IMPACT OF FRONT-OF-PACK NUTRITION LABELLING ON DIETARY CHOICES IN NEPAL

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Abstract

An unhealthy diet is a leading contributor to the increasing burden of obesity and diet-related non-communicable diseases (NCDs). There has been increasing global interest and evidence in support of front-of-pack labelling (FOPL) as a policy strategy to promote healthy diets. There are various FOPL schemes being implemented across different regions with varied regulatory systems. There remains a gap and limited evidence about which scheme works best and which regulatory approach is effective. Importantly, there is an absence of evidence from low- and middle-income countries to support its implementation is such countries. The purpose of this thesis was to assess the equity impact of FOPL across socio-economic status (SES) groups by reviewing the global evidence and whether it is effective and feasible to introduce FOPL in the context of Nepal.

The thesis utilised three different methodological approaches to achieve the study objectives. These methodologies included: 1) a systematic review assessing the equity impact of FOPL across SES at a global level; 2) an experimental study investigating the effects of different FOPL schemes in guiding healthier food choices among Nepalese consumers; and 3) a qualitative study exploring the views of key stakeholders on the feasibility of introducing FOPL as a policy tool in Nepal.

The first study systematically reviewed the impact of FOPL and assessed whether it had differential effects in consumer understanding and use across SES groups. The review suggests interpretable labels such as Nutri-score, multiple traffic light labelling (MTLL), health star rating, and warning labels are likely to have better results in making healthier choices for all populations including low SES groups.

The second and third studies were conducted in Nepal to explore the effectiveness and feasibility of FOPL in the country. The second study utilized an experimental research design which included three different FOPL schemes: MTLL, Nutri-score and warning labels and a control condition (no FOPL). For the experiment, mock product packages of five pairs of commonly purchased food products were designed, each consisting of a healthier and a less healthy variant. Participants were randomly allocated to one of the experimental conditions or a control group. They were presented with the images of product pairs and asked to select the one which they

thought was healthier. The study found MTLL significantly increased the consumers' ability to correctly identify the healthier products, indicating MTLL can be an effective option in the Nepalese context. Nutri-score and MTLL were the most preferred FOPL schemes by the consumers and were reported to be easy to understand.

The third study utilised a qualitative approach and interviewed key informants from government health and food authorities, food industries, non-government organizations, and consumers to ascertain their views on the possibility of introducing FOPL in Nepal. The study found favourable response and support from the public health, food and industry sectors for the introduction of FOPL in the country. Most participants stated FOPL can be a potential tool to improve people's dietary habits and to prevent the emerging obesity and NCDs in the country. The study identified several potential advantages of FOPL such as ease of use, at-a-glance informed choices, improving people's nutrition literacy, and having potential to reformulate the products. However, the introduction of FOPL is a robust process and requires several steps including policy and strategy formulation, defining a legislative framework, developing or adopting an appropriate FOPL scheme along with nutrient profiling criteria, and establishment of monitoring and evaluation mechanism. The study revealed several barriers for the introduction of FOPL in the country which include poor government accountability, slow decision-making process, legal enforcement, limited resources, and perceived poor industry compliance. Participants suggested interpretable labels such as simple signposts or logos, Nutri-score and MTLL might perform better among Nepalese consumers given low literacy rates. The FOPL system should be accompanied by an effective education program to make consumers aware of the proposed scheme and to enable them to use the labels.

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List of Abbreviations

5-CNL	5-Color nutrition label
DALY	Disability adjusted life years
DFTQC	Department of Food Technology and Quality Control
DI	Daily intake
DIG	Daily intake guideline
DoHS	Department of Health Services
EU	European Union
FOPL	Front-of-pack labelling
GBD	Global burden of disease
GDA	Guideline daily amount
HICs	High-income countries
HPI	Healthy purchase index
HSR	Health star rating
ICN2	Second International Conference on Nutrition
LMICs	Low- and middle-income countries
MoAD	Ministry of Agriculture and Livestock Development
MoHP	Ministry of Health and Population
mRI	Modified reference intake
MSNP	Multi-sector Nutrition Plan
MTLL	Multiple traffic light labelling
NCDs	Non-communicable diseases
NDHS	Nepal demographic and health survey
NGO	Non-government organization
NHRC	Nepal Health Research Council

NIP	Nutrition information panel
NPC	National Planning Commission
PNNS	Programme National Nutrition Sante
SDGs	Sustainable development goals
SDI	Socio-demographic index
SES	Socio-economic status
SPPS	Statistical Packages form Social Scientists
TLL	Traffic light labelling
UK	United Kingdom
UN	United Nations
US	United States
WHO	World Health Organization

Statement of Original Authorship

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

Signature: QUT Verified Signature

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Chapter 1: Introduction

This research reviewed the impact of front-of-pack nutrition labelling (FOPL) in promoting healthy diets across socio-economic groups, and investigated its effects and feasibility in the context of Nepal. This chapter outlines the background, context, and purpose of the research.

1.1 BACKGROUND

The global food system has changed drastically, shifting the world from undernutrition and micronutrient deficiency to obesity and diet-related non-communicable diseases (NCDs) including cardiovascular disease, diabetes, and many forms of cancer (Development Initiatives, 2018). Economic development, along with the increasing urbanization, trade liberation, and advancement in food technology, has led to greater access to a wide range of processed and packaged foods which now comprise a large share of diets around the world (World Health Organization [WHO], 2017). Over the years, there have been significant changes in people's dietary patterns (Hawkes et al., 2017; Juul & Hemmingsson, 2015). A recent finding from the Global Burden of Disease (GBD) study reveals the consumption of nearly all healthy foods and nutrients is suboptimal (e.g., fruits, vegetables, nuts, whole grains, and milk) while unhealthy foods has exceeded the recommended intake (e.g., sugar sweetened beverages, sodium, and processed meat) (Afshin et al., 2019). Dietary factors are the leading risk factors attributing to 11 million deaths and 255 million disability adjusted life years (DALYs) globally. The study also highlights the burden is disproportionately higher in low-income settings. Many low- and middle-income countries (LMICs) are moving towards a dietary pattern that comprises highly processed and energy-dense, nutrient poor foods, resulting in a double burden with the coexistence of two or more forms of malnutrition (Perez-Escamilla et al., 2018).

These dietary and nutrition transitions have seen a steady rise in obesity and diet-related NCDs, and have important implications for national and international efforts of combating malnutrition, emphasizing the need for comprehensive food system interventions to promote healthy food production, distribution, and consumption. A wide array of policy options and interventions exist for governments in shaping food

system regulations to create and secure healthy food environments. Nutrition labelling is one of the strategies that can be leveraged to promote healthy eating by means of nutrition education and can also promote product reformulation (Cecchini et al., 2010).

Many countries have considered introducing nutrition labelling, providing information about nutrient content of foods, as an important public health strategy to address obesity and diet-related chronic diseases. Information on the nutritional quality of foods at the point of purchase allows consumers an informed choices to improve their purchase decisions and diets (Grunert & Wills, 2007). Countries such as Australia, New Zealand, European Union (EU), Canada, the United States (US), Hong Kong, and Malaysia have made nutrition labelling mandatory on all packaged foods (Hawkes et al., 2017; Kelly & Jewell, 2018). The provision of nutrition information started to appear as "Nutrition Facts" or a "Nutrition Information Panel (NIP)" in the form of tables or grids at the back of packaged foods since 1990s to provide consumers appropriate information to make informed healthier choices. However, evidence consistently identified poor understanding and use of the NIP because of the complexity of the numerical information and its positioning at the back of the pack (Besler et al., 2012; Cowburn & Stockley, 2005; Mhurchu & Gorton, 2007).

In recent years, a graphical or front-of-pack labelling (FOPL), which displays nutrition information in an interpretative way, is gaining popularity (Hawkes, 2010; Jones et al., 2019). FOPLs are usually voluntary and use interpretive aides like symbols and colours, conveying the information in an easy-to-understand way (Cecchini & Warin, 2016; Mhurchu et al., 2018). Countries such as the United Kingdom (UK), United Arab Emirates, Islamic Republic of Iran, and Saudi Arabia have adopted voluntary traffic light labelling (TLL) using red, amber, and green colours to indicate the level of nutrient content (high, medium, or low) (Al-Jawaldeh et al., 2020). Similarly, European countries have introduced different FOPL systems including endorsement logos (e.g., Healthy Choice logo, Heart Symbol, Keyhole logo), summary indicators (e.g., Nutri-score), nutrient specific interpretative system (e.g., Colour-coded % reference intake) and nutrient specific warning system (e.g., Red warning) (Kelly & Jewell, 2018). Australia and New Zealand have developed the health star rating (HSR) that assigns stars from 0.5 to 5 to rate the healthiness of products (Health Star Rating Advisory Committee, 2017).

Due to the simpler format and prominent positioning on the front of the package, these labels are more noticeable and are designed to enhance consumers' attention towards nutrition information (Becker et al., 2015; Bix et al., 2015). Studies have reported that FOPL schemes are comprehensible and effective in guiding people to make healthier food choices (Campos et al., 2011; Hersey et al., 2013). Interpretive labels are more understandable than reductive or numeric labels, and therefore, preferred by the consumers (Feunekes et al., 2008). Consumers often express a preference for simple and comprehensible labels (Andrews et al., 2011). For example, a survey in France noted Nutri-score as the most preferred FOPL scheme among consumers followed by Multiple traffic light labelling (MTLL) (Julia et al., 2017).

While FOPL is gaining traction, it has been argued whether it is a public health approach or a marketing strategy (Brownell & Koplan, 2011). There are concerns relating to industry influence in the decision-making process on FOPL and the existence of multiple FOPL systems creating confusion and difficulty among consumers (Kleef & Dagevos, 2015; Thow et al., 2019). Importantly, the varying nutrient profiling approaches, lack of consistency, and validation may inadvertently promote unhealthy foods (Foltran et al., 2010; Lawrence et al., 2019). For example, discretionary and ultra-processed foods that are high in fat, salt, or sugar are currently being promoted with HSR scores of 2.5 or more in Australian markets demonstrating the inadequacy of the system to integrate comprehensive nutrient profiling (Lawrence et al., 2018).

The adoption and implementation of FOPL require scientific evidence to further accelerate its uptake as an important policy option. The French Nutri-score has been considered a scientifically compelling model based on research evidence. Although the development process went through prolonged discussion and controversies, the policy decision is justified on the ground of its reliance on science and public health impact (Julia et al., 2018). Studies have demonstrated the effectiveness of Nutri-score in terms of enhancing consumers' ability in correctly identifying healthier foods and increasing the nutritional quality of the intended and actual purchases (Andreeva et al., 2021; Egnell et al., 2020). Similarly, the Chilean warning label has received overwhelming support from public health communities and many countries (e.g., Canada, Israel) are considering adopting a similar system (Kanter et al., 2018). Evidence shows the warning labels are effective in capturing consumer attention to

nutrients of concern and reducing the intention to purchase unhealthy products (Cabrera et al., 2017; Khandpur et al., 2018).

Overall, FOPL has gained significant global attention. Despite the conflicting interests and debates surrounding the multiple approaches and likely impact on overall health, FOPL may play an important role in promoting healthier food choices. More research and empirical evidence are required to make realistic assumptions about the effectiveness of FOPL with respect to improving diets and population health.

1.2 THE CONTEXT OF NEPAL

Nepal is a landlocked country located in South Asia, with a population of 29.3 million (World Bank, 2019). It is among the low-income countries in the world where 25% of its population is still below the national poverty line on less than USD 0.50 per day (World Food Programme, 2019). The country is currently in a recovering phase from the destruction and economic set back due to a massive earthquake in 2015. Along with this economic transition, the country is undergoing rapid demographic and epidemiological shifts. While infectious diseases continue to be the leading causes of morbidity and mortality in the country, it is also witnessing a steady rise in obesity and NCDs like cardiovascular diseases, diabetes, and cancers (Dhungana et al., 2018; Mishra et al., 2015; Nepal Health Research Council [NHRC] et al., 2019). The country has witnessed a three times increase in the prevalence of overweight and obesity from 7.2% in 2007 to 24.3% in 2019 (Dhimal et al., 2020; NHRC, 2014). According to the latest survey report, the prevalence of overweight is 20.0% and obesity is 4.3% (Dhimal et al., 2020). The report showed an increased disease risk in metropolitan and sub-metropolitan regions (29%) compared to rural areas (15.4%). The risk is greater among the individuals with the highest household wealth quintile (24.9%) than those with the lowest wealth quintile (16.3%).

Like many other LMICs, people's dietary patterns and lifestyle have changed over the years. The city areas in particular are witnessing high rates of fast food and packaged food consumption, leading to the increased risk of obesity (Bhandari et al., 2016; Poudel et al., 2018; Shrestha et al., 2016). On the other hand, the intake of fruits and vegetables is low among Nepalese people (Dhimal et al., 2020; Dhungana et al., 2018; NHRC, 2014). In a survey among children aged 12-23 months, Pries et al. (2019) found a high consumption of unhealthy snack foods and beverages consumption. Of

the total snack foods and beverages consumed by the children, 75% were classified as unhealthy based on the nutrient profiling and these foods contributed a quarter of the dietary energy intake from non-breastmilk foods. The children from the poorest households were more likely to consume the unhealthy foods whereas the consumption was lower among the children whose caregivers had higher levels of education.

Policies and programs related to nutrition and diet

The government of Nepal has identified nutrition as a priority agenda and has developed several nutrition related policies and strategies. The National Nutrition Policy and Strategy 2004 (updated in 2008) and The Nepal Health Sector Strategy, 2016-2021 guide the nutrition programmes and activities in the health sector in the country (National Planning Commission [NPC], 2017). In 2014, Nepal implemented the Multi-sector Nutrition Plan (MSNP) 2013-17 which mainly addressed the causes of undernutrition and contributed to improving the nutritional status of women and children. As a continuation of this plan, the MSNP-II (2018 – 2022) has been formulated and is primarily focused on activities to improve maternal and child nutrition by scaling up the nutrition-specific interventions targeted for these groups (NPC, 2017).

There are no specific policies or guidelines to address dietary risk factors for obesity and NCDs in Nepal. The National Nutrition Policy and Strategy presented a brief dietary guideline for life-style related diseases which included key messages such as consumption of a variety of foods including fruits, vegetables, cereals/grains, and fibres, limit salt and sugar intake, maintain healthy body weight and promote physical activities, and control alcohol consumption and tobacco use (Ministry of Health and Population [MoHP], 2004). There is a food composition table which provides information on the average amount of nutrient contents in different categories of foods (Department of Food Technology and Quality Control [DFTQC], 2012). It also provides recommended daily nutrient intakes for children, adolescents, adults, and pregnant women, and lactating mothers. However, comprehensive dietary guidelines are lacking in the country.

Nutrition labelling

Currently, there is no specific national policy and strategy or regulation on nutrition labelling in Nepal. Food safety is regulated through the Food Act, 1966 which

restricts the production, distribution, and sale of adulterated or sub-standard foods (Government of Nepal, 1992). The Consumer Protection Act, 1997 prohibits misleading publicity or advertisements of any goods and services including food. General food labelling requirements in relation to food packaging and language are described in the Food Regulation, 1970 (Khalid, 2014). It includes the description of food in an easily visible manner; manufacturer/entrepreneur name and address; listing of food ingredients, weight or volume of the product; batch number, dates of manufacture and expiry; specification of colours or preservatives added, and description of each nutrient content like minerals or vitamins (Government of Nepal, 1998). However, it does not specifically mention the clear requirement for labelling nutrient content like calories, fat, saturated fat, sugar, and sodium.

1.3 STATEMENT OF PROBLEM

FOPL has been a focus for nutrition research over the last decade. A growing body of literature has enhanced our understanding of FOPL and consumer responses to the labels. However, there exists little empirical and consistent evidence to support FOPL in improving diet and health. Literature suggests there are varying impacts of nutrition labelling across population subgroups with substantial differences in the consumer groups who notice and use nutrition information subject to their age, gender, and SES (Campos et al., 2011; Hawkes et al., 2015; Long et al., 2015; Sinclair et al., 2014). There is currently little empirical evaluation of FOPL to suggest whether there are differential effects across socioeconomic strata. Much of the research about FOPL has mainly assessed the impact on improving people's understanding and promoting healthy choices at a population level with limited stratified analysis by socio-economic position (Campos et al., 2011; Cecchini & Warin, 2016; Cowburn & Stockley, 2005; Crockett et al., 2018). Importantly, studies on FOPL have predominantly been conducted in high-income countries (HICs) like the US, Australia, and Europe, which have different governance and socio-economic structures compared to LMICs. Research on the impact of FOPL in addressing nutrition inequalities is lacking with limited evidence from LMICs including Nepal. While Nepal is facing the emerging challenge of obesity and NCDs, national policies and actions in the country are still directed towards addressing undernutrition and micronutrient deficiencies (Sharma et al., 2017). There has been little attention towards preventive public health approaches to address dietary risks and associated diseases. The emerging burden of obesity and

NCDs along with increasing dietary risks indicates government health system need to focus on these areas (Dhimal et al., 2020; NHRC, 2014).

Nutrition labelling including FOPL is one cost-effective strategy the government could consider to promote healthy eating (Sacks et al., 2011). However, there is no specific policy or guideline on nutrition labelling in Nepal. Current food labelling regulation is limited to general food packaging such as industry name, manufacture and expiry dates, batch number, and listing of ingredients. It does not specifically require labelling of nutrient content including calories, fats, sugars, and sodium. There is no specific regulation on nutrition labelling in Nepal and it has not yet introduced any FOPL system. Studies related to nutrition labelling, FOPL in particular, are lacking to support its introduction in the Nepalese context and it is still unclear whether FOPL would be effective in improving diets among Nepalese consumers. Therefore, this study assessed the effectiveness and feasibility of FOPL in the context of Nepal. The findings may inform public health and nutrition policies about the effects of FOPL to promote healthy eating in Nepal and potentially other LMICs.

1.4 PURPOSES

The research aimed to assess the equity impact of FOPL across socio-economic groups by systematically reviewing the global evidence and then investigate whether it is effective and feasible to introduce FOPL in the context of Nepal. The specific objectives were:

- to systematically review the impact of FOPL in consumer understanding and use across socio-economic status (SES) at a global level
- to assess the effectiveness of different FOPL schemes in consumer understanding in Nepal
- to explore stakeholders' views on the feasibility of FOPL introduction in the context of Nepal

Research questions

1. How effective are FOPL schemes in addressing socio-economic inequalities in consumer understanding and use at a global level?
2. What is the effectiveness of FOPL formats in guiding healthier food choices in Nepal?

3. What are stakeholders' views on the feasibility of FOPL introduction in Nepal?

1.5 SIGNIFICANCE

With changing dietary practices and sedentary lifestyle, the risk of obesity and diet-related diseases is expected to continue to rise unless appropriate policy actions are taken. Importantly, LMICs including Nepal are facing a serious challenge of dual burden of malnutrition along with the increasing rates of NCDs. FOPL can be an important means of empowering people to make healthier choices. Given the limited literature on the effects of FOPL across SES strata, the findings from this thesis are likely to generate an evidence on how FOPL might influence the consumers' food choices in low- to middle-income settings.

In Nepal, where there does not exist any nutrition labelling system, the findings of this research may inform health and nutrition policies to consider FOPL as a preventive strategy to promote healthy eating and to address obesity and diet-related diseases. The understanding of the effects of FOPL among Nepalese consumers may provide an important insight in considering FOPL in health and nutrition policies. The key stakeholders' views on the FOPL may aid in shaping the nutrition labelling regulation and contribute to the development of appropriate FOPL system in the country.

1.6 THESIS OUTLINE

This thesis includes seven chapters:

Chapter 1 consists of background and context of the research. It outlines the aim and objectives of this program of research.

Chapter 2 of this thesis provides a review of the literature on diet and its effect on health globally and in low- to middle-income settings including Nepal and what role nutrition labelling, particularly FOPL has in promoting healthy food choices. Different aspects of FOPL including its effectiveness, various systems being implemented across different regions, and ongoing debates on FOPL implementation are discussed in this section.

Chapter 3 deals with the design and methodology of this program of research. This thesis comprises three studies: a systematic review (Study 1) assessing the impact

of FOPL across SES at a global level; an experimental study (Study 2) investigating the effectiveness of FOPL in guiding food choices among consumers in Nepal; and a qualitative study (Study 3) exploring stakeholders' views on the feasibility of FOPL introduction in the context of Nepal. This chapter describes the methodology used for each study in different sections.

Chapter 4 presents narrative synthesis of the systematic review with the analysis and discussion of the findings.

Chapter 5 presents the results of two studies conducted in Nepal. This is a mixed-method study applying quantitative and qualitative approaches to assess the effectiveness and feasibility of introducing FOPL in Nepal. The first section presents the results of the experimental study and the second section presents the qualitative findings synthesized in several themes.

Chapter 6 presents discussion of the results of the two studies (experimental and qualitative studies) carried out in Nepal. Although different methodological approaches were used, these studies are related and their findings inform and help understand each other. The experiment informed the qualitative study by generating evidence on the effects of FOPL among Nepalese consumers and the qualitative findings provided in-depth understanding of how FOPL may influence consumer choices including facilitators and barriers of the FOPL use. Therefore, the results and discussion of these studies are combined and the findings are interpreted together within the same context.

Chapter 7 provides conclusions and recommendations.

Chapter 2: Literature Review

This chapter begins with a literature review on the global situation of diets and their association with population health relating to obesity and diet-related NCDs (2.1); analysis of contribution of packaged and processed foods on obesity and NCDs (2.2); and global efforts (2.3) including nutrition labelling as a public health initiative to address obesity and diet-related diseases (2.4). The next sections deal with the emergence of FOPL, various FOPL systems being implemented across different regions (2.5), and current evidence on the impact of the FOPL in relation to consumer understanding and use, and product reformulation (2.6), as well as the ongoing debates and controversies that FOPL is facing (2.7). The last section (2.8) describes the present nutrition situation of Nepal, how it is transitioning to obesity and diet-related NCDs, and a brief overview on national nutrition policies and programs including labelling requirements in the country.

2.1 DIETS AND HEALTH

Diets and nutrition have a crucial impact on human health; an unhealthy diet is an important cause of poor health, responsible for more deaths and disability than any other risks, including tobacco and alcohol use. The GBD study (Afshin et al., 2019) shows that unhealthy diets are responsible for 11 million deaths and 255 million DALYs, globally. This corresponds to 22% of all deaths and 15% of all DALYs among adults, respectively. Cardiovascular disease is the leading cause of diet-related deaths (10 million) and DALYs (207 million) followed by cancer (913,090 deaths and 20 million DALYs) and type 2 diabetes (338,714 deaths and 24 million DALYs). More than 5 million diet-related deaths (45%) and 177 million diet-related DALYs occur among adults aged younger than 70 years. The leading dietary risk factors are a high intake of sodium attributing to 3 million deaths and 70 million DALYs, followed by a low intake of whole grains (3 million deaths and 82 million DALYs), and a low intake of fruits (2 million deaths and 65 million DALYs).

The GBD study also highlights that the consumption of nearly all healthy foods and nutrients is suboptimal while the intake of unhealthy foods has exceeded the

recommended amount. For example, the global consumption of sugar-sweetened beverages is far higher than the optimal intake, processed meat is 90% greater than the optimal amount, red meat is 18% greater than the optimal amount, and sodium is 86% greater than the optimal amount (Afshin et al., 2019). As a result, the prevalence of overweight and obesity, and diet-related NCDs is increasing worldwide. According to the WHO (2021), more than 1.9 billion adults are overweight, of these over 650 million are obese. This corresponds to 39% of the adults aged 18 years and over who are overweight, with 13% obese. The worldwide prevalence of obesity has nearly tripled since 1975.

There exists significant disparities at national and subnational levels with the burden of obesity and chronic diseases disproportionally falling on the populations with low SES (WHO, 2010). Once considered a problem in HICs, obesity and diet-related diseases are now increasing in LMICs. The prevalence of obesity increased by a factor of 1.7 in LMICs between 1980 and 2015 (Afshin et al., 2017). Forty-one countries in the world are facing a serious burden of all forms of malnutrition (undernutrition, obesity, and double burden), 32 of which are LMICs (Development Initiatives, 2018). According to the GBD study, the highest rates of all diet-related deaths and DALYs are observed in low-middle socio-demographic index (SDI) countries (344 deaths per 100000 population and 7797 DALYs per 100000 population) and high-middle SDI countries (347 deaths per 100 000 population and 6998 DALYs per 100 000 population) (Afshin et al., 2017). In HICs, the prevalence is disproportionately higher in low SES population (Booth et al., 2017; Wang & Lim, 2012). In contrast, the risk is more prevalent in higher SES groups in LMICs (Allen et al., 2017). The burden, however, shifts towards lower SES population as the country's income increases (Dinsa et al., 2012; Swinburn et al., 2011).

2.2 ROLE OF PACKAGED AND ULTRA-PROCESSED FOODS ON DIETS

There are many factors contributing to changing dietary patterns and increasing rates of obesity and related chronic diseases. These include rising incomes, urbanization, trade liberalization, developments in food technology leading to high production of ultra-processed foods, the replacement of local markets with supermarkets, and advertising and marketing strategies, resulting in greater access to, and intake of a wider range of foods that are high in refined carbohydrates, calories, fats, sugars, and salt (WHO, 2017). The large quantities of the ultra-processed foods

being produced, have been made available in the market at relatively cheaper prices (Monteiro, Cannon, et al., 2017). On the other hand, prices for healthy options such as fruits, and vegetables are rising, and have become more inaccessible especially for the poor. On average the prices of fruits and vegetables have increased by 2% to 3% a year (55% – 91% between 1990 and 2012) whereas the prices of processed foods have fallen over the same period (Wiggins et al., 2015). The Global Nutrition Report (Development Initiatives, 2018) reveals that packaged and processed foods, such as sugar-sweetened beverages, dairy products, cake mixes, pies, pastries, sweets, baked foods, chips and crackers, and processed meats now comprise a large share of many diets around the world. Globally, sales of total per capita volumes of packaged food rose from 67.7 kg per capita in 2005 to 76.9 kg in 2017. While ultra-processed foods dominate the food supply in HICs, the consumption of these products are now increasing in LMICs (Luiten et al., 2016; Monteiro, Cannon, et al., 2017; Moubarac et al., 2013). For example, between 1998 and 2012, per capita retail sales of snacks and soft drinks increased from 1.3 to 2.8 and 5.6 to 20.9, respectively, in LMICs (Monteiro et al., 2013).

The increased availability of obesogenic ultra-processed foods, is one of the predominant drivers of the global obesity burden (Vandevijvere et al., 2015). Over a quarter (26.4%) of foods purchased by a household in Europe consists of ultra-processed foods and the countries with high availability of ultra-processed foods are more likely to have higher rates of obesity (Hall, 2018; Monteiro, Moubarac, et al., 2017). Prospective studies using data from French NutriNet-Sante cohort observed a significantly increased risk of cardiovascular diseases (Srour et al., 2019), cancers (Fiolet et al., 2018), and irritable bowel syndrome (Schnabel et al., 2018) with increased consumption of ultra-processed foods in the diet. According to a study by Rico-Campà et al. (2019), a high consumption of ultra-processed foods (more than 4 servings a day) is associated with a 62% increased risk of all-cause mortality compared with a consumption of less than 2 servings a day. For each additional serving of ultra-processed foods, the mortality risk increases by 18%.

2.3 GLOBAL COMMITMENTS AND TARGETS TO ADDRESS OBESITY AND DIET-RELATED NON-COMMUNICABLE DISEASES

In 2004, the WHO adopted the Global Strategy on Diet, Physical Activity and Health, which calls upon all stakeholders to take actions at global, national, and local levels to improve diets and physical activity (WHO, 2004). Similarly, the WHO Global Action Plan for the Prevention and Control of NCDs (WHO, 2013) has recognized the critical importance of reducing dietary risk factors and related NCDs, adopting a set of voluntary targets, to be met by 2025. These targets include halting the rise in obesity and diabetes, a 30% relative reduction in salt intake or a 25% relative reduction in the prevalence of raised blood pressure, and reducing overall mortality of cardiovascular disease, cancer, and diabetes. In 2014, the Second International Conference on Nutrition (ICN2) galvanized the global efforts, committing world leaders and governments to establishing national policies and strategies to combat malnutrition and strengthen sustainable food systems (Food and Agriculture Organization, 2014). In 2015, the United Nations (UN) Sustainable Development Goals (SDGs) set targets, to be achieved by 2030, which also includes ending malnutrition in all its forms (target 2.2); and reducing mortality from NCDs by one third (target 3.4) (United Nations, 2015). A year after, the UN General Assembly adopted the UN Decade of Action on Nutrition 2016–2025 to accelerate the implementation of action towards the SDG targets and the ICN2 commitments, advocating for increased investment and implementation of policies and programmes to improve food security and nutrition (Development Initiatives, 2018). The WHO Commission on Ending Childhood Obesity noted the evidence linking unhealthy food consumption to childhood obesity and proposed a set of recommendations including nutrition labelling to reduce the risk of obesity (WHO, 2016). These global efforts highlight the dietary risks and emphasize preventive measures to promote healthy diets such as nutrition education and labelling.

2.4 NUTRITION LABELLING AS A TOOL TO ADDRESS OBESITY AND DIET-RELATED DISEASES

Nutrition labelling has been considered an important means of empowering consumers and promoting healthier eating (Grunert and Wills, 2007). Labelling provides consumers with information about the nutrition content of food products, enabling them to make informed healthier food choices. Figure 2-1 shows the logic model explaining the process by which nutrition labelling can influence healthier food

purchasing and consumption, resulting in improved diet quality and reductions in diet-related disease burden (Crockett et al., 2018). The labelling increases consumers' understanding of the healthiness of foods, as well as encourages manufacturers to reformulate their products increasing the availability of healthy foods. There are many factors which may influence the impact of nutrition labelling including food prices, taste of food, cultural context and individual characteristics such as age, gender, and body weight (Crockett et al., 2014).

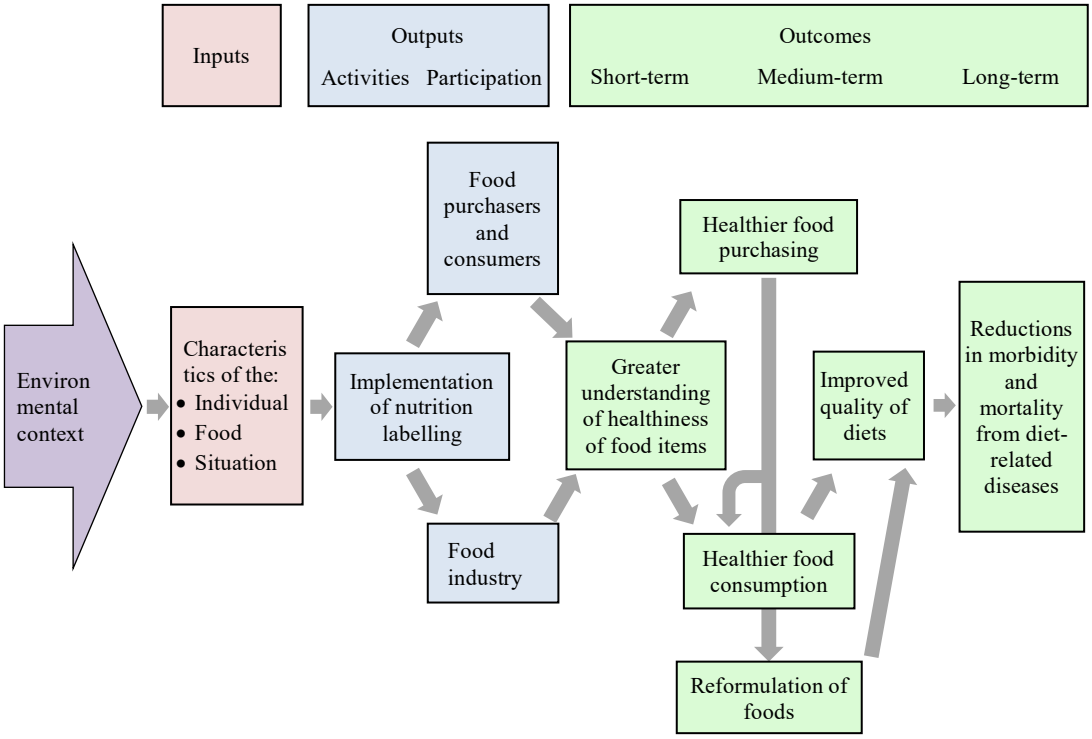
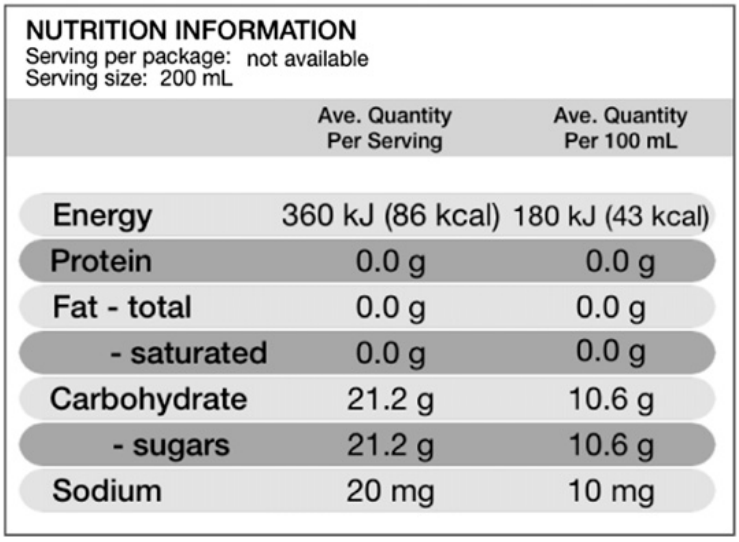


Figure 2-1: Logic model of the process by which nutrition labelling may have an impact on diets and health (Crockett et al., 2018)

The types and forms of labelling vary with regards to nutrient content and display formats. The Codex Alimentarius Commission (Codex), the joint WHO and Food and Agriculture Organization of the UN, categorizes nutrition labelling into two components: nutrient declarations and supplementary nutrition information. A nutrient declaration is a listing of the nutrient content of a food in the form of 'NIP' usually on the back or the side of the package – see Figure 2-2 (Kelly & Jewell, 2018). Supplementary nutrition information is usually provided in the form of a 'graphical' or 'FOPL', which displays nutrition information in an interpretative way such as TLL,

Guideline daily amount (GDA), and nutrient scoring (Hawkes, 2010; Kelly & Jewell, 2018). The labelling also exists in the form of nutrition warning and health claims (WHO, 2017).



