement/micronutrient dilution from snack foods and SSB is not yet clear,[33] as it has not yet been established if such displacement translates into micronutrient deficiencies or growth faltering.[30,38]

The inconclusive evidence among studies in this review and evidence from high-income settings indicates that more research on the potential impact of snack

foods/SSB on growth among young children in LMIC is needed. Numerous studies among school-age children/adolescents in LMIC, particularly South and Southeast Asia, have identified a relationship between snack food/SSB consumption and overweight/obesity[90–97] and waist circumference.[98] A positive association between SSB consumption and overweight/obesity among pre-schoolers in the United States has also been noted,[53] while another United States study found an association between SSB consumption and growth faltering among pre-schoolers.[36] The influence of such consumption patterns on growth outcomes would likely be different in LMIC contexts, where constrained diets are often nutrient-poor, and among young children, whose nutrient requirements are high. Given these differing circumstances, micronutrient dilution from high consumption of energy-dense/nutrient-poor foods could plausibly contribute to micronutrient deficiencies and poor growth outcomes, and requires further research.

Limitations in study design, particularly related to sampling and measurement, challenge the ability to draw conclusions across papers identified in this review. Among the nine studies assessing % TEI from snack foods/SSB, only two provided nationally representative estimates, both from Mexico.[74,77] Three of the remaining studies assessed non-random samples, including convenience samples of stunted children and mothers attending health services,[72,73,78] limiting conclusions from these papers to wider populations. The four studies testing associations with nutritional outcomes also did not utilize representative samples - three studies systematically sampled mothers attending health centres for child health/vaccination services [49,82,83] and one included all children within catchment areas of selected health facilities.[81] Additionally, limitations in measurement of exposure and outcomes are noted among the four studies testing associations between consumption and nutritional outcomes. First, none of these studies utilized a comparable measurement of consumption of snack foods/SSB; the four separate measurements of consumption included: any consumption in the last week, consumption on at least 4 days in the previous week, daily consumption based on weekly recall, and 'use' or 'non-use' of foods for child feeding. In addition to restricting comparability across the four

studies, such measurements crudely capture consumption of snack foods and SSB, and would not accurately estimate the magnitude of consumption that would theoretically influence nutritional outcomes. A comparable measure of consumption, specifically one that quantifies the intakes of snack foods/SSB such as % TEI, would aid investigations into the relationship between consumption and diet/nutritional outcomes. Finally, while two studies used standardized measurements and definitions for anthropometrics, the lack of definition of 'growth delay' in the paper by Vakili et al.[82] (2015) prohibits understanding of the study findings and comparison with other papers.

The wide range of definitions used for snack foods and SSB, both in studies testing associations and studies describing % TEI, is clear from this review. Varying definitions included: the NOVA classification (with further variation between studies on inclusion of processed and/or ultra-processed foods);[99] specific food types such as 'desserts' and 'candy'; and food categorization such as 'sugary foods'. Additionally, three studies did not provide a specific definition of snack foods, or indicate if both foods and SSB were included in their definition. As diets continue to evolve in LMIC, there is a need for a standardized definition to allow for comparisons between geographic areas, rural and urban populations, and across time. Such a definition could include food/beverage types that are typically common across geographies (ie. candies, biscuits, soft drinks) but also context-specific foods (e.g. instant noodles, *aguas frescas*), and could also differentiate snack foods versus SSB given differential trends in use for young child feeding. The underlying hypothesis for influence of these foods on diet/nutritional status is centred upon these foods being both energy-dense and nutrient-poor, therefore, it is also recommend that the nutrient profile of these foods be assessed when possible.

While screening was carried out twice, the screening procedure for this systematic review was carried out by only one author which presents a limitation. In addition, while included studies were evaluated for the quality of their methods, analysis and risk of bias, no formal quality assessment (such as a CASP checklist) was used.

This review indicates that snack foods and SSB contribute a substantial proportion of dietary energy intakes among young children in LMIC. However, there is a need to standardize definitions of such foods and coordinate measurement in order to better understand the influence of these consumption patterns on nutritional outcomes. Though diet displacement and micronutrient dilution from processed foods and added sugars has been noted among children in high-income settings, the impact of such dilution in contexts struggling with undernutrition may be significantly higher and may be contributing to childhood undernutrition. Additional studies exploring the relationship between % TEI from processed foods and SBBs and nutritional outcomes – including nutrient intakes, micronutrient status, and growth - among representative samples of young children in LMIC, particularly in Asia and Africa, are needed to better understand this issue. As economies develop and food systems change, there is a timely need for further investigation into the role of these foods in child nutritional outcomes in order to protect and promote nutritious and appropriate young child feeding.

Table 2.1. Summary of studies assessing contribution of snack food/SSB consumption to TEI

Reference	Age, sample size, location	Dietary assessment methods[1]	Food/ beverage	Snack food/SSB definition	Snack food/SSB consumption[2]
Anderson et al. (2008)	12-42 mths (N=210) Sub analysis: 12-23 mths (n=61) Cambodia (Phnom Penh, urban)	Quantitative 24HR (1 day)	Unclear	Snack foods (definition not provided)	• Snack food products were the predominant source of energy for partially breastfed (42% TEI) and non-breastfed (36% TEI) children 12-23 mths of age • 38.2 % TEI from snacks/SSB among all 12-23 mth olds
Denney et al. (2017)	0-48 mths (N=2057) Sub-analysis: 6-23 mths (n=767) Mexico (national)	Quantitative 24HR (1 day)	Food & beverage	Sweets: cookies, cakes, pies/pastries, sweetened breads, candy, Mexican desserts, ice cream, sugars, syrups, jelly, fruit drinks, soft drinks, sweetened tea/coffee, artificially sweetened beverages, Yakult, sweet traditional beverages; Salty snacks: grain snacks and those made from starchy vegetables	• Among 6-11 mths olds, 4.3% of TEI from cookies, 1.7% from sweet traditional beverages, 1.0% from sweetened breads, and 1.0% from salty snacks; among 12-23 mth olds, 4.9% of TEI from sweetened breads, 4.7% from sweet traditional beverages, 3.9% from cookies, 2.6% from sweetened tea/coffee, 2.2% from salty snacks, and 1.3% from fruit-flavoured drinks • 16.1% TEI from snacks/SSB among 6-23 mth olds
Jeharsae et al. (2011)	1-5 yrs (N=478) Sub-analysis: 12-23 mths (n not provided) Thailand (conflict area)	Quantitative 24HR (1 day)	Unclear	Definition not provided	• Snacks accounted for 19.3% of TEI among children 12-23 mths old

Reference	Age, sample size, location	Dietary assessment methods[1]	Food/ beverage	Snack food/SSB definition	Snack food/SSB consumption[2]
Karnopp et al. (2017)	1-72 mths (N=770) Sub-analysis: <24 mths, non-exclusive breastfeeding (n=214) Brazil (Pelotas, urban)	Quantitative 24HR (1 day)	Food & beverage	Ultraprocessed foods: bread, cakes and baked products, cookies, ice cream, chocolates, candies and sweets in general; cereal bars, breakfast cereals with added sugar, sweetened and flavoured yogurt and dairy beverages; energy drinks; frozen and ready-to-heat foods [pasta, pizza, burgers], nuggets, frankfurters and sausages, and pre-prepared dishes and sauces; hydrogenated vegetable fat [margarine and halvarine], chips; sauces; sweet and savoury snacks; soft drinks and processed juices; canned meat and dehydrated soups; ready-made noodles; infant formula, complementary formula, and processed baby food; and artificial sweeteners).	• 19.7% of TEI from ultra-processed foods among children <24 mths: 12.9% of TEI from 'others foods' (industrialized juice, processed baby food, supplements and powdered infant formula), 2.6% from cookies, 1.9% from bread, and 1.8% from candies/sweets • 19.7% TEI from snacks/SSB among non-exclusively breastfed <24 mth olds
Kavle et al. (2015)	6-23 mths (N=120) Egypt (Qaliobia – peri-urban, Sohag - rural)	Quantitative 24HR (1 day)	Food & beverage	Junk foods: high energy, low in nutrient content and/or high in fat and/or contain added sugar (sugary biscuits, cream-filled sponge cakes, candy, fizzy drinks) or have high salt content (crisps/chips)	• 20.9% of TEI came from junk foods among 6-8 mths olds, 18.8% among 9-11 mths and 9.0% among 12-23 mths • 14.3% TEI from snacks/SSB among 6-23 mth olds
Lander et al. (2010)	6-23 mths (N=128) Mongolia (Ulaanbaatar and 4 provincial capitals, urban)	Quantitative 24HR (1 day)	Unclear	Snacks and sugars: 'mainly doughnuts and biscuits' (definition not provided)	• Among 6-8 mth olds, 27% of TEI came from snacks, 35% of TEI for 9-11 mth olds, and 40% of TEI for 12 - 23 mth olds

Reference	Age, sample size, location	Dietary assessment methods[1]	Food/ beverage	Snack food/SSB definition	Snack food/SSB consumption[2]
Roche et al. (2011)	0-23 mths (N=32) Peru (Amazonas district, rural)	Quantitative 24HR (2 days, non-consecutive)	Unclear	Market foods; packaged and commercially sold (definition not provided)	• 13.1% TEI from market foods
Rodríguez-Ramirez et al. (2016)	0-23 mths (N=926) Sub analysis 6-23 mths (n=749) Mexico (national)	Quantitative 24HR (1 day)	Food & beverage	Dairy SSB: milk shake, atole with milk, milk with sugar/honey Non-dairy SSB: beverages prepared with water and fruit or its juice (natural or industrialized) and sugar/honey, sodas, carbonated beverages, soft drinks with calorie-sweeteners, fruit juices (natural and industrialized), coffee/tea/infusion/water with sugar/honey, atole with water Sweet cereals/bread/cookies: oats, tapioca, milk pudding, granola bars, fresh bread and bakery, cakes, cookies, pastries, desserts Snacks and desserts: chips, fried snacks made of wheat flour, candies, gummies, lollies, ice cream/popsicles, jam, marmalade	• Among 12-23 mth olds, approximately 10% of TEI from sweetened cereal foods, 3% from snacks and desserts, 5% from non-dairy SSB, and 5% from dairy SSB (exact proportions not clear in figures presented) • Approximately 20% TEI from snacks/SSB among 6-23 mth olds (exact proportions not clear in figures presented)
Valmórbida & Vitolo (2014)	12-16 mths N=388 Brazil (Porto Alegre, urban)	Quantitative 24HR (2 non-consecutive days)	Food & beverage	Non-recommended foods: candies, lollipops, chocolates, cookies, jello, petit suisse cheese, chocolate milk, sausages, snacks, soft drinks, artificial juices, and foods with added sugar	• 13.6% of TEI from non-recommended foods

[1] 24HR = 24-hour recall
[2] TEI = total energy intake

Table 2.2 Summary of studies testing associations between snack food/SSB consumption and nutritional outcomes

Reference	Age, sample size, location, study design	Dietary intake assessment methods	Food/ beverage focus	Comparison groups	Statistical methods	Snack food/SSB definition	Nutritional outcome	Direction of association (p-value) [1]
Budree et al. (2017)	6-12 mths (N=1071) South Africa (Paarl, peri-urban) Cohort	Questionnaire: frequency of consumption in previous day, week and month	Food & beverage	Consumption of inappropriate foods daily vs. no consumption of inappropriate foods daily	Linear regression	Inappropriate foods: juices, soft drinks, sugary foods, fried foods	BMIZ HAZ WAZ MUACZ (at 12 mths)	NS NS NS NS
Faber (2007)	6-12 mths (N=479) South Africa (KwaZulu-Natal, rural) Cross-sectional	Questionnaire: unquantified frequency of consumption in the previous week	Food & beverage	Consumption of food types at least 4 days per week	χ^2 test	Miscellaneous foods: sugar, biscuits, sweets, savoury snacks, and carbonated beverages	Anaemia (haemoglobin concentration <100 g/L)	NS
Jimenez-Cruz et al. (2010)	5-24 mths (N=810) Mexico (Tijuana, Tuxtla, and Reynosa; urban) Cross-sectional	Questionnaire: frequency of consumption in the previous week	Food & beverage	Consumption of high-fat content snacks and/or sweetened drinks at least once in the previous week vs. no consumption	Logistic regression	High-fat snacks (HFS) (ie. potato and corn ships) and carbonated/non-carbonated sweetened drinks (CSD)	Overweight/obese (BMIZ > 2)	+ (<0.001)

Reference	Age, sample size, location, study design	Dietary intake assessment methods	Food/ beverage focus	Comparison groups	Statistical methods	Snack food/SSB definition	Nutritional outcome	Direction of association (p-value) [1]
Vakili et al. (2015)	6-24 mths (N=300) Iran (Masshad, urban) Cross-sectional	Questionnaire: use of junk food for child feeding (definitions of regular use and sometimes use not provided)	Food	Use of junk foods for child feeding vs. non-use of junk foods	χ^2 test	Junk food: definition not provided	Growth delay (definition not provided)	+ (<0.001)

[1] NS = not significant

Chapter 3: Methods

STUDY COMPONENTS

The study design included two components whose methods are detailed here separately:

- QUALITATIVE COMPONENT

  This component facilitated the development of tools and methods for the survey, as well gathered qualitative data to meet objective 1, and was implemented prior to the quantitative survey.

  - Formative research for survey design

  The objective of this research was to assess 1) definitions of snacks among Kathmandu Valley caregivers to evaluate the appropriateness of the study definition for survey analysis; 2) commercial and non-commercial snack foods and beverages fed to infants and young children to be included in the specific types of foods defined as snacks during survey analysis; and 3) caregivers' recall of their child's food/beverage consumption to inform methods and reduce recall error during the dietary 24-hour recall (24HR) for the survey. This research utilized structured observations and FGD with participatory exercises.

  - Qualitative research for objective 1

  The objective of this research was to assess 1) caregivers' perceptions of commercially produced snack foods and beverages; and 2) factors that influence their use of these foods. This research utilized FGD with participatory exercises.

- QUANTITATIVE COMPONENT

  This component included a quantitative survey and collected the data necessary to meet objectives 1-5 and was implemented from February – April 2017. The intention of this phase of the research was to gather quantitative data – including dietary, biochemical, anthropometric and caregiver and

child characteristics – to describe the dietary intakes and nutritional status of 12-23 month old children in Kathmandu Valley, and to assess consumption patterns and nutrient profiles of snack foods and beverages.

QUALITATIVE COMPONENT - METHODS

Data were collected from caregivers of children 12-23 months of age in Kathmandu Valley using structured observations and FGD with participatory exercises. These methods built upon behaviour-centered design methods developed by the Environmental Health Group (EHG) at LSHTM.[100] The objectives, design, sample selection, methods, and results from the formative research for survey design are detailed below. Results from the qualitative research for objective 1 are presented in Chapter 4.

A) STRUCTURED OBSERVATIONS

The objectives of the structured observations were to understand: 1) caregivers' use of commercial and non-commercial snack foods and beverages for IYCF and 2) caregivers' ability to recall their child's food/beverage consumption and the extent of recall bias occurring. These findings were used to inform questionnaire design and the methods used in the interactive multiple-pass 24HR in the quantitative survey. Ten 12-hour observations of children 12-23 months of age were conducted in October 2016. Observation presented the opportunity to observe true feeding practices, as well as the social and environmental context in which these practices occur.

A.1 Study population, sampling, and recruitment

Using areas that were anticipated to provide participants from a range of SES backgrounds, five neighbourhoods across Kathmandu Valley's three districts – Bhaktapur, Kathmandu, and Lalitpur– were purposively selected as locations for these observations. Two households with a child 12-23 months of age were purposively sampled from each area, which provided a total sample size of ten households. Purposive sampling involved recruiters walking through the

neighbourhood and asking strangers or personal contacts which were households with young children living in them. Recruiters explained the procedures of the research activity to identified households and selected a day for the observation.

A.2 Process for structured observations

Four female research assistants were trained in structured observation methodology, the specific objectives of these observations, and the tools to be used. To ensure consistency in observation methods, all four research assistants participated in a mock observation. Specifically, all research assistants observed the same child together over the course of a day, with a debrief mid-way through and at the end of the day. During these debriefs, notes on tools were compared to identify gaps/errors in note-taking and feedback provided on observation techniques (ex. ways to be more discrete during observation or polite tactics for dealing with a caregiver/child that wanted to interact with the observer). Additionally, one male researcher was trained to conduct a semi-quantitative 24HR on the day following observation. Tools were pre-tested and revised as necessary. During data collection, observations were conducted from 7am -7pm with two research assistants assigned to a household. To account for day-of-the-week effect, observations were conducted on varying days of the week, including weekend days. One day between each observation was used to conduct the semi-quantitative 24HR in the morning, and for the team to debrief on main findings from the observation and 24HR in the afternoon.

Upon arrival, research assistants explained the procedure for the observation again, reiterating that the child's activities were to be followed with as little disruption as possible and that household members should carry on with their daily lives as usual. Written informed consent was obtained from all caregivers who agreed to participate. The child was followed throughout the day, and all activities of the child and caregiver(s) were noted on an unstructured form, with time and activity details noted. Feeding episodes for the child were recorded with specific details on a structured form, including: time of consumption, food details (ingredients, preparation methods, brands used, etc.), estimated quantities of snacks, who fed the

child, how and where they were fed, if the child fed him/herself, and context of snack provision (i.e. behaviours of caregiver and child just before and during the feed). At the end of the observation, a gift of thanks was provided to the primary caregiver and they were informed that another researcher would be visiting them the next morning to ask follow-up questions. On the day following observation, the research assistant who had not conducted observations visited the caregiver and conducted a semi-quantitative 24HR to assess their recall of foods/beverages fed to the child. The research assistants who conducted the interview also completed a short questionnaire regarding household materials/asset ownership in order to categorize households into urban national wealth quintiles using the Equity Tool.[101] The procedure and forms used for structured observations can be found in Appendix 1.

A.3 Results from structured observations and incorporation into survey design

The sample for structured observations provided households from a range of SES backgrounds, with 4 of 10 houses coming from lower SES and 6 from middle or high SES (Table 3.1). Additionally, the types of primary caregivers included in the sample were diverse and included: grandmothers, adoptive grandmothers, aunts, and mothers. While fathers were not observed to be primary caregivers in this sample, they were present during observation in several households and so we were able to observe their behaviours as secondary caregivers. Finally, three households had working mothers and so we were able to observe the patterns of activities and caregiver support received in this circumstance.

Table 3.1 Ages and wealth ranking of households included in structured observations

Neighborhood (District)	Age of child (months)	Wealth ranking[1] (1 = poorest / 5 = wealthiest)
Bagmati slum (Kathmandu)	14	1
	23	2
Bhaisepati (Lalitpur)	15	5
	13	5
Bouda (Kathmandu)	12	4
	21	4
Koteshwor (Kathmandu)	20	5
	23	3
Nagadesh (Bhaktapur)	23	4
	13	2

[1] Wealth rankings were based on use of Equity Tool app questionnaire for urban Nepal: http://www.equitytool.org/nepal-2/

Accuracy of 24HR: Comparison of what children consumed during observations and what caregivers reported in subsequent 24HRs found that snacks fed to children were commonly omitted; these included: biscuits, fruits, milk, candy, and porridges. Observations also showed that in addition to primary caregivers, other caregivers/relatives/neighbours provided snacks to children throughout the day, resulting in omission of snacks by primary caregivers during recalls.

> *Implication for the quantitative survey methods:* Based on these findings, a pictorial recall-aid of commonly fed foods was developed for use during the quantitative survey and all caregivers involved in caring for and feeding the child over the recalled day were asked to prospectively tick off foods/beverages consumed by the child. Further details on the use of the pictorial recall-aid are provided in the methods section for the quantitative survey.

Meal patterns and foods consumed: In contrast to the typical meal pattern among Nepali adults based on two main meals of the day (referred to as *khana*; often consisting of rice, dal, and seasonal vegetables*)*, children were typically fed multiple times throughout the day and received around 3-4 meals with snacks in-between (Table 3.2). Children were fed a meal soon after waking up in the morning, then were fed another meal later in the morning when the rest of the family was having their first *khana*. The other main meal occurred in the evening when the family ate. In the mid-day an afternoon meal was served as well. Between these meals, light snacks were fed at intervals either when the child was fussy or simply when the caregiver decided to prepare something. The types of foods fed to the child differed depending on the type of meal; dal, rice and vegetables were more commonly fed during *khana* while *lito* (porridge made from legume/grain flours), *jaulo* (porridge made from whole grains/legumes), or hot milk with biscuits were typically the foods fed as the additional meals for the child in early morning and late afternoon. While meals served to the children were typically larger in portion size than snacks, the quantities

of food actually consumed by children often did differ between meals and snacks and was typically small. During structured observations, it was noted that all children consumed commercial snack food/beverage products at least once during the 12-hour period. Every child who was observed consumed biscuits, with consumption of biscuits occurring both as a snack and as a meal. The breakfast meal of almost all the children was hot milk or tea with biscuits. During this breakfast meal, the quantity of biscuits consumed was often a whole packet of 4-8 biscuits. Commercial snack food products, such as biscuits or cheeseballs/crisps, were also commonly eaten as a snack during tea-time (morning or afternoon).

Table 3.2 Summary of meal patterns identified during structured observations

Meal type	Time of consumption	Description of foods consumed
Morning meal	Early after child wakes up (6-8am)	Hot milk; biscuits; tea
Khana meal	Mid-morning (9-11am)	Dal and rice; *jaulo*; often prepared using foods cooked for rest of family but served to child in separate dish and made mushy
Light snacks	Mid-day (11 – 1am)	Hot milk; egg; banana; snack products
Afternoon meal	Afternoon (2-3pm)	*Jaulo*; *lito*; rice and hot milk
Light snacks	Tea-time (4-6pm)	Biscuits; hot milk; tea; snack products
Khana meal	Evening (7-8pm)	Dal and rice; *jaulo*; often prepared using foods cooked for rest of family but served to child in separate dish and made mushy

Implication for the quantitative survey methods: These findings indicated that a definition of 'snack foods/beverages' based on time of consumption or portion size would not be an appropriate definition for consumption measurement in the quantitative survey. Some foods that were feds as snacks between meals were also fed during meals, and so excluding meals from the definition of snacks would underestimate consumption. Additionally, because both meals and snacks were consumed in similar amounts by young children, a definition based on portion size would likely result in measurement error. These findings regarding definitions of snack foods/beverages were further explored during FGD and are presented below.

B) FGD AND PARTICIPATORY EXERCISES

Seven facilitated FGD with participatory exercises were conducted among caregivers of children 12-23 months of age in November 2016. The objectives were to: 1) identify Nepal-specific definitions of snacks and the types of foods/beverages given to children as snacks, 2) elicit caregivers' perceptions of these foods and beverages and 3) identify factors influencing their use for IYCF.

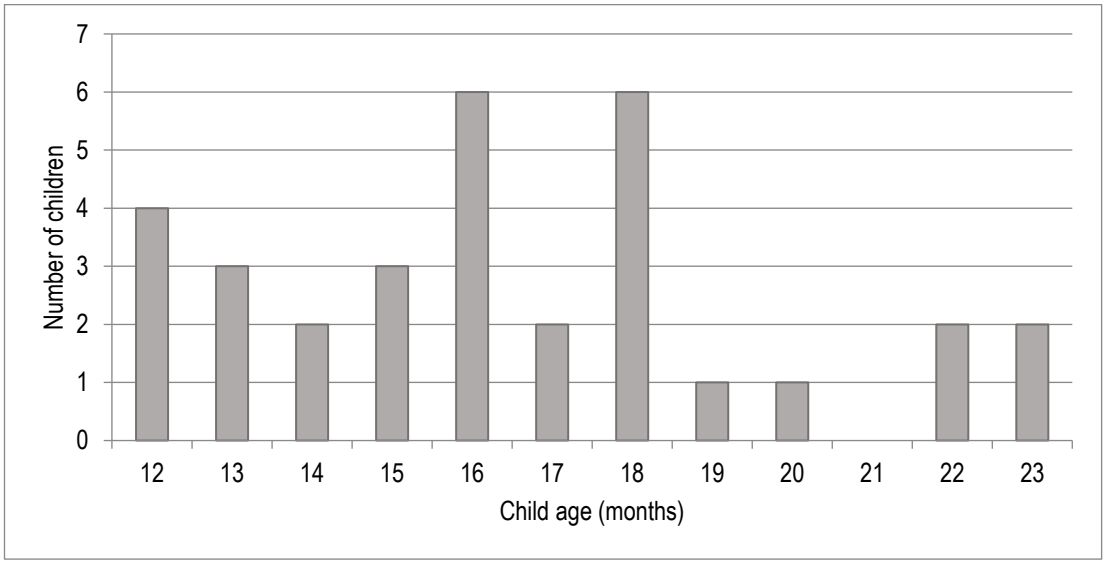
B.1 Study population, sampling, and recruitment

Primary caregivers of children 12-23 months of age were purposively sampled from Kathmandu Valley neighbourhoods of varying SES, with all three districts of Kathmandu Valley represented in this sampling. Three types of caregivers were sampled: 1) non-working mothers 2) working mothers, and 3) grandmothers. Focus on these caregiver types was based on findings from structured observations of children in Kathmandu Valley, when it was observed that mothers and grandmothers were typically the caregivers involved in child feeding, and among working mothers it was grandmothers that then typically cared for children. Recruiters worked through female community health volunteers (FCHV) in each location to identify caregivers with a child 12-23 months of age. Details of the participating groups are shown in Table 3.3 and distribution of ages of caregivers' children in Figure 3.1.

Table 3.3 Details of FGD participants

Neighbourhood (District)	**# of participants**	**Caregiver type**	**SES**
Baneshwor (Kathmandu)	5	Mothers (working)	Mid/high
Budanilkantha (Kathmandu)	4	Mothers	Mid/high
Imadol (Lalitpur)	3	Grandmothers	Low/mid
Lazimpat (Kathmandu)	3	Mothers (working)	Mid/high
Nagarkot (Bhaktapur)	6	Mothers	Low/mid
Patan Dhoka (Lalitpur)	5	Grandmothers	Mid
Sinamangal (Kathmandu)	6	Mothers	Low

Figure 3.1 Ages of FGD participants' children (N = 32)



B.2 Process for FGD and participatory exercises

FGD were conducted in a private space to ensure anonymity and facilitate open discussion, which were typically rooms in a community centre or clinic. Four persons facilitated the FGD: 1) a facilitator, 2) a note-taker 3) a translator for the researcher, and 4) the study researcher. Prior to the beginning the discussion, the facilitator explained the study details to caregivers and obtained informed written consent from each participant. There were no refusals for participation by caregivers. Discussions were audio-recorded, and exercises photographed; photographs of participants' faces were not taken. Each discussion lasted one hour on average, and the research team debriefed the findings and themes as a group after each discussion to ensure they correctly captured the key points. Saturation in responses was reached after seven FGD. Participants received a gift of appreciation after the discussion.

The FGD began with introductions and a brief, general discussion on the topic of child feeding, covering the foods caregivers feed their child and why they choose these foods. This led into a more specific guided discussion on *khaja* (Nepali word for 'snack') and caregivers' definitions of snacks. This discussion was followed by a series of guided participatory exercises, as follows:

1. **Free-listing**: This method was used to elicit all the different types of foods and beverages, commercial and non-commercial, consumed as snacks by children according to their caregivers. As participants provided an answer, pictures of these foods/beverages were placed in the center of the group; if no picture was on hand, participants were asked to draw an image to represent the food/beverage.

2. **Grouping/categorization**: After all the snack foods/beverages provided to children were listed, this exercise was used to understand how caregivers perceive relationships between these foods/beverages and attributions associated with certain foods/beverages. Participants were asked to group together foods/beverages that they thought were similar, based on whatever similarities they perceived. Participants could agree or disagree with one another, and they were probed on differing opinions of these groups of foods/beverages.

3. **Ranking**: These exercises were used to elicit caregivers' perceptions of the different types of snacks that were free-listed. While these rankings are important, the discussions between participants during this ranking process also brought out varying opinions among caregivers on these perceptions. The specific continuums on which participants were asked to rank foods/beverages included those that were identified from previous research in this urban Nepal context:[19] child preference, healthiness, convenience, and cost. The order in which these continuums were presented to the participants was consistent across FGD.

B.3 Key findings from FGD and incorporation into survey design

Common snacks provided to children: The snack foods and beverages fed to young children were similar across caregiver groups. *Jaulo* (soft mixture of rice and lentils), *lito* (porridge made of ground legumes, grains and/or nuts), fruits (apple, banana, pomegranate, orange, papaya, mango), eggs, milk, biscuits, cheeseballs, chocolate, and juice drinks were almost always included as responses. Other foods that were reported, but not consistently across groups included: bread, roti, tea, instant noodles, Horlicks, kheer, curd, cornflakes/Chocos, and potato chips.

> *Implication for the quantitative survey methods:* To ensure context-specific classification, the foods and beverages reported in these FGD were included in the category of snack foods and beverages used for analysis of dietary intake data from the survey.

Factors influencing decision-making on what foods to feed children: Across all discussion groups, caregivers reported that they chose foods to feed their child to benefit child health and nutrition. Specifically, caregivers mentioned children's growth and development, sometimes brain development, and that they opted to choose foods that contained the nutrients children needed. In addition, caregivers across all group reported choosing foods to please their child and that they often opted for foods their child liked. Convenience of foods as a factor in feeding decisions was also discussed. It was noted across groups that the definition of convenience was not based solely on preparation and access but depended on how much a child liked a food – if the child ate it easily, it was considered convenient to feed. Finally, cost was discussed but not reported to be a strong driver of food choices among caregivers who participated in these FGD.

> *Implication for the quantitative survey methods:* Perceptions of these snack foods and beverages informed the development of a survey questionnaire module related to reasons commercial snack foods/beverages were used for IYCF. The mixed-methods paper on perceptions of commercial snack food/beverage

products (Chapter 4) is based on these qualitative findings from FGD and the quantitative results from the survey questionnaire module.

Definition of snacks: When considering meal patterns among adults, there was general consensus on what a snack (*khaja*) was - *khaja* was defined as a small eating episode in the afternoon and what kept hunger down between *khana* (two main meals of the day, typically *dal bhat*). But when considering young children's meal patterns, there were differences noted between the *khaja* consumed by adults and that consumed by a child. For adults, caregivers noted that *khana* is typically a bigger portion size, intended to fully fill the stomach, while *khaja* is smaller in portion size. For young children, participants said the portion sizes for *khana* and *khaja* are similar. Some participants said *khaja* as it exists for adults does not exist for young children; for adults, *khaja* is typically eaten once in the afternoon, but caregivers reported that their children eat snacks throughout the day because they need to be fed frequently. While the meal pattern for adults was clear, the meal pattern for children was more dependent on feeding when the caregiver thought the child was hungry/would need something 'in the belly'. Some caregivers did not refer to these non-*khana* feeding episodes for children as *khaja*, but as 'light meals'.

Implication for the quantitative survey methods: These findings were consistent with findings from structured observations and confirmed that a definition of 'snack' based on timing or portion size was not appropriate for this context or age group. These findings were used to inform the definition of 'snack food/beverage' to be used for analysis in the quantitative survey (detailed in the following section).

QUANTITATIVE COMPONENT - METHODS

A cross-sectional quantitative survey was conducted among primary caregivers of children 12-23 months of age and included: an interviewer-administered questionnaire, a 4-pass interactive 24HR of all foods/beverages consumed by

children, anthropometric measurements of mothers and children, and capillary blood sample collection from children. Data collection was conducted in one season from February – April 2017.

Study population and exclusion criteria

The population of interest for this study were children 12-23 months of age in Kathmandu Valley, Nepal and their primary caregivers. Primary caregivers were defined as caregivers who typically provided the majority of care to the child in a day; these included: mothers, fathers, grandparents, uncles and aunts, siblings, or a household helper. For inclusion in the study, children had to be 12-23 months of age on the day of interview, children and their primary caregivers had to be current residents of Kathmandu Valley (defined as living in the Valley for the last 6 months) and provide their consent. Children were excluded if the child was severely ill or if they had a congenital/physical malformation that inhibited feeding.

Sample size calculations

Sample size estimations for this survey were based on the primary outcomes of interest: anticipated differences in LAZ and WLZ, iron status, and micronutrient intake between high and low consumers of USFB. These calculations were based on means and standard deviations for haemoglobin, LAZ, and WLZ for children 12-23 months of age in urban Nepal.[62] Power was first calculated for a difference between two groups, and because terciles were used for comparisons the sample size was multiplied by three. Calculations also accounted for a design effect of 2 due to the cluster-sampling; in the absence of appropriate data to determine the specific intra-cluster correlation (ICC) for this study, the design effect of 2 was chosen as a conservative estimate. The sample size calculations indicated that a minimum sample size of 702 caregiver-child pairs would allow for detection of biologically meaningful differences in the primary nutritional outcomes of interest between low and high consumers of USFB, as detailed in Table 3.4.

Table 3.4 Sample size calculation details for outcomes of interest

Outcomes	Measurement	Power	Difference between low/high USFB consumers	Sample required[1]
Iron status	Hemoglobin	90%	1.0 g/dl	516 (n=172 per tercile)
Linear growth	LAZ	80%	0.5 LAZ	666 (n=222 per tercile)
Ponderal growth	WLZ	80%	0.5 WLZ	666 (n=222 per tercile)
Dietary adequacy	Mean nutrient intake	90%	0.3 SD	702 (n=234 per tercile)

[1]α = 0.05 for all calculations

Sampling procedure and participant recruitment

A multi-stage cluster sampling procedure was used for this survey. Kathmandu Valley has three districts - Bhaktapur, Kathmandu, and Lalitpur- which are comprised of municipalities, each of which is further divided into wards. For the first stage, these municipality wards were used as the primary sampling unit; 78 clusters of an anticipated 10 caregiver-child pairs were assigned across wards based on probability proportional to size (PPS) using ward population estimates from the 2011 Nepal Census.[102] To assign clusters, a list of all 1,136 Kathmandu Valley municipality wards and their populations was compiled, with wards ordered randomly and a running cumulative population noted. A sampling interval was determined by dividing the total cumulative population (2,455,599) by the 78 clusters: 31,482. A random number between 1 and 31,482 was identified, and the ward within this first cumulative population was the first assigned a cluster. The remaining clusters were assigned by adding the sampling interval until all 78 clusters had been assigned. Wards with larger populations had a higher probability of being assigned more than one cluster. The final 78 clusters were assigned across 68 municipality wards: 8 in Bhaktapur, 42 in Kathmandu, and 18 in Lalitpur.

Participants within each cluster were recruited 2-3 days prior to the scheduled day of data collection by a trained recruitment team. For each cluster, a random starting Global Positioning System (GPS) point was identified through a sampling grid method[103] using maps of the relevant municipality wards from Nepal's Department of Survey. If a municipality ward was allocated more than one cluster, the

corresponding number of random starting GPS points were identified. After the recruitment team arrived at the GPS point, the first household to the right when facing north was approached to identify an eligible caregiver/child pair. Households were defined as family members who lived together in one home and shared meals from the same cooking pot. Households on both sides of the street were approached and the recruitment team would continue along the street until it ended or until the boundary of the ward was reached, at which point the team would turn right or backtrack to the first street off the right. If an apartment building was encountered, a floor and then unit on that floor were selected randomly to approach first, and then all subsequent units in the building were approached. A FCHV from each ward would join the recruitment team in order to facilitate introduction to the households and to also inform the team if a young child lived in households where members were not home/did not answer when approached. In instances where the FCHV did not know the non-responsive household, neighbours were asked if a young child lived inside. Recruitment began in early morning hours when all household members were likely to be home; if neighbours or an FCHV confirmed that a young child lived in a non-responsive household, a household member would be phoned or the household would be revisited once later in the day to see if someone had returned home.

Once a household was found with a child 12-23 months of age, the recruitment team would begin the recruitment process. The team would ask to speak with the child's primary caregiver. If the primary caregiver was not home, the team would call them on their cell phone or visit them at their workplace. The primary caregiver would confirm the child's exact age and date of birth, and answer a series of questions to identify if they and the child were eligible for the study. If more than one eligible caregiver-child pair lived in a household, one would be randomly selected. If the child was from a multiple birth, one of the children would be randomly sampled.

If the caregiver-child pair was eligible, the recruitment team would explain the survey, involvement required by the caregiver/child, estimated date and length of the interview, and ask for their willingness to participate. If the caregiver agreed to

participate, their contact details would be noted on a participant list and their home's location indicated on an attached map in order to aid the data collection team on the day of interview. Additionally, the caregiver received a pictorial recall-aid and was counselled to use the aid on the day prior to interview by ticking off any of the foods/beverages shown and the approximate time the child ate them. If the primary caregiver left the child with another caregiver, they were instructed to give the recall-aid to that caregiver for use as well (see pictorial recall-aid in Appendix 2). This process of approaching households and recruiting participants was repeated until 12 caregiver-child pairs were recruited for the cluster, with the assumption that up to three caregivers/children would be unavailable on the day of interview due to illness, family emergency, or change of mind.

On the day of interview, interviewers were assigned to caregivers by their supervisor, and began interviews when caregivers were available. Structured interviews and dietary assessments were conducted in the caregivers' home in order to ensure a comfortable environment and to also aid portion size estimation by using household utensils. Interviews lasted approximately 90 minutes, after which the caregiver and child would be guided to a central location in the municipality ward (typically a private room in a school, temple, or community centre) for anthropometric measurements followed by blood sampling. Informed written consent was obtained from all participants and a gift of baby cloth, feeding bowl, and hand-soap was provided as a thank you. Children with anaemia were provided counselling by the trained nurses and any cases of severe anaemia were referred to the ward health centre, and followed up one week after interview.

Questionnaire design

Questionnaire development was based on prior surveys conducted in Nepal, including adaptation of modules from the Nepal Demographic and Health Survey (DHS), the Nepal Living Standards Survey, and prior surveys conducted by HKI in Kathmandu Valley;[19,62] the questionnaire used for this survey can be found in Appendix 3. Data were collected on demographic and socio-economic characteristics

pertaining to the caregiver and child, including: a household roster (age and sex of all household members), caregiver educational attainment, parity, asset ownership, caste/ethnicity, religion, and living conditions. The questionnaire collected data on additional factors related to child nutrition, including: food security using the Household Food Insecurity Access Scale (HFIAS),[104] immunization status, birth weight, and child morbidity. A module on migration among household members was also included. A module based on findings from the formative research phase collected data on main reasons caregivers fed commercial snack foods and SSB to their children. The questionnaire was translated into Nepali, back-translated, and pre-tested prior to data collection.

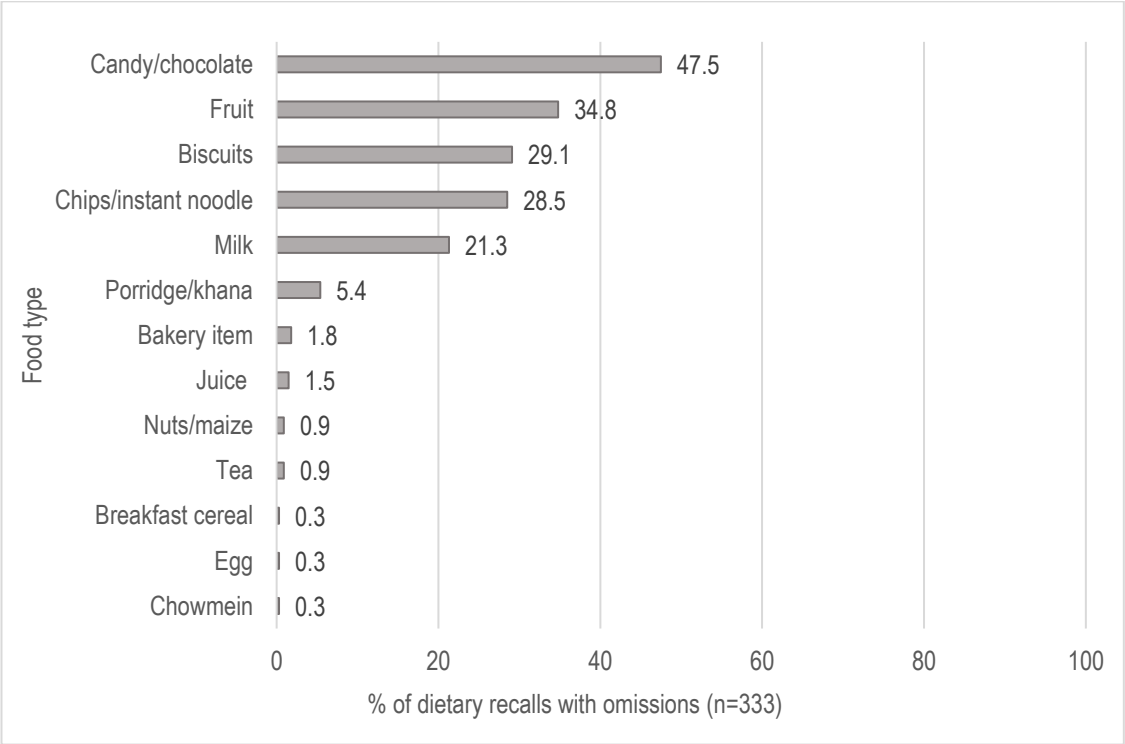
Dietary assessment

An interactive, quantitative, 4-pass 24HR interview was conducted with each caregiver to gather dietary intake data for their child 12-23 months of age during the day prior to interview;[105,106] see Appendix 3 for tools used during the 24HR. The first pass involved caregivers listing all the foods and drinks consumed by the child in the previous day and the time at which they were consumed. At the end of this first pass, the interviewer would cross-check this recall with the information ticked off in the pictorial recall-aid and verify any omissions or additions. During the second pass, the caregiver was asked to provide further details of these foods/drinks, including ingredients in dishes, cooking preparation, who fed the child, and if the food/drink was part of a main meal. Additionally, caregivers were asked if foods were commercially produced, and if so, for the brand name/flavour. In the third pass, caregivers were asked to estimate the portion size of foods and drinks consumed by the child; this was done primarily by weighing food models, but caregivers were asked to report number of pieces/packages for some foods/beverages. A pictorial size guide was also developed for common vegetables and fruits, whereby caregivers could indicate if the size was 'small', 'medium' or 'large'. To determine the weight for each of these sizes, the weights of six pieces per size per fruit/vegetable were averaged. Additionally, circle models of 3 common sizes were used for caregivers to estimate the size of rotis served to their children. For mixed dishes fed to the child,

individual recipes for these dishes were collected and caregivers were asked to estimate quantities of all ingredients used in the dish. For *lito* recipes, a separate form was used (see Appendix 3) and caregivers asked to estimate the quantity of raw ingredients (typically grains/legumes/nuts) that were then ground up for the *lito*; with this ratio of ingredients, caregivers were then asked to estimate the quantity of *lito* powder fed to the child. In the fourth pass, the interviewer summarized the first pass and verified if the child had consumed anything else, if so, these items were included and the passes repeated for these items. Recalls were collected for every child, and a repeated measure was collected on a non-consecutive day among a random sample of 10% of the children. Recalls were conducted on all days of the week to account for day-of-the-week effect, and repeated recalls were typically conducted 2-3 days after the initial dietary recall. Dietary data collection was conducted within one agricultural season (early February – early April 2017) in order to minimize variation in diets across the data collection period; within this winter season, certain foods were more common (oranges) while others were less common (mangos).

