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Exploring Malaysia's Expanding Waistlines: the Role of Dietary Public Health Messages and Guidelines in Tackling Overweight and Obesity Issues

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ABSTRACT

Overweight and obesity in Malaysia pose serious threats to health. Prevalence has escalated to alarming levels in recent decades despite a multitude of dietary public health messages geared toward obesity prevention and health promotion. Gaps between health messages, messengers, and the public must be identified and closed to effectively combat obesity and overweight. This review article aims to examine dietary public health messages, guidelines, and programmes for the prevention of obesity in Malaysia, and explore potential reasons for the continued rise in prevalence. Dietary public health communication in Malaysia has progressed and improved substantially over the years. However, most messages have been designed for a general audience, with little consideration of differences in physical, social, cultural, and environment backgrounds, and varying levels of comprehension. We offer several recommendations to increase the effectiveness of dietary public health messages in fighting the obesity epidemic, based on a cross-sectoral, place-based approach that recognizes the complexity of underlying causes of obesity.

Keywords: Dietary public health messaging; Obesity; Malaysia; Place-based approach; Cross-sectoral approaches

INTRODUCTION

Obesity has tripled worldwide since 1975, reaching epidemic proportions in both developing and developed countries; as of 2018, 13% of adults are obese and 39% overweight (World Health Organisation (WHO), 2018). Meanwhile, the prevalence of overweight and obesity among children and adolescents has risen from 4% in 1975 to 18% in 2016 (WHO, 2018). The Global Burden of Disease Study (Ng *et al.*, 2013) reported a prevalence of overweight and obesity in Southeast Asia of 22.1% among men and 28.3% among women, with the highest rates in Malaysia at 48.3% and 48.6% for men and women, respectively. The 2015 Malaysian National Health and Morbidity Survey (NHMS) reports similar numbers, estimating the national prevalence of overweight and obesity in adults at 30.0% and 17.7%, respectively, for a total of 47.7% (Institute for Public Health (IPH), 2015). In just two decades, the prevalence of overweight adults has doubled from 16.6%, while obesity has increased four-fold from 4.4% (IPH, 1996).

Malaysia has stated its intent to stop the rise in prevalence of obesity by 2025 (Ministry of Health, 2016). The US$1-2 billion (RM4.26– 8.53 billion) spent to combat obesity in 2016—including direct and indirect costs—is equivalent to ~10-19% of national healthcare expenditures (Asia Roundtable on Food Innovation for Improved Nutrition (ARoFIIN), 2016). Public health messages around nutrition—such as those issued by the Ministry of Health—are important as one of a range of efforts for health promotion and obesity. Yet, despite all these actions, obesity rates have continued to rise sharply.

Failure to halt the dramatic increase in the prevalence of overweight and obesity in Malaysia and worldwide has contributed to increased health risks for non-communicable diseases (NCDs) such as diabetes, cardiovascular diseases and cancers and other health issues, leading to higher morbidity and mortality rates. About 8% of total mortality each year is attributed to obesity (Beaglehole *et al.*, 2011). Beyond increased risk of obesity-related chronic diseases and poorer quality of life, the healthcare costs of treating obesity-related disease conditions are rapidly escalating. On average, obese Malaysian males and females lose from 6–11 years and 7–12 years of productive life, respectively (ARoFIIN, 2016).

This paper reviews some of the dietary public health messages, guidelines, and programmes related to overweight and obesity in Malaysia. It identifies possible reasons for the continuing increase in prevalence in the face of abundant public health messages and offers recommendations for a more systemic, place-based approach to slowing and reversing the rise in obesity.

Dietary Public Health Messages

Public Health Messages Related to Nutrition and Obesity in Malaysia

In recent decades, the Malaysia Ministry of Health (MOH) has disseminated numerous public health messages, various sets of nutritional and dietary guidelines, and a series of programmes for the public and for health professionals. The National Plan of Action for Nutrition of Malaysia (NPANM) underlies Malaysia's strategy for addressing nutritional public health; three versions of the plan have been published since 1996 (National Coordinating Committee on Food and Nutrition (NCCFN), 1996; NCCFN, 2006; NCCFN, 2016).

Table 1 compares the evolving aims of the three NPANM and the evolution of the main areas of focus and facilitating strategies. In the 1996-2000 version, most targets and goals addressed nutritional deficiencies, with no set target for overweight and obesity. At the time, the prevalence of overweight and obesity were 16.6% and 4.4%, respectively (IPH, 1996). By 2003, these had increased to 26.7% and 12.2%, representing nearly two- and three-fold increases, respectively, over just seven years (Azmi et al., 2009). By the launch of the second NPANM in 2006, national prevalence of overweight and obesity among adults was reported at 29.1% and 14.1% (IPH, 2006), with prevalence of NCDs also on the rise. The new plan, accordingly, shifted to meet the new needs, aiming to enhance the nutritional status of the entire population and prevent and control diet-related NCDs. NPANM II set a population-level goal of not more than 30% overweight and not more than 15% obese—targets which were not achieved. In view of the current critical situation, the third and most recent NPANM (2016-2025) has adopted a goal of *no further increase* in any obesity-related indicators, taking NHMS 2015 data as a baseline. It has also established new indicators, such as abdominal obesity and overweight and obesity among adults above 60 years of age.

Whereas all three plans have taken on such basic goals as ensuring food quality and safety and promoting appropriate diets and healthy lifestyles, focal areas and facilitating strategies for nutrition have evolved in successive NPANMs (Table 1). For example, NPANM I prioritized the prevention and management of infectious diseases, while NPANM II addressed complementary feeding for children and promoted institution-building strategies to strengthen research, development, and capacity. NPANM III recognises the importance of systemic action and local context, promoting multidisciplinary teamwork that builds capacities and empowers communities, the inclusion of food systems frameworks in nutritional strategies, and the development of targeted guidelines for vulnerable groups.