NUTRITION INFORMATION
Serving per package: not available
Serving size: 200 mL

	Ave. Quantity Per Serving	Ave. Quantity Per 100 mL
Energy	360 kJ (86 kcal)	180 kJ (43 kcal)
Protein	0.0 g	0.0 g
Fat - total	0.0 g	0.0 g
- saturated	0.0 g	0.0 g
Carbohydrate	21.2 g	10.6 g
- sugars	21.2 g	10.6 g
Sodium	20 mg	10 mg

Figure 2-2: An example of a nutrition information panel

Many countries have adopted regulatory legislation to ensure nutrition labelling standards, though rules and regulations vary widely across countries (Kasapila & Shaarani, 2016). The US was the first country to regulate mandatory nutrition labelling legislation in 1994, which requires a NIP on all pre-packaged foods (Hawkes, 2010). The European Union adopted a directive in 1990 making nutrition labelling voluntary, except where claims are made. Later, it was made mandatory and required to label packaged foods with the nutrient contents like calories, fats, sugars, and salt (Morestin et al., 2011). Food Standards Australia and New Zealand made it a mandatory requirement for most pre-packaged foods to have a NIP for both countries in 2002 (Curran, 2002). At the same time, food authorities worldwide are introducing voluntary FOPL initiatives, especially in countries with a high burden of obesity and NCDs (Kanter et al., 2018).

2.5 FRONT-OF-PACK LABELLING (FOPL)

FOPL is a form of supplementary nutrition information that presents simplified nutrition information on the front-of-pack of pre-packaged foods. It includes symbols/graphics, text or both to provide information about the nutrient value of a food product (Codex Committee on Food Labelling Electronic Working Group, 2019).

FOPL is being increasingly recognised worldwide, with the aim to assist consumers to make appropriate food choices. According to a review by Jones et al. (2019), 31 governments have endorsed some form of FOPL globally. A majority of the governments have voluntary approach (21) for its implementation while a few countries have mandatory regulation (10). Some countries have more than one FOPL schemes (e.g., Israel have both red warnings and a green endorsement logo), and some labels are being implemented in more than one country (e.g., HSR in Australia and New Zealand). Most of these FOPL systems are implemented in HICs and upper middle-income countries. A majority of the FOPL systems were introduced in the last decade. The FOPL implementation has intensified over the last five years, particularly focusing on labels that evaluate product unhealthfulness.

Jones et al. (2019) in their review identified 31 unique FOPLs schemes being implemented across the globe (Table 2-1). Of these, 26 have interpretive elements. Positive signposts have subjective words (e.g., good or healthier), symbols (e.g., ticks or hearts), and colours to indicate relative healthfulness of a food product within category. The nutrient-specific formats have descriptive words (e.g., low, medium, and high); meaningful colour (red, yellow, green, and black) and salient symbols (e.g., stop signs and traffic lights) to illustrate specific nutrient content of a product.

FOPL can be broadly categorised as summary indicators and nutrient-specific systems as follows:

Summary indicators

Interpretive positive signpost: These systems provide a positive evaluative judgement and use symbols, words, and colour to assess overall absolute healthfulness of a product. Labels are displayed only if the products meet a defined nutrition standard and nutrient criteria for the symbol or logo vary across food groups in terms of nutrients and values applied (Jones et al., 2019; Kelly & Jewell, 2018). Examples include Healthy Choice logos (Belgium and Poland), and a Keyhole logo (Denmark, Iceland, Norway, and Sweden).

Spectrum rating: These systems provide both positive and negative evaluative judgements and use customisable continuum to summarise nutritional quality overall. For example, French Nutri-score uses colour and letter to indicate its evaluation (i.e.,

dark green to red colour corresponding to letters A to E). Similarly, Australia's HSR displays star logo in any colour ranging from 0.5 to 5 (Health Star Rating Advisory Committee, 2017; Jones et al., 2019).

Negative signpost: These systems use symbols, words and colour to highlight overall unhealthfulness of a food product (e.g., overall warning). The system is not in use currently (Jones et al., 2019).

Nutrient-specific systems

Interpretive systems: The nutrient-specific interpretive labels provide information on individual nutrients with the use of meaningful colour, words and/or symbols. For example, United Kingdom's MTLL uses red, amber, and green colours to indicate the level of nutrient content (high, medium, or low) and Chile's warning labels use black stop-sign for products that exceed limits for sugar, sodium, saturated fat and energy (Jones et al., 2019; Kelly & Jewell, 2018).

Non-interpretive or reductive systems: Non-interpretive labels provide some assessment of the contribution that serving of food makes to nutrient intakes but do not provide an evaluative judgement about how the numerical value should be interpreted. Examples include % RI and GDA, which present the amount of nutrient as a percentage of recommended daily intake (Kelly & Jewell, 2018).

Table 2-1: FOPL systems and their characteristics

Name and symbol	Characteristics	Requirements or criteria	Interpretive element	Countries
Positive signposts				
Healthy Choice logo 	Two versions: - Green logo with text 'healthy choice' representing healthy choices within basic categories essential to a healthy diet (including bread, milk, fruit and vegetables) - Blue logo with text 'conscious choice' to assist consumers to select healthier option within non-basic products	Units: 100 g/ml or per serving Nutrients included: Saturated fat, trans fatty acids, added sugar, sodium, energy Limits: Nine basic and 6 non basic product groups with nutrient criteria	Text and tick symbol	Netherlands, Belgium, Poland, Czech Republic, Mexico
Green Endorsement logo 	Squiggle within a green circle	Units: mg/100 ml Nutrients included: sodium, saturated fat and fibre	Symbol	Israel

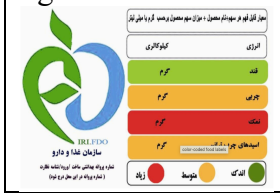
Name and symbol	Characteristics	Requirements or criteria	Interpretive element	Countries
Healthier Choices 	Red pyramid label; there are 10 logo variants	Units: % limits Nutrients included: Total fat, saturated fat, trans fat, sodium, total sugars, whole grains, dietary fibre and calcium Limits: Nutrient criteria exist for over 60 food and beverages categories; At least 20% or 25% more or less of the nutrient/ingredient needed	Text and symbol	Singapore
Healthier Choices 	Can be displayed in two schemes: - multi chrome with three colours (orange, green, and blue) - monochrome (black, navy blue, or white); background colour and logo must be in high contrast to increase the visibility	Units: 100 g/ml and per serving Nutrients included: Total fat, total sugar, saturated fat, sodium, protein, calcium, fibre, and iron Limits: Ready-to-eat meals, beverages, sauces, dairy products, instant foods, snacks, ice creams, and fat and oil. Point system in six categories from worst (0) to best (5)	Text and symbol	Thailand
Healthier Choices 	A red circle and a tick	Units: 100 g/ml Nutrients included: Saturated fat, total sugars, sugars, sodium, and calcium Limits: Nutrient criteria exist for over 60 categories of foods and beverages	Text and symbol	Brunei

Name and symbol	Characteristics	Requirements or criteria	Interpretive element	Countries
Healthy Living Guarantee Mark 	Green cloud with the text “Live well”	Units: g/100 g Nutrients included: Fat, total sugars, and salt Limits: Nutrient criteria exist for over 47 categories of foods and beverages	Text and symbol	Croatia
Heart Symbol 	Heart symbol with encircling text “better choice”	Units: % Limits Nutrients included: Total fat, saturated and unsaturated fat, sugars, sodium, and fibre Limits: Nutrient criteria exist for 22 food categories; based on Finnish nutrition recommendation; threshold criteria vary across food groups	Text and heart symbol	Finland
Keyhole 	Always green with a white keyhole (black with a white if colour not available) followed by the registered trademark symbol	Units: 100 g/ml Nutrients included: Total fat, saturated and trans-fat, sugars, sodium, fibre, and wholegrains Limits: Nutrient criteria exist for 33 food groups; Thresholds set by category	Keyhole symbol	Norway, Sweden, Denmark, Iceland, Lithuania

Name and symbol	Characteristics	Requirements or criteria	Interpretive element	Countries
Protective Food logo (Little Heart logo) 	Heart symbol gives the products' specific nutritional properties that make a healthier choice compared with other food products in the same category	Units: 100 g/ml Nutrients included: Energy, added sugars, fat, ratio of fatty acids, salt, and fibre Limits: Threshold criteria based on European Commission Regulations	Heart symbol	Slovenia
Healthier Choice logo 	Two colours (red or black) are allowed	Units: 100 g/ml Nutrients included: Energy, fat, sodium, sugars, fibre, whole grains, calcium, protein Limits: Thresholds set by category	Text and symbol	Malaysia
Nutrio-Sello 	Nutritional stamp logo for products with lower levels of sugar, fats and sodium.	Nutrients included: Energy, sodium, sat fat, total sugars	Text and symbol	Mexico

Name and symbol	Characteristics	Requirements or criteria	Interpretive element	Countries
Weqaya logo 	Weqaya is an Arabic word for prevention	Units: 100 g/ml, per serving Nutrients included: Total fat, saturated fat, trans fat, sodium, total sugar, fibre, wholegrain, artificial sweeteners Limited to 100% vegetable juices, unsweetened low-fat milk, and other fermented dairy products Thresholds set by category	Text and symbol	United Arab Emirates
Green signpost 	Positive green logo	Units: 100 g Nutrients included: Total sugar, sodium, fat, saturated fat and fibre Limits: Thresholds set by category	Text and symbol	Israel
Heart Tick 	A signpost with a heart check mark; products that carry the logo must meet the Nigerian Heart Foundation nutrient criteria	Nutrients included: Total fat, sodium, added sugar, fibre, trans fat, cholesterol Limits: Thresholds set by category	Text and symbol	Nigeria System

Name and symbol	Characteristics	Requirements or criteria	Interpretive element	Countries
Good Food logo 	Blue and green certification mark	Nutrients included: not available	Text and symbol	Zambia
Overall spectrum rating systems				
Health Star Ratings 	Scale of ½ star (least healthy) to 5 stars (most healthy)	Units: 100 g/ml Nutrients included: Saturated fat, energy, sodium, total sugars, and protein Limits: Calculations of points for each of the nutrients of concern and ingredients	Texts and stars	Australia and New Zealand
Nurti-Score 	Scale of five (dark green to dark red; letters A to E) according to healthfulness of products, with dark green and A indicating the best nutritional quality	Units: 100 g/ml Nutrients included: Energy, saturated fat, total sugars, sugars, sodium, and protein Limits: Calculations of points for each nutrient of concern and ingredients based on French dietary recommendation	Traffic light colour coding and letters	France, Belguim, Spain, Germany

Name and symbol	Characteristics	Requirements or criteria	Interpretive element	Countries
Nutrient-specific interpretive systems				
Multiple traffic lights 	Green, yellow, and red colour to indicate low, medium, and high level of each nutrient	Units: Per serving of stated size Nutrients included: Total fat, total sugar, sodium Limits: Threshold set by criteria	Traffic light colour coding	South Korea
Multiple traffic lights 	Green, yellow, and red colour to indicate low, medium, and high level of each nutrient	Units: 100 g/ml Nutrients included: Fat, sugars, and salt Limits: Threshold set by criteria	Traffic light colour coding	Ecuador
Multiple traffic lights 	Green, yellow, and red colour to indicate low, medium, and high level of each nutrient	Units: Per 100g/100mL Nutrients included: Total fat, total sugar, sodium, trans fats, energy Limits: Threshold set by criteria	Traffic light colour coding	Iran

Name and symbol	Characteristics	Requirements or criteria	Interpretive element	Countries
Multiple traffic lights 	Green, yellow, and red colour to indicate low, medium, and high level of each nutrient	Units: 100 g/ml Nutrients included: Energy, fat, saturated fat, total sugar, salt Limits: Threshold set by criteria	Traffic light colour coding	UK
Multiple traffic lights 	Green, orange, and red colour to indicate low, medium, and high level of each nutrient	Units: Per 100g/100mL Nutrients included: Total fat, total sugar, sodium, trans fats, energy Limits: Threshold set by criteria	Traffic light colour coding	Saudi Arabia
Traffic lights (children's snacks)	Green, orange, and red colour indicate low, medium, and high level of each nutrient	Units: Per serving Nutrients included: Total sugar, fat, sat fat and sodium Limited categories 'kids foods'	Traffic light colour coding	South Korea

Name and symbol	Characteristics	Requirements or criteria	Interpretive element	Countries
Traffic lights on beverages 	Green, orange, or red in inner circle of the logo to indicate low, medium, or high sugar (in three national languages)	Units: Per 100mL Nutrients included: Total sugar Thresholds apply across drink category	Traffic light colour coding	Sri Lanka
Red warning labels 	Separate symbols for sugar (spoon), sodium (salt shaker), and saturated fat (solid fat and knife), with text "High in [nutrient]	Units: 100 g/ml Nutrients included: Saturated fat, sodium, and sugars Limits: Threshold set by criteria	Text and symbol	Israel
Warning labels 	Separated black stop sign for each critical nutrient	Units: 100 g/ml Nutrients included: Energy, saturated fat, sodium, and total sugars Limits: Threshold set by criteria	Text and symbol	Chile

Name and symbol	Characteristics	Requirements or criteria	Interpretive element	Countries
High salt warning label	Foods that are high in salt are required to carry a "high salt content" Warning	Units: 100 g Nutrient included: Sodium	Text	Finland
Warning labels 	Separated black stop sign for each critical nutrient	Units: 100 g Nutrients included: Total Fat, Saturated fat, sodium, sugars Limits: Threshold set by criteria	Text and symbol	Uruguay
Warning labels 	Separated black stop sign for each critical nutrient	Units: Per 100g/100mL Nutrients included: Total sugar, Sat fat, trans fat, sodium Limits: Threshold set by criteria Thresholds across food supply,	Text and symbol	Peru
Nutrient-specific non-interpretive system				
Guideline Daily Amount	Percentage daily intake	Units: Package size, single serve or multiple serving packages Units: Nutrients included: Sat fat, other fats, total sugars, sodium, energy	Text	Mexico,

Name and symbol	Characteristics	Requirements or criteria	Interpretive element	Countries
Guideline Daily Amount with warning text	Percentage daily intake Should consume in small amounts and exercise for better health	Units: Per serving Nutrients included: Energy, total sugar, fat, sodium Percentage daily intake		Thailand
Reference intake	Percentage daily intake	Units: Per serving Nutrients included: Energy, total sugar, fat, sat fat, sodium		European Union
Guideline Daily Amount for energy	Percentage daily intake	Units: Per serving Nutrients included: Energy		Philippines Malaysia

2.6 IMPACT OF FOPL

The primary objective of FOPL is to provide consumers with information about nutrient content of food in an easy-to-understand way, supporting them to make healthy food choices. It also has potential to encourage reformulation of products as food industries seek competitive advantages and wish to avoid unfavourable nutrient content disclosures. The effectiveness of FOPL can be assessed in a number of ways: by measuring the level of understanding and use by consumers during food selection; whether it stimulates change in purchasing behaviour and consumption of healthy foods; and the extent of its influence on product reformulation.

Consumers' understanding

Literature suggests FOPL has greater effects on consumer understanding and comprehension compared to the traditional NIP, indicating that interpretive labels with symbols or colours are more understandable and effective than reductive labels (Campos et al., 2011; Grunert & Wills, 2007; Hersey et al., 2013). FOPLs are easily noticeable and are more likely to be looked at than NIP (Graham et al., 2015). FOPL significantly increases consumers' ability to compare the products and identify healthier food items (Borgmeier & Westenhoefer, 2009; Findling et al., 2018). Consumers tend to prefer interpretive FOPLs to reductive labels, summary indicators in particular (Talati et al., 2016). An online experimental study comparing different formats of FOPL across the US, Canada, Australia, and the UK found that FOPL with 'high in" descriptions, red colour and warning symbols increased the likelihood of correctly identifying the food products with high levels of saturated fat or sugar (Goodman et al., 2018). There is a growing evidence consistently suggesting Nutri-score and warning labels have better results in improving consumer understanding of nutrient quality of food products than other formats (Al-Jawaldeh et al., 2020; Arrúa et al., 2017; Ducrot et al., 2015b; Egnell, Ducrot, et al., 2018; Khandpur et al., 2018).

Purchase intention/behaviour and consumption

There is evidence FOPL may influence consumers' purchasing decisions and consumption behaviour. However, much of the research on FOPL has been conducted in simulated settings, which do not accurately reflect the real-world purchasing scenario in which people make their food choices. A review assessing the effectiveness

of different FOPL formats showed that FOPL would increase the number of people selecting a healthier food by about 17.95% and would decrease the calorie intake/choice by about 3.59% (Cecchini & Warin, 2016). Ducrot et al. (2016) in their interventional study simulated a shopping situation and evaluated the effects of different formats of FOPL including GDA, Five-Colour Nutrition label (Nutri-score), MTLL, and Green Tick on purchase intention. The study noted that all FOPL formats, except the GDA, significantly increased overall nutrient quality of foods selected, compared with the no label condition. Emrich et al. (2017) used modelling in their study in Canada to assess the potential impact of avoiding unhealthy food items with red traffic lights and replacing them with favourable products. The results showed significant reduction in calorie intake (5%), saturated fat intake (14%) and sodium intake (6%). Another study (Elshiewy & Boztug, 2018) using individual-level purchase data observed 9.5% reduced calorie purchases for products presenting FOPL compared to the products only with nutrition information panels. A meta-analysis by Shangguan et al. (2019) evaluating the effect of food labelling on consumer dietary behaviour revealed food labelling reduced intakes of energy by 6.6%, total fat by 10.6% and other unhealthy food products by 13%. They noticed traffic light labels increased the selection of healthier products by 1.9% and reduced the selection of unhealthy products carrying red labels by 2.3%. Other studies have shown no effect of FOPL on consumers' food choices and consumption. For example, an experimental study among 420 shoppers in Germany found that various FOPL formats did not influence food choices and consumption decisions, though these labels helped them to identify the healthier products (Borgmeier & Westenhoefer, 2009). Another field experiment in UK also showed no effects of FOPL on calorie intake (Crockett et al., 2014).

Reformulation of products

Currently there is limited evidence on the impact of FOPL on product reformulation. A review showed that reformulation of products to meet the labelling criteria lead to healthier product composition and a small reformulation would result in more favourable ratings (Kelly & Jewell, 2018). In the Netherlands, a study observed a significant increase in fibre content and reduced levels of sodium, added sugar, and calories in the reformulated products to meet the criteria of the Healthy Choice Logo (Vyth et al., 2010). A meta-analysis reported food labelling decreased

the contents of trans fat by 64.3% and sodium by 8.9% in reformulated food products (Shangguan et al., 2019).

2.7 KEY ISSUES AND CONTROVERSIES IN FOPL

Although FOPLs are gaining momentum worldwide, it has attracted controversies surrounding its inception, implementation and effectiveness. First, there is a concern whether the FOPL actually improves the population diet and health or it is simply a self-promotion strategy for the food industries (Brownell & Koplan, 2011). While FOPL is intended to help consumers make healthier choices, extra information can create confusion and could be deceptive (Kleef & Dagevos, 2015; Nestle & Ludwig, 2010). It has been argued that there is imbalance between the public health and industry actors in the current decision-making process on FOPL. The strong influence of the food industry through relationships, knowledge, and resources may result in a tempering of public health interests, in favour of industry interests (Thow et al., 2019). Second, there are multiple FOPL systems currently being implemented across different regions. Evidence indicates that the coexistence of a range of labels in the market place may impede consumer comprehensions and label use (Draper et al., 2011). Third, there have been critics of nutrient profiling approaches and different criteria being used with lack of validation and transparency (Foltran et al., 2010). For example, HSR algorithm in Australia is heavily debated for its technical flaws that do not necessarily align with the dietary guidelines. As a result, discretionary and ultra-processed foods that are high in fat, salt or sugar are being promoted with HSR score of 2.5 or more (Lawrence et al., 2019).

2.8 THE CONTEXT OF NEPAL

2.8.1 Overweight and obesity and non-communicable diseases

Nepal continues to face a serious challenge of undernutrition and food insecurity. The Nepal Demographic and Health Survey (MoHP et al., 2017) shows that 36% of children younger than five years of age are stunted, and 27% are underweight. The prevalence of undernutrition is significantly higher among low SES groups (stunting: 46%) compared to those of high SES (stunting: 17%). At the same time, 22% of the women and 17% of men are overweight or obese. Contrary to undernutrition, the rate of overweight and obesity is greater among high SES groups; 45% of women and 32%

of men in the highest wealth quintile are overweight or obese compared with 10% women and 5% men in the lowest wealth quintile (MoHP et al., 2017). According to the Nepal NCDs risk factor survey, around one fifth of Nepalese adults are overweight or obese. The overall prevalence of overweight and obesity increased from 7.2% in 2007 to 24.3% in 2019. The risk is higher in urban areas than in rural areas and among high-income groups (Dhimal et al., 2020; NHRC, 2014). In children, the prevalence of overweight or obesity is 25.9% (14.6% overweight and 11.3% obese) (Koirala et al., 2015). Another study by Karki et al. (2019) reports similar findings where more than a quarter of children are overweight or obese. The study found higher prevalence in male children and noted higher risk among children of mothers having higher educational level compared to those with low education.

The country is also experiencing high rates of diet-related NCDs such as cardiovascular diseases, diabetes, and cancers (Dhungana et al., 2018; Mishra et al., 2015). According to Nepal burden of disease study, NCDs are the leading causes of morbidity and mortality in the country accounting to two thirds of estimated deaths and 59% of the DALYs in 2017 (NHRC et al., 2019). The health system priorities thus need to balance the growing burden of NCDs.

2.8.2 Dietary risks

A typical Nepalese diet consists of two main meals a day with tea and snacks in between. There exists a wide variety of cuisines based on the cultural and ethnic diversity. Yet, the main meal constitutes of rice, lentils, and vegetables throughout the country. People usually have home prepared foods with occasional eating outside in restaurants. With growing economic activities and rapid urbanization, the country is now experiencing changes in people's lifestyle and dietary patterns especially in city areas (Dhungana et al., 2018; Poudel et al., 2018). People are purchasing more pre-packaged and fast foods with high calorie and sugar intake which are more convenient but unhealthy at the same time (Shrestha et al., 2016). Household expenditure on commercial food products such as breads, biscuits and noodles has increased while the expenditure on cereals and pulses has declined in the country (Khanal et al., 2017). An analysis of nationally representative data shows households' food consumption is changing rapidly, potentially shifting towards less healthy trends (Central Bureau of Statistics, 2013). According to the study, households reported consuming 84% more sugar in 2011 compared to 2004. There has been an almost tenfold increase in

households' sweets consumption from 16 to 137 gm per month over the period. This study observed a slight improvement in consumption of fruits and vegetables, but it is still below the recommended intake. Similarly, in the latest NCDs risk factor survey, nearly 20% of adults reported consuming processed foods that are high in salt "often" or "always"(Dhimal et al., 2020). This report also shows inadequate intake of fruits and vegetables where around 97% of adults had the consumption rate below recommended intake (i.e. less than 5 servings a day), particularly among low SES groups and in rural areas.

In a school based survey among children aged 13–17 years, a third of children reports drinking carbonated soft drinks one or more times per day (WHO, 2015). Another study by Karki et al. (2019) highlights children consuming ultra-processed foods such as potato chips, sweets, ice creams, and sausages are more likely to be overweight or obese. This study also indicates high consumption of processed foods among children belonging to family with higher monthly income compared to those with less income. Similarly, another study reports high consumption of unhealthy snack foods and beverages among children aged 12-23 months (Pries et al., 2019).

2.8.3 Nutrition policies and labelling

Nutrition is as a priority public health agenda and there has been a strong commitment from national and external development partners to improve the current situation in Nepal (Kennedy et al., 2016; Webb et al., 2016). Nutrition policies and programs are focused on reducing undernutrition mostly relating to poverty and food insecurity while over-nutrition has received little attention (Government of Nepal, 2018; NPC, 2017). The MSNP (2018-2022) is a national integrated nutrition plan that comprises a range of activities involving multiple sectors to improve the nutrition status in the country (NPC, 2017). However, the emphasis is on addressing undernutrition, infant and young child feeding, and micronutrient deficiencies.

With changing dietary practices and sedentary lifestyle, the risk of obesity and related diseases is expected to continue to rise unless appropriate policy actions are taken. Nutrition labelling is one cost-effective strategy that the Nepalese government could consider to promote healthy eating. Currently there is no specific national policy and strategy or regulation on nutrition labelling in Nepal. Food safety is regulated through the Food Act, 1966 which restricts production, distribution and sale of

adulterated or sub-standard foods (Government of Nepal, 1992). The Consumer Protection Act, 1997 prohibits misleading publicity or advertisements of any goods and services including food. General food labelling requirements in relation to food packaging and language are described in the Food Regulation, 1970 (Khalid, 2014).

The Food Regulation (Government of Nepal, 1998) defines a label as a description or sign written, printed, or marked on a container and/or on a cover containing any food for sale. The labelling requirement includes the description of food in an easily visible manner; the name and address of manufacturer/entrepreneur; specification of food ingredients, weight or volume of the product; batch number, dates of manufacture and expiry; specification of colours or preservatives added in the form of statement or symbol or sign but not misleading or false claims; and description of each nutrient content like minerals or vitamins. However, it does not specifically mention the clear requirement for labelling nutrient content like calories, fat, saturated fat, sugar, and sodium.

2.9 SUMMARY

The prevalence of overweight and obesity and diet-related NCDs is rapidly increasing worldwide. The risk is higher in LMICs and mostly affecting low SES groups. Globally, there has been an increased intake of unhealthy foods that are high in calories, fat, sugars, and sodium while the consumption of healthy foods and nutrients (e.g., fruits and vegetables) is suboptimal. The increased availability of obesogenic ultra-processed foods is one of the predominant drivers of the global obesity burden. The ultra-processed foods already have a large market share in HICs and are now increasingly being available in LMICs resulting a steady rise in obesity and diet-related diseases in these countries.

Nutrition labelling has potential to improve population diets by helping consumers to make healthier choices. FOPL, a supplementary nutrition information provided on the front-of-package, is gaining traction worldwide. Many countries have adopted FOPL as a policy strategy to guide consumers to make healthier food choices. A wide range of FOPL systems are being implemented in different countries. There is a growing evidence suggesting effectiveness of FOPL in improving consumer understanding of nutrition information, influencing purchase decisions and consumption, and product reformulation. However, evidence on the effects of FOPL

predominately comes from HICs. There is a gap in literature to support its implementation in LMICs including Nepal.

Despite the increasing burden, obesity and NCDs have been neglected in national health and nutrition policies in Nepal. National nutrition programs focus on improving undernutrition and do not adequately address obesity and NCDs. As such, the government can consider introducing FOPL as a policy measure to address dietary risks. However, the country lacks clear guideline on nutrition labelling and there does not exist any FOPL system. The existing food labelling regulation does not have specific requirement for nutrient information. Studies related to nutrition labelling are lacking in Nepal and it is unclear how FOPL works among Nepalese consumers. It is also important to understand whether or not it is feasible to introduce FOPL as a policy tool. Therefore, this program of research aims to assess the effectiveness and feasibility of introducing FOPL in Nepal. This thesis first reviews the global evidence on the impact of FOPL across SES and explores how it can be reflected in policy context of Nepal.

Chapter 3: Research Design

This chapter outlines the design and methodology of the research to achieve the objectives stated in section 1.4 of Chapter 1. The thesis comprises a systematic review (3.1) and two studies in Nepal: an experimental study (3.2) and a qualitative study (3.3). The first section explains the relationship between these studies and how they combine to answer the research questions. The later section describes each study in detail.

Objective

The aim of this thesis was to review the impact of FOPL in consumer understanding and use across socio-economic strata and to assess the effectiveness and feasibility of FOPL in Nepal.

Research design

The thesis utilised three different study approaches to achieve the study objectives. As detailed in Table 3.1, the first study systematically reviewed the equity impact of FOPL to assess whether it had differential effects across socio-economic strata and identified the labelling formats which were likely to have positive effects for all population subgroups including low SES groups. The second and third studies were conducted in Nepal to explore the effectiveness and feasibility of FOPL in the country. The second study, using an experimental research design, investigated the effects of different FOPL schemes in guiding healthier food choices among Nepalese consumers. The third study explored the feasibility of FOPL in the country utilising a qualitative approach and explored views from key stakeholders including representatives from public health, food and nutrition sectors, food industries, and consumers.

Table 3-1: Research questions, objectives and studies

Research question	Objectives	Study
1. How effective are FOPL schemes in addressing socio-economic inequalities in consumer understanding and use at a global level?	1.1. To review the impact of FOPL across SES groups in promoting healthier choices 1.2. To review whether the labelling format is likely to have an equitable impact	Systematic review
2. What is the effectiveness of FOPL schemes in guiding healthier food choices in Nepal?	2.1 To assess the effectiveness of different FOPL schemes in consumer understanding in Nepal 2.2. To assess consumers' preference towards different FOPL formats	Experimental study
3. What are stakeholder's views on the feasibility of FOPL introduction in Nepal?	3.1. To explore the perspectives of different policy actors (public health experts, nutrition experts and food industries) on the feasibility of FOPL 3.2. To assess consumers' view on the acceptability of FOPL	Qualitative study

Figure 3-1 below describes the interconnections and logical sequence of the studies. The thesis began with the systematic review (study 1), identifying the potential FOPL formats that were likely to have an equitable impact across SES. The findings from the systematic review formed the framework for the experimental study conducted among Nepalese consumers. This experimental study (study 2) generated evidence on the effectiveness of FOPL in the context of Nepal. The results from this study informed the qualitative study (study 3) by generating topics and questions to guide semi-structured interviews regarding the choice of FOPL scheme and consumer preferences.