Of the 823 24HR conducted, including 745 initial recalls and 78 reassessments, the pictorial recall-aid was used in 84.9% (n=699) of interviews. Among interviews that used the recall-aid, over half (52.4%, n=366) did not have any omissions from the 24HR (i.e. foods ticked in the pictorial recall-aid that were not recalled), 23.9% (n=167) had one omission, 17.2% (n=120) had 2-3 omissions, and 6.6% (n=46) had 4 or more omissions. Figure 3.2 details the proportion of interviews with omissions detected by type of food; candy/chocolate, fruit, biscuits, chips/instant noodles, and milk were the most commonly omitted foods.

Figure 3.2 Dietary recall omissions captured by pictorial recall-aid, by food type



In order to standardize details collected in the second pass and measurements of recipes and portion sizes in the third pass, a probe and portion size guide was developed (see Appendix 4). In this guide, standardized probes for all dishes and single foods/ingredients were detailed along with guidance for food models, including a 'best portion size food model' and an 'alternative portion size model'. Condiments that were determined to be used in small amounts with negligible nutritional content were not measured during interviews, including: garlic, ginger, pickles, herbs/spices, chilies, and tea leaves. The 24HR tools, recall-aid and portion size guide were all pilot-tested among caregivers of children 12-23 months of age during a 2-week period in December 2017 to ensure feasibility and acceptance by caregivers. Pilot-testing was conducted in municipality wards that were not sampled for the quantitative survey.

Market surveys

To acquire cost information of foods and beverages fed to the children participating in the quantitative survey, market surveys were conducted at several time points throughout the study - market surveys for commercial foods consumed by children were conducted in September 2016 and May 2017, and a market survey for non-commercial foods consumed by children was conducted in March 2017. Initially, in September 2016, commonly consumed commercial snack food and beverage products identified in previous HKI research[19] were sought out at various points-of-sale. Product categories included the following, with specific brands identified in datasets of the previous HKI research:

- Biscuits/cookies (sweet)
- Chips/crisps/crackers (savoury)
- Candy/chocolate
- Cakes/muffins/doughnuts
- Traditional sweet snacks: *mithai*, *titaura*
- Traditional savoury snacks: *dalmoth*, *nimki*
- Frozen snacks: ice cream, popsicle, ice-ee
- Instant noodle
- SSB: soda, juices, chocolate/malt beverage

In order to take into account varying caregiver preferences and price/availability of products, a range of point-of-sale types were included in the market survey. The point-of-sale types presumed to be most commonly frequented by caregivers of varying SES backgrounds were identified based on conversations with HKI staff and the locations of these points-of-sale types also took into account the variation in SES of neighbourhoods within Kathmandu Valley. The points-of-sale types for the September 2016 market survey included the following:

- Small corner stores
    - 7 purposively selected across all districts of Kathmandu Valley (7 neighborhoods were identified to provide an anticipated range of SES areas - 1 store each in 4 lower SES areas and 3 middle/high SES areas)
- Medium independent grocery stores
    - 4 purposively selected across Kathmandu Valley
- Large national chain supermarkets
    - 4 purposively selected across Kathmandu Valley (each a different chain)

Two researchers worked as a team to conduct the market survey – one to identify products and one to record the relevant information. Upon arriving at the identified point-of-sale, the team introduced themselves to the store owner/manager and requested permission to look through store for certain products. If any of the pre-determined snack products were found, the weight and price of the product was noted. If more than one product size was available, all weights/prices were noted**.** The first time the product was found in the market survey, one package of that product was purchased in order to obtain nutrient information from the label. If the product package did not have a weight on the package, the product was purchased and weighed at the HKI office. At the end of each day, the product weight/price information was entered in Excel and at the end of the survey the average costs per 100 grams edible portion and per 100 kcal were calculated. Nutrient information was recorded from labels and values converted to per 100 grams and included in the food composition table.

In March 2017, another market survey was conducted in order to capture cost information on non-commercial snack foods/beverages that were commonly fed to the survey sample of children. These included: fruits, milk, grains, legumes/nuts, and eggs. This survey was conducted during quantitative survey data collection to ensure that costs were recorded within the same season as when dietary data were collected. To collect weight/price information for these foods, interviewers and nurses involved in the survey data collection were each given a list of these non-commercial foods/beverages and instructed to visit stores/vendors near their home commonly frequented by child caregivers. They then collected information (price per weight) on as many of the foods as available. In total, market data was collected from 11 neighbourhoods across Kathmandu Valley, covering all 3 districts. Costs per 100 edible grams and per 100 kcal for each food were calculated.

Finally, in May 2017, any additional commercial food/beverage products consumed by children who participated in the survey that were not captured in the September 2016 market survey were purposively sampled for information on weight/price, and the costs per 100 edible grams and per 100 kcal calculated, and label nutrient content

information added to the food composition table. To aid logistics of data collection, these two different time points were used for collecting cost data for commercial snack foods/beverages commonly consumed and it was assumed that costs would remain stable over the six month period.

Biochemical measurements

Biochemical measures were collected and analysed to assess children's iron status, including: haemoglobin, serum ferritin, and soluble transferrin receptor (sTfR). Trained phlebotomists measured children's haemoglobin on-site using HemoCue 201+. Children with concentration levels less than 11.0 g/dL were classified as anaemic: mild anaemia as < 11.0 g/dL - ≥ 10.0 g/dL; moderate as < 10.0 g/dL - ≥ 7.0 g/dL and severe as < 7.0 g/dL.[107] As haemoglobin concentration can be affected by altitude, elevation was measured at each municipality ward and used to adjust haemoglobin during analysis.[107] In total, haemoglobin was measured for 725 children, with 20 caregivers declining anaemia testing for their child. Serum ferritin and sTfR was also measured to identify iron deficiency. Serum ferritin level is a biochemical indicator of total body iron stores in an individual; low levels indicate depletion of these iron stores, which is a precursor for iron deficiency. During early stages in the development of iron deficiency, an increase in the level of sTfR will occur as the supply of iron to the body becomes more deficient. Serum ferritin levels below 12 μg/L and sTfR levels greater than 8.3 mg/L were used to indicate iron deficiency in a child.[107] As concentrations of serum ferritin can be altered in the presence of infection and even among children that appear healthy,[108] concentrations of two acute phase proteins – C-reactive protein (CRP) and α-1 acid glycoprotein (AGP) – were measured to adjust for presence of inflammation in children.[109]

150 μL of capillary whole blood were collected from each child by trained phlebotomists; the protocol for blood sample collection can be found in Appendix 5. Blood samples were kept in a cold-box and transported to a Kathmandu Valley laboratory within two hours of collection. At the lab, samples were processed to separate serum and stored at -20° C. At the end of data collection, serum samples

were shipped and analysed at the VitMin lab of Dr. Juergen Erhardt in Germany using the sandwich enzyme-linked immunosorbent assay (ELISA) method.[110]

Anthropometric measurements

Height/length and weight of children and mothers were measured by two trained nurses using standardized procedures[111] with length/height boards (Shorr boards) and SECA scales (model 878U; ± 0·1kg precision). Two repeated measures for height/length and weight were taken in serial, entered and averaged in analysis. If the two measures of height/length differed by more than 0.5cm or if weight measures differ by more than 0.5kg, these measurements were discarded, and the two serial measurements were taken again. The protocol for anthropometric measurement can be found in Appendix 6.

Recruitment and training of field team

Interviewer and nurse candidates were recruited through website and social media sites and selected based on the following criteria: 1) bachelor's or masters' in a health/nutrition/nursing; 2) prior survey experience and 3) prior experience in health/nutrition programs. After candidates were short-listed, in-person hiring interviews were conducted, which included assessment of 1) interviewing skills, 2) numeracy skills, 3) English language skills, 4) attitude/personality and 5) ability to participate in the full schedule of training and data collection. Two phlebotomists with prior experience in paediatric blood sample collection and three nurses with prior experience in anthropometric measurements for population-based surveys were also selected. Interviewer candidates were selected to conduct caregiver interviews and 24HR, and nurse candidates were selected to conduct anthropometric measurements and assist blood sample collection. In addition to leading blood sample collection, phlebotomists served as assistants to nurses for anthropometric measurements.

A training of interviewers, nurses, and phlebotomists was held for two weeks in early February 2017. All participants were informed about the study's objectives,

background and design, as well as their expected roles, responsibilities, and ethics. For the interviewers, the first week involved classroom-based training on the structured interview questionnaire and 24HR methodology, along with case studies and practical exercises. The second week was devoted to in-field practice. This practice was conducted in municipality wards that were not sampled for the survey. For nurses and phlebotomists, the first week also involved classroom-based training and practical exercises, with the second week involving anthropometric standardization, following WHO methods for assessing technical error measurement (TEM).[112] For the TEM assessment, 9 mothers and their children 12-23 months of age were measured for height/length and weight by the three nurses being evaluated. Each nurse conducted measurements twice in serial, with the first measurements of a child rotated across the nurses to avoid bias from children becoming fussier over time. An anthropometric expert-measurer also took measurements for comparison; this measurer was from a local research firm and is responsible for trainings during large-scale surveys with anthropometric measurements (i.e. DHS, MICS). The criterion for precision among the nurses being evaluated was a TEM below 1.5 times the expert-measurer's TEM (0.65) for child length and below twice the expert-measurer's TEM (0.20) for mother height. All nurses demonstrated a TEM of <0.65 for child length (range: 0.27 – 0.50) and <0.20 for mother height (range: 0.16 – 0.19). All nurses were also within twice the expert-measurer's TEM for both child weight (0.12) and mother weight (0.16). Post-training and prior to data collection, the entire field team had two days of 'dress rehearsal' with mothers of children 12-23 months of age living in municipality wards that were not included in the survey sample.

Management of questionnaire data

Stata 15 was used to clean, code, and analyse all data. Data from structured interviews were collected electronically on Samsung tablets using the open-source online platform Ona and Open Data Kit (ODK) application. Each day completed questionnaires were submitted to the Ona platform and the database downloaded and stored securely. Programmed skip patterns and constraints limited the potential

of interviewer error, but data checks were run weekly to ensure data quality. These checks included cross-checking coding of household member information (sex and education level), cluster codes, and other data inconsistencies. At the end of data collection, the data were cleaned, and open-response entries were translated from Nepali to English.

Management of dietary data

Dietary data from the 24-HRs were collected on paper forms that were thoroughly reviewed by a supervisor immediately after the interview so that corrections or clarifications from caregivers could be obtained. Data from the paper dietary forms was then entered into an Excel spreadsheet, which calculated the quantities consumed for each food/beverage in food model form. Ten percent of dietary data were cross-checked against paper forms by a trained HKI colleague to determine if data entry errors occurred, which were determined to be low. Conversion factors were developed to convert quantities captured in food models to raw weights of foods/beverages consumed. For this process, foods/beverages consumed among children in the survey were sourced within Kathmandu Valley and repeated volume/weight measurements taken for actual foods and their corresponding food models to arrive at a ratio of densities (see Appendix 7). Individual recipes were collected for all 745 children participating in the survey. In cases where the primary caregivers interviewed had not been present at the time of food preparation/feeding and individual recipes or portion sizes were not able to be collected, average recipes/portion sizes were estimated from the recipe data from the survey population.

A food composition table (FCT) was compiled specifically for this study, following procedures from Food and Agriculture Organization's (FAO) International Network of Food Data Systems (INFOODS). A list of foods that were anticipated to be consumed by children 12-23 months of age in urban Nepal was developed based on review of food composition tables from prior dietary surveys[113] and consultation with local experts. Energy and nutrient values per 100g of each food/beverage in this

list was then compiled from a combination of contextually relevant and/or reliable published food composition tables, including (in order of hierarchy for use): the Food Composition Table for Bangladesh;[114] the United States Department of Agriculture National Nutrient Database for Standard Reference (USDA SR28);[115] the 2015 McCance and Widdowson Composition of Foods Integrated Databases;[116] the Association of Southeast Asian Nations (ASEAN) Food Composition Database;[117] and the Food Composition Database for Nepal.[118] To account for nutrient losses due to cooking, retention factors were applied as appropriate.[114,119] Entries were also included for any packaged foods consumed by children in the survey; nutrient information was recorded from labels where possible, and values imputed from similar products in either the USDA SR28 or McCance and Widdowson FCT were gaps remained. Fifteen of the most commonly consumed packaged food products were sent to Mahidol University in Bangkok, Thailand for content analysis of energy and several nutrients (Ca, Fe, Zn, Na, total fat, total sugar, carbohydrate, and protein) and these analysed values were included in the food composition table. These products included: 3 infant cereals, 4 biscuits, 2 chocolates, 2 instant noodles, 2 savoury snacks (i.e. cheeseballs or crisps), and 2 SSB – analysed values can be found in Appendix 8.

Variable creation

Below is a description of the variables generated for analysis in this thesis. Description of covariates used in analysis can be found in relevant chapters.

Primary exposure variable: terciles of USFB consumption

Definitions of snacks used in research and guidelines are wide-ranging, and most common definitions are based on food type, portion size, or time of consumption.[120,121] Given that the objective of this thesis was to explore the nutritional implications of snack food/beverages consumption, *a priori* categorization of specific foods as snacks was used as a definition, rather than defining a snack based on time of consumption or portion size of a food consumed. The reasoning for this decision being that the nutritional quality of specific foods are hypothesized to

influence nutritional status more than portion size or timing of consumption. Formative research for survey methods further confirmed that portion size and timing were less appropriate for this context and age group, as portion sizes for meals versus snacks did not differ greatly among young children in Nepal and timing of meal patterns was not consistent.

To create a category of USFB, food types were first categorized as snack foods/beverages and these foods were then nutrient profiled to identify those that were unhealthy. Categorized snack foods and beverages included foods/beverages identified as snacks for young children in prior research,[70,122,123] including: biscuits, chocolates/candy, bakery items, savoury chips/crisps, and SSB (e.g. soft drinks, juice drinks). Additional Nepal-specific snack foods identified through the formative research described above were also included in this category: milk, chocolate/malt-powder based drinks, tea, fruits, eggs, breakfast cereals, commercial infant cereal, *jaulo* (porridge made of rice and legumes), and homemade *lito* (infant cereal made of grains/legumes flour). Within this overall category of snack foods or beverages, foods were then sub-categorized as 'unhealthy' or 'healthy' using a nutrient profiling model from the United Kingdom's Food Standards Agency (UK FSA),[124] which was developed to guide regulation on marketing of unhealthy foods to children. The UK FSA model evaluates the presence and degree of 'negative' nutrients (energy, total sugar, saturated fat, and sodium per 100g)[125] and 'positive' nutrients (fibre and protein per 100g, and % fruit/vegetable/nut) to categorize foods as unhealthy or healthy. For powdered products requiring reconstitution, the nutrient profile score was calculated per 100g of reconstituted product. Two snack food/beverages that were categorized as 'unhealthy' – whole fat milk and egg yolk - were excluded from this category based on global feeding recommendations of animal-source foods for children below two years of age.[126] Details on the types of foods categorized as healthy or unhealthy can be found in Chapter 5.

Terciles of USFB consumption – low/moderate/high consumption - were created based on the proportion of total energy from non-breastmilk foods (% TEI-NBF) contributed by snack foods/beverages identified as 'unhealthy' (i.e. USFB). Total

energy intakes from non-breastmilk foods were calculated based on intake of all foods and beverages reported by caregivers during the 24HR.

Primary nutritional outcomes

Dietary: Dietary outcomes of interest were 1) total intakes of energy and nutrients from non-breastmilk foods and 2) dietary inadequacy based on the percentage of children at risk of inadequate intakes of nutrients from both complementary foods and estimated intakes of breastmilk. Energy and nutrient intakes were calculated using 24HR data and the compiled FCT. To evaluate dietary inadequacy, estimated usual intake distributions adjusted for within-person variability[127] were generated for 12 nutrients (protein, Ca, Fe, Zn, vitamins A, C, B1, B2, niacin, B6, B12, and folate) using PC Software for Intake Distribution Estimation (PC-SIDE).[128] This software uses sub-sample repeated measures of dietary intakes to adjust usual intake distributions by reducing day-to-day variability,[129] thereby reducing variance of the distribution. Estimated nutrient contributions from breastmilk for breastfed children were included in this analysis.[68] An estimate of breastmilk intake was calculated by subtracting the median energy intake from non-breastmilk foods from the total energy required for a child equal to the average child weight in our sample (i.e. average child weight was 9.7kg which has an energy requirement of 800kcal; median energy intake for a breastfed child was 595 kcal and so an estimated intake of 205 kcal was assumed for breastmilk). This quantity in energy was converted to grams (293g), and nutrients per this weight were added to nutrient intakes for all breastfed children. The proportions of children at risk of inadequate intakes were evaluated by assessing the percent of children with intakes below the Estimated Average Requirement (EAR) for all nutrients, with the exception of iron, which was assessed with the full probability approach.[127] Based on the dietary patterns of children in this study, whereby the diet is predominantly rice and legumes with limited intakes of meat, a low bioavailability of iron and zinc was assumed.

Iron status: The biochemical outcomes were haemoglobin, sTfR, and serum ferritin. Haemoglobin was adjusted for elevation[130] and serum ferritin was adjusted for

inflammation using CRP and AGP.[131] A haemoglobin concentration less than 11.0 g/dL was categorized as anaemia.[107] Iron deficiency anaemia (IDA) was defined as the presence of anaemia, alongside either low serum ferritin concentration (<12 μg/L) or elevated sTfR concentrations (>8.3 mg/L).[107]

Anthropometric status: The anthropometric outcomes were LAZ and WLZ, which were calculated using the WHO growth standards.[132] Stunting was defined as LAZ <-2SD, wasting as WLZ<-2 SD, and overweight/obese as WLZ>2 SD.

Data analysis

Proportions and means ± (SD) were calculated to describe the sample and USFB consumption patterns, and medians with interquartile ranges (IQR) calculated for non-normally distributed data. For bivariate analyses, two-sided Pearson's chi-square tests were used to test differences in proportions, independent sample t-tests or analysis of variance (ANOVA) for differences in means, and Kruskal-Wallis test for differences in medians. Non-normally distributed outcome data were log transformed prior to analysis. When exploring factors associated with high USFB consumption, odds ratios and 95% CI were calculated using ordinal logistic regression for bivariate and multivariable analyses with cluster adjustment. Comparisons of nutrient intakes between USFB terciles were made using cluster-adjusted ANOVA models, and Bonferroni post-hoc tests to identify specific differences between low and high USFB consumption terciles. Inter-group comparisons (low and high USFB consumers) of the percentage at risk of inadequate nutrient intakes were made using Pearson's chi-squared test. The relationships between consumption of USFB and outcomes related to iron and anthropometric status were explored using linear regression for continuous outcomes and logistic regression for binary outcomes, using random effects to account for cluster sampling. Final fit of the adjusted model was assessed using manual backward selection and Akaike information criterion (AIC). Variance inflation factors (VIF) were used to explore collinearity of covariates in the adjusted models.

Ethical considerations

Ethical approvals for this study were granted by LSHTM (ref 11719) and the Nepal Health Research Council (NHRC). An amendment for the final survey tool after changes based on pre-testing was also approved by LSHTM. All approval letters can be found in Appendix 9.

Written informed consent was obtained from all caregivers prior to participation in the study, with the informed consent form read aloud to all participants in case of low literacy. Caregivers' participation was fully voluntary and all were able to opt out at any point or from any component of the study. Confidentiality of participants was ensured; recruitment forms with contact details for participants were kept in a locked drawer in the HKI office during data collection and destroyed after data collection, and no identifying information was recorded in questionnaires during structured interviews.

Chapter 4: Perceptions of commercial snack food and beverages for infant and young child feeding: a mixed-methods study among caregivers in Kathmandu Valley, Nepal

ABSTRACT

Ensuring nutritious complementary feeding is vital for child nutrition. Prior research in Kathmandu Valley found high consumption rates of commercially produced snack foods among young children, which are often energy-dense/nutrient-poor. This mixed-methods study was conducted to elicit Nepali caregivers' perceptions of commercial snack foods and beverages and factors influencing their use for young child feeding. Seven facilitated FGD were conducted with Kathmandu Valley caregivers of children 12-23 months and a survey of 745 primary caregivers of children 12-23 months of age was then conducted. During the FGD, caregivers reported commonly providing commercial food and beverage products to their children as snacks and 98.6% of caregivers participating in the survey reported feeding their child such a food in the previous week. Because of processing and packaging, snack foods were not trusted by many FGD participants and considered as 'junk foods' and not healthy for children. However, commercial snack foods were consistently ranked highly on convenience, both because of minimal preparation and ease of feeding; 48.5% of all surveyed caregivers reported providing a snack food because of convenience. Other family members' diets or provision of snack foods as treats also influenced children's consumption of these snack foods and beverages. This study indicates that caregivers of young children prefer snack options that are nutrient-rich, however, this may conflict with preferences for foods that require minimal preparation and are appealing to young children. Such findings carry programmatic implications for interventions aiming to address children's diet quality in urban Nepal.

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First Name(s)	Alissa Madeline		
Surname/Family Name	Pries		
Thesis Title	Snacks and nutrition during the complementary feeding period: a cross-sectional study among children 12-23 months of age in Kathmandu Valley, Nepal		
Primary Supervisor	Elaine Ferguson		

If the Research Paper has previously been published please complete Section B, if not please move to Section C.

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Stage of publication	**In press**

SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	A.P. developed the research objectives, study design, qualitative and quantitative tools, managed data collection, conducted quantitative data analysis, and drafted the paper with feedback from all co-authors. N.S. facilitated the focus group discussions, and managed, analyzed the qualitative data with feedback from A.P., and drafted the write up for the qualitative results.

SECTION E

Student Signature	
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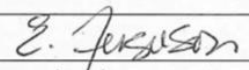
Supervisor Signature	
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INTRODUCTION

A 'nutrition transition' has been identified in many low and middle income countries (LMIC), with diets increasing in added sugars, fats and refined carbohydrates.[5] Among children living in countries experiencing such dietary transitions, there has been marked growth in consumption of processed foods, including commercially produced snack food and beverage products.[16–18,133,134]

Despite improvements in the nutritional status of children in Nepal, stunting among children under five years of age remains high at 36% and wasting at 10% nationally, and 32% and 9% in urban areas.[59] Snack food consumption is prevalent among young children in Nepal, particularly in urban areas.[133] A survey among Kathmandu Valley children 6-23 months of age found that 57% and 43% had consumed commercially produced biscuits/cookies and sweets/candy, respectively, in the day prior to interview and the proportion of children consuming snack foods was higher than those consuming dark green leafy vegetables (35%), orange-fleshed fruits (1%) and vegetables (8%), or eggs (24%).[19]

These consumption patterns are cause for concern; often, snack food products are energy-dense and micronutrient-poor. [3,22–24] Exposure to foods early in life has also been shown to establish dietary preferences that remain throughout childhood and into adulthood,[47,48] potentially establishing unhealthy eating patterns and increasing risk of overnutrition and related chronic disease later in life. Over one-quarter of women in urban Nepal are overweight/obese[59] and overnutrition affects 40 million children globally, with the majority of these children living in LMIC.[58] In a context such as urban Nepal, understanding the drivers behind caregivers' decisions to use commercial snack foods and beverages for young child feeding could lead to insights on how to mitigate increasing consumption rates and to prevent overweight/obesity in adulthood. This study assessed a sample of Kathmandu Valley caregivers' perceptions of commercial snack foods and beverages and elucidated factors that influence their use for child feeding.

METHODS

A mixed-methods design was used for this study; a qualitative component involved FGD and participatory exercises, and a quantitative component involved a structured interview during a survey. The qualitative component was conducted first in November 2016 in order to inform survey tool deign and methods, which was then conducted February – April 2017.

FGD AND PARTICIPATORY EXERCISES

Seven facilitated group discussions, including participatory exercises, among caregivers of children 12-23 months of age were conducted to elicit caregivers' perceptions of commercial snack foods and beverages and factors influencing their use for IYCF. Thirty-two caregivers of children 12-23 months of age were purposively sampled from areas of Kathmandu Valley anticipated to have populations of varying SES. Discussion groups were stratified by three caregiver types: 1) non-working mothers 2) working (paid employment) mothers, and 3) grandmothers. Participants were purposively recruited with the assistance of FCHV in each location who were able to identify caregivers with a child 12-23 months of age.

Tool and process for group discussions and exercises

Group discussions were led by a facilitator and were conducted in a private space and audio-recorded. The process began with a discussion on child feeding, covering the foods fed to children and caregivers' considerations around these food choices. This led into a guided discussion on *khaja* (the Nepali word for 'snack') and caregivers' definitions of snacks and snacking, followed by a series of guided participatory exercises based on behaviour-centered design methods,[135] including: free-listing of all foods fed to young children as snacks, categorization of foods into groups based on perceived similarities, and ranking based on continuums of: health, child preference, convenience, and cost. A discussion guide was used by the facilitator; this tool and the methods were pre-tested prior to data collection to ensure participant understanding.

The audio-recorded group discussions were transcribed verbatim and translated from Nepali to English. Each transcript was checked against the recording to ensure completeness and accuracy of translation. NVivo 11 was used for the analysis of qualitative data. A data driven inductive thematic analysis was conducted following methods outlined by Braun & Clarke,[136] which has been used as a basis for analysis in similar studies seeking to understand caregivers' feeding practices for young children.[137] Transcripts were initially auto-coded based on the questions in the discussion guideline; these were reviewed and three major domains specific to commercial snack foods were identified: 1) use of commercial snack foods and beverages for children, 2) reasons for feeding commercial snack food to the children, and 3) caregiver's perception of commercial snack foods for young children. Within domains, emerging themes were identified and coded; for example, for the domain "reasons for feeding commercial snack food to children", eight themes were identified and under the domain "caregiver's perceptions of commercial snack foods for young children", four themes were identified. The process of coding was led by one researcher on the team and reviewed by another researcher. As the coded data were grouped thematically, a consensus was developed between the two researchers on the themes generated.

QUANTITATIVE SURVEY

A cross-sectional representative survey was conducted among 745 primary caregivers of children 12-23 months of age living in Kathmandu Valley. Primary caregivers were defined as caregivers who typically provided the majority of care to the child in a day. A multi-stage cluster random sampling procedure was used for this survey. Sampling units were based on municipality wards; using ward population estimates from the 2011 Nepal Census,[102] 78 clusters of nine child-caregivers pairs were assigned to these units based on PPS. The final 78 clusters were assigned across 68 municipality wards: eight in Bhaktapur, 42 in Kathmandu and 18 in Lalitpur. Participants in each cluster were sampled 2-3 days prior to scheduled data collection by a trained recruitment team through door-to-door visits for random selection. Caregivers were excluded from participation 1) if the child was severely

ill; 2) if the child/caregiver did not live in Kathmandu Valley; 3) if the child had a congenital/physical malformation that inhibited feeding.

Questionnaire design and data management

Data were collected on demographic and socio-economic characteristics pertaining to the caregiver, household, and child. Children's frequency of consumption of snack foods and beverages in the week prior to interview were also measured using methods adapted from Faber & Benade[18] and which have been previously used in this Nepali context.[19] A module regarding caregivers' decisions to feed commercial snack foods and SSB to their child was developed based on preliminary FGD findings. Caregivers were asked to provide open-ended responses on reasons why they chose to feed specific types of snack foods and beverages to their child in the previous week; responses were captured with pre-coded response options based on themes identified in the FGD, and any additional non pre-coded responses were entered as text. All tools for this survey were translated into Nepali, back-translated, and pre-tested prior to data collection. Data were cleaned and open-response entries were translated from Nepali to English. Reported reasons for providing snack food and beverages to children were coded based on finalized themes emerging from the FGD findings. Wealth quintiles were developed based on principal components analysis using variables related to caregiver SES.[138] Descriptive statistics and Pearson's χ^2 tests were run using Stata 15. Ethical approvals for this study were obtained from LSHTM and NHRC. Written informed consent was obtained from all FGD and quantitative survey participants.

RESULTS

Findings from the qualitative component of this study are first presented; the three identified domains and their themes are detailed below. Findings from the quantitative survey regarding reasons for use of commercial snack foods/beverages are then presented.

QUALITATIVE FGD

1) Use of commercial snack foods and beverages for children

Commercially packaged foods, including beverages like juice drinks and chocolate/malt powder-based drinks and foods like instant noodles, candies, chocolates, savoury snacks, and biscuits, were consistently mentioned as *khaja* (Nepali word for 'snack') for children across all groups, in addition to home-made foods like: *jaulo* (porridge made of rice and lentil), milk, *lito* (porridge made of grains and legumes), *dal bhat* (rice, lentil, vegetables, pickle, meat/fish), boiled eggs, and fruits. For both commercial and non-commercial foods, several caregivers reported minimal differences in foods fed as *khana* (Nepali word for the 'main meals') and *khaja* for young children; *lito, jaulo,* and *dal bhat* were given as both meals and snacks to young children. Caregivers noted that foods fed as *khaja* began to differ as children grew up, with one difference being the introduction of commercial foods. Home-made foods were more suitable for young children as these foods were soft, while commercial snack foods, like instant noodles, were harder and considered more appropriate for older children: *"While they are young they eat home-made food, they may like market foods when they grow up."* (Mother, mid/high SES)

2) Reasons for feeding commercial snack foods to young children

Factors influencing caregivers' decisions to use commercial foods products for young child feeding were voiced throughout FGD. These reasons are detailed here:

- <u>Child likes it:</u> All caregivers reported being motivated by a child's food preferences, and reported opting to feed commercial snack food and beverages because these foods were most liked by children: *"(He) eats biscuit, I give (him) whatever he prefers."* (Grandmother, mid SES)

- <u>Lack of time:</u> Caregivers reported using commercial snack foods when they did not have time to prepare home-made foods. This occurred particularly when caregivers were rushing to go somewhere or when they were working (inside or

outside the home). Commercial foods, like biscuits, were easy for them to give to their children at such busy times*: "When I can't make time, I give such foods*." (Mother, working, mid/high SES) /*"Sometimes I do not have time to prepare and give food due to household work, so I give that for convenience."* (Mother, low SES)

- Other adults provide as a gift/treat: Grandmothers in particular reported that they do not often provide commercial snack foods to their child, but rather other household members, neighbors, or visitors/guests provide them: *"I try to avoid it (cheeseballs) as much as possible but sometimes others buy it for the child."* (Grandmother, mid SES) /*"Child happily accepts it, they (visitors) wonder what should they buy for the child and then buy a packet of cheese balls for one hand and a chocolate for another."* (Grandmother, mid SES)

- Child demand: Caregivers reported that children demand or cry for commercial snack foods: *"Sometimes (he) quarrels and asks and I give (cheeseballs and noodles), sometimes juice drinks."* (Mother, low SES). Several caregivers reported these demands often occurred when they were outside the home: "*It is a problem when I am out with my child. (He) will not move a step unless I buy it and at the end I have to buy. My child sees those things hanging in the shops."* (Mother, working, mid/high SES)

- Influence of older children: Some caregivers reported that their children demand commercial snack foods when they saw older children eating them or if the older child shared them with the younger: *"They want to eat junk foods like cheese balls, chips when they see older children eating."* (Mother, working, mid/high SES) /*"We share the same social environment with others and the child sees other children having it."* (Mother, working, mid/high SES)

- Easy to feed: Caregivers noted commercial snack foods were easy to feed their children: *"When we make lito or jaulo we have to coax the child to feed, either play a song or walk around (with them). But for these foods (commercial snack food) we don't*

have to coax them, they easily eat it." (Mother, working, mid/high SES)

- Alternative when child will not eat anything: Several caregivers reported feeding commercial snack foods when their child refused to eat any other food. Additionally, some noted that when a child was not eating anything they provided commercial snack foods in the hope it would increase their appetite: *"Sometimes (he/she) doesn't eat when I give any food, so I try giving market foods to see if the child eats*" (Mother, low SES) /*"Usually the child wants it (chocolate). Instead of keeping him hungry, I give it to my child. It's an option when the child is not eating anything."* (Mother, working, mid/high SES)

- To distract or pacify children: Caregivers of all types and SES reported feeding commercial snack foods to their children in order to keep them occupied or pacify them when they were fussy/crying: *"Chips are only to distract them when they cry or quarrel."* (Mother, mid/high SES) / *"Child troubles (me), that's why we give (juice drinks)."* (Grandmother, mid SES)

3) Caregivers' perception of commercial snack foods for young children

- Perceived child preference for commercial snack foods and beverages

Snack food and beverage products were perceived as highly liked by young children. Caregivers interpreted their children's preference for certain foods based on facial expressions and if they showed interest in a particular food: *"My child does drink the juice, and will finish one whole packet of litchi juice."* (Mother, mid/high SES). Commercial packaged foods were consistently ranked highly on the child preference continuum. Savoury snack foods, chocolate, and juice drinks were noted as the foods which were eaten most eagerly by children: "*We should place the chocolate at the top, (they) eat it with much pleasure. No matter how much they eat it, they will keep the chocolate in their mouth when given."* (Mother, low SES). Many caregivers noted that children preferred commercial foods to home-made foods, and that feeding commercial foods could reduce a child's appetite or

willingness to eat home-made foods: "*My child doesn't feel like eating rice if she gets cheese ball, Kurkure (a spicy chip), chocolate, and biscuits."* (Mother, low SES) / *"If the child gets these, they would go on eating. Children prefer packaged food over home-cooked ones."* (Mother, working, mid/high SES).

- <u>Perceived unhealthiness and distrust of commercial snack products</u>

  Across all caregiver types and SES, there was agreement that most commercial snack foods and beverages were not considered healthy or nutritious for young children. During ranking exercises, caregivers placed non-commercial foods - milk, egg, meat, ghee, green leafy vegetables, and fruits – as the most healthy and nutritious, while commercial foods – instant noodles, cheeseballs and potato chips, biscuits, juice drinks, and chocolates - were ranked the lowest. Commercial foods were considered to be lacking in nutritional content: *"There is no vitamin in it (noodles)."* (Mother, low SES). Several caregivers spontaneously used the word "junk food" to describe the nutritional quality of commercial snack foods: *"They (juice drinks) have different value, this is junk food."* (Mother, working, mid-high SES).

  Caregivers were wary of what they perceived as unhealthy characteristics of commercial snack foods. Ingredients like monosodium glutamate (MSG) and artificial coloring were considered particularly unhealthy for their children: *"Moong dalmot (savoury snack) is not that good in my experience because it has MSG."* (Mother, working, mid/high SES) / *"They say the seasoning (in noodles) makes the child weak."* (Mother, mid/high SES) /*"They say that we should not give much of it (cheeseballs) to children because of the food coloring."* (Grandmother, mid SES). Caregivers also reported not trusting some commercially packaged foods because they could not see the product/ingredients, and were suspicious of the processing used to manufacture these foods: "*They (commercially packaged foods) are seal packed, there are talks that many inedible things were found in these things, and so I don't feel these are healthy."* (Mother, working, mid/high SES). Additionally,

distrust of manufacturing and expiration dates were reported: *"This one (juice) comes in packets, we don't know when it's made."* (Mother, working, mid/high SES)

However, caregivers reported trusting several brands of commercial products. Horlicks (a malt-powder based drink) and Lactogen (a breastmilk substitute) were perceived as healthy because they were fortified and believed to be manufactured in accordance with a child's nutritional requirement: *"It (Horlicks drink) is nutritious, helps brain and body development."* (Mother, low/mid SES) /*"Milk powder, like Farex and Lactogen, are made according to the child's age, we have to believe these products."* (Mother, working, mid/high SES) Caregivers from low/mid SES perceived Horlicks drink as a high-quality food product that was fed to children by mothers who could afford it.

- <u>Convenience in preparation and feeding of commercial snack foods</u>

  Commercial foods were commonly ranked as the most convenient foods to feed as snacks. Caregivers noted that they were easy to prepare/ready-to-eat: *"Chocolate is very convenient. No need to wash it or slice it."* (Mother, low SES) In particular, the combination of milk and biscuits, commonly fed as a breakfast meal for young children, was considered highly convenient across caregiver types and SES groups: "*To give biscuits is easy, quite easy, just tear the package and give.*" (Mother, working, mid/high SES) /*"No required cooking, just heat the cold milk and put biscuits, and then feed."* (Grandmothers, low/mid SES)

  Caregivers' consideration of convenience was not based solely on ease of food preparation, but also included if a child ate a food easily and if it was easy to feed. In some cases, foods that required greater preparation time were still considered convenient if a child ate them eagerly/easily, such as *dal bhat*. Conversely, though easy to prepare, *lito* was not considered convenient because children did not like it and they fussed during feeding time. Caregivers ranked commercial foods as convenient because they were easy to feed: *"The child eats half of the food (home-cooked food) and throws away half. They eat such things (commercially foods) themselves, 1-year-old child can hold it and eat."* (Mother,

working, mid/high SES). Convenience of snack foods and beverages, both in terms of reduced preparation time and feeding time, was noted across all groups but was particularly emphasized among working mothers.

- Perceived cost of commercial snack foods

  Commercial snack foods were consistently ranked as the least expensive snacks, while fruits, meat, dry fruits, and nuts were considered the most expensive. Caregivers noted that commercial products are available in small packages and are not costly when purchased: *"They are cheap, yes… These ones (commercial snack foods) can be bought in small packets, and in less amount of money. This one (rice) needs to be bought in more quantity, and less money is not enough."* (Mother, working, mid/high SES) Some caregivers felt that costs of commercial food products depended on the quality: *"It depends on the quality and size. Some (chocolate) costs 10 rupees, some 20. Small ones are not of good quality."* (Mother, working, mid/high SES) /*"If we pay higher, we get better quality."* (Mother, working, mid/high SES)

QUANTITATIVE SURVEY RESULTS

The majority (90.3%, n=673) of survey respondents were mothers and 7.1% were grandmothers; male caregivers, such as fathers and grandfathers, were rare. The average caregiver age was 29 years, with a range of 17-74 years. Thirteen percent had no formal education, and 14.9% had attended tertiary level education. Seventeen percent of primary caregivers reported currently working outside the home, with most of these caregivers involved in sales/service industries. Almost all children (98.4%) had consumed a snack food or beverage product in the week prior to interview; frequency of snack food and beverage consumption in the week prior to interview is presented in Table 4.1. Biscuits, candy/chocolates, savoury snacks, and instant noodles were the most commonly consumed, having been eating by 92.1%, 82.8%, 66.0%, and 59.2% of all children, respectively, in the week prior to interview. Juice drinks and malt/chocolate-based drinks were consumed by approximately one-third (38.5%) and one-quarter (23.0%) of children, and soft drinks were the least commonly consumed in the week prior to interview (15.3%).

Table 4.1 Frequency of snack food and beverage consumption in previous week

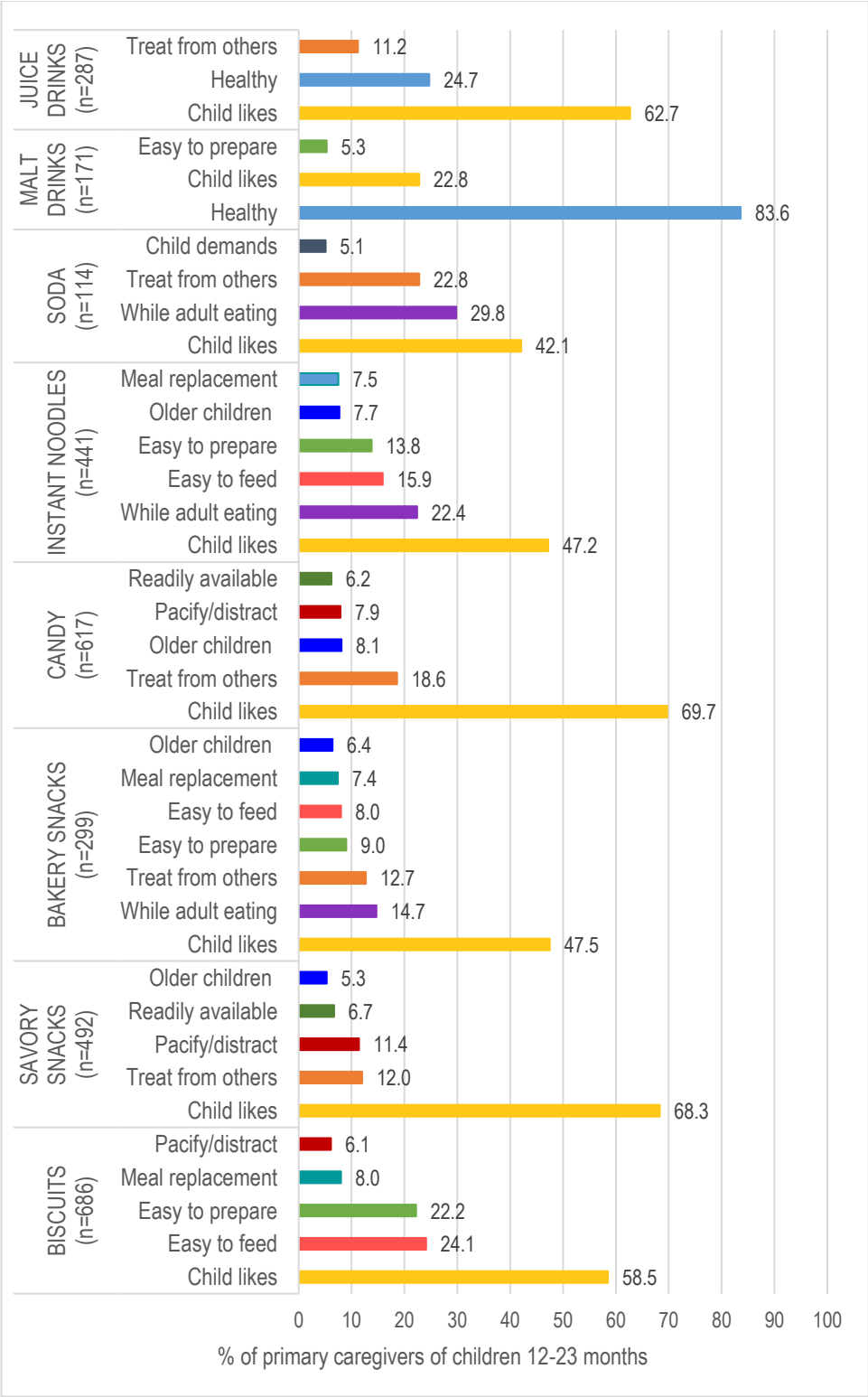
Category of snack food/beverage	%(n)[1]
Biscuits	
Every day	41.7 (311)
Most days (4-6 days)	15.6 (116)
Approximately once a week (1-3 days)	34.8 (259)
No consumption in last week	7.9 (59)
Savoury snacks	
Every day	10.1 (75)
Most days (4-6 days)	12.2 (91)
Approximately once a week (1-3 days)	43.8 (326)
No consumption in last week	33.9 (253)
Bakery snacks	
Every day	2.5 (19)
Most days (4-6 days)	3.1 (23)
Approximately once a week (1-3 days)	34.5 (257)
No consumption in last week	59.9 (446)
Candy/chocolate	
Every day	23.6 (176)
Most days (4-6 days)	15.7 (117)
Approximately once a week (1-3 days)	43.5 (324)
No consumption in last week	17.2 (128)
Instant noodles	
Every day	3.0 (22)
Most days (4-6 days)	4.8 (36)
Approximately once a week (1-3 days)	51.4 (383)
No consumption in last week	40.8 (304)
Soft drink	
Every day	0.3 (2)
Most days (4-6 days)	0.8 (6)
Approximately once a week (1-3 days)	14.2 (106)
No consumption in last week	84.7 (631)
Malt/chocolate drinks	
Every day	12.5 (93)
Most days (4-6 days)	3.0 (22)
Approximately once a week (1-3 days)	7.5 (56)
No consumption in last week	77.0 (574)
Juice drinks	
Every day	2.5 (19)
Most days (4-6 days)	4.2 (31)
Approximately once a week (1-3 days)	31.8 (237)
No consumption in last week	61.5 (458)

[1] N=745

Caregivers' reasons for feeding snack food and beverage products to their child 12-23 months of age in the week prior to interview are presented in Figure 4.1; snack food and beverage products included: biscuits/cookies, candy/chocolates, savoury snacks (potato chips, cheeseballs, etc.), bakery snacks (cakes, muffins, donuts, etc.), instant noodles, soda/fizzy drinks, malt/chocolate powder-based drinks, and juice drinks. Child preference was the most prevalent reason across all categories of snack

foods and beverages, except for malt/chocolate powder-based drinks. Convenience was commonly reported as one reason why caregivers used these foods for young child feeding; half of caregivers who provided a snack food in the previous week (49.3%, n=361) reported doing so because the food was easy to feed or because it was easy to prepare. Biscuits/cookies were the most highly convenient snack food, with nearly a quarter of caregivers that fed biscuits reporting they fed this food because it was easy to feed (24.1%, n=165) or easy to prepare (22.0%, n=151). Many caregivers who described commercial snack foods or beverages as convenient options because their child eagerly ate them/these foods were easy to feed also reported feeding a snack food because the child liked it (p=0.021). Almost one-fifth (18.1%, n=133) of caregivers reported using these foods to pacify or distract an upset child and 15.0% of caregivers fed biscuits/cookies, instant noodles, or bakery snacks as a meal/food alternative for a fussy child who would not eat anything else. Responses that a snack food was fed as a meal replacement/alternative for children who would not eat anything else and responses that these foods were fed to distract or pacify an upset child were also correlated with caregivers' who reported feeding these foods because the child liked it (p=0.013 and p=0.002, respectively).