The Malaysian Dietary Guidelines are an important strand of public health messages related to nutrition. Aimed primarily at health care providers, they are "intended to act as a tool for healthy eating promotion towards achieving the National Plan of Action for Nutrition Malaysia" (NCCFN, 2010). Established in 1999 with eight key messages designed to prevent nutritional deficiency and chronic diseases, the Guidelines were revised and updated in 2010, splitting

several of the original messages to more specifically emphasize, for example, the importance of daily physical activity and fruit consumption, and adding four new guidelines, for a total of fourteen key messages (Figure 1). These changes reflect a better understanding of the origins of obesity and lifestyle-related disease in Malaysia.

Another strand of promotion of public health nutrition encompasses the visually-oriented Malaysian Food Pyramid and Healthy Plate, aimed at the general public. The Malaysian Food Pyramid, modelled on the United States Department of Agriculture (USDA) Food Guide Pyramid (USDA, 1992), was first introduced in 1997 (Tee, 2011) and was intended as a visual guide to assist the public in planning suitable daily food consumption in terms of choices and quantities. In 2016, the Malaysian Healthy Plate, modelled on the USDA MyPlate (Table 2), was released to supplement and in some ways supersede the Food Pyramid. The Malaysian Healthy Plate was heavily promoted to the public through mass media, with a message of *suku-suku-separuh* ("quarter-quarter-half" in Bahasa Malaysia), referring to fractions of a typical plate: one quarter for meat or fish (protein-based foods), one quarter for grains or carbohydrate-based foods, and half for vegetables and a serving of fruit. The healthy plate concept is highly visual and relatable, and thus easier to understand and put into practice than the more abstract food pyramid.

Public health spending in Malaysia

One way to improve the visibility and impact of public health messages is to increase expenditures. While specific data on spending on public health nutrition messages and the costs of nutrition-related disease are difficult to access, evidence from other sources suggests that Malaysia spends far more on treatment than on prevention. For example, according to providers of health services in Malaysia from 1997 to 2015, expenditures on hospitals, ambulatory health care, medicines, and medical appliances greatly exceed the expenditure on health prevention and promotion services (Table 3). Indeed, expenditure on hospital treatment amounted to 50% or more of total health expenditures (including public and private sectors), while less than 5% was spent on provision and administration of public health programmes. Over the same period, similar trends are seen for total health expenditure by the function of health services (Table 4). About 55-65% of expenditure was for services of curative care, whereas just 4-6% was spent on prevention and public health services (Jackson & Shiell, 2017).

While these figures would seem to indicate a low level of public health spending in Malaysia, they are actually fairly high with respect to the average share of total healthcare spending directed to prevention services in OECD countries, in most cases less than 3%. Indeed, health expenditure data must be interpreted with caution. For one, these data measure only expenditures by the health agency, excluding spending by other agencies or other actors that may promote public health. For another, public health spending feeds into the systemic

causes of health and is likely to have non-linear effects. For example, greater spending on public health promotion, including dietary messages, is likely to extend life expectancy. As such, individuals encountering the medical system may be older on average, with ailments that are more expensive to treat. Thus, high expenditures on treatment could potentially be indicative either of underspending on prevention, or of a highly efficient system of prevention. More careful analysis of this issue in the Malaysian context would be valuable.

Evolution and controversy in dietary guidelines

Nutritional and dietary guidelines have evolved significantly over the past century, in parallel with greater understanding of the pathophysiological underpinnings of ill health. Modern nutritional science began with a strong focus on single-nutrient deficiencies and a concern over food shortages (Mozaffarian & Forouhi, 2018). Isolation of Vitamin C as a cure for scurvy in 1932 was followed by the identification of other single-nutrient deficits related with health issues, such as Vitamin A deficiency with night blindness, Vitamin D with rickets, thiamine with beriberi, and niacin with pellagra (Mozaffarian & Forouhi, 2018). These relatively simple successes inspired a reductionist approach to nutritional science, in which the relevant nutrient for a given disease was identified and a target intake established (Messina *et al.*, 2001). This information was translated into simple messages for public consumption.

As such diseases were progressively eradicated through advances in nutritional science and improvements in farming and food production, other issues began to gain in prominence. Perhaps unsurprisingly, the reductionist approach that had previously been so successful was applied to these issues. This is readily seen in the 1980 United States Dietary Guidelines (USDA, 1980), in which the public was instructed to avoid fats (including saturated fat and cholesterol), which received the lion's share of the blame for heart disease and the obesity epidemic. Guidelines for dietary fat were first introduced by the United States and United Kingdom Governments with the aim of reducing the prevalence of coronary heart disease. Despite a lack of evidence from randomised controlled trials to support such guidelines, they have prevailed for 40 years (Harcombe *et al.*, 2015). Malaysian Dietary Guidelines closely follow the United States guidelines, limiting the intake of foods high in fats and minimising use of fats and oils in cooking. The Malaysian Food Pyramid also recommends reduced intake of fat, oils, sugar, and salt, although exact quantities are not mentioned. In the meantime, the 1980s saw an accelerating increase in obesity and overweight in the US and other industrialized nations, and the emergence of chronic diseases related to overnutrition (Mozaffarian, 2017).

Clinicians are now questioning existing food guidelines, which, in addition to adopting a reductionist perspective that now seems inadequate, are over-reliant on observational studies and small-scale, short-term interventions. Such studies are susceptible to confounding factors and errors in self-reported dietary assessments, and thus have questionable relevance

to the real world (Mozaffarian & Forouhi, 2018). One major shift in nutritional thinking has been with respect to the role of fat. Indeed, there is evidence that restricting total fat intake has led to higher carbohydrate intake, resulting in increases in obesity and diabetes (Harcombe, Baker & Davies, 2017). In a systematic review and meta-analysis across low, middle, and high-income countries, Sartorius et al (2018) concluded that a high-carbohydrate diet, or an increased percentage of total energy intake in the form of carbohydrates, correspondingly increases the odds of obesity. While current opinion is not unanimous, this and numerous other findings question prevailing assumptions and messages on good dietary practices. Such scientific debate over complex nutritional issues is inevitable and ought to produce better knowledge over time. However, it has also contributed to an ever-changing set of dietary recommendations, in which a nutrient is labelled harmful at one point in time, then healthy, then harmful again, causing public confusion and scepticism about scientific claims regarding nutrition (Mozaffarian, 2017). This confusion has been compounded by the accumulation of increasingly complex and nuanced findings which are more difficult to communicate than previous issues around single-nutrient deficiencies.