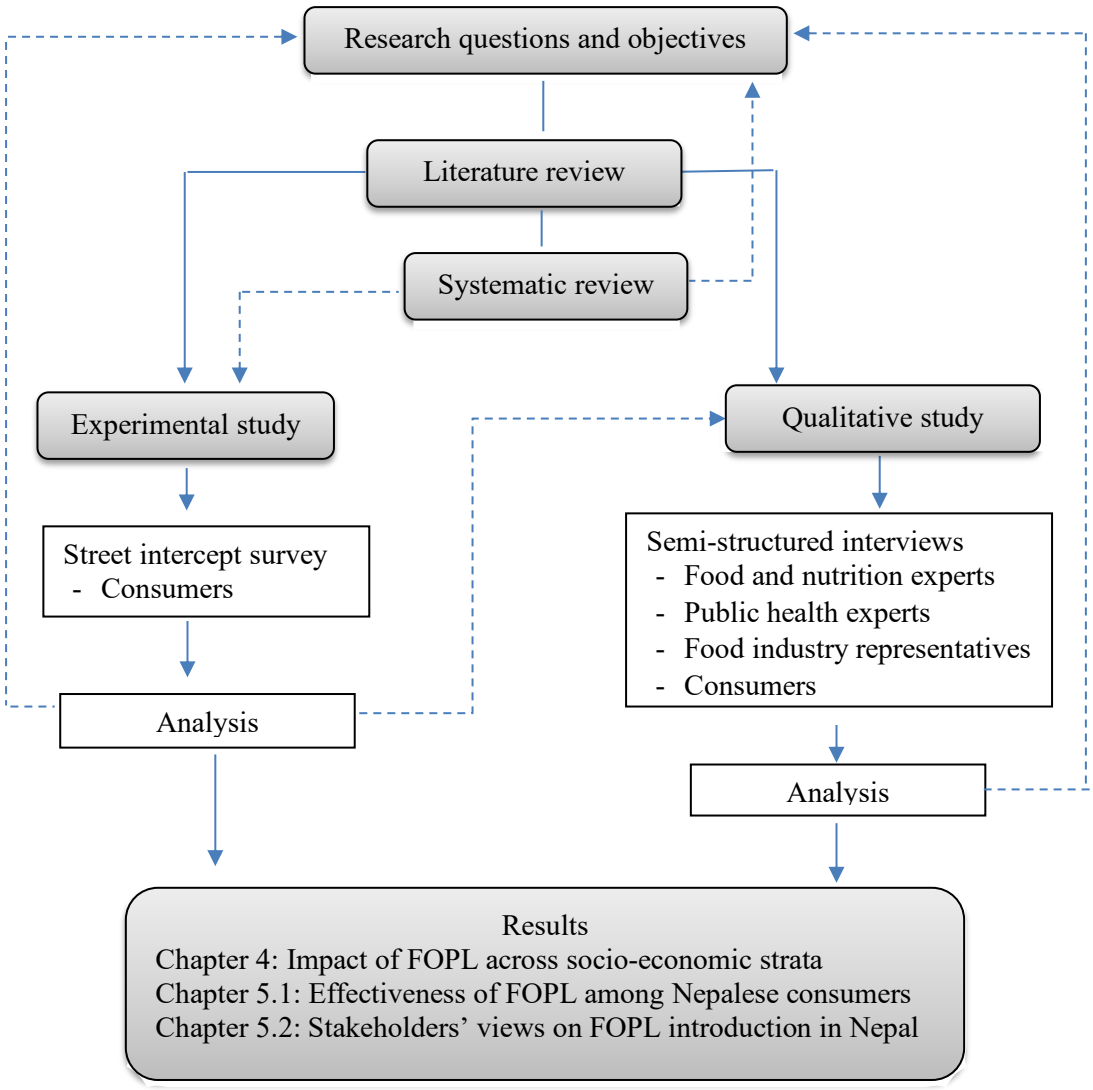


Figure 3-1: An overview of the research design

3.1 STUDY 1: SYSTEMATIC REVIEW

This systematic review assessed global evidence on the effectiveness of FOPL on socio-economic inequalities in dietary choices. The review is registered in PROSPERO (registration number: CRD42019131459).

The systematic review was guided by the following research question:

- How effective are FOPL schemes in addressing socio-economic inequalities in consumer understanding and use at a global level?

Objectives

The systematic review had two objectives:

1. To review the impact of FOPL across SES in promoting healthier choices
2. To review whether the labelling format is likely to have an equitable impact

Interventions

This review included FOPL on food items in any format. These formats included TLL, GDA, HSR, Nutri-score, health or nutrition tick or symbol, warning labels and other labelling formats at the front-of-package of food items.

Comparator/control: Absence of FOPL

Study design

The review included all types of study designs consisting of experimental, observational, and qualitative studies.

Context

The review included studies conducted in the real world and experimental settings. Studies were only included if they reported stratified analysis on the effectiveness of nutrition labelling across SES or were conducted among low SES settings.

Search strategy

This systematic review was conducted according to the PRISMA-Equity 2012 Extension guideline for systematic reviews and the Cochrane guidance. Various electronic databases were searched including PubMed, CINAHL (via EBSCOhost), EMBASE, PsycINFO, Scopus and Web of Science using the key terms “nutrition

label", "food label", "front-of-package label", "health star rating", "traffic light label", "guideline daily amount", "Nutri-score", "choice logo", "healthy choice", "keyhole", "heart symbol", "warning label", "nutrition sign or symbol or tick or rating or mark or logo or warning" and "socio-economic status", "income", or "education".

The search was restricted to include studies published until October 2020. Studies conducted in languages other than English were excluded. Studies presenting results exclusively in children were excluded as children are less involved in household grocery shopping. The studies conducted in clinical settings (e.g., hospitals, patients) were also excluded as individuals with health conditions might have special dietary requirements and may not represent general populations.

Outcomes

The study outcomes were assessed in terms of consumer understanding and use of FOPL. For this review, the measures of outcome included exposure or awareness and understanding of FOPL, preferences and support, self-reported use, influence on purchase decision, change in purchases, and change in consumption patterns. The review also assessed the outcomes for different formats of FOPL to investigate whether the labelling formats have differential effects across SES.

Data extraction and synthesis

The initial screening of titles and abstracts of the articles identified in the search was conducted by the first author. Full texts of the potentially eligible studies were retrieved and assessed by first author based on the eligibility criteria for the inclusion. In case of uncertainty as to whether a paper meet the eligibility critera, the paper was assesed by a second reviewer. Disagreement about a study's inclusion were resolved by discussion to reach a consensus. Data were extracted on the basis of study design, study population, sample size, study setting, SES measures, and outcomes. All references and databases were maintained in Endnote X8. Due to the broad nature of this review with heterogeneity across interventions, study methods, and multiple outcomes, there was limited scope for meta-analysis. Therefore, narrative synthesis of the results from the included studies was conducted. The data synthesis were structured around the interventions, SES measures, and outcomes reported, providing summaries of the intervention effects across SES for one or multiple outcomes for each studies.

The studies were also analysed according to the format of FOPL to examine if there existed any differential effects of the FOPL formats across SES.

Assessment of risk of bias

All quantitative studies were critically appraised for their methodological quality using the quality assessment checklist developed by Sarink et al. (2016). The checklist is based on the Effective Public Health Practice Project Quality Assessment Tool for Quantitative Studies and the Methods for Evaluating Research Guideline Evidence framework. For qualitative studies, the Critical Appraisal Skills Program Qualitative Research checklist (Critical Appraisal Skills Programme, 2018) was used to assess their methodological quality.

3.2 STUDY 2: EXPERIMENTAL STUDY

The second study investigated the effectiveness of FOPL in guiding healthier food choices among consumers in Nepal. The objective was achieved by assessing consumers' ability to identify healthier food products across different FOPL formats. This study also assessed the consumers' preference towards different FOPL schemes.

Research question and objectives

Study 2 sought to answer the following research question:

- What is the effectiveness of FOPL schemes in guiding healthier food choices in Nepal?

Objectives

1. To assess the effectiveness of different FOPL schemes in consumer understanding in Nepal
2. To assess consumers' preference towards different FOPL formats

Study design

Study design involved an experiment among Nepalese consumers using a between-subjects design where each participant was exposed to one of the experimental or a control conditions.

Front-of-pack labelling

Three different FOPL schemes: MTLL, Nutri-score and warning labels were developed for the experiment. These schemes were selected based on the global evidence which were found to perform better in supporting consumers to make healthier food choices as informed by the narrative review and available literature. Nepal did not have any specific nutrition labelling system at the time of this study.

1. ***Multiple traffic light labelling***: MTLL, a nutrient-specific labelling format, is a widely used FOPL scheme (See below Figure 3-2). It is a colour-coded system that provides an evaluation of nutrients, in particular: energy, fat, saturated fat, sugars, and sodium. Green, amber, and red colours reflect low, moderate, and high nutrient contents in the food item, respectively. Evidence suggests greater effects of the MTLL scheme in improving consumer understanding of healthier food choices compared to NIP and

reductive FOPLs. For example, Borgmeier and Westenhoefer (2009) found MTLL led consumers to more accurately identify healthier food products than other FOPL formats (such as healthier choice tick and GDA). In a multi-country study where participants rated their perceptions of different FOPL, MTLL received the most favourable responses and consumer rated MTLL the highest for containing the most information needed (Talati et al., 2019). In another study, consumers preferred MTLL to DIG and considered it easier to understand and more conducive to making quick product comparisons (Talati et al., 2016).

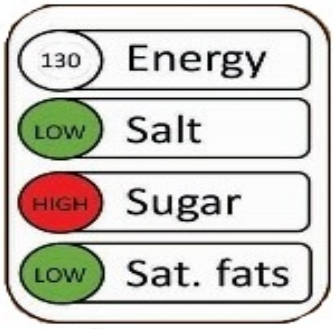


Figure 3-2: Multiple traffic light labelling

2. ***Nutri-score:*** Nutri-score is a summary indicator labelling system introduced in France (Refer to Figure 3-3). This label provides information about the overall nutritional quality of a food product. It is a scale of five colours (from green to red) with corresponding letters (from A to E). Nutri-score has been consistently found to improve consumer understanding of the nutritional quality of food products (Ducrot et al., 2015a; Julia et al., 2017). Previous studies comparing the effect of different FOPLs in ranking product healthfulness observed Nutri-score yielded better results compared to other formats including MTLL and GDA (Ducrot et al., 2015b; Egnell, Talati, et al., 2018). Another study evaluated the effectiveness of different FOPLs (Nutri-score, MTLL, Green tick, and GDA) on consumers' purchasing intentions in a simulated shopping setting. The results showed better nutritional quality of the shopping cart for Nutri-score than other FOPL formats (Ducrot et al., 2016).

Figure 3-3: Nutri-score

3. ***Warning labels:*** Warning labels denote foods that are high in certain critical nutrients like sugars, saturated fats, and sodium. For this study, the Chilean warning label system was used which indicates high levels of nutrients of concern using separated black stop signs. The unhealthy products had a warning label with 'high in' (e.g., sugar for yoghurt) (as illustrated in Figure 3-4). Warning labels are effective in drawing consumer attention to these nutrients of concern and are likely to influence healthy purchase behaviour (Cabrera et al., 2017). Compared to no FOPL condition, warning labels improved consumers' ability to identify unhealthy products (Goodman et al., 2018) and, in some cases, more than MTLL (Khandpur et al., 2018). In another study, warning labels had a greater effect on reducing healthfulness perceptions of products containing high amount of nutrients of concern than Nutri-score and HSR, and had a significant effect on consumers' purchase intention of these products (Ares et al., 2018).

Figure 3-4: Warning label

4. ***No FOPL:*** This was a control condition, where food products were not given any FOPL.

Food products and packaging

For the experiment, five food products available in a Nepalese market were selected (Figure 3-5). The products were: bread, biscuit, noodles, yoghurt, and soft drink. These products represented commonly consumed packaged foods particularly for breakfast or as a snack (Pries et al., 2019; Sharma et al., 2019). These products were chosen to represent food categories with different nutritional composition. Each product consisted of a healthier and a less healthy variant. In order to minimise pre-existing conceptions about the products or brands, mock products with fictitious brand names and packages were developed. The packaging for each product pair were designed with similar brand names, images and colours to limit the influence of appearance on consumer perception on product healthfulness. The packages included a brand and product name, product image, net weight and FOPL. The products were designed in Adobe Photoshop 2020 version.

Each FOPL scheme were applied to all of the test products and the labels were placed on the top right corner of the package. For all conditions, NIP was provided on the back of the package (As illustrated in Figure 3-6). Nutrient content on energy, saturated fats, sugars, and sodium, per 100 gm or ml and per serving were used in the nutrient information of the products. Although NIP is not mandatory in Nepal, some food products display NIP either at the back or side of the package in the market. Most of the food products (particularly ultra-processed foods) in the country are imported and carry NIP. In addition, some food industries in the country are voluntarily providing nutrition information in their products. However, the nutrition information provided are not uniform across the food products given the lack of standard nutrition labelling criteria. NIP was included in this experimental study in order to resemble the market products. It was also important to compare the findings of this study with other similar studies where the effects of FOPL are evaluated in comparison to NIP.

Figure 3-5: Designs of food products and packages [a) biscuits, b) bread, c) juice, d) instant noodles, and e) yoghurt]

Nutrition Information Panel		
Servings per package: 10 **Serving size: 70 g (2 slices)**		
	Qty per serving	Qty per 100 gm
Energy	**847 KJ**	**1210 KJ**
Protein	6.5 g	9.3 g
Total fats	3.3 g	4.7 g
Saturated fats	0.7 g	1.0 g
Sugars	2.1 g	3.0 g
Salt	1100 mg	1600 mg

Figure 3-6: An example of NIP provided on the back of the package

Labelling criteria

Nutrition information for all products were obtained from the NIP on food package. An Australian NIP for similar food products were used as a reference. For MTLL, green amber and red colours were determined using the UK guideline for FOPL (Food Standards Agency, 2016). For the Nutri-score, nutritional calculation algorithm was used based on the NIP for 100 gm or ml of the product (Sante publique France, 2018). An online calculator (Colruyt Group, 2019) was used to determine the nutritional score for each food product. For the warning labels, cut-off values for energy, salt, sugars, and saturated fats were used according to the Chilean law of food labelling (Corvalán et al., 2019).

Table 3-2: Labelling criteria for MTLL (Nutrient content per 100 gm or 100 ml)

Text	**Low**	**Medium**	**High**	
Colour code	**Green**	**Amber**	**Red**	
Solid foods				
Salt (gm)	≤ 0.3	≤ 0.3 to ≤ 1.5	>1.5	>1.8g/portion
Sugars (gm)	≤ 5	≤ 5 to ≤ 22.5	>22.5	>27g/portion
Saturated fats (gm)	≤ 1.5	≤ 1.5 to ≤ 5.0	>5.0	>6.0 g/portion
Drinks				
Salt (gm)	≤ 0.3	≤ 0.3 to ≤ 0.75	>0.75	>0.9 g/portion
Sugars (gm)	≤ 2.5	≤ 2.5 to ≤ 11.25	>11.25	>13.5 g/portion
Saturated fats (gm)	≤ 1.5	≤ 1.5 to ≤ 8.75	>8.75	>10.5 g/portion

Table 3-3: Cut-off values for warning labels

Nutrient content	Cut-off values (2019)
Solid food (per 100 gm)	
Energy (KJ)	1150 (275 Kcal)
Salt (mg)	400
Sugars (gm)	10
Saturated fats (gm)	4
Liquids (per 100 ml)	
Energy (KJ)	70 (293 Kcal)
Salt (gm)	100
Sugars (gm)	5
Saturated fats (gm)	3

Study setting

This study was conducted in three districts of Nepal, namely Kathmandu, Bhaktapur, and Lalitpur, collectively referred to the Kathmandu Valley. Kathmandu is the capital of the country and the rest are adjoining cities. The rationale for this selection of sites was based on the fact that people from all over the country are clustered in these cities in search of better job opportunities and facilities like education, health, and occupation, which makes them densely populated areas of the country, and therefore a good sample distribution and size. The rapid urbanization and sedentary lifestyle in the area have increased the population vulnerability to obesity, NCDs, and risk factors including unhealthy dietary practices.

Study participants

Participants aged 18 years and older were recruited for the survey. The participants were eligible if they had main or shared responsibility of grocery shopping in their household.

Sample size

The sample size was determined by power analysis using the G*power program. It was estimated assuming 20% differences in mean score with significance level (alpha) at 0.05 and power (1-beta) at 90%. The percentage difference was based on a previous study on FOPL (Watson et al., 2014). The minimum sample size required for this study was 248 (62 in each group). Considering the non-response rate of 25% - 30% and to allow subgroup analysis, the required sample number was increased to approximately 100 in each group.

Participant recruitment and randomization

Field work for this research was carried out during January and February 2020. Participants were recruited using the street-intercept method outside supermarkets and grocery stores. Participants were approached in a respectful manner and asked if they would be willing to participate in the study. Each participant were well informed about the study purpose and verbal consent was obtained prior to the experiment. The participation was entirely voluntary. Participants were randomly allocated to one of the experimental conditions or a control group. Block randomization was used in a block of 12 by generating random sequence using excel function [+RAND()]. The process was conducted by the principal researcher. The allocation code was concealed to the research assistants.

Four research assistants were hired to assist the recruitment and data collection. They were appropriately trained, making sure that each of them were confident on the study purpose, questionnaire, participant selection process, participants' allocation and experimental procedures. They were also oriented on research integrity, ethical concerns, data handling, and privacy.

Procedure

Once participants were allocated to their assigned experimental conditions, face-to-face interviews were conducted. Participants were asked to imagine that they were in a supermarket or grocery store to purchase foods for their household. Participants were instructed that they would be presented with a set of food products in different categories and that they had to select the products which they thought were healthier and would consider buying. After the brief introduction, the research assistants showed a set of printed packages of the food products featuring one of the FOPL schemes or no FOPL to each participant. The order of presentation of the product pictures were randomised among participants. The products within the pair with the same FOPL were also randomly presented to the participants.

Performance measure

Perceived healthiness: First participants were shown a pair of food products featuring one of the FOPL formats and asked to assess the healthiness of the product. They were then asked to compare the products and select the one which they thought was healthier. This choice task was repeated for the remaining products with the same

labelling format so that each consumer was exposed to all sets of the food products. Participants could access the NIP provided at the back of the product packages while making their decision. The time taken to compare and decide about the product healthfulness, as well as the number of times the participants refer to the NIP, were recorded for each pair. Participants were then asked information about how they determined the healthier product.

Preferences: Participants were presented with the images of one food item featuring different FOPL schemes and asked to select the one they prefer most. Each FOPL scheme had same level of healthiness to limit the influence of different nutritional value. Participants were asked to select one of the FOPL conditions or an option "none". They were also asked to provide reasons for their preferences.

After the completion of the task, each participant was asked to provide information about socio-demographics, height and weight.

At the end, respondents were asked if they would be willing to participate in a semi-structured interviews related to this study and if so, were asked to provide their contact details. They were informed that selection for the interviews will be based on their responses to the survey (e.g., food purchasing behaviour, income). Participants were also informed that only a few individuals (4-6 participants) would be required for the follow-up interviews, so they might not receive a call. They were told that interviewees would be contacted within 2-3 weeks by phone.

Questionnaire

A structured questionnaire was developed as informed by the previous studies on FOPL. The questionnaire was adapted from a study by Pettigrew et al. (2017), particularly the questions relating to food purchasing and preferences towards different formats. The choice task questions were based on an experimental study by Watson et al. (2014). The questions assessed perceived healthiness of the food products, acceptance or intention to use FOPL, and preferences towards FOPL. The questionnaire also included information about participants' demographics and socio-economic characteristics (age, gender, ethnicity, education, and income), self-reported height and weight, nutrition knowledge, and self-reported label reading behaviour. The questionnaire was translated in Nepali language. The initial (forward) translation of the questionnaire was conducted by the principal researcher. The initial translation was

then back translated into English to ensure the accuracy of the translation. To avoid bias, the backward translation was conducted by one of the research students (Nepalese) at QUT who was unaware of the intent and concepts underlying the research questions. The questionnaire was then pilot tested to ensure its accuracy and comprehensibility. For the pilot testing, ten adult participants who were involved in grocery shopping in their household were selected and interviewed outside a grocery store in Kathmandu.

For the field work, the research assistants were trained to deliver the questionnaire, making sure that they understood each question. The research assistants were public health graduates who could undertake the research process as they possessed sound research knowledge and field experience. During the field work, the principal researcher organised regular meetings with the research assistants to check if the field procedures were being properly implemented. In each meeting, the principal researcher cross-checked and verified the completed questionnaires and ensured the research assistants were following the procedure as they were trained.

Statistical analysis

All statistical analyses were conducted using IBM Statistical Packages form Social Scientists (SPSS) version 25. The study groups were compared using a chi-square test to assess any differences in their socio-demographic characteristics. BMI was computed using the self-reported weight and height information. Level of education and income were used as a proxy measure for SES. The correct healthier choices, the number of times that participants access NIP and the time taken for the product comparison were reported descriptively using means and standard deviations. The mean differences in the correct number of healthier choices across the FOPL formats were analysed using One-way Analysis of Variance (ANOVA) and a Post hoc Tucker HSD test. To examine the influence of participants background characteristics, two-way ANOVAs were conducted using experimental condition as the first factor and age, gender, education, income, BMI, and perceived knowledge as the second factor. The mean differences in the time taken and the number of times NIP accessed for the product comparison across the groups were analysed using ANOVA test. The preference towards the FOPL schemes were reported in percentages. The different study groups were also compared and tested against respondents' background variables (socio-demographic characteristics, BMI, perceived nutrition knowledge,

and self-reported label reading behaviour) using two-way ANOVA and Chi square tests. All the tests were examined at the significance level of $p<.05$. Qualitative responses were analysed manually and structured within a set of categories. These categories were then extracted to SPPS to perform descriptive statistical tests.

3.3 STUDY 3: QUALITATIVE STUDY

This third study explored the feasibility of introducing FOPL as a policy tool to promote healthy diets in Nepal. A qualitative method was the most appropriate approach for this study as it required the exploration of possibility of introducing nutrition labelling in Nepal from multiple perspectives. The study explored the views of key stakeholders including government health and food authorities, food industries, non-government organizations, and consumers on FOPL.

Research question

The following research question informed the qualitative study phase:

- What are stakeholder's views on the feasibility of introducing FOPL in Nepal?

Objective

- To explore the perspectives of different policy actors (public health experts, nutrition experts, and food industries) on the feasibility of FOPL
- To assess consumers' view on the acceptability of FOPL policy

Study design

This was a qualitative research using semi-structured interviews as the primary research approach.

Study setting

The study was carried out in Kathmandu, Lalitpur and Bhaktapur districts of Nepal. The concerned Ministries of Nepal i.e., Ministry of Health and Population (MoHP) and Ministry of Agriculture and Livestock Development (MoAD) are situated in Kathmandu. The MoHP is responsible for overall policy, planning, and organisation of health sector in the country. Nutrition related activities are implemented through the Nutrition section of the Department of Health Services (DoHS) under the MoHP. Under the MoAD, The Department of Food Technology and Quality Control (DFTQC) is the governing body for food quality control system and responsible for the enforcement of Food Act and Regulations including labelling. Majority of non-government organizations working in health and nutrition sectors were operating through their head offices located in these districts. Similarly, major industries were

also situated in these areas including Industrial District Management Limited where 97 industries (out of 131) were operating at the time of the study.

The study included the representatives from the above-mentioned key stakeholders. In addition, given that the experimental study was conducted in the same study area this allowed for wider selection of consumer participants for the study.

Participants and recruitment process

Participants comprised diverse sectors including representatives from government and non-government organizations working in public health, food and nutrition sectors, food industries, and consumers. Key informants for this study were selected purposively and strategically. The suitable participants were identified from the principal researcher's own network and with the advice from the health and food authorities of Nepal. The process began with the brainstorming of individuals working in public health, food and nutrition sectors in Nepal. The potential participants were also identified through colleagues who were working in DoHS (as Senior Public Health Officers in Child Health Division and National Health Information Education and Communication Centre) and in nutrition programs led by non-government organizations like Helen Keller International Nepal. The participants, particularly related to food labelling in Nepal, were identified with the help of a colleague working in the MoAD. A snowball sampling technique was used to further identify the potential participants from non-government and industry sectors. In this sampling technique, researchers begin by identifying several participants who fit the study criteria and then ask these people to suggest others to be included in the study (Tracy, 2019).

The study commenced with a network analysis of potential participants from government health and food authorities in Nepal. First, participants from the MoHP and DoHS who were involved in nutrition related policies and programs were selected to obtain insights on whether nutrition labelling can be incorporated into health policies. Participants were selected based on their expertise and work experience in public health, particularly in nutrition and NCDs. Next, the representatives from DFTQC, the government body responsible for food related regulation in Nepal, were identified based on expertise and involvement in food related regulation including labelling. The participants were purposively selected by the principal researcher as being influential in health and nutrition related policies in Nepal. Some participants

especially those working in public health sector were known to the researcher. However, these participants were senior officials and unlikely to be influenced by the pre-existing relationship. The potential key informants were contacted first by telephone or by visiting the respective offices.

The rest of the participants were identified by asking the above key informants the stakeholders who they suggested to be included in the study. Based on their recommendations and relevancy, the potential participants who could represent the food industry, non-government sectors, and nutrition experts were identified. Once these participants were identified, they were contacted by telephone.

For consumers, eligible participants were adults older than 18 years of age, who had main or shared responsibility of purchasing groceries in their households. Participants were selected from the list of respondents from the experimental study who agreed they would be willing to participate in semi-structured interviews. There were limited number of participants who agreed to be contacted. Respondents were contacted through mobile within 2-3 weeks and asked whether they would be willing and available to participate in the interviews. The participants were purposively selected based on their availability and were representative of gender.

Participants were recruited until no new relevant information was obtained. In qualitative research, there is no set formula to determine the sample size. Data saturation, a concept based on the grounded theory is a widely accepted technique to determine the number of participants. Saturation occurs when few new data are being generated and the number of samples are considered adequate when new information fits into the categories that have already developed in the data analysis process (Liamputtong, 2013). A total of 21 interviews were conducted for this study. These included government health representatives - 4 (MoHP and DoHS), government food representatives - 3 (MoAD and DFTQC), non-government representatives - 4, food industry representatives - 3, and consumers - 7).

Data collection procedures

Each identified participant were contacted and a convenient location and time were determined for the interview. All interviews were held in a place convenient to each research participant. Each respondent ware asked what works best for them and decided a suitable time and venue for the interview. The key-informant interviews

were conducted in their respective offices located at health and agriculture ministries, DoHS, DFTQC, non-government organizations, and food industries. Consumer interviews were held at their home and appropriate space at grocery stores. It was ensured that the interview space was quiet and had adequate privacy.

The one-on-one semi-structured interview was conducted to explore the views of the key informants and consumers. Participants received a brief explanation about the study prior to the interview and provided written informed consent. All interviews were conducted face-to-face and audio-recorded. Face-to-face interviews provided the opportunity to build rapport and encouraged participant to speak more comfortably. For both key-informants and consumers, participants were informed that they could stop the interviews if any discomfort occurs, or participants wish to stop. The interviews were 30-70 minutes long. To protect privacy and ensure confidentiality, the name and titles of each participant were removed from the audio-recordings. In order to maintain the anonymity of participants, all participants were coded and referred to by their organizational category. By ensuring strong confidentiality measures, it was expected that participants would be encouraged to be more open in their responses.

An interview guide was used for the semi-structured interviews using FOPL as a focus of conversation. Questions included the consumption of ultra-processed and packaged foods consumption pattern and its effect on health and nutrition situation in Nepal, the possibility of introducing FOPL (voluntary or mandatory), potential nutrient profiling systems, preferences for different FOPL formats, advantages and disadvantages of FOPL, likelihood of acceptability by the food industry and consumers, barriers and enablers to the introduction and implementation of FOPL. The guide for consumers included a set of questions relating to food purchasing behaviour, nutrition label use, preferences, and barriers and enablers to the use of FOPL. Since the interviews were semi-structured, the order of questions and wording varied between participants.

The participants were acknowledged for their time. They were not compensated for their participation in the study due to cultural considerations.

Data Analysis

Data from the interviews were analysed using thematic analysis. Thematic analysis for this study was the most appropriate approach given that it helped in identifying, analysing and reporting patterns (themes) within data (Braun & Clarke, 2006). All interviews were transcribed verbatim from the audio recording and thoroughly read to get general sense of the ideas presented. The thorough reading and re-reading of the entire data set allowed familiarization with the data to identify possible patterns. Significant statements and phrases related to the subject matter were marked or noted down and an initial listing of ideas in the data were extracted from the transcripts.

Next, initial codes were produced from the extracted data. Coding typically unfolds in primary and secondary cycles in which the first cycle involves naming a segment of data as a code and the secondary cycle includes selecting and synthesizing the most significant codes and assembling the initial codes into a meaningful theme (Tracy, 2019). The first cycle of coding process for this study began with the examination of the data and assigning words or phrases identified as relevant to the research questions. These codes were then organised into categories to generate meaningful potential themes. The process involved searching for patterns of meaning and issues of potential interest in the data. Deductive and inductive coding were used to identify categories and themes. As with qualitative approaches, for this study, analysis involved a repeated moving back and forward between the data, the coded extracts and the themes produced. Once the themes were defined in a coherent way, detailed analysis were conducted for each theme with accompanying narrative. As writing was an integral part of analysis in qualitative studies, it involved noting down of ideas and potential coding themes from beginning through entire analysis process (Braun & Clarke, 2006). Findings were presented in a descriptive narrative form and the final write-up involved concise, coherent and logical analysis within and across themes.

3.4 ETHICS

The Queensland University of Technology Human Research Ethics Committee (Approval Number 1900000964) approved this research. The study also obtained ethical clearance from the Ethical Review Board, Nepal Health Research Council (Approval Number 1554). All study participants were provided with a written information sheet explaining the purpose of the research, the methods used, the duration of participation, and any foreseeable risks. To ensure the anonymity of participants, the participants were identified in terms of their organisational category (e.g., government health authority).

Chapter 4: Narrative Synthesis of Systematic Review

This chapter presents the results and discussion of the systematic review (study 1). The purpose of this review was to assess the equity impact of FOPL across SES at a global level. The review was conducted through a systematic search process using key terms for FOPL and SES. A narrative synthesis of the articles was carried out exploring the differential effect of FOPL in consumer understanding and use by SES for one or multiple outcomes.

4.1 RESULTS

A total of 14934 articles were identified in the electronic search; 151 articles were retrieved for the full text reading with 33 studies meeting the inclusion criteria (see Tables 4-1 and 4-2). The majority of the studies were excluded because they did not report specific FOPL or present the findings by a SES measure. Of the articles which met the inclusion criteria, 18 were experimental studies. Two of the articles (Jáuregui et al., 2020; Vargas-Meza et al., 2019a) were based on the same study population and therefore we counted them as one study. Similarly, another two articles (Ducrot et al., 2015a; Ducrot et al., 2015b) based on the same Nutrinet-Sante cohort were also counted as one study. Ten articles were observational studies including online surveys (n=5), interview surveys (n=3), a telephone survey (n=1) and a study based on household purchase data (n=1). There were five qualitative studies. All of the studies were conducted in HICs and upper middle-income countries with the majority of studies conducted in European countries (n=12), Australia (n=6), US (3), Chile (n=2), Ecuador (n=2), Mexico (n=2), Brazil (n=2), Malaysia (n=1), New Zealand (n=1), Thailand (n=1), and Uruguay (n=1). Of note, four studies from France were based on the Nutrinet-Sante study population, a web-based prospective cohort study implemented since 2009 to investigate the association and determinants of nutrition status and health outcomes. The majority of the studies was conducted among nationally representative samples and among adult populations. Two studies also included children in their studies; one assessed the label viewing behaviour among the American consumers in parent/child pairs (Graham et al., 2015) and the other assessed the preferences between different formats of FOPL among Australian consumers including children aged 10 years and above (Pettigrew et al., 2017). Similarly, one qualitative study assessing the understanding of FOPL among low- and middle-income Mexican consumers

included five groups of participants including young people aged 13 to 15 years who participated in separate focus groups (Vargas-Meza et al., 2019b).

Twenty studies used participants' income or education or both as the proxy measures of SES while four studies used postcodes of the area of residence: Indices of Multiple Deprivation (Crockett et al., 2014) and Australian Bureau of Statistics' Socio-Economic Indexes for Areas (Dana et al., 2019; Miller et al., 2019; Pettigrew et al., 2017). Two qualitative studies used SES based on the household possession of material goods (Correa et al., 2019; de Morais Sato et al., 2019) and one qualitative study used a geo-reference system (Basic Geostatistical Areas) to assess where stores were located as a proxy estimation of SES. Six studies were conducted in low- and middle-income settings (Blitstein et al., 2020; Franckle et al., 2018; Orozco et al., 2017; Pettigrew & Pescud, 2013; Vargas-Meza et al., 2019a, 2019b). We defined low SES as the reported lowest level of educational attainment or income or SES index.