Figure 4.1 Reported reasons caregivers fed snack foods of beverages, by snack category



Nearly one-third (29.9%, n=219) of caregivers reported feeding snack food or beverage products because they believed they were healthy. This was predominantly driven by snack beverages - 83.6% (n=143) of caregivers who fed malt/chocolate powder-based drinks and 24.7% (n=71) of those who fed juice drinks

in the last week reported doing so because they thought it was healthy and/or good for the child's development. The presence/influence of others was commonly reported as a reason why the child ate the snack food or beverage; 32.1% (n=235) of all snacks were fed as a treat from a neighbour or guest, with candy/chocolates the most common snack provided as a treat. Several foods, including instant noodles, soda/soft drinks, and bakery snacks, were commonly fed to the child when either the caregiver, or another adult/relative, was eating the food themselves. Only 7 (1.0%) caregivers who fed snack foods or beverages to their child reported cost as a reason for doing so.

Reasons for using snack foods or beverages were compared between caregiver types and between wealth status groups based on differences noted during FGD. While grandmothers participating in FGD more commonly reported that snack foods were fed as a treat by other adults, there was no difference in the proportion of surveyed grandmothers reporting that their child ate snack food or beverage because it was fed as a treat, as compared to mothers (25.0% versus 33.0%; p=0.234). Surveyed grandmothers were more likely than mothers to provide a snack food or beverage to their child as a meal replacement/food alterative when the child would not eat anything else (26.9% vs. 13.9%, p=0.011). Surveyed mothers were more likely than grandmothers to report that their child ate a snack food or beverage because they were influenced by an older child/sibling (18.7% vs. 7.7%, p=0.046). The proportion of caregivers currently working outside the home who reported feeding snack foods or beverages to their child because these foods were convenient in terms of preparation time, compared to caregivers who were not currently working, approached significance (p=0.067). Nearly all (97.1%) of the poorest caregivers who fed a malt/chocolate power-based beverage to their child in the previous week reported doing so because they believed it was healthy/good for development, as compared to 71.4% of the wealthiest caregivers who fed such a beverage in the previous week (p=0.060).

DISCUSSION

This study explored caregivers' use of snack food and beverage products for young child feeding, their perceptions of these foods, and reasons for choosing such foods for their children. Feeding of snack food and beverages to young children 12-23 months of age was highly prevalent among caregivers participating in this study, with almost all surveyed children having consumed such a food in the week prior to interview and all FGD generating such foods in free-listing of snacks fed to children. The driving factors for use of snack food products were child preference, perceived convenience in terms of preparation and feeding, provision of these foods as treats, influence of other household members, and perceived healthiness of certain foods. The low cost of these foods was not found to be a motivating factor.

The influence of child preference on caregivers' use of snack food products for child feeding has been noted widely in literature across geographies.[19,76,134,139–146] Child preference was the most common reason reported by caregivers in this study, however, this response may serve as an initial catch-all response. It is probable that the reason 'the child likes it' is coupled with another motivating factor for caregivers, illustrated by the correlations found between this response and responses related to convenience in child feeding and feeding to pacify/distract a child. These correlations in responses may indicate that while caregivers are selecting these foods because of child preference, this preference aids another underlying motivation for the caregiver. Young child feeding that follows children's cues for certain foods, either feeding whatever is easily eaten without fuss or that which a child demands, has been noted in other studies. Chaidez et al.[147] found that mothers of toddlers in Mexico often followed their child's cues for food preference and fed whatever the child wanted, reporting that they did not want to see the child cry, and mothers in Egypt provided crisps, cakes and fizzy drinks when a child refused to eat family foods and reported that these foods had a calming effect on fussy children.[76]

The use of snack food and beverage products for non-nutritive feeding (the provision of food for reasons other than health/development, such as feeding for behaviour management) among Kathmandu Valley caregivers is potentially concerning. When

used routinely, such approaches to child feeding have been shown to result in diets that are more likely to deviate from dietary recommendations, greater consumption of SSB and processed foods, and reduced consumption of healthier options like fruits and vegetables.[148–151] One US study found that when using food to manage a child's behaviour, mothers of pre-schoolers reported that they paid less attention to the nutritional content of foods.[152] Additionally, exposure to certain tastes during infancy and early childhood have been shown to establish preferences.[153] Many snack food and beverage products are high in sugar or sodium content and formulated to be palatable, thereby, potentially setting a path for less healthy dietary preferences throughout life.[47] The mechanisms by which feeding behaviours influence nutritional outcomes in children, not only in terms of food choices by mothers but also the interaction of feeding practices themselves, merits further exploration in LMIC settings. Feeding practices that indulge child demand/preferences can encourage excess energy intake and weight gain among infants,[154] with several studies showing that 'feeding to soothe' can result in inappropriate feeding practices.[155,156]

The influence of convenience on use of commercial food and beverage products has been previously noted by caregivers in Nepal[19] and South Asia.[145,157] Across both FGD and survey interviews, caregivers commonly reported providing biscuits as a breakfast meal because they were quick to prepare and their children ate them easily, saving time in both tasks. Ultra-processed foods are manufactured as ready-to-eat, intentionally highly convenient, and sometimes referred to as 'convenience foods'.[158,159] However, frequent consumption of such foods has been found to lower the nutritional quality of diets.[87,160,161] In this Kathmandu study, working caregivers reported turning to snack food and beverage products in order to save time on food preparation; a study by Verma & Punia[146] also found that commercial snack foods were preferred among working women because of their perceived convenience and time saving attributes. Literature has indicated that women's high workloads may negatively impact child nutrition in Nepal.[162,163] Further research on use of nutrient-

poor commercial food products among working women would aid further understanding of how this relationship is mediated in a changing food environment.

Family and social context influenced child feeding among caregivers in this study. Children were commonly provided snack food and beverage products when other family members were eating these foods or were provided these foods as a treat from relatives or guests. Similar patterns were found among mothers of toddlers in Mexico, where children were provided tastes of soda or snack foods if another family member was consuming the item and toddlers' older siblings often served as dietary role models.[147] Ventura & Birch[164] argue that social modelling plays an important and influential role in shaping a child's diet. Conversely, many studies have shown that the influence of social modelling can also improve diet quality among children.[165–167] This could therefore serve as a mechanism for reducing snack food and beverage product consumption among young children in Nepal. In addition to providing a positive model for consumption, some influential family members, such as grandmothers,[168] could be leveraged to improve feeding practices of other family members. In this current study, grandmothers reported a preference to avoid commercial snack products, but were also more likely than mothers to provide these foods to fussy children when other foods were rejected. It is therefore important to not only leverage nutritional knowledge, but to also ensure confidence among all types of caregivers in their child feeding skills to facilitate nutritious diets.

Discussions with caregivers revealed a tension between perceived negatives of commercial snack foods (unhealthiness), the positives (highly convenient) and their children's preference and demand for these foods. Caregivers repeatedly ranked most snack food and beverage products as 'least healthy' and categorized 'market foods' as 'junk foods', with the exception of malt-based beverages. However, despite their stated distrust of packaged foods and knowledge that these foods were of minimal nutritional value, caregivers still provided these foods to their children, noting that convenience or the need to feed a fussy child something appealing outweighed their desire to avoid such foods. Some FGD participants were hesitant to rank these foods highly on child preference because mothers and grandmothers

felt they were not good for children. Caregivers reported that they often catered to their child's preferences, even though they considered commercial snack foods to be unhealthy and not nutritious: *"Market food has monosodium glutamate, we should not feed them, but sometimes the child doesn't calm down."* (Mother, low SES) /*"They (commercial snack foods) are not nutritious, we give these foods when the child gets fussy."* (Mother, low SES) /*"The child likes it (savoury snack) and I have to give it. The child wants to eat it, prefers it, so I give."* (Mother, working, mid/high SES). Although caregivers perceived commercial snack food to be convenient and liked by the child, some discussed that the health and nutrition benefits of foods were more important when selecting snacks for their children: *"A packet of cheeseballs can be easy but we have to consider everything. We do consider his choice also. The child's choice, plus nutrition as well is taken into consideration while we feed the child."* (Mother, working, mid/high SES).

Similar results have been noted in prior Kathmandu research, where mothers of children 6-23 months of age reported a taboo against feeding packaged foods for fear they would make their children sick, however, nearly all of these mothers provided a commercially produced snack food to their child in the previous week.[69] In Bangladesh, Rahman et al.[145] found that mothers perceived packaged snack foods as not safe for children, but still reported feeding them because children preferred the taste. Parents often face competing factors when making child-feeding decisions, with convenient and flavourful products serving as a reluctant solution.[140,169] If interventions aim to discourage caregivers from relying on commercial snack food and beverage products, they could consider integrating features of snack food products that appeal to mothers (palatable to children and easy to prepare/ready-to-eat) into high-quality, nutritious food options. It is also important to note that some commercial snacks foods typically high in sugar content, specifically juice drinks and malt/chocolate-based drinks, were considered healthy by some caregivers. This may indicate that while caregivers generally considered market foods to be unhealthy, advertising/packaging of some products may influence Nepali caregivers perceptions, as noted by Menger-Ogle & Graham.[170] Additionally, while caregivers attributed processing characteristics of certain commercial snack foods to be unhealthy, such as additives and colouring agents, no caregivers noted concerns

about high sugar content of these foods. Given the rising rates of diabetes in South Asia[171] and public health concerns regarding high sugar consumption, there is a need to raise awareness on this issue in Nepal.

There are several limitations to this study. As a cross-sectional study, it is not possible to ascertain causality of factors influencing caregivers and their feeding behaviours. While this study indicates use of commercial snack foods and beverages is common among Nepali caregivers, further information is needed on the degree that these foods contribute to child diets and how this contribution influences child nutrition. Additionally, this study was limited to an urban location within Nepal, and while urbanization is occurring rapidly, the majority of the national population resides in rural areas. There is a need for further behavioural research into caregivers' demand for these products to test and identify the cause-effect relationships behind such feeding practices. There is also a need to understand factors influencing IYCF practices of caregivers in rural settings.

To change behaviours, it is necessary to understand the range of factors motivating a behavioural choice. In this study, Kathmandu caregivers were found to hold general knowledge of what is nutritious and not nutritious for their young children, but have stated that they need options which are time-saving and pleasing to their children, and feeding strategies that can address the challenges of young, fussy eaters. Additionally, because social context can influence what children eat, nutritional knowledge among all household members is necessary in order to promote a young child's healthy diet.

Chapter 5: Contribution of USFB to diets of 12-23 month olds in Kathmandu Valley, Nepal

ABSTRACT

USFB consumption among young children has been noted in many LMIC, however, there is a lack of information on the contribution of these foods to children's diets in these contexts. This study describes the nutrient profiles and costs of snacks consumed by young children in Kathmandu Valley, Nepal, and assesses the proportion of total energy intake from non-breastmilk foods (% TEI-NBF) contributed by USFB and factors associated with high USFB consumption. A cross-sectional survey was conducted among 745 randomly sampled primary caregivers of children aged 12-23 months. Of 239 unique snack foods and beverages consumed, 180 (75.3%) were classified as unhealthy based on nutrient profiling, with 158 of these being commercially branded. Median cost/100 kcal of USFB was lower as compared to healthy snacks. Ninety-one percent of children had consumed an USFB in the previous 24 hours, with these foods contributing a mean % TEI-NBF of 24.5±0.7 among all children. Biscuits (10.8%), candy/chocolate (3.5%), and savoury snacks (3.4%) provided the largest % TEI-NBF. Children who were older, female, or from the poorest households had significantly higher odds of high USFB consumption, while children whose caregivers were of upper caste/ethnicity or had achieved tertiary education had lower odds of consumption than other children. To reduce USFB consumption, interventions should seek to further understand social/cultural drivers of feeding practices, target disadvantaged populations, and ensure caregivers are fully aware of the nutritional quality of food products they choose for their children.

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First Name(s)	Alissa Madeline		
Surname/Family Name	Pries		
Thesis Title	Snacks and nutrition during the complementary feeding period: a cross-sectional study among children 12-23 months of age in Kathmandu Valley, Nepal		
Primary Supervisor	Elaine Ferguson		

If the Research Paper has previously been published please complete Section B, if not please move to Section C.

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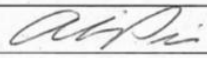
SECTION D – Multi-authored work

For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	A.P. developed the study objectives and research design, with feedback from E.F. S.F. and A.R. A.P. developed the study tools, led interviewer training with support from N.S., and managed data collection with support from N.S. A.P. cleaned and analysed the data, with guidance from A.R. on some statistical analyses. A.P. drafted the paper witih feedback from all co-authors.

SECTION E

Student Signature	
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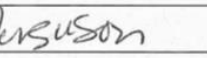
Supervisor Signature	
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INTRODUCTION

Alongside the growing global availability of processed foods, consumption of USFB has become increasingly prevalent in diets of young children in LMIC.[16–18,69] In populations undergoing economic transition, the presence of processed and ultra-processed foods in diets is increasing.[1,5] For young children, the incorporation of ultra-processed foods into diets introduces foods typically high in sodium/sugar/unhealthy fats at an age when taste preferences are being established[47,172] and could potentially displace consumption of more nutrient-dense foods.[88] Despite evidence on the increasing prevalence of these shifting consumption patterns, there is limited evidence from LMIC on the nutrient profiles and cost of these foods, which are often assumed to be energy-dense, nutrient-poor, and inexpensive.[173]

Despite improvements in child health and survival over the past decade, improvement in diet quality among young children in Nepal has been slow. Between 2006 and 2014, the proportion of Nepali children 6-23 months of age achieving MAD only rose from 29.5% to 35.4%,[174] with limited dietary diversity driving these sub-optimal diets in both rural and urban settings.[59] USFB consumption is also highly prevalent among children under two years of age in urban Nepal. A 2014 study in Kathmandu Valley found that three-quarters of children 6-23 months of age had consumed a commercially produced snack food product in the previous day, and snack food product consumption was higher than consumption of many micronutrient-rich foods, including dark green leafy vegetables, orange-fleshed fruits and vegetables, and eggs.[19] Given the low nutrient-density of many complementary foods in LMIC[27] and that nearly two-thirds of children in urban Nepal are not consuming an adequately diverse diet, high consumption of nutrient-poor snack foods and beverages during the developmentally vital complementary feeding period is concerning. However, there is little information on how much USFB are contributing to dietary intakes among young children, both in Nepal specifically and in LMIC globally.[175]

To address these evidence gaps, the aim of this study was to describe characteristics of USFB consumed by children 12-23 months of age in Kathmandu Valley, including their nutrient profiles and costs, and to assess the contribution of USFB to children's energy intakes. Additionally, to build the understanding of factors associated with unhealthy consumption patterns among infants and young children for program design and targeting,[133] this study also investigated characteristics of children and their primary caregivers associated with high consumption of USFB.

METHODS

Study design

A cross-sectional survey was conducted from February – April 2017 among 745 randomly sampled young children and their caregivers in Kathmandu Valley, Nepal. An electronic interviewer-administered questionnaire, a paper-based quantitative multiple-pass 24HR of children's dietary intake, and anthropometric measurements of mothers were collected. Ethical approval for this study was obtained from the NHRC (reference 563) and LSHTM (reference 11719).

Study population and sampling

The populations of interest for this study were children 12-23 months of age in Kathmandu Valley and their primary caregivers. The age range of 12-23 months was chosen to cover the nutritionally important complementary feeding period, focusing on older children whose snack consumption was anticipated to be higher than children 6-11 months.[133] Primary caregivers were defined as caregivers who provided the majority of care to the child in a day and included: mothers, fathers, grandparents, uncles and aunts, siblings, or a household helper. Children were excluded if they were severely ill on the day of interview, if the child/caregiver did not permanently reside in Kathmandu Valley, or if the child had a congenital/physical malformation that inhibited feeding. Sample size estimations for this survey were calculated based on the primary outcomes of interest for the overall study, which were to assess differences in anthropometrics and micronutrient

intakes between high and low consumers of USFB. The calculated sample size for these assessments required a minimum of 702 children.

Children and their caregivers were selected using multi-stage cluster sampling. For the first stage, 78 clusters were assigned across 1,136 Kathmandu Valley municipality wards based on probability proportionate to size of ward population.[102] In total, 68 wards were randomly selected for clusters using a random number generator, with larger wards having more than one cluster assigned. Children and their caregivers in each cluster were recruited 2-3 days prior to scheduled data collection by a trained recruitment team. For each cluster, a random starting GPS point was identified through a sampling grid method[103] using government municipality ward maps provided by the Nepal Survey Department. From the GPS point, the first household to the right when facing north was approached to identify an eligible caregiver/child pair. Children and caregivers were first screened for eligibility and then asked if they would like to participate in the study. If more than one eligible child lived in a household or if a child was from a multiple birth, one child would be randomly selected by a random number generator. Caregivers who agreed to participate were provided information on the study procedure and a pictorial dietary tool to aid accurate recall during interview (detailed below). Eleven to twelve caregiver-child pairs per cluster were recruited, with the assumption that several caregivers/children could be unavailable on the day of interview due to illness, family emergency, or change of mind. In the second stage of sampling, all caregivers were contacted on the day of interview and caregivers who were no longer available or children who were ill were removed from the sampling frame. Between 9-10 child-caregiver pairs per cluster were interviewed; if more than 10 child-caregiver pairs were available in a cluster on the day of data collection, 10 were randomly sampled for interview. Interviews were conducted in caregivers' homes to ensure a comfortable environment and to aid portion size estimation through use of each household's own utensils for the 24HR. Informed written consent was obtained from all caregivers prior to the interview.

Questionnaire, dietary assessment, and anthropometric measurements

Interviewers first administered the questionnaire and then conducted the 24HR, after which caregivers who were mothers were brought to a central location for anthropometric measurements. Data were collected on demographic and socio-economic characteristics pertaining to the caregiver and child, including: caregiver age, educational attainment, parity, asset ownership, caste/ethnic group (including upper castes [e.g. Brahman/Chhetri]; relatively advantaged janajatis [e.g. Newar, Gurung)]; disadvantaged non-dalit Terai caste groups [e.g. Thakur/Yadav]; disadvantaged janajatis [e.g. Magar/Tamang]; and dalits), religion, living conditions, and child age and sex. The questionnaire collected data on additional factors related to child nutrition, including: breastfeeding, food security,[104] and child morbidity in the 24 hours and two weeks prior to interview. The questionnaire was translated into Nepali, back-translated, and pre-tested prior to data collection. Height and weight of mothers were measured by trained nurses using standardized procedures,[111] and calibrated height measuring boards (Shorr Boards) and SECA digital scales (model 878U) with ± 0.1kg precision. Two serial measures for height and weight were taken; if the two measures of height differed by more than 0.5cm or if weight measures differ by more than 0.5kg these results were discarded and two more serial measures taken.

An interactive 4-pass 24HR was conducted with each caregiver to obtain information on all foods/beverages consumed by their child over the previous day,[106] including information on the time of day each food/beverage was consumed and who fed the child. Recalls were conducted on all days of the week/weekend to account for day-of-the-week effect at the group level. Portion sizes were estimated using food models and household utensils, with individual recipes and measurements of all ingredients collected for mixed dishes. Portion size estimations were weighed using digital scales (Tanita Model KD-810) with ± 1g precision. To standardize details collected for foods/beverages and portion size measurements, a probe and portion size guide was developed for interviewers. Caregivers were also asked to recall

brands/flavours of commercial products fed to the child, and interviewers verified responses against product packaging available in the household. Additionally, based on formative research, a pictorial dietary recall-aid was developed for caregivers to reduce recall error. Foods commonly consumed by young children (porridge, eggs, milk, biscuits, savoury snacks, candy, fruits, etc.) were presented pictorially with a grid of times across the day. Caregivers were provided the recall-aid 2-3 days in advance of the interview, and instructed to tick any foods/beverages provided to the child during the day that would be recalled. On the day the interview, the recall-aid was collected by interviewers prior to recall, then reviewed by interviewers after the caregiver recalled all foods/beverages to clarify any recall omissions/inclusions. All tools for the 24HR were pilot-tested among caregivers of children 12-23 months of age during a 2-week period in December 2016; pilot-testing was conducted in municipality wards that were not sampled for the survey to avoid bias.

Three market surveys were conducted in September 2016 and May 2017 (for commercial snack food products) and in March 2017 (for non-commercial snack foods). Collection of costing data for non-commercial foods was conducted during the survey to ensure real-time costs (which could vary during other agricultural seasons), while the cost of commercial food products was assumed to be steady across time. Costs of commercial snack food and beverage products were collected at 15 points-of-sale frequented by caregivers of varying SES across all three districts of Kathmandu Valley, including small corner stores, medium independent stores, and large national chain supermarkets. One sample of each product was also purchased for the nutrient content on labels. Nutrient information for commercial products was extracted from labels, and incorporated in the food composition table used for analysis (detailed below). Costing data for non-commercially produced food/beverages (including fruits, milk, grains, legumes, sugar, and eggs) was collected from 11 local markets across Kathmandu Valley covering all three districts. Costs across stores/markets were averaged for each food/beverage in Nepali rupees (NPR), which were then used to calculate the cost per 100 kilocalories (kcal) for each food/beverage as an appropriate food price metric when considering nutritional

quality of diets.[176] Median costs/100kcal of foods and inter-quartile ranges were calculated for categories of foods/beverages.

Data management

Data from the structured interviews were collected electronically on Samsung tablets using the open-source online platform Ona and ODK application, with completed questionnaires submitted to the Ona platform each night. Dietary data from the 24HR were collected on paper forms and thoroughly reviewed by a supervisor after each interview. Data from the paper dietary forms were then entered into Microsoft Excel, and the quantities consumed for each food/beverage were calculated using food-model conversion factors calculated specifically for this study. These conversion factors were developed to convert food model quantities to estimated raw weights of foods/beverages consumed. An average recipe for each mixed dish was also calculated for use in cases where the primary caregivers interviewed had not been present at the time of food preparation/feeding and individual recipes/portion sizes were not collected for that child.

A FCT was compiled, following guidelines from the FAO INFOODS. This compiled FCT used values from: relevant published FCT,[114–118] from nutrient content information on product labels, and from analysed food samples. Fifteen of the most commonly consumed packaged food products were analysed for energy and nutrient (Ca, Fe, Na, Vitamin A, total fat, sugar, carbohydrate and protein) content. Retention factors were applied to account for micronutrient losses from cooking preparation.[114,119]

As the focus of this study was snack foods, and not the act of snacking, the definition of 'snacks' was based on categorization of specific food types, not time of consumption.[120,121] Snack foods and beverages included foods/beverages commonly referred to in previous literature as snacks, including: biscuits, chocolates/candy, bakery items, savoury chips/crisps, and SSB (soft drinks, juice drinks). Additional Nepal-specific snack foods were identified through formative research, which included milk, chocolate/malt-powder based drinks, tea, fruits, eggs, breakfast cereals, commercial infant cereal, homemade *jaulo* (porridge made of rice and

legumes), and homemade *lito* (infant cereal made of grains/legumes flour). Within this overall category of snack foods or beverages, foods were then sub-categorized as 'unhealthy' or 'healthy' using a nutrient profiling model from the UK FSA,[124] which was developed to guide regulation on marketing of unhealthy foods to children. The UK FSA model evaluates the presence and degree of 'negative' nutrients (energy, total sugar, saturated fat, and sodium per 100g) and 'positive' nutrients (fibre and protein per 100g, and % fruit/vegetable/nut) to categorize foods as unhealthy or healthy.[125] For powdered products requiring reconstitution, the nutrient profile score was calculated per 100g of reconstituted product. Two snack food/beverages that were categorized as 'unhealthy' – whole fat milk and egg yolk - were excluded from this category based on global feeding recommendations of animal-source foods for children below two years of age.[126] Terciles of USFB consumption – low/moderate/high consumption - were created based on the proportion of total energy from non-breastmilk foods (% TEI-NBF) contributed by snack foods/beverages identified as 'unhealthy'. TEI-NBF were calculated based on intake of all foods and beverages reported by caregivers during the 24HR. Whether a child was breastfed or not on the day prior to interview was measured in order to assess breastfeeding status. Quantities of breastmilk intake were not measured and, therefore, total energy intakes reported are based on dietary energy contributions from non-breastmilk foods only.

Statistical analyses

Data were cleaned and analysed using Stata (version 15). Data and open-response entries were translated from Nepali to English for analysis. To create quintiles of wealth, relative household wealth status was assessed using a wealth index developed through principal components analysis, including relevant variables related to SES: asset ownership, household crowding, home ownership, floor/wall/roof material, source of energy for cooking, and source of drinking water.[138] Household food security was assessed based on the Household Food Insecurity Access Scale.[104] Proportions, means ± SD, and medians with IQR for non-normally distributed data were calculated to describe the sample and USFB

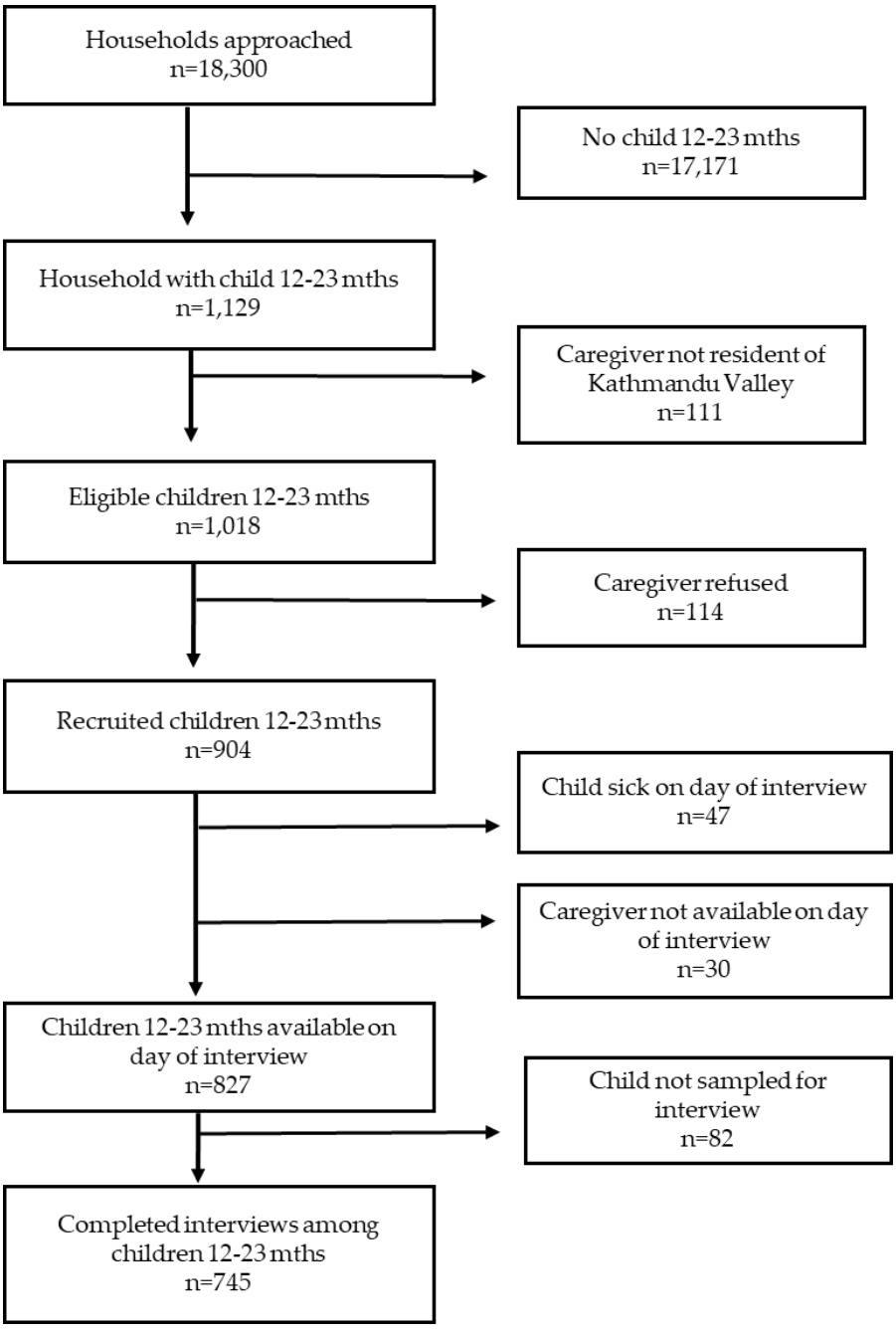
consumption patterns. Two-sided Pearson's chi-square tests were used to test differences in proportions, independent sample *t*-tests or ANOVA for differences in means, and Kruskal-Wallis test for differences in medians. Odds ratios and 95% CI were calculated using ordinal logistic regression for bivariate and multivariable analyses with cluster adjustment. Bivariate analyses explored associations between factors hypothesized to be associated with USFB consumption based on discussions with local experts, prior literature on snack food consumption, and findings from formative research, including: feeding by siblings/secondary caregivers,[177] educational attainment,[19,178] SES,[141] maternal anthropometrics,[179] and child age.[133] Final fit of the adjusted model was assessed using manual backward selection and AIC. To test the appropriateness of an ordinal regression, the assumption of proportional odds for the dependent variable was assessed using the Brant test. This test was non-significant for the overall regression model (p=0.215), indicating the assumption was not violated. One independent variable did violate this assumption; removal of this variable from the model did not change the overall model fit or results, and so was excluded from the final model. Collinearity of independent variables was explored through VIF.

RESULTS

Description of the study population

Results from participant sampling are detailed in Figure 5.1. Of the 904 child-caregiver pairs recruited, 827 were available for interview on the day of data collection; of the 77 children/caregivers who were not available, 47 were because the child was sick and 30 were because the caregiver was no longer available (most commonly due to visiting relatives or attendance at wedding/festival). The final sample included 745 child-caregiver pairs.

Figure 5.1 Participant recruitment, exclusion, and inclusion



Demographic and socio-economic characteristics of caregivers, households, and children are presented in Table 5.1. The majority of caregivers were mothers of the children (90.3%), Hindu (83.4%), and had a mean age of 29 years. Just over half of the children (55.6%) had no siblings, and median household size was 4 members. On

average, USFB contributed 24.5±0.7% TEI-NBF across all children, and on average 5.2±0.3%, 21.5±0.3%, and 46.9±0.9% TEI-NBF among the lowest, moderate, and highest terciles of USFB consumption, respectively. Comparing socio-demographics across terciles of USFB consumption showed significant differences related to caregiver religion, caste/ethnicity, education, and wealth status (Table 5.1). Specifically, as compared to high USFB consumers, a higher proportion of low USFB children had Hindu caregivers (89.2% vs. 76.2%, $p<0.001$), while more high USFB consumers had Buddhist caregivers (17.7% vs. 8.0%, $p=0.003$). Two-thirds of caregivers were of either upper caste/ethnicity or advantaged janajati ethnicity. Both low and moderate USFB consumers were more likely to be from an upper caste/ethnicity as compared to high USFB consumers (49.1% vs. 22.6%, $p<0.001$). More children of caregivers who attended only primary school were high consumers of USFB as compared to low consumers (23.8% vs. 14.1%, $p=0.021$), while more children of caregivers who attended university or post-graduate studies were low USFB consumers as compared to high consumers (24.1% vs. 6.9%, $p<0.001$). Among households in the poorest wealth quintile, a higher proportion of children were high USFB consumers as compared to low (28.6% vs. 11.7%, $p<0.001$), and a higher proportion of children living in food insecure households were high USFB consumers (18.5% vs. 8.8%, $p=0.005$).

Table 5.1 Caregiver, household, and child characteristics, by USFB consumption tercile[1,2]

	Total N=745	Low n=249	Moderate n=248	High n=248
%TEI-NBF[3]	24.5 ± 0.7	5.2 ± 0.3	21.5 ± 0.3	46.9 ± 0.9
CAREGIVER CHARACTERISTICS				
Relationship to child				
Mother	90.3 (673)	86.3 (215)[a]	91.5 (227)[a]	93.2 (231)[b]
Grandmother	7.1 (53)	9.6 (24)	6.9 (17)	4.8 (12)
Other[4]	2.6 (19)	4.0 (10)	1.6 (4)	2.0 (5)
Age (years)				
17-19	2.8 (21)	2.4 (6)	2.0 (5)	4.0 (10)
20-49	92.2 (687)	92.0 (229)	92.3 (229)	92.3 (229)
49-74	5.0 (37)	5.6 (14)	5.7 (14)	3.6 (9)
Religion				
Hindu	83.4 (621)	89.2 (222)[a]	84.7 (210)[a]	76.2 (189)[b]
Buddhist	12.3 (92)	8.0 (20)[a]	11.3 (28)[a,b]	17.7 (44)[b]
Other[5]	4.3 (32)	2.8 (7)	4.0 (10)	6.1 (15)
Ethnic group				
Upper caste	40.3 (300)	58.6 (146)[a]	39.5 (98)[b]	22.6 (56)[c]
Advantaged janajati	26.6 (198)	22.1 (55)	26.2 (65)	31.5 (78)
Disadvantaged janajati	26.2 (195)	15.7 (39)[a]	25.8 (64)[b]	37.1 (92)[c]
Dalit/non-dalit terai caste	7.0 (52)	3.6 (9)	8.5 (21)	8.9 (22)
Caregiver education				
No formal education	12.8 (95)	13.7 (34)	10.5 (26)	14.1 (35)
Primary	20.3 (151)	14.1 (35)[a]	23.0 (57)[b]	23.8 (59)[b]
Secondary	52.1 (388)	48.2 (120)	52.8 (131)	55.2 (137)
Tertiary	14.9 (111)	24.1 (60)[a]	13.7 (34)[b]	6.9 (17)[b]
Paid work in the last month	30.9 (230)	23.3 (58)[a]	36.3 (90)[b]	33.1 (82)[a,b]
Paid work outside the home	16.8 (125)	14.1 (35)	17.7 (44)	18.6 (46)
Maternal nutritional status[6]				
Maternal overweight/obese	42.4 (284)	42.7 (93)	45.1 (101)	39.5 (90)
Maternal underweight	5.5 (37)	6.4 (14)	3.1 (7)	7.0 (16)
HOUSEHOLD CHARACTERISTICS[7]				
District of residence				
Kathmandu	68.2 (508)	75.9 (189)[a]	64.9 (161)[b]	63.7 (158)[b]
Lalitpur	22.1 (165)	16.1 (40)[a]	25.8 (64)[b]	24.6 (61)[a,b]
Bhaktapur	9.7 (72)	8.0 (20)	9.3 (23)	11.7 (29)
Male head of household	69.4 (517)	72.7 (181)	68.6 (170)	66.9 (166)
Migration of household member	20.7 (154)	20.1 (50)	23.0 (57)	19.0 (47)
Food secure household	86.4 (644)	91.2 (227)[a]	86.7 (215)[a,b]	81.5 (202)[b]
Household wealth				
Wealthiest	20.0 (149)	23.3 (58)	21.4 (53)	15.3 (38)
Fourth	20.0 (149)	24.5 (61)	16.9 (42)	18.6 (46)
Middle	20.0 (149)	22.1 (55)	22.2 (55)	15.7 (39)
Second	20.0 (149)	18.5 (46)	19.8 (49)	21.8 (54)
Poorest	20.0 (149)	11.7 (29)[a]	19.8 (49)[a]	28.6 (71)[b]

	Total N=745	Low n=249	Moderate n=248	High n=248
CHILD CHARACTERISTICS				
Age (months)				
12-17	56.1 (418)	69.9 (174)[a]	53.2 (132)[b]	45.2 (112)[b]
18-23	43.9 (327)	30.1 (75)[a]	46.8 (116)[b]	54.8 (136)[b]
Sex, female	47.1 (351)	40.6 (101)	50.8 (126)	50.0 (124)
Sibling living in household	44.4 (331)	41.4 (103)	50.0 (124)	41.9 (104)
Currently breastfed	91.1 (679)	91.2 (227)	89.5 (222)	92.7 (230)
Morbidity				
Illness in last 24 hrs	22.4 (167)	19.3 (48)	23.4 (58)	24.6 (61)
Illness in last 2 weeks	66.0 (492)	65.9 (164)	64.5 (160)	67.7 (168)

[1]Values are percent(n) and mean ± robust standard error
[2]Differing letters (a,b,c) indicate difference between groups at p<0.05 based on ANOVA with Bonferroni post-hoc test
[3]TEI-NBF: total energy intake from non-breastmilk foods
[4]Other caregiver types included: aunt, father, house helper, cousin, and grandfather
[5]Other religions included: Christian, Kirat, and Muslim
[6]Of caregivers who are mother (n=670); overweight/obese = BMI>=25; underweight = BMI<18.5
[7]Household of child

Description of USFB consumption

A total of 239 unique snack foods or beverages were consumed among the children 12-23 months of age, with 180 (75.3%) of these foods or beverages categorized as 'unhealthy' based on nutrient profiling. Biscuits made up a large proportion of snack foods consumed by the children, with 73 unique biscuit products consumed across all children. Of the 180 USFB, 87.8% (n=158) were commercially produced/branded, with the remaining sold by a vendor/shop but not branded. All snacks consumed by the children, healthy and unhealthy, provided on average 54.2% TEI-NBF, with USFB providing nearly half of this contribution to dietary energy intake (24.5% TEI-NBF). The % TEI-NBF by categories of USFB and their prevalence of consumption among all children are detailed in Table 5.2. Though unhealthy snack beverages were consumed by nearly one-third of all children, unhealthy snack foods provided a far greater contribution to TEI-NBF (2.0% vs. 22.5%, respectively). The most commonly consumed categories of unhealthy snack foods were biscuits, candy, and savoury snacks, which also contributed the greatest % TEI-NBF (3-11%). Fruit juice drinks were consumed by less than 10% of all children, but provided the largest % TEI-NBF of all unhealthy snack beverages. Median intakes of saturated fat, sugar, and sodium among all children were 8.7g (IQR: 4.8-14.2g), 28.4g (IQR: 17.2-44.1g), and 250mg

(IQR: 152-407mg), respectively, with USFB providing an average of 30.9% of total saturated fat, 31.1% of total sugar, and 44.9% of total sodium intakes among all children.