The controversial role of the food industry in dietary public health messages

Dietary guidelines from governments and advocacy organisations, themselves often muddled, compete with messages from other sources, misinforming and confusing the public. In some cases, the food industry exacerbates this situation, including through promotion of unhealthy products, misleading marketing campaigns, targeting of children and other susceptible groups, corporate lobbying, co-opting of organisations and social media through financial support, and attacks against science and scientists. This may cause increasing distrust towards health professionals and reluctance among the public to accept public health messages (Crossley, 2002).

One prominent example of the influence of the food industry is the aggressive food marketing tactics used to promote junk food consumption among children. For instance, in 2012, the United States fast food restaurant industry spent $4.6 billion on advertising, while combined advertising on so-called “healthier” foods, including milk ($169 million), bottled water (i.e., as an alternative to soft drinks) ($81 million), vegetables ($72 million) and fruit ($45 million) was less than one-twelfth that total (Harris *et al.*, 2013). An average child in the United States watches about 4,700 food-related advertisements per year, of which 84% are for junk food (Harris *et al.*, 2015); equivalent data on food marketing in Malaysia are not available at present, but it seems likely that unhealthy food advertising is equally predominant, if not more so, in this context. While powerful food companies have begun to be criticised and regulated in wealthier nations, less-developed countries remain vulnerable, often lacking junk food marketing policies, in part because they do not have the financial wherewithal to combat the well-resourced food industry. Less-developed countries also generally have a higher

fraction of young people, who are more vulnerable to aggressive marketing tactics, and so will see higher impacts (Kovic *et al.*, 2018).

Another conspicuous example involves sugar-sweetened beverages (SSBs), a top contributor to overall sugar consumption (Baker & Friel, 2014). In industry-sponsored research on the health effects of SSBs (Bes-Rastrollo *et al.*, 2013) and artificial sweeteners (Mandrioli, Kearns & Bero, 2016), the likelihood of conclusions favourable to the sponsor is higher than in non-industry-sponsored studies. Children and adolescents are frequent targets of SSB marketing strategies. This is critical because taste preferences are formed during youth and adolescence—habitual exposure to SSBs leads to unhealthy lifetime dietary habits (Gostin, 2018). Indeed, Brownell and Warner (2009) found that the food industry purposefully targeted youth populations to lock in new generations of consumers, a strategy previously adopted with much success by tobacco companies. SSB consumption is associated with increased waist circumference and other cardiometabolic risk factors independent of physical activity levels and dietary patterns (Loh *et al.*, 2017).

Even when the food industry promotes healthier foods, it is usually done in ways that rely on reductionist messages that are easy to grasp, and that promise to improve health regardless of dietary and lifestyle context. The boom in the vitamin and dietary-supplement industries relies on such marketing, despite a lack of evidence that these products benefit the general population (Jenkins *et al.*, 2018). Similarly, the benefits of other so-called health foods and diets, including juices and gluten-free diets, have frequently been overstated and taken out of the context of the original research (Freeman *et al.*, 2017). Such messages are further reinforced by dietary advice presented in the media, often based on the weakest forms of evidence, and therefore contributing to public misconceptions about food and health (Cooper *et al.*, 2012).

Cross sector approaches in improving dietary public health messages

To develop effective messages to combat obesity, it is necessary first to understand the systemic factors that give rise to obesity. Public health research, recommendations, and interventions relating to overweight and obesity prevention and treatment are often based on a simple energy balance model which neglects the complex physiological, behavioural and environmental systems involved (Hafekost *et al.*, 2013). Human physiology is evolutionarily adapted to food-scarce environments and is regulated at several levels by complex, multiple feedback mechanisms that homeostatically regulate energy balance to maintain body weight, making weight loss difficult (Flier, 2017). One example of such regulatory mechanisms is the effect of calorie restrictions on the resting metabolic rate, which decreases energy expenditures in response to reduced energy input (Martin *et al.*, 2011; Martin *et al.*, 2007). Even when weight loss is achieved, compensatory physiological responses to perceived food scarcity during dieting encourage weight gain up to a year later. These physiological

adaptations may be poorly suited to modern human habitats that promote high energy intake and low energy expenditure, characterized by "an essentially unlimited supply of convenient, relatively inexpensive, highly palatable, energy-dense foods", combined with lifestyles that require only minimal levels of physical activity for survival (Hill & Peters, 1998; Peters, 2003; Cohen, 2008). For this reason, Hill and Peters (1998) remarked that the culprit in the increasing prevalence of obesity is the environment that promotes obesity-causing behaviours. Since we are unable to change our physiology, it is the obesogenic environment that must be "cured" to stop and reverse the obesity epidemic (Hill & Peters, 1998). Indeed, while poor dietary habits and inadequate physical activity are known contributing factors to the development of obesity and many NCDs (Booth *et al.*, 2012; Lachat *et al.*, 2013), public health professionals generally agree that genetic, biological, and psychological changes at the individual level are insufficient to explain the rapid modern rise in obesity rates. Therefore, the obesity epidemic must originate in a broader environmental, societal, and policy context (Koplan *et al.*, 2005; Novak & Brownell, 2012; Kumanyika *et al.*, 2013). A systems perspective, capable of recognizing the shape and potential impacts of feedback mechanisms, is required to navigate these issues.