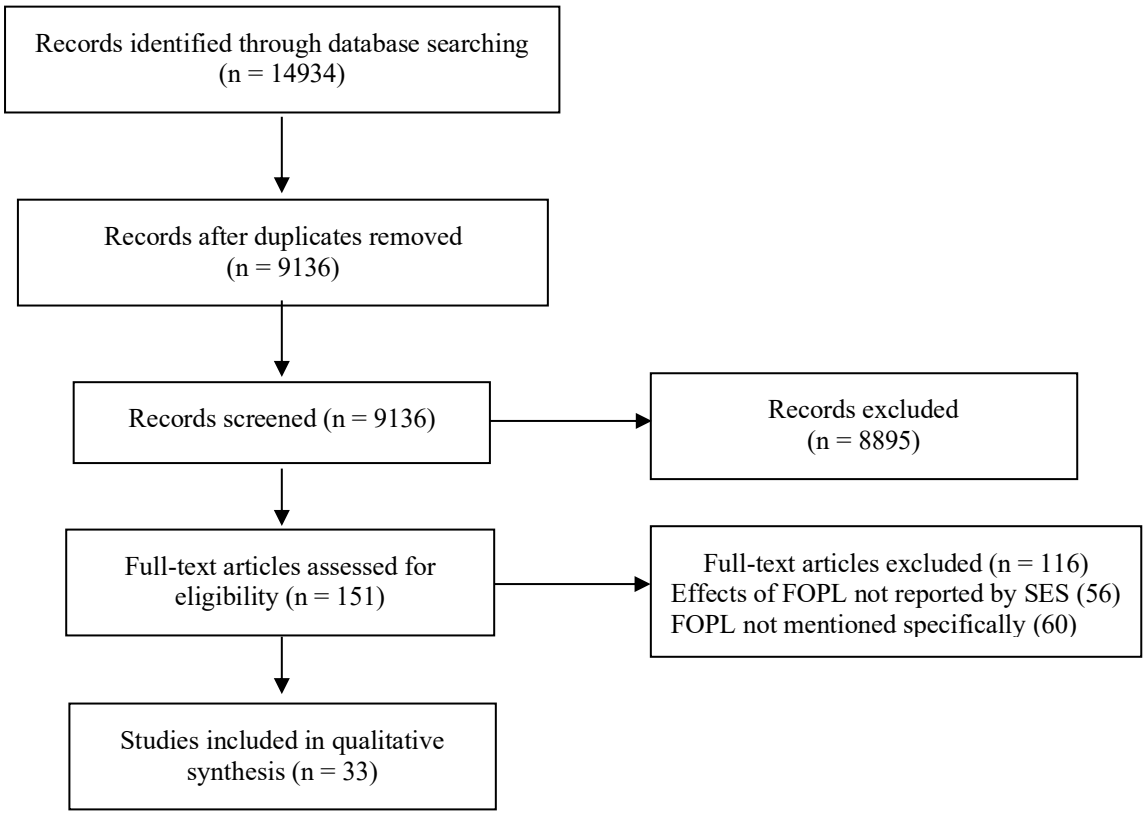


Figure 4-1: Flow diagram of the literature search and study inclusion

Effectiveness of the FOPL on awareness and understanding

Table 4-1 presents the characteristics of the studies and results for the awareness and understanding of the FOPL by socio-economic gradient.

Awareness and perception: Lahti-Koski et al. (2012) assessed the awareness of the Heart symbol in Finland after its introduction in 2000 and compared the changes over a 9-year period. The study found increased awareness of the symbol in all educational groups. When the symbol was first launched, the awareness level significantly varied across SES groups; both men and women in higher educational groups were more aware of the symbol. The differences between the educational groups gradually decreased by the mid-2000s. Graham et al. (2015) reported participants of all education and income groups were significantly more likely to view FOPL compared to the nutrition fact label and the label viewing significantly increased with the access to explanatory signage. The study did not notice significant differences in the label viewing across socioeconomic subgroups. Machin et al. (2017) examined the influence of different FOPL on the perception of healthfulness of ultra-processed foods with high levels of nutrients of concerns across SES groups. The study reported a significant influence of the FOPL formats in healthfulness perception and perceived recommended consumption frequency of the products among low SES populations. In general, low-income participants perceived the products with FOPL as healthy and appropriate for frequent consumption. However, the products featuring TLL were perceived as less healthy and received lower consumption frequency scores than those featuring GDA. Mejean et al. (2013) also noted a significant interaction effect between the perception of FOPL and SES with the low SES individuals reporting more positive attitudes towards simple TLL and Tick labels. The review identified three studies reporting limited knowledge and awareness among low SES groups. Sulong et al. (2019) conducted a study to determine the awareness and understanding of front-of-pack Energy icon on food labels in Malaysia. Overall, a majority of consumers were aware of and had good understanding of the Energy icon. The level of understanding was positively associated with educational status; individuals in higher educational groups tend to have better understanding of the FOPL. Orozco et al. (2017) assessed the awareness of TLL in Indigenous and Mestiza (mixed race) women in a limited resource area in Ecuador. The level of awareness was limited in both populations and was much lower in Indigenous people. Women with higher education had better knowledge of TLL than those with low or no education in both ethnic

groups. In another study conducted in Ecuador, Teran et al. (2019) found higher knowledge of TLL among higher educational groups.

Comprehension and understanding: The review identified nine studies investigating the objective understanding of different FOPL schemes with seven studies showing beneficial effects in their overall population including low SES groups. Six of these studies reported no significant differential effect by SES groups while one study showed improvement in a low SES setting. Borgmeier and Westenhoefer (2009) conducted an experimental study in a controlled setting and found the presence of FOPL increased the ability of the participants of both low and high SES to correctly identify the healthier choices. Santos et al. (2020) evaluated the effects of different FOPL on consumers' selection of food products based on perceived nutritional quality. The correct healthier choices increased with the presence of all FOPL formats compared to the no FOPL condition for all SES subgroups. Similar results were noted by Watson et al. (2014) where the number of correct healthier choices were significantly higher among those exposed to FOPL compared to the control group. However, no significant association was found between the labelling formats and SES. Similarly, Feunekes et al. (2008) did not find a significant interaction effect between comprehension and perceived healthiness of FOPL and SES. Pongutta et al. (2019) noted GDA with text or colour improved consumers 'ability to identify product healthfulness for all SES groups. Smith Edge et al. (2014), however, reported the more nutrient information on the front of packages improved comprehension scores for people at all education levels, including those with lower educational levels. Vargas-Meza et al. (2019a) compared the acceptability and understanding of three different FOPL formats among low-and middle-income Mexican consumers. The study found MTLL and warning labels were more accepted and understood by all participants than GDA and required less time to identify the least healthy product. There were two studies which reported consumers of low SES were likely to have less understanding of FOPL than those of high SES (Ducrot et al., 2015a; Ducrot et al., 2015b; Egnell, Ducrot, et al., 2018). These studies noted the odds of correct product ranking was greater among the participants with a higher educational level.

Table 4-1: Study characteristics and effect of FOPL on awareness and understanding across SES

Author, year and country	Study design and setting	Study population/ sample size	Types/formats of FOPL	SES measure	Outcome measure	Effect by SES
Borgmeier and Westenhoefer (2009) Germany	Experimental (controlled setting)	420 (18-80 years)	Healthier choice tick; MTLL; Monochrome GDA; Colour coded GDA; No FOPL	Education	Food choice[a] (number of correct choices)	Overall, the number of correct healthier choices increased with the presence of FOPL among all participants of both low and high SES
Ducrot et al. (2015a) France	Experimental (online)	13578 (≥18 years)	GDA; 5-CNL; MTLL; Green tick; No FOPL	Education	Product ranking	Participants with higher educational level had a higher percentage of correct product ranking
Ducrot et al. (2015b) France	Experimental (online)	14230 (≥18 years)	GDA; 5- CNL; MTLL; Green tick; No FOPL	Education Income	Product ranking	Participants of high SES were more likely to correctly rank the products
Egnell, Ducrot, et al. (2018) France	Experimental (online)	3751 (≥18 years)	Nutri-score; SENS; mRI; MTLL	Education Income	Product ranking	Participants with a higher educational level had higher odds of correct product rankings
Feunekes et al. (2008) UK, Germany, Italy, and Netherland	Experimental (online)	776 (18-55 years)	Healthier choice tick; Health protection factor; Stars; Smileys; MTLL; Wheel of health	Education	Perceived healthiness	No significant effects across SES
Graham et al. (2015) United States	Experimental (controlled setting)	155 parent/child pair (≥18 years; 6-9 years)	Facts up front label; MTLL; No FOPL	Education Income	Label viewing	No significant differences in the label viewing across SES

Author, year and country	Study design and setting	Study population/ sample size	Types/formats of FOPL	SES measure	Outcome measure	Effect by SES
Vargas-Meza et al. (2019a) Mexico	Experimental (online)	2105 (≥18 years)	GDA; MTLL; Warning labels	Low-income neighbourhood	Acceptability, Food choice [a] (number of correct choices)	Higher level of acceptability and understanding of MTLL and warning labels compared to GDA
Machin et al. (2017) Uruguay	Experimental (controlled setting)	300 (18-70 years)	GDA; TLL	Income	Perceived healthiness, Perceived recommended consumption frequency	Significant interaction effect between income and FOPL schemes
Mejean et al. (2013) France	Experimental (online)	38763 (≥ 18 years)	PNNS; Green Tick; TLL; Colour range logo; MTLL	Education	Perception	Significant interaction between SES and FOPL schemes; low SES groups were more likely to favour STL, Green tick and PNNS while high SES groups were more likely to favour MTLL and CR logo
Pongutta et al. (2019) Thailand	Experimental (face to face interviews)	1364 (≥ 10 years)	GDA; GDA with text 'high' or 'low'; Green colour coded GDA; Green colour coded GDA with text	Education	Food choice [a] (number of correct choices)	Overall, healthier choices increased with GDA with text or colour than ordinary GDA; no significant effect by SES
Pettigrew et al. (2017) Australia	Experimental (online)	1558 (≥18 years) 500 (10-17 years)	DIG; MTLL: HSR	SES by area postcode	Preferences	Low SES participants significantly more likely to indicate no preference compared to medium to high SES
Santos et al. (2020) Portugal	Experimental (online)	357 (≥18 years)	TLL; GDA; Nutri-score; HSR; No FOPL	Education	Food choice [a] (number of correct choices)	Higher odds of correct healthier choices with the presence of FOPL across all SES subgroups

Author, year and country	Study design and setting	Study population/ sample size	Types/formats of FOPL	SES measure	Outcome measure	Effect by SES
Smith Edge et al. (2014) United States	Experimental (online)	7363 (18-70 years)	Version 1: no FOPL Version 2: calories only; Version 3: calories with sat fats, sodium and sugars; Version 4: calories with 3 nutrients to limit and one to encourage (protein, vitamin A or iron)	Education	Comprehension	More information on FOPL improved comprehension scores at all education levels
Watson et al. (2014) Australia	Experimental (online)	4357 (≥18 years)	% DI; Monochrome % DI; MTLL plus interpretive text; Monochrome plus interpretive text; MTLL plus overall TLL; HSR; No FOPL	Education Income	Food choice [a] (number of correct choices)	Overall, the number of correct choices for all FOPL groups was significantly higher than control condition; no significant differences across SES groups
Dana et al. (2019) Australia	Observational (online)	1558 (≥18 years)	HSR	SES by postcode	Preference	Higher SES groups were more likely to have neutral and low preferences for FOPL
Gregori et al. (2014) 16 European countries	Observational (telephone interview)	7550 adults (≥18 years)	GDA; TLL	Education	Self-reported understanding	Higher educational groups had a higher level of understanding
Julia et al. (2017) France	Observational (online)	21702 (≥18 years)	Nutri-score; SENS; mRI; MTLL	Education Income	Preference	Lower educational groups more likely to have no preference; low-income groups preferred MTLL while high-income groups preferred Nutri-score
Lahti-Koski et al. (2012) Finland	Observational (online)	29378 (15-64 years)	Heart symbol	Lahti-Koski 2012	Awareness	In the initial years of the launch of the symbol, awareness level was significantly lower among low SES groups; later, no differences noted across SES groups

Author, year and country	Study design and setting	Study population/ sample size	Types/formats of FOPL	SES measure	Outcome measure	Effect by SES
Miller et al. (2019) Australia	Observational (online)	3430 (≥ 18 years)	Warning labels	SES according to area postcode	Support	Support for warning labels varied significantly; support was lower among those from least advantaged areas
Orozco et al. (2017) Ecuador	Observational (face to face interviews)	394 (18-75 years)	TLL	Indigenous population vs Mestiza	Awareness	Low level of awareness in both ethnic groups
Sulong et al. (2019) Malaysia	Observational (self-administered)	366 (18-60 years)	Energy icon	Education	Awareness, understanding	Higher level of understanding in higher educational groups
Teran et al. (2019) Ecuador	Observational (face to face interviews and observation)	73	TLL	Education	Knowledge	Higher educational groups were more likely to report knowing about TLL

FOPL, Front-of-pack labelling; SES, socio-economic status; MTLL, Multiple traffic light label; GDA, Guideline Daily Amount; 5-CNL, 5-Color Nutrition label; mRI, Modified reference intake; TLL, Traffic light label; DIG, Daily Intake Guideline; HSR, Health Star Rating; % DI, % Daily Intake; PNNS, Programme National Nutrition Sante

[a] Food choice refers to participants' ability to identify the healthy/unhealthy products in choice task experiment measured in terms of number of correct choices

Preferences and support: In a survey conducted in France by Julia et al. (2017) a significant interaction effect was observed between SES and FOPL preferences. When shown Nutri-score, MTLL, SENS (a 4-point colour-coded scale), and modified reference intake (mRI), participants with a low education were more likely to have no specific preferences. Pettigrew et al. (2017) noted a similar pattern in their study conducted in Australia where participants were shown an image featuring the Daily Intake Guideline, MTLL, and HSR, and asked to select the one they preferred the most. Low SES participants compared to those in middle to high SES were significantly more likely to indicate no preferences to any of the FOPL. Miller et al. (2019) assessed the public support for the warning labels for sugar sweetened beverages and found support for warning labels was slightly lower among the people from the least advantaged areas. However, another study in Australia assessing consumers' views on the importance of nutrition information on HSR found those having neutral and low preferences for FOPL were more likely to be of higher SES (Dana et al., 2019).

Effectiveness of FOPL on self-reported use, consumption and purchases by SES

Table 4-2 presents the effects of FOPL on consumers' self-reported use, consumption and purchases.

Self-reported use: Two out of four studies assessing the self-reported use of FOPL showed beneficial effects in low SES groups. Lahti-Koski et al. (2012) observed increased use of the Heart symbol among low education groups in Finland. After the introduction of the Heart symbol, self-reported use was significantly greater among high education groups during the early years of its introduction. In a later study period, the differences across SES decreased mostly due to increased awareness and use among low education population sub-groups. Similarly, in an online survey in Australia, the use of the Heart Foundation tick was significantly higher among males with a low education level than those with a high education level (Williams & Mummery, 2013). The other two studies reporting limited use of FOPL among low SES populations were conducted in Ecuador. One of these studies observed low use of TLL in all populations with no significant difference by SES (Teran et al., 2019) and the other showed limited use of TLL among Indigenous people (Orozco et al., 2017).

Consumption and purchases: The review identified two studies examining the effect of FOPL on consumption and both studies did not find a significant influence on food intake. Borgmeier and Westenhoefer (2009) asked participants to select food they would like to eat in

a given day from a virtual grocery store and found FOPL formats did not have a significant influence on consumption of energy and other nutrient intakes. Modest variation was observed in the envisaged consumption for sodium intake and protein intake in relation to education. Increasing education was associated with higher sodium and protein intake in the TLL condition whereas intakes were higher in low educational groups in the Tick label condition. Crockett et al. (2014) investigated the effect of FOPL on calorie consumption, reporting no significant effect of FOPL on consumption but observed a significant three-way interaction effect between FOPL, SES, and weight concern. The study suggested weight concerned participants of low SES were more likely to consume less after viewing the FOPL compared to those who did not view the label. The weight concerned individuals of high SES ate more in response to seeing a low fat label compared to those who were not concerned about their weight.

Four studies measured the influence of FOPL on consumers' purchase intention and two of these studies showed better results in all populations including low SES groups. Feunekes et al. (2008) measured the differences in the intended use of FOPL in purchasing and reported the overall purchase intention of healthy products increased after exposure to FOPL while the unhealthy purchases decreased. However, the study did not notice any significant differences in the effects of FOPL in purchase intentions across SES groups. Blitstein et al. (2020) conducted an experimental study in a virtual supermarket setting to evaluate how low-income consumers use different FOPL to select food products for their families. Participants were randomly assigned to one of the FOPL schemes or a control condition in a simulated shopping task and asked to compare and select the products. The result showed all FOPL schemes significantly improved the nutritional quality of food products in shopping baskets compared to the control condition. Jáuregui et al. (2020) investigated the effect of different FOPL schemes on food choices among low- and middle-income Mexican consumers. The study observed lower nutritional quality of foods in the shopping cart among individuals with low education and income across all FOPL schemes. Another study comparing the effect of different FOPL schemes on consumers' purchase intentions in a virtual online supermarket setting also noted relatively small effect in low SES groups although the overall nutritional quality of the food selected in the shopping cart increased with the presence of FOPL compared to the control group (Ducrot et al., 2016).

There were only two studies measuring the effect of FOPL on actual purchases and both studies observed low SES groups are less likely to benefit. Ni Mhurchu et al. (2017) evaluated

the effects of TLL and HSR on the healthiness of food purchases in New Zealand. The study did not find a significant difference in the healthiness of the purchases between the FOPL and control groups. However, NIP was found more effective than TLL and HSR for low-income participants. Taillie, Reyes, et al. (2020) evaluated the changes in beverage purchases following the introduction of labelling regulation in Chile. The study used monthly longitudinal data on household beverage purchases. Overall, the volume of high-in beverage (i.e., high sugars, salt, saturated fats, or energy content) purchases decreased by 23.7% after the implementation of the regulation. The reduction was larger for the households with higher education compared to those with lower education.

Table 4-2: Study characteristics and effect of FOPL on self-reported use, consumption and purchases across SES

Author, year and countries	Study design and setting	Study population/ sample size	Types/formats of FOPL	SES measure	Outcome measure	Effect by SES
Blitstein et al. (2020) United States	Experimental (online)	1452 (Adults)	Shining Stars; TLL; Hybrid label (stars and GDA); No FOPL	Low-income setting	HPI	HPI scores were significantly higher in all FOPL groups than in the control group
Borgmeier and Westenhoefer (2009) Germany	Experimental (controlled setting)	420 (18-80 years)	Healthier choice tick; TLL; Monochrome GDA; Colour coded GDA; No FOPL	Education	Envisaged daily food consumption	There was no significant effect of FOPL on consumption
Crockett et al. (2014) UK	Experimental (real world setting)	287 (≥18 years)	Green low-fat label; Red high-fat label; No FOPL	SES by postcode	Calorie consumption	Significant three-way interaction of seeing label, SES and weight concern; weight concerned participants of low SES were likely to consume less after viewing the label
Ducrot et al. (2016) France	Experimental (online)	11981 (≥18 years)	GDA; 5-CNL; MTLL; Green tick; No FOPL	Education Income	Purchase intention	Nutritional quality increased with FOPL for both low and high SES groups
Feunekes et al. (2008) UK, Germany, Italy and Netherland	Experimental (online)	776 (18-55 years)	Healthier choice tick; Health protection factor; Stars; Smileys; MTLL; Wheel of health	Education	Behavioural intention of use	Overall, healthy purchases increased and unhealthy purchases decreased but no significant effect was noted across SES
Franckle et al. (2018) United States	Experimental (real world setting)	148 (≥18 years)	TLL No FOPL	Low-income Latino community	In-store purchases, self-reported consumption	Intervention groups were less likely to report buying sugar sweetened beverages than the control group

Author, year and countries	Study design and setting	Study population/ sample size	Types/formats of FOPL	SES measure	Outcome measure	Effect by SES
Jáuregui et al. (2020) Mexico	Experimental (online)	2194 (≥18 years)	GDA: MTLL; Warning labels	Education Income	Nutritional quality of shopping cart	Low SES groups were more likely to have lower nutritional quality in their shopping cart across all FOPL schemes
Ni Mhurchu et al. (2017) New Zealand	Experimental (real world setting)	1413 (≥18 years)	TLL; HSR; No FOPL	Education Income	Healthiness of food purchases	There was no significant effect of FOPL on healthiness of consumer food purchases
Lahti-Koski et al. (2012) Finland	Observational (online)	29378 (15-64 years)	Heart symbol	Education	Self-reported use	The reported use of the symbol was higher among higher educational groups in the early years of its implementation; later, no differences were observed
Orozco et al. (2017) Ecuador	Observational (face to face interviews)	394 (18-75 years)	TLL	Indigenous population vs Mestiza	Self-reported use	The use of TLL was lower among the Indigenous population than the Mestiza population
Taillie, Reyes, et al. (2020) Chile	Longitudinal	2099 – 2015 2077 – 2016 2100- 2017 Households	Warning labels	Education Household asset index	Household beverage purchases	A larger reduction of high-in beverage purchases was noted among households with higher education
Teran et al. (2019) Ecuador	Observational (face to face interviews and observation)	73	TLL	Education	Use	No significant effect by education
Williams and Mummery (2013) Australia	Observational (online)	1446 (≥18 years)	Heart foundation tick	Education Income	Self-reported use	Those with lower education reported a significantly higher use of the label

FOPL, Front-of-pack labelling; SES, socio-economic status; TLL, Traffic light label; GDA, Guideline Daily Amount; HPI, Healthy purchase index; 5-CNL, 5-Color Nutrition Label; MTLL, Multiple traffic light label; HSR, Health Star Rating

Qualitative findings

Correa et al. (2019) assessed awareness of warning labels among mothers of children aged 2-14 years in Chile using a qualitative approach. The study found mothers of all SES groups were aware of and reported using the labels while purchasing food products. Another study conducted in Brazil reported high SES participants viewed warning labels as an education tool and used them more frequently to compare products than low SES participants (de Morais Sato et al., 2019). The technical terms used in the labels were the main barriers to the participants in low SES groups. Nieto et al. (2019) explored consumers' perceptions and use of FOPL among different SES groups in Mexico. The findings highlight participants across all SES groups perceive FOPL as difficult to understand and use. Consumer participants reported the information provided, particularly in GDA, was technical and the numerical values were confusing. Participants also reported they did not trust the nutritional claims displayed on the food products, suggesting they were a marketing strategy. Pettigrew and Pescud (2013) conducted a study among low-income parents of overweight children and reported they used claims on front of pack as a source of information. However, the percentages of daily intake values used in the labels were reported as confusing and difficult to understand. Similarly, Vargas-Meza et al. (2019b) assessed the awareness and acceptability of different FOPL among low and middle SES Mexican consumers. This study found most participants were aware of GDA but had limited understanding and use because of the complicated values. Participants indicated the HSR, MTLL and the warning labels were acceptable because they were clearly visible and easy to understand.

Effectiveness of the FOPL formats across SES

Comprehension and understanding: In an experimental study, participants' ability to identify the healthier choices increased with the presence of FOPL in all SES groups (Borgmeier & Westenhoefer, 2009). Other studies showed all FOPL formats significantly increased the individual's ability to correctly identify the healthier choices with significant differences across SES subgroups and the labelling formats (Ducrot et al., 2015a; Ducrot et al., 2015b). The odds of correctly ranking the healthier products significantly increased with higher education and income levels. The 5-Colour coded nutrition label (CNL), a previous version of Nutri-score, had the best

performance among all population sub-groups followed by the MTLL. Similarly, in a study by Egnell, Ducrot, et al. (2018), Nutri-score showed better results in product ranking across all subgroups. Santos et al. (2020) found all FOPL schemes performed better than no FOPL condition across all SES subgroups and reported TLL yielded more correct choices followed by HSR, GDA, and Nutri-score. Significant differences between educational levels were noted for TLL where higher educational groups made more correct choices than lower educational groups. Pongutta et al. (2019) compared different formats of GDA and reported the GDA with text or colour increased people's ability to identify healthier choices than the ordinary GDA; however, no significant association was noted across level of education. In a study conducted among low- and middle-income Mexican consumers, Vargas-Meza et al. (2019a) reported MTLL and warning labels were more accepted and understood than GDA. Similar findings were found in a qualitative study where participants of low and middle SES indicated GDA was more complicated and difficult to understand whereas the MTLL and HSR were highly acceptable and easy to understand (Vargas-Meza et al., 2019b). The warning labels were effective at conveying information about critical nutrient contents. Participants expressed black warning labels as disruptive and less attractive while red warning labels were attractive, related to traffic signs, and acted as an alert.

Consumption and purchases: Ducrot et al. (2016) noted the formats of FOPL and SES had significant effect on consumers' purchases. 5-CNL and MTLL yielded better nutritional quality foods selected among the consumers of all SES groups. MTLL had greater effect in low-income groups while 5-CNL performed better in the high-income groups. In a study conducted among low- and middle-income Mexican consumers, Jáuregui et al. (2020) found MTLL and warning labels improved the overall nutritional quality of the purchases than GDA.

Preferences and support: Julia et al. (2017) assessed the perception of different labelling formats and found a significant interaction effect between FOPL formats and SES. Overall, most participants chose the Nutri-score as the preferred format followed by MTLL and SENS. Individuals with a low education were more likely to indicate no specific preference followed by mRI and Nutri-score while those with a high education were more inclined to MTLL, SENS, and Nutri-score; MTLL was the most preferred format for all income groups. Similar patterns were observed in a study by Pettigrew

et al. (2017) in Australia where the low SES groups were significantly more likely to have no preferences for FOPL format compared to those in high SES groups. The HSR was the most preferred FOPL across all SES groups followed by the MTLL. Another study also reported significant differences in the perception of FOPL across SES where the participants with a low education mostly favoured the simple TLL and Green tick label while those with a high education were in favour of the MTLL and Colour Range logo (Mejean et al., 2013).

Risk of bias

Seven of eighteen experimental studies scored ≥ 9 points (out of 11) (Blitstein et al., 2020; Borgmeier & Westenhoefer, 2009; Ducrot et al., 2016; Ni Mhurchu et al., 2017; Pettigrew et al., 2017; Santos et al., 2020; Watson et al., 2014). Three of ten observational studies scored ≥ 8 points (out of 10) (Lahti-Koski et al., 2012; Taillie, Reyes, et al., 2020; Williams & Mummery, 2013), and four of 5 qualitative studies scored ≥ 8 points (out of 10) (de Morais Sato et al., 2019; Nieto et al., 2019; Pettigrew & Pescud, 2013; Vargas-Meza et al., 2019b). The main reason for the low score of the experimental studies was lack of blinding of the participants to the research question. Most of the quantitative studies did not report the participation rate and did not have a control group, and only one observational study measured the outcomes prior to the policy implementation. Lack of reporting of the relationship between the researcher and participants in the qualitative studies was the main reason for reducing their scores.

4.2 DISCUSSION

This narrative review summarises the effectiveness of FOPL across socio-economic gradient and assesses whether the various formats of FOPL have differential impacts. Overall, the evidence suggests FOPL is effective for all population subgroups and may be more beneficial in low SES groups. In general, people from both low and high SES groups are more likely to pay attention to FOPL than the conventional NIP. There are higher rates of label viewing, awareness and self-reported use of FOPL in lower SES groups. However, people from low SES backgrounds have less understanding of FOPL compared to those from high SES backgrounds. Five of ten studies that assessed consumer understanding of FOPL reported better comprehension of the labels among higher SES populations. On the other hand, a significant proportion of the population particularly from low SES backgrounds showed no

preferences to any of the FOPL formats. This lack of interest in FOPL suggests level of exposure and awareness are not adequate among these population subgroups to bring about desired changes in attitude and perception towards FOPL. It also depends on how people, particularly from low SES backgrounds, perceive the problem. For low SES groups, unaffordability is a major barrier for healthy choices, underpinning higher levels of support for regulations which intend to reduce the cost of healthier foods than labelling measures (Farrell et al., 2016).

Increasingly, FOPL is promoted as a tool to facilitate healthier choices. However, there are robust discussions about whether FOPL leads to healthy eating and improve health (Kleef & Dagevos, 2015). This review highlights, despite having a significant influence on perceived healthiness of food, FOPL may not have a significant impact on actual food choices for all population subgroups. Three studies in this review found FOPL increased the purchase intention of healthy products for all population subgroups, including low SES groups (Blitstein et al., 2020; Ducrot et al., 2016; Feunekes et al., 2008), while one observed lower nutritional quality in shopping carts among low SES groups (Jáuregui et al., 2020). Only one study evaluated the effect of FOPL in actual food purchases and found the warning labels significantly reduced the purchase of beverages with high levels of nutrients of concern with a larger reduction observed in higher SES groups (Taillie, Reyes, et al., 2020). Both studies which evaluated the influence of FOPL on consumption behaviour did not find significant effects in general and across SES (Borgmeier & Westenhoefer, 2009; Crockett et al., 2014). Given the limited evidence-based literature, there is a need for more empirical research to support the efficacy of FOPL to improve dietary practices and population health.

Nutrition interventions including nutrition labels often reach those who have relatively good nutrition literacy and healthy behaviour, which is strongly correlated with high SES. For instance, we found those with higher levels of education were the first to accept FOPL in Finland. The level of awareness and use of the Heart symbol significantly varied across SES when first introduced. This disparity diminished later, mainly because of increased uptake by low SES groups, suggesting FOPL can benefit consumers especially for those from a low SES background although this may take a longer time period. While we acknowledge there are many factors that influence

purchasing decisions, it is important to improve understanding and acceptability of labels to enable individuals to make healthy decisions.

Previous studies suggest people with low levels of education and income may have difficulty in understanding nutrition labels. Labels with too much information and numbers are difficult to interpret (Campos et al., 2011; Cowburn & Stockley, 2005). Therefore, labels with simple designs and equitable reach are important to help translate nutrition information into healthy dietary practice. TLLs and GDA are the most popular FOPL formats currently being implemented across all countries. Overall, these formats have better results at the population level, and in particular, for those who have good nutrition literacy. Our results suggest simple and colour coded summary labels are likely to be the most effective approach. For example, Nutri-score, a colour coded summary indicator of overall nutritional quality, performed well across all SES subgroups particularly in those with low nutritional knowledge. Green tick, Heart symbol, and the HSR are other labels with wide penetration in all segments of population including those with low SES, helping consumers to make healthier choices. Similarly, this review found warning labels might increase selection of healthier products by discouraging the consumption of unhealthy products with high levels of nutrients of concern. While many public health interventions face challenges reaching all population subgroups, FOPL complemented with targeted and collaborative nutrition actions for low SES groups have the potential to equitably promote healthier choices.

This review had two main strengths. First, the review included a comprehensive and systematic search process in several databases to synthesise all available evidence on the impact of FOPL across socio-economic position including low SES groups. Previous reviews have focused on analysis of the effect of FOPL at a population level. In addition, this review compared the effects of various FOPL schemes across SES groups, producing new evidence about the differential effectiveness of FOPL formats. Second, the qualitative assessment contributed to better understanding about how FOPL influences consumer food choices among low SES populations and identified barriers to the use of the nutrition labels.

There were a few limitations of this review. It is possible relevant articles were not included given the restrictions in the search terms and only those published in English were considered which may have led to the exclusion of studies from non-

English speaking countries. In addition, the review excluded grey literatures as it was difficult to verify the quality of the study without peer-review. Despite these limitations, the review provides insights as to the equity impact of FOPL in consumer understanding and use across SES.

4.3 CONCLUSION

The results from this review indicate appropriate FOPL may help consumers, including those from low SES backgrounds, to make healthier food choices. The evidence assessing the effects across SES suggests simple and interpretive FOPL formats such as Nutri-score, MTLL, and warning labels are more comprehensible and equitable in effect. Though FOPL is deemed to be effective for overall populations, complementary interventions including awareness campaigns targeted for low SES subgroups could be part of broader labelling regulations to increase the equity effects in promoting healthy diets.

Future research implications

Most of the studies included in this review, particularly the experimental studies were conducted in simulated settings. The evaluations in real world scenarios taking factors such as price, advertisement, and other nutrition interventions into consideration would further enhance the understanding of the differential effects of FOPL by SES. Given limited evidence, further research in real-life settings is needed to understand how FOPL influences actual purchases and consumption. For this endeavour, researchers and retailers could collaborate on large-scale studies using innovative approaches and technologies [e.g., Ni Mhurchu et al. (2017)]. Similarly, there were few studies conducted in low SES populations. Studies should prioritise understanding, comprehension, and effectiveness of FOPL in these populations as they are most at-risk and share the high burden of obesity and diet-related diseases (Afshin et al., 2019; Swinburn et al., 2011). Ideally, these studies would include qualitative studies which could provide in-depth understanding of comprehensibility and barriers of use. There was also a lack of evidence on the effects of FOPL in LMICs. As these countries are moving towards a dietary pattern that comprises highly processed and energy-dense, nutrient poor foods, resulting in an increased rate of obesity and diet-related diseases (Afshin et al., 2019; Perez-Escamilla et al., 2018), an assessment of

the effectiveness of FOPL could have important implications in efforts to promote healthy eating. Further research could also focus on the broader impact of FOPL, including gaining the perspectives of manufacturers on the impact of FOPL, such as sales and product reformulations. Finally, further studies are needed to investigate the impacts of FOPL on population health outcomes, such as reductions in the prevalence of obesity and diet-related diseases.