Table 5.2 Consumption of USFB and contribution to intakes of energy, sugar, sodium, and saturated fats[1]

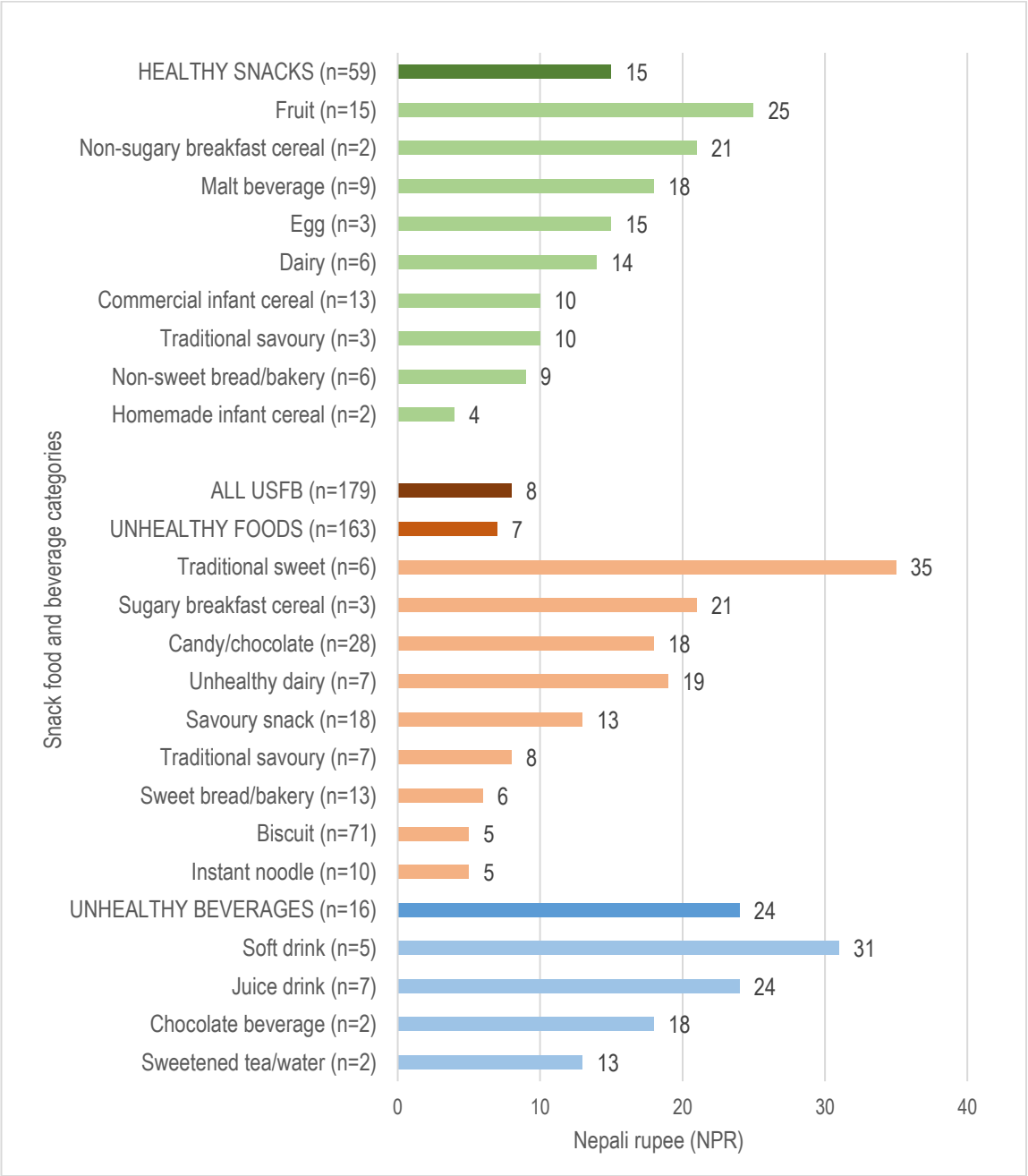
Food categories	Consumption by children	% TEI-NBF[2]	% total sugar	% total sodium	% total saturated fat
ALL USFB	91.0 (678)	24.5 ± 0.7	31.1 ± 1.0	44.9 ± 1.1	30.9 ± 1.0
UNHEALTHY SNACK FOODS	89.7 (668)	22.5 ± 0.7	22.8 ± 0.8	44.3 ± 1.1	30.9 ± 1.0
Biscuits	68.6 (511)	10.8 ± 0.5	10.7 ± 0.5	20.7 ± 0.9	13.1 ± 0.6
Candy/chocolates	55.2 (411)	3.5 ± 0.2	8.5 ± 0.5	1.8 ± 0.2	6.1 ± 0.4
Savoury snacks	39.7 (296)	3.4 ± 0.3	0.7 ± 0.1	10.3 ± 0.7	5.4 ± 0.4
Instant noodles	16.8 (125)	2.2 ± 0.2	0.3 ± 0.05	7.0 ± 0.7	3.1 ± 0.3
Sweet bread/bakery	12.6 (94)	2.0 ± 0.2	1.8 ± 0.3	3.1 ± 0.4	2.5 ± 0.3
Traditional savoury snacks	4.2 (31)	0.2 ± 0.04	0.1 ± 0.03	0.7 ± 0.2	0.2 ± 0.06
Processed dairy[3]	1.7 (13)	0.2 ± 0.09	0.2 ± 0.1	0.2 ± 0.07	0.2 ± 0.09
Sugary breakfast cereal	1.7 (13)	0.1 ± 0.03	0.1 ± 0.03	0.3 ± 0.1	0.1 ± 0.01
Traditional sweet snacks	1.6 (12)	0.1 ± 0.04	0.4 ± 0.2	0.2 ± 0.09	0.2 ± 0.1
UNHEALTHY SNACK BEVERAGES	31.3 (233)	2.0 ± 0.2	8.3 ± 0.6	0.6 ± 0.09	0.0 ± 0.0
Sweetened tea/water	22.0 (164)	0.8 ± 0.08	4.7 ± 0.4	0.1 ± 0.01	0.0 ± 0.0
Fruit juice drinks	8.9 (66)	1.0 ± 0.1	2.9 ± 0.4	0.3 ± 0.06	0.0 ± 0.0
Soft drinks	2.7 (20)	0.1 ± 0.04	0.5 ± 0.1	0.1 ± 0.03	0.0 ± 0.0
Chocolate-powder drinks	1.2 (9)	0.1 ± 0.04	0.2 ± 0.09	0.1 ± 0.05	0.0 ± 0.0

[1]Values presented as n(%) and mean ± robust standard error
[2]TEI-NBF: total energy intake from non-breastmilk foods
[3]Included ice cream and sweetened curd

Consumption of USFB most commonly occurred in the morning (before 10am) and afternoon (between 2-6pm), with 64.8% (n=483) and 66.2% (n=493) of children consuming USFB at these times, respectively. Forty-one percent of children (n=306) consumed an USFB mid-day (10-2pm) and one-quarter (26.4%, n=197) consumed them in the evening (after 6pm). Children were typically fed USFB by their primary caregiver, but 32.6% (n=243) of children were also fed an USFB by a secondary caregiver. The most common secondary caregivers feeding USFB were fathers (9.7%, n=72), grandmothers (8.5%, n=63), siblings (7.8%, n=58), and aunts (7.8%, n=58). There was no significant difference in the proportion of high USFB consumers who were fed any food from secondary caregivers as compared to low USFB consumers (44.8% vs. 37.8%, p=0.286).

Median cost/100kcal of healthy and unhealthy snack foods/beverages are presented in Figure 5.2. The median cost for USFB was 8 NPR/100kcal versus 15 NPR/100kcal for healthy snack foods and beverages ($p<0.001$). Biscuits, which provided the largest % TEI-NBF among all USFB, were the least expensive USFB. The median expenditure per child on total kcal of USFB consumed was 10 NPR, with no difference noted across wealth quintiles ($p=0.247$). There was also no difference in cost/100kcal of USFB consumed across wealth groups ($p=0.060$). The median expenditure per child on total kcal of healthy snack foods/beverages consumed was 22 NPR, with the poorest households spending a median of 13 NPR and the wealthiest households spending 30 NPR ($p<0.001$). Median cost/100kcal of USFB consumed was also significantly higher among the wealthiest households, as compared to the poorest households (14 vs. 12 NPR/100kcal, <0.001).

Figure 5.2 Median cost/100kcal of USFB and health snack foods[1]



[1]One snack (pizza) excluded due to missing costing data; this snack was consumed by one child at one time point

Factors associated with high consumption of USFB

In the adjusted model, children who were female, 18 months or older, or from the poorest households were more likely to be high consumers of USFB, while children of caregivers who had higher educational attainment or were of an upper caste/ethnicity were less likely to be high USFB consumers (Table 5.3). Comparison of % TEI-NBF from USFB categories by child sex and age, and caregiver caste/ethnicity, wealth status, and educational attainment, are presented in supplemental Tables 5.4 – 5.8. Female children had significantly higher % TEI-NBF from unhealthy snack foods, but not unhealthy snack beverages, as compared to male children. Child age, wealth status, educational attainment, and caste/ethnicity showed an association with % TEI-NBF from both unhealthy snack foods and unhealthy snack beverages. Children in the poorest households had higher % TEI-NBF from biscuits and savoury snacks, as compared to children in higher wealth quintiles ($p=0.002$ and $p=0.005$, respectively). Children of caregivers who achieved tertiary education had lower % TEI-NBF across all categories of USFB.

Table 5.3 Ordinal logistic regression model for high consumption1 of USFB (comparison to low/moderate consumption)[2]

	Unadjusted			Adjusted		
	OR[3]	95% CI[4]	P	OR	95% CI	P
District of residence						
Kathmandu	1	-		1	-	
Lalitpur	1.52	1.08 – 2.13	0.027	1.49	0.95 – 2.33	0.061
Bhaktapur	1.52	0.97 – 2.41		1.43	0.97 – 2.10	
Caregiver is mother of child	1.83	1.15 – 2.90	0.010			
Caregiver age						
17-19 (ref)	1	-	0.255			
20-49	0.63	0.29 – 1.39				
49-74	0.47	0.19 – 1.15				
Religion, Hindu	0.49	0.34 – 0.70	<0.001			
Ethnic group						
Upper caste (ref)	1	-		1	-	
Advantaged janajati	2.66	1.96 – 3.59	<0.001	2.55	1.80 – 3.63	<0.001
Disadvantaged janajati	3.82	2.73 – 5.34		2.98	2.14 – 4.16	
Dalit/non-dalit terai caste	3.52	2.18 – 5.68		2.61	1.53 – 4.44	
Caregiver education						
Tertiary (ref)	1	-		1	-	
Secondary	2.73	1.77 – 4.22	<0.001	1.93	1.21 – 3.06	0.040
Primary	3.51	2.23 – 5.53		1.77	1.06 – 2.96	
No formal education	2.53	1.43 – 4.49		1.45	0.79 – 2.67	
Worked in the last month	1.40	1.03 – 1.89	0.030			
Works outside the home	1.27	0.88 – 1.84	0.208			
Male head of household	0.82	0.62 – 1.08	0.152			
Migration of household member	0.95	0.70 – 1.29	0.745			
Food secure household[2]	0.53	0.38 – 0.76	<0.001			
Household wealth index						
Wealthiest (ref)	1	-		1	-	
Fourth	1.06	0.69 – 1.63		1.11	0.75 – 1.64	
Middle	1.06	0.68 – 1.68	<0.001	1.16	0.72 – 1.84	0.052
Second	1.53	0.96 – 2.43		1.53	0.92 – 2.54	
Poorest	2.58	1.63 – 4.06		2.15	1.29 – 3.60	
Child age						
12-17 months (ref)	1	-	<0.001	1	-	<0.001
18-23 months	2.14	1.65 – 2.79		2.06	1.57 – 2.71	
Child sex, female	1.33	1.04 – 1.70	0.024	1.35	1.06 – 1.73	0.016
Sibling living in household	1.02	0.80 – 1.30	0.885			
Child illness in last 24 hours	1.26	0.94 – 1.67	0.120			
Currently breastfed	1.15	0.72 – 1.83	0.553			

[1]High consumption = children in highest tercile consumption from USFB (mean 46.9% TEI-NBF)
[2]Low consumption = children in lowest tercile of consumption from USFB (mean 5.2% TEI-NBF); moderate consumption = children in middle tercile of consumption from USFB (mean 21.5%-NBF)
[3]OR: odds ratio
[4]CI: confidence interval

DISCUSSION

This study among 12-23 month old children in Kathmandu Valley indicates that the majority of snack foods and beverages consumed by young children are unhealthy according to their nutrient profile. Most children had consumed an USFB in the previous 24 hours, and USFB contributed on average almost half of TEI-NBF among the highest consumers and one-quarter of TEI-NBF among all children. Being female, over 18 months of age, or being from the poorest wealth quintile increased a child's likelihood of high USFB consumption, while children from upper caste/ethnicity households or with a caregiver who attained tertiary-level education had lower odds of being high consumers.

The high % TEI-NBF contributed by USFB in the diets of 12-23 month olds among urban children in Nepal is alarming. It is comparable to the % TEI from USFB among 12-23 month olds reported in other low- and middle-income settings, which range from 9 – 40% with a median of 19%,[72–80] and is also comparable to toddlers and school-age children in high-income settings.[12,34] The higher % TEI-NBF from USFB among 18-23 month olds as compared to 12-17 month olds observed in this study is consistent with intakes reported in high-income settings[180] and general trends of increased USFB consumption with age in LMIC settings,[74,80] including Nepal.[19] This relationship likely relates to introduction of new foods/flavours and incorporation of family foods into the diet as a child ages. In addition to increasing the risk for overnutrition in childhood by providing excessive energy intakes,[50,53] early consumption of USFB can establish taste preferences for less healthy foods that continue into later childhood.[172] Another consequence of high USFB consumption is the potential for displacement of other nutrient-rich foods,[88] which could be detrimental for growth and development among this young age group.

Our study results showing an association between higher wealth status/educational attainment with lower USFB consumption are consistent with other studies in LMIC.[19,70,73,79,178] It has been hypothesized that families in low-income settings may be more inclined to purchase energy-dense snack food products because these products could be a more affordable food option.[141,173] While there was no difference

in total amount spent on USFB across levels of wealth in this study, wealthier households spent significantly more on healthy snacks for their children. This may indicate that while the low costs of USFB facilitated use across all wealth groups, or that all children prefer low-cost USFB, the higher costs of healthier foods may have differentially influenced snack choices by caregivers of varying wealth status. The role of education and provision of snack foods to young children has also been previously explored, with studies noting an inverse relationship between caregiver educational attainment and unhealthy food consumption among children in both high and low/middle income contexts.[178,181] In Nepal, increasing levels of maternal educational attainment have been correlated with improved IYCF practices[182] and prevalence of commercial snack food consumption in Kathmandu Valley has been found to be lower among young children with mothers who have attended university.[19] This relationship between higher caregiver education and lower USFB consumption could be related to higher nutritional literacy or understanding of product labels among caregivers with higher levels of education. High USFB consumption among children in low socio-economic households, where families likely already have limited access to healthy nutrient-rich foods, highlights an area where more programmatic work is needed to improve complementary feeding in urban Nepal.

The increased odds of high USFB consumption among female children and lower odds among children from upper caste households has not been reported elsewhere; these results indicate that socio-cultural beliefs may be influencing diets of young children in Nepal. Although inequitable intra-household food allocation by sex has been noted in South Asian contexts including Nepal,[183] literature on the influence of child sex and feeding of USFB is extremely limited. Fledderjohann et al.[184] found greater consumption of fresh milk by sons as compared to daughters among Indian children below 5 years of age; further exploration of our data showed that male children consumed a higher % TEI-NBF from healthy snacks than female children, particularly dairy-based snacks. No studies exploring sex differentials in feeding of USFB to infants and young children have been identified. While preference for the birth of a son has been noted in some regions,[185] sex-difference in complementary

feeding practices have not been noted in the last decade in Nepal[174] and it cannot be assumed that differentials in feeding of USFB is a result of gender bias. Female infants in Nepal are typically introduced to solid foods around 1 month earlier than male children during *pasni* (rice feeding ceremony for infants),[186] which may tie to a belief that female children can be introduced to a wider range of foods, potentially including USFB, earlier than boys. Sugar contributed a greater % TEI-NBF among female as compared to male children, illustrated by their greater % TEI-NBF from candy, indicating that there may be a preference to feed females sweeter foods than males. Innate preference for sweet foods in early childhood is typically similar for both sexes,[187] supporting the hypothesis that the difference in USFB consumption by child sex is caregiver-driven, rather than responding to preferences among female children. Caste/ethnicity also play a strong role in food beliefs and eating practices, which may account for the differences in USFB consumption by ethnic groups in this study and which have been noted in a previous Kathmandu Valley study.[19] Among upper caste groups, particularly Brahmin, the concept of 'purity' influences both eating practices and food restrictions,[188] and such beliefs and practices could be contributing to lower % TEI-NBF from USFB among children in these households. Achievement of MDD has been found to be lower among young children from disadvantaged societal/ethnic groups,[174] and higher consumption of nutrient-poor USFB among these children with already limited diet quality is concerning. Further research on caregivers' perceptions of foods among boys versus girls, and feeding practices across ethnic groups, would provide needed insights for interventions hoping to reduce consumption of USFB during the complementary feeding period.

Nine out of ten USFB items consumed by children in this study were commercially branded food or beverage products. Such products are typically high in sugar/sodium/unhealthy fats, and the USFB consumed by children in Kathmandu Valley provided nearly one-third and one-half their total sugar and sodium intakes, respectively, and were primarily commercial biscuits, candy, savoury snacks, instant noodles, and bakery products. While many processed or ultra-processed foods are not marketed as intended for infants and young children, they are commonly consumed by children during the complementary feeding period in LMIC.[133] As

young children are biologically inclined to favour highly sweet or salty foods[48] and because such products require minimal preparation and are easily self-fed, caregivers may opt for such foods for their young children because they are perceived to be appealing to the child and convenient to feed.[158] There is a need for front-of-pack labelling to ensure Nepali caregivers are well informed about the nutritional quality of commercially produced foods they provide to their young children, and a need for regulations to ensure that their decisions around child-feeding are free from marketing influence.

This study has several limitations. First, the cross-sectional design restricts the ability to establish causality of factors associated with high USFB consumption among children. Second, while USFB consumption is typically higher in urban as compared to rural areas,[133] by focusing this study in Kathmandu Valley, the extent of USFB in diets of young children in rural areas remains unknown. However, this study's finding that USFB are a major part of diets among young children in urban Nepal is an important one – though the majority of Nepal's population is rural, the country has one of the fastest rates of urbanization globally[189] and so health and nutrition of urban populations is increasingly important to consider. Third, while children's current breastfeeding status was assessed, no quantification of breastmilk intake was measured and therefore the energy intakes presented are unable to include specific energy contributed by breastmilk. However, no relationship between breastfeeding status and USFB consumption was found, indicating that intakes were similar for both breastfed and non-breastfed children. Fourth, because measuring salt intake in dietary assessments is difficult and often results in over-estimation, our estimates of sodium intake were based on sodium content in foods as per our compiled food composition table. However, we analysed the actual sodium content of the 15 most commonly consumed food products to ensure accuracy during analysis. While salt is not commonly added to infant foods (sugar is more commonly added, and was measured), we note that there could be under-estimation of salt intake in our analysis. However, given typical infant feeding practices in Nepal and our careful consideration of sodium values in foods, it is unlikely that this limitation would change findings. Finally, the nutrient profiling model (UK FSA) used in this study

was developed to restrict marketing of unhealthy foods to children of all ages. This model was selected in lieu of any existing models for young children specifically because it has been validated.[190] Given that children below two years of age have different nutrient requirements than older children, there is a need for development of a nutrient profiling model for foods consumed during the complementary feeding period.

Predominantly processed foods that are high in sugar or sodium should be discouraged from regular use in young child feeding and appropriate regulatory measures should be taken so that caregivers are aware of the nutritional quality of commercially produced foods and beverages fed to their children. Given the relationships between caregiver wealth status/educational attainment and high USFB consumption, there is indication that this unhealthy consumption pattern is greatest among populations of lower SES; disadvantaged populations should therefore be targeted to improve awareness of the nutritional quality of snacks fed to children. Finally, as programs look towards tackling the growing double burden in LMIC, consideration of how feeding practices and socio-cultural beliefs interact with use of USFB for children should be explored.

SUPPLEMENTAL TABLES

Table 5.4 % TEI-NBF from USFB by child sex[1,2]

Food categories	% TEI-NBF (all) N=745	% TEI-NBF (female) N=351	% TEI-NBF (male) N=394	*p*
ALL USFB	24.5 ± 0.7	26.3 ± 1.4	22.9 ± 1.0	0.016
UNHEALTHY SNACK FOODS	22.5 ± 0.7	24.3 ± 1.4	20.9 ± 0.9	0.015
Biscuits	10.8 ± 0.5	10.7 ± 0.9	10.9 ± 0.6	0.809
Candy/chocolates	3.5 ± 0.2	4.2 ± 0.4	3.0 ± 0.2	0.006
Savoury snacks	3.4 ± 0.3	4.0 ± 0.5	2.8 ± 0.3	0.022
Instant noodles	2.2 ± 0.2	2.2 ± 0.5	2.1 ± 0.3	0.854
Bakery items	2.0 ± 0.2	2.3 ± 0.5	1.7 ± 0.3	0.285
UNHEALTHY SNACK BEVERAGES	2.0 ± 0.2	2.0 ± 0.3	1.9 ± 0.2	0.823

[1]Values presented as mean ± robust standard error
[2]TEI-NFB: total energy intake from non-breastmilk foods

Table 5.5 % TEI-NBF from USFB by child age[1,2]

Food categories	% TEI-NBF (all) N=745	% TEI-NBF (12-17 mth) N=300	% TEI-NBF (18-23 mth) N=445	*p*
ALL USFB	24.5 ± 0.7	21.3 ± 0.9	28.6 ± 1.4	<0.001
UNHEALTHY SNACK FOODS	22.5 ± 0.7	19.8 ± 0.9	26.0 ± 1.4	<0.001
Biscuits	10.8 ± 0.5	9.9 ± 0.6	12.0 ± 0.9	0.027
Candy/chocolates	3.5 ± 0.2	3.2 ± 0.3	4.0 ± 0.4	0.050
Savoury snacks	3.4 ± 0.3	3.1 ± 0.4	3.7 ± 0.5	0.224
Instant noodles	2.2 ± 0.2	1.9 ± 0.3	2.5 ± 0.5	0.165
Bakery items	2.0 ± 0.2	1.2 ± 0.2	3.1 ±0.5	<0.001
UNHEALTHY SNACK BEVERAGES	2.0 ± 0.2	1.5 ± 0.2	2.6 ± 0.4	0.002

[1]Values presented as mean ± robust standard error
[2]TEI-NFB: total energy intake from non-breastmilk foods

Table 5.6 % TEI-NBF from USFB by caste/ethnicity[1,2]

Food categories	% TEI-NBF (all) N=745	% TEI-NBF (upper caste) N=300	% TEI-NBF (non-upper caste) N=445	*p*
ALL USFB	24.5 ± 0.7	17.9 ± 1.3	29.0 ± 1.0	<0.001
UNHEALTHY SNACK FOODS	22.5 ± 0.7	16.4 ± 1.3	26.6 ± 0.9	<0.001
Biscuits	10.8 ± 0.5	7.8 ± 0.9	12.8 ± 0.6	<0.001
Candy/chocolates	3.5 ± 0.2	3.0 ± 0.4	3.9 ± 0.3	0.028
Savoury snacks	3.4 ± 0.3	1.9 ± 0.5	4.4 ± 0.4	<0.001
Instant noodles	2.2 ± 0.2	1.2 ± 0.4	2.8 ± 0.4	<0.001
Bakery items	2.0 ± 0.2	1.8 ± 0.5	2.1 ± 0.3	0.573
UNHEALTHY SNACK BEVERAGES	2.0 ± 0.2	1.5 ± 0.3	2.3 ± 0.2	0.026

[1]Values presented as mean ± robust standard error
[2]TEI-NFB: total energy intake from non-breastmilk foods

Table 5.7 % TEI-NBF from USFB by poorest households (wealth quintile 1)[1,2]

Food categories	% TEI-NBF (all) N=745	% TEI-NBF (wealth quintile 1) N=149	% TEI-NBF (wealth quintiles 2-5) N=596	*p*
ALL USFB	24.5 ± 0.7	32.1 ± 1.9	22.6 ± 0.8	<0.001
UNHEALTHY SNACK FOODS	22.5 ± 0.7	29.4 ± 1.8	20.8 ± 0.7	<0.001
Biscuits	10.8 ± 0.5	14.0 ± 1.3	10.0 ± 0.5	0.002
Candy/chocolates	3.5 ± 0.2	3.9 ± 0.5	3.4 ± 0.2	0.342
Savoury snacks	3.4 ± 0.3	5.2 ± 0.8	2.9 ± 0.3	0.005
Instant noodles	2.2 ± 0.2	2.9 ± 0.7	2.0 ± 0.2	0.172
Bakery items	2.0 ± 0.2	2.9 ± 0.7	1.8 ± 0.3	0.139
UNHEALTHY SNACK BEVERAGES	2.0 ± 0.2	2.7 ± 0.5	1.8 ± 0.2	0.059

[1]Values presented as mean ± robust standard error
[2]TEI-NFB: total energy intake from non-breastmilk foods

Table 5.8 % TEI-NBF from USFB by educational attainment[1,2]

Food categories	% TEI-NBF (all) N=745	% TEI-NBF (tertiary) N=111	% TEI-NBF (secondary or lower) N=634	*p*
ALL USFB	24.5 ± 0.7	15.3 ± 1.6	26.1 ± 0.8	<0.001
UNHEALTHY SNACK FOODS	22.5 ± 0.7	14.1 ± 1.5	24.0 ± 0.7	<0.001
Biscuits	10.8 ± 0.5	8.7 ± 1.2	11.1 ± 0.5	0.036
Candy/chocolates	3.5 ± 0.2	2.1 ± 0.5	3.8 ± 0.2	0.001
Savoury snacks	3.4 ± 0.3	1.6 ± 0.5	3.7 ± 0.3	<0.001
Instant noodles	2.2 ± 0.2	0.9 ± 0.4	2.4 ± 0.3	<0.001
Bakery items	2.0 ± 0.2	0.3 ± 0.3	2.3 ± 0.3	<0.001
UNHEALTHY SNACK BEVERAGES	2.0 ± 0.2	1.1 ± 0.4	2.1 ± 0.2	0.015

[1]Values presented as mean ± robust standard error
[2]TEI-NFB: total energy intake from non-breastmilk foods

Chapter 6: USFB consumption and associations with dietary, biochemical, and growth outcomes among young children in urban Nepal

ABSTRACT

Consumption of USFB in LMIC is rising. While global attention has been focused on the increased risk these consumption patterns have for overnutrition, little is known about the relationship between USFB consumption and young children's diet/nutritional outcomes in contexts where nutrient-density of complementary foods is often low. This study assessed the association of high USFB consumption, as compared to low consumption, with nutrient intakes, dietary adequacy, iron status, and growth and among young children in Kathmandu Valley, Nepal. A cross-sectional survey was conducted among a representative sample of 745 primary caregivers of children 12-23 months of age. Food consumption was measured through quantitative 24HR, and anthropometric measurements and capillary blood samples were collected from the children. Primary outcomes included: nutrient intakes, risk of inadequate nutrient intakes, LAZ and WLZ, and concentrations of haemoglobin, serum ferritin, and transferrin receptor. These nutritional outcomes were compared between lowest and highest terciles of consumption based on contribution of USFB to total energy intakes (TEI) from non-breastmilk foods. On average, 46.9% TEI came from USFB among the highest tercile consumers, compared to 5.2% TEI among the lowest. Compared to low, high USFB consumers had lower nutrient intakes and a greater proportion were at risk of inadequate intakes for eight nutrients. Mean LAZ was nearly 0.3SD lower among high USFB consumers than low consumers ($p=0.003$). No associations were found with stunting prevalence or iron status. Prevalence of overweight/obesity was low. In this LMIC context, high USFB consumption among young children was associated with inadequate micronutrient intakes, which may contribute to poor growth outcomes. Addressing increased availability of USFB in LMIC food systems should be a priority for policies and programs aiming to safeguard child nutrition.

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Primary Supervisor	Elaine Ferguson		

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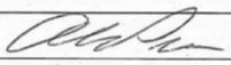
Student Signature	
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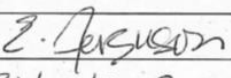
Supervisor Signature	
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INTRODUCTION

Recent decades have seen marked growth in global availability of energy-dense, nutrient-poor snack foods and beverages, with consumption rising among adults and children in LMIC.[69,191] With escalating rates of non-communicable disease and childhood obesity, the role of these foods in overall diets and their deleterious impact on nutrition and health has become a substantial global health concern.[192] While the risk for overnutrition among children in high-income settings has been explored,[50] there has been less research on how overconsumption of energy-dense/nutrient-poor foods and beverages may potentially lead to micronutrient dilution during a critical period of growth and development. In LMIC where the nutrient-density of complementary feeding diets is often low,[193] displacement of nutrient-rich foods by USFB is particularly concerning. However, there is limited research on the correlation between unhealthy diets and nutritional outcomes during the complementary feeding period in these contexts.[175]

High consumption of commercially produced snack foods and beverages among infants and young children below two years of age has been previously noted in urban Nepal, with the prevalence of commercial snack food and beverage consumption higher than consumption of micronutrient-rich foods such as eggs and fruits.[69] In this context, where nearly one-third of children are stunted and half are anaemic, and where only one in two children achieve the minimum recommendation for dietary diversity,[59] such high consumption of USFB could increase risks for inadequate dietary intakes and the associated negative functional outcomes because of diet displacement. There is a need to understand the role USFB play in dietary adequacy and nutritional status in this context. The objective of this study, therefore, was to assess associations between high, as compared to low, USFB consumption and nutritional outcomes among children 12-23 months of age in Kathmandu Valley, Nepal including: nutrient intakes, dietary adequacy, iron status, and anthropometry.

METHODS

Study design and sampling

A cross-sectional survey was conducted among primary caregivers and their 12-23-month-old children living in Kathmandu Valley, Nepal from February-April 2017. Participants were selected using two-stage cluster sampling. In the first stage, a total of 78 clusters were randomly allocated across 1,136 municipality wards of Kathmandu Valley based on probability proportional to population size, with larger wards having a higher probability of having more than one cluster assigned. In the second stage, a random GPS point was identified within the ward for each cluster and 12-13 caregivers were recruited from this starting point 2-3 days prior to data collection using standardized procedures,[103] with the assumption that up to 3 children/caregivers would be unavailable on the day of interview due to illness, family emergency, or change of mind. Children/caregivers who did not permanently reside in Kathmandu Valley, and children who were severely ill or had a congenital/physical malformation that inhibited feeding were excluded. If more than one eligible child lived within a household or if eligible children were from a multiple birth, one was randomly selected. Recruited caregivers were contacted on the day of interview to assess availability and 9-10 available caregivers interviewed. If more than ten of the recruited caregivers in a cluster were available, ten would be randomly selected for interview. Ethical approval for this study was obtained from the NHRC and LSHTM. Written informed consent was obtained from all caregivers.

Study procedures

We collected dietary, anthropometric, and biochemical data for each child, and administered a questionnaire through structured interview with primary caregivers. Interviews and dietary assessments were conducted first within caregivers' homes to ensure a comfortable environment and to also aid portion size estimation by using household utensils used for cooking/child feeding. Caregivers and children were then brought to a central location within the ward where anthropometric measurements and blood sampling were conducted. All tools were pretested and

methods pilot-tested prior to data collection to ensure comprehension and comfort among participants.

Questionnaire development was based on prior surveys conducted in Nepal, and included adapted questions from the Nepal Demographic and Health Survey, Nepal Living Standards Survey, and prior surveys conducted in Kathmandu Valley among caregivers of young children.[19] Data were collected on demographic and socio-economic characteristics pertaining to the caregiver and child, as well as factors related to child health and nutrition. Interviewers administered the questionnaires and collected this data electronically on tablets using the open-source online platform Ona and ODK application. Completed questionnaires were submitted to the Ona platform daily and the database downloaded and stored securely. Programmed skip patterns and constraints limited the potential of enumerator error, but data checks were run weekly to ensure data quality.

For the dietary assessment, trained interviewers administered a single, interactive, four-pass 24HR to gather information on the quantities of foods/beverages consumed by the child over the previous day.[106] The first pass involved caregivers listing all the foods and drinks consumed by the child in the previous day and the time at which they were consumed. During the second pass, the caregiver was asked to provide further details of these foods/drinks, including ingredients in dishes and cooking preparation. In the third pass, caregivers were asked to estimate the portion size of foods and drinks consumed by the child by weighing food models. In the fourth pass, the interviewer summarized the first pass and verified if the child had consumed anything else, if so, these items were included. To minimize memory error, during recruitment 2-3 days prior to interview, caregivers were given a pictorial food chart and instructed to use it on the specified day prior to data collection. Specifically, caregivers were asked to tick all foods/beverages consumed by their child at the time of consumption and to hand over the pictorial food chart to any other caregivers who watched the child. On the day of interview, interviewers collected these food charts prior to interview and at end of the first pass of the 24HR they would cross-check the foods/beverages recalled by the caregivers with the

information ticked off in the food chart and verify any omissions or additions. Dietary data from 24HR were collected on paper forms that were thoroughly reviewed by a supervisor after each interview; when necessary, further clarification from a caregiver would be obtained during their visit to the central location for anthropometric measurements/blood sample collection. Data from the paper dietary forms were then entered into an Excel database.

Across the total sample, recalls were conducted on all days of the week to account for day-of-the-week effect at the group level, and a non-consecutive repeat 24HR was conducted 2-3 days later among one randomly sampled child per cluster (n=78; 10.5% of the sample) to account for intra-individual variation. Household utensils and standardized food models were used to estimate portion sizes, which were weighed using digital scales (Tanita Model KD-810; ± 1g precision). Individual recipes were collected for mixed dishes consumed. Conversion factors were developed to convert quantities measured using food models to actual gram weights consumed. In cases where caregivers had not been present at the time of a feeding, average recipes calculated from the rest of the sample were used to estimate the grams of ingredients consumed. Energy and nutrient intakes from food/beverages consumed by a child were calculated using a FCT compiled for this study. For commercial products consumed by the children, caregivers were asked to recall brands and flavours and a market survey was conducted after data collection to capture nutrient content information from these product labels. In addition, energy and nutrient (Ca, Fe, Na, Vitamin A, total fat, sugar, carbohydrate and protein) content of the fifteen most commonly consumed food/beverage products were assessed by Mahidol University (Bangkok, Thailand) to ensure accuracy during analysis of children's nutrient intakes.

Two trained nurses measured the length and weight of each child using standardized procedures[111] with calibrated length boards (Shorr Boards) and SECA digital scales (model 878U; ± 0·1kg precision). Two serial measurements of length and weight were taken, and the mean used in analysis. If the two measures of length differed by more than 0.5cm or if weight measures differ by more than 0.5kg, the

measurements were performed again. Two trained phlebotomists collected capillary blood samples from each child to assess concentrations of haemoglobin, serum ferritin, sTfR, and two acute phase proteins – CRP and AGP. Children's haemoglobin was measured on-site using HemoCue (model 201+) and 150 μL of capillary whole blood was collected. Blood samples were kept appropriately cold and brought to a Kathmandu Valley within two hours of collection for serum separation and storage, and serum samples were analysed at the VitMin Laboratory (Willstaett, Germany) using the sandwich ELISA method.[110]

Exposure and outcomes

Exposure for this study was the highest tercile of USFB consumption as compared to the lowest tercile of consumption, with terciles (low/moderate/high) based on the contribution of these foods to each child's total energy intakes (% TEI) from non-breastmilk foods. Snack foods and beverages were defined based on food type instead of time of consumption or portion size. These food types included foods commonly defined as snack foods or beverages in the literature and by caregivers in Kathmandu Valley.[177] The United Kingdom's Food Standard Agency's nutrient profiling model was used to then categorize these snack foods/beverages as either 'unhealthy' or 'healthy'.[194]

The primary dietary outcomes compared were daily intakes of energy and nutrients from non-breastmilk foods, and the percentage of children at risk of inadequate intakes of nutrients from both complementary foods and breastmilk. To evaluate dietary inadequacy for each USFB consumption tercile, estimated usual intake distributions (adjusted for intra-person variability) were generated for 12 nutrients (protein, Ca, Fe, Zn, vitamins A, C, B_1, B_2, Niacin, B_6, B_{12}, and folate) using PC-SIDE.[128] Estimated nutrient contributions from breastmilk for breastfed children were included in this analysis;[68] an estimate of breastmilk intake was calculated by subtracting the median energy intake from non-breastmilk foods from the total energy required for a child equal to the average weight of a breastfed child in our sample. The proportions of children at risk of inadequate intakes were evaluated by assessing the percent of children with intakes below the EAR for all nutrients, with

the exception of iron, which was assessed with the full probability approach.[127] Based on the dietary patterns of children in this study, a low bioavailability of iron and zinc was assumed. The primary anthropometric outcomes were LAZ and WLZ, which were calculated using WHO growth standards.[132] Stunting was defined as LAZ <-2 SD and wasting as WLZ<-2 SD, while overweight/obese was defined as WLZ>2 SD. The primary biochemical outcomes were haemoglobin, sTfR, and serum ferritin. Elevation was measured at each municipality ward and used to adjust haemoglobin[130] and concentrations of two acute phase proteins – CRP and AGP – were also measured and serum ferritin was adjusted accordingly for the presence of infection.[131] A haemoglobin concentration less than 11.0 g/dL was categorized as anaemia.[107] IDA was defined as the presence of anaemia, alongside either low serum ferritin concentration (<12 μg/L) or elevated sTfR concentrations (>8.3 mg/L).[107]

Statistical analysis

Sample size for this study allowed detection of a 0.3 SD difference in nutrient intakes between low and high terciles of USFB consumption (1-β=0.9; α=0.05), as well as a 0.5 difference in LAZ and WLZ (1-β=0.8; α=0.05). Data were cleaned and analysed using STATA-15 (Stata Corp. College Station, Texas, USA). Data were summarized as proportions or means ± SD for normally distributed data, and medians with IQR for non-normally distributed data.

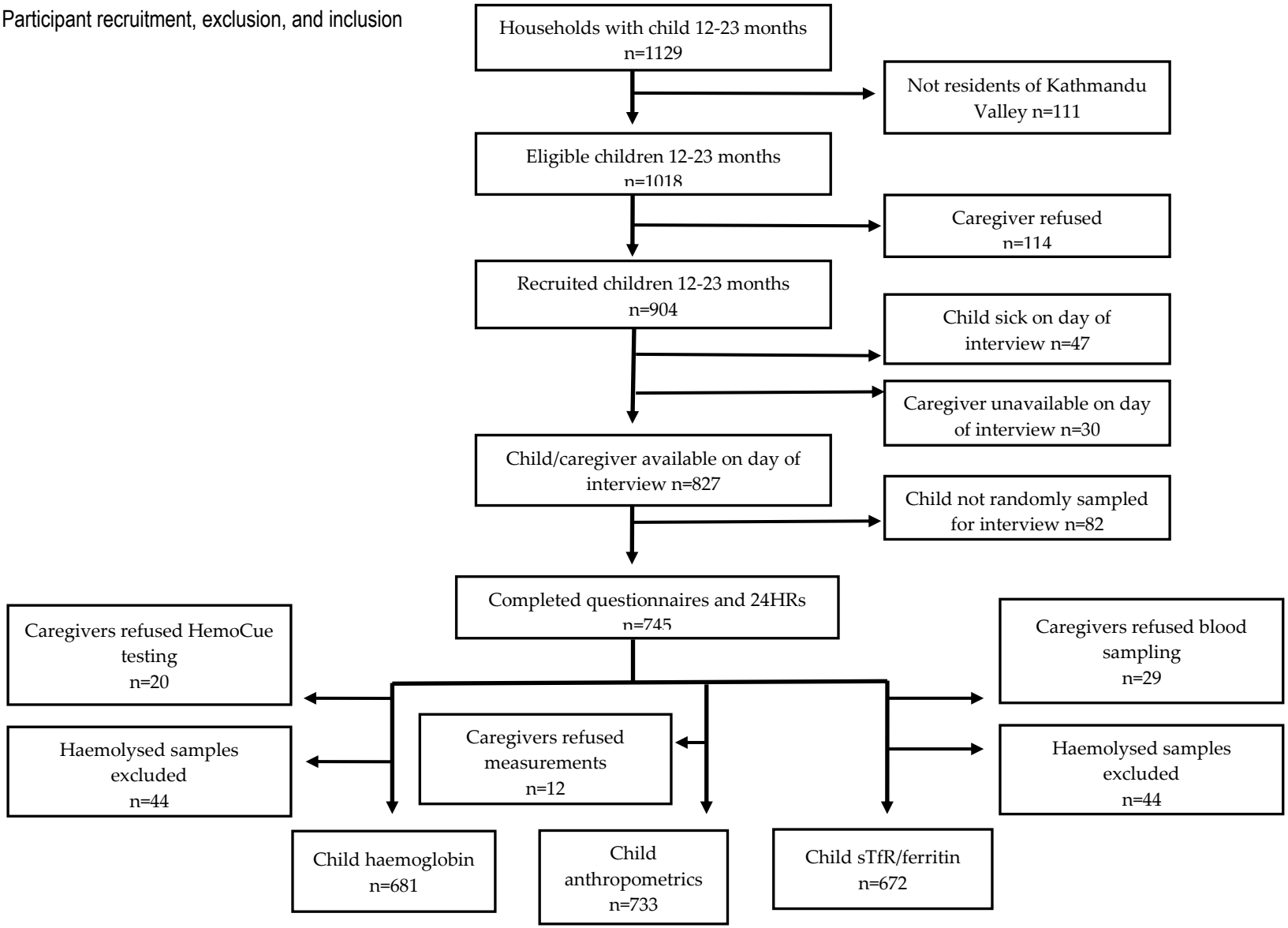
Comparisons of nutrient intakes between USFB terciles were made using cluster-adjusted ANOVA models, and Bonferroni post-hoc tests to identify specific differences between low and high USFB consumption terciles. Inter-group comparisons (low and high USFB consumers) of the percentage at risk of inadequate nutrient intakes were made using Pearson's chi-squared test. The relationships between consumption of USFB and outcomes related to iron and anthropometric status were explored using linear regression for continuous outcomes and logistic regression for binary outcomes, using random effects to account for cluster sampling. Non-normally distributed outcome data were log transformed prior to analysis. Adjusted models included covariates that are known to influence child nutrition;[68] these included caregiver educational attainment, caregiver

caste/ethnicity, household wealth status, breastfeeding status, household food security, vitamin A supplementation or deworming in last 6 months, full immunization status, and child morbidity in last 2 weeks. A household wealth index was developed based on principal components analysis and wealth quintiles were then created.[138] The HFIAS was used to categorize children's households as 'food secure' or 'food insecure (mild/moderate/severe)'.[104] Caste/ethnicity was categorized into four groups: upper caste/ethnicity (e.g. Brahmin/Chhetri), advantaged janajati (e.g. Newar/Gurung), disadvantaged janajati (e.g. Tamang/Limbu), and other socially disadvantaged groups (e.g. Dalit/religious minorities). Children's age, sex, and birthweight were also included a priori as biological factors assumed to affect nutritional status. Birthweight and immunization status were taken from national health cards (when available) or caregivers' recall. VIF were used to explore collinearity of covariates in the adjusted models; no values exceeded 1.25.