It is important to consider how health messages feed into the physiological-environmental system that underlies obesity and the conditions necessary for information to be effective in this context. Public health messages aimed at reducing obesity must transcend an implied *information-deficit* model which assumes that supplying basic knowledge on nutrition is enough to achieve change. Rather, such messages are best understood as attempts to convince a very broad, diverse audience to make behavioural and lifestyle changes that are both difficult and at odds with their contextual cues and incentives. This differs from traditional marketing, which delivers uncomplicated, attractive messages to targeted audiences, and it should be no surprise that health messages achieve lower response rates (Kelly & Barker, 2016). This problem is compounded when health sector messages compete against those from commercial food and "health" industries. The latter promote simpler products while also generating profits, allowing the private sector to far outspend the health sector in this context. At present, guidelines for health promotion focus on communication techniques, such as limiting the number of ideas to avoid confusing readers (US Department of Health and Human Services, 2006), reducing jargon and technical language, using active voice and conversational style, and providing concrete examples (Wigington, 2008). Indeed, beyond failing to enable healthier behaviour, poorly crafted messages may contribute to negative self-perceptions and, in the process, generate more pervasive problems (Penney & Kirk, 2015; Rudoplh & Hilbert, 2017). Yet, while important, such techniques do not address the broad range of obstacles in the messaging environment.

Because knowledge is necessary, but not sufficient, to change behaviour (Worsley, 2002; Patton, 2008), messages targeted at individual behaviour need to be accompanied by

strategies that create contexts where people are encouraged or naturally predisposed to act on these messages. Therefore, health communicators also need to consider how to influence the key actors who shape these environments. For example, the failure of town and transport planners to consider health issues in, for instance, the design of parks, recreation centres, and other public spaces has been seen as a cause of the rise in the prevalence of obesity, NCDs, and sedentary behaviour (WHO, 2004). A wide range of stakeholders—both public and private, at federal, state, and municipal levels—must play a role in halting the obesity crisis. Physical, social and cultural environments associated with work (Schulte *et al.*, 2007; Hyun & Kim, 2018), food (Mattes & Foster, 2014; Steeves, Martins & Gittelsohn, 2014), family (González Jiménez *et al.*, 2012; Huang *et al.*, 2017) and community (Yoon & Kwon, 2014) all enable and constrain the individual choices and behaviours that affect obesity. For example, in Malaysia, the widespread practice of serving sweet and savoury snacks at morning and afternoon tea at functions, conferences, and meetings enables over-consumption of food and cements frequent eating as a social norm. Working hours (Cheong *et al.*, 2010), availability of fast food (Abdullah *et al.*, 2015), and school nutrition (SCHEMA, 2018), among other factors, also play key enabling/constraining roles in Malaysia. Health messages and other policy interventions must target these physical, social and cultural environments, connecting actors and creating new feedback links to reshape systems in ways that promote health.

Within Malaysia there is such heterogeneity in sociocultural environments that both the message and the way it is communicated must be tailored to local contexts, highlighting the importance of place-based thinking. Indeed, rates of obesity in Malaysia vary by geographical locations and ethnicity (IPH, 2015), and these differences are greater than can be explained by simple urban/rural differentiation. Varied diets and cultures (Nurul Fadhilah, Teo & Foo, 2016; Lee, 2017) imply that the changes needed to achieve healthy and socially-acceptable eating habits and lifestyles may be very different for different ethnic and social groups. Similarly, identifying the appropriate form of messages and messengers for a target group is important and requires local knowledge (WHO, 2017). Acquiring and using this knowledge depends on early and consistent community engagement and participation in both research and policy processes, before problems and potential solutions are formulated (Bodison *et al.*, 2015). Accounting for the particularities of place will better allow for the development of targeted and tailored messages, programmes, guidelines, and interventions to meet age, gender, culture, socioeconomic, and geographical needs.

Recommendations for improving dietary public health messages in Malaysia

To make dietary health messages in Malaysia more effective vehicles for change, we suggest three broad strategic actions: building capacity and receptivity for complex ideas, mobilising a diversity of messengers, and implementing key policy interventions that target the food environment.

406 ***Creating receptivity for complex ideas***

407 While health messages should be simple, to enhance communication, many important dietary
408 messages are inherently complex. In keeping with the systems view of dietary public health
409 outlined above, various actions could be taken to improve the efficacy of messages in Malaysia
410 without making them simplistic. First, an ability to understand complex messages needs to
411 be developed within the community. Reductionist thinking continues to dominate in science
412 curricula, shaping the types of evidence people expect to see and are receptive to. Systems
413 thinking, complexity, and holistic approaches to problem-solving could be introduced in
414 school science curricula, for example in relation to biology, metabolism, and nutrition (Fardet
415 & Rock, 2014). In the long term, exposure to these concepts can create an ability to
416 understand the interconnected concepts necessary to address present and future nutrition
417 challenges. While rewriting basic curricula will take years, if not decades, the cost of nutrition-
418 related diseases—to say nothing of other complexity-related societal challenges—warrants
419 such an effort. A body of evidence suggests that such concepts can be understood by lay
420 people, practitioners, and students, given appropriate pedagogy (SCHEMA, 2018; Newell &
421 Siri, 2016). Second, it is still necessary to simplify complex messages, without making them
422 simplistic, to meet existing capacities for comprehension. The Malaysia Healthy Plate is a good
423 example of such translation. Further successes will depend in part on the involvement of local
424 community leaders and members, as called for in NPANM III.

425

426 ***Mobilising diverse messengers through a multi-sector approach***

427 As food is deeply tied to a wide range of social and cultural values, a multi-sector approach
428 that addresses diet from a broader set of perspectives could increase effectiveness of dietary
429 messages. While the Ministry of Health has actively fought overweight and obesity, gaps
430 remain that could be filled by other ministries which have historically been less engaged on
431 this issue, but whose activities and responsibilities have consequences for urban health.
432 These would include the Ministries of Urban Well-being, Housing and Local Government;
433 Education; Finance; Transport; Women, Family and Community Development; Agriculture
434 and Agro-Based Industry; and Youth and Sports. Many of these government ministries have
435 access to different community organisations, and their contacts could be used to deliver
436 messages and implement interventions specific to target specific communities. A good
437 example is the KOSPEN programme, a collaboration between the Ministry of Health and the
438 Ministry of Rural Development to recruit and mobilise community health volunteers (Ministry
439 of Health, 2016).