Chapter 5: Effectiveness and Feasibility of FOPL in Nepal

This chapter presents the results of two studies conducted in Nepal. Study 2 utilised an experimental research design to examine the effects of FOPL in guiding healthier choices among Nepalese consumers. Study 3, utilising a qualitative approach, assessed key stakeholders' views on the feasibility of introducing FOPL in Nepal.

5.1 STUDY 2: EXPERIMENTAL STUDY

An experimental study was undertaken to assess the effects of FOPL in determining product healthfulness among Nepalese consumers. This study included three different FOPL schemes: MTLL, Nutri-score, and warning labels and a control condition (no FOPL). For the experiment, mock product packages of five pairs of commonly purchased food products were designed, each consisting of a healthier and a less healthy variant. Each FOPL scheme was applied to all of the test products and the labels were placed on the top right corner of the package. Participants aged 18 years and older who had the main or shared responsibility of grocery shopping in their household were enrolled in the experiment. Participants were recruited using the street-intercept method outside supermarkets and grocery stores and randomly allocated to one of the experimental conditions or the control group. The participants were presented with the images of food product pairs featuring their allocated FOPL scheme or no FOPL and asked to select the one which they thought was healthier. The participants were then exposed to the images of one food item featuring different FOPL schemes and asked to select the one they prefer most. The results are analysed and compared in terms of participants' ability to identify the healthier products across different experimental and control conditions. The preferences towards the different FOPL schemes are reported in percentages and compared against participants' background characteristics.

Participants' characteristics

There was a total of 410 participants in the study. Of these, 293 (71.5%) were female and 117 (28.5%) were male. The mean age of the participants was 38.75 years

(SD 12.17). Table 5-1 shows the socio-demographic characteristics of the study participants across the four experimental conditions. There were no significant differences in the participants' socio-demographic characteristics between the four study groups in relation to their age, education, income, and BMI except for gender. The number of females were higher in all experimental and control groups. There was a significant difference in the number of participants between the Nutri-score and the control conditions (19 vs 40 males and 83 vs 63 females).

Table 5-1: Participants' characteristics across the FOPL conditions

	Nutri-score (n=102)	MTLL (n=102)	Warning labels (n=103)	Control (n=103)	Total (n=410)	Significance
Gender						
Male	19 (18.6)	30 (29.4)	28 (27.2)	40 (38.8)	117 (28.5)	$\chi^2 = 10.398$, $p = 0.015^*$
Female	83 (81.4)	72 (70.6)	75 (72.8)	63 (61.2)	293 (71.5)	
Age (years)						
18-34	43 (42.2)	38 (37.3)	42 (40.8)	43 (41.7)	166 (40.5)	$\chi^2 = 9.638$, $p = 0.141$
35-54	41 (40.2)	45 (44.1)	47 (45.6)	54 (52.4)	187 (45.6)	
55 and above	18 (17.6)	19 (18.6)	14 (13.6)	6 (5.8)	57 (13.9)	
Education						
Primary level and below	24 (23.5)	15 (14.7)	24 (23.3)	14 (13.6)	77 (18.8)	$\chi^2 = 6.728$, $p = 0.347$
High school level	34 (33.3)	40 (39.2)	36 (35.0)	45 (43.7)	155 (37.8)	
Undergraduate and above	44 (43.1)	47 (46.1)	43 (41.7)	44 (42.7)	178 (43.4)	
Income						
≥ 35000	15 (14.7)	9 (8.8)	8 (7.8)	13 (12.6)	45 (11.0)	$\chi^2 = 8.028$, $p = 0.236$
360000-60000	63 (61.8)	64 (62.7)	65 (63.1)	52 (50.5)	244 (59.5)	
Above 60000	24 (23.5)	29 (28.4)	30 (29.1)	38 (36.9)	121 (29.5)	
BMI						
> 25	57 (55.9)	56 (54.9)	72 (69.9%)	67 (65.0)	252 (61.5)	$\chi^2 = 6.852$, $p = 0.077$
≤ 25	45 (44.1)	46 (45.1)	31 (30.1)	36 (35.0)	158 (38.5)	

* p value < 0.05

Purchase and consumption of selected food products

Biscuits and instant noodles were the most frequently bought and consumed products whereas yoghurt and juice were purchased and consumed less frequently. The majority of the study participants reported purchasing (56.3%) and eating biscuits (58.5%) often and approximately a quarter of the participants reported they consume biscuits 'sometimes'. Nearly half of the participants stated they often buy (47.1%) and eat noodles (51%) while around 37% reported they 'sometimes' eat noodles. One third

of the participants reported buying (34.4%) and eating bread often (34.1%) while around 44% of them reported consuming bread 'sometimes'. Similarly, 29% of the participants reported drinking juice often and 48% 'sometimes'. The consumption of yoghurt was relative low as only 17% of the participants reported consuming it often while majority of them (56.1%) reported they consume yoghurt 'sometimes'.

Table 5-2: Purchase and consumption of selected food products

	Biscuit n (%)		**Bread n (%)**		**Juice n (%)**		**Instant noodles n (%)**		**Yogurt n (%)**	
Frequency	Buy	Eat	Buy	Eat	Buy	Eat	Buy	Eat	Buy	Eat
Never	1 (0.2)	0 (0)	23 (5.6)	6 (1.5)	6 (1.5)	7 (1.7)	1 (0.2)	2 (0.5)	19 (4.6)	13 (3.2)
Rarely	15 (3.7)	5 (1.2)	52 (12.7)	49 (12)	83 (20.2)	83 (20.2)	24 (5.9)	36 (8.8)	76 (18.5)	88 (21.5)
Sometimes	89 (21.7)	116 (28.3)	149 (36.3)	179 (43.7)	197 (48)	197 (48)	150 (36.6)	154 (37.6)	211 (51.5)	232 (56.6)
Often	231 (56.3)	240 (58.5)	141 (34.4)	140 (34.1)	119 (29)	120 (29.3)	193 (47.1)	209 (51)	91 (22.2)	71 (17.3)
Always	74 (18)	49 (12)	45 (11)	36 (8.8)	5 (1.2)	3 (0.7)	42 (10.2)	9 (2.2)	13 (3.2)	6 (1.5)

Perceived knowledge of nutrition and health

Nearly half of the study participants (49%) agreed they knew quite a lot about nutrition and health while a third of them (33.4%) were neutral about their perceived knowledge about nutrition.

Self-reported use of nutrition label (NIP)

When asked about the use of NIP while buying food products, 47% of the participants reported they used it 'sometimes'. Only a quarter of them reported using NIP often while buying food products and 1 in 10 participants reported they never use it.

Ability to determine the healthier product

When presented with five product pairs with their randomised FOPL scheme and asked to choose a healthier option, mean number of correct healthier choices was the highest for MTLL (2.19 out of 5). It was followed by Nutri-score (2.06), warning labels (1.8), and then the control (1.46). The one-way ANOVA test showed a statistically

significant difference in the mean number of correct healthier choices between the FOPL groups (F (3,410) = 10.675, p = 0.028). The post hoc Tuckey HSD test showed the MTLL yielded significantly higher scores of correct choices than the control group (p = 0.027). There were no statistically significant differences for the mean number of correct healthier choices for Nutri-score and warning labels.

Table 5-3: Comparison of mean number of correct choices

Groups	Number of correct choices			95% Confidence Interval	
	N	Mean	Std. Deviation	Lower Bound	Upper Bound
Multiple traffic light label	102	2.19*	1.79	1.83	2.54
Nutri-score	102	2.06	1.99	1.67	2.45
Warning labels	103	1.80	1.80	1.45	2.15
Control (no label)	103	1.46*	1.87	1.09	1.82

*Post hoc test p = 0.015.

A two-way ANOVA was conducted to examine the influence of participants' background variables on the number of correct choices across the experimental conditions. The two-way ANOVA using FOPL format and education as independent factors showed significant main effects for both FOPL format (F (3,410) = 2.955, p = 0.032) and educational level (F (3,410) = 3.202, p = 0.042). There was no significant interaction effect between educational level and FOPL format (F (3,410) = 1.319, p = 0.247) indicating the influence of participants' educational status did not differ between the experimental conditions. The two-way ANOVA using FOPL format and income level yielded a significant main effect only for income level (F (3,410) = 17.55, $p < 0.001$) but no significant interaction effect was observed (F (3,410) = 0.816, p = 0.558). There were no statistically significant interaction effects between FOPL formats and other variables including age, gender, BMI, perceived nutrition knowledge, and self-reported label reading.

Time taken for product comparison

The average time taken for a product comparison was 11 seconds. There was no statistically significant differences between the FOPL groups and the time taken for product comparison as determined by the one-way ANOVA test [F (3, 405) = 0.038, p = 0.990].

Use of NIP

On average, participants used the NIP 3 times while comparing the healthiness for a pair of products. There was no statistically significant differences between the FOPL groups and the number of times NIP was used for making product comparison [F (3, 407) = 0.076, p = 0.973].

FOPL preference

When asked to compare all the FOPL options, Nutri-score was the most preferred among the respondents (32%), followed by MTLL (30.3%) and warning labels (17.2%). One fifth of the participants reported no preference for any of the FOPL schemes. There was a significant association between the experimental conditions and the FOPL preferences where the participants in each FOPL group were more likely to select the same FOPL as their preferred format. Nearly half of the participants in MTLL group for the product choice experiment selected MTLL as their preferred format. Similarly, 39% of the participants in Nutri-score group preferred Nutri-score the most and 33 % of those in warning labels group preferred the warning labels.

Table 5-4 shows the preferences of the FOPL schemes by socio-demographic characteristics of the participants. There was a significant association between the FOPL preferences and the participants' age, educational level, income, perceived nutrition knowledge, and self-reported label reading behaviour. Younger age groups were more likely to prefer MTLL and Nutri-score while those aged above 55 years were more likely to state no preference for any of the FOPLs. Participants in the low educational and income groups were more likely to indicate no preference for any of the FOPLs. Nutri-score was the most preferred FOPL among participants with high school level of education while those with undergraduate or higher education preferred MTLL. Among the participants who disagreed they knew quite a lot about nutrition, 47% selected Nutri-score as their preferred FOPL followed by MTLL (26.7%) The participants who were neutral about their nutrition knowledge were likely to prefer Nutri-score (34.3%) and indicate no preference for any FOPL format (30.6%). Thirty eight percent of the participants who reported reading nutrition labels (NIP) never or rarely were likely to select MTLL as the preferred FOPL while 29% of them indicated no preference for any FOPL. For those who often or always read nutrition label, Nutri-score was the most preferred FOPL followed by MTLL and warning labels.

Table 5-4: FOPL schemes preferences by sociodemographic characteristics

	MTLL	Nutri-score	Warning labels	None	Significance
Overall	123 (30.3)	130 (32.0)	70 (17.2)	83 (20.4)	$\chi^2 = 4.255$, $p = 0.235$
Experimental group					
MTLL	49 (48.0)	23 (22.5)	12 (11.8)	18 (17.6)	$\chi^2 = 39.406$, $p < 0.001$*
Nutri-score	23 (23.0)	39 (39.0)	11 (11.0)	27 (27.0)	
Warning labels	21 (20.6)	28 (27.5)	33 (32.4)	20 (19.6)	
Control (No FOPL)	30 (29.4)	40 (39.2)	14 (13.7)	18 (17.6)	
Gender					
Male	43 (36.8)	36 (30.8)	15 (12.8)	23 (19.7)	$\chi^2 = 4.255$, $p = 0.235$
Female	80 (27.7)	94 (32.5)	55 (19.0)	64 (20.8)	
Age (years)					
18-34	57 (34.3)	52 (31.3)	39 (23.5)	18 (10.8)	$\chi^2 = 39.406$, $p < 0.001$*
35-54	54 (29.0)	69 (37.1)	23 (12.4)	40 (21.5)	
55 and above	12 (22.2)	9 (16.7)	8 (14.8)	25 (46.3)	
Education					
Primary level and below	17 (23.3)	20 (27.4)	3 (4.1)	33 (45.2)	$\chi^2 = 43.452$, $p < 0.001$*
High school level	41 (26.5)	60 (38.7)	30 (19.4)	24 (15.5)	
Undergraduate and above	65 (36.5)	50 (28.1)	37 (20.8)	26 (14.6)	
Income					
≤ 35000	9 (20.5)	13 (29.5)	6 (13.6)	16 (36.4)	$\chi^2 = 16.813$, $p = 0.010$*
36000-60000	84 (34.7)	74 (30.6)	35 (14.5)	49 (20.2)	
Above 60000	30 (25.0)	43 (35.8)	29 (24.2)	18 (15.0)	
BMI					
> 25	72 (58.5)	82 (63.1)	47 (67.1)	49 (59.0)	$\chi^2 = 1.747$, $p = 0.626$
≥ 25	51 (41.5)	48 (36.9)	23 (32.9)	34 (41.0)	
Perceived nutrition knowledge (I know quite a lot about nutrition)					
Disagree	16 (26.7)	28 (46.7)	11 (18.3)	5 (8.3)	$\chi^2 = 27.063$, $p < 0.001$*
Neutral	33 (24.6)	45 (34.3)	14 (10.4)	41 (30.6)	
Agree	74 (34.9)	56 (26.4)	45 (21.2)	37 (17.5)	
Self-reported label reading (NIP)					
Never/rarely	25 (23.4)	41 (38.3)	10 (9.3)	31 (29.0)	$\chi^2 = 17.542$, $p = 0.007$*
Sometimes	56 (29.6)	58 (30.7)	38 (20.1)	37 (19.6)	
Often/Always	42 (38.2)	31 (28.2)	22 (20.0)	15 (13.6)	

*$p < 0.05$

Reasons for the preferred FOPL

Nutri-score

Among the 406 respondents, nearly one third of the participants selected Nutri-score as their preferred FOPL. The most common reasons for preferring this label were: ease of understanding due to the grading system denoted by ABCDE (56.6%), having colour indication (17.8%), and having an overall rating of the nutrient content (12.4%).

MTLL

Among the 406 respondents, 123 selected MTLL as their preferred FOPL. Forty percent of the respondents who preferred MTLL reported it was easy to understand and one fifth of them reported it indicated the level of each nutrient content. In addition, participants also reported they liked the colour indication as well as the high/medium/low levels of nutrients provided.

Warning labels

Seventy out of 406 respondents selected the warning labels as their preferred FOPL. Most of the respondents preferring this label reported it to be easy (42.9%) and it indicated high levels of nutrient content including calories (30%). Some respondents mentioned there are separated warning signs for individual nutrient (e.g., sugars, salts, sat fats) which is easy to understand and it saves time.

5.2 STUDY 3: QUALITATIVE STUDY

This study explored stakeholders' views on the feasibility of the introduction of FOPL in Nepal using a qualitative approach. Semi-structured interviews were conducted among participants comprising diverse sectors including representatives from government and non-government organizations working in public health, food and nutrition sectors, food industries, and consumers. The key informants representing government health and food authorities were first identified and selected purposively based on their expertise and work experience in health and nutrition sectors including food labelling. Participants from non-government organizations and food industries were selected using a snowball sampling technique. Consumer participants were selected from the list of participants of the experimental study who agreed they would be willing to participate in semi-structured interviews. A total of 21 interviews were conducted including participants from the government health authority (4), the government food authority (3), non-government organizations (4), the food industry (3), and consumers (7). Data from the interviews were analysed using thematic approach and the analysis of the results produced eight themes. The first theme discusses the consumption of ultra-processed foods among Nepalese consumers. The second theme presents the current food and nutrition labelling requirement in the country and its use by consumers. Third, the key informants' views on the possibility of introducing FOPL in the country are discussed. The fourth theme presents the potential advantages of FOPL followed by theme 5 which represents participants' perception about food industry acceptance. Theme 6 reflects the perception of the consumer's acceptance and ability to use FOPL. The seventh theme presents conceptions about challenges to the introduction of FOPL and the final theme, theme 8, represents the participants' preference for different FOPL systems.

5.2.1 Consumption of ultra-processed foods

Most consumer participants reported they cook and eat their main meals at home which included rice, pulses and vegetables. The participants reported consuming ultra-processed and packaged foods mainly in their breakfast and snacks. The most commonly consumed ultra-processed foods were bread, biscuits, instant noodles, cheese balls (cheese flavoured puffed corn snack), potato chips, chocolates, etc. The consumer participants reported increasing consumption of ultra-processed and

packaged foods because of their taste, busy lifestyle, and preference for ready-to-eat foods.

Most health, food and industry participants perceived the majority of people still cook main meals at home while the ultra-processed and packaged foods are mostly preferred as snacks. The participants acknowledged the people mainly get their energy intake from rice and other staple foods, and noted changing food habits especially in urban areas where the practice of traditional home-made foods is shifting towards ready-to-eat fast foods due to urbanization. The majority of participants noted the lack of studies or data on the production and consumption of the ultra-processed food products in the country. However, they assumed increasing trends in the consumption of these food products especially among children and adolescents. For example, a government health participant noted a high preference for ultra-processed foods by younger age group populations.

> *"The consumption is high particularly among adolescents and children. Mothers would prefer noodles rather than preparing lunch as long as schools do not have any restrictions. Children like noodles and it is convenient for mothers too."*
>
> - Government health authority 1

Another government food sector participant reflected similar sentiments where the consumption of ultra-processed foods is perceived to be higher among children and adolescents. According to a food industry participant, children are easily influenced by advertisements and prefer ultra-processed foods as they taste better. The participant stated the changing lifestyle could be a main reason for the increasing consumption of ultra-processed foods and explained people have become busier and have less time to prepare foods at home.

> *"Maybe because of the changing lifestyle, people prefer to have ready-to-eat foods as they are busy and have less time to prepare traditional dishes. There is certain segment of population, younger population in particular, who prefer to have the ultra-processed foods. They are influenced by advertisements and these foods are tastier compared to our traditional foods. Even my daughter does not want our traditional foods. There is always a big 'no' 'no' but is happy to eat packaged foods such as lays, and chocolates"*

- Food Industry 3

A consumer participant who owned a local grocery store reported high demand and sales of the ultra-processed foods. Consumers often seek convenient and ready-to-eat options and the products such as instant noodles, and chips are mostly purchased by younger people and parents of small children. The participant explained:

> *"Many people buy packaged food products particularly "Wai Wai" noodles. It is very convenient and ready to eat. Parents often buy food products such as cheese balls, chips, and chocolates for their children."*

- Consumer 1

Most participants including consumers identified increased availability, easy access and less preparation time as the major factors for the increasing consumption of ultra-processed foods. Participants noted these foods are cheaper, tastier, and easily accessible in the market while healthy foods such as fruits and vegetables are expensive. Lack of awareness about the effects of unhealthy food consumption is another reason for the increased consumption of the ultra-processed foods. A food sector participant asserted:

> *"First, healthy foods are expensive e.g., fruits and vegetables. Second, there is lack of awareness on implications of unhealthy food consumption…. There is easy access to the unhealthy foods (ultra-processed) in the market. These foods which have high contents of calorie, sodium, fats and sugars, and low content of micronutrients and fibre are being increasingly consumed."*

- Non-government food sector 4

How do consumers determine healthiness of foods?

Participants identified a number of factors that determine consumer food choices. Brand, price, taste, convenience and advertisements were the major factors affecting consumer food choices. When asked how people determined the healthiness of food products, most consumer participants reported they relied on perceived quality of the products based on the brand name and price. They considered expensive food products to be quality products and are healthier than the cheaper options. Some consumer participants indicated the products with nutrition and health claims on the packages such as 'sugar free', or 'cholesterol free' are healthier. Other consumer

participants relied on what grocery owners tell them. One participant reported he would ask the shop owner about the quality or healthiness of food products before purchasing them.

> *"I usually ask shop owner about the food products whether they are healthy and ask them to provide me only the healthy products not the unhealthy ones."*
>
> - Consumer 5

Most health, food, and industry participants perceived people rarely care about the nutritional components while buying food products. As noted by a health sector participant, the majority of people select foods as per their convenience, taste and advertisements rather than nutrient contents of the foods.

> *"People mainly select foods based on their taste and convenience…People are also influenced by advertisements and sometimes, they buy products recommended by friends or family members. I don't think they are much concerned about healthiness of foods"*
>
> - Government health authority 4

5.2.2 Current food and nutrition labelling requirement

Participants noted the lack of nutrition labelling system in Nepal. Participants, particularly from the government food authority, mentioned the existing labelling requirement in the country is limited and does not include comprehensive nutrition labelling. Participants said in relation to the changing dietary pattern, there are ongoing discussions at a policy level to make necessary changes in the existing labelling regulation. One of the participants, representing government food sector, asserted:

> *"With the current scenario of increasing consumption of ultra-processed foods, our regulations are shaping up. At present, we are in the process of amendments in our food labelling regulation and discussions are being made. Once these changes are made, we can regulate nutrition labelling."*
>
> - Government food authority 3

A food industry participant mentioned nutrition labelling is not compulsory within the present mandatory labelling requirements. However, some manufactures have been providing nutrition information on the packages of their food products

proactively. One participant told about a non-government organization (NGO) working on FOPL initiative to provide a logo in children's complementary foods. The NGO has adopted HSR algorithm to categorise the food products.

> *"At present, we are working on children's foods. In the next stage, we will include other food categories such as dried fruits and vegetables. This NGO is working in partnership with some food industries. It has adopted Australian HSR as a reference and the food products which have a HSR score 3 or more will be given a logo (picture of children's hand promoted by the NGO)."*
>
> - Non-government food sector 4

Use of food labels including NIP

Most consumer participants stated they often looked for expiry dates in food products and sometimes checked the list of ingredients. A few consumer participants mentioned they sometimes check the information about calorie content and the amount of *"Ajino moto"(monosodium glutamate)*. Most of the consumers reported they did not read the nutrient information provided on the back of the packages. However, a few consumer participants reported checking the nutrient information if buying foods for children and the family members who have health conditions (e.g., diabetes). For example, a consumer participant stated:

> *"I am more conscious while buying foods for children and check for nutrient contents and expiry dates. Similarly, my parents have poor health condition and I look for sugar contents in their food products. But I do not care about such information while buying food products for myself and other family members."*
>
> - Consumer 7

The food, health and industry sector participants noted lack of practice of reading and using nutrition label among Nepalese consumers. They reported noticing nutrient information panel provided on the back of some food products but doubted its understanding and use by the consumers due to the small font size and complex numerical information. A health sector participant assumed there might be a small section of the population who seeks out nutrient information such as the amount of sugars, carbohydrates, and fats in the food products.

"There may be a small population subgroup who have now started to seek information like sugar free, fat content, carbohydrate content and expiry date. There are nutrition labels provided in some food products which are in small font sizes. People may read these information but I am not sure whether they are able to understand the labels."

- Government food authority 4

5.2.3 Possibility of the introduction of FOPL

Most health and food sector participants considered FOPL as a potential strategy to improve health and nutrition status in the country. A health sector representative stated current nutrition policies and programs focus on undernutrition because of the high prevalence. There are limited activities to address obesity and non-communicable diseases (NCDs). The participant noted in relation to the changing dietary pattern and increasing rates of obesity and diet-related diseases, FOPL can help to improve nutrition status.

There were differing views on whether FOPL should be initiated immediately. Some health and food sector participants reported undernutrition and micro-nutrient deficiencies as major health problems which need to be prioritised at the moment. Similarly, industry participants perceived the consumption of ultra-processed foods is relatively low in the country and its effects on health are not much significant. There are other important areas that government needs to focus such as food security and safety. For example, an industry participant explained many food products in the Nepalese market are not properly packaged which compromises the food safety and quality. In many cases, consumers cannot ensure whether the foods they are buying are safe enough to consume. The participant also raised issues relating to false claims provided on the food packages.

"First, we need to ensure food security and food safety. In our context, we cannot even assure that the foods buying are safe enough to consume ... It is the most sensitive issue which we are not being able to address properly. Second, we need to address packaging and misleading claims. ... We need to control unpackaged food items such as meat and perishable foods. All food products should be properly packaged ensuring the safety. Then only we can think of other issues including nutrition labelling."

- Food industry 2

On the other hand, some health sector participants noted the policy should start thinking of ways to address obesity and NCDs as the country is undergoing nutrition and epidemiological transitions. As such, FOPL could be one effective strategy to reduce the dietary risk factors. As expressed by a government health participant, FOPL can be integrated in the existing health programs to improve overall health and nutrition status.

> *"While we continue to implement our existing programs, we need to incorporate new approaches and initiatives such as nutrition labelling to improve our situation. We can integrate FOPL in our existing programs and it can be an effective approach which will have positive effects on overall health and nutrition status."*

- Government health authority 3

Another government health participant expressed similar opinion, explaining that the policy discussion on FOPL can be initiated ahead before the country faces consequences of unhealthy food consumption in health. The participant elucidated other priorities such as undernutrition may setback the likely effects of unhealthy food consumption at the moment but considering its long-term health effects, it is imperative to start thinking of ways to address the dietary risk factors. An industry participant also agreed it is important to initiate the nutrition labelling as people have started to adopt different dietary practices due to increased access to information and social media.

> *"It is just the matter of time; we should initiate the intervention before we face the consequences of unhealthy food consumption. The effects of increased ultra-processed food consumption in health are not seen immediately. Since we do not have much dependency on packaged foods at present, it is obvious to think that we have other priorities. But we should initiate the process of developing guidelines and start discussions at policy level. It will also help in addressing the existing under nutrition as well as preventing obesity and diet-related health problems."*

- Government health authority 4

Participants noted the introduction of FOPL requires a robust process including several steps to develop and implement FOPL. The key steps suggested by the participants involve policy advocacy, formulation of policy and strategy, development of regulatory and monitoring mechanism, nutrient profiling, multi-sectoral coordination and support, and public education campaigns.

Policy advocacy

Most participants mentioned the introduction of FOPL requires extensive discussions and exercises at policy level. It requires policy advocacy at decision making level to justify the need of FOPL in relation to the changing dietary and nutrition scenario. For this, a government representative suggested to conduct a consultative meeting involving the Ministry of Health and Population (MoHP), the National Planning Commission (NPC), the Ministry of Agriculture and Livestock Development (MoAD) and other stakeholders, presenting the global evidence on the effectiveness of FOPL.

> *"There should be an exercise at policy level. For this, we can have high level consultative meetings and advocacy including MoH, NPC, Ministry of Finance and Import Divisions, and other stakeholders. We can present the evidence on the effects of FOPL including international practices, and justify the need in our context"*
>
> - Government health authority 1

Formulation of policy and strategy

Participants from health, food and industry sectors suggested the FOPL should first be addressed in policy. The system cannot be implemented unless it is incorporated in the national policy and strategy. Some participants mentioned about a food labelling regulation currently being developed by the DFTQC under MoAD which may include some provision of FOPL. According to the government food participants, further steps can be proceeded only after the endorsement of the labelling regulation.

Regulatory and monitoring mechanism

The majority of the participants emphasized the importance of strong regulatory and monitoring mechanism for the effective implementation of the FOPL. The participants felt there is a need of a regulatory system with defined requirements and regular monitoring mechanism to execute the FOPL as it is likely that some private sectors may not follow the system properly. Another non-government participant raised a concern about potential manipulations by food industries in absence of a regulatory agency to verify the nutrition labels claimed in food products. The participant elaborated:

> *"Many businesses have capitalised the idea of labelling. But can we believe what they claim? For example, it's written "No cholesterol" in vegetable oil and people may think they won't suffer from high cholesterol level by consuming this oil. The main issue is, are such claims from the industries correctly stated. Therefore, if we don't have a regulatory agency that can verify such claims, there might be a lot of manipulations in Nepal."*
>
> - Non-government food sector 5

Participants suggested the system be driven by the government and addressed from the policy level. The DFTQC could be a governing body as it is mainly related to food regulation. The participants, particularly from food industry, noted that private sectors are mainly profit-oriented and may not be willing to provide nutrition labels unless it is obligated. For instance, one of the participants mentioned the primary aim of FOPL is to promote healthy eating and it is the government's responsibility to ensure health of its citizens. The participant also noted unlike developed countries, there are many unorganised small food industries in Nepal who may not be willing to participate unless there is a government binding.

> *"I think the government has an important role in it (FOPL). Food industries are profit oriented and unless they are compelled, I don't think food companies would invest so much in it... In our context, consumers are ignorant and not much aware about the healthy choices. If we plan to intervene, government should lead the initiative by developing a framework ... FOPL is more about promoting healthy eating than marketing a product. It is the responsibility of the*

government to ensure health of its citizens. Therefore, there should be a government binding. We cannot expect private sectors to come up with such initiatives… In developed countries where there are organised corporates and well set food industries, they can come forward to provide FOPLs. However, in countries like us where there are many informal and unorganised small industries, governments must enforce regulation; it has to lure and convince industries to provide the labels."

- Food industry 3

Mandatory or voluntary regulation

There were mixed views on whether there should be a mandatory or voluntary regulation. Most participants felt it would be difficult to enforce mandatory FOPL regulation. The participants, particularly from government health and food authorities, suggested to introduce the system voluntarily. In the present context where existing mandatory food standards are not being effectively implemented, mandatory FOPL would not be an easy task as stated by one of the government participants.

"It is difficult to enforce mandatory regulation for labelling. We are still not being able to fully implement mandatory food standards. In such context, mandatory FOPL would not be easy. We can introduce it voluntarily."

- Government food authority 2

Participants raised concerns about food industry acceptance for mandatory regulation and noted the requirement of a certain time frame for industries to implement FOPL. An industry participant commented it can be initiated with a voluntary approach and implemented in phases before moving to a mandatory system. A non-government participant argued for a mandatory system given a certain time frame for industries to comply. The participant suggested if the private sector can be involved from the beginning and made accountable, it might not be challenging to implement a mandatory FOPL system.

Food industry participants preferred a voluntary approach to start with. The participants admitted, in many cases, food industries may not be willing to provide the information unless it is mandatory. However, some food industries may find FOPL helpful in promoting their products and could adopt it voluntarily. One of the industry

participants explained some proactive industries may pick it up first and promote it which may encourage other industries to come along. The participant suggested to initiate FOPL with some largely consumed basic food products such as milk to help consumers to select healthier options.

> *"It should be voluntary initially. Some major food industries such as dairy, bakery, may take it positively as a marketing strategy. Industries always seek opportunity to promote their products and the proactive and competitive industries may pick it up first. However, we cannot expect the same response from all, small scale industries in particular. For example, if there are 10 players in bakery items and if one or two of them provide FOPL in their products, rests will be compelled to think of it. I think it should be voluntary and it takes time for industries to comply. ... Why don't we start with milk or other healthy products? We can start with basic and mostly consumed foods so that people start to make healthier choices."*
>
> - Food industry 3

Nutrient profiling for FOPL

Participants reported a lack of dietary guidelines or standards in the country which can be used for nutrient profiling of FOPL. Some food participants mentioned the only existing document is a Food Composition Table providing information about the nutrient components of different foods along with the recommended dietary daily intakes of nutrients for children, adolescents, adults, pregnant women, and lactating mothers. It may provide some useful inputs in the nutrient profiling for the FOPL but many participants felt a need to develop a comprehensive nutritional criteria including cut-off values for the labelling. For this, participants suggested the government should first develop a criteria to categorise food products and set values to determine the product healthiness, for example, limits to consider "high" or "low" nutrient content. They suggested an international dietary guideline or standards can be adopted and contextualised in the Nepalese setting.

> *"We do not have such food or nutrition standards at the moment. There is one food based dietary guideline. I am not aware if MoHP has any. As we do not have enough capacity and resources to conduct research, so we can adopt an*

internationally accepted dietary guideline. We can replicate a successful FOPL model in our context."

- Government food authority 3

In addition to the critical nutrients, some health and food participants suggested positive nutrients (such as vitamins and minerals) can be included in the system which may help to improve micronutrient deficiencies in the country.

Participants mentioned the food labelling regulation being developed by the DFTQC which might include nutrient information and standards for the nutrition labelling. One of the government food authority participants said once this labelling regulation is endorsed, the required guideline and nutrition standards can be developed accordingly. Most participants highlighted a government body should be responsible for the development of the nutrient profiling criteria and for this the DFTQC and the DoHS can jointly initiate the process with the involvement of other concerned stakeholders.

Multiple sector coordination and support

Most participants stated there should be a multi-sectoral approach for the introduction and implementation of FOPL. Participants suggested the nutrition section under the DoHS and DFTQC work together with the engagement of other stakeholders to come up with a concrete plan for FOPL. Importantly, many participants stated a need for additional resources and support to implement the FOPL measure. Given the limited resources in the country, participants, especially from the government authorities, suggested the private sector or an external agency could support the government to introduce the system. As it would take several processes and time for government to immediately introduce a new program, it would be better if an external partner could help piloting the FOPL system. This would also help to generate evidence on the effectiveness of FOPL to inform the policy.