RESULTS

Of 1,018 eligible caregivers of children 12-23 months of age identified, 114 (11.2%) declined participation and 77 (7.6%) were lost to follow-up on the day of interview; a final sample of 745 caregivers were interviewed (Figure 6.1). Of these, 733, 725, and 716 caregivers agreed to allow the collection of anthropometric data, haemoglobin, or 150uL blood samples, respectively. Blood samples from 44 children were excluded from micronutrient status analysis because of haemolysis during processing. There were no statistical differences in demographic characteristics between the children with or without missing biochemical or anthropometric data.

Figure 6.1 Participant recruitment, exclusion, and inclusion



The majority of families were Hindu and from upper caste or advantaged ethnic groups (Table 6.1). Close to 70% of primary caregivers had at least a secondary level of education, and just over 15% engaged in paid work outside the home. The most common primary caregivers were mothers (90.3%, n=673) and grandmothers (7.1%, n=53). The majority of households were food secure (86.4%, n=644). Close to 10% of children were low birthweight and two-thirds had been ill with fever, diarrhea, or cough within two weeks of the survey. The majority of children were immunized and had received a vitamin A supplement in the past six months and close to half had been dewormed. Nearly all children were still breastfeeding, with breastfed children receiving a median of eight breastfeeds (IQR: 6-12) on the day prior to the interview.

Table 6.1 Socio-demographic characteristics of caregivers and children[1]

N	745
CAREGIVER CHARACTERISTICS	
Age (years)	29.2 ± 8.5
Religion	
Hindu	83.4 (621)
Buddhist	12.3 (92)
Other	4.3 (32)
Ethnic group	
Upper caste	40.3 (300)
Advantaged janajati	26.6 (198)
Disadvantaged janajati	26.2 (195)
Other socially disadvantaged groups	7.0 (52)
Caregiver education	
No formal education	12.8 (95)
Primary	20.3 (151)
Secondary	52.1 (388)
Tertiary	14.9 (111)
Paid work in the last month	30.9 (230)
Works outside the home	16.8 (125)
CHILD CHARACTERISTICS	
Age (months)	17.6 ± 3.3
Sex, female	47.1 (351)
Low birthweight[2]	9.4 (65)
Experienced illness in last 2 weeks[3]	66.0 (492)
Preventative health	
Deworming in last 6 months	48.5 (361)
Vitamin A supplementation in last 6 months	83.9 (625)
Fully immunized	95.3 (710)

[1]Values presented as mean ± standard deviation and %(n)
[2]Low birthweight defined as <2.5 kg; birthweight data missing for n=51
[3]Included experiences of fever, cough, or diarrhea

On average, USFB contributed 24.5% of TEI from non-breastmilk foods among all children, and contributed on average 5.2%, 21.5%, and 46.9% of TEI among children in the low, moderate, and high terciles of USFB consumption, respectively. Among all children, commercial foods were the main source of energy from USFB, including biscuits (10.8% TEI), candy/chocolates (3.5% TEI), savoury snacks (3.4% TEI), instant noodles (2.2% TEI), and bakery items (2.0% TEI). Commercial SSB, including fruit drinks, soft drinks and chocolate beverages, provided 1.2% TEI on average across all children. There was no difference in breastfeeding status (91.2%, 89.5%, and 92.7%; p=0.45) or median number of breastfeeds (9, 8, and 9; p=0.39) across increasing terciles of USFB consumption. Intakes of 12 nutrients from non-breastmilk foods were significantly higher among low consumers of USFB as compared to high consumers (Table 6.2). There was little evidence of a difference in energy or fat intakes across USFB consumption terciles.

Table 6.2 Median nutrient intakes from non-breastmilk foods, by USFB consumption tercile[1,2,3]

	All children (n=745)	Low (n=249)	Moderate (n=248)	High (n=248)	*P*[4]
Energy, *kcal*	615 (439 – 855)	666 (459 – 875)	613 (462 – 802)	594 (385 – 833)	0.10
Total fat, *g*	19.9 (12.5 – 32.3)	20.8 (13.3 – 33.0)	20.0 (12.6 – 31.6)	19.3 (11.8 – 32.2)	0.98
Total protein, *g*	19.0 (12.3 – 28.5)	23.5 (15.6 – 33.5)[a]	18.9 (13.0 – 27.8)[b]	15.7 (10.2 – 23.2)[c]	<0.001
Calcium, *mg*	245 (111 – 455)	353 (184 – 566)[a]	252 (112 – 455)[b]	161 (67 – 314)[c]	<0.001
Iron, *mg*	3.5 (2.1 – 5.6)	4.0 (2.6 – 6.6)[a]	3.3 (2.3 – 5.0)[b]	3.0 (1.7 – 5.0)[b]	<0.001
Zinc, *mg*	2.6 (1.6 – 4.0)	3.3 (2.2 – 5.0)[a]	2.5 (1.7 – 4.0)[b]	1.8 (1.2 – 3.1)[c]	<0.001
Vitamin C, *mg*	14.0 (5.0 – 32.2)	17.1 (6.3 – 34.6)[a]	15.1 (5.6 – 34.3)[a,b]	9.5 (3.4 – 25.6)[b]	0.004
Vitamin A, *ug RAE*	122 (53 – 227)	170 (88 – 301)[a]	116 (54 – 226)[b]	81 (31 – 171)[c]	<0.001
Thiamin, *mg*	0.3 (0.2 – 0.6)	0.4 (0.3 – 0.7)[a]	0.3 (0.2 – 0.5)[b]	0.3 (0.2 – 0.5)[b]	0.054
Riboflavin, *mg*	0.6 (0.3 – 1.1)	0.8 (0.4 – 1.3)[a]	0.6 (0.3 – 1.1)[b]	0.5 (0.2 – 0.8)[b]	<0.001
Niacin, *mg*	4.1 (2.4 – 6.6)	4.8 (2.9 – 7.4)[a]	4.2 (2.5 – 6.7)[b]	3.4 (2.1 – 5.8)[b]	0.005
Vitamin B6, *mg*	0.4 (0.2 – 0.6)	0.4 (0.3 – 0.7)[a]	0.4 (0.3 – 0.6)[a]	0.3 (0.2 – 0.5)[b]	<0.001
Vitamin B12, *ug*	0.7 (0.3 – 1.3)	0.9 (0.5 – 1.5)[a]	0.7 (0.3 – 1.3)[b]	0.6 (0.2 – 1.0)[b]	<0.001
Folate, *ug*	57.2 (32.7 – 93.6)	72.0 (43.3 – 120.9)[a]	57.4 (34.1 – 90.6)[b]	47.6 (25.2 – 71.2)[c]	<0.001

[1]Values presented as median (interquartile range)

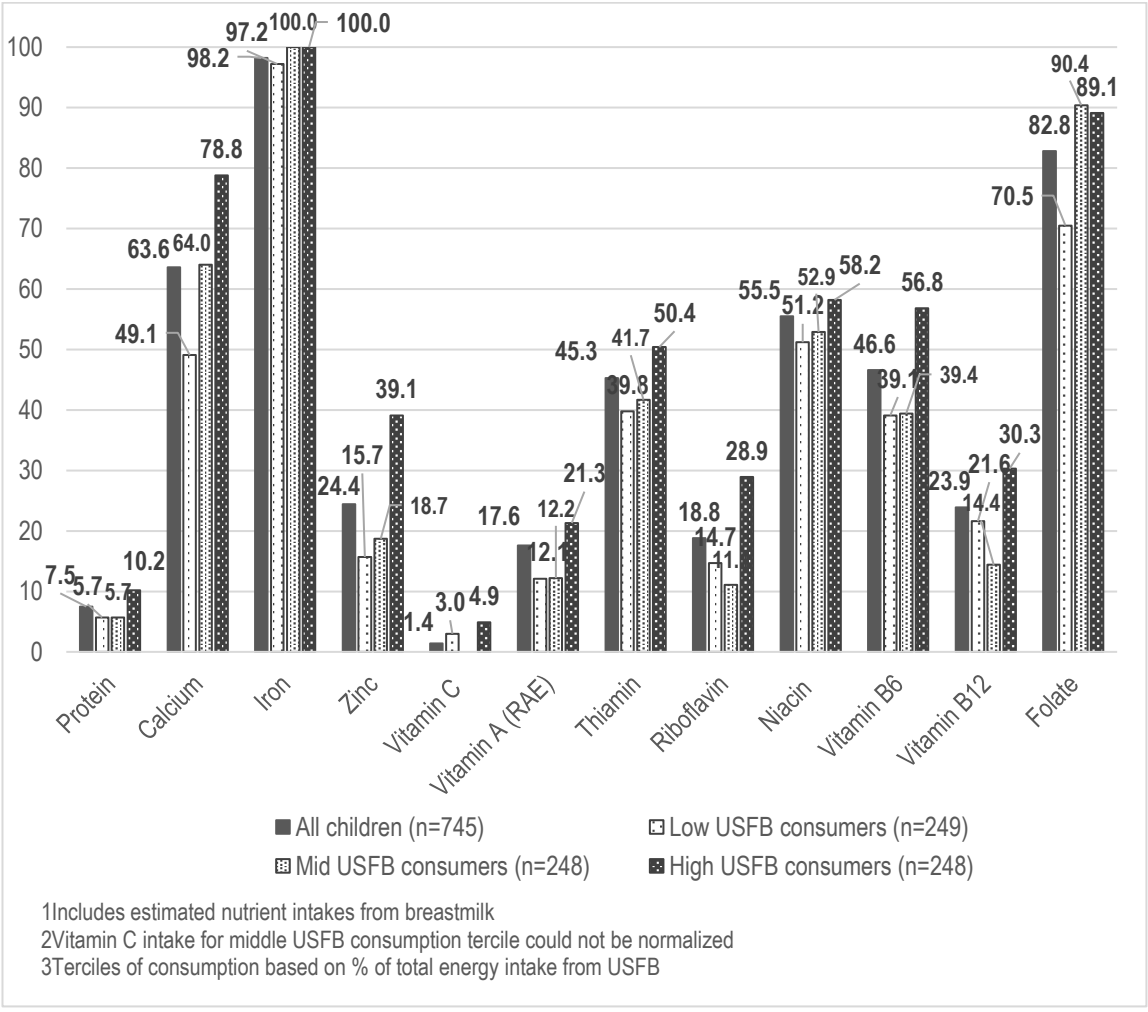
[2]Analysis of variance test of log transformed data with cluster adjustment used; Bonferroni post-hoc tests conducted to compare between groups with differences in subscript lettering indicating differences between groups

[3]Low consumption = children in lowest tercile of % TEI from USFB (mean 5.2% TEI); moderate consumption = children in moderate tercile of % TEI from USFB (mean 21.5% TEI); high consumption = children in highest tercile of % TEI from USFB (mean 46.9% TEI)

[4]Overall p-value of effect of USFB consumption terciles on nutrient intakes

Over one third of children were at risk of inadequate intakes of calcium, iron, thiamine, niacin, folate, and vitamin B6 (Figure 6.2). A significantly higher proportion of high USFB consumers were at risk of inadequate intake for eight nutrients as compared to low USFB consumers, including: calcium ($p<0.001$), zinc ($p<0.001$), vitamin A ($p=0.005$), thiamin ($p=0.02$), riboflavin ($p<0.001$), vitamin B_6 ($p<0.001$), vitamin B_{12} ($p=0.03$), and folate ($p<0.001$).

Figure 6.2 Proportion of children at risk of inadequate intakes, by terciles of USFB consumption[1,2,3]



Nearly all children were at risk of inadequate iron intakes, regardless of USFB consumption tercile. Of the 672 children whose iron status was assessed, over one-third were anaemic and one-quarter of children had iron-deficiency anaemia (Table 6.3). Nearly one-fifth of children were stunted whereas less than 6% of children were wasted, and prevalence of overweight/obesity was very low (Table 6.3).

Table 6.3 Nutritional status outcomes, by terciles of USFB consumption[1,2]

	All children	Low USFB consumption (5.2% TEI)	Moderate USFB consumption (21.5% TEI)	High USFB consumption (46.9% TEI)
Iron status				
n	681	222	227	232
Haemoglobin (Hb) (g/dL)	11.2 ± 1.1	11.2 ± 1.1	11.2 ± 1.2	11.1 ± 1.1
Anaemia (Hb<11.0 g/dL)	37.7 (257)	35.1 (78)	39.2 (89)	38.8 (90)
n	672	216	224	232
Serum ferritin (µg/L)	15.6 (8.8 – 24.6)	14.8 (8.5 – 24.2)	14.7 (8.7 – 25.1)	16.8 (9.2 – 24.2)
Low serum ferritin (<12.0 µg/L)	36.9 (248)	38.0 (82)	38.4 (86)	345 (80)
sTfR (mg/L)	8.6 (7.4 – 10.7)	8.4 (7.4 – 11.0)	8.7 (7.5 – 10.1)	8.5 (7.3 – 10.8)
High sTfR (>8.3 mg/L)	56.1 (377)	53.7 (116)	59.4 (133)	55.2 (128)
Iron-deficiency anaemia	28.7 (193)	27.3 (59)	30.4 (68)	28.5 (66)
Anthropometric status				
n	733	246	242	245
LAZ	-0.93 ± 1.09	-0.75 ± 1.15	-0.93 ± 1.04	-1.12 ± 1.06
Stunting (LAZ < -2)	18.8 (138)	15.9 (39)	18.6 (45)	22.0 (54)
WLZ[3]	-0.42 ± 1.00	-0.44 ± 1.08	-0.43 ± 1.00	-0.41 ± 0.93
Wasting (WLZ < -2)[3]	5.2 (38)	6.1 (15)	5.4 (13)	4.1 (10)
Overweight/obese (WLZ < 2)[3]	0.6 (4)	0.4 (1)	0.8 (2)	0.4 (1)

[1]Terciles of consumption based on % of TEI from USFB

[2]Values presented as mean ± standard deviation; median (interquartile range); or %(n)

[3]One WLZ value excluded as an outlier; n=732 for all children and n=245 for low USFB consumption group

High USFB consumption was negatively associated with LAZ, whereas it was not significantly associated with iron status, WLZ, stunting, or wasting (Table 6.4). In adjusted models, the LAZ of children who consumed a high % TEI from USFB was close to 0.3 SD lower than those who had low USFB consumption. In the adjusted model, the overall significance of all three USFB consumption terciles for LAZ was p=0.013, with mean LAZ -0.13 lower among moderate USFB consumers as compared to low USFB consumers. Table 6.4 presents results comparing high and low USFB consumption terciles; model results comparing moderate to low terciles are presented in supplemental Table 6.5.

Table 6.4 Effect of high vs. low USFB consumption on iron and anthropometric status outcomes[1]

	Unadjusted[2]			Adjusted[2,3]		
Iron status						
	n	β (95% CI)[4]	*p*	n	β (95% CI)	*p*
Haemoglobin (g/dL)	681	-0.08 (-0.29 – 0.13)	0.44	639	-0.09 (-0.32 – 0.14)	0.44
Serum ferritin (µg/L)	672	0.09 (-0.04 – 0.22)	0.20	632	0.08 (-0.07 – 0.23)	0.28
Transferrin receptor (mg/L)	672	-0.02 (-0.07 – 0.04)	0.58	632	0.01 (-0.05 – 0.06)	0.84
	n	OR[5] (95% CI)	*p*	n	OR (95% CI)	*p*
Iron-deficiency anaemia	672	1.06 (0.70 – 1.60)	0.79	632	1.27 (0.78 – 2.07)	0.34
Anthropometric status[6]						
	n	β (95% CI)	*p*	n	β (95% CI)	*p*
LAZ	733	-0.37 (-0.56 – -0.18)	<0.001	684	-0.29 (-0.49 – -0.10)	0.003
WLZ[7]	732	0.03 (-0.15 – 0.21)	0.77	683	-0.09 (-0.28 – 0.10)	0.37
	n	OR (95% CI)	*p*	n	OR (95% CI)	*p*
Stunting (LAZ < -2)	733	1.51 (0.95 – 2.39)	0.08	684	1.25 (0.70 – 2.24)	0.45
Wasting[5] (WLZ < -2)	732	0.65 (0.29 – 1.48)	0.31	683	1.11 (0.40 – 3.04)	0.84

[1]High consumption: 46.9% of TEI from USFB; low consumption: 5.2% TEI from USFB
[2]Comparisons between high and low snack consumers made using random-effects linear and logistic regression with cluster adjustment
[3]Adjusted for: child age, sex, morbidity, deworming, immunization status, vitamin A supplementation, birthweight, breastfeeding status, caste/ethnicity, caregiver education, household food security and wealth status
[4]CI: confidence interval
[5]OR: odds ratio
[6]Children with length/weight measurements but without birthweight data missing (n=49) from anthropometric adjusted models
[7]One WLZ value excluded as an outlier

DISCUSSION

Few studies have assessed the relationship between USFB consumption and nutritional outcomes among children below two years of age in a LMIC;[175] to our knowledge, this is the first study to comprehensively assess this relationship across a range of nutritional outcomes, including: nutrient intakes, dietary adequacy, iron status, and growth. In this Kathmandu Valley context, high compared to low USFB consumers were at higher risk of inadequate intakes for eight micronutrients and had significantly lower mean LAZ. There was no association between USFB

consumption and overweight/obesity. While prior research has primarily focused on the relationship between the consumption of unhealthy foods and child overnutrition, our study indicates that an unhealthy dietary pattern among young children may contribute to poor linear growth in contexts where the nutrient-density of complementary foods is low and a high proportion of children are at risk of inadequate micronutrient intakes.

Our findings in Kathmandu Valley support the theory that displacement of traditional foods by USFB may be diluting the micronutrient content of diets during the complementary feeding period. This study builds on prior studies of older children living in both high and moderate-to-low income countries. High intakes of added sugar were negatively associated with micronutrient intakes among 1-3 year old South African children,[88] and high snack consumption was associated with low intakes of protein and vitamin C among rural Indonesian school children.[23] In the United States, the consumption of energy-dense and nutrient-poor foods were inversely associated with dietary intakes of micronutrients among school-age children.[195] In LMIC settings, where the micronutrient content of complementary foods is typically low, the displacement of traditional foods by USFB is particularly concerning for young child health and development.

In our study, mean LAZ was significantly lower with increasing terciles of USFB consumption while the prevalence of overweight/obesity was low, suggesting that high USFB consumption contributes to linear growth faltering but not excessive weight gain during the complementary feeding period among children in urban Nepal. These results from Kathmandu Valley challenge the current assumption that overnutrition is the main outcome of concern when USFB consumption is high. In populations where most children are at risk of inadequate nutrient intakes and the prevalence of overweight/obesity is low, micronutrient deficiencies and poor linear growth are instead major concerns. Our findings contrast a previous study that did not find an association between snack food consumption and LAZ among 6-12 month olds in peri-urban South Africa[83] when children who consumed USFB daily were compared with those who did not. This study, however, did not consider the

quantity of snack foods consumed or their contribution to overall dietary adequacy, as indicative of micronutrient displacement. Additional research is needed to build the body of evidence around this relationship.

High USFB consumption was not associated with overweight/obesity or mean WLZ among children in our study. These results agree with a South African study that showed no association between BMIZ and unhealthy food consumption among 12 month olds.[83] However, our findings contrast with a Mexican study which found that 5-24 month-olds who consumed high-fat snacks or sweetened drinks in the previous week were at higher odds of being overweight/obese than other children.[84] Ultimately, the different measures used for food consumption in these studies (i.e. weekly or daily consumption without consideration of overall dietary intake) pose a challenge for comparison with our study. Further, the prevalence of overweight/obesity in our study was very low compared with the Mexico study (<1% vs 19%). Our study also was not powered to detect associations with anthropometric status as categorical outcomes. Despite the low prevalence of overweight/obesity observed in our study, the dietary pattern of these Kathmandu Valley children is cause for concern. In Nepal, the prevalence of adult obesity[59] and diabetes[196] is increasing, which indicates these unhealthy eating patterns in young urban Nepali children critically needs to be addressed.

Our dietary results suggest 1-2 year old children living in Kathmandu Valley are at high risk of multiple micronutrient deficiencies, which are further exacerbated by high intakes of USFB. The biochemical analyses conducted for this study confirm that iron deficiency is common. IDA affected nearly one-third of children in our study, which is comparable to the 2016 national rates of IDA among 6-23 month olds (22%).[61] The lack of association between iron status and consumption of USFB, however, is not surprising because nearly all the children were at risk of inadequate dietary intakes of iron. Further, our dietary results point to a need to investigate the biochemical status of multiple micronutrients in this population where over 20% of children were at risk of inadequate intakes of thiamine, niacin, folate, vitamins B_6 and B_{12}. Investigation into the biochemical zinc status of high versus low USFB

consumers is also warranted given the role of this nutrient in child growth and the negative association found between USFB consumption and LAZ.

There are several limitations to this study. First, the cross-sectional design prevents our ability to infer a causal relationship between the USFB consumption observed among children in this study and their nutritional outcomes. However, our results present a plausible biological pathway for this relationship by showing that lower nutrient intakes/higher risk of dietary inadequacy, and ultimately poorer growth outcomes were present among high versus low USFB consumers. Secondly, we did not directly measure breastmilk consumption but instead estimated it at the population level. While we took into account these estimated breastmilk intakes when assessing dietary adequacy and controlled for breastfeeding status in analyses, this source of error could attenuate associations between dietary intakes and other variables. Future research in this age range would benefit from precise quantification of breastmilk consumption. Finally, this study was not powered to detect inter-group differences in the categorical statuses of IDA, stunting, overweight/obesity or wasting. A positive trend was found in the prevalence of stunting prevalence across USFB consumption terciles, which was consistent with the negative association observed with LAZ, however it was not significant. Future studies are needed, including cohort studies that can provide greater understanding of causality and studies that are adequately powered for categorical outcomes.

With growing efforts aimed to address the role of unhealthy foods and beverages in the rise of child overnutrition, results from this study call for researchers, program implementers, and policy-makers to expand our understanding and actions on the potential impact of these foods among younger children. While snacks are an important part of complementary feeding practices, programs should revisit definitions of recommended snacks and consider discouraging unhealthy foods not only to prevent child obesity but also to safeguard nutritious diets for growth and development. Our results suggest that rapidly changing food environments and subsequent dietary patterns in LMIC[191] might reverse recent achievements in the reduction of childhood stunting in LMIC. There is a need to regulate the marketing

of USFB to ensure children are protected from targeted advertising[125] and support caregivers in making healthy food choices.[170] To further advocate market regulation, there is also a crucial need for further research on the role of these foods in young children's diets and the consequent nutritional and functional outcomes. If such unhealthy food products are not only contributing to rising rates of obesity and NCDs but also associated with poor growth and development, there is an even greater need to enact and enforce marketing regulations to reduce their harmful nutritional impact.

SUPPLEMENTAL TABLES

Table 6.5 Effect of middle vs. low USFB consumption on iron and anthropometric status outcomes[1]

		Unadjusted[2]			Adjusted[2,3]	
Iron status						
	n	β (95% CI)[4]	*p*	n	β (95% CI)	*p*
Haemoglobin (g/dL)	681	-0.04 (-0.25 – 0.16)	0.67	639	-0.04 (-0.26 – 0.18)	0.71
Serum ferritin (µg/L)	672	0.05 (-0.08 – 0.18)	0.47	632	0.03 (-0.11 – 0.17)	0.66
Transferrin receptor (mg/L)	672	-0.004 (-0.06 – 0.05)	0.89	632	0.001 (-0.05 – 0.06)	0.94
	n	OR[5] (95% CI)	*p*	n	OR (95% CI)	*p*
Iron-deficiency anaemia	672	1.16 (0.77 – 1.75)	0.48	632	1.33 (0.84 – 2.09)	0.22
Anthropometric status[6]						
	n	β (95% CI)	*p*	n	β (95% CI)	*p*
LAZ	733	-0.18 (-0.37 – 0.01)	0.07	684	-0.13 (-0.32 – 0.05)	0.15
WLZ[5]	732	0.001 (-0.17 – 0.18)	0.99	683	-0.08 (-0.26 – 0.09)	0.36
	n	OR (95% CI)	*p*	n	OR (95% CI)	*p*
Stunting (LAZ < -2)	733	1.22 (0.76 – 1.95)	0.42	684	0.99 (0.57 – 1.73)	0.98
Wasting[7] (WLZ < -2)	732	0.87 (0.41 – 1.87)	0.72	683	1.01 (0.42 – 2.48)	0.98

[1]Middle consumption: 21.5% of TEI from USFB; low consumption: 5.2% TEI from USFB
[2]Comparisons between middle and low snack consumers made using random-effects linear and logistic regression with cluster adjustment
[3]Adjusted for: child age, sex, morbidity, deworming, immunization status, vitamin A supplementation, birthweight, breastfeeding status, caste/ethnicity, caregiver education, household food security and wealth status
[4]CI: confidence interval
[5]OR: odds ratio
[6]Children with length/weight measurements but without birthweight data missing (n=49) from anthropometric adjusted models
[7]One WLZ value excluded as an outlier

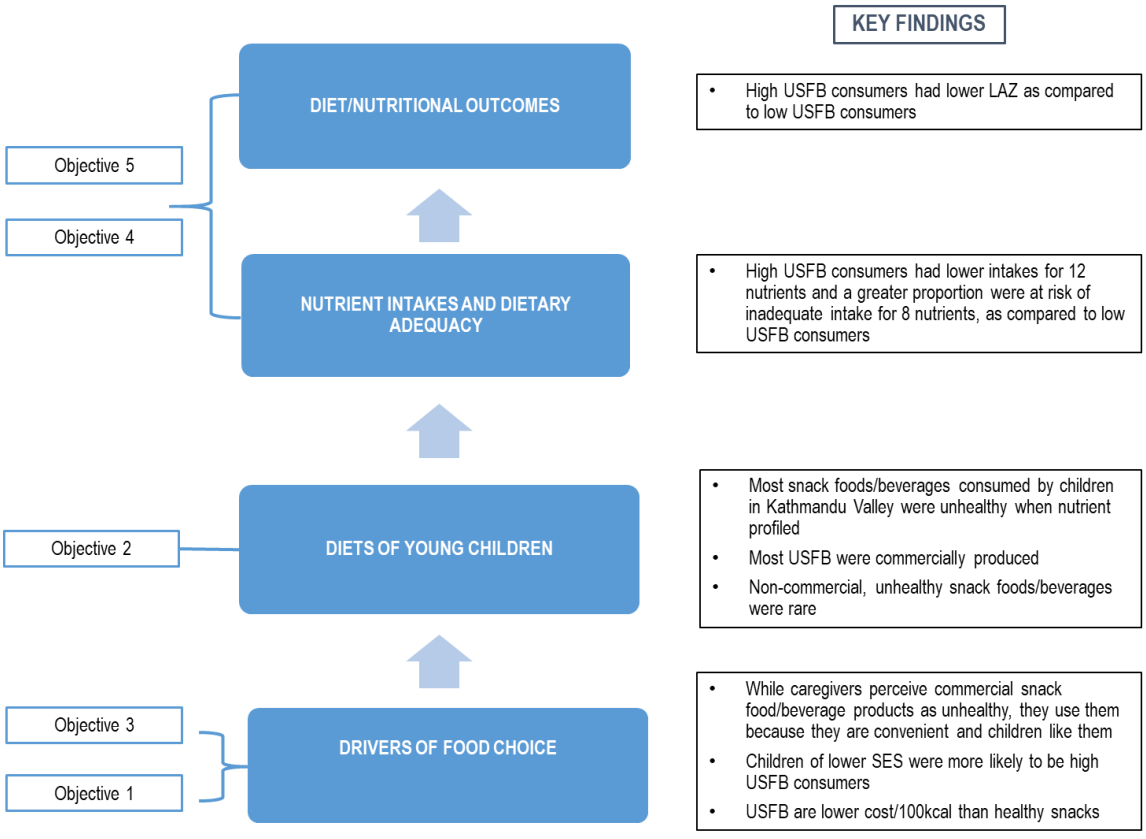
Chapter 7: Discussion and conclusions

In this final chapter, the main findings from the research paper chapters of this thesis (Chapters 2, 4-6) will be summarized as they relate to the primary objectives of the thesis. Additionally, the strengths and limitations of the study design, the relevance of the findings as they relate policy and program considerations, and areas for future relevant research will be discussed.

MAIN FINDINGS

The key findings of this thesis are presented here and detailed as they relate to the conceptual framework for this study in Figure 7.1.

Figure 7.1 Conceptual framework for thesis – key findings



A systematic review (**Chapter 2**) of prior literature on the contribution of snack foods and SSB to dietary energy intake among young children below two years of age in LMIC and the relationship between consumption of these foods and nutritional

outcomes revealed a major gap in the evidence. While several studies presented the proportion of energy intakes contributed by snack foods and SSB during the complementary feeding period, these studies were primarily conducted in Latin America and Southeast Asia and there were no studies conducted in regions that carry the highest burden of malnutrition, namely South Asia and sub-Saharan Africa. Though a substantial number of studies have reported on the proportion of children who consume unhealthy foods in the previous day or week[69,70,133,197] – this systematic review shows there is limited information of the actual contribution of these foods to infant and young child diets in LMIC. The evidence gap is even greater for understanding whether consumption of these foods is associated with functional nutritional outcomes, such as growth or micronutrient status, in contexts where nutrient-density of complementary foods is often limited. No studies explored nutrient displacement by testing the relationship between consumption and nutrient intakes or dietary adequacy and only one study explored the relationship with micronutrient status, specifically anaemia. The studies identified by this review varied in their definitions of 'snack foods' and also in how consumption of these food was measured, which limited comparability. This review identified a major literature gap in understanding the contribution of unhealthy snacks to diets and nutritional status of young children in LMIC, and highlighted limitations in research design and measurement among existing studies that should be addressed in future research.

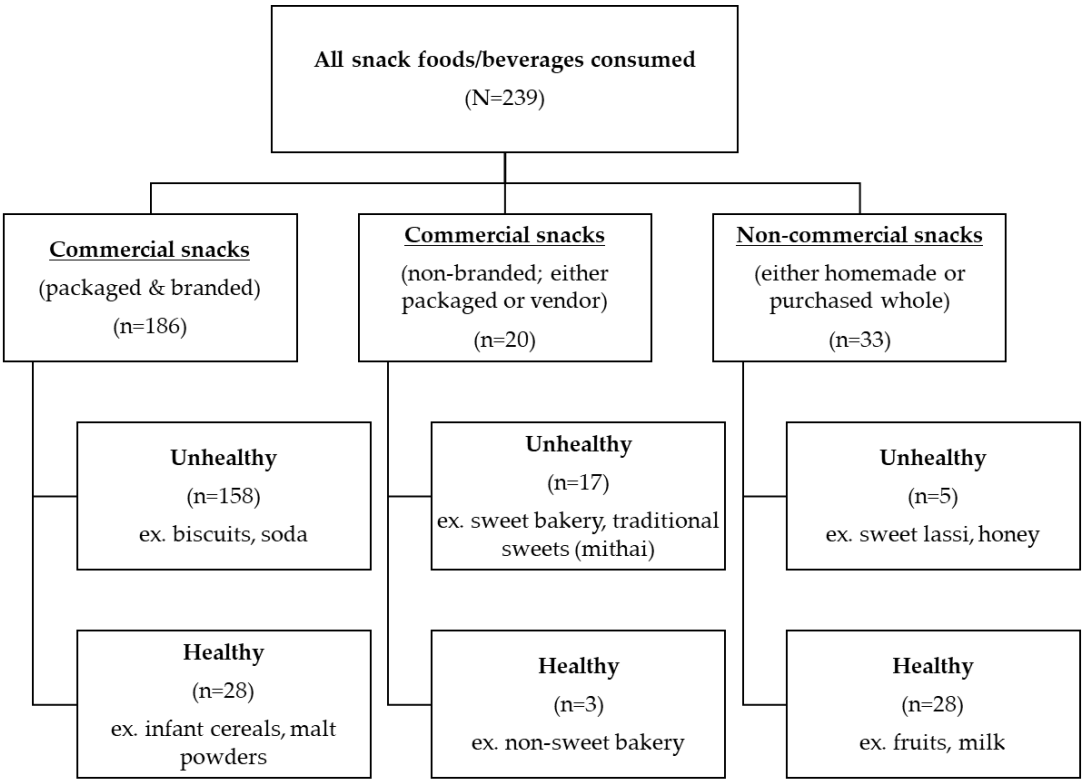
Chapter 4 addressed Objective 1 of this thesis by describing caregivers' perceptions of commercial snack foods and beverages and their reasons for use in young child feeding. This mixed-methods paper presented themes generated from qualitative FGD among primary caregivers, and these findings were triangulated with results from the quantitative survey among caregivers of children 12-23 months of age. Caregivers perceived commercial snack foods and beverages to be unhealthy and were particularly wary of characteristics related to processing, including: artificial colouring, additives/preservatives, and packaging. Caregivers who participated in the FGD categorized commercial snack foods as 'junk foods', however, this negative perception was not the only factor influencing their food choices. The convenience

of commercial foods and children's strong preference for these foods were competing drivers that motivated their use. Additionally, the social context of families was found to drive feeding of commercial snack foods and beverages. The practice of visitors/relatives gifting these foods to young children was common – in addition to being reported among FGD participants, one-third (32.1%, n=235) of surveyed caregivers reported this as the reason why their child ate a commercial snack food/beverage in the previous week. These findings point to characteristics inherent to commercial foods – convenience and palatability – as well as social behaviours – influence of visitors and relatives' behaviours – as factors that drive feeding practices for young children in urban Nepal.

Chapter 5 addressed Objectives 2-3 of this thesis by describing the consumption of USFB among children 12-23 months of age, and exploring child and caregiver characteristics associated with high consumption of these foods. Over 230 unique snack foods and beverages were consumed by young children in this Kathmandu Valley, Nepal study and three-quarters of these were nutrient profiled as 'unhealthy'. Nearly 90% of the USFB were commercially branded, packaged foods/beverages, while the remaining were primarily commercially sold and packaged but not branded. Non-commercial USFB were rare and made up only 2.1% (n=5) of all snack foods/beverages consumed (see Figure 7.2). It is often assumed that USFB are typically commercially branded/packaged products, and this finding confirms this assumption in the urban Nepal context. On average, USFB contributed 24.5% TEI-NBF, with 22.5% TEI-NBF contributed from unhealthy snack foods and only 2.0% TEI-NBF contributed by unhealthy snack beverages. While this energy contribution from USFB is comparable to those identified among children in high-income settings,[34,195] the relatively lower contribution from beverages differs from trends in other settings where SSB contribute more substantially to young children's energy intakes, including Australia[34] and Mexico.[74,77] The category of USFB that contributed the largest % TEI-NBF was biscuits (10.8%), which were observed as the main breakfast food for all 10 children who participated in structured observations during formative research for this study (see Chapter 3). Other USFB categories typically high in sugar content were also substantial contributors to % TEI-NBF,

including candy/chocolates (3.5%) and sweet bakery items (2.0%). The median cost/100kcal for USFB was significantly lower than the median cost/100kcal for healthy snack foods and beverages. There was no significant difference between wealth quintiles in median cost/100kcal spent on USFB. However, the wealthiest quintile had a higher median cost/100kcal spent on healthy snacks and beverages, indicating that wealth status was not associated with purchasing more/less expensive USFB but that wealthier families did have higher expenditure on healthy snacks. Additional descriptive statistics of the costs/100kcal, including range of costs by snack food/beverage categories, can be found in Appendix 10. On average, among the highest tercile of USFB consumers, 46.9% TEI-NBF came from USFB and SES was strongly associated with high consumption of USFB in this population – children from the poorest wealth quintile, of caregivers who had lower levels of educational attainment, and of caregivers from lower caste/ethnic groups all had greater odds of being high USFB consumers.

Figure 7.2 Breakdown of all snack foods/beverages consumed, by commercial/non-commercial and unhealthy/healthy



Chapter 6 addressed Objectives 4-5 and answered the main research question of this thesis. This chapter described the diets and nutritional status of children in this study and assessed the relationship between high USFB consumption and dietary/nutritional outcomes, as compared to low USFB consumption. Children 12-23 months of age in Kathmandu Valley were found to have limited diet quality during the complementary feeding period, with 30% or more children at risk of inadequacy for six nutrients. Nearly all children were at risk of dietary inadequacy for iron and 29% had iron-deficiency anaemia. Nearly one-fifth (19%) of children were stunted while 5% were wasted, indicating moderate/high prevalence of stunting and low/moderate prevalence of wasting among this sample.[198] Median energy intake from non-breastmilk foods among all children was 615 kcal. This is slightly lower than expected energy intakes from complementary foods for this age group,[199] but given that these Kathmandu Valley children on average were slightly small (mean LAZ: -0.93) their energy requirements would be lower. Occurrence of overnutrition was rare, with only four children (0.6%) categorized as overweight/obese based on WLZ, and there was no difference in energy intakes between high and low USFB consumers. As compared to low consumption (5.2% TEI-NBF), high consumption of USFB was associated with lower dietary intakes of 12 nutrients and a greater proportion of high USFB consumers were at risk of dietary inadequacy for eight nutrients. High USFB consumption was also negatively associated with LAZ, with a nearly 0.3SD difference in LAZ between low and high consumers after controlling for other covariates of undernutrition, including SES. These results indicate that in a context where diet quality and overnutrition are low during the complementary feeding period, micronutrient displacement from USFB that are energy-dense and nutrient-poor is associated with dietary inadequacy and poor growth status.

METHODOLOGICAL CONSIDERATIONS

The main strengths and limitations for consideration when interpreting these thesis findings are summarized here.

First, dietary recalls are subject to error, stemming from potential bias in caregivers' ability to recall all the foods/beverages consumed by a child, potential measurement error in their ability to estimate portion sizes, and potential social desirability bias[200] resulting in caregivers underreporting certain foods, including commercial snack foods and beverages. In an attempt to minimize recall and social desirability bias error, the pictorial recall-aid was developed based on formative research, however, the ability of such a tool to minimize omissions/additions in a recall should be validated in future research.

Additionally, analysis of dietary data is dependent on food composition tables, which can vary in reliability. While care was taken to compile a FCT for this study that balanced published food composition tables with regionally-relevant food composition databases for Nepal/South Asia, there may be error for foods where nutrient composition data are less reliable. This could be due to varying reliability of food databases and variability in accurate nutrient content data for locally manufactured/processed foods. To minimize error results from imputation of values for these manufactured foods, the 15 most commonly consumed commercially packaged foods were analysed for energy and nutrient content. The potential error for foods that were not analysed and which had minimal nutrient content information on labels must be noted.

The categorization of foods as 'unhealthy' was based on a validated nutrient profiling model used to identify foods that should have restricted marketing among children. However, this model is not specific to the nutrient requirements of young children under two years of age and its use assumes that the foods identified as 'unhealthy' for pre-school and school age children would be the same. With no existing validated model for the complementary feeding period, this model was selected as the best option. However, the different nutrient requirements for younger children in this study as compared to older children, particularly around fats, is noted. Foods that were categorized as 'unhealthy' due to high saturated fat content but which are included in dietary recommendations, specifically animal-source foods like whole milk and egg yolk, were excluded from USFB categorization.

Due to cost constraints, it was not possible to quantify breastmilk intake and analysis was thus limited to estimated breastmilk intakes. The use of estimated quantities of breastmilk intake is common in dietary assessments of young children,[39,73,80] but this estimation does introduce error. While some studies estimate breastmilk intake based on individual-level energy requirements calculated from each child's weight, a population level approach was chosen so that any error associated with this estimation was distributed equally across the sample. Additionally, with only one 24HR per child, actual energy intake at the individual-level could not be established and so estimation of breastmilk intake using a population-level median energy intake was felt to be more appropriate. Despite these limitations in dietary assessment, strengths included collection of individual recipe data to allow measurement of differing nutrient content across households, and the development/use of the pictorial recall-aid to reduce omissions, as mentioned above.

In addition to these considerations for dietary methods, there are also strengths and limitations related to sampling and study design. The relatively high response rate (81%) for this survey and randomized sampling procedure potentially minimized selection bias in this study. In addition, the large sample size meant the study was adequately powered to assess the hypothesized relationships between the primary exposure variable (high USFB consumption) and outcomes of interest (nutrient intakes, dietary adequacy, and LAZ/WLZ). However, this study was not powered to detect categorical anthropometric differences by USFB terciles. Though a positive trend in the relationship of USFB consumption and stunting prevalence was observed, the sample size was not large enough to identify any statistical significance. Finally, the cross-sectional design of this study limits any ability to establish causation between high USFB consumption and these dietary or nutritional outcomes.

RESEARCH, POLICY, AND PROGRAM IMPLICATIONS

Beyond responding to the primary research questions, this thesis also provides 'food for thought' for researchers, policy-makers, and program-implementers engaged in

the world of IYCF, including: considerations for definitions of 'snack foods/beverages' and measurement of consumption in both research and guidelines, and considerations for regulatory-based solutions and community-based solutions in Nepal.

As food systems and diets shift globally , the significance of how 'snack foods' are defined and measured in research and dietary guidelines for young children must be highlighted and carefully considered. In lieu of any global definition of 'snack food', much of the formative research conducted for this study aimed to identify a meaningful and appropriate definition of 'snack foods and beverages' that matched the research question and context. Through this, it was determined that a behavioural definition that differentiated snacks based on portion size or time of consumption was not applicable for this age group, and that categorization based on food type was most appropriate for the research question (**Chapter 3**). During the complementary feeding period, the WHO defines a 'snack' as a food/beverage consumed between meals;[201] recent reviews of the literature on 'snacks' found that definitions based on time of consumption, type of foods consumed, or amount of a food consumed are also commonly used to define snacks, with little consensus of definitions across the literature.[120,202] Even within these definitions there is wide variation in how they are operationalized. In the systematic review for this thesis (**Chapter 2**), studies assessing consumption of snack foods/beverages (definition based on food type) did not use consistent food categories in this definition and also varied in inclusion of foods and/or beverages. Furthermore, there was also wide variation in measurement of consumption across these studies, ranging from weekly frequency, consumption in the previous day, or contribution of snack foods to TEI. The variation of definitions for snacks challenges the ability to draw conclusions about the role of these foods in diets and their nutritional implications. In their review, Johnson & Anderson[120] identified 26 studies assessing the relationship between snacking and obesity, however, wide variation in definitions of snacking precluded comparison of findings across studies. An analysis by Gregori et al.[203] found that varying definitions of snacks resulted in vast variability (70%) in results on associated probability of obesity among children and adolescents. Beyond this

analysis, it is not clear how varying definitions correlate with variability in relationship with other nutritional outcomes, and it has been noted that research which specifically investigates the impact of definition/measurement variation on study findings is extremely limited.[121]

Based on the findings from this study, it is recommended that the act of 'snacking' (defined as frequent feeding episodes throughout the day) continue to be a dietary recommendation to achieve young children's energy and nutrient requirements given their limited stomach capacity, but that guidance be developed regarding the nutritional-quality of foods, particularly commercial foods, fed to young children. The lack of attention or guidance on how to deal with energy-dense and nutrient-poor foods (such as USFB) in dietary guidelines for children under two years of age has been previously noted for high-income settings,[34] and results from this Kathmandu Valley study provide urgency for such guidelines in LMIC settings. Additionally, it is recommended that researchers focus on 'food types', particularly energy-dense and nutrient-poor foods, when studying the influence of food consumption patterns on young children's diet and nutritional outcomes, and that the measurement of consumption appropriately matches the hypothesized influence on outcomes. Specifically, weekly frequency of consumption or consumption in the previous day are useful as indicators of consumption trends, but a measurement with greater resolution and significance for overall contribution to diets, such as contribution to total kcal/% TEI, may be more appropriate when considering indicators for dietary/nutritional outcomes.