440

441 The food industry is a key player in shaping the food environment and has often (though not
442 always) done so in ways that undermine health messages. So-called "influencers"—public
443 health activists, celebrity nutritionists, politicians, and food bloggers, to name a few—have
444 the potential to shape societal paradigms and purchasing choices, thus influencing changing
445 industry practices (Sbicca, 2012; Byrne, Kearney & MacEvilly, 2017; Johnstone & Lindh,

2018). The Malaysian health sector should consider how to engage with such influencers, to encourage them to use messages based on the best available evidence. Direct engagement with the food industry would be beneficial. Indeed, the United States Centers for Disease Control and Prevention (CDC) acknowledged that the food industry's "expertise, reach, and innovation can help address challenges in food production, formulation, and distribution; facilitate greater innovation for public good; and build capacity" despite the potential for bias (CDC, 2018). Nevertheless, partnerships between the health sector and the food industry must be governed by clear principles to avoid actions and perceptions that would compromise health promotion goals (Mozaffarian, 2017; CDC, 2018; Freedhoff & Hébert, 2011).

Complementing Messages with Regulatory and Fiscal Policy

Regulation is an important mechanism for shaping the nutrition information environment to catalyse desired behaviours. Yet, ensuring the accuracy and credibility of messages can be challenging. A 2010 WHO resolution, endorsed by 192 United Nations member states, urged regulation of food and beverage marketing to children to address the childhood obesity epidemic (WHO, 2010). However, many countries rely on food industry self-regulation in marketing (Hawkes & Lobstein, 2011). Malaysia, for example, has implemented food advertising regulations such as banning fast-food advertisements on children's television programmes, yet the Malaysian Ministry of Health has also endorsed self-regulation in the food industry. A prominent example is the Malaysian Food Manufacturing Group's "Responsible Advertising to Children – Malaysia Pledge" (Food Industry Asia, 2012; Food Industry Asia, 2013), the effects of which have not been studied. In some cases, the source of funding for nutritional research creates likely conflicts of interest. For example, the Ministry of Health endorsed a popular malt drink, produced by a large multi-national company and marketed as a nutritious "Healthier Choice". In 2018, a national controversy erupted over this drink's sugar content (Thiagarajan, 2018), while it simultaneously came to light that the company in question funds substantial nutrition research in Malaysia. This research included a study claiming correlations between consumption of malt drinks, physical activity and micronutrient intake among Malaysian children (Hamid *et al.*, 2015). Such findings may be legitimate; for example, there might be cultural factors in this population associated with both malt-drink consumption and physical activity that explain the observed correlations. Nevertheless, results like this raise suspicion of conflicts of interest when there are perceived lack of transparency or external accountability (Mozaffarian, 2018). Indeed, such situations can also create suspicion of other otherwise non-controversial results. Advertising regulations and Ministry of Health endorsements must be seen to be based on reliable and unbiased research to maintain the credibility of health promotion information.

Subsidies and taxes can also reinforce or subvert health messages and the capacity of the target audience to act upon them. They must be considered in the local economic and political context. For example, the WHO recommends restricting sugar consumption to less than 10%

of total energy intake, and advocates a further reduction to below 5% (WHO, 2015). Yet, sugar consumption worldwide exceeds these levels; indeed, Malaysian per-capita sugar consumption is among the highest in the world (11-19 tsp/day) (Swarna Nantha, 2014; Amarra, Khor & Chan, 2016); this is approximately 9-15% of total intake, assuming 2000kcal/day. One response has been to tax products with high sugar content, such as SSBs, and this has been effective in some contexts (Colchero *et al.*, 2017; WHO, 2017; Gostin, 2018). Yet, in Malaysia, the price of sugar is perceived to broadly affect food prices, making it an important political issue on a wider scale. In fact, sugar was subsidised until 2013, and Malaysia still maintains a price ceiling on sugar, with politicians continuing to advocate subsidies (anon, 2017) or lowering this ceiling (Ganeshwaran, 2018). At the same time, SSB taxes have been studied by the Ministry of Health in the past, and have been proposed again recently in response to rising diabetes rates (anon, 2018). The contrasting positions on sugar prices and SSB taxes highlight the conflicting priorities between the trade and health arms of the Malaysian Government, illustrating the need for coordinated policy and mainstreaming of health in all government action.

Subsidies can provide an effective complement to taxation in promoting better nutrition. In neighbouring Singapore, the Health Promotion Board has coupled messages on the consumption of brown rice and other whole grains with subsidises for these staple ingredients in the food service industry (Singapore Health Promotion Board, 2018). High consumption of white rice has been shown to increase Type II diabetes risk, particularly in Asian populations (Hu *et al.*, 2012) but white rice is culturally far more popular, perceived as finer and more desirable. Furthermore, brown rice carries a higher price tag, in part due to economies of scale. This subsidy attempts to shift private sector practice to reinforce health messages on rice consumption. Such strategies are worth exploring in Malaysia, where many consumers have high price-sensitivity, and the direct cost of diabetes alone is estimated at RM 2.04 billion annually (Feisul Idzwan *et al.*, 2017).

CONCLUSION

Being overweight or obese increases the risk of many health problems and imposes significant economic and social costs on society. The alarmingly high prevalence of overweight and obesity in Malaysia thus represents a serious threat, not only to the health of its citizens, but to achieving other societal aspirations, including the United Nations Sustainable Development Goals (United Nations, 2015). This article reviewed dietary public health messages and guidelines connected to overweight and obesity issues and examined gaps in some of these messages. Although dietary public health communication in Malaysia has progressed and improved substantially over the years, most messages have been designed for a general audience, with little consideration of differences in physical, social, cultural, and environment backgrounds, and varying levels of comprehension. Such messages also compete with promotional information disseminated by profit-making food and “health” industries. We suggest that cross-sector approaches grounded in an appreciation of local context can offer

solutions to make dietary health messages more effective, in particular by increasing understanding of the complex determinants of obesity, taking advantage of the systemic roles of multi-sector stakeholders, and implementing specific policy interventions that target the Malaysian food, social-cultural, and environmental contexts.