"For the countries like us, we seek support from external sources for any new program as government has limited resources. In the initial phase, someone (private or non-government sector) has to come forward to support the government, maybe in piloting phase for initial 1 or 2 years… We need to consider our resources and there are certain processes to adopt a new program

in policy/strategy.…There should be a third party (agent) to focus on this program which can provide technical support and bring all stakeholders together."

- Government health authority 3

Awareness campaigns

All participants including consumers emphasized a need for a massive awareness program to make people aware of the proposed FOPL system. Participants highlighted the importance of behaviour change communication to enable consumers to effectively use the FOPL. For instance, one health sector participant noted all population subgroups may not be able to correctly interpret and use the FOPL. Therefore, it is crucial that the mass communication activities reach all communities to bring about changes in their behaviour. The participant also suggested to design interventions targeted for school children.

"It (FOPL) will be very helpful but we need advocacy and behaviour change communication programs including interventions targeted for school children. For example, children are aware of 'Jeevanjal' (rehydration solution) but they do not know how to use it. Therefore, it is necessary to think of effective ways to reach all communities."

- Government health authority 2

Other participants shared a similar thought and suggested to include the labelling information in school curriculum to make it more effective. Given the increasing access to information and communication media, participants thought advocacy campaigns can successfully reach communities. One of the health participants noted a presence of effective health system network in the country which can be utilised in the campaigns to reach grass root levels.

5.2.4 Potential advantages of FOPL

Participants identified several advantages of the introduction of FOPL. Most consumer participants stated FOPL provides nutrition information at-a glance and found FOPL to be easy to use. They suggested it would be very helpful if there were a simple message or a logo which could be easily understandable. FOPL may grab

consumer attention and the continuous exposure would make people conscious about the nutrient quality of food products as highlighted by a consumer participant:

> *"We have a busy life and we pick foods without paying attention to their nutrient contents. If such labels or logos are displayed, it will make us conscious. We may not notice them at first, but they will click in our mind."*
>
> - Consumer 7

Ease of use due to simplified information was a key advantage mentioned by the participants from health, food and industry sectors. Most participants noted NIP being too complex and difficult to comprehend due to numerical information. Therefore, a simple message indicating the high or low nutrient content would be easier. A food industry participant noted people hardly look into the information provided on the back of the packages. As such, a symbol or a signpost indicating the nutrient quality of a food product could enable consumers to make healthier choices. The participant elaborated the FOPL may also improve nutrition literacy and people would start seeking nutrient information as there would be mass campaigns for FOPL.

> *"It would be very helpful in our context where people do not have adequate nutrition knowledge. If we could provide a symbol or a signpost categorising the food products, it would help people to choose healthier options… I think it would also help to increase nutritional awareness among people. When we do campaigns, people would start realising that there are differences in the nutritional components of the food products of different companies. Until now people are just considering taste, attractive packaging and availability."*
>
> - Food industry 3

A government health participant stated that FOPL would provide informed choices for consumers so that they can choose food products according to their need, explaining it would help people to consume the necessary nutrients while avoiding the harmful ones. A few participants indicated the FOPL could potentially increase the availability of healthy food products in market due to the product reformulation and this would improve people's diets which in turn would help to address the current undernutrition as well as to anticipate the future impact of unhealthy food consumption. For instance, a government health participant explained:

"If FOPL could be provided in one product, other manufactures may be willing to provide the labels, particularly in healthier products. At the same time, industries may start reformulating their products with better nutrient quality due to the market competition."

- Government health authority 3

As noted by a food industry participant, FOPL could potentially benefit all stakeholders, consumers in particular. Food industries can use FOPL to promote their products while consumers can have health gains which in turn would improve country's health and economy.

"There will be a win-win situation for all. Industries are interested to increase their benefits, government is interested to increase tax revenues, and consumer wish to have better health. If FOPL can benefit all then we can definitely implement the system."

- Food industry 1

Other food industry participants confirmed that FOPL could be beneficial to them as it may help to promote their products. One of the participants noted the FOPL could enhance food industries' credibility. The participant explained the existence of numerous unorganised food companies producing cheaper options but the nutrient quality often being compromised. In this context, if we could provide FOPL, consumers would be conscious about the nutrient content of the food products and it can help the organised food industries to sustain.

"I think organised and quality food industries will get due credit. There are numerous small food companies which produce food products in cheaper prices while similar products with better nutrient quality may cost higher. It affects the organised food industries financially. For example, most dairy products including milk are being marketed through unorganised informal sector where their quality is compromised due to unhygienic practices and packaging. In our market, we can find milk just packaged in a plastic bag tied with a rubber band and they are being sold in a cheaper price. But the organised dairy industries must ensure the safety and hygiene. There are costs associated with human resources, packaging, labelling, testing and many other overhead expenditure. If government does not intervene in time, such organised food industries may

collapse. In such situation, if dairy industries start to provide FOPL such as a star rating, people would be conscious and would buy milk products with better nutrient quality. This way, it can help organised food industries."

- Food industry 3

5.2.5 Perception about the consumers' acceptance and ability to use FOPL

Most consumer participants stated nutrition labelling, particularly FOPL, is very important and it would be helpful for them to choose healthier food products. If FOPL is provided, most of the participants expressed their intention to use it while purchasing food products. When asked whether they would be able to understand the FOPL, most of the consumer participants admitted they can understand simple logo or coloured messages. Some participants said they would ask grocery owners or other people to help read the label for them in case they do not understand it. For instance, a consumer participant asserted:

"If there were labels provided on the front of packages displaying information about the amount of calorie, vitamin, protein and other nutrients, we would be able to choose healthier products… I will definitely use it while buying food products. Even if I don't understand the label, I will ask someone to read it for me."

- Consumer 1

One of the consumer participants raised concerns about the price of the food products might increase with the FOPL. The participant expressed the willingness to buy the products based on the FOPL if it would not cost more.

"If there are not much differences in the prices of labelled and unlabelled products, we will choose the better one. But if there is a huge price difference, we won't be able to buy the labelled product even if we know it is better."

- Consumer 7

Participants from health, food and industry sectors reported the consumer behaviour has changed in recent years, shifting from local markets to supermarkets. They also noted increasing consumer practice of reading labels such as expiry dates, and nutrient information to some extent. As the literacy rate is increasing, many

participants perceived consumers would be able to read and use FOPL. Participants acknowledged people are becoming more health conscious and are trying to adopt healthy eating practices such as "Keto diet" due to increased access to information and social media. In this context, consumers may be willing to use FOPL while selecting food products. One of the government participants explained consumers always seek healthy food products; for instance, consumer often buy organic products regardless of the price as these products are considered to be healthy.

> *"Consumers will definitely use FOPL. People would certainly choose the healthier products if they can afford. Why do people choose organic foods regardless of the price? It's because they are healthier."*
>
> - Government food authority 2

One of the industry participants argued whether all population subgroups would be able to use FOPL in the present context where majority of people are unaware of their nutrition requirement. The participant also mentioned about the differences in consumer groups purchasing groceries from local market to supermarket and explained it would only be effective if FOPL can be provided in all products.

> *"It seems good but the problem is people do not even know their daily calorie or nutrition requirement. In such context, who would be able to select foods by reading the nutrition labels? There may be certain groups who can use it but not all. It may be effective but it will take time and we are not in the position to immediately implement FOPL… At present, I don't think FOPL would be effective immediately. If it can be applied in all food products in all retail market, consumers may be able to use it. But if it is only provided in some premium products in supermarkets, it won't make a difference as we have different ranges of consumers."*
>
> - Food Industry 2

While many participants acknowledged consumers would be able and willing to use the FOPL, it was suggested to complement the intervention with massive advocacy campaigns to educate people about the proposed FOPL system.

5.2.6 Perception about food industry acceptance

Many study participants discussed food industry acceptance and compliance. Some participants from government health and food authorities thought industries would not resist though there may arise some issues relating to costs. One food authority participant suggested industries would be happy to provide FOPL if it does not impose additional costs. Other participant argued it is likely that industries may not cooperate due to the additional costs and testing requirements.

A few participants noticed industries may not have adequate knowledge and do not realise the importance of FOPL. Therefore, it will be necessary to convince the food industries and make them realise their social responsibility. For this, participants stressed it is important to involve food industries in development process of FOPL through a public-private partnership model. A non-government participant said the private sector should be involved in decision making with equal sharing of the program ownership as it is ultimately the industries who would implement the program. It would also make industries more accountable and help to ensure compliance and sustain the program. The participant described:

> *"Private sectors should be involved in the decision-making process of FOPL. The ownership should also be equally shared with the private sectors. DFTQC is the responsible body to monitor the quality of food products in Nepal. There is a provision of sample testing twice a year. Is it possible to assure the quality throughout the year just by checking two samples? Therefore, food industry should be made accountable to ensure the quality. For this, it is must to involve private sector… Government should welcome the private sectors in a supportive way so that they are willing to join the nutrition movement. It won't be sustainable only by enforcing laws and actions; food industries may initially comply but they may again start deceiving consumers."*
>
> - Non-government food sector 4

Food industry participants also highlighted the importance of involving food companies in decision making process for FOPL. One participant indicated the involvement of food industries would allow government to consider the practical issues while implementing the system. Importantly, it would be more inclusive and easier to come to a consensus. Participants suggested to include Federation of Nepalese

Chambers of Commerce and Industries (FNCCI), Confederation of Nepalese Industries (CNI) and other industry associations in the development process of FOPL. This way, it would be easier to convince food industries to participate. The participants stated that food industries will not oppose government FOPL regulation provided a certain time frame for them to implement. However, the participants admitted food industries may not be willing to provide FOPL unless required by the policy as it would add costs. Food industries would consider providing FOPL only if it is beneficial to them. Therefore, any proposed FOPL system should be convincing that it adds value to the food industries. One of the participants commented consumers should be able to decide what they should eat and the government have an important role in making consumers aware of healthy eating.

> *"It is not difficult for the industries to implement FOPL if government introduces the system. The food industries should be provided a timeframe to implement which could be 6 months or a year… There are costs associated with FOPL, therefore, industries will only follow the required mandatory standards. They won't be willing to implement new intervention such as FOPL at their own expenses…Industries will implement FOPL voluntarily if it is beneficial to them. For example, if their sales increase by having a star rating, they will be willing to provide the labels, which will benefit both consumers and industries…Food industries can provide labels as required which can help consumers to be select healthier options. However, consumers decide what they should eat. Food industries do not have role in making consumers aware; it is the government's responsibility to conduct awareness campaign."*
>
> - Food Industry 1

Another food industry participant confirmed industries would definitely comply if government introduces the system, explaining that many food companies have been operating since long and would not want to risk their investment by not complying the government standards. The participant expressed a willingness to provide FOPL as it would also help in marketing of the products. For example, health benefits of a product can be used for the product promotion by claiming low contents of nutrients of concern such as sugars, salts, or calorie.

Other participants reflected a similar idea that food industries may find FOPL helpful in promoting their products and suggested FOPL can be viewed as a marketing

strategy to promote their products. One of the participants did not view food industry compliance as a challenge and elucidated in relation to changing consumer behaviour and growing supermarkets, FOPL may offer food companies an opportunity to make their products look different and attract consumers by allowing them to easily differentiate the products based on the nutrient quality. There may be some additional costs, but it can be viewed as an investment which may help to boost their sales. The participant explained:

> *"We did not have culture of going to department stores but now we can see many department stores even outside Kathmandu where local stores are being replaced by supermarkets. People have many choices in such supermarkets where they can find similar products of different brands. There are separate aisles for sugars, oils and other food categories. There should be a change in production strategy as the way market is changing and it is now time to think how to make our products different from others; FOPL may have an important role in it... I don't think industry compliance as a major challenge as I see this positively as a marketing tool. There are definitely costs associated with testing. But industries already need to conduct several tests in order to comply with the existing standards and have most information about the products. We just need to provide a symbol or a signpost based on a criteria. Rather it is an investment and helps in marketing. It will boost and strengthen food industries."*
>
> - Food Industry 3

Some participants discussed the presence of many small-scale food companies in the country operated with minimum investment and by small groups of people who often lack adequate education and skills. As such policy needs to consider the costs to these industries and think of ways to convince them to comply. One of the government food participants stated:

> *"We have many small-scale industries (e.g., spices) operated by the people who often lack adequate education and skills. They do not have other good income generating options (such as other job opportunities, foreign employment) and do not even have sufficient resources to invest. Their only focus is to sustain rather than upgrading. We need to convince them first, make them aware and monitor regularly."*

- Government food authority 1

Another government participant commented that food industries might raise concerns about the additional costs and may not be willing to provide FOPL if they cannot increase the product price. Therefore, government should consider supporting food industries, small businesses in particular, through subsidies or any incentives at least in initial phase.

"First, we must make food industries aware of the labelling. Since they have to spend extra resources (e.g. lab testing), they might raise concerns relating to the cost. They might ask if they can increase the price of the product… The system will be beneficial but in the initial phase, the government should consider providing subsidies to the food manufacturers to address the issues relating to the cost of production"

- Government food authority 2

5.2.7 Perceived challenges to the introduction of FOPL

Policy making is often a slow and complex process and this complexity was viewed as a major barrier by participants to introducing FOPL in the country. Importantly, FOPL is more about a regulatory process and legal enforcement was seen more challenging to initiate the system. Most participants said FOPL should first be incorporated in policy and regulation, after which further steps including development of guideline or criteria can proceed. The slow government process in Nepal was noted as a potential barrier. One of the food authority participants stated that they have been working on food labelling regulation for three years but yet not finalised it and was still unsure about the time of its endorsement.

"It's been almost three years we've started working on food labelling regulation and still not sure how long it takes to enforce it."

- Government food authority 1

Another government health participant mentioned the many processes and channels required in making a new policy.

Limited resources including insufficient human resources and lack of laboratory facilities were identified as other potential barriers to the introduction of FOPL. Most government participants from the food authority stated the country lacks sufficient

human resources and infrastructure even to run the current regulatory activities. Similarly, the participants noted the lack of adequate laboratory facilities for testing, especially with the small food industries.

Participants identified lack of ownership and accountability within the government as one of the major barriers to the introduction of FOPL. Most government participants mentioned there are already many activities being implemented under the government health and food authorities. As such, there may arise concerns about which department should be responsible to initiate and lead the development process of FOPL.

> *"It is possible to introduce FOPL. But we already have so many activities; different ministries have their own priorities. MoH may wish that DFTQC take initiative and we will support the program. Similarly, DFTQC may wish MoH take the lead in the program and we will be supporting it. It may require a push factor or an agent (maybe a non-government sector) to initiate the program."*
>
> - Government health authority 3

Food industry compliance was viewed as another potential challenge by many participants, particularly from food and health sectors. Participants stated that it would be difficult to convince food industries to implement FOPL as it might incur additional costs to them. A few participants commented about the food industry concerns in relation to the product nutrient quality as manufactures may not wish to disclose the nutrient information of the products, particularly those with low nutrient value. For instance, one government health participant asserted:

> *"The major challenge would be to convince food industries. Although, development process of FOPL and its outcomes are related to health sector, food industries play an important role in its implementation. It depends on the acceptance by the food companies and cost implication it would have for them. The main challenge I can see is all food manufacturers want to promote their products as quality products; so will it be accepted by all food industries?"*
>
> - Government health authority 3

Consumers' understanding and acceptance was another potential challenge as identified by the majority of the participants. The participants raised concerns that in

the present context, where people do not even pay attention towards the existing labels such as expiry dates, would consumers be able to use the FOPL. Illiteracy was perceived as one of the hindering factors to the consumers' ability to read and use FOPL.

5.2.8 Preference for different FOPL system

When asked about which potential FOPL system may work best in the Nepalese context, the majority of the participants including consumers preferred to have a simple logo or a signpost which is easy to understand. The participants discussed about the consumers' ability to interpret the nutrient information provided in the labels, particularly the numerical values and percentages. Therefore, most of the participants suggested to use a symbol or colours in the FOPL instead of text messages so that it can also benefit illiterate groups. For example, an industry participant said a simple logo system can be used with green colour indicating healthier options and red indicating less healthy options.

The participants' views on different FOPL systems including Nutri-score, MTLL and warning labels are summarised below:

Nutri-score

The majority of the study participants including consumers, food, health, and industry sectors identified Nutri-score as an effective FOPL. The colour indication and overall rating of the nutrient quality of a food product were the key attributes mentioned by the participants for preferring Nutri-score. Most participants said the summary score system is easy to comprehend and most consumers would be able to interpret it. Consumer participants liked the Nutri-score because they found it easy to understand due to its colours and category like A, B, C, D, and E. A non-government participant suggested it would be better to increase the font size of the product rating to make it more visible.

> *"In Nutri-score, we can make the letter more visible so that it's easier for people (e.g., we can highlight C by increasing its font size)."*
>
> - Non-government food sector 4

MTLL

The MTLL was another preferred system by the study participants as it was perceived to work better among Nepalese consumer. The key reason for its preference was the use of green, yellow and red colours. A government health participant stated MTLL would be easier for consumers to understand as people are aware of traffic light colors. Many participants including consumers mentioned colour indication about the nutrient content would make people conscious in selecting foods. On contrary, one of the non-government participants thought that consumers may find MTLL difficult and confusing as there are different colours for individual nutrients.

> *"If a product has green colour for fats and red colour for sugar, it may create confusion among consumers. I do not prefer multiple traffic light label…It has both green as well as red colours for different nutrients which will create confusion."*
>
> - Non-government food sector 4

Warning labels

A warning label was identified as another potential FOPL that could be effective in Nepal. With the increasing burden of obesity, labels such as "high in" can help people to avoid the foods containing high amount of nutrients of concern as expressed by a government health participant. Alternatively, the other government food participant suggested a "low in" label to help consumers select products with low amount of nutrients of concern.

> *"We have undernutrition as well as problem of obesity. As such warning labels could make people aware of the high nutrient content. Those who are obese or have high blood pressure can avoid high sugar content. In addition, we can develop a system showing low level of nutrients such as 'low in sugar' so that people with diabetes can choose such products."*
>
> - Government food authority 2

One of the industry participants noted warning labels are more complicated and difficult to understand for many consumers due to illiteracy. Some participants also raised concerns from the food industry perspectives that manufacturers may not be willing to provide warning labels as it may affect their product marketing.

Chapter 6: Discussion

The previous chapter in this thesis investigated the effectiveness and feasibility of the introduction of FOPL in Nepal using a mixed-method approach. Study 2 using an experimental design examined the effectiveness of three different FOPL schemes (MTLL, Nutri-score, and warning labels) in guiding healthier food choices among Nepalese consumers. Study 3 explored key stakeholders' views on the possibility of the introduction of FOPL using a qualitative approach. This chapter will focus on the most significant results of these studies. The experimental study found MTLL significantly increased the consumers' ability to correctly identify the healthier products. The qualitative findings revealed a favourable response and support from the public health and food sectors, and food industry for FOPL and suggested key steps in developing and implementing FOPL in the country.

6.1 EFFECTIVENESS OF FOPL

In the product choice experiment, MTLL significantly improved participants' ability to correctly identify the healthier options. The finding is consistent with previous studies suggesting MTLL improves consumer understanding of nutrient quality of food products compared to other FOPL formats and a NIP (Al-Jawaldeh et al., 2020; Egnell, Talati, et al., 2018; Santos et al., 2020). The finding is comparable with a similar study where MTLL produced the highest average score for the correct healthier choices (Watson et al., 2014). However, the mean score for the correct comparison was relatively low for MTLL (2.19 out of 5) in the present study compared to 7.6 (out of 9) reported in the study by Watson et al. (2014). The lower score can be attributed to poor knowledge and understanding about the FOPL among Nepalese consumers. The poor performance may also be explained by the differences in socio-economic contexts across the countries and prior exposures to the labels. The qualitative findings clearly identified a lack of nutrition labelling or FOPL system in Nepal and therefore the consumers lacked a proper understanding of FOPL systems being tested.

The finding that MTLL yielded better results can be explained by consumers' familiarity with the traffic light colours elucidated in the qualitative results. The use of well-known colours where green indicates "go" and red indicates "stop" corresponding to traffic signals may be easy for consumers to understand (Vasiljevic et al., 2015). Evidence suggests MTLL scheme improves consumer understanding of nutritional quality of foods compared to NIP and other forms of FOPL (Hawley et al., 2012; Neal et al., 2017). Borgmeier and Westenhoefer (2009) found MTLL most often influenced the perceived healthiness of foods. Similarly, in a large-scale survey conducted across 12 countries, the MTLL received the most favourable rating out of five FOPL formats (HSR, MTLL, Nutri-Score, reference intakes, and warning label) regarding trust, liking, ease of understanding and necessary information (Talati et al., 2019).

There is a growing evidence consistently suggesting Nutri-score, a summary score system providing an overall summary rating about the healthfulness of a product, performs better in enhancing consumer understanding and influencing purchase decisions (Al-Jawaldeh et al., 2020; Ducrot et al., 2015b; Egnell, Talati, et al., 2018; Julia et al., 2018). Similarly, warning labels have gained increasing support relating to their ability to help consumers in avoiding food products with nutrients of concern (Neal et al., 2017). Evidence consistently demonstrates the effectiveness of this scheme in improving consumer understanding and influencing purchase decisions (Goodman et al., 2018; Khandpur et al., 2018; Taillie, Hall, et al., 2020; Taillie, Reyes, et al., 2020). However, the present study did not find significant differences for the effects of Nutri-score and the warning labels in determining healthy products. The non-significant results can partly be explained by the low level of consumer awareness and poor understanding of the labels being tested. Importantly, most of the evidence on FOPL including Nutri-score and the warning labels are from high-income and upper middle-income countries which have a different economic and socio-cultural context compared to LMICs (e.g., Nepal) and hence the results may not be comparable.

6.2 USE OF NIP

There were no significant differences in the number of times the participants used NIP in the product choice experiment, indicating its meaningful use. This finding reflects a lack of understanding and use of NIP among Nepalese consumers. The self-reported use of NIP seems high as a quarter of participants in the experiment reported

using it ‘often’ and nearly half of them reported using it ‘sometimes’. However, the qualitative results noted consumers rarely looked for the nutrient information.

Consumer participants in this study reported checking expiry labels and list of ingredients on the packages rather than the nutrient information. Most consumer participants determined the quality or healthiness of food products based on the brand name and price of the food products. The finding is consistent with a study in India where consumers compared products by brand rather than the nutrient information (Singla, 2010). Brand familiarity is one of the major influencing factors for consumer food choices. Consumers tend to prefer familiar brands and perceive reputed brands to be of higher quality (Castro et al., 2018).

Nutrition label use is influenced by consumers’ self-efficacy (self-confidence in one’s ability to eat a healthy diet) and level of nutrition and health knowledge (Cha et al., 2014; Walters & Long, 2012). Bryła (2020) found consumers with higher education were more likely to read nutrition labels compared to lower educational groups. Furthermore, individual’s diet consciousness and health status are important predictors for nutrition label use. For instance, Lewis et al. (2009) reported participants with chronic diseases were more aware of nutritional recommendations, frequently checked for specific nutrients, and used nutrition labels more often compared to those without chronic diseases. This study reflects similar findings as some consumer participants reported seeking nutrient claims such as ‘sugar free’ on the product packages especially while purchasing foods for those with ill health conditions (e.g., diabetes).

Few key informants in this study perceived there may only be a small segment of the population who might have started to seek nutrient information to some extent. But they argued whether consumers were able to understand the numerical information in the NIP. Several studies have shown poor understanding and use of NIP due to the complexity of the numerical information (Besler et al., 2012; Kasapila & Shaarani, 2016; Koen et al., 2016). FOPL overcomes this barrier by simplifying the nutrition information and is intended to enhance the consumers’ understanding of the nutritive value of a food product. While NIPs are needed, a simplified FOPL can enhance consumers’ understanding and can induce healthier purchases (Elshiewy & Boztug, 2018; Temple & Fraser, 2014)

6.3 PERCEIVED NEED AND ADVANTAGES OF FOPL

The global interests in FOPL emerged with the increasing rates of obesity and diet-related NCDs, particularly relating to high consumption of unhealthy ultra-processed foods. Ultra-processed food products already have a large share of food market in most HICs and is rapidly increasing in LMICs (Vandevijvere et al., 2019). Over a period of 2009-2019, sales of ultra-processed foods and beverages increased at the rate of 4.4% and 6.6%, respectively in LMICs (Baker et al., 2020). The South and South East Asian Region experienced a large percentage increase in total volume sales of ultra-processed foods (67.3%) and ultra-processed beverages (120.0%) during the period 2002-2016 (Vandevijvere et al., 2019).

Consistent with these findings, this study noted increasing consumption of ultra-processed foods in Nepal especially in city areas. The consumption was perceived to be higher in younger age populations who are easily influenced by the attractive packaging and advertisements. Previous studies carried out in Nepal have reported the consumption of ultra-processed foods has increased in the country due to urbanization, rising income level, and trade liberalization (Sharma & Pudasaini, 2020; Subedi et al., 2017). Khanal et al. (2017) in their study noted a significant rise in budget expenditure share on the ultra-processed foods such as bread, biscuits, and noodles in the country. The cheaper cost of energy-dense foods with less nutritive value, relative to fresh foods (such as fruit and vegetables), may be one factor contributing to the increasing consumption of these foods. Furthermore, urbanization, work and time pressures, more women in the workforce, and increased availability of ready-made foods mean Nepalese eating patterns are likely to continue to change unless an appropriate action is taken.

The high intake of ultra-processed foods containing excess amounts of energy, added sugars, salt, and saturated fats is likely to contribute to a steady rise in obesity and diet-related NCDs (Monteiro et al., 2019). Given the well-established linkage between ultra-processed foods consumption and poor health, the increasing consumption of these foods was viewed as a serious public health threat by most key informants in this study. Nepal is already witnessing an increasing rate in obesity and diet-related NCDs and it is expected to continue to rise (MoHP et al., 2017; NHRC et al., 2019). One effective way to improve population nutrition and health is to improve eating patterns, in particular, reducing the consumption of energy-dense foods

(containing high-sugar, high-fat, and high-salt), and increasing the intake of fresh fruits and vegetables.

FOPL can be one effective measure to guide consumers to make healthier food choices. Participants in this study identified several potential advantages and supported the introduction of FOPL. Most participants found FOPL to be easily noticeable. This at-a-glance information enabled consumers to make healthy decisions supporting evidence that FOPL are more likely to be noticed than NIP (Graham et al., 2015). In addition to helping consumers make healthier food choices, most participants in this study perceived FOPL system would enhance people's nutrition literacy. This was demonstrated in a study where Cavaliere et al. (2020) found increased use of nutrition labels enhanced consumers' nutritional knowledge. Another advantage of FOPL is food industries may be encouraged to reformulate products to improve nutritional quality which may increase availability of healthy food on the market. This was observed in the Netherlands where there was a significant increase in fibre content and reduced levels of sodium, added sugar, and calories in reformulated products after the Healthy Choice Logo was introduced (Vyth et al., 2010). Shangguan et al. (2019) A meta-analysis, which pooled results of six studies evaluating the effect of food labelling on reformulation outcomes, found food labelling altered industry formulations for trans fat and sodium. The study reported reduced contents of trans fat by 64.3% and sodium by 8.9% in reformulated food products.

6.4 KEY CONSIDERATIONS AND STEPS FOR THE INTRODUCTION OF FOPL

The effectiveness of the FOPL system depends on how it is developed and implemented including good governance, transparency and accountability in development processes, validity of nutrient profiling, and strong monitoring and evaluation mechanisms for continuous improvement (Jones et al., 2019). This study identified the requirement of a robust process for the introduction of FOPL in Nepal. It should include formulation of policy and strategy, enforcement of regulation, nutrient profiling, and establishing a monitoring mechanism.

The development of FOPL is an iterative process and needs key considerations and steps to be taken. This study emphasized a need for justification of the FOPL measure in the country and evidence of its effectiveness. For this to occur, it was

suggested a consultative meeting be conducted at a policy level to discuss the need and possible ways to introduce the system. As a country prepares to introduce FOPL, the WHO recommends carrying out a need assessment including an epidemiological analysis of obesity and NCDs, an analysis of the legal framework, and review of relevant national health and nutrition policies (WHO, 2019). The needs assessment will allow the opportunity to design and shape the FOPL framework taking into account the economic, political and socio-cultural context as FOPL must meet the needs of the population of a given country (World Cancer Research Fund International, 2019).

At present, there are many country examples of successful FOPL implementation which may provide an opportunity for the countries such as Nepal to adapt an appropriate system (Jones et al., 2019). The validated systems along with the experiences of other countries would provide guidance and scientific evidence for the introduction of FOPL in countries which may not have sufficient resources to develop a new system. However, the policy should carefully consider the needs and national context while adapting the appropriate FOPL approaches.

6.4.1 Policy relevancy and alignment

While the importance of FOPL in promoting healthy eating was acknowledged, the study highlighted concerns regarding the urgency and relevancy of the intervention in the present policy context. In relation to the increasing rates of obesity and NCDs in the country, most participants in the study felt the national policy should initiate strategies including FOPL to address the dietary risks. On the other hand, a few participants raised concerns around other public health and food priorities such as the underlying high prevalence of undernutrition and micronutrient deficiencies, food insecurity, and food safety issues. The participants in the study emphasized the health and nutrition policies still need to be focused towards ending poverty and undernutrition before introducing other measures such as FOPL. Given the high burden of undernutrition and communicable diseases, it seems obvious to prioritise these health needs. The Nepal government has selected support for the obesity and NCDs prevention and control activities. A few NCD interventions are reflected in policy documents, but the emphasis is still on reducing undernutrition. To make progress on obesity and NCDs, countries like Nepal need to focus on policies which can influence population dietary behaviour and lifestyle. To date, the Nepalese

government has not supported any initiatives to encourage healthier food choices such as tax-based interventions, restrictions on food advertisements to children and nutrition labelling. The government lacks strategic approach for nutrition labelling and there is no acknowledgement of FOPL in the existing labelling regulation.

Effective FOPL may enable consumers to identify healthier foods and may facilitate a healthier diet. But difficulty in producing short-term evidence of the outcomes of the intervention often makes FOPL less appropriate in explicit policy objectives and weakens the necessity of the program (Jones et al., 2019; World Cancer Research Fund International, 2019). One way to overcome this challenge is to integrate FOPL and define clear objectives in existing policy. FOPL could be a part of a broad suite of policies needed to improve public health nutrition and prevent obesity. It is crucial that the broad objective of the intervention (e.g., reducing burden of NCDs) should be linked to the short-term outcomes such as improving consumers' understanding of nutrition and health (World Cancer Research Fund International, 2019).

This study noted FOPL can be introduced as a part of a comprehensive public health and nutrition strategy to improve population diets, and to prevent obesity and diet-related diseases in Nepal. WHO (2019) suggests the regulation can be aligned with other national policies, food regulations, and the Codex guidance. A few countries have started to explicitly incorporate FOPL in their broader nutrition and NCD plans and some have integrated FOPL with other regulations (Jones et al., 2019). For example, in Chile, FOPL is regulated with the marketing restrictions of the products carrying labels (Corvalán et al., 2019). Currently, the Nepal government is in the process of an amendment of the food labelling regulations in the country. The DFTQC has been working on a draft 'Food Packaging and Labelling Regulation'. This provides an opportunity to incorporate FOPL in the policy document. The FOPL system should supplement national nutrition policies and dietary guidelines. For instance, the messages such as consumption of fresh fruit and vegetables should continue alongside the FOPL measure to reduce the consumption of unhealthy foods (WHO, 2019).

6.4.2 Government led system

This study highlighted a need for government ownership for the introduction of FOPL as most participants suggested the system should be initiated and led by the

government. WHO (2019) recommends the governments initiate the FOPL development process and retain specific responsibility for setting regulatory objectives, scope and nutrient profiling. Government led development is perceived as more credible and consumers tend to trust the system (Jones et al., 2019; Kelly & Jewell, 2018).

This study raised an important concern about potential manipulations by food industries in the absence of a strong regulatory agency. This reflects the lack of confidence and trust on private sectors and food industries, indicating the importance of government intervention especially when it is concerned with sensitive issues such as health and food. Hence, it is crucial the system be regulated by the government including development, implementation, and monitoring and evaluation of the FOPL system (WHO, 2019). A majority of current FOPL regulations across the globe were initiated by governments, particularly through health ministries or food authorities (Jones et al., 2019).

The present study identified two government authorities in Nepal - DoHS under MoHP and DFTQC under MoAD which might lead the initiation and development of FOPL in the country. The DFTQC is a national authority responsible for the food related regulation in the country while MoHP is accountable for the planning and implementation of all national health programs. However, there was a lack of accountability within the government about who should lead the process. The study also indicated a limited government capacity to introduce FOPL given resource constraints and numerous other health and food priorities. These findings are in line with a previous study by Buse et al. (2020) reporting the government inefficiencies in implementing NCDs interventions in Nepal. They noted a lack of accountability mechanisms and limited budget sources in the country despite having the activities reflected in policy and strategy documents.