Based on discussions of findings with infant and young child nutrition experts and stakeholders in Nepal, several specific policy and program recommendations were identified as achievable and meaningful in the present Nepali context. First, given that USFB consumption was found to be prevalent across the entire sample of children 1-2 years of age, there is a need to consider incorporating strategic messaging around this issue into the national nutrition strategy to address the demand side for USFB. Much of the behaviour-change strategy in Nepal is based around timely introduction of complementary foods and provision of micronutrient-

rich infant foods, such as *lito* and *jaulo*. Qualitative and quantitative results from this study found that as children age during the complementary feeding period, caregivers begin to transition feeding away from baby-specific foods, like *lito* and *jaulo*, and into greater consumption of 'family foods', which can include USFB. This study indicates that the shifting diets within the 6-23 month range of complementary feeding should be a focus for behaviour-change communication and awareness should be raised around the risk of unhealthy foods for children's nutrition, particularly commercially produced USFB that are the most dominant in diets. Given the socio-economic and cultural factors found to be associated with feeding of USFB in this Kathmandu Valley study, programs implementing such messaging need to be tailored for urban populations, and healthy food options need to be promoted which are convenient and acceptable to children.

Second, to address the supply side of USFB, the contents and labelling of commercial USFB products in Nepal should be improved. Results from this study found that the majority of USFB were commercially produced, and therefore could be reformulated by manufacturers to reduce the sugar/sodium content. Additionally, while caregivers participating in FGD reported being wary of these commercial foods because of what they lacked nutritionally or because of the presence of additives (**Chapter 5**), none reported the presence of certain unhealthy nutrients, such as sugar or sodium, as a concern. Currently, label standards in Nepal require minimal nutritional information and most products consumed by children in this study did not provide nutrient content information beyond energy content and ingredients. Requiring additional nutrient content on labels, particularly sugar, sodium, and unhealthy fats, would allow caregivers to make informed decisions around the packaged foods they feed to their children. Furthermore, though regulatory-based solutions to unhealthy food consumption in high-income and LMIC are nascent and evaluations are still forthcoming, some studies indicate that restrictions on health/nutrition claims and front-of-pack labelling techniques could encourage healthier choices of packaged foods by Nepali caregivers.[170,204]

FUTURE RESEARCH

There are several areas for future research that have been identified through this thesis, both in terms of gaps within the literature and also points of expansion to build upon findings of this study:

1) Results from the systematic review (**Chapter 2**) provide a strong call for the research community to conduct additional research on the contribution of USFB to diets during the complementary feeding and to assess the relationship between USFB consumption and diet and nutritional outcomes. This thesis study explored the relationship between USFB consumption and a range of outcomes in a LMIC setting with prevalent child undernutrition, but there is a need for additional studies to be conducted in more geographical settings, particularly Africa and South Asia, to build a body of knowledge on this issue. Given the limited diet quality noted generally among children in this study (**Chapter 6**), there is a particular need for future studies to assess the relationship with dietary intakes, dietary adequacy, and a wider range of micronutrient statuses that are strongly related to child growth and development, such as zinc status. Additionally, beyond geographical diversity, there is a need for further research in LMIC settings with diverse experiences of the nutrition transition. This study tested these relationships in a setting where child overnutrition was low and prevalence of nutrient inadequacies were high, but there is a need to explore USFB consumption patterns and relationships with nutritional outcomes in double burden contexts where over- and undernutrition among children are prevalent. While additional cross-sectional studies can provide further descriptive results to explore these relationships in other LMIC contexts, there is a need for research with study designs that would allow for a better understanding of the causality of these relationships, such as panel or cohort studies.

2) Results from this thesis raise several questions about how USFB consumption relates to young child feeding practices, which would be beneficial for

inclusion in future research. First, though this study did not find a difference in breastfeeding status/median breastfeeding episodes across USFB consumption terciles (**Chapter 6**), it is plausible that USFB has a relationship with breastmilk intake given that consumption of highly energy-dense foods have been shown to reduce breastmilk consumption in some contexts.[205] Without actual quantification of breastmilk consumed, it was not possible to assess any displacement of breastmilk by USFB in this thesis, however, this is an important question that could be answered by future studies. Second, FGD results (**Chapter 4**) pointed to the role of child demand/preference for certain foods and the potential trend of non-nutritive, child-indulgent feeding in Kathmandu Valley. Responsive feeding, defined as a reciprocal relationship whereby a child provides a cue and a caregiver not only recognizes this signal but responds supportively and appropriately, can aid the establishment of healthy dietary behaviors.[206] Non-responsive feeding has been shown to play a role in children's nutritional status in both high-income[207] and LMIC settings.[208] Literature on responsive feeding indicates that certain caregiver practices can modify children's acceptance of/demand for certain foods in low/middle income contexts.[209] Responsive feeding could play an important role in high consumption of USFB among children, either by positive responsive feeding abating overconsumption of these foods or by negative non-responsive feeding enabling overconsumption; there is a need for future studies on this topic to better understand the role of responsive feeding.

3) While much consideration of diet and nutrition during the complementary feeding period has been focused on promoting consumption of nutritious food, this study provides evidence that unhealthy foods are being consumed in quantities that may negatively influence dietary and growth outcomes. In order to begin tracking this diet trend and also create evidence-based policy recommendations to mitigate high unhealthy food consumption among young children, there is a need for additional analyses to develop indicators and nutrition-profiling systems specific for this age group. First, the WHO IYCF indicators currently do not include an indicator of unhealthy diets.

While revisions of the indicators are currently considering the inclusion of sugary/savoury snack food and SSB consumption,[210] modeling could be conducted to identify the food categories that are associated with compromised dietary adequacy for young children in order to refine measurement for such an indicator. Second, this thesis categorized USFB based on nutrient profiling (**Chapter 5**), however, the profiling model used was not specific to nutrient requirements of young children. Future research is needed to assess the 'construct validity' of existing nutrient profiling models for older children in order to evaluate their appropriateness for young children's nutrient requirements and to potentially lead to the development of a model to be used to assess healthiness of all food products during the complementary feeding period.[211,212]

CONCLUSIONS

Findings from this study indicate that high USFB consumption among young children is associated with dietary inadequacy in Kathmandu Valley, which may contribute to poor growth outcomes. In LMIC contexts where the nutrient density of complementary feeding diets is low, addressing the increased availability and use of unhealthy, inexpensive food/beverage products should be a priority for policies and programs aiming to safeguard child nutrition. Local and international food products should be reformulated to improve their healthiness, specifically by lowering their sugar and/or sodium content and improving micronutrient content. National standards for labels should be expanded to provide caregivers with the nutritional information needed to make informed food choices for their children. Finally, strategic messaging to encourage healthy snack foods/beverages should be incorporated into national IYCF and behaviour-change communication strategies, and be tailored and targeted for urban and rural populations in order to address Nepal's transitioning food system.

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Appendix 1: Procedures for structured observations and forms

Structured observations of children 12-23 months of age

ARCH Nepal – Snack study protocol

Helen Keller International

Objective: The intention of this component of the research is to rapidly assess 1) caregivers' use of commercial and non-commercial snack foods and beverages for infant and young child feeding; 2) the context in which children consume these foods and 3) how well caregivers' recall their child's food/beverage consumption. These findings will be used to inform the design of the tool used in the quantitative survey with caregivers and the methods used in the 24 hour recall during this survey.

Background on method: Observation is considered more accurate than other methods of data collection as a means of documenting what people actually do, rather than what they say they do. Structured observation can also provide rich, contextual detail about target behaviours and how they fit within broader daily routines and the community and household environments. It may also highlight unforeseen barriers and/or desirable behaviours, which could be useful in developing the intervention design.

There are three types of observation: unstructured observation, videoed observation and structured observation. Unstructured observation requires the fieldworkers to take notes throughout the observation process. These should aim to document everything that happens (even if irrelevant to the target behaviour) and the time at which it happens. Videoed observation requires the observer to video all that happens for the duration of the observation period. Structured observation is useful where some information is known about the behaviour as it allows for more detail to be captured about target behaviours and for it to be captured in such a way that it is comparable across households (normally a detailed spreadsheet is used for this). In this study, we will be conducting structured observations.

There are several limitations noted for this methodology: Subject to observer bias; difficult to understand how generalizable the practices of that day were to other days; and time consuming.

Sample size, study population and recruitment: Ten primary caregivers of children 12-23 months of age will be purposively sampled from low income and middle/high income households with different caregiver types. Recruiters will explain the study details to identified caregivers, and obtain consent of those caregivers who agree to participate. Recruiters will then work with the caregivers to identify a day for the observation–within 1-2 days of recruitment; observations will be conducted over a one weekend day and four weekdays to account for day-of-the-week effect. Recruiters will emphasize that nothing is required in preparation for the observation and that the caregiver's activities will be followed with as little disruption as possible.

Process:

1) On the day of observation, consent should be sought from all family members or friends that are likely to be in that setting during the observation.
2) Observations will take place approximately from 7am – 7pm, with 2 field workers in each observation. This will allow field workers to take breaks as needed without missing observation.
3) Field workers should ask the participants before they begin if there is anything they would be unhappy or uncomfortable with them observing. If so, these activities should not be observed.
4) The task of the field worker will be to follow the activities of the primary individual, in this case the child 12-23 months of age. Observers should also take note of the way the primary individual interacts with their environment, objects around them and other individuals in the setting.
5) Field workers should take general notes of all activities that the child is involved in on the first page of the tool. Any time the child is fed or eats anything, the field works should note these details on the second page of the tool.
6) Observers should try to limit their interactions with participants during the observation. Of course a certain degree of small talk is permissible but they must not actively probe the participant about her actions or behaviour or share opinions that may bias his/her actions. They should also avoid assisting the participant and should definitely avoid correcting behaviour.

Unstructured form for activity details during structured observations

Name of observer: _____

Date of observation: _____

Age of child: _____ Sex of child (circle): Male Female

NOTES ON GENERAL ACTIVITES:

TIME	DESCRIPTION OF ACTIVITY

NOTES ON FEEDING ACTIVIES:

TIME	DESCRIPTION OF FOOD -*INGREDIENTS* -*PREPARATION* -*ESTIMATED QUANTITY* - *WHO PREPARED?*	TYPE OF MEAL - SNACK? - KHAJA? - KHANA? - Light or heavy	COMMERCIALLY PRODUCED? - Details? - Brand?	WHO FED CHILD? 1 – MOTHER 2 – MOTHER-IN-LAW 3 – CHILD (SELF) 4 – FATHER 5 – SIBLING	OTHER NOTES: - Context? What is happening? - Responsive feeding? - Utensils or dishes used? - More details the better! ☺

Structured form for details of feeding episodes during structured observations

Interviewer: Interview date: Day of week:				VDC: VDC ward:		Sex of child: Age of child (mths): Caregiver ID:	
Estimated time of consumption	Place of consumption	Food or beverage	Description	Cooking method	Amount consumed	Commercially produced? (Y/N)	Who fed this to the child?

Appendix 2: Pictorial food chart

	बिहान							दिउँसो, साँझ र राती									
	५	६	७	८	९	१०	११	१२	१	२	३	४	५	६	७	८	९
बिस्कुटहरु 																	
चक्लेटहरु 																	
फलफूलहरु 																	
दूध 																	
जउलो वा लिटो 																	
नुनिलो खानेकुरा जस्तै चिप्स, कुरकुरे 																	

Appendix 3: Survey tools (questionnaire and 24hr forms)

INTERVIEW INFORMATION		
Q1. INTERVIEWER ID		
Q2. DATE OF INTERVIEW	_____ / _____ / _____	
Q3. CAREGIVER ID		
Q4. DISTRICT	KATHMANDU BHAKTAPUR LALITPUR	
Q5. MUNICIPALITY		
Q6. MUNICIPALITY WARD		
HOUSEHOLD ROSTER		

DEFINITION OF A HOUSEHOLD

A household is a group of people who live together and take food from the "same pot." In our survey, a household member is someone who has lived in the household at least 6 months (not necessarily the previous 6 months), and at least half of the week in each week in those months.

Even those persons who are not blood relations (such as servants, lodgers, or agricultural laborers) are members of the household if they have stayed in the household at least 3 months of the past 6 months and take food from the "same pot."

Generally, if one person stays more than 3 months out of the last 6 months outside the household, they are not considered household members. We do not include them even if other household members consider them as household members.

Exceptions to these rules should be made for:

Consider as household member

A newborn child less than 3 months old.

Someone who has joined the household through marriage less than 3 months ago.

Servants, lodgers, and agricultural laborers currently in the household and will be staying in the household for a longer period but arrived less than 3 months ago.

Do not consider as household member

A person who died very recently though stayed more than 3 months in last 6 months.

Someone who has left the household through marriage less than 3 months ago.

Servants, lodgers, and agricultural laborers who stayed more than 3 months in last 6 months but left permanently.

This definition of the household is very important. The criteria could be different from other studies you may be familiar with, but you should keep in mind that you should not include those people who do not meet these criteria. Please discuss any questions with your supervisor.

NOW WE WOULD LIKE INFORMATION ON THE DIFFERENT PERSONS WHO USUALLY LIVE IN YOUR HOUSEHOLD. PLEASE TELL ME ABOUT ALL THE PERSONS WHO LIVE IN YOUR HOUSEHOLD, STARTING WITH YOUR CHILD AND THEN YOURSELF, AND THEN THE OTHER HOUSEHOLD MEMBERS.

	Relation to respondent child Respondent child.....….1 Mother of child .....2 Father of child……..…3 Grandmother of child (paternal) .4 Grandfather of child (paternal…..5 Grandmother of child (maternal) 6 Grandfather of child (maternal) ..7 Sister of child.....8 Brother of child.....9 Aunt of child.…….10 Uncle of child.....11 Cousin of child.....12 Not related/ house helper.....13	**Sex** Male=1 Female=2	**What is the age of this household member?** *(**Note**: collect age in completed years; if <5 years, in completed months)*
	HH1	**HH1**	**HH3**
1 (child)	1		
2 (respondent)			
3			
4			
5			
6			
7			
8			
9			
10			
11			

CHILD CHARACTERISTICS		
CH1. WHAT IS THE NAME OF THIS CHILD? *(Do not record the name, simply ask and use name throughout the interview)*		
CH2. DO YOU HAVE A CARD WHERE (NAME'S) VACCINATIONS ARE WRITTEN DOWN THAT I CAN SEE?	1. YES 0. NO	
CH3. WHAT IS THE AGE OF (NAME) IN MONTHS?	_____	
CH4. WHAT IS THE DATE OF BIRTH FOR (NAME)? *(Verify date with child's health card)*	_____ / _____ / _____	
CH4A. (Was the child's date of birth verified with the health card?)	1. YES 0. NO	
CH5. HAS (NAME) RECEIVED ANY IMMUNIZATIONS?	1. YES 0. NO	
NOTE: CHECK HEALTH CARD TO SEE IF ANY IMMUNIZATIONS WERE GIVEN TO THE CHILD. IF SO, ANSWER THE FOLLOWING QUESTIONS BASED ON THE INFORMATION ON THE HEALTH CARD. IF THE CHILD DOES NOT HAVE A HEALTH CARD, ASK THESE QUESTIONS TO THE CAREGIVER.		
CH5A. DID (NAME) RECEIVE A BCG IMMUNIZATION?	1. YES 0. NO 8. DK/CR	(If responded '1' to CH5)
CH5B. DID (NAME) RECEIVE A DPT/HEPATITIS B IMMUNIZATION?	1. YES 0. NO 8. DK/CR	(If responded '1' to CH5)

CH5BA. HOW MANY DOSES OF THE DPT/HEPATITIS B IMMUNIZATION DID (NAME) RECEIVE?	1. FIRST DOSE 2. SECOND DOSE 3. THIRD DOSE	(If responded '1' to CH5A)
CH5C. DID (NAME) RECEIVE A POLIO IMMUNIZATION?	1. YES 0. NO 8. DK/CR	(If responded '1' to CH5)
CH5CA. HOW MANY DOSES OF THE POLIO IMMUNIZATION DID (NAME) RECEIVE?	1. FIRST DOSE 2. SECOND DOSE 3. THIRD DOSE	(If responded '1' to CH5B)
CH5D. DID (NAME) RECEIVE A MEASLES IMMUNIZATION?	1. YES 0. NO 8. DK/CR	(If responded '1' to CH5)
CH6. WHAT WAS THE BIRTHWEIGHT OF (NAME) IN KILOGRAMS? *(Enter '88' if caregiver can't remember/does not know)*	_____	(If responded '1' to CH2)
NOTE: NO MORE INFORMATION REQUIRED FROM THE HEALTH CARD, THIS CAN BE RETURNED TO THE CAREGIVER.		
CH7. HAS (NAME) EVER BEEN BREASTFED?	1. YES 0. NO	
CH8A. DID (NAME) RECEIVE BREASTMILK YESTERDAY DURING THE DAY OR NIGHT?	1. YES 0. NO	(If responded '1' to CH7)
CH8B. HOW MANY FEEDS OF BREASTMILK DID (NAME) RECEIVE YESTERDAY, DURING THE DAY OR NIGHT?	_____	(If responded '1' to CH8A)
CH9. WAS (NAME) GIVEN ANY DRUG FOR INTESTINAL WORMS IN THE LAST SIX MONTHS?	1. YES 0. NO	

CH10. DID (NAME) RECEIVE A VITAMIN A CAPSULE DURING THE LAST VITAMIN A CAMPAIGN?	1. YES 0. NO	
CH11. HAS (NAME) HAD DIARRHEA IN THE LAST TWO WEEKS?	1. YES 0. NO	
CH11A. WHEN (NAME) HAD DIARRHEA, WAS HE/SHE GIVEN LESS THAN USUAL TO DRINK (INCLUDING BREASTMILK), ABOUT THE SAME AMOUNT, MORE THAN USUAL, OR NOTHING TO DRINK? *(If less, Probe: Was he/she given much less than usual or somewhat less)*	1. MUCH LESS 2. SOMEWHAT LESS 3. ABOUT THE SAME 4. MORE 5. NOTHING TO DRINK 8. DON'T KNOW/CAN'T REMEMBER	(If responded '1' to CH11)
CH11B. WHEN (NAME) HAD DIARRHEA, WAS HE/SHE GIVEN LESS THAN USUAL TO EAT, ABOUT THE SAME AMOUNT, MORE THAN USUAL, OR NOTHING TO EAT? *(If less, Probe: Was he/she given much less than usual or somewhat less)*	1. MUCH LESS 2. SOMEWHAT LESS 3. ABOUT THE SAME 4. MORE 5. NOTHING TO EAT 8. DON'T KNOW/CAN'T REMEMBER	(If responded '1' to CH11)
CH12. HAS (NAME) BEEN ILL WITH A FEVER AT ANY TIME IN THE LAST TWO WEEKS?	1. YES 0. NO	
CH12A. WHEN (NAME) HAD A FEVER, WAS HE/SHE GIVEN LESS THAN USUAL TO DRINK (INCLUDING BREASTMILK), ABOUT	1. MUCH LESS 2. SOMEWHAT LESS 3. ABOUT THE SAME 4. MORE 5. NOTHING TO DRINK	(If responded '1' to CH12)

THE SAME AMOUNT, MORE THAN USUAL, OR NOTHING TO DRINK? *(If less, Probe: Was he/she given much less than usual or somewhat less)*	8. DON'T KNOW/CAN'T REMEMBER	
CH12B. WHEN (NAME) HAD A FEVER, WAS HE/SHE GIVEN LESS THAN USUAL TO EAT, ABOUT THE SAME AMOUNT, MORE THAN USUAL, OR NOTHING TO EAT? *(If less, Probe: Was he/she given much less than usual or somewhat less)*	1. MUCH LESS 2. SOMEWHAT LESS 3. ABOUT THE SAME 4. MORE 5. NOTHING TO EAT 8. DON'T KNOW/CAN'T REMEMBER	(If responded '1' to CH12)
CH13. HAS (NAME) HAD AN ILLNESS WITH A COUGH AT ANY TIME IN THE LAST TWO WEEKS?	1. YES 0. NO	
CH13A. WHEN (NAME HAD AN ILLNESS WITH A COUGH, DID HE/SHE BREATHE FASTER THAN USUAL WITH SHORT, RAPID BREATHS OR HAVE DIFFICULTY BREATHING?	1. YES 0. NO	(If responded '1' to CH13)
CH13B. WAS THE FAST OR DIFFICULT BREATHING DUE TO A PROBLEM IN THE CHEST OR TO A BLOCKED OR RUNNY NOSE?	1. CHEST ONLY 2. NOSE ONLY 3. BOTH 8. DON'T KNOW	(If responded '1' to CH13A)
CH13C. WHEN (NAME) HAD A COUGH, WAS HE/SHE GIVEN LESS THAN USUAL TO DRINK (INCLUDING BREASTMILK), ABOUT THE SAME AMOUNT,	1. MUCH LESS 2. SOMEWHAT LESS 3. ABOUT THE SAME 4. MORE 5. NOTHING TO DRINK	(If responded '1' to CH13)

MORE THAN USUAL, OR NOTHING TO DRINK? *(If less, Probe: Was he/she given much less than usual or somewhat less)*	8. DON'T KNOW/CAN'T REMEMBER	
CH13D. WHEN (NAME) HAD A COUGH, WAS HE/SHE GIVEN LESS THAN USUAL TO EAT, ABOUT THE SAME AMOUNT, MORE THAN USUAL, OR NOTHING TO EAT? *(If less, Probe: Was he/she given much less than usual or somewhat less)*	1. MUCH LESS 2. SOMEWHAT LESS 3. ABOUT THE SAME 4. MORE 5. NOTHING TO EAT 8. DON'T KNOW/CAN'T REMEMBER	(If responded '1' to CH13)
SECONDARY CAREGIVERS		
SC1. DO YOU EVER LEAVE (NAME) WITH SOMEONE ELSE IF YOU ARE NOT AVAILABLE TO TAKE CARE OF (NAME)?	1. YES 0. NO	
SC2. In a month, how often do you usually leave (name) with someone else? Once a month, once a week, several days a week, or everyday?	1. ONCE A MONTH 2. ONCE A WEEK 3. SEVERAL DAYS A WEEK 4. EVERYDAY	(If responded '1' SC1)
SC3. IN A DAY WHEN YOU LEAVE (NAME) WITH SOMEONE ELSE, HOW LONG DO YOU USUALLY LEAVE (NAME)? (Enter number of hours; if response is less than 1 hour enter '0'. If respondent doesn't know/can't remember enter '88')	_____	(If responded '1' SC1)

SC4. WHO IS THE PERSON YOU MOST OFTEN LAVE (NAME) WITH? (*Do not read out responses, select response provided; select only one)*	1. MOTHER OF CHILD 2. GRANDMOTHER OF CHILD 3. AUNT OF THE CHILD 4. UNCLE OF THE CHILD 5. SISTER/BROTHER OF CHILD 6. FATHER OF CHILD 7. GRANDFATHER OF CHILD 8. DAYCARE 9. HOUSE HELPER 10. OTHER (SPECIFY)	(If responded '1' SC1)
SC4A. WHAT IS THE AGE OF THE SISTER/BROTHER OF THE CHILD YOU MOST OFTEN LEAVE (NAME) WITH?	_____	(If responded '5' to SC4)
SC4SPE. OTHER SPECIFY	_____	(If responded '8' to SC4)
SC5. WHAT DOES THIS PERSON DO TO CARE FOR (NAME) WHEN YOU ARE NOT AVAILABLE? (*Do not read out responses, select response provided; select all that apply)*	1. FEED THE CHILD 2. BATHE THE CHILD 3. PLAY WITH THE CHILD 4. WATCH THE CHILD 5. MASSAGE THE CHILD 6. OTHER (SPECIFY) 8. DON'T KNOW	(If responded '1' SC1)
SC5SPE. OTHER SPECIFY	_____	(If responded '6' to SC5)

CAREGIVER CHARACTERISTICS		
C1. OF THE CHILDREN 59 MONTHS OF AGE AND YOUNGER RESIDING IN YOUR HOUSEHOLD, HOW MANY ARE YOU THE PRIMARY CAREGIVER OF?	_____	

C3. HOW OLD WERE YOU AT YOUR LAST BIRTHDAY?	_____	
C4. HAVE YOU EVER ATTENDED SCHOOL?	1. YES 0. NO	
C4A. WHAT WAS THE HIGHEST GRADE YOU COMPLETED? *(If did not complete Grade 1, enter '0'; if cannot remember enter '88')*	_____	(If responded '1' to C4)
C4B. HIGHEST LEVEL OF SCHOOL COMPLETED *(Choose appropriate option from highest grade reported in C4A)*	1. PRIMARY (1-7) 2. SECONDARY (8-10) 3. HIGHER SECONDARY (11-12) 4. UNIVERSITY AND ABOVE (BA, MA) 5. NON-FORMAL EDUCATION 8. DON'T KNOW/CAN'T REMEMBER	(If responded '1' to C4)
C5. ARE YOU THE HEAD OF YOUR HOUSEHOLD?	1. YES 0. NO	
C5A. IS THE HEAD OF YOUR HOUSEHOLD MALE OR FEMALE? *(If caregiver is HH head, do not ask but note by yourself)*	1. MALE 2. FEMALE	
C5B. HAS THE HEAD OF YOUR HOUSEHOLD EVER ATTENDED SCHOOL?	1. YES 0. NO	(If responded '0' to C5)
C5C. WHAT WAS THE HIGHEST GRADE THEY COMPLETED? *(If did not complete Grade 1, enter '0;'if cannot remember enter '88')*	_____	(If responded '0' to C5 and '1' to C5B)

C5D. HIGHEST LEVEL OF SCHOOL COMPLETED *(Choose appropriate option from highest grade reported in M8A)*	1. PRIMARY (1-7) 2. SECONDARY (8-10) 3. HIGHER SECONDARY (11-12) 4. UNIVERSITY AND ABOVE (BA, MA) 8. DON'T KNOW/CAN'T REMEMBER	(If responded '0' to C5 and '1' to C5B)
C6. ARE YOU CURRENTLY MARRIED OR LIVING WITH A MAN AS IF MARRIED?	1. YES, CURRENTLY MARRIED 2. YES, CURRENTLY LIVING WITH A MAN 0. NO	
C6A. HAVE YOU EVER BEEN MARRIED OR LIVED TOGETHER WITH A MAN AS IF MARRIED?	1. YES, FORMERLY MARRIED 2. YES, FORMERLY LIVED WITH A MAN 0. NO	(If responded '0' to C6)
C6B. WHAT IS YOUR MARITAL STATUS NOW: ARE YOU WIDOWED, DIVORCED, OR SEPARATED?	1. WIDOWED 2. DIVORCED 3. SEPARATED	(If responded '1' or '2' to C6A)
C6C. ARE YOU CURRENTLY PREGNANT?	1. YES 0. NO 8. DON'T KNOW	
C7. WHAT IS YOUR RELIGION?	1. HINDU 2. BUDDHIST 3. MUSLIM 4. KIRAT 5. CHRISTIAN 6. OTHER (SPECIFY)	
C7spe. SPECIFY OTHER RELIGION:	_____	(If responded '6' to C7)
C8. WHAT IS YOUR CASTE/ETHNICITY?	_____	
C8A. CODE CASTE/ETHNICITY (Refer to caste/ethnicity sheet for categories)	1. DALIT 2. DISADVANTAGED JANAJATI 3. DISADVANTAGED NON-DALIT TERAI CASTE 4. RELIGIOUS MINORITY 5. ADVANTAGED JANAJATI 6. UPPER CASTE	

C9. WHAT IS THE MAIN SOURCE OF DRINKING WATER FOR MEMBERS OF YOUR HOUSEHOLD?	1. PIPED INTO DWELLING 2. PIPED TO YARD/PLOT 3. PUBLIC TAP/STANDPIPE 4. TUBE WELL OR BOREHOLE 5. PROTECTED WELL 6. UNPROTECTED WELL 7. PROTECTED SPRING 8. UNPROTECTED SPRING 9. RAINWATER 10. TANKER TRUCK 11. SURFACE WATER 12. BOTTLED WATER 13. OTHER (SPECIFY)	
C9spe. SPECIFY OTHER SOURCE OF DRINKING WATER:	_____	(If responded '13' to C9)
C10. DOES YOUR HOUSEHOLD HAVE: (Check all that apply)	1. RADIO 2. TELEVISION 3. MOBILE TELEPHONE 4. NON-MOBILE TELEPHONE 5. REFRIGERATOR 6. TABLE 7. CHAIR 8. BED 9. SOFA 10. CUPBOARD 11. COMPUTER/LAPTOP 12. CLOCK 13. FAN 14. DHIKI/JANTO	
C10A. DOES ANY MEMBER OF THIS HOUSEHOLD OWN: (Check all that apply)	1. WATCH 2. BICYCLE/RICKSHAW 3. MOTORCYCLE/SCOOTER 4. THREE-WHEEL TEMPO 5. ANIMAL-DRAWN CART 6. CAR OR TRUCK	
CH10B. WHAT IS YOUR HOUSEHOLD'S MAIN SOURCE OF ENERGY FOR COOKING?	1. ELECTRICITY 2. LPG 3. FIREWOOD 4. BIOGAS 5. KEROSENE 6. ANIMAL DUNG 7. DRIED LEAVES/STRAW 9. OTHER (SPECIFY)	

C10Bspe. SPECIFY OTHER SOURCE OF ENERGY		(If responded '9' to CH10B)
CH10C. DOES YOUR HOUSEHOLD OWN THE HOUSE YOU LIVE IN, USE IT FOR FREE, OR RENT IT?	1. OWN 2. FREE USE 3. RENT	
C11. MAIN MATERIAL OF THE FLOOR: *(Observe and record)*	1. EARTH/SAND 2. DUNG 3. WOOD PLANKS 4. PALM/BAMBOO 5. PARQUET OR POLISHED WOOD 6. VINYL OR ASPHALT STRIPS 7. CERAMIC TILES 8. CEMENT 9. CARPET 10. OTHER (SPECIFY)	
C11spe. SPECIFY OTHER MATERIAL OF FLOOR:	_____	(If responded '10' to C10)
C12. MAIN MATERIAL OF THE ROOF: *(Observe and record)*	1. NO ROOF 2. THATCH/PALM LEAF 3. RUSTIC MAT 4. PALM/BAMBOO 5. WOOD PLANKS 6. CARDBOARD 7. GALVANIZED SHEET 8. WOOD 9. CALAMINE/CEMENT FIBER 10. CERAMIC TILES 11. CEMENT 12. ROOFING SHINGLES 13. OTHER (SPECIFY)	
C12spe. SPECIFY OTHER MATERIAL OF ROOF:	_____	(If responded '13' to C12)
C13. MAIN MATERIAL OF THE EXTERIOR WALLS: *(Observe and record)*	1. NO WALLS 2. CANE/PALM/TRUNKS 3. MUD/SAND 4. BAMBOO WITH MUD 5. STONE WITH MUD 6. PLYWOOD 7. CARDBOARD 8. REUSED WOOD 9. CEMENT 10. STONE WITH LIME/CEMENT 11. BRICKS	

	12. CEMENT BLOCKS 13. WOOD PLANKS/SHINGLES 14. OTHER (SPECIFY)	
C13spe. SPECIFY OTHER MATERIAL OF EXTERIOR WALLS:	_____	(If responded '14' to C13)
C14. HOW MANY ROOMS IN THIS HOUSEHOLD ARE USED FOR SLEEPING?	_____	
C15. DOES ANY MEMBER OF THIS HOUSEHOLD HAVE A BANK ACCOUNT/COOPERATIVE/OR OTHER SAVINGS ACCOUNT?	1. YES 0. NO 8. DON'T KNOW	
C16. HAVE YOU DONE ANY PAID WORK IN THE LAST SEVEN DAYS?	1. YES 0. NO	
C16A. ALTHOUGH YOU DID NOT DO ANY PAID WORK IN THE LAST SEVEN DAYS, DO YOU HAVE ANY PAID JOB OR BUSINESS FROM WHICH YOU WERE ABSENT FOR LEAVE, ILLNESS, VACATION OR ANY OTHER SUCH REASON?	1. YES 0. NO	(If responded '0' to C16)
C16B. HAVE YOU DONE ANY PAID? WORK IN THE LAST 12 MONTHS?	1. YES 0. NO	(If responded '0' to C16)
C16C. WHAT IS YOUR OCCUPATION, THAT IS, WHAT KIND OF PAID WORK DO YOU MAINLY DO?	1. PROFESSIONAL/TECHNICAL/ MANAGERIAL 2. CLERICAL 3. SALES AND SERVICES 4. SKILLED MANUAL 5. UNSKILLED MANUAL 6. AGRICULTURE 7. OTHER (SPECIFY)	(If responded '1' to C16 OR if responded '1' to C16B)

C16Cspe. SPECIFY OTHER KIND OF WORK:	_____	(If responded '7' to C16C)
C16D. DO YOU DO THIS PAID WORK INSIDE YOUR HOME OR ELSEWHERE?	1. IN HOME 2. ELSEWHERE	(If responded '1' to C16 OR if responded '1' to C16B)
MIGRATION AND REMITTANCES		
M1. ARE THERE ANY PEOPLE THAT ARE NOT CURRENT HOUSEHOLD MEMBERS BUT WERE HOUSEHOLD MEMBERS SOMETIME IN THE PAST 2 YEARS AND ARE EXPECTED TO COME BACK TO THIS HOUSEHOLD?	0. NO 1. YES	
M2. WHAT IS THE RELATION OF THIS PERSON OR THESE PEOPLE TO YOUR CHILD? *(Select all responses given by the caregiver)*	1. FATHER 2. MOTHER 3. GRANDFATHER 4. GRANDMOTHER 5. AUNT 6. UNCLE 7. BROTHER 8. SISTER 9. OTHER (SPECIFY)	(If responded '1' to M1)
M2SPE. SPECIFY OTHER RELATIONSHIP TO CHILD:	_____	(If responded '9' to M2)
M2A. HOW LONG AGO DID THE CHILD'S _____ LEAVE THIS HOUSEHOLD? *(If less than 1 year, enter the number of months not years. If less than 1 month write '0' in the months section)*	_____ YEARS _____ MONTHS	(If responded '1' to M2)
M2B. WHAT COUNTRY DOES THE CHILD'S _____ LIVE IN NOW?	1. NEPAL 2. INDIA 3. BHUTAN 4. CHINA	(If responded '1' to M2)

	5. BANGLADESH 6. HONG KONG 7. MALAYSIA 8. JAPAN 9. SAUDI ARABIA 10. QATAR 11. UNITED ARAB EMIRATES 12. UNITED KINGDOM 13. UNITED STATES OF AMERICA 14. SOUTH KOREA 15. AUSTRALIA 16. ISRAEL 17. OTHER (SPECIFY)	
M2BSPE. SPECIFY OTHER PLACE WHERE CHILD'S _____ WORKS:	_____	(If responded '17' to M2B)
M2C. IS IT AN URBAN OR RURAL AREA?	1. URBAN 2. RURAL 3. DON'T KNOW	(If responded '1' to M2)
M2D. WHAT IS THE MAIN REASON WHY THE CHILD'S _____ LEFT THIS HOUSEHOLD?	1. TO BE TOGETHER WITH FAMILY/RELATIVES 2. OTHER FAMILY REASONS 3. EDUCATION 4. TRAINING 5. LOOKING FOR WORK 6. START NEW JOB 7. START NEW BUSINESS 8. JOB TRANSFER 9. CONFLICT/WAR 10. NATURAL DISASTER 11. EASIER LIFESTYLE 12. OTHER	(If responded '1' to M2)
M2E. IS THE CHILD'S _____ WORKING WHERE THEY ARE NOW?	0. NO 1. YES	(If responded '1' to M2)
M2F. WHAT IS THE PRIMARY TYPE OF JOB OF THE CHILD'S _____? *(Select job category based on response provided)*	2. PROFESSIONAL/TECHNICAL/MANAGERIAL 3. CLERICAL 4. SALES AND SERVICES 5. SKILLED MANUAL 6. UNSKILLED MANUAL 7. AGRICULTURE 9.OTHER (SPECIFY)	(If responded '1' to M2E)

M2FSPE. SPECIFY TYPE OF JOB CHILD'S _____ HAS:	_____	(If responded '9' to M2F)
M2G. DURING THE PAST 12 MONTHS, HAVE THE MEMBERS OF THIS HOUSEHOLD RECEIVED MONEY OR GOODS FROM THE CHILD'S _____?	0. NO 1. YES	(If responded '1' to M2)
M2GA. WHAT WAS RECEIVED, MONEY OR GOODS OR BOTH? *(Select all that apply)*	1. MONEY 2. GOODS	(If responded '1' to M2G)
M2H. HOW MANY TIMES DID THE MEMBERS OF THIS HOUSEHOLD RECEIVE MONEY OR GOOD FROM THE CHILD'S _____ DURING THE PAST 12 MONTHS?	_____	(If responded '1' to M2G)
M2HA. HOW MUCH MONEY DID THE HOUSEHOLD MEMBERS RECEIVE FROM THE CHILD'S _____ DURING THE PAST 12 MONTHS?	_____ Nepalese Rupees	(If responded '1' to M2GA)
M2HB. WHAT IS THE VALUE OF ALL THE GOODS RECEIVED BY THE HOUSEHOLD MEMBERS FROM THE CHILD'S _____ DURING THE PAST 12 MONTHS?	_____ Nepalese Rupees	(If responded '2' to M2GA)

M2HC. WHAT WAS THE USE OF THE MONEY RECEIVED FROM THE CHILD'S _____ DURING THE PAST 12 MONTHS? *(Select the two most important to the respondent)*	1. Daily use (food or other consumables) 2. Education 3. Business 4. Investment 5. Household assets/durables 6. Savings 7. Repay a loan 8. Marriage/burial expenses 9. Other (specify)	(If responded '1' to M2GA)
M2HCSPE. SPECIFY OTHER USE OF REMITTANCES FROM CHILD'S _____:	_____	(If responded '9' to M2HC)
HOUSEHOLD FOOD SECURITY		
H.1 IN THE PAST FOUR WEEKS, DID YOU WORRY THAT YOUR HOUSEHOLD WOULD NOT HAVE ENOUGH FOOD?	1. YES 0. NO	
H1A. HOW OFTEN DID THIS HAPPEN?	1. RARELY (ONCE OR TWICE IN THE PAST FOUR WEEKS) 2. SOMETIMES (THREE TO TEN TIMES IN THE PAST FOUR WEEKS) 3. OFTEN (MORE THAN TEN TIMES IN THE PAST FOUR WEEKS)	(If responded '1' to H1)
H2. IN THE PAST FOUR WEEKS, WERE YOU OR ANY HOUSEHOLD MEMBER NOT ABLE TO EAT THE KINDS OF FOODS YOU PREFERRED BECAUSE OF A LACK OF RESOURCES?	1. YES 0. NO	
H2A. HOW OFTEN DID THIS HAPPEN?	1. RARELY (ONCE OR TWICE IN THE PAST FOUR WEEKS) 2. SOMETIMES (THREE TO TEN TIMES IN THE PAST FOUR WEEKS) 3. OFTEN (MORE THAN TEN TIMES IN THE PAST FOUR WEEKS)	(If responded '1' to H2)

H3. IN THE PAST FOUR WEEKS, DID YOU OR ANY HOUSEHOLD MEMBER HAVE TO EAT A LIMITED VARIETY OF FOODS DUE TO A LACK OF RESOURCES?	1. YES 0. NO	
H3A. HOW OFTEN DID THIS HAPPEN?	1. RARELY (ONCE OR TWICE IN THE PAST FOUR WEEKS) 2. SOMETIMES (THREE TO TEN TIMES IN THE PAST FOUR WEEKS) 3. OFTEN (MORE THAN TEN TIMES IN THE PAST FOUR WEEKS)	(If responded '1' to H3)
H4. IN THE PAST FOUR WEEKS, DID YOU OR ANY HOUSEHOLD MEMBER HAVE TO EAT SOME FOODS THAT YOU REALLY DID NOT WANT TO EAT BECAUSE OF A LACK OF RESOURCES TO OBTAIN OTHER TYPES FO FOOD?	1. YES 0. NO	
H4A. HOW OFTEN DID THIS HAPPEN?	1. RARELY (ONCE OR TWICE IN THE PAST FOUR WEEKS) 2. SOMETIMES (THREE TO TEN TIMES IN THE PAST FOUR WEEKS) 3. OFTEN (MORE THAN TEN TIMES IN THE PAST FOUR WEEKS)	(If responded '1' to H4)
H5. IN THE PAST FOUR WEEKS, DID YOU OR ANY HOUSEHOLD MEMBER HAVE TO EAT A SMALLER MEAL THAN YOU FELT YOU NEEDED BECAUSE THERE WAS NOT ENOUGH FOOD?	1. YES 0. NO	
H5A. HOW OFTEN DID THIS HAPPEN?	1. RARELY (ONCE OR TWICE IN THE PAST FOUR WEEKS) 2. SOMETIMES (THREE TO TEN TIMES IN THE PAST FOUR WEEKS)	(If responded '1' to H5)

	3. OFTEN (MORE THAN TEN TIMES IN THE PAST FOUR WEEKS)	
H6. IN THE PAST FOUR WEEKS, DID YOU OR ANY HOUSEHOLD MEMBER HAVE TO EAT FEWER MEALS IN A DAY BECAUSE THERE WAS NOT ENOUGH FOOD?	1. YES 0. NO	
H6A. HOW OFTEN DID THIS HAPPEN?	1. RARELY (ONCE OR TWICE IN THE PAST FOUR WEEKS) 2. SOMETIMES (THREE TO TEN TIMES IN THE PAST FOUR WEEKS) 3. OFTEN (MORE THAN TEN TIMES IN THE PAST FOUR WEEKS)	(If responded '1' to H6)
H7. IN THE PAST FOUR WEEKS, WAS THERE EVER NO FOOD TO EAT OF ANY KIND IN YOUR HOUSEHOLD BECAUSE OF LACK OF RESOURCES TO GET FOOD?	1. YES 0. NO	
H7A. HOW OFTEN DID THIS HAPPEN?	1. RARELY (ONCE OR TWICE IN THE PAST FOUR WEEKS) 2. SOMETIMES (THREE TO TEN TIMES IN THE PAST FOUR WEEKS) 3. OFTEN (MORE THAN TEN TIMES IN THE PAST FOUR WEEKS)	(If responded '1' to H7)
H8. IN THE PAST FOUR WEEKS, DID YOU OR ANY HOUSEHOLD MEMBER GO TO SLEEP AT NIGHT HUNGRY BECAUSE THERE WAS NOT ENOUGH FOOD?	1. YES 0. NO	
H8A. HOW OFTEN DID THIS HAPPEN?	1. RARELY (ONCE OR TWICE IN THE PAST FOUR WEEKS) 2. SOMETIMES (THREE TO TEN TIMES IN THE PAST FOUR WEEKS)	(If responded '1' to H8)

	3. OFTEN (MORE THAN TEN TIMES IN THE PAST FOUR WEEKS)	
H9. IN THE PAST FOUR WEEKS, DID YOU OR ANY HOUSEHOLD MEMBER GO A WHOLE DAY AND NIGHT WITHOUT EATING ANYTHING BECAUSE THERE WAS NOT ENOUGH FOOD?	1. YES 0. NO	
H9A. HOW OFTEN DID THIS HAPPEN?	1. RARELY (ONCE OR TWICE IN THE PAST FOUR WEEKS) 2. SOMETIMES (THREE TO TEN TIMES IN THE PAST FOUR WEEKS) 3. OFTEN (MORE THAN TEN TIMES IN THE PAST FOUR WEEKS)	(If responded '1' to H9)

COMMERCIAL FOOD USE		
FF1. DID ***(NAME)*** EAT ANY BISCUITS/COOKIES IN THE LAST WEEK?	YES..... 1 NO..... 2 (Skip to FF2) DK/CAN'T REMEMBER .....8 (Skip to FF2)	
FF1A. HOW OFTEN? *(Read options out loud and check one that applies)*	Every day.....1 Most days (at least 4 days per week).....2 Approximately once a week (less than 4 days but at least once per week) .....3 Seldom (less often than once a week) ……...4 Never.....5	
FF2. DID ***(NAME)*** EAT ANY ANY SAVORY SNACKS (CHIPS, CRISPS) IN THE LAST WEEK?	YES..... 1 NO..... 2 (Skip to FF3) DK/CAN'T REMEMBER .....8 (Skip to FF3)	
FF2A. HOW OFTEN? *(Read options out loud and check one that applies)*	Every day.....1 Most days (at least 4 days per week).....2 Approximately once a week (less than 4 days but at least once per week) .....3 Seldom (less often than once a week) ……...4	

	Never..... 5	
FF3. DID ***(NAME)*** EAT ANY CAKE/DOUGHNUTS/SPONGECAKE IN THE LAST WEEK?	YES..... 1 NO..... 2 (Skip to FF4) DK/CAN'T REMEMBER .....8 (Skip to FF4)	
FF3A. HOW OFTEN? *(Read options out loud and check one that applies)*	Every day.....1 Most days (at least 4 days per week).....2 Approximately once a week (less than 4 days but at least once per week) .....3 Seldom (less often than once a week) ……...4 Never..... 5	
FF4. DID ***(NAME)*** EAT ANY CANDY/SWEETS/CHOCOLATE IN THE LAST WEEK?	YES..... 1 NO..... 2 (Skip to FF5) DK/CAN'T REMEMBER .....8 (Skip to FF5)	
FF4A. HOW OFTEN? *(Read options out loud and check one that applies)*	Every day.....1 Most days (at least 4 days per week).....2 Approximately once a week (less than 4 days but at least once per week) .....3 Seldom (less often than once a week) ……...4 Never..... 5	
FF5. DID ***(NAME)*** EAT ANY SOFT DRINKS IN THE LAST WEEK?	YES..... 1 NO..... 2 (Skip to FF6) DK/CAN'T REMEMBER .....8 (Skip to FF6)	
FF5A. HOW OFTEN? *(Read options out loud and check one that applies)*	Every day.....1 Most days (at least 4 days per week).....2 Approximately once a week (less than 4 days but at least once per week) .....3 Seldom (less often than once a week) ……...4 Never..... 5	
FF6. DID ***(NAME)*** EAT ANY CHOCOLATE/MALT-	YES..... 1 NO..... 2 (Skip to FF7)	

BASED DRINKS IN THE LAST WEEK?	DK/CAN'T REMEMBER .....8 (Skip to FF7)	
FF46. HOW OFTEN? *(Read options out loud and check one that applies)*	Every day.....1 Most days (at least 4 days per week).....2 Approximately once a week (less than 4 days but at least once per week) .....3 Seldom (less often than once a week) ……...4 Never.....5	
FF7. DID ***(NAME)*** EAT ANY FRUIT DRINKS IN THE LAST WEEK?	YES..... 1 NO..... 2 (End) DK/CAN'T REMEMBER .....8 (End)	
FF7A. HOW OFTEN? *(Read options out loud and check one that applies)*	Every day.....1 Most days (at least 4 days per week).....2 Approximately once a week (less than 4 days but at least once per week) .....3 Seldom (less often than once a week) ……...4 Never.....5	

Interviewer ID: _____ Caregiver ID:_____

24-Hour Recall First Pass

Now I'd like to ask you some questions about the foods and beverages your young child consumed yesterday. I'd like you to think about everything the child ate or drank, beginning when they first woke up in the morning, then all through the day until they went to sleep in the evening.