List of Abbreviations

ARoFIIN	Asia Roundtable on Food Innovation for Improved Nutrition
CDC	United States Centers for Disease Control and Prevention
MANS	Malaysian Adults Nutrition Survey
NCDs	Non-communicable diseases
NHMS	National Health and Morbidity Survey
NPANM	National Plan of Action for Nutrition of Malaysia
SSBs	Sugar-sweetened beverages
USDA	United States Department of Agriculture
WHO	World Health Organization

Conflict of Interest

The authors declare that they have no conflicts of interest.

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References

Abdullah NN, Mazlin MM, Mohd Harriszamani AB & Al-Kubaisy W (2015). Trend on Fast Food Consumption in Relation to Obesity among Selangor Urban Community. *Procedia - Social and Behavioral Sciences*, ASLI QoL2014 (Annual Serial Landmark International Conference on Quality of Life) / AQoL 2014 Istanbul (ABRA International Conference on Quality of Life) (August):505–13. https://doi.org/10.1016/j.sbspro.2015.08.189.

Amarra MSV, Khor GL & Chan P (2016). Intake of Added Sugar in Malaysia: A Review. *Asia Pac J Clin Nutr* 25(2): 227-40.

Anon (2018). *Govt Considering Soda Tax to Encourage Healthy Living, Says PM*. In Malay Mail. August 27, 2018. From https://www.malaymail.com/s/1666339/govt-considering-soda-tax-to-encourage-healthy-living-pm-says [Retrieved November 1 2018].

Anon (2017). *Selangor PKR Youth Wants Sugar Subsidy Restored*. In: Malay Mail. March 3, 2017. From https://www.malaymail.com/s/1327357/selangor-pkr-youth-wants-sugar-subsidy-returned [Retrieved November 1 2018].

ARoFIIN (2016). *Tackling Obesity in ASEAN: Prevalence, Impact and Guidance on Interventions*. The Economist Intelligence Unit (EIU) and the Asia Roundtable on Food Innovation for Improved Nutrition (ARoFIIN). From http://www.arofiin.org/News/tid/54/Tackling-Obesity-in-ASEAN-Prevalence-Impact-and-Guidance-on-Interventions [Retrieved June 1 2018].

Azmi MY, Junidah R, Siti Mariam A, Safiah MY, Fatimah S, Norimah AK, Poh BK, Kandiah M, Zalilah MS, Wan Abdul Manan W, Siti Haslinda MD & Tahir A (2009). Body Mass Index (BMI) of Adults: Findings of the Malaysian Adult Nutrition Survey (MANS). *Mal J Nutr* 15(2): 97–119.

Baker P & Friel S (2014). Processed Foods and the Nutrition Transition: Evidence from Asia. *Obes Rev* 15(7):564–77. https://doi.org/10.1111/obr.12174.

Beaglehole R, Bonita R, Horton R, Adams C, Alleyne G, Asaria P, Baugh V, Bekedam H, Billo N, Casswell S, Cecchini M, Colagiuri R, Colagiuri S, Collins T, Ebrahim S, Engelgau M, Galea G, Gaziano T, Geneau R, Haines A, Hospedales J, Jha P, Keeling A, Leeder S, Lincoln P, McKee M, Mackay J, Magnusson R, Moodie R, Mwatsama M, Nishtar S, Norrving B, Patterson D, Piot P, Ralston J, Rani M, Reddy KS, Sassi F, Sheron N, Stuckler D, Suh I, Torode J, Varghese C & Watt J (2011). Priority Actions for the Non-Communicable Disease Crisis. *Lancet* 377(9775):1438–1447. https://doi.org/10.1016/S0140-6736(11)60393-0.

Bes-Rastrollo M, Schulze MB, Ruiz-Canela M & Martinez-Gonzalez MA (2013). Financial Conflicts of Interest and Reporting Bias Regarding the Association between Sugar-Sweetened Beverages and Weight Gain: A Systematic Review of Systematic Reviews. *PLoS Medicine* 10(12). *https*://doi.org/10.1371/journal.pmed.1001578.

Bodison SC, Sankaré I, Anaya H, Booker-Vaughns J, Miller A, Williams P, Norris K & Community Engagement Workgroup (2015). Engaging the Community in the Dissemination, Implementation, and Improvement of Health-Related Research. *Clin. Transl. Sci.* 8(6):814–19. https://doi.org/10.1111/cts.12342.

Booth FW, Roberts CK & Laye MJ (2012). Lack of Exercise Is a Major Cause of Chronic Diseases. *Compr. Physiol.* 2(2):1143–1211. https://doi.org/10.1002/cphy.c110025.

Brownell KD & Warner KE (2009). The Perils of Ignoring History: Big Tobacco Played Dirty and Millions Died. How Similar Is Big Food? *The Milbank Quarterly* 87(1):259–94. https://doi.org/10.1111/j.1468-0009.2009.00555.x.

Byrne E, Kearney J & MacEvilly C (2017). The Role of Influencer Marketing and Social Influencers in Public Health. *Proceedings of the Nutrition Society* 76 (OCE3). https://doi.org/10.1017/S0029665117001768.

Centers for Disease Control and Prevention (2018). *CDC's Guiding Principles for Public-Private Partnerships: A Tool to Support Engagement with the Private Sector to Achieve Public Health*. US Centers for Disease Control and Prevention, USA.

Cheong SM, Mirnalini K, Karuthan C, Chan YM & Hazizi AS (2010). Prevalence of Obesity and Factors Associated with It in a Worksite Setting in Malaysia. *Journal of Community Health* 35(6):698–705. https://doi.org/10.1007/s10900-010-9274-1.

Cohen DA (2008). Obesity and the Built Environment: Changes in Environmental Cues Cause Energy Imbalances. *Int J Obes* 32(Suppl 7)(December):S137-142. https://doi.org/10.1038/ijo.2008.250.