In countries such as Nepal where there is poor governance and weak regulatory system, private sector can have an important role in supporting the government for the FOPL initiatives. Civil societies and non-government agencies can advocate and support the government for the improved nutrition policies and strategies including the initiation of FOPL (Champagne et al., 2020). There should be a multi-sectoral stakeholder engagement process for the development of a trusted system and the

government must ensure there are no conflicts of interests throughout the process (WHO, 2019).

6.4.3 Legislative framework

One of the key elements in the development of FOPL is the analysis and design of an appropriate legislative framework (World Cancer Research Fund International, 2019). Governments can choose to implement FOPL through mandatory regulation or they may decide to leave the system optional. Currently, the majority of FOPL systems are being implemented through a voluntary approach while a few countries have introduced a mandatory labelling requirement (Jones et al., 2019).

Within the context of improving population nutrition and obesity prevention, FOPL can contribute to reduced consumption of calories and nutrients of concern (such as salt, sugar and saturated fat). Advocacy for healthy lifestyle choices in public health and health promotion is an important strategy and is more effective when paired with regulation (Magnusson, 2010). Compulsory FOPL is difficult to legislate when there is a powerful disincentive for the food industry to implement a reform which could destabilize the demand for unhealthy foods and impact revenue. Until food industry can be convinced to comply or is obligated by the regulation, little is likely to change (Magnusson, 2010). Evidence suggests a voluntary system may experience a low level of coverage and may take longer to implement (Champagne et al., 2020; Kanter et al., 2018). For example, five years after the implementation of a voluntary HSR system in Australia, the logo appeared on 41% of the eligible products (Shahid et al., 2020). Mandatory systems, despite being challenging to implement, are likely to overcome this low coverage.

This study indicated poor governance in Nepal and given a weak regulatory system, mandatory FOPL may not be possible to implement. In this context, the government could consider voluntary FOPL regulation with a specified timeframe (e.g., two years) to allow food industries to comply. Meanwhile, there should be appropriate approaches to ensure widespread coverage and penetration of the FOPL (e.g., effective monitoring of food industries).

6.4.4 Food industry compliance and engagement

The participation of the food industry is vital in FOPL, especially when it comes to implementing an interpretive scheme such as TLL and warning labels. Despite having potential to encourage healthier eating, food industry compliance was viewed as one of the major barriers for the FOPL initiatives in Nepal. One of the major constraints for the food industry to introduce FOPL is it interferes with revenues which flow from the demand for unhealthy foods. Governments or those advocating for FOPL must resist opposition from food industry, as manufacturers are likely to oppose any obligation to label products as unhealthy (Temple, 2020). The food industry interference with government initiatives to implement a compulsory TLL scheme in Australia is well documented (Magnusson, 2010). The food industry has also raised several concerns in its attempts to oppose the development of FOPL relating to issues such as justification of the specific FOPL, being trade restrictive, global inconsistency, and regulatory approaches (Thow et al., 2018).

The present study revealed food industry's concerns relating to additional costs and limited testing capacity particularly for small companies, making it difficult to implement the system. Furthermore, the study noted views such as consumers are responsible for making decisions about what to eat and it is the responsibility of government to make consumers aware of healthy eating. This finding is consistent to a study where the food industry criticized the proposed warning labels in Colombia in terms of the negative impacts it would have on sales, excessive costs, and the fact consumers should be able to make healthy decisions (Mialon et al., 2021). There is a powerful disincentive for food industry to resent the FOPL system but this does not mean manufacturers are unwilling to support the introduction of FOPL. This study noted a favourable response from the food industry for the introduction of FOPL in Nepal. The food industry participants were in support of FOPL initiatives and suggested a specific time frame should be provided for its implementation allowing the manufacturers to modify their packaging materials.

This study revealed the food industry's interests and willingness to participate as FOPL can serve as a marketing strategy to promote their products. It seems that industry is keen to pick up the idea to boost their sales. It will help to increase the uptake of FOPL but may result in biased selection and coverage of the food products. It is possible the food industry will resist the proposal to explicitly state FOPL,

especially when products are unhealthy. It has been demonstrated that food industries are selective in choosing foods to display FOPL and are more likely to provide the labels in certain food categories (i.e., healthier products). For instance, Australia introduced a voluntary FOPL system - Daily Intake Guideline (DIG) in 2006. However, a survey conducted in 2012 revealed almost all food companies avoided displaying the quantity of saturated fat and sugar in energy-dense, nutrient-poor snacks (Carter et al., 2013). Another study revealed 76% of the food products displaying HSR in the country had a rating equivalent to or greater than 3.0 (Shahid et al., 2020). Evidence suggests the application of FOPL across all products leads to a greater effectiveness (Talati et al., 2019). Hagmann and Siegrist (2020) found FOPL had only a minimal effect on product healthfulness evaluation when only some of the products were labelled, indicating the labelling of all products is needed for maximum effect. Therefore, it is important to ensure the FOPL is applied to all food products. Countries are encouraged to set a condition that use of FOPL requires manufacturers to display the labels across all their product ranges (WHO, 2020).

Early engagement with the food industry can help to familiarize the industry with the proposed FOPL system and to ensure that industry can use the nutrient profiling criteria (WHO, 2019). In settings where FOPL is voluntary, industry engagement can be secured through a commitment procedure (e.g., industry pledge or charter) (WHO, 2020). This study also revealed the importance of food industry involvement in the development process of FOPL to convince the manufactures to implement the system. The food industry participants also expressed their interests in having participation in developing FOPL system in the country. This study suggests the government can consider providing support to food industry, small companies in particular, through incentives or subsidies at least in the initial phase of FOPL implementation to encourage them to comply.

6.4.5 Monitoring and evaluation

Given an unregulated market and the absence of a strong regulatory system, industry compliance was noted as one of the major challenges Nepal could face while implementing FOPL. This study noted a need for a strong monitoring mechanism while designing a FOPL system. Establishment of an effective monitoring and evaluation mechanism is a key element in FOPL development to ensure its compliance

and enforcement. Furthermore, most participants in this study suggested the government should facilitate the monitoring of the food industries to make them adhere to the system.

The regular information system and follow-ups on the effects of the FOPL help to take necessary corrective measures and allows continuous improvement as the system progresses. The FOPL policy should consider baseline measurements before implementation of the regulation and set periodic milestones and timelines for the evaluation (Champagne et al., 2020; WHO, 2020). WHO recommends countries consider the extent and fidelity of the implementation, effects on consumer understanding, product purchases, product reformulation, and dietary intakes while designing a monitoring and evaluation framework for FOPL (WHO, 2019).

Effective monitoring and evaluation may also help to increase the uptake of the system as there was less support for mandatory FOPL regulation in Nepal. It can make food industries accountable and push for wider penetration of the system and the information can also be used to call for mandatory regulation (Jones et al., 2019). The monitoring may also include the compliance with other regulations such as restriction of misleading information and nutrition claims, and assessment of the unintended consequences of the FOPL measure (e.g., price changes) (WHO, 2019).

6.4.6 FOPL preference

Given the lack of a FOPL system in Nepal, it may be appropriate to adapt an existing scheme, which takes less time and costs less than developing a new scheme. The government should select a FOPL system that is easy to understand and use. Most participants in this study including consumers selected Nutri-score and MTLL as their preferred FOPL schemes due to their colour indication. This finding supports the evidence suggesting consumers tend to prefer interpretive labels (Julia et al., 2017; Kelly & Jewell, 2018; Pettigrew et al., 2017). Literature suggests interpretive labels with aids such as colours and symbols are more effective and perform consistently well in enhancing consumer understanding in all population subgroups including those with poor nutrition literacy (Al-Jawaldeh et al., 2020; Jones et al., 2019; Kelly & Jewell, 2018; Neal et al., 2017). Non-interpretive labels with numerical information are difficult to comprehend, particularly for consumers with low levels of nutrition literacy and low education (Kelly & Jewell, 2018). Previous studies suggest nutrient-

specific FOPL schemes such as MTLL are better than non-interpretive labels such as GDA (Cecchini & Warin, 2016; Talati et al., 2016).

The emerging evidence suggests directive and summary systems are easy to understand and have better results across all subgroups (Ducrot et al., 2016; Khandpur et al., 2018). Summary score systems, providing an overall summary score about the nutrient quality of the product, such as the Nutri-Score and the HSR systems are effective in helping consumers to determine product healthfulness (Ducrot et al., 2015b; Julia et al., 2018). Prior studies demonstrate the summary indicators are more easily understood and are likely to avoid confusion relating to individual nutrient interpretation (Al-Jawaldeh et al., 2020; Ducrot et al., 2015b). Consistent with these findings, participants in this study preferred Nutri-score the most. The scheme was perceived to be effective in the context of Nepal as it provides an overall rating of the nutrient quality of the food products which is easier to comprehend than nutrient-specific information.

Consumers are also interested in having information about which foods or nutrients to consume less of and the labels indicating the unhealthfulness are likely to be effective in guiding consumers to select nutritionally favourable products (Kelly & Jewell, 2018). As such, warning labels have gained significant support from public health communities and countries are considering introducing the system to reduce the consumption of unhealthy diets (Kanter et al., 2018). Warning labels are designed to allow consumers to easily identify food products that contain excessive amounts of critical nutrients and are likely to improve consumers' understanding and purchase decisions (Arrúa et al., 2017; Cabrera et al., 2017; Khandpur et al., 2018; Taillie, Hall, et al., 2020; Vargas-Meza et al., 2019b). Warning labels were the least preferred scheme in this study and were perceived to be difficult to understand. The product choice experiment also failed to produce significant effect of the warning labels in determining product healthiness. The finding is in line with a study where the technical terms in warning labels were the main barriers to low SES groups (de Morais Sato et al., 2019). The study also found consumers with low level of education having less preference for all FOPL schemes. Similar findings were reported in other studies where low SES groups were more likely to indicate no preference for FOPL system (Julia et al., 2017; Watson et al., 2014).

While global consistency is important, it is crucial to consider a national context when adapting a FOPL scheme. Much of the available evidence on the performance of FOPL in guiding consumers' food choices comes from developed countries, limiting the generalizability of the research to LMICs including Nepal. Given a low literacy level in the country, the government could consider interpretable FOPL schemes which are easy to understand and enable at-a-glance decisions. The present study found low levels of understanding of all FOPLs among consumers and suggests simple signpost or logo scheme could be effective in Nepalese context.

The product choice experiment in this study provides evidence of the potential effectiveness of MTLL in helping consumers determine product healthiness, indicating the use of red, amber, or green colours may be more useful among Nepalese consumers. Similarly, Nutri-score, a summary score system, was identified as another potential FOPL scheme that can be easily understood by all population subgroups. It is recommended to undertake consumer testing of the proposed FOPL system to ensure its suitability (WHO, 2019). Furthermore, it is important the FOPL policy has an impact on low SES groups, the most nutritionally at-risk groups (Templin et al., 2019). Often equity considerations are lacking in Nepalese NCDs' policies which can undermine the overall effects of the intervention (Buse et al., 2020). Therefore, the system must consider impacts on equity when designing a framework including a targeted education program to reach this particular group. It is recommended the government develops a single system to improve the effectiveness of FOPL (Champagne et al., 2020).

6.4.7 Nutrient profiling

Experience demonstrates the effectiveness of FOPL depends on the nutrient profiling underpinning the FOPL schemes. The nutrient profiling criteria should be justified by scientific evidence and there should be a robust and transparent development process. A lack of validity and transparency about the nutrient criteria can undermine confidence in the scheme (Al-Jawaldeh et al., 2020). When adapting a FOPL system, it must be ensured the underpinning nutrient profiling criteria reflect national dietary guidelines and people's eating practices (WHO, 2019).

The present study clearly identified a lack of national dietary guidelines or standards in Nepal. As such it is suggested the FOPL system be aligned with global or regional dietary guidance (e.g., guideline developed by WHO and its regional office)

(Champagne et al., 2020). WHO recommends governments should be responsible for developing or adopting nutrient profiling criteria based on authoritative scientific information which makes the system more credible and free from commercial and other vested interests (WHO, 2019).

Most nutrient profiling models of FOPL tend to focus on the nutrients of concern relating to NCDs, particularly saturated and trans-fatty acids, sodium, and sugars, as well as energy (Kelly & Jewell, 2018). In the present study, some health and food sector participants suggested to include positive nutrients (e.g., vitamins, minerals, and fibre) as well considering the high prevalence of micronutrient deficiencies in the country. However, governments should be careful when deciding about the inclusion of positive nutrients in FOPL as the presence of positive nutrients in products may overinflate the perceived healthfulness of products (Hawley et al., 2012; WHO, 2019). However, most of the evidence on FOPL are from HICs where the public health need for micronutrients is relatively less compared to obesity and NCDs and therefore the inclusion of positive nutrients may not have much significance in those countries. Nevertheless, a country should consider its need and context when adopting an appropriate FOPL system and the underpinning nutrient profiling criteria.

6.4.8 Public educational campaign

FOPL is intended to guide consumers in making healthy decisions but the information may not always be effective in improving food choices. Knowledge is necessary but may not be adequate to motivate behaviour change. Food choices often change gradually over time as consumers assimilate new information, change attitudes, and adopt new behaviour (Guthrie et al., 2015). An individual's understanding or knowledge of FOPL should be reflected in the use of this information while making purchasing decisions. However, studies have highlighted most consumers have difficulty understanding information provided by FOPL and NIP because of the complexity of nutrition information (Campos et al., 2011; Kelly & Jewell, 2018). In addition, the level of understanding and use of nutrition labels have been found to vary across different age groups, gender and SES levels (Campos et al., 2011; Cowburn & Stockley, 2005).

To improve consumers' comprehensibility of the nutrition information, it is important FOPL systems be accompanied by effective educational interventions.

Consumers should be made aware of proposed FOPL systems to enable them to correctly interpret and use the FOPL. Graham et al. (2015) found the presence of signage about the purpose of FOPL increased consumers' visual attention towards FOPL, indicating the explanatory signage may improve consumer use of the FOPL. In addition, increased familiarity with a FOPL system improves its understanding and use (WHO, 2019).

Nutrition education may have a positive impact on the likelihood of using nutrition labels. Evidence suggests consumers with low health and nutrition literacy are less likely to understand and use nutrition labels (Campos et al., 2011). An effective education programme should also help consumers understand what is considered a healthy diet to help consumers improve their purchase decisions (Champagne et al., 2020). The effect can be bidirectional. Cavaliere et al. (2020) found label use increased consumers' nutritional knowledge, which in turn favoured a healthy diet. In Nepal where most people lack adequate nutrition knowledge, well-resourced FOPL campaigns and continued exposure would help in improving people's nutrition literacy. Given inequities in obesity and NCDs, and uneven nutrition literacy across population groups in the country, the education program should particularly target the nutritionally most at-risk groups and those with low education levels.

To summarise, governments need to focus on policies which could influence population dietary behaviour and make progress on improving nutrition and decreasing obesity. Public health advocates often speak of creating supportive environments which encourage healthy lifestyle and choices. This study shows FOPL may have a positive impact in guiding consumer food choices in Nepal. As the country is witnessing higher rates of obesity and diet-related NCDs, the government should consider introducing an appropriate FOPL system to impact population health. The best option is to adopt a simple interpretive FOPL scheme, such as MTLL and Nutri-Score, shown to be effective in improving consumers' comprehension of healthier choices. However, introducing a new labelling system will be challenging and likely be opposed by the food industry. There are several key concerns and steps to be considered including policy advocacy and alignment, framing a legislative approach, establishment of monitoring and evaluation, and designing an effective education campaign. More research is needed into which FOPL schemes are more effective in

persuading Nepalese consumers to make healthy decisions and identifying ways to incorporate the system into the policy context.

STRENGTHS

This research incorporates three different studies including a systematic review assessing the equity effects of FOPL across SES, an experimental study investigating the effectiveness of FOPL in guiding consumers' food choices in Nepal, and a qualitative study providing insights to the policy context of introducing FOPL in the country. This robust methodological approach is one of the major strengths of this thesis. The first study was a systematic review, investigating the equity impact of FOPL in consumer understanding and use at a global level. The review included a comprehensive and systematic search process to synthesise all available evidence on FOPL providing better understanding about how FOPL influences consumer food choices across socio-economic position including low SES populations (see details in chapter 4).

The second study was an experiment which assessed the effects of different FOPL formats on consumer food choices. The major strength of this study was it involved field work to collect primary data and answer the research question. Participants were recruited outside grocery stores and supermarkets, representing the consumers who were involved in grocery shopping. The field research, as opposed to for example a simulated setting, provided the opportunity to enrol a relevant population sample. Second, the study used validated questionnaire adapted from previous similar studies (Pettigrew et al., 2017; Watson et al., 2014). The questionnaire was pilot tested and modified according to the local context. Using the validated tools ensures the results of this experiment can be comparable to other studies. Third, the study used mock products designed for this experiment with fictious brand names which minimised the potential influences of brands on consumer food choices. Finally, the use of commonly purchased food products in the experiment with available NIP represented a real market scenario.

The third study utilised a qualitative approach to assess the stakeholders' views on the possibility of introducing FOPL in Nepal. One of the major strengths of this study is it involved fieldwork to collect primary data. All interviews were carried out face-to-face which allowed detailed discussion about the FOPL in the Nepalese policy

context. The in-person interviews offered rapport building with the participants and helped to understand their perspectives. It provided an opportunity to understand the personal (for example, facial expressions and hand gestures) and social context (for example, the real-world market environment where people interact) lacking in other types of interviews such as telephone or online interviews. In addition, it facilitated comfortable conversation and encouraged participants to speak freely about the issues related to FOPL. Second, the primary researcher carried out the field research providing an insider's perspective to the study. The primary researcher conducted all the interviews and transcribed the data allowing better interpretation of the non-verbal signs and gestures which occurred during the interviews. Finally, the study included a wide range of participants representing government and non-government health and food stakeholders, food industries and consumers. Selecting individuals from diverse sectors enriched the data as different participants offered unique perspectives and varying opinions on FOPL based on their experiences. For instance, food and health sector participants provided insights as to the need and relevancy of FOPL in the policy context. The inclusion of food industries helped to identify the practical issues relating to the FOPL implementation in the country. Similarly, the consumer perspectives reflected their understanding, ability and barriers to use FOPL.

LIMITATIONS

There were a few limitations of this research. In the systematic review, it is possible some relevant articles were not included given the restrictions in the search terms and only those published in English were considered. Limitations of this review are discussed in detail in chapter 4.

The experimental study was subject to several limitations. First, the study results may not be generalised to the entire Nepalese population. The experiment was conducted in limited samples from selected urban areas of Nepal given resource and time constraints. The study participants had higher levels of education and income compared to national averages (MoHP et al., 2017; Nepal Rastra Bank, 2016). However, the sample size was calculated scientifically and an adequate number of participants were enrolled to allow appropriate statistical tests and analyses across SES. Second, despite the experiment being carried out in a natural setting, the effects of different FOPL formats were investigated using pictures of mock products in selected food categories. The limited number of products within each food category

may not resemble the real-world scenario. In actual markets, there might be a number of food products to compare with and several other factors influencing consumer decisions (e.g., price and taste). The mock packages, however, were designed carefully to resemble the market products but with fictious brand names and without price labels in order to minimise the effect of brand and price on consumer food choices. Third, the time taken for the product comparison and number of times the participants used NIP were recorded manually which could have been more accurate using technologies (e.g., automatic recording in an online survey). Other studies, particularly online studies, had used computer generated digital recording for the measurement of time and flip over of the products. The present study was paper-based and the questionnaire was administered face-to-face. Therefore, it was not possible to use such methods. However, the research assistants were trained to record the time as precisely as possible. In addition, this study did not specifically measure nutrition knowledge. However, self-reported perceived nutrition knowledge was assessed based on the participants' responses to the statement "I know quite a lot about nutrition and health". Nevertheless, the present research is the first study to investigate the effect of FOPL among Nepalese consumers, generating evidence to support a FOPL system in the country.

There were two main limitations in the qualitative study. First, participants from the government health and food authorities were selected purposively through a personal network. Although considerable care was taken to define the eligibility criteria and selection process, it is possible some key informants could have been missed. In addition, a few policy level participants declined to be interviewed due to their unavailability during the time of data collection, which may have affected validity of the information. Particularly, the participants from the Ministry of Health could not be reached as many were responding to the COVID-19 pandemic in the country. However, a wide range of participants from different sectors were included to enrich the data. Second, there were limited views on FOPLs particularly for the consumer participants due to lack of prior exposure and low level of knowledge about FOPL. To ascertain consumers' views, participants were selected from the list of respondents from the product choice experiment so they had some level of exposure to FOPL. Each of the participants was first provided brief information about different FOPLs by showing pictures to make the concept familiar. The researcher further explained the

key concepts to make ideas clear to each respondent during interviews. Relevant information was gathered through probing and establishing connections between several ideas.

Despite these limitations, this thesis contributes to the improved understanding on the impact of FOPL across SES at a global level. In the present context, where most research on FOPL come from HICs, this thesis generates evidence on the effectiveness of FOPL in Nepal, a low-income country. To my knowledge, this is the first research to investigate the effects of FOPL in guiding consumer food choices and exploring the policy context of introducing FOPL in Nepal.

FUTURE RESEARCH IMPLICATIONS

The systematic review suggests FOPL may help consumers to make healthy decisions. The future research on FOPL should focus on addressing two major concerns. Firstly, there is a need of 'real world' studies on FOPL as opposed to simulated settings to enhance the understanding of the impact of FOPL in improving population nutrition. Secondly, more studies need to be conducted in LMICs as there are limited evidence on the effectiveness of FOPL. More research and empirical evaluations on the effects of FOPL in consumer understanding, consumption, and purchase decisions are required to make more realistic assumptions about the effectiveness of FOPL.

The product choice experiment in this thesis suggests FOPL might be helpful among Nepalese consumers in determining product healthfulness. Further research in real-life settings is needed to understand how FOPL influences actual purchases and consumption taking factors such as price, taste, and brand into consideration. For this, researchers and retailers should collaborate on a large-scale study in the country examining innovative FOPL approaches. Future research could also focus on objective understanding of nutrition knowledge and its interaction with the effect of FOPL as studies have indicated nutrition knowledge is associated with SES including level of education and may influence the effect of nutrition labelling (Heshmat et al., 2016; Hieke & Taylor, 2012).

The qualitative study of this thesis explored the views from key stakeholders about the possibility of introducing FOPL in Nepal. The study showed a positive attitude towards the introduction of FOPL. Future research may focus on identifying

ways to frame FOPL in health and nutrition policies including need assessment, analysis of legal framework and resources as well as practical considerations for FOPL use among consumers in Nepal.

Furthermore, given the dietary impact of meals eaten in fast food and restaurants, future research may also explore the effectiveness of FOPL in such settings.

Chapter 7: Conclusions and Recommendations

7.1 CONCLUSIONS

With the growing burden of obesity and diet-related NCDs, FOPL has gained significant global attention as a policy strategy to promote healthy diets. There are a range of FOPL schemes being implemented in different regions and the regulatory systems vary from country to country. There remains a gap and limited evidence about which scheme works the best and which regulatory approach is effective. Therefore, it is important governments choose the system most appropriate to the national context. This thesis provides an insight into the effects of FOPL on consumer food choices in Nepal and how it can be reflected in the policy context.

The systematic review of the global evidence on the impact of FOPL suggests FOPL may help consumers to make healthier food choices for all populations including low SES groups. Interpretive FOPL formats such as Nutri-score, MTLLs, and warning labels are easy to understand and equitable in effect. The product choice experiment examining the effects of the three different FOPL formats among Nepalese consumers found MTLL significantly increased the consumers' ability to correctly identify the healthier products, indicating MTLL can be an effective option in the Nepalese context. As people are well aware of the traffic light colours, MTLL can be easily understood by most consumers. The qualitative results indicate interpretive summary labels (e.g., Nutri-score) and a simplified signpost or a logo may perform better in guiding consumers to select healthy products given low literacy rates in the country.

Nepal is currently undergoing a rapid nutrition transition, resulting in an increased rate in obesity and NCDs. While undernutrition still remains a priority on the public health agenda, addressing dietary risks has also become important to address the obesity and NCDs. FOPL is one strategy Nepal government can leverage to promote healthy eating. The positive response from the public health and food sectors, food industry, and consumers indicates it is possible to introduce FOPL in the country.

Nepal can adopt an appropriate FOPL scheme based on the global evidence. However, the policy should carefully consider the need and assess the suitability of the proposed system within the national context. The introduction of FOPL is a robust process and involves several steps and considerations. The key steps include policy and strategy formulation, defining a legislative framework, developing or adopting an appropriate FOPL scheme and the underpinning nutrient profiling criteria, establishment of monitoring and evaluation mechanisms, and designing effective public education programs. The government (either health or food authority) should lead the process and take responsibility for development, implementation, monitoring and evaluation. This study found less support for mandatory FOPL legislation, suggesting a voluntarily approach in the country. A timeframe (e.g., two years) can be specified for industries to implement FOPL.

There may arise several concerns while considering FOPL as a policy tool including opposition by food industries. It is important to engage all concerned stakeholders, allowing them to share their views while resolving the arguments. Given resource constraints, the government can seek support from external sources including in the non-government sector. Lack of accountability within government, slow decision-making process, and perceived other health priorities may hinder the introduction of FOPL in the country. Nonetheless, the government can progress FOPL as a part of comprehensive public health and nutrition strategy to improve population diets. A well designed FOPL system allows informed choices, guiding consumers to make healthy purchase decisions and may contribute to the prevention of obesity and diet related NCDs. The FOPL measure should be supported by an effective public education program ensuring the intervention reaches all population subgroups, including those with low education and nutrition literacy. More research and empirical evaluations on the effects of FOPL are required to inform policy about its effectiveness in guiding consumers' food choices in Nepal.

7.2 RECOMMENDATIONS

In relation to increasing burden of obesity and diet-related NCDs in Nepal, the findings of this study may inform health and nutrition policies to incorporate FOPL to promote healthy eating. The first recommendation is the government should consider FOPL as one of the policy tools to improve the population diet in the country. At

present, the 'Food Labelling and Packaging Regulation' is in the process of an amendment. It may be best to reflect the FOPL initiatives in this policy document.

Second, an appropriate FOPL may be adopted which takes less time and costs less than developing a new scheme. The policy should carefully consider the needs and national context while adapting the FOPL approaches. The experimental study suggests MTLL may be effective as most Nepalese consumers are aware of traffic light colours. In addition, simple logo or summary indicators (e.g., Nutri-score) may be helpful to make healthy choices for all consumers including those with a low educational background. It is important to undertake consumer testing of the proposed FOPL system to ensure its suitability in Nepalese context.

Third, it is recommended the government (either DoHS or DFTQC) takes the lead in the process of developing or adapting an appropriate FOPL scheme. It is important the government ensures the transparency of the FOPL development procedure to increase the credibility and use of the system. At the same time, a public authority should monitor the food industry to increase compliance to the system. A guideline developed by WHO on FOPL can be referred to which is intended to support countries to develop, implement, and monitor and evaluate FOPL systems (WHO, 2020).

Finally, it is recommended public education campaigns are designed to facilitate the use of the proposed FOPL system. An effective education program should include campaigns targeted for low nutrition literacy groups to increase the understanding and use of the FOPL system.

The specific recommended activities can be summarised as follows:

Short-term

- Undertake consultations at policy level with the involvement of all stakeholders including food industry and consumer for policy advocacy
- Conduct a need assessment and feasibility study including analysis of resources and legal framework for FOPL introduction
- Collaborate with researchers, food industries, and other relevant stakeholders to carry out large-scale studies to evaluate the effectiveness of a proposed FOPL system

Medium-term

- Design an appropriate FOPL intervention as a part of comprehensive health and nutrition policies with clear objectives, specific activities, and a monitoring structure
- Implement the FOPL initiatives voluntarily
- Monitor and evaluate the progress and ensure industry compliance

Long-term

- Consider mandatory FOPL regulation in order to increase the uptake of the system
- Evaluate the impact on nutrition and health outcomes (e.g., changes in adiposity) and product reformulation

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Appendices

Appendix A

Questionnaires

QUT	**Queensland University of Technology** **Impact of front-of-pack nutrition labelling on dietary choices**
Experimental Study - Questionnaire	

Screening questions		
S1. Are you aged 18 years or older?	☐ (1) Yes	Continue
	☐ (2) No	End
S2. Which of the following best applies to you? (single response)		
I buy all/most of the food products in my household.	☐ (1)	Continue
I buy about half of the food products in my household.	☐ (2)	Continue
I sometimes buy the food products in my household (less than half the time).	☐ (3)	End

Consent		
Consent has been read and obtained	☐ (1) Yes	Continue
	☐ (2) No	End
Location and date		
Supermarket/grocery shop ID	……	
Supermarket/grocery shop name	……	
Address	…… ……	
Interviewer ID	……	
Date	……../……/…… (dd/mm/year)	
Time of interview (24 hour clock)	……	

Section 1: Food purchasing and eating behaviour

1. When you go to grocery shopping, how often do you buy the following foods for yourself or others?

Please select ONE option per row

	Never	Rarely	Sometimes	Often	Always
	(1)	(2)	(3)	(4)	(5)
Bread					
Biscuits					
Noodles					
Soft drink					
Yoghurt					

2. How often do you eat the following foods?

Please select ONE option per row

	Never	Rarely	Sometimes	Often	Always
	(1)	(2)	(3)	(4)	(5)
Bread					
Biscuits					
Noodles					
Soft drink					
Yoghurt					

3. Can you please tell us about your diet?

Please select ONE

☐ I eat a healthy diet because it helps me keep fit and well.	(1)
☐ I eat a mostly healthy diet but sometimes it is difficult to maintain it.	(2)
☐ I eat what I like and do not worry about how healthy it is.	(3)

4. Do you have any special dietary requirements?

☐ No special dietary requirements	(1)
☐ Food allergies (e.g., lactose intolerance, gluten intolerance)	(2)
☐ Diabetes	(3)
☐ Heart disease	(4)
☐ High blood pressure	(5)
☐ Vegetarian/vegan	(6)
☐ Religious considerations (e.g., Halal)	(7)
☐ Other (please specify) …….	(8)

5. Compared to most people, I know quite a lot about nutrition and health.

Please select ONE per row	Strongly disagree	Disagree	Don't know	Agree	Strongly disagree
	(1)	(2)	(3)	(4)	(5)

6. This is an example of a typical nutrition information panel (NIP) from the back or side of a food package. How often do you use this information?

Nutrition Facts

Serving size: 1 serving = Approximately 57g

	Qty per serving	Qty per 100g / 100ml	% daily intake*
Energy	623	1090	7
Energy Cal	149	261	
Protein	5.0	8.8	10
Total Fat	1.2	2.1	2
Saturated Fat	LESS THAN 1g	LESS THAN 1g	1
Carbohydrate	28.3	49.6	9
Sugars	LESS THAN 1g	LESS THAN 1g	0
Sodium	214	375	9

Please select ONE per row	Never	Rarely	Sometimes	Often	Always
	(1)	(2)	(3)	(4)	(5)

Section 2: Choice task

You will now be shown pictures of some sample food products. Each time you will be shown two products, one of them is healthier than other. Imagine you are in a supermarket or a grocery store and thinking of buying these food products. Out of the two products, you have to choose the one which you think is healthier and would consider buying. The brand names and packages have been made up but the information represents commonly available foods in the market. You may not have previously seen the nutrition labelling system that appears on the front of the packages [Do not include the last information for control group]. On each package, you can see the Nutrition Information Panel on the back of pack if you want.