	Time	Food & Drink
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		

Did the caregiver use the recall aid? YES: [_____] NO: [_____]

If YES, write an 'X' next to the foods that were added because of the recall aid.

24-Hour Recall Second, Third and Fourth Passes

1) Weight of child's bowl #1:_____ 2) Weight of child's cup:_____ 3) Weight of plastic bata_____

	1st pass	2nd pass						3rd pass							
#	Food or dish	Description (use probes) - Dish or combo? - Ingredients? - Color, variety, size?	Cooking Method (code)	Comm Brand (Y/N)	Place Eaten (code)	Who gave child? (code)	Khana (Y/N)	Recipe prepared in pot	Recipe pot	Child served	Child Left-over	Combo?	Utensil (code)	Units	Food model (code)

LITO OR KWATI RECIPE				
Ingredients	**Weight of ingredient used in recipe**	**Utensil (code)**	**Units**	**Food model (code)**

Codes for 2nd Pass:

Cooking method	**Place eaten**	**Who fed the child**
1. Raw/not cooked 2. Boiled/pressure cooked 3. Fried (deep or shallow) 4. Grilled 5. Baked/roasted 6. Other (specify)	1 - At home 2 - At relative/friend/neighbor home 3 - Outdoors 4 - Daycare/preschool 5 - Restaurant 6 - Other (specify)	1 - Mother 2 - Grandmother 3 - Father 4 - Sibling 5 - Aunt 6 - Uncle 7 - Grandfather 8 - Helper 9 - Self 10 - Neighbor child 11 - Neighbor adult 12 - Other (specify)

Codes for 3rd Pass:

Units	Model	
g – grams Kg – kilogram P – pieces Pac – packet cm – centimeters S – segments Cu – cup (ice cream) Co – cone (ice cream) Sli – slice (carrot, radish, cucumber)	1 - Water 2 - Play dough 3 - Boiled rice 4 - Beaten rice 5 - Raw rice 6 - Puffed rice 7 - Sugar 8 - Wheat flour	9 - Roasted peanuts 10 - Actual food as eaten 11 - Actual food in package or skin 12 - # 13 - Length (ruler)

Appendix 4: Portion size/food model guide

COMMON DISHES:

Dish	Probes	Best portion size	Alternative portion size
PLAIN RICE	• What color? • What variety? • Was it parboiled?	• Use boiled rice	------
JAULO	• What are the ingredients?	• Use a water model	------
KHICHIDI	• What are the ingredients?	• Use a water model	------
LITO	• Is it home-made or commercial? (collect recipe if home-made) • If home-made, what ingredients went into the powder? • If commercial, what brand? • What liquid did you cook it with? (if any, ingredient) • Did you add anything to it? (if any, ingredient)	• Use a water model	------
RICE AND MILK	• What are the ingredients?	• Use a water model	------
RICE AND SHREDDED MEAT	• What are the ingredients?	• Use boiled rice	
BEATEN RICE AND MILK	• What are the ingredients?	• Use a water model	------
BEATEN RICE AND CURD	• What are the ingredients?	• Use boiled rice	------

Dish	Probes	Best portion size	Alternative portion size
BISCUITS AND MILK	• Was anything added to the milk? (ex. sugar – if any, the milk becomes a mixed dish) • Were the biscuits and milk combined in a dish?		
	• If in a dish together	• This is mixed dish: Use a water model for milk and use water model again for milk+biscuits	------
	• If **not** in a dish together	• This is not a mixed dish, measure each ingredient as single	
KHEER	• What are the ingredients?	• Use a water model	------
HALUWA	• What are the ingredients? • What type of flour?	• Use boiled rice	------
GAJAR/FARSI HALUWA	• What type of haluwa? • What are the ingredients?	• Use boiled rice	------
ROTI	• Was it small, medium or large? • What type of flour? • Were any other ingredients added to the dough?	• Use prepared roti from home	• # of roti • Use play-dough if only small bites given
PURI	• Was it small, medium or large? • What type of flour? • Were any other ingredients added to the dough?	• Use prepared puri from home	• # of puri • Use play-dough if only small bites given
PANCAKE	• Was it small, medium or large? • What type of flour? • What are the ingredients?	• Use prepared pancake from home	• # of pancake • Use play-dough if only small bites given
PARATHA	• Was it small, medium or large? • What type of flour? • Was it stuffed or plain? • If stuffed, what are the ingredients?	• Use prepared paratha from home	• # of paratha • Use play-dough if only small bites given

Dish	Probes	Best portion size	Alternative portion size
PULAO	• What are the ingredients?	• Use boiled rice	------
FRIED RICE	• What are the ingredients?	• Use boiled rice	------
NOODLE DISH	• Was it cooked or uncooked? • If cooked, how was it prepared? • What are the ingredients?		
	• If soup, were only noodles or only broth eaten? Or both?	• Use a water model	------
	• If fried/gravy →	• Use boiled rice	------
	• If uncooked →	• Use actual noodles	• # of packet
DAL	• What are the ingredients?	• Use a water model	------
TARKARI	• What type of tarkari was it? • What are the ingredients? • How was it prepared (soup, gravy or fry)?		
	• If soup →	• Use a water model	------
	• If gravy →	• Use boiled rice	------
	• If fry →	• Use peanuts	------
ACHAR	• What type of achar was it? • What are the ingredients? • Is it soupy or chunky (boiled potato)?	• Use a water model if soupy • Use peanuts if chunky	------

Dish	Probes	Best portion size	Alternative portion size
SAAG	• What type of saag was it? • What are the ingredients? • Was it soupy?	• Use boiled rice if fried • Use a water model	------ ------
GUNDRUK	• What type of saag was used? • Was it soupy or achaar? • Was anything added to it?	• Use water model if soupy • Use boiled rice if achaar	
MEAT/FISH DISHES	• How was it prepared – soup/gravy (this is mixed dish) OR grilled/ fried/boiled (this is single ingredient)? • Were the chunks of meat shredded and mixed with rice? If so, this is a mixed dish. • If mixed dish, what are the ingredients?	MIXED DISH: • Use a water model for soup/gravy given to child • Use peanuts for meat/fish used in recipe for whole dish	------
	• If grilled/fried/boiled (no soup/gravy) →	• Use play-dough for chunks	------
EGG	• How was it prepared (fried, boiled, scrambled, omelet)?		

Dish	Probes	Best portion size	Alternative portion size
	• If fried/boiled →	• Ask # of egg(s)	------
	• If scrambled/omelet? • If omelet, was small, medium, large? • What are the ingredients? • How many eggs?	• Use boiled rice for scrambled • # of omelet	------ ------
MO-MO	• What type of mo-mo (paneer, veg, buff, chicken, pork, goat)? • How was it prepared (steam, fried, pan-fried, jhol)? • If jhol, what kind of jhol?	• Ask # of momo eaten • If jhol, use water model for broth	------
TEA	• What are the ingredients?	• Use a water model	------
HORLICKS/ CHOCOLATE AND MILK	• What are the ingredients?	• Use a water model	------
INFANT FORMULA	• What was the brand? • What was the stage/age category?	• Use a water model	------
CERELAC	• What was the brand? • What was the stage/age category? • Was anything added to it? • What was the flavor?	• Use a water model	
MASHED FRUIT/VEG	• What type of fruit or vegetable? • How many mashed?	• Use boiled rice	------

INGREDIENTS	Ingredient	Probes	Best portion size	Alternative portion size
GRAINS AND CEREALS	RICE (RAW)	• What color? • What variety? • Was it parboiled?	• Use raw rice	------
	WHEAT	• [None. Only one type]	• Use wheat from house	• Use raw rice
	MAIZE	• What color? • Dried for fresh? • If fresh, was it on or off cob?	• Use maize from house	• Use raw rice if dried • Use boiled rice if fresh off cob • Use ruler if fresh on cob
	BARLEY	• [None. Only one type]	• Use barley from house	• Use raw rice
	OATS	• Were they whole or refined/instant?	• Use oats from house	• Use beaten rice
	FLOUR	• What type? • Is it refined or un-refined? • Is it fortified or un-fortified? • Is it home-made or packaged? • If packaged, what is the brand?	• Use flour	------
	SEMOLINA	• What is the brand?	• Use semolina from house	• Use flour
	BEATEN RICE	• What variety?	• Use beaten rice from house	• Use beaten rice model
	PUFFED RICE	• [None. Only one type]	• Use puffed rice	------

	PASTA	• Is it whole wheat or refined? • What shape? • What is the brand?	• Use pasta from house	• Use peanuts
	VERMICELLI	• What is the brand?	• Use vermicelli from house	• Use raw rice
LEGUMES/SEEDS	LENTIL	• What variety? • Split or whole? • Skin or no skin? • If kwati, what are the ingredients? If home-made, take recipe	• Use lentil from house	• Use raw rice
	BEAN SEED	• What variety? • Is it fresh or dried?	• Use bean from house	• Use raw rice
	BEAN IN POD	• What variety?	• Use beans in pod from house	• Use peanuts
	NUT	• What type? • Roasted or raw?	• Use nuts in house	• Use peanuts
VEGETABLES	POTATO	• What color? • Was it small, medium, or large? • Peeled or un-peeled?	• Use potato from house	• # of potatoes (for each color & size)
	ONION	• What color? • Was it small, medium, or large?	• Use onion from house	• # of onions (for each color & size)
	GREEN ONION	• [None. Only one type]	• Use green onion from house	• # of bulbs
	GREEN GARLIC	• [None. Only one type]	• Use green garlic from house	• # of bulbs

	TOMATO	• Was it small, medium, or large?	• Use tomato from house	• # of tomatoes (for each size)
	GREEN LEAFY VEGETABLES	• What variety? • Was it fresh or dried?		
		• If fresh →	• Use GLV from house	• Use peanuts
		• If dried →	• Use GLV from house	• Use flour
	EGGPLANT	• Was it green or purple? • Was it long or round? ○ If long, was it small, medium, or large?	• Use eggplant from house	• # of eggplants (for each color, shape, & size)
	CAULIFLOWER	• Were the leaves used?	• Use cauliflower from house	• Use roasted peanuts
	GOURD: SNAKE, RIDGE, BITTER, BOTTLE, ASH, POINTED, SPONGE, SPINE	• What variety?	• Use gourd from house	• Use roasted peanuts
	PUMPKIN	• Was it green or yellow?	• Use pumpkin from house	• Use roasted peanuts
	BROCCOLI	• Were the leaves used? • Was the stem peeled?	• Use broccoli from house	• Use roasted peanuts
	OKRA	• [None. Only one type]	• Use okra from house	• Use roasted peanuts
	CUCUMBER	• Was it small, medium or large? • Was it peeled or unpeeled?	• Use cucumber from house	• # of cucumbers • # of slices

	CARROT	• Was it small, medium, or large? • Was it peeled or unpeeled?	• Use carrot from house	• # of carrot (for each size and un/peeled) • # of slices
	RADISH	• What color was it? • Was it long or short/round? • If long, was it small, medium, or large? • Was it peeled or unpeeled?	• Use radish from house	• # of radish (for each color, size, & un/peeled) • # of slices
	TURNIP	• Was it peeled or unpeeled?	• Use turnip from house	• Use roasted peanuts
	CABBAGE	• Was it purple or green?	• Use cabbage from house	• Use roasted peanuts
	MUSHROOM	• What variety? • Was it canned? • Was it fresh or dried?	• Use mushroom from house	• Use roasted peanuts • # of cans
MEAT/ FISH/ EGG	EGG	• What kind of egg? • Was only white or yellow part eaten?	• # of eggs	--------

	MEAT/FISH	• If fish, what type? If type, unknown – large or small fish? • If chicken, what pieces (thigh? breast? leg? wing?)? If all pieces, write all parts. • If chicken or goat, skin or no skin? • Was it an organ or meat? If organ, what organ?	• Estimated g/kg used for recipe OR • Use roasted peanuts for amount in recipe • Use play-dough for amount served to child	
FATS	GHEE	• Was it animal or vegetable? • Was it liquid or solid?	• Use a water model if liquid • Use flour if solid	--------
	OIL	• What kind of oil?	• Use a water model	--------
	BUTTER	• Was it salted or unsalted?	• Use butter in house	• Use wheat flour
FRUITS	APPLE	• What color was it? • Was it large or small? • Was it peeled or unpeeled? • Was it grated?	• # of apple (if not grated)	--------
			• Use beaten rice (if grated)	
	BANANA	• Was it green or yellow? • Was it short/fat or long/skinny?	• Length of banana using ruler	

	ORANGE/MANDARIN	• Was it small, medium or large?	• # or pieces/segments of orange	
	WATERMELON	--------	• Use peanuts for pieces of watermelon	
	PAPAYA	--------	• Use peanuts for pieces of papaya	
	POMEGRANATE	--------	• Use puffed rice	--------
	GRAPES	• What color?	• # of grapes	--------
	GUAVA	• What color inside/outside? • Was it peeled or unpeeled? • Was it small, medium or large?	• # of guava	--------
	PERSIMMON	--------	• # of persimmon	--------
	RAISIN	• What color?	• Use raisins in house	• Use # of pieces if small amount • Use boiled rice
DAIRY	CURD	• Was it sweet or not sweet?	• Use water model	--------

	MILK	• What kind of animal? • Was it full fat or skim? • Was it liquid or powdered? • If commercial, what color was the packet?	• Use water model for liquid • Use flour for powdered	--------
	CONDENSED MILK	--------	• Use water model	--------
	PANEER	--------	• For recipe, ask grams/kg • For child served, use play-dough	--------
	CHEESE	• What kind was it?	• Use cheese in house	• Use play-dough
SWEETENER	SUGAR	• What color was it?	• Use sugar	--------
	HONEY	• Was it solid or liquid?	• Use water model for liquid • Use flour for solid	--------
POWDERED FOOD/DRINK	LITO POWDER/CERELAC	• What was the brand? • If Cerelac, what is the stage/age category? What flavor?	• Use flour for powder • Use water for prepared version	--------

	CHOCOLATE POWDER/HORLICKS	• What was the brand?	• Use flour for powder • Use water for prepared version	--------
	INFANT FORMULA	• What was the brand? • What stage/age category was it?	• Use flour for powder • Use water for prepared version	--------
SPREADS	JAM/NUTELLA/PEANUT BUTTER/CHEESE	• What flavor? • What brand was it?	• Use foods in house	• Use wheat flour
SNACK FOODS	BISCUITS/COOKIES	• What brand was it? • Price?	• Use actual biscuits in house	• # of pieces/packet
	CHOCOLATE	• What brand was it? • Price?	• Use actual chocolate in house	• # of segments/packet
	CANDY	• What brand was it? • Price?	• Use actual candy in house	• # of pieces/packet
	LOLLIPOP	• What brand was it? • Price?	• Use actual lollipop in house	• # of pieces
	JUICE DRINK	• What brand was it?	• Use water model	--------

	SOFT DRINK	• What brand was it?	• Use water model	--------
	CHIPS/CHEESEBALLS	• What brand was it? • Price?	• Use actual chips in house	• # of pieces/packet
	NIMKI	• What brand was it?	• Use actual nimki in house	• # of pieces/packet
	INSTANT NOODLES	• What brand was it?	• Use actual noodles in house	• # of packet
	BREAD	• What brand was it? • What color?	• Use actual bread in house	• # of pieces
	PUFFS/DOUGHNUT/CAKE	• For cake, what kind? And was there cream/icing? • What brand was it?	• Use actual cake/puffs in house	• # of pieces
	MITHAI	• What kind and sub-type? • What brand was it?	• Use actual mithai in house	• # of pieces
	JELLY	• What flavor? • What brand was it?	• Use actual jelly in house	• # of packet

	ICE CREAM	• What flavor? • What brand? • Cone or cream? • Individual serving cup or scoop?	• # of cup or scoop • # of cone	
	JALEBI/JERI	• What brand was it? • Was it small, medium or large?	• Use actual jeri in house	• # of pieces
	CORNFLAKES/CHOCOS	• If cornflakes, what flavor? • What brand was it?	• Use actual cornflakes in house	• Use puffed rice

Appendix 5: Protocol for blood sampling

HELEN KELLER INTERNATIONAL (HKI) NEPAL – ARCH PROJECT

As part of the study, 'Snacks, diet, and nutrition during the complementary feeding period: a cross-sectional study among children 12-23 months of age in Kathmandu Valley, Nepal', biochemical measurements will be made for children 12-23 months of age. Specifically, 150 uL of capillary blood will be sampled to measure haemoglobin, serum ferritin, soluble transferrin receptor (sTfR) – as measures of iron status, retinol binding protein (RBP) – as a measure of vitamin A status, and alpha 1-acid glycoprotein protein (AGP) and c-reactive protein (CPR) – as measures of inflammation. This protocol details the procedure for collecting blood samples, and is based on guidelines from the World Health Organization[213] and prior blood sampling procedures conducted by HKI Nepal. The following information will be covered:

- General precautions for blood sample collection
- Considerations prior to sample collection
- Procedure for haemoglobin testing
- Procedure of capillary blood sample collection
- Procedure for blood samples after collection

GENERAL PRECAUTIONS FOR BLOOD SAMPLE COLLECTION

There are universal precautions that must be taken when collecting blood samples, for the protection and safety of study participants and study staff. These include:

- Always wear gloves throughout sample collection, and until all waste materials are disposed. The gloves themselves are biohazardous waste after use and must be disposed of as well, and never reused.
- Be careful to avoid penetrating injuries that could risk blood contamination. Immediately after sampling is complete, lancets must be put in a sharps container to prevent accidental injury.
- Do not eat or drink during sample collection.
- Appropriately dispose of biohazardous materials each day after sample collection.

CONSIDERATIONS PRIOR TO SAMPLE COLLECTION

Collecting biochemical samples, particularly from children, during a study can be a sensitive procedure and scary for the young child. It is important to build a rapport with the caregiver and ensure that they are comfortable and well-informed. Some things that can help to build rapport with the caregiver:

- Be respectful and confident in your interactions
- Smile and have good eye contact with the caregiver
- Express thanks for their participation in the study
- Acknowledge and address any nervousness
- Remind them of their confidentiality
- Ask if the caregiver has any questions

It should also be ensured that all equipment necessary for sample collection is present and prepared before proceeding with blood sample collection. The following materials should be accounted for each time:

- Gloves
- Hand sanitizer
- Alcohol swabs
- 1.5 mm lancets[213]
- HemoCue 201 microcuvettes
- HemoCue 201 machine
- Batteries for HemoCue
- Cotton gauze
- Biohazard specimen bag
- Collection tubes and sticky labels
- Plasters/bandaids
- Sharps container
- Styrofoam box with ice packs
- Chart paper
- Scissors

A sticky label should also be prepared for the 150 uL sample before each collection to ensure that the tubes are labelled when the sampled is taken. Each label should have the following information written on it and stuck onto the tube before any of the sampling procedures begin:

- Child/caregiver ID

PROCEDURE FOR HAEMOGLOBIN TESTING

1) Find a clean, private and comfortable place to collect the sample.
2) The clinician will seat the caregiver and child comfortably, and explain the procedure: *"We will be testing your child's blood to see if they have enough iron in their blood. If they do not have enough iron in their blood, they may have anemia. This may mean that their blood is not able to carry oxygen through their body. I will need to prick your child's finger to get some blood. The machine will tell us if their iron levels are low or not."*
3) Lay down clean chart paper on flat surface, this is where supplies will be placed. Ensure the machine and inner equipment of the HemoCue have been cleaned after their last use.
4) Clinician and interviewer sanitize hands and put on gloves.
5) Power on the HemoCue machine and move cuvette holder into loading position.
6) When three dashes appear, the HemoCue is ready for use.
7) Have caregiver sit in a chair and hold child on their lap, comfortably and firmly. The child's legs should be immobilized by positioning the caregiver's legs around the child's.
8) Ask the caregiver which hand of the child they would like to have pricked. This arm should be extended, and the caregiver should secure the other arm by tucking it under their own. The caregiver should hold the elbow of the arm to be pricked and use their other hand to graps and hold their child's wrist.
9) Identify a finger for the prick – it should not be a finger with a scar, wound, infection, swelling, deformity or rash. Select either the middle or ring finger.
10) Warm the child's hand to increase blood flow prior to prick, this can be done by rubbing the hand or wrapping it in a warm cloth.
11) Secure the child's hand below their heart level, ensuring that it will not move and that the hand and arm muscles are relaxed.
12) Clean the puncture site well with an alcohol swab and clinician will press thumb lightly into top knuckle of child's finger.
13) Clinician will then maintain press on the fingertip and puncture the side of fingertip with the lancet.
14) Dispose of lancet in sharps container.
15) Wipe away first drop of blood with gauze, disposing of gauze in biohazard container.
16) Avoid holding the finger too hard, or milking the finger after it has been pricked.
17) When second drop of blood is large enough, fill cuvette by placing in middle of the drop. The clinician will hand this to the interviewer so they can prepare to next collect the larger capillary blood sample. The clinician should continue to hold onto the finger of the child.

18) If cuvette is not filled correctly, discard the cuvette and fill a new one. Also inspect for any air bubbles, if any are present, discard the cuvette and fill a new one.
19) After filling the cuvette, wipe excess blood on the gauze.
20) The interviewer will place the cuvette in the holder on the HemoCue machine and pusher holder into machine. They will confirm the reading with the clinician after the next capillary blood sample of 150 uL is collected.
21) The interviewer will discard the cuvette and lancet in the biohazard container.
22) After the following 150 uL draw of blood, the clinician will report the haemoglobin level to the caregiver and their anemia status. Any cases of severe anemia will be referred to a health center.
23) The interviewer should clean the inner equipment of the HemoCue after each day.

PROCEDURE OF CAPILLARY BLOOD SAMPLE COLLECTION

1) After completing the sampling for the haemoglobin test, the clinician will collect 150 uL of capillary blood in a tube. The clinician should explain to the caregiver that this blood will be sent to a laboratory for analysis of the child's iron status, vitamin A status, and inflammation.
2) The clinician should still be holding the child's finger from the haemoglobin test.
3) Take the tube and allow the blood to drop vertically into the tube. Do not allow blood to drip down the side of the finger into the tube.
4) Collect drops until the 150 uL line is reached.
5) Avoid massaging or milking the finger during this blood sample collection.
6) Clean the puncture site and put a plaster on the child's finger.
7) The clinician and interviewer will double check to ensure that there is a label on the tube with correct information.
8) Place tube in rack in Styrofoam box with ice packs to keep cool.
9) Clean area where sampling has occurred, ensuring that all rubbish is thrown in the biohazard container or sharp container as appropriate, including gloves.
10) Reassure child and thank caregiver.

LOG BOOK ENTRIES

- After each blood sample is taken, enter the caregiver ID in the log book with the date and time of collection

- When samples are brought to the lab for processing, the survey supervisor will note down when the samples left the study site.
- Upon their arrival at the lab, the lab technician will note down at what time the samples were received and what time they were processed.

PROCEDURE FOR BLOOD SAMPLES AFTER COLLECTION

1) Samples should be brought to CMDM laboratory in Kathmandu within 2 hours of collection.
2) Biohazardous materials created throughout the day's sample collection should be disposed of as appropriate in this laboratory.
3) Samples should be centrifuged and at least 50 uL serum stored in 0.2 mL PCR tubes. These tubes must be clearly labelled with the child ID.
4) Serum samples should be frozen in a secure freezer at < -20 ° C until data collection is complete (~ 3 months). Samples should be carefully stored together in an organized fashion, either in a box or Ziploc bag.

Appendix 6: Protocol for anthropometric measurement

HELEN KELLER INTERNATIONAL NEPAL – ARCH PROJECT

As part of the study, 'Snacks, diet, and nutrition during the complementary feeding period: a cross-sectional study among children 12-23 months of age in Kathmandu Valley, Nepal', anthropometric measurements will be taken for 702 children 12-23 months of age and their mothers. Specifically, length (cm) and weight (kg) of children and height (cm) and weight (kg) of mothers will be recorded. If a child's primary caregiver is NOT their mother, adult anthropometrics should not be taken, only those of the child.

This protocol details the procedure for collecting this anthropometric data, and is based on guidelines from the CDC (2007), Cogill (2003), and WHO (2008). The following information will be covered:

- Equipment
- Measurement procedure
- Data quality

EQUIPMENT:

Scales:

Scales used for anthropometric measurement of children will be portable and field-friendly. An electronic scale will be used for both children and mothers. The electronic scales should read to at least one decimal point kilograms. Scales should be calibrated prior to use, and recalibrated after every 50th mother/child weight measurement.

Calibration of scales:

To calibrate means to use known weights to see if the scales are reading correctly. At the beginning of each day's weighing session, the measurement team should weigh two or three known weights on the scales to make sure the scales are still accurate. For example, you can weigh a five kilogram bag of grain or sack of rice that has been purchased from a store and make sure the scales read five kilograms. This should be done with with two or three known weights to ensure the scales are accurate. If the weight does not read accurately, the measurement team will need to 'zero' the scales before taking any measurements for the day.

Length boards/height measuring instruments:

Because the children included in this study will be below 2 years of age, length boards will be used to measure their recumbent length, rather than standing height. The board will be portable and measure at least 120 cm. For mothers, this length board will be converted to a height board.

MEASUREMENT PROCEDURE:

Standardized methods are vital to ensure quality measurements of anthropometry. Measurement teams responsible for taking measurements will be trained and evaluated on the follow procedures prior to data collection.

- Prior to measurement
  - Explain purpose of measurements and procedure to mothers, and answer any questions that arise
  - Ensure a comfortable, shaded, clean location for measurements

- Measurement of length/height and weight
  - Two persons will make up the measurement team – the measurer and assistant.
  - For children, one will position the child's head and record the measurements, while the other will hold the child's lower legs and take the actual measurements. The mother should be present to comfort the child, ensuring they are as calm as possible, but should not be directly involved with measurement.
  - Begin with measurements of the mother, as the child may become upset when they are being measured. The order of measurement should be as follows:

    1) Height of mother

    2) Weight of mother

    3) Weight of child

    4) Length of child

    These measurements must be taken in duplicate – meaning this series of 4 measurements will be repeated to ensure an accuracy and precision.

  - The average of the two measurements will be taken during analysis. If the measurements are very different from one another (difference in length of more than 1 cm for adult height, or more than 0.5 cm for child length, or more than 0.5kg for adult or child weight), the measurements will be discarded and two more taken.

MOTHERS

Measuring the height of the mother:

1. Erect the height board, place it against a wall, and ensure the base of board is touching the ground/floor. If the base is not even, place small stones of papers under edges to make it stable.
2. Ask the mother to remove any hair ornaments.
3. The clinician will help the mother stand against the wall, with their feet flat, body weight evenly distributed and heels touching the back of the board. Instruct the mother to stand with the heels

   together and toes apart. The toes should point slightly outward at approximately a 60ºangle. Check that the back of the head, shoulder blades, buttocks, and heels make contact with the backboard. NOTE: Depending on the overall body conformation of the individual, all four contact points – head, shoulders, buttocks, and heels – may not touch the backboard.
4. Align the head in the Frankfort horizontal plane. The head is in the Frankfort plane when the horizontal line from the ear canal to the lower border of the orbit of the eye is parallel to the floor and perpendicular to the backboard. Many people will assume this position naturally, but for some the measurer may need to gently tilt the head up or down to achieve the proper alignment. Instruct the mother to look straight ahead.
5. Ask the mother to take a deep breath and hold this, the measurer will then bring the head piece down to rest firmly on the mother's head. It should be tapped twice to ensure it is firmly placed.
6. The measurer will read the height measurement to 0.1 cm to the assist, who will repeat this measurement back to ensure it was heard properly and then record.

Measurement of weight of the mother:

1. Ensure that the mother is wearing light clothing and that shoes, heavy jewellery and accessories are removed.
2. The measurer will assist the mother to step on the scale and stand still until a weight measurement is shown on the scale. The measurer will read this weight measurement to the assistant to one decimal point.
3. The assistant will repeat the measurement called out to ensure it was heard properly and then record the weight value in the tablet.

4. The measurer will assist the mother off the scale.

CHILDREN

Measuring weight of child:

1. Ensure that the child is not wearing clothing. Have the assistant hold them warm wrapped in blanket.
2. Measurer will assist the mother to step on the scale, standing in the center with feet apart and still, and holding a blanket out to receive the child. When the weight measurement is displayed, zero the scale.
3. Have assistant pass the child to the mother and have them wrap the child in the blanket held by the mother, and hold them close against the chest. The measurer will then read out the weight measurement as this will equal the weight of the child to one decimal point. The assistant will repeat the measurement out loud to ensure they heard properly and then record this measurement.
4. The measurer will assist the mother off the scale.

Measuring length of child:

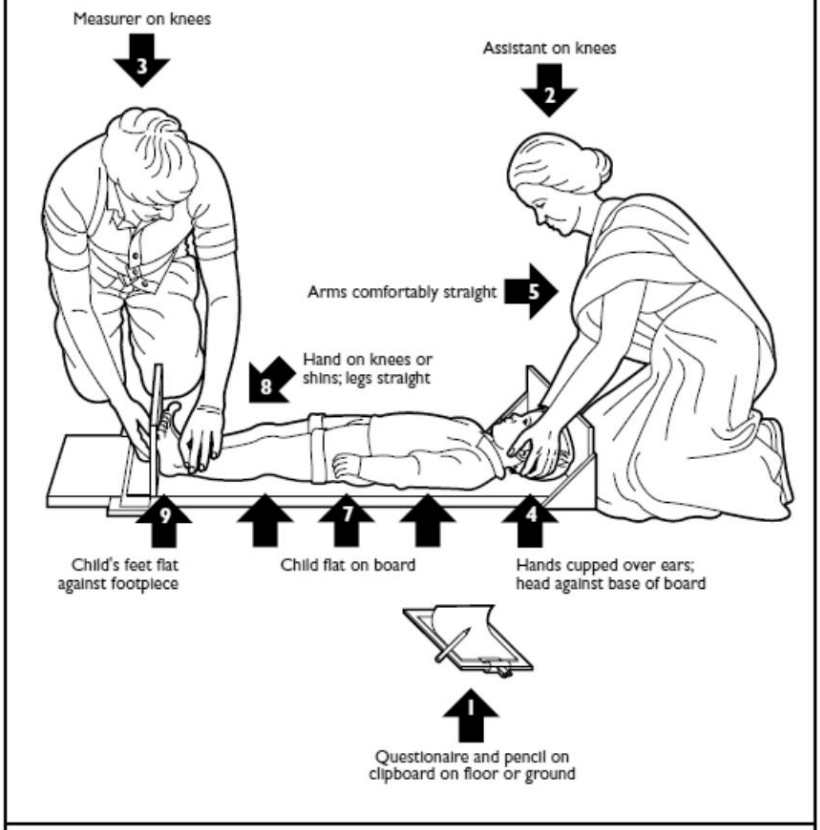
1. Ensure that the length board is on flat sturdy surface, such as the floor or a solid table
2. Lay a soft cloth on the upper part of board to ensure comfort of the child; ensure that this cloth does not cover the lower portion where the measurement must be read.
3. Have the tablet with the electronic questionnaire prepared for data entry nearby and have the assistant kneel behind the top of the length board where the child's head will be placed (see Arrow 2 in Figure 2).
4. The measurer will be positioned on the child's right side, towards the lower half where the measurement will be taken (Arrow 3)
5. The measurer, with assistance from the mother, will lay the child on the board, ensuring the head is supported with one hand and the trunk of the child with the other hand. Have the mother kneel near the left side of the child to keep them calm.
6. The assistant will cup their hands over the child's ears (Arrow 4) and with arms comfortably straight (Arrow 5), position the child's head against the top board so that they

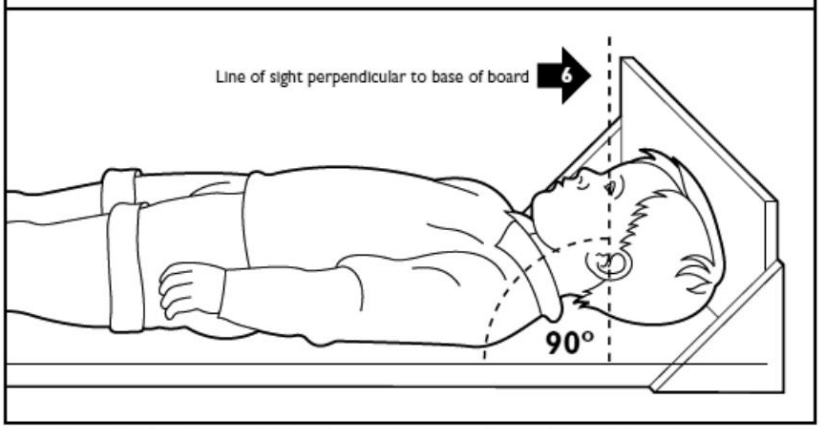
are looking straight up, and their sight line perpendicular to the ground/floor (Arrow 6). This sight line is from their lower eyelash to the mid-ear.

7. Ensure the child is flat and in the center of the board (Arrow 7), the measurer will place their left hand on the child's shins or knees (Arrow 8), pressing them firmly against the board. With their right hand, the measurer will firmly place the foot piece against the child's heels (Arrow 9). It is necessary to ensure that the child is not pushing their toes against the foot piece, as this will result in an inaccurate measurement. The measurer can tickle/massage the child's feet to have them flat before placing the foot pieces against the child's heels.
8. Measurement should be quick, and as soon as the foot piece is correctly positioned. The measurer will call out the length measurement, to the nearest 0.1 cm. The assistant will call back the measurement to ensure they heard properly. Then the measurer will release the foot piece and the child's legs.
9. The assistant will release the child's head and record the measurement in the tablet, showing it to the measurer to confirm.

Figure 1. Diagram for measuring child length[111]

Figure 5.2. Child Length Measurement - For Infants and Children 0-23 Months





Source: How to Weigh and Measure Children: Assessing the Nutritional Status of Young Children, United Nations, 1986.

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DATA QUALITY

Efforts will be made before and during data collection in order to ensure data quality for anthropometric measurements. Prior to data collection, all interviewers and clinicians will participate in a technical error of measurement (TEM) standardization exercise in order to practice taking and recording measurements of young children and adults, and to ensure accuracy and precision among measurement teams. Additionally, supervision of anthropometric measurements will be conducted. This will include direct observation of measurements periodically and inspection of anthropometric data nightly.

References:

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Cogill, B. (2003). Anthropometric indicators measurement guide. Revised edition. Washington, D.C., Academy for Educational Development [AED], Food and Nutrition Technical Assistance Project, 92. Retrieved from http://www.developmentgateway.org/download/202582/anthro_2003.pdf

World Health Organization (WHO) (2008). WHO child growth standards: training course on child growth assessment. WHO: Geneva.