Colchero M, Juan Rivera-Dommarco A, Popkin BM & Ng SW (2017). In Mexico, Evidence Of Sustained Consumer Response Two Years After Implementing A Sugar-Sweetened

Beverage Tax. *Health Affairs* 36(3):564–571. https://doi.org/10.1377/hlthaff.2016.1231.

Cooper BEJ, Lee WE, Goldacre BM & Sanders TAB (2012). The Quality of the Evidence for Dietary Advice given in UK National Newspapers. *Public Understanding of Science* 21(6):664–673. https://doi.org/10.1177/0963662511401782.

Crossley ML (2002). Resistance to Health Promotion: A Preliminary Comparative Investigation of British and Australian Students. *Health Education* 102(6):289–299. https://doi.org/10.1108/09654280210446838.

Fardet A & Rock E (2014). Toward a New Philosophy of Preventive Nutrition: From a Reductionist to a Holistic Paradigm to Improve Nutritional Recommendations. *Adv Nutr* 5(4):430–446. https://doi.org/10.3945/an.114.006122.

Feisul Idzwan M, Soraya A, Mohd Rizal AM, Zanariah H, Nik Jasmin NM, Fatanah I, Azimatun NA & Goh A (2017). What Are the Direct Medical Costs of Managing Type 2 Diabetes Mellitus in Malaysia? *Med J Malaysia* 72(5):7.

Flier JS (2017). What Fuels Fat. *Scientific American* 297(3):72–81. https://doi.org/10.1038/scientificamerican0907-72.

Food Industry Asia (2012). Government and Industry Come Together to Tackle NCDs. From https://foodindustry.asia/government-and-industry-come-together-to-tackle-ncds [Retrieved 8 Mar 2018].

Food Industry Asia (2013). *Malaysia Launches First Responsible Advertising to Children Pledge*. From https://foodindustry.asia/malaysia-launches-first-responsible-advertising-to-children-pledge [Retrieved 8 Mac 2018].

Freedhoff Y & Hébert PC (2011). Partnerships between Health Organizations and the Food Industry Risk Derailing Public Health Nutrition. *Can Med Assoc J* 183(3):291–292. https://doi.org/10.1503/cmaj.110085.

Freeman AM, Morris PB, Barnard N, Esselstyn CB, Ros E, Agatston A, Devries S, O'Keefe J, Miller M, Ornish D, Williams K & Kris-Etherton P (2017). Trending Cardiovascular Nutrition Controversies. *J Am Coll Cardiol* 69(9):1172–1187. https://doi.org/10.1016/j.jacc.2016.10.086.

Ganeshwaran K (2018). *Pakatan Govt May Lower Ceiling Price of Refined Sugar*. In Business News The Star Online. From https://www.thestar.com.my/business/business-news/2018/05/25/price-review-may-affect-msm/ [Retrieved 24 October 2018].

González Jiménez E, Aguilar Cordero MJ, García García CJ, García López P, Álvarez Ferre J, Padilla López CA & Ocete Hita E (2012). Influence of family environment of the development of obesity and overweight in a population of school children in Granada (Spain). *Nutricion Hospitalaria* 27(1):177–184. https://doi.org/10.1590/S0212-16112012000100021.

Gostin LO (2018). Tackling Obesity and Disease: The Culprit Is Sugar; the Response Is Legal Regulation. *The Hastings Center Report* 48(1):5–7. https://doi.org/10.1002/hast.804.

Hafekost K, Lawrence D, Mitrou F, O'Sullivan TA & Zubrick SR (2013). Tackling Overweight and Obesity: Does the Public Health Message Match the Science? *BMC Medicine* 11(1):41. https://doi.org/10.1186/1741-7015-11-41.

Hamid JJM, Loy SL, Mohd Nasir MT, Norimah AK, Tan SY, Appukutty M, Nurliyana AR, Thielecke F, Hopkins S, Ong MK, Ning C & Tee ES (2015). Characteristics associated with the consumption of malted drinks among Malaysian primary school children:

findings from the MyBreakfast study. *BMC Public Health* 15:1322. https://doi.org/10.1186/s12889-015-2666-5.

Harcombe Z, Baker JS, Cooper SM, Davies B, Sculthorpe N, DiNicolantonio JJ & Grace F (2015). Evidence from Randomised Controlled Trials Did Not Support the Introduction of Dietary Fat Guidelines in 1977 and 1983: A Systematic Review and Meta-Analysis. *Open Heart* 2(1):e000196. https://doi.org/10.1136/openhrt-2014-000196.

Harcombe Z, Baker JS & Davies B (2017). Evidence from Prospective Cohort Studies Does Not Support Current Dietary Fat Guidelines: A Systematic Review and Meta-Analysis. *Br J Sports Med* 51(24):1743–1749. https://doi.org/10.1136/bjsports-2016-096550.

Harris JL, Schwartz MB, Munsell CR, Dembek C, Liu S, LoDolce M, Heard A, Fleming-Milici F & Kidd B (2013). *Fast Food FACTS 2013: Measuring Progress in Nutrition and Marketing to Children and Teens 128*. Yale Rudd Center for Food Policy & Obesity, Yale.

Harris JL, Shehan C, Gross R, Kumanyika S, Lassiter V, Ramirez AG & Gallion K (2015). Rudd Report: Food Advertising Targeted to Hispanic and Black Youth: Contributing to Health Disparities. Storrs, CT: Rudd Center for Food Policy and Obesity, University of Connecticut. http://www.uconnruddcenter.org/files/Pdfs/272-7%20%20Rudd_Targeted%20Marketing%20Report_Release_081115%5B1%5D.pdf.

Hawkes C & Lobstein T (2011). Regulating the Commercial Promotion of Food to Children: A Survey of Actions Worldwide. *Int J Pediatr Obes* 6(2):83–94. https://doi.org/10.3109/17477166.2010.486836.

Hill JO & Peters JC (1998). Environmental Contributions to the Obesity Epidemic. *Science* 280(5368):1371–74.

Hu EA, Pan A, Malik V & Sun Q (2012). White Rice Consumption and Risk of Type 2 Diabetes: Meta-Analysis and Systematic Review. *BMJ* 344 (March):e1454. https://doi.org/10.1136/bmj.e1454.

Huang H, Che Wan Jasimah WMR & Jenatabadi HS (2017). Family Environment and Childhood Obesity: A New Framework with Structural Equation Modeling. *International Journal of Environmental Research and Public Health*, 14 (2). https://doi.org/10.3390/ijerph14020181.

Hyun HS & Kim Y (2018). Associations between Working Environment and Weight Control Efforts among Workers with Obesity in Korea. *Int J Med Res* 46(6):2307–2316. https://doi.org/10.1177/0300060518764212.

Institute for Public Health (2015). *National Health and Morbidity Survey 2015 (NHMS 2015). Vol. II: Non-Communicable Diseases, Risk Factors & Other Health Problems.* Ministry of Health, Kuala Lumpur.

Institute for Public Health (1996). *Second National Health and Morbidity Survey (NHMS 2).* Ministry of Health, Kuala Lumpur.

Institute for Public Health (2006). *The Third National Health and Morbidity Survey (NHMS III).* Ministry of Health, Kuala Lumpur.

Jackson H & Shiell A (2017). *How Much Does Australia Spend and Is It Enough?* Canberra: Foundation for Alcohol Research and Education, Australia.

Jenkins DJA, Spence JD, Giovannucci EL, Kim YI, Josse R, Vieth R, Mejia SB, Viguiliouk E, Nishi S, Sahye-Pudaruth S, Paquette M, Patel D, Mitchell S, Kavanagh M, Tsirakis T, Bachiri L, Maran A, Umatheva N, McKay T, Trinidad G, Bernstein D, Chowdhury A, Correa-Betanzo J, Del Principe G, Hajizadeh A, Jayaraman R, Jenkins A, Jenkins W,

Kalaichandran R, Kirupaharan G, Manisekaran P, Qutta T, Shahid R, Silver A, Villegas C, White J, Kendall CWC, Pichika SC, Sievenpiper JL (2018). Supplemental Vitamins and Minerals for CVD Prevention and Treatment. *J Am Coll Cardiol* 71(22):2570–2584. https://doi.org/10.1016/j.jacc.2018.04.020.

Johnstone L & Lindh C (2018). The Sustainability-Age Dilemma: A Theory of (Un)Planned Behaviour via Influencers. *J Consumer Behav* 17(1):e127–139. https://doi.org/10.1002/cb.1693.

Kelly MP & Barker M (2016). Why Is Changing Health-Related Behaviour so Difficult? *Public Health* 136 (July):109–116. https://doi.org/10.1016/j.puhe.2016.03.030.

Koplan JP, Liverman CT, Kraak VI & Committee on Prevention of Obesity in Children and Youth (2005). Preventing Childhood Obesity: Health in the Balance: Executive Summary. *J Acad Nutr Diet* 105(1):131–138. https://doi.org/10.1016/j.jada.2004.11.023.

Kovic Y, Noel JK, Ungemack JA & Burleson JA (2018). The Impact of Junk Food Marketing Regulations on Food Sales: An Ecological Study. *Obes Rev* 19(6):761–769. https://doi.org/10.1111/obr.12678.

Kumanyika S, Libman K & Garcia A (2013). *Strategic Action to Combat the Obesity Epidemic: Report of the Obesity Working Group 2013*, 48. WISH Obesity Report, Qatar.

Lachat C, Otchere S, Roberfroid D, Abdulai A, Seret FMA, Milesevic J, Xuereb G, Candeias V & Kolsteren P (2013). Diet and Physical Activity for the Prevention of Noncommunicable Diseases in Low- and Middle-Income Countries: A Systematic Policy Review. *PLoS Medicine* 10(6):e1001465. https://doi.org/10.1371/journal.pmed.1001465.

Lee RLM (2017). Malaysian Identities and Mélange Food Cultures. *Journal of Intercultural Studies* 38(2):139–154. https://doi.org/10.1080/07256868.2017.1289907.

Loh DA, Moy FM, Zaharan NL, Jalaludin MY & Mohamed Z (2017). Sugar-Sweetened Beverage Intake and Its Associations with Cardiometabolic Risks among Adolescents. *Pediatr Obes* 12(1):e1–e5. https://doi.org/10.1111/ijpo.12108.

Mandrioli D, Kearns CE & Bero LA (2016). Relationship between Research Outcomes and Risk of Bias, Study Sponsorship, and Author Financial Conflicts of Interest in Reviews of the Effects of Artificially Sweetened Beverages on Weight Outcomes: A Systematic Review of Reviews. *PLOS ONE* 11 (9):e0162198. https://doi.org/10.1371/journal.pone.0162198.

Martin CK, Das SK, Lindblad L, Racette SB, McCrory MA, Weiss EP, DeLany JP & Kraus WE (2011). Effect of Calorie Restriction on the Free-Living Physical Activity Levels of Nonobese Humans: Results of Three Randomized Trials. *J Appl Physiol* 110(4):956–963. https://doi.org/10.1152/japplphysiol.00846.2009.

Martin CK, Heilbronn LK, de Jonge L, DeLany JP, Volaufova J, Anton SD, Redman LM, Smith SR & Ravussin E (2007). Effect of Calorie Restriction on Resting Metabolic Rate and Spontaneous Physical Activity. *Obesity* 15(12):2964–2973. https://doi.org/10.1038/oby.2007.354.

Mattes R & Foster GD (2014). Food Environment and Obesity. *Obesity* 22(12):2459–61. https://doi.org/10.1002/oby.20922.

Messina M, Lampe JW, Birt DF, Appel LJ, Pivonka E, Berry B & Jacobs DR (2001). Reductionism and the Narrowing Nutrition Perspective: Time for Reevaluation and

Emphasis on Food Synergy. *J Am Diet Assoc* 101 (12): 1416–1419. https://doi.org/10.1016/S0002-8223(01)00342-X.

Ministry of Health, Malaysia (2016). *National Strategic Plan for Non-Communicable Disease (NSPNCD) 2016-2025*. 2016. Ministry