Product pair 1

[Picture] *[Picture]*

7. Which of these two products do you think is healthier?

Please select ONE

☐ Product A is heathier	(1)
☐ Product B is healthier	(2)
☐ Both have same level of healthiness	(3)
☐ I am not sure which is healthier	(4)

8. Time taken to decide _____ seconds

9. Number of times NIP referred _____

10. Assuming you are interested in buying this type of food, how likely would you be to buy this specific food product?

Please select ONE per row

	Very unlikely	Unlikely	Don't know	Likely	Very likely
	(1)	(2)	(3)	(4)	(5)
Product A					
Product B					

Product pair 2

[Picture] *[Picture]*

11. Which of these two products do you think is healthier?

Please select ONE

☐ Product A is heathier	(1)
☐ Product B is healthier	(2)
☐ Both have same level of healthiness	(3)
☐ I am not sure which is healthier	(4)

12. Time taken to decide _____ seconds

13. Number of times NIP referred _____

14. Assuming you are interested in buying this type of food, how likely would you be to buy this specific food item?

Please select ONE per row

	Very unlikely	Unlikely	Don't know	Likely	Very likely
	(1)	(2)	(3)	(4)	(5)
Product A					
Product B					

Product pair 3	
[Picture]	*[Picture]*

15. Which of these two products do you think is healthier?

Please select ONE

☐ Product A is heathier	(1)
☐ Product B is healthier	(2)
☐ Both have same level of healthiness	(3)
☐ I am not sure which is healthier	(4)

16. Time taken to decide _____ seconds

17. Number of times NIP referred _____

18. Assuming you are interested in buying this type of food, how likely would you be to buy this specific food item?

Please select ONE per row

	Very unlikely	Unlikely	Don't know	Likely	Very likely
	(1)	(2)	(3)	(4)	(5)
Product A					
Product B					

Product pair 4	
[Picture]	*[Picture]*

19. Which of these two products do you think is healthier?

Please select ONE

☐ Product A is heathier	(1)
☐ Product B is healthier	(2)
☐ Both have same level of healthiness	(3)
☐ I am not sure which is healthier	(4)

20. Time taken to decide _____ seconds

21. Number of times NIP referred _____

22. Assuming you are interested in buying this type of food, how likely would you be to buy this specific food item?

Please select ONE per row

	Very unlikely	Unlikely	Don't know	Likely	Very likely
	(1)	(2)	(3)	(4)	(5)
Product A					
Product B					

Product pair 5

[Picture] *[Picture]*

23. Which of these two products do you think is healthier?

Please select ONE

☐ Product A is heathier	(1)
☐ Product B is healthier	(2)
☐ Both have same level of healthiness	(3)
☐ I am not sure which is healthier	(4)

24. Time taken to decide _____ **seconds**

25. Number of times NIP referred _____

26. Assuming you are interested in buying this type of food, how likely would you be to buy this specific food item?

Please select ONE per row

	Very unlikely	Unlikely	Don't know	Likely	Very likely
	(1)	(2)	(3)	(4)	(5)
Product A					
Product B					

27. How did you choose or decide which is the healthier product?

28. How helpful was the label on the front-of-pack when choosing food product?

Please select ONE	Very unhelpful	Unhelpful	Don't know	Helpful	Very helpful
	(1)	(2)	(3)	(4)	(5)

29. How difficult or easy is it for you to understand this label?

Please select ONE	Very difficult	Difficult	Don't know	Easy	Very easy
	(1)	(2)	(3)	(4)	(5)

30. Would you consider using this label while buying food products?

Please select ONE

☐ I am not influenced by this label.	(1)
☐ This label is helpful, but I would choose food products based on my own knowledge.	(2)
☐ I do not know how to choose food products based on this label.	(3)
☐ I would choose certain food products based on this label.	(4)
☐ I would choose all my food products based on this label.	(5)

31. Which label do you prefer to see on the packaged food products?

Please select ONE

(1) ☐ Multiple Traffic Lights (picture)
(2) ☐ Nutri-Score (picture)
(3) ☐ Warning labels (picture)
(4) ☐ *None*

32. Could you please tell us reasons for your preference?

The following questions ask about your background information such as your education, income, height, and weight. These questions are important to make sure we get opinions from a wide range of people.

Section 3: Socio-demographic information		
33. Gender	☐ Male	(1)
	☐ Female	(2)
	☐ Other (specify) …….	(3)
	☐ Prefer not to say	(4)
34. Age	…… years	
35. What is your ethnic group?	……	

36. How many people, including yourself, live in your household?	…….	
37. What is the highest level of education you have completed?	☐ No formal schooling	(1)
	☐ Less than primary school	(2)
	☐ Primary school	(3)
	☐ Secondary school	(4)
	☐ High school completed	(5)
	☐ College/University	(6)
	☐ Post graduate degree	(7)
38. What is your current work status?	☐ Government employee	(1)
	☐ Non-government employee	(2)
	☐ Self-employed	(3)
	☐ Student	(4)
	☐ Homemaker	(5)
	☐ Retired	(6)
	☐ Unemployed	(7)
39. What is the average earnings of your household? (actual or estimate)	Per month ……..	
	OR per year ……..	
Self-reported height and weight		
40. Height	In centimetres (cm) …….	
41. Weight	In kilograms (kg) …….	
42. Are you pregnant? (women only)	☐ Yes	(1)
	☐ No	(2)

Thank you for your participation in the study

Impact of front-of-pack nutrition labelling on dietary choices

Contact information for semi-structured interview

Would you be willing and able to participate in a semi-structured interview related to this study?

☐ Yes (1) ☐ No (2)

If yes, please provide your name and phone number.

Name: …….

Phone: ……

Note: Participants will be selected based on the responses to this survey. Only a few individuals will be approached as we only require 4-6 participants for the interviews. Therefore, you may not receive a call. If selected, we will contact you by phone within 2-3 weeks.

Thank you for your participation in the study

Appendix B

Interview guides

QUT	**Impact of front-of-pack nutrition labelling on dietary choices**
Interview guide – Public health, food and nutrition sectors	

Questions

1. What is the current status of nutrition and health in the country?
   - Particularly relating to diet and related non-communicable diseases

2. What do you think about the consumption of processed and ultra-processed foods among Nepalese consumers?
   - Availability in the market, consumption status, its likely impact on health

3. What influences consumer food purchasing decisions?
   - Brand, price, packaging, nutrient content, advertisement, etc.

4. How do you think consumers determine the healthiness of a food product?

5. Where do you think they get nutrition information from?

6. Do you think nutrition labelling, front-of-pack nutrition labelling (FOPL) in particular, can help consumers to make healthier food choices?

7. What do you think about the nutrition labelling or FOPL policy?
   - Regulatory mechanism, mandatory or voluntary, etc.

8. What are the possible nutrient profiling systems that could be utilised for the FOPL?
   - Nutrients to be included, inclusion criteria, standards etc.

9. What are the advantages of FOPL on the food products?

10. Can you think of any disadvantages of FOPL?

11. What do you think, would consumers be able to use FOPL while purchasing food products?
    - Level of understanding, attitude, enablers to use

12. What are the reasons do you think that would prevent consumers using FOPL?

13. Can you think of any FOPL formats that would be effective in the Nepalese context?
    - E.g., Multiple traffic light labelling, Nutri-score, Warning labels

14. If the government considers a labelling policy, what do you feel about its acceptance by food industries?
    - Uptake, compliance, resistance

15. Is there anything else you would like to say about the nutrition labelling or FOPL?

QUT	**Impact of front-of-pack nutrition labelling on dietary choices**
Interview guide – food industries	

Questions

1. What is the current status of the production of processed and ultra-processed foods in the country?
   - Production and availability in the market

2. How is the market demand and consumption of processed and ultra-processed foods among Nepalese consumers?
   - Purchase and consumption

3. What influences consumer food purchasing decisions?
   - Brand, price, packaging, nutrient content, advertisement, etc.

4. What roles do food industries have to promote healthy eating?

5. What do you think about the nutrition labelling or front-of-pack nutrition labelling (FOPL) policy to help consumers make healthier choices?
   - Regulatory mechanism, mandatory or voluntary, etc.

6. If the government considers a labelling policy, what do you feel about its implementation?
   - Uptake, compliance, reasons that prevent you to comply

7. What are the advantages of FOPL on the food products?

8. Can you think of any disadvantages of FOPL?

9. What do you think, would consumers be able to use FOPL while purchasing food products?
   - Level of understanding, attitude, enablers to use

10. What are the reasons do you think that would prevent consumers using FOPL?

11. Can you think of any FOPL formats that you would consider be effective in the Nepalese context?
   - E.g., Multiple traffic lights, Nutri-score, Warning labels

12. Is there anything else you would like to say about the nutrition labelling or FOPL?

QUT	**Impact of front-of-pack nutrition labelling on dietary choices**
Interview guide – consumers	

Questions

1. What kind of food products do you usually consume and purchase for your households?
   - Processed and ultra-processed foods, fruits and vegetables intake

2. What influences your food purchase decisions?
   - Brand, price, packaging, nutrient content, advertisement, etc.

3. Tell me about a healthy diet. What do you think a healthy diet consists of?

4. How do you determine the healthiness of a food product?

5. Where do you get nutrition information from?

6. When you are in a supermarket or a grocery shop, have you ever noticed any food or nutrition labels?
   - E.g., nutrition information panel, logos, health claims

7. How do you use nutrition label information?

8. What do you think of nutrition labelling on the front-of-pack of packaged food products?
   - Which nutrient information should be included, would it be helpful

9. What are the advantages of having front-of-pack nutrition labelling (FOPL) on the food products?

10. Can you think of any disadvantages of FOPL?

11. What do you think, would you be able to use FOPL while purchasing food products?
    - Understanding and use

12. What are the reasons do you think that would prevent consumers using FOPL?

13. What type of FOPL would you prefer to have on the food products?
    - E.g., Multiple traffic lights, Nutri-score, Warning labels

14. Is there anything else you would like to say about the nutrition labelling or FOPL?

Appendix C

Participant information sheets

Queensland University of Technology
Participant Information - Experimental Study

Impact of front-of-pack nutrition labelling on dietary choices

QUT Ethics Approval Number 1900000964
NHRC Ethics Approval Number

Research team

Principal Researcher:	Ms Anita Shrestha	PhD student, QUT
Associate Researchers:	Dr Margo Sendall	Principal Supervisor, QUT
	Prof Katherine White	Associate Supervisor, QUT
	Dr Jenni Mays	Associate Supervisor, QUT
	Dr Katherine Cullerton	External Supervisor, UQ

Why is the study being conducted?

This research project is being undertaken as part of a PhD, for Anita Shrestha at QUT, Australia.

The purpose of this research project is to assess whether front-of-pack nutrition labelling improves the dietary choices Nepalese people make when buying food. Front-of-pack nutrition labelling (FOPL) is one of the ways to promote healthy eating. It provides nutrition information about the food products in an easy-to-understand way and may help people to make healthier food choices. There are various types of FOPL used across different regions. In Nepal, there currently does not exist any nutrition labelling system and it is unclear whether FOPL would influence food choices among Nepalese consumers.

This study will look at the effects of different types of FOPL when people buy food. We are seeking people who are responsible for buying foods in their households. Therefore, you are invited to participate in this research project.

What does participation involve?

Participation will involve completing a choice task where you have to select a food product which you think is healthier. You will be shown pictures of sample food products and asked to assess how healthy the different products are and choose the one you would consider buying. The interview will ask questions about:

- the sorts of foods you buy,
- how much you know about nutrition,
- which type of front-of-pack labels you prefer
- your background information (e.g., age, education, income, height, and weight)

The interview will take approximately 25-30 minutes of your time. Your participation in this research project is entirely voluntary. If you agree to participate you do not have to answer any question(s) you don't want to. You can stop your participation in the study at any stage without us commenting or any punishment. Any answers you've already given that can be linked to you will be removed.

What are the possible benefits for me if I take part?

It is expected that this research project will not benefit you directly. There is no reward or incentive for your participation in this research. However, the information you provide is important to this study, and the outcomes of the research may inform public health and nutrition policies about the effects of FOPL to help people make healthier food choices.

What are the possible risks for me if I take part?

There are no risks associated with your participation in this research project except the time it takes to do the study. However, there are some questions which might be personal to you (such as income, height and weight). You don't have to answer any question if you don't want to.

What about privacy and confidentiality?

All comments and responses provided in this study will be kept confidential. Information that might identify you personally is not asked about in any of the responses. Personal information (e.g., name, and contacts) if provided will be coded and kept separate from your answers, which will only be seen by the researcher herself and the supervisory team.

The codes plus identifying information will be destroyed at the end of the project (April 2021). Any data collected as part of this research project will be stored securely as per QUT's Management of research data policy. Data will be stored for a minimum of 5 years. It can be disclosed if it is to protect you or others from harm, if specifically required by law, or if a regulatory or monitoring body such as the ethics committee requests it.

How do I give my consent to participate?

We would like to ask you to provide a verbal consent to confirm your agreement to participate in this research project.

What if I have questions about the research project?

If you have any questions or require further information please contact one of the listed research team members below:

Anita Shrestha anita.shrestha@hdr.qut.edu.au

Margo Sendall m.sendall@qut.edu.au

What if I have a concern or complaint regarding the conduct of the research project?

QUT is committed to research integrity and the ethical conduct of research projects. If you wish to discuss the study with someone not directly involved, particularly in relation to matters concerning policies, information or complaints about the conduct of the study or your rights as a participant, you may contact the QUT Research Ethics Advisory Team (phone: 61 7 3138 5123 or email: humanethics@qut.edu.au). You may also contact Nepal Health Research Council (+977 1 4254220 or email: nhrc@nhrc.gov.np).

Thank you for helping with this research project.

Please keep this sheet for your information.

Participant Information – Participant Information – Study 3 Interview (public health and industry representatives)

Impact of front-of-pack nutrition labelling on dietary choices

QUT Ethics Approval Number 1900000964

NHRC Ethics Approval Number 1554

Research team

Principal Researcher:	Ms Anita Shrestha	PhD student, QUT
Associate Researchers:	Dr Margo Sendall	Principal Supervisor, QUT
	Prof Katherine White	Associate Supervisor, QUT
	Dr Jenni Mays	Associate Supervisor, QUT
	Dr Katherine Cullerton	Associate Supervisor, UQ

Why is the study being conducted?

This research project is being undertaken as part of a PhD, for Anita Shrestha at QUT, Australia.

The purpose of this research project is to assess whether front-of-pack nutrition labelling is likely to improve dietary choices among Nepalese consumers. An unhealthy diet is a major risk factor for obesity and many non-communicable diseases such as heart diseases, diabetes and cancers. Nutrition labelling, providing information about the nutrient content of food products, is one strategy to promote healthy eating. Front-of-pack nutrition labelling (FOPL) is intended to convey nutrition information in an easy-to-understand way and may help people to make healthier food choices. There are various labelling formats being implemented across different regions. In Nepal, there currently does not exist any nutrition labelling system and it is unclear whether FOPL would influence food choices among Nepalese consumers.

This study will explore the views of key stakeholders on feasibility of FOPL in Nepalese context; whether FOPL would be a potential means to promote healthy eating. We are seeking key informants who have extensive knowledge and experience in public health, food and nutrition sectors. The study also seeks to get views from industry representatives as food industries have major role in the production and distribution of food products, and can influence what people eat. Therefore, you are invited to participate in this research project.

What does participation involve?

Participation will involve an audio recorded interview on FOPL, which will take approximately 30 to 45 minutes of your time.

Depending on the role of the person being interviewed, questions will include information about:

- Current status of diets and health mainly focused on obesity and non-communicable diseases,
- Purchase and consumption of packaged foods,
- Feasibility of FOPL and likely effects on food choices,

- Acceptance of FOPL by food industries and consumers, and
- Enablers and barriers to implementation of FOPL

Your participation in this research project is entirely voluntary. You do not have to answer any question(s) you are uncomfortable answering. You can withdraw from the interview at any stage without comment or penalty. Any information already obtained that can be linked to you will be destroyed.

What are the possible benefits for me if I take part?

It is expected that this research project will not benefit you directly. However, the information you provide is valuable to this study, and the outcomes of the research may inform public health and nutrition policies about the effects of FOPL to promote healthy eating.

There is no provision of any reward or incentive for your participation in this research. However, we will acknowledge you including all other participants anonymously in all the reports related with this study.

What are the possible risks for me if I take part?

There are no risks associated with your participation in this research project beyond giving up your time for the interview. You don't have to answer anything you don't want to. The audio-recording will be transcribed into written form but your name and other identifiable information will be removed to ensure confidentiality. If you would like to have a copy of the written form of your interview, please let me know and I can provide it to you once it is ready. You can edit (remove or add) any information in it.

What about privacy and confidentiality?

All comments and responses are anonymous. Personal identifying information is not sought in any of the responses during the interview. The interview will be audio-recorded. Your name and title will not appear on any of the recorded information from this study. Every effort will be made to ensure the data are presented in a non-identifiable manner to ensure confidentiality.

Personal information (e.g., name, contacts) if provided will be coded and stored separately. Only the researcher herself and the supervisors will have access to the audio-recording and information with your name on it. The recording will not be used for any other purpose.

The codes plus identifying information will be destroyed at the end of the project (April 2021). Any data collected as part of this research project will be stored securely as per QUT's Management of research data policy. Data will be stored for a minimum of 5 years, and can be disclosed if it is to protect you or others from harm, if specifically required by law, or if a regulatory or monitoring body such as the ethics committee requests it.

How do I give my consent to participate?

We would like to ask you to sign a written consent form enclosed herewith to confirm your agreement to participate in this research project.

What if I have questions about the research project?

If you have any questions or require further information please contact one of the listed researchers:

Anita Shrestha anita.shrestha@hdr.qut.edu.au

Margo Sendall m.sendall@qut.edu.au

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You may also contact Nepal Health Research Council via +977 1 4254220 or email: nhrc@nhrc.gov.np.

Thank you for helping with this research project.

Please keep this sheet for your information.

Participant Information – Study 3
Interview (consumers)

Impact of front-of-pack nutrition labelling on dietary choices

QUT Ethics Approval Number 1900000964
NHRC Ethics Approval Number 1554

Research team

Principal Researcher:	Ms Anita Shrestha	PhD student, QUT
Associate Researchers:	Dr Margo Sendall	Principal Supervisor, QUT
	Prof Katherine White	Associate Supervisor, QUT
	Dr Jenni Mays	Associate Supervisor, QUT
	Dr Katherine Cullerton	External Supervisor, UQ

Why is the study being conducted?

This research project is being undertaken as part of a PhD, for Anita Shrestha, QUT, Australia.

The purpose of this research project is to assess whether front-of-pack nutrition labelling is likely to improve dietary choices among Nepalese consumers. An unhealthy diet is a major risk factor for obesity and many non-communicable diseases such as heart diseases, diabetes and cancers. Nutrition labelling, providing information about the nutrient content of food products, is one strategy to promote healthy eating.

Front-of-pack nutrition labelling (FOPL) is intended to convey nutrition information in an easy-to-understand way and may help people to make healthier food choices. There are various labelling formats being implemented across different regions. In Nepal, there currently does not exist any nutrition labelling system and it is unclear whether FOPL would influence food choices among Nepalese consumers. This study will explore the views of consumers on FOPL; how they perceive the labelling and likelihood of its acceptance.

We are seeking consumers who are responsible for purchasing foods in their households. Therefore, you are invited to participate in this research project. You have also participated in the experimental study earlier where you were exposed to different formats of FOPL.

What does participation involve?

Participation will involve an audio recorded interview on FOPL, which will take approximately 30 to 45 minutes of your time.

The questions will include information about your:

- Purchase and consumption of packaged foods,
- Understanding of a healthy diet,
- Nutrition information, and
- Views on FOPL (e.g., likelihood to use, preferences)

Your participation in this research project is entirely voluntary. If you agree to participate you do not have to answer any question(s) you are uncomfortable answering. You can withdraw from the interview at any stage without comment or penalty. Any information already obtained that can be linked to you will be destroyed.

What are the possible benefits for me if I take part?

It is expected that this research project will not benefit you directly. There is no provision of any reward or incentive for your participation in this research. However, the information you provide is valuable to this study, and the outcomes of the research may inform public health and nutrition policies about the effects of FOPL to promote healthy eating.

What are the possible risks for me if I take part?

There are no risks associated with your participation in this research project beyond giving up your time for the interview. You don't have to answer anything you don't want to. The audio-recording will be transcribed into written form but your name and other identifiable information will be removed to ensure confidentiality. If you would like to have a copy of the written form of your interview, please let me know and I can provide it to you once it is ready. You can edit (remove or add) any information on it. .

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Thank you for helping with this research project.

Please keep this sheet for your information.

Appendix D

Consent forms

QUT	**Consent Form – Study 3** **Interview (public health and industry participants)**
Impact of front-of-pack nutrition labelling on dietary choices QUT Ethics Approval Number 1900000964 NHRC Ethics Approval Number 1554	

Research team

Ms Anita Shrestha	anita.shrestha@hdr.qut.edu.au	+61 426557953
Dr Margo Sendall	m.sendall@qut.edu.au	+61 7 3138 3526
Prof Katherine White	km.white@qut.edu.au	+61 7 3138 4689
Dr Jenni Mays	j.mays@qut.edu.au	+61 7 3138 4612
Dr Katherine Cullerton	k.cullerton@uq.edu.au	+61 7 3346 4619

Statement of consent

By signing below, you are indicating that you:

- Have read and understood the information document regarding this research project.
- Have had any questions answered to your satisfaction.
- Understand that if you have any additional questions you can contact the research team.
- Understand that you are free to withdraw without comment or penalty.
- Understand that if you have concerns about the ethical conduct of the research project you can contact the QUT Research Ethics Advisory Team (phone: +61 7 3138 5123 or email humanethics@qut.edu.au) or Nepal Health Research Council (+977 1 4254220 or email: nhrc@nhrc.gov.np).
- Understand that the interview will be audio-recorded.
- Agree to participate in the research project.

Name _____

Signature _____

Date _____

Please return the signed consent form to the researcher.

Consent Form – Study 3
Interview (consumers)

Impact of front-of-pack nutrition labelling on dietary choices
QUT Ethics Approval Number 1900000964
NHRC Ethics Approval Number 1554

Research team

Anita Shrestha	anita.shrestha@hdr.qut.edu.au	+61 426557953
Margo Sendall	m.sendall@qut.edu.au	+61 7 3138 3526
Katherine White	km.white@qut.edu.au	+61 7 3138 4689
Jenni Mays	j.mays@qut.edu.au	+61 7 3138 4612
Katherine Cullerton	k.cullerton@uq.edu.au	+61 7 3346 4619

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- Understand that the interview will be audio-recorded.
- Agree to participate in the research project.

Name _____

Signature _____

Date _____

Please return the signed consent form to the researcher.

Appendix E

Nutrition information for product packaging

Packaging of the food products

Food products:

- Total designs: 10
- Biscuits, bread, noodles, juice and yoghurt
- Each consisting of a healthier and a less healthy variant

Packaging:

- Each product pair with similar brand names, images and colours

Information on package:

- Brand name (English and Nepali), product name (English and Nepali), product image, net weight and front-of-package label (FOPL)
- FOPL at top right corner of the package
- Nutrition information panel (NIP) at the back of each package

Design framework (front)

FOPL

Brand name (Nepali and English)
Product name (Nepali and English)

Product image

Weight (….g/ml)

Design framework (back)

Nutrition Information Panel

Servings per package: …
Serving size: … g/ml

	Qty per serving	**Qty per 100 gm**
Energy	…. KJ	…. KJ
Protein	…. g	…. g
Total fats	…. g	…. g
Saturated fats	…. g	…. g
Sugars	…. g	…. g
Salt	…. mg	…. mg

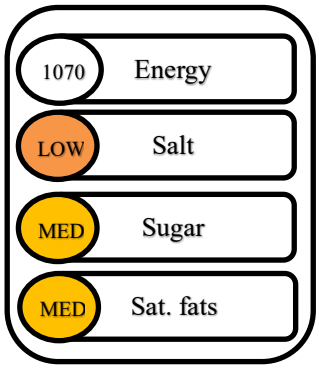
1. BISCUIT (350 g)

NIP

Servings per package: 10
Serving size: 35 g

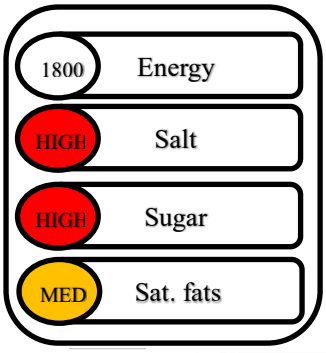
	Qty per serving	Qty per 100 gm
Energy	375 KJ	1070 KJ
Protein	1.1 g	3.0 g
Total fats	6.3 g	18.0 g
Saturated fats	1.2 g	3.5 g
Sugars	2.9 g	8.2 g
Salt	100 mg	160 mg

FOPL



Servings per package: 10
Serving size: 35 g

	Qty per serving	Qty per 100 gm
Energy	630 KJ	1800 KJ
Protein	1.1 g	3.0
Total fats	5.2 g	14.8 g
Saturated fats	1.3 g	3.8 g
Sugars	8.0 g	22.8 g
Salt	300 mg	800 mg



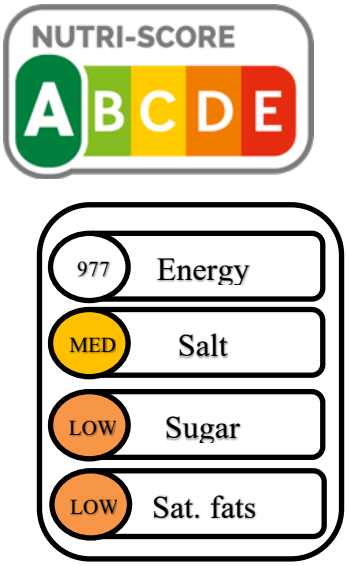
2. BREAD (700 g)

NIP

Servings per package: 10
Serving size: 70 g (2 slices)

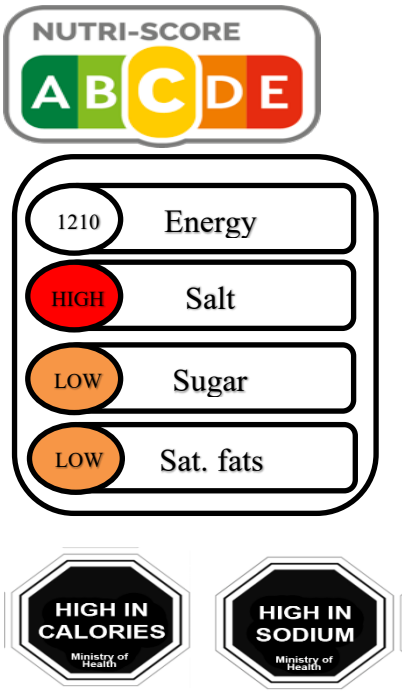
	Qty per serving	Qty per 100 gm
Energy	684 KJ	977 KJ
Protein	6.4 g	9.2 g
Total fats	2.2 g	3.2 g
Saturated fats	0.4 g	0.5 g
Sugars	2.1 g	3 g
Salt	200 mg	350 mg

FOPL



Servings per package: 10
Serving size: 70 g (2 slices)

	Qty per serving	Qty per 100 gm
Energy	847 KJ	1210 KJ
Protein	6.5 g	9.3 g
Total fats	3.3 g	4.7 g
Saturated fats	0.7 g	1.0 g
Sugars	2.1 g	3.0 g
Salt	1100 mg	1600 mg



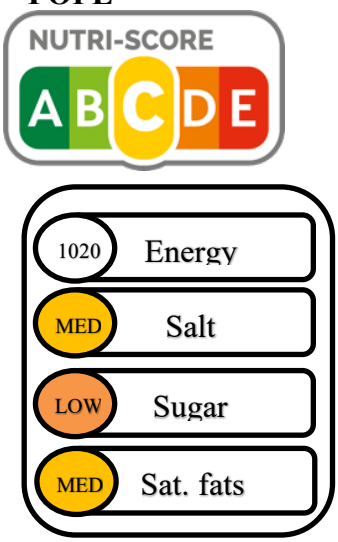
3. NOODLES (60 g)

NIP

Servings per package: 1
Serving size: 60 gm

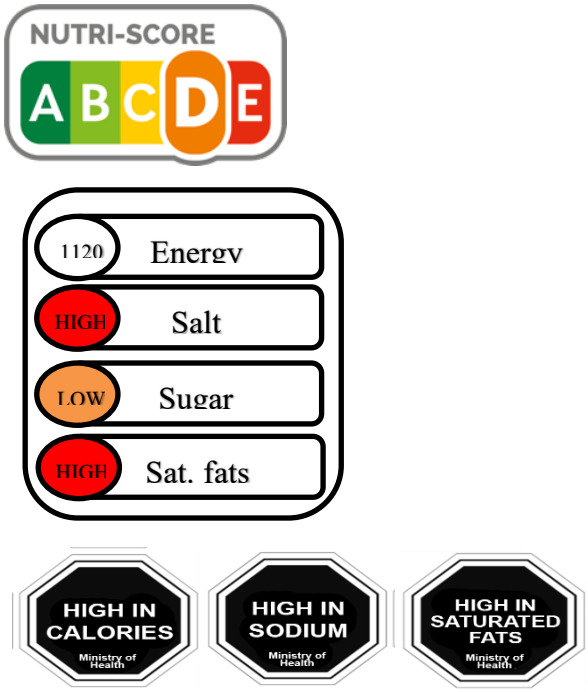
	Qty per serving	Qty per 100 gm
Energy	612 KJ	1020 KJ
Protein	4.1 g	6.8 g
Total fats	7.9 g	13.2 g
Saturated fats	2.3 g	3.8 g
Sugars	0.2 g	0.3 g
Salt	200 mg	380 mg

FOPL



Servings per package: 1
Serving size: 60 gm

	Qty per serving	Qty per 100 gm
Energy	1038 KJ	1730 KJ
Protein	5.2 g	8.6 g
Total fats	9.1 g	15.1 g
Saturated fats	4.1 g	6.8 g
Sugars	2.3 g	3.8 g
Salt	900 mg	1560 mg



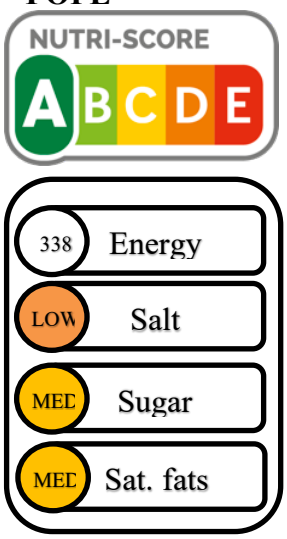
4. YOGHURT (1 kg)

NIP

Servings per package: 10
Serving size: 100 gm

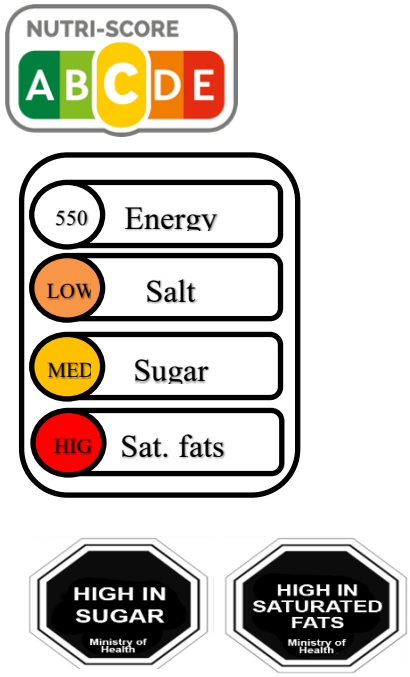
	Qty per serving	Qty per 100 gm
Energy	338 KJ	338 KJ
Protein	6.3 g	6.3 g
Total fats	2 g	2.0 g
Saturated fats	1.4 g	1.4 g
Sugars	4.5 g	4.5 g
Salt	60 mg	60 mg

FOPL



Servings per package 10
Serving size: 100 gm

	Qty per serving	Qty per 100 gm
Energy	550 KJ	550 KJ
Protein	4.9 g	4.9 g
Total fats	9.5 g	9.5 g
Saturated fats	6.8 g	6.8 g
Sugars	11.4 g	11.4 g
Salt	100 mg	100 mg



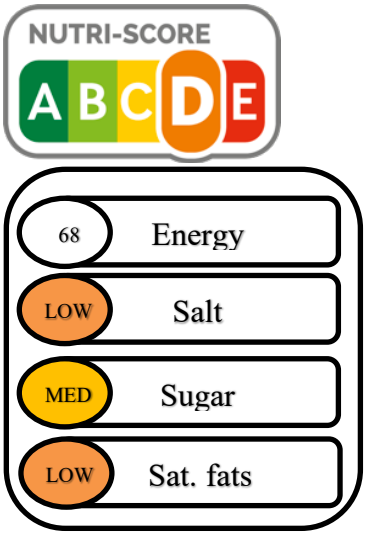
5. MANGO JUICE (250 ml)

NIP

Servings per package: 1
Serving size: 250 ml

	Qty per serving	Qty per 100 gm
Energy	170 KJ	68 KJ
Protein	0.8 g	0.3 g
Total fats	0 g	0 g
Saturated fats	0 g	0 g
Sugars	7.5 g	3.0 g
Salt	<50 mg	<50 mg

FOPL



Servings per package 1
Serving size: 250 ml

	Qty per serving	Qty per 100 gm
Energy	473 KJ	189 KJ
Protein	0 g	0 g
Total fats	0 g	0 g
Saturated fats	0 g	0 g
Sugars	29.5 g	11.8 g
Salt	<5 mg	<5 mg