Appendix 7: Conversion factors for dietary data

		water	playdoh	boiled rice	beaten rice	raw rice	puffed rice	sugar	flour	peanuts	actual food	actual food in pack/skin	number (piece)	length (cm)
	unit code	g	g	g	g	g	g	g	g	g	g	g	P	cm
	size	0	0	0	0	0	0	0	0	0	0	0	0	0
	price	0	0	0	0	0	0	0	0	0	0	0	0	0
GRAINS	model	1	2	3	4	5	6	7	8	9	10	11	12	13
food name	**food code**													
Rice, basmati	100100			0.99		0.99			1.19		1			
Rice, white, long	100200	0.83		0.99		0.97			1.2		1			
Rice, white, short	100300			1.01		1.01			1.19	2.94	1			
Rice, white, long, pbld	100400			1		1.02			1.27		1			
Puffed rice	100500						1				1			
Beaten rice	100600				1				1.2		1			
Rice flour	100700										1			
Wheat flour, white	100800								1.04		1			
Wheat flour, wholegrain	100900								1		1			
Wheat, wholegrain	103100								1		1			
Daliya, Patanjali	103200										1			
Semolina	101000								1.18		1			
Maize, dried	101100	0.61		1.09		0.91				2.24	1		0.32	
Maize, fresh	101200			1.08		0.76					1		0.27	7.87
Maize flour, yellow	101400								0.81		1			
Barley, wholegrain	101600										1			
Barley, flour	101700								0.71		1			
Vermicelli	101800					0.36					1			
Buckwheat flour	102100								0.98		1			
Millet, flour	102500								1.03		1			
Oats	102700				0.83				0.83		1			

		playdoh	beaten rice	peanuts	actual food	actual food in pack/skin	number (piece)	number (small)	number (medium)	number (large)	number (slice)	length (cm)
	unit code	g	g	g	g	g	P	P	P	P	Sli	cm
	size	0	0	0	0	0	0	1	2	3	0	0
	price	0	0	0	0	0	0	0	0	0	0	0
TUBERS	model	2	4	9	10	11	12	12	12	12	12	13
food name	**food code**											
Potato, white, fried	200120			2.02	1							
Potato, white	200100				1			18	80	203		
Potato, white, peeled	200130				1	0.85		13	68	174		
Potato, white, peeled, boiled	200140	0.67			1							
Potato, white, peeled, fried	200150	0.66		2.08	1							
Taro, raw	200400			2.22	1							
Sweet potato, raw	200500			2.11	1							
Yam, raw	200600		1.1	2.11	1							
Potato, red, fried	201120	0.54		1.62	1							
Potato, red	201100				1			18	80	203		
Potato, red, peeled, raw	201130				1	0.85		13	68	174		
Potato, red, boiled	201110	0.72			1							
Potato, red, peeled, fried	201140	0.67		1.81	1							
Potato, red, peeled, boiled	201150	0.63		2.3	1							
French fry	200160				1		9.6					
Radish, white	201200				1			153	334	622	13.33	8.75

		water	boiled rice	raw rice	flour	peanuts	actual food	actual food in pack/ skin	number (piece)
	unit code	g	g	g	g	g	g	g	P
	size	0	0	0	0	0	0	0	0
	price	0	0	0	0	0	0	0	0
LEGUMES/NUTS	model	1	3	5	8	9	10	11	12
food name	**food code**								
Pigeon pea, split	310100			1.08	1.17		1		
Pigeon pea, whole	310200			1.08	1.17		1		
Chickpea, split	310400	0.78		0.97	0.96	2.84	1		
Chickpea, whole	310500		1.37	0.99	0.99	2.8	1		
Horse gram, whole	310900			1.03	1.38		1		
Grasspea, split	311200			1.08			1		
Lentil, red	311400			0.97	1.23		1		
Kidney bean	311700			0.92	1.04	2.48	1		
Lentil, mung, split	311800			1	1.36		1		
Lentil, mung, whole	311900			1.02	1.34		1		
Pea, fresh	312000			0.73		2.22	1	0.42	0.37
Pea, dried	312100	0.73		0.96	1.23	2.61	1		0.26
Broad bean, fresh	312500					2.22	1		
Broad bean, dried	312600			0.88	1.09		1		
Fava bean in pod	312530					1.59	1		
French bean	313700		0.83			1.59	1		
Lentil, black gram, split	312700	0.75		0.96	1.16		1		
Lentil, black gram, whole	312800			1.02	1.26		1		
Cow pea	313000		1.41	1.04	1.23	2.88	1		
Soybean, dried	313100	0.66		0.89	0.9	2.68	1		
Soybean, fresh	313200						1		
Nutrila soybean chunk	313300					0.6	1		
Masaura	313800					1.27	1		
Black bean	313400			1.02	1.34		1		
Navy bean	313500		1.38	0.95			1		
Lentil, average	313900						1		
Peanut, roasted	320900				1.38		1	0.77	0.93
Cashew, roasted	321000				0.88		1		1.9
Almond, raw	321100				0.74		1		0.97
Almond, roasted	321200				0.74		1		0.97
Walnut, raw	321300				0.94		1		
Pistachio, raw	321400				0.76		1		0.53

		boiled rice	beaten rice	peanuts	actual food	actual food in pack/skin	number (piece)	number (small)	number (medium)	number (large)	number (slice)	length (cm)
	unit code	g	g	g	g	g	P	P	P	P	Sli	cm
	size	0	0	0	0	0	0	1	2	3	0	0
	price	0	0	0	0	0	0	0	0	0	0	0
VEGETABLES	model	3	4	9	10	11	12	12	12	12	12	13
food name	**food code**											
Garlic, leaves	410100				1		40.83					
Green onion	410200				1		16.83					
Mustard leaves	410500			0.62	1							
Broad mustard leaf	410600			0.57	1							
Garden cress	411700			0.57	1							
Spinach	412200			0.76	1							
Fenugreek, leaves	412400			0.59	1							
Dill, fresh	412800			0.67	1							
Lamb's quarter leaves	412900			0.59	1							
Gundruk (rayo)	413000	0.17	0.25	0.3	1		3.17					
Asparagus	420100			1.7	1							
Barela (balsalm apple)	423600				1		64					
Bamboo shoot	423700	1.26			1							
Cabbage, green	420200			1.12	1							
Pumpkin, orange	420400			2.1	1							
Pumpkin, green	423800			2	1	0.85						
Carrot	420600				1	0.81		50	80	191	10	
Onion, red	420800			1.97	1	0.84		39	80	154		
Cauliflower	421000			1.59	1							
Capsicum	421100			1.64	1		64.5					
Tomato	421300				1			15	53	112		
Eggplant	421500			1.58	1			82	108	137		

		boiled rice	beaten rice	peanuts	actual food	actual food in pack/skin	number (piece)	number (small)	number (medium)	number (large)	number (slice)	length (cm)
	unit code	g	g	g	g	g	P	P	P	P	Sli	cm
	size	0	0	0	0	0	0	1	2	3	0	0
	price	0	0	0	0	0	0	0	0	0	0	0
VEGETABLES	model	3	4	9	10	11	12	12	12	12	12	13
food name	**food code**											
Okra	421600			1.21	1		11.33					
Cucumber, peeled	421900				1						15.67	
Cucumber, unpeeled	421930				1							22.8
Bottle gourd	422000			1.7	1							
Bitter gourd	422200			1.47	1							
Bitter gourd, dried	422230				1							
Broccoli	422600			1.19	1							
Mushroom, button	423000			1.38	1							
Mushroom, oyster	423100			0.95	1							

		playdoh	boiled rice	beaten rice	raw rice	puffed rice	flour	peanuts	actual food	actual food in pack/skin	number (piece)	number (small)	number (medium)	number (large)	segment (small)	segment (medium)	segment (large)	length (cm)
	unit code	g	g	g	g	g	g	g	g	g	P	P	P	P	S	S	S	cm
	size	0	0	0	0	0	0	0	0	0	0	1	2	3	1	2	3	0
	price	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FRUITS	model	2	3	4	5	6	8	9	10	11	12	12	12	12	12	12	12	13
food name	**food code**																	
Banana	500100								1	0.58								6.81
Papaya	500200	0.68						2.23	1									
Orange	500500								1	0.7		130	146	153	13	14.6	15.3	
Apple, peeled	500800	0.68	1.2	1.57					1			94	132	182				
Apple, unpeeled	500820								1			128	180	232				
Watermelon	501000	0.68						2.13	1									
Coconut, fresh	501400								1		39							
Coconut, dried	501410				0.27		0.61		1									
Dates, dried	501800	0.25			0.66		0.87		1		3.83							
Pomegranate	501900					5.92			1			116	131					
Raisins	502300						1.04		1		0.42							
Grape, green	502800								1		4.15							
Grape, purple	502900							2.13	1		5.1							
Strawberry	503400							1.82	1		6.88							

		playdoh	peanuts	actual food	number (piece)	length (cm)
	unit code	g	g	g	P	cm
	size	0	0	0	0	0
	price	0	0	0	0	0
MEAT	model	2	9	10	12	13
food name	**food code**					
Chicken, breast, no skin, raw	610100		3.01	1		
Chicken, breast, no skin, fried	610120	0.67	1.83	1		
Chicken, breast, no skin, boiled	610110	0.62	2.71	1		
Chicken, breast, with skin, fried	610220	0.63	1.89	1		
Chicken, breast, with skin, raw	610200		2.93	1		
Chicken, leg, no skin, raw	610300		2.66	1		
Chicken, leg, no skin, fried	610320	0.65	1.98	1		
Chicken, leg, with skin, fried	610420	0.63	2	1		
Chicken, leg, with skin, boiled	610410	0.71	1.75	1		
Chicken, leg, with skin, raw	610400		2.72	1		
Chicken, all, no skin, fried	610720	0.66	1.9	1		
Chicken, all, no skin, boiled	610710	0.66	2.23	1		
Chicken, all, no skin, raw	610700		2.84	1		
Chicken, all, skin, fried	610820	0.63	1.95	1		
Chicken, all, skin, boiled	610810	0.66	2.23	1		
Chicken, all, skin, raw	610800		2.83	1		
Chicken, gizzard, fried	612100	0.66		1		
Goat, meat, raw	610900		2.85	1		
Goat, meat, fried	610920	0.81	1.76	1		
Buffalo, meat, raw	611100		2.7	1		
Buffalo, meat, fried	611120	0.73	1.66	1		
Buffalo, meat, boiled	611110	0.63	1.91	1		
Buffalo, liver, fried	611130	0.69		1		
Buffalo, intestine, fried	611140	0.69		1		
Buffalo, meat, dried	611150		2.06	1		
Pork, meat, fried	611220	0.63	1.57	1		
Buffalo, sausage, fried	611600	0.54		1	32.25	
Chicken, sausage, fried	611700	0.52		1	40.75	3.37
Goat, liver, fried	611920	0.69		1		
Goat, liver, raw	611900		3.2	1		
Chicken, liver, fried	612020	0.59	1.61	1		
Chicken, liver, raw	612000		2.56	1		

		water	playdoh	flour	peanuts	actual food	number (piece)	number (pack)	number (slice)
	unit code	g	g	g	g	g	P	Pac	Sli
	size	0	0	0	0	0	0	0	0
	price	0	0	0	0	0	0	0	0
DAIRY/EGG/FISH	model	1	2	8	9	10	12	12	12
food name	**food code**								
Milk, buffalo, full fat	620200	1.01				1			
Milk, cow, low fat	620300	1.01				1			
Milk, cow, full fat	620400	1.03				1		508	
Milk, mixed, full fat	620410	1.02				1		508	
Powdered milk, full fat	620600			0.93		1			
Condensed milk, liquid	621110	1.28				1			
Curd, cow, no sugar	620800	1.09				1			
Curd, cow, with sugar	620900	1.09				1			
Paneer	621000		0.78		2.31	1			
Cheese, Amul	621500					1	20		20
Egg, chicken	630100					1	55.67		
Egg, chicken, whites	630110					1	39.67		
Egg, chicken, whites, boiled	630130		0.82			1			
Egg, chicken, yolk	630120					1	15.67		
Egg, duck	630200					1	59.67		
Egg, duck, whites	630210					1	30		
Egg, quail	630300					1	9.75		
Egg, chicken, fried	630140		0.82			1			
Fish, Rahu, fried	710320		0.6			1			
Fish, Rahu, boiled	710310		0.79			1			
Small fish, dried	710800				0.75	1	0.53		

		water	playdoh	sugar	flour	actual food	number (pack)
	unit code	g	g	g	g	g	Pac
	size	0	0	0	0	0	0
	price	0	0	0	0	0	0
FATS/SUGARS/SUPPLEMENTS	model	1	2	7	8	10	12
food name	**food code**						
Ghee, animal	820200	0.76			1.25	1	
Ghee, vegetable	820300				1.23	1	
Oil, mustard	820400	0.9				1	
Oil, soybean	820500	0.9				1	
Oil, sunflower	820600	0.9				1	
Oil, olive	821300	0.89				1	
Oil, average	821500	0.9				1	
Sugar, white	830100			1	1.47	1	
Honey	830200	1.42			1.96	1	
Jaggery	830300		1.05			1	
MNP, Baalvita	910100					1	1
Badampak, Patanjali	910400				0.94	1	
LNS, eezee20	910200					1	20
LNS, PlumpySup	910300					1	92

		water	flour	actual food	number (small)	number (medium)	number (pack) 5 rs	number (pack) 10 rs	number (pack) 20 rs	number (pack) 25 rs	number (pack) 35 rs
	unit code	g	g	g	P	P	Pac	Pac	Pac	Pac	Pac
	size	0	0	0	1	2	0	0	0	0	0
	price	0	0	0	0	0	5	10	20	25	35
BEVERAGES	model	1	8	10	12	12	12	12	12	12	12
food name	**food code**										
Soda, Sprite	1190100	0.94		1							
Soda, Mountain Dew	1190200	0.94		1							
Soda, Mirinda	1190300	0.97		1							
Soda, Fanta	1190400	0.97		1							
Soda, Coca-cola	1190500	0.96		1							
Juice drink, average	1190600	1		1			80	80			
Juice drink, Frooti	1190700	1		1						200	
Juice drink, Litchi	1190800	1		1			80		170		
Juice drink, Real	1190900	1		1					200	200	
Juice drink, Mazza	1191000	1		1							
Juice drink, Rio	1191100	1		1				80			200
Sweet lassi	621600	1.04		1							
Malt powder, Boost	1191200		1.02	1							
Malt powder, Bourvita	1191300		1.4	1							
Malt powder, Complan	1191400		0.78	1							
Nutritional powder, Ensure	1191500		0.93	1							
Malt powder, Horlicks, classic	1191600		1.31	1							
Malt powder, Horlicks, junior	1191700		1.13	1							
Malt powder, Maltorich	1191800		1.11	1							
Malt powder, Viva	1191900		1.01	1							
Nutritional powder, Pediasure	1192000		0.86	1							

		water	flour	actual food	number (small)	number (medium)	number (pack) 5 rs	number (pack) 10 rs	number (pack) 20 rs	number (pack) 25 rs	number (pack) 35 rs
	unit code	g	g	g	P	P	Pac	Pac	Pac	Pac	Pac
	size	0	0	0	1	2	0	0	0	0	0
	price	0	0	0	0	0	5	10	20	25	35
BEVERAGES	model	1	8	10	12	12	12	12	12	12	12
food name	**food code**										
Nutritional powder, KidsPro	1192010		0.90	1							
Juice powder, Tang	1192100		1.44	1							
Cocoa powder	1192200		0.93	1							
Juice, orange	1010100	1		1		72.67					
Juice, pomegranate	1010300	0.97		1	64						

		actual food	number (piece)	number (pack)	number (pack) 10 rs	number (pack) 20 rs
	unit code	g	P	Pac	Pac	Pac
	size	0	0	0	0	0
	price	0	0	0	10	20
BISCUITS	model	10	12	12	12	12
food name	**food code**					
Biscuit, average	1110100	1	6.16	52.14		
Biscuit, cookie, average	1110200	1	8.94			
Biscuit, 20-20	1110300	1	5		45	
Biscuit, bourbon, average	1110400	1	9.29		50	
Biscuit, butter cracker, average	1110500	1	3.33		50	
Biscuit, butter cracker, Kwality	1110600	1	3.33			
Biscuit, butter cracker, Nebico	1110700	1	3.33			
Biscuit, Braker's	1110800	1	6.16			
Biscuit, butter cookie, Sparsha	1110900	1	6.16			
Biscuit, Butter Crunch	1111000	1	6.16			
Biscuit, cheese cracker	1111100	1	4.35			
Biscuit, Choco	1111200	1	3.17			
Biscuit, coconut, average	1111300	1	6.82		55	65
Biscuit, coconut, Nebico	1111400	1	6.82			
Biscuit, coconut, Goodlife	1111500	1	6.82			
Biscuit, coconut, Star	1111600	1	6.82			
Biscuit, coconut, Dream Lite	1111700	1	6.82			
Biscuit, cookie, Khajurico	1111800	1	9.38			
Biscuit, cookie, Upsav	1111900	1	8.5			
Biscuit, Crackies, Goodlife	1112000	1	2.5		55	
Biscuit, cream cracker, average	1112100	1	5.12			
Biscuit, digestive, average	1112200	1	10.83			
Biscuit, digestive, Britannia	1112300	1	14.71			
Biscuit, digestive, Goodlife	1112400	1	7.5			
Biscuit, Digestive, McVities	1112500	1	8.33			
Biscuit, Digestive, Nebico	1112700	1	8.93			
Biscuit, digestive, Parle	1112800	1	14.71			
Biscuit, Treat	1112900	1	6.43			
Biscuit, Delux Sugar Cracker	1113000	1	7.81			
Biscuit, Deo, chocolate vanilla	1113100	1	25			
Biscuit, Dhoom cream, chocolate	1113200	1	6		45	
Biscuit, Parle-G	1113300	1	5			
Biscuit, Oreo	1113400	1	9.79			50
Biscuit, Monaco	1113500	1	2.63		50	
Biscuit, Family Toast	1113600	1	4.46			
Biscuit, Feel It vanilla cream	1113700	1	6			
Biscuit, Fit Kit	1113800	1	4.46			
Biscuit, Glucose, Nebico	1114000	1	5			
Biscuit, Good Day, butter	1114100	1	8.33			
Biscuit, Good Day, pistachio	1114200	1	8.33			
Biscuit, Good Day, cashew	1114300	1	8.33			
Biscuit, Googly	1114400	1	6.16		95	
Biscuit, Gushup, Salty	1114500	1	2.5		50	
Biscuit, Happy Happy	1114600	1	5		40	

		actual food	number (piece)	number (pack)	number (pack) 10 rs	number (pack) 20 rs
	unit code	g	P	Pac	Pac	Pac
	size	0	0	0	0	0
	price	0	0	0	10	20
BISCUITS	model	10	12	12	12	12
food name	**food code**					
Biscuit, High Energy	1114700	1	7.17			
Biscuit, Horlicks	1114800	1	5.17			
Biscuit, Jack Cracker	1114900	1	3.13			
Biscuit, KFP	1115000	1	6.16			
Biscuit, Love 21	1115100	1	6.16			
Biscuit, Marie, Priyagold	1115200	1	4.76			
Biscuit, Marie, average	1115300	1	4.72		51.6	71
Biscuit, Marie, Brittania	1115400	1	5.77			
Biscuit, Marie, Goodlife	1115500	1	4.55		50	
Biscuit, Marie, McVities	1115600	1	3.97			
Biscuit, Marie, Parle	1115700	1	4.55		50	
Biscuit, Marie, Kwality	1115800	1	4.55		50	
Biscuit, Milk Bikis	1115900	1	4.08			
Biscuit, Nice	1116000	1	6.16		50	
Biscuit, Oat, Brittania	1116100	1	8.33			
Biscuit, Vitamilk	1116200	1	3.5		42	98
Biscuit, Doodh, Patanjali	1116300	1	5.26			
Biscuit, Real Butter	1116400	1	3.33			
Biscuit, Ribbon, National	1116500	1	6.16			
Biscuit, Soaltee	1116600	1	2.5		50	
Biscuit, Tasty	1116700	1	2.62		55	
Biscuit, Thinarrowroot, average	1116800	1	2.73		60	
Biscuit, Thinarrowroot, Britannia	1116900	1	2.73			
Biscuit, Thinarrowroot, Nebico	1117000	1	2.73			
Biscuit, Tiger	1117100	1	5		40	
Biscuit, Top	1117200	1	3.85		50	
Biscuit, Toast	1117300	1	10.63			
Biscuit, Tradition	1117400	1	6.16			
Biscuit, Veg Munch	1117500	1	7.65			

		playdoh	beaten rice	raw rice	puffed rice	actual food	number (piece)	number (small)	number (medium)	number (large)	number (pack)	length (cm)
	unit code	g	g	g	g	g	P	P	P	P	Pac	cm
	size	0	0	0	0	0	0	1	2	3	0	0
	price	0	0	0	0	0	0	0	0	0	0	0
TRADITIONAL SNACKS	model	2	4	5	6	10	12	12	12	12	12	13
food name	**food code**											
Dalmot, aloo bhujiya	1160100				2.74	1						
Dalmot, moong	1160200			0.54		1						
Dalmot, mixed	1160300		0.9			1						
Dhungri	1160400					1	6.4					0.38
Nimki	1160700					1	1.5					
Ladoo, motichoor	1150100					1					39.67	
Mithai, barfi	1150200					1					24	
Mithai, rasbari	1150300					1					50.67	
Mithai, soan papdi	1150400					1					21.33	
Gudpak	1150500	0.78				1						
Jeri	1150600					1		38	58	65		
Malpowa	1150700					1	47					
Jam, average	830400					1						
Khapse	1150800	0.42				1						
Papad	1230100					1	7.2					
Puri for pani puri	1230200					1	3.75					
Puri	1230300					1		33.33	42.33	52.33		
Roti, rice flour	1230400					1		33.33	42.33	52.33		
Roti, white flour	1230500					1		33.33	42.33	52.33		
Roti, wholewheat	1230600					1		33.33	42.33	52.33		
Paratha	1160800	0.84				1	180.8					

		playdoh	beaten rice	raw rice	puffed rice	actual food	number (piece)	number (small)	number (medium)	number (large)	number (pack)	length (cm)
	unit code	g	g	g	g	g	P	P	P	P	Pac	cm
	size	0	0	0	0	0	0	1	2	3	0	0
	price	0	0	0	0	0	0	0	0	0	0	0
TRADITIONAL SNACKS	model	2	4	5	6	10	12	12	12	12	12	13
food name	**food code**											
Samosa, outer	1160900					1						
Samosa, stuffing	1161000					1						
Pakoda, average	1161100	0.5				1	19.4					
Chatpate	1161200				1	1						

		playdoh	puffed rice	peanuts	actual food	number (piece)	number (pack) 5 rs	number (pack) 10 rs	number (pack)15 rs	number (pack) 20 rs	number (pack) 35 rs	number (pack) 40 rs	number (pack) 50 rs	number (pack) 80 rs	number (pack) 100 rs	number (segment) 10 rs	number (segment) 20 rs	number (segment) 40 rs	number (segment) 50 rs	number (segment)
	unit code	g	g	g	g	P	Pac	Pac	Pac	Pac	Pac	Pac	Pac	Pac	Pac	S	S	S	S	S
	size	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	price	0	0	0	0	0	5	10	15	20	35	40	50	80	100	10	20	40	50	0
CANDY/SAVOURY SNACKS	model	2	6	9	10	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
food name	**food code**																			
Lollipop	1130100				1	6.9														
Candy, average	1130300				1	3														
Candy, coffee	1130400				1	3.8														
Candy, Hajmola	1130500				1	0.55														
Candy, Halls	1130600				1	2.6														
Candy, Vicks	1130700				1	2.6														
Candy, toffee	1130800				1	3														
Chewing gum	1130900				1	1														
Candy, Londondairy	1131000				1	3														
Candy, Lactofun	1131200				1	3														
Candy, Litchi	1131300				1	2														
Candy, jelly	1131400				1	118														
Candy, Kacha Aam	1131700				1	3														
Candy, Rasilo	1132000				1	3														
Chocolate, average	1132100				1	8														
Chocolate, Mars	1132200				1						33				51					
Chocolate, 5 Stars	1132300				1			10.1		20.5										
Chocolate, Chocofun	1132400				1		12	18		18										

		playdoh	puffed rice	peanuts	actual food	number (piece)	number (pack) 5 rs	number (pack) 10 rs	number (pack)15 rs	number (pack) 20 rs	number (pack) 35 rs	number (pack) 40 rs	number (pack) 50 rs	number (pack) 80 rs	number (pack) 100 rs	number (segment) 10 rs	number (segment) 20 rs	number (segment) 40 rs	number (segment) 50 rs	number (segment)
	unit code	g	g	g	g	P	Pac	Pac	Pac	Pac	Pac	Pac	Pac	Pac	Pac	S	S	S	S	S
	size	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	price	0	0	0	0	0	5	10	15	20	35	40	50	80	100	10	20	40	50	0
CANDY/SAVOURY SNACKS	model	2	6	9	10	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
food name	**food code**																			
Chocolate, Dairymilk Silk	1132500	1			1															5
Chocolate, Kit-Kat	1132600				1	9		7		13										
Chocolate, MilkyBar	1132700				1			6.5												
Chocolate, Snickers	1132800				1							32		50						
Chocolate, Kinder	1132900				1	20														
Chocolate, Gems	1133000				1	0.89														
Chocolate, Dairymilk	1133100				1			5.8		13		25	34			1.93	1.63	2.5	2.5	
Cheeseballs, average	1120100				1	0.4	8	15												
Cheeseballs, Kwiks	1120200			0.2	1	0.4	8	15		25										
Cheeseballs, Golmol	1120300				1	0.4	8	15												
Cheeseballs, UnMe	1120400				1	0.4		15												
Cheeserings, UnMe	1120500				1	0.87		15												
Potato chips, average	1120600				1	1														
Popcorn	1120700		0.53	0.2	1	0.12														
Prawn cracker	1120800				1	2.8														
Chips, average	1120900				1	0.9		15.67	29											
Chips, chicken cracker	1121000				1	0.57		12												
Chips, Kurmure	1121100				1	0.5	15	15												

		playdoh	puffed rice	peanuts	actual food	number (piece)	number (pack) 5 rs	number (pack) 10 rs	number (pack)15 rs	number (pack) 20 rs	number (pack) 35 rs	number (pack) 40 rs	number (pack) 50 rs	number (pack) 80 rs	number (pack) 100 rs	number (segment) 10 rs	number (segment) 20 rs	number (segment) 40 rs	number (segment) 50 rs	number (segment)
	unit code	g	g	g	g	P	Pac	Pac	Pac	Pac	Pac	Pac	Pac	Pac	Pac	S	S	S	S	S
	size	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	price	0	0	0	0	0	5	10	15	20	35	40	50	80	100	10	20	40	50	0
CANDY/SAVOURY SNACKS	model	2	6	9	10	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
food name	**food code**																			
Chips, Kurkure	1121200				1	1.03		22		40		80								
Chips, Chinese Chilly	1121300			0.22	1	0.83														
Chips, Chocorings	1121400				1	0.87														
Chips, Kwiks	1121500				1	1.09		15												
Chips, Lays	1121600			0.47	1	1.05		15		22		42								
Chips, Potato Cracker	1121700				1	0.64		15		25		55								
Chips, Pringles	1121800				1	1.52														

		playdoh	beaten rice	puffed rice	peanuts	actual food	number (piece)	number (pack)	number (pack) 10 rs	length (cm)	number (cone)
	unit code	g	g	g	g	g	P	Pac	Pac	cm	Co
	size	0	0	0	0	0	0	0	0	0	0
	price	0	0	0	0	0	0	0	10	0	0
BFAST CEREAL/BAKERY/ICE	model	2	4	6	9	10	12	12	12	13	12
food name	**food code**										
Weetabix, original	1200100					1	17.4				
Cereal, Chocos	1200200		0.39	1.58	0.61	1	0.42				
Muesli	1200300		0.63			1					
Cornflakes, average	1200400		0.37			1					
Cornflakes, fruit	1200500			1.49		1					
Chocopie	1140100					1		28			
Donut, average	1140200	0.19				1	58.33				
Donut, average, with cream	1140300					1	76.33				
Cotton candy	1130200					1			6.25		
Bun, average	1140400					1	71				
Bun, average, with cream	1140500					1	71.5				
Bread, white	1140600	0.27				1	21.25				
Fruit cake, average	1140700					1	24.5				
Cupcake, average	1140800					1	28.25				
Muffin, average	1140900					1	28.25				
Gwaramari	1141000					1	17				
Cake, average	1141100	0.28				1	84				
Coconut bread, with cream	1141200					1	71.5				
Puff, Star	1141300					1	12.5				
Puff, average	1141400					1	12.5				
Puff, Khajurico	1141500					1	12.5				
Ice cream, chocolate	1170100					1					57.5
Ice cream, vanilla	1170200					1					69

		flour	actual food
	unit code	g	g
	size	0	0
	price	0	0
BMS/CPCF	model	8	10
food name	**food code**		
SMA, Stage 3	1210100	0.84	1
Lactogen Stage 2	1210200	0.87	1
Lactogen Stage 3	1210300	0.81	1
Lactogen Stage 4	1210400	0.91	1
Infant formula, average	1210500	0.86	1
Infant formula, Jadual Menyusu, Stage 3	1210600	0.8	1
Farex, Stage 2	1210700	0.87	1
Farex, Stage 3	1210800	0.86	1
Farex cereal, Stage 2	1220100	1.05	1
Cerelac, Stage 1	1220200	0.9	1
Cerelac, Stage 2	1220300	0.92	1
Cerelac, Stage 3	1220400	0.92	1
Cerelac, Stage 4	1220500	0.91	1
Cerelac, Stage 5	1220600	0.82	1
Lito powder, average	1220700	0.91	1
Lito, Chaudary	1220800	1.02	1
Lito, Naya	1220900	0.93	1
Lito, Mammam	1221000	0.77	1
Lito, Gyan	1221100	0.9	1
Lito, Shree	1221200	0.94	1
Lito, Sagun	1221300	0.91	1

		boiled rice	raw rice	puffed rice	flour	actual food	number (pack)	number (pack) 2.5 rs	number (pack) 5 rs	number (pack) 10 rs	number (pack) 25 rs
	unit code	g	g	g	g	g	Pac	Pac	Pac	Pac	Pac
	size	0	0	0	0	0	0	0	0	0	0
	price	0	0	0	0	0	0	2.5	5	10	25
NOODLES	model	3	5	6	8	10	12	12	12	12	12
food name	**food code**										
Pasta, fusilli	1180100	0.74				1					
Noodle, stick	1180200	1.01				1					250
Soup powder, mushroom	1181300				0.73	1					
Soup powder, chicken	1181400				0.78	1	44				
Instant noodle, ABC	1180300					1					
Instant noodle, average	1180400					1	70				
Instant noodle, Cindraramen	1180500					1	70				
Instant noodle, Golmol	1180600					1				20	
Instant noodle, Humpty Dumpty	1180700					1			20		
Instant noodle, Mama	1180800					1		10	20		
Instant noodle, Maggi	1180900					1	70				
Instant noodle, Rara	1181000					1	70				
Instant noodle, Tens	1181100					1	45				
Instant noodle, Wai Wai	1181200	0.56	0.4	2.99		1					

Appendix 8: Food composition analysis results

Nutrient information per 100g										
Product	**Moisture (g)**	**Energy (kcal)**	**Total fat (g)**	**Protein (g)**	**Total carb (g)**	**Total sugar (g)**	**Calcium (mg)**	**Iron (mg)**	**Sodium (mg)**	**Zinc (mg)**
Infant cereal 1	1.69	425.02	8.9	16.42	69.81	32.11	561.15	12.2	184.29	3.60
Infant cereal 2	3.46	392.31	2.71	12.21	79.77	2.63	46.57	5.8	15.60	2.79
Infant cereal 3	6.57	394.58	5.98	15.71	69.48	10.95	164.56	9.7	28.57	4.72
Biscuit 1	2.48	434.63	9.99	7.82	78.36	16.43	40.73	6.8	336.45	0.58
Biscuit 2	3.01	419.65	7.37	7.85	80.48	19.42	24.72	2.2	336.41	1.11
Biscuit 3	2.18	486.68	21.04	7.43	66.9	6.5	28.88	1.95	761.8	0.44
Biscuit 4	2.76	466.88	16.24	6.39	73.79	23.3	23.33	1.31	229.44	0.38
Chocolate 1	1.59	530.01	28.09	4.58	64.72	36.43	69.67	8.75	79.8	0.86
Chocolate 2	19.3	424.2	21.44	7.26	50.55	44.14	169.86	2.02	104.27	0.86
Instant noodle 1	3.22	470.46	20.02	9.93	62.64	2.05	25.44	1.68	1433.49	0.6
Instant noodle 2	2.88	465.91	18.91	11	62.93	2.27	63.74	3.04	1384.57	0.78
Savory snack 1	0.43	482.91	19.03	7.49	70.42	3.07	41.37	0.61	771.39	0.48
Savory snack 2	3.01	473.77	19.93	5.02	68.58	4.57	100.69	1.69	1071.1	0.41
SSB 1	84.43	86.36	0	0.11	21.48	14.26	2.75	0.07	13.29	0.27
SSB 2	1.83	382.66	1.54	11.84	80.36	11.37	752.95	28.06	424.37	4.48

Appendix 9: Ethical approvals

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Keppel Street, London WC1E 7HT
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www.lshtm.ac.uk

Observational / Interventions Research Ethics Committee

Ms Alissa Pries

LSHTM

7 September 2016

Dear

Study Title: Snacks and nutrition during the complementary feeding period: a cross-sectional study among children 12-23 months of age in Kathmandu Valley, Nepal

LSHTM Ethics Ref: 11719

Thank you for responding to the Observational Committee's request for further information on the above research and submitting revised documentation.

The further information has been considered on behalf of the Committee by the Chair.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised, subject to the conditions specified below.

Conditions of the favourable opinion

Approval is dependent on local ethical approval having been received, where relevant.

Approved documents

The final list of documents reviewed and approved by the Committee is as follows:

Document Type	File Name	Date	Version
Information Sheet	CONSENT FORM for CAREGIVERS structured observation	20/06/2016	1
Information Sheet	CONSENT FORM for CAREGIVERS survey	20/06/2016	1
Investigator CV	CV_Alissa Pries_2016	20/06/2016	1
Investigator CV	CVr-Elaine-Ferguson_2016	20/06/2016	1
Advertisements	Recruitment form	22/06/2016	1
Protocol / Proposal	LSHTM ethics protocol ARCH snack research_June17	22/06/2016	1
Covering Letter	LSTHM ethics response cover letter Aug 16	16/08/2016	1
Information Sheet	CONSENT FORM for CAREGIVERS focus group discussions v2	16/08/2016	2
Information Sheet	BACKGROUND AND LITERATURE REVIEW	16/08/2016	1
Information Sheet	PROCEDURE FOR ANTHROPOMETRIC MEASUREMENT	16/08/2016	1
Information Sheet	PROCEDURE FOR BLOOD SAMPLE COLLECTION	16/08/2016	1
Protocol / Proposal	LSHTM ethics protocol ARCH snack research_Aug16 v2	16/08/2016	2
Protocol / Proposal	TOOLS FOR FORMATIVE RESEARCH	16/08/2016	1
Protocol / Proposal	TOOLS FOR SURVEY	16/08/2016	1

After ethical review

The Chief Investigator (CI) or delegate is responsible for informing the ethics committee of any subsequent changes to the application. These must be submitted to the Committee for review using an Amendment form. Amendments must not be initiated before receipt of written favourable opinion from the committee.

The CI or delegate is also required to notify the ethics committee of any protocol violations and/or Suspected Unexpected Serious Adverse Reactions (SUSARs) which occur during the project by submitting a Serious Adverse Event form.

end of the study, the CI or delegate must notify the committee using an End of Study form.

All aforementioned forms are available on the ethics online applications website and can only be submitted to the committee via the website at: http://leo.lshtm.ac.uk

Additional information is available at: www.lshtm.ac.uk/ethics

Yours sincerely,

Professor John DH Porter
Chair

ethics@lshtm.ac.uk
http://www.lshtm.ac.uk/ethics/

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Research Ethics Committee

Ms Alissa Pries
26 January 2017

Dear Alissa,

Study Title: Snacks and nutrition during the complementary feeding period: a cross-sectional study among children 12-23 months of age in Kathmandu Valley, Nepal

LSHTM MSc Ethics ref: 11719 - 1

Thank you for submitting your amendment for the above research project.

Your amendment has been assessed by the Research Governance & Integrity Office and has been approved as a non-substantial change. The amendment does not require further ethical approval from the observational ethics committee.

List of documents reviewed:

Document Type	File Name	Date	Version
Other	TOOLS FOR SURVEY_amended version	26/01/2017	2

Any subsequent changes to the application must be submitted to the Committee via an Amendment form on the ethics online applications website: http://leo.lshtm.ac.uk .

Best of luck with your project.

Yours sincerely,

Rebecca Carter

Research Governance Coordinator

Ethics@lshtm.ac.uk
http://www.lshtm.ac.uk/ethics/

Improving health worldwide

Government of Nepal

Nepal Health Research Council (NHRC)

Estd. 1991

Ref. No.: 563

22 September 2016

Dr. Rajendra Pant
Principal Investigator
Child Health Divison
Teku, Kathmandu

Subject: Approval of Research Proposal entitled **Snack Consumption and nutritional status during the complementary feeding period: a cross sectional study among children 12-23 months of age in Kathmandu valley, Nepal**

Dear Dr. Pant,

It is my pleasure to inform you that the above-mentioned proposal submitted on **3 August, 2016 (Reg.no. 210/2016** please use this Reg. No. during further correspondence) has been approved by NHRC Ethical Review Board on **21 September 2016.**

As per NHRC rules and regulations, the investigator has to strictly follow the protocol stipulated in the proposal. Any change in objective(s), problem statement, research question or hypothesis, methodology, implementation procedure, data management and budget that may be necessary in course of the implementation of the research proposal can only be made so and implemented after prior approval from this council. Thus, it is compulsory to submit the detail of such changes intended or desired with justification prior to actual change in the protocol before the expiration date of this approval. Expiration date of this study is **June 2018**

If the researcher requires transfer of the bio samples to other countries, the investigator should apply to the NHRC for the permission. The researchers will not be allowed to ship any raw/crude human biomaterial outside the country; only extracted and amplified samples can be taken to labs outside of Nepal for further study, as per the protocol submitted and approved by the NHRC. The remaining samples of the lab should be destroyed as per standard operating procedure, the process documented, and the NHRC informed.

Further, the researchers are directed to strictly abide by the National Ethical Guidelines published by NHRC during the implementation of their research proposal and submit progress report and full or summary report upon completion.

As per your research proposal, the total research amount is **NRs. 67,81,526** and accordingly the processing fee amount to **NRs. 2,03,446.** It is acknowledged that the above-mentioned processing fee has been received at NHRC.

If you have any questions, please contact the Ethical Review M & E section of NHRC.

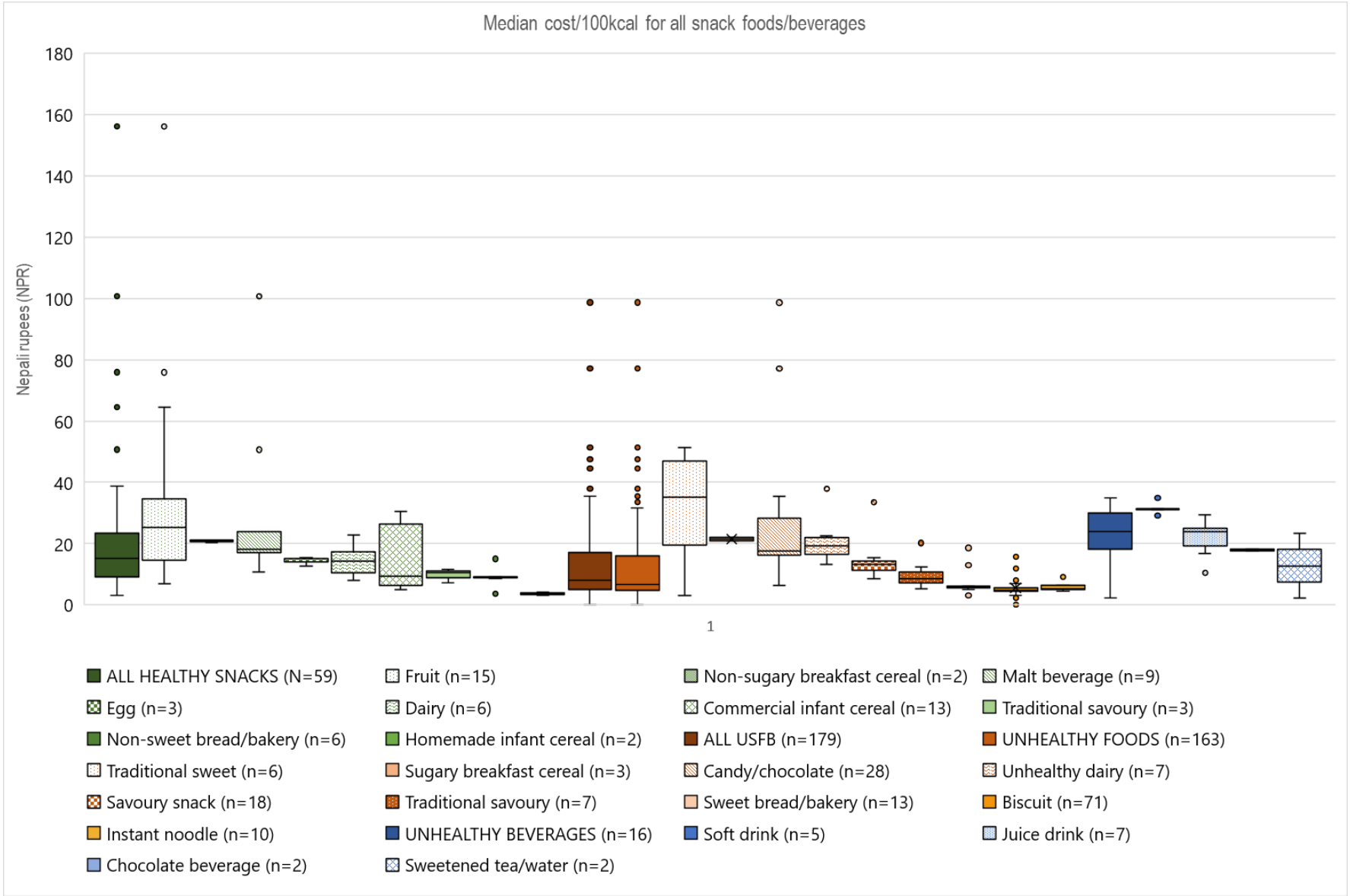
Thanking you,

.....

Dr. Khem Bahadur Karki
Member Secretary

Appendix 10: Descriptive statistics of costs/100 kcal of all snack foods/beverages

Descriptive statistics of costs/100kcal for all snack foods/beverages			
Food category	**Median (IQR)**	**Minimum**	**Maximum**
ALL HEALTHY SNACK FOODS/BEVERAGES (n=59)	15 (9-24)	3	156
Fruit (n=15)	25 (15-35)	7	156
Non-sugary breakfast cereal (n=2)	21 (21-21)	20	21
Malt beverage (n=9)	18 (17-24)	11	101
Egg (n=3)	15 (14-15)	13	15
Dairy (n=6)	14 (10-17)	8	23
Commercial infant cereal (n=13)	10 (6-26)	5	30
Traditional savoury (n=3)	10 (9-11)	7	12
Non-sweet bread/bakery (n=6)	9 (9-9)	4	15
Homemade infant cereal (n=2)	4 (3-4)	3	4
ALL UNHEALTHY SNACK FOODS/BEVERAGES (n=179)	8 (5-17)	0	99
UNHEALTHY FOODS (n=163)	7 (5-16)	0	99
Traditional sweet (n=6)	35 (20-47)	3	51
Sugary breakfast cereal (n=3)	21 (21-22)	21	22
Candy/chocolate (n=28)	18 (16-28)	6	99
Unhealthy dairy (n=7)	19 (16-22)	13	38
Savoury snack (n=18)	13 (11-14)	9	35
Traditional savoury (n=7)	8 (7-11)	5	20
Sweet bread/bakery (n=13)	6 (6-6)	3	19
Biscuit (n=71)	5 (4-5)	0	16
Instant noodle (n=10)	5 (5-6)	5	9
UNHEALTHY BEVERAGES (n=16)	24 (18-30)	2	35
Soft drink (n=5)	31 (31-31)	29	35
Juice drink (n=7)	24 (19-25)	11	30
Chocolate beverage (n=2)	18 (18-18)	18	18
Sweetened tea/water (n=2)	13 (8-18)	2	23


Median cost/100kcal for all snack foods/beverages
Nepali rupees (NPR)
180
160
140
120
100
80
60
40
20
0
1
ALL HEALTHY SNACKS (N=59)
Fruit (n=15)
Non-sugary breakfast cereal (n=2)
Malt beverage (n=9)
Egg (n=3)
Dairy (n=6)
Commercial infant cereal (n=13)
Traditional savoury (n=3)
Non-sweet bread/bakery (n=6)
Homemade infant cereal (n=2)
ALL USFB (n=179)
UNHEALTHY FOODS (n=163)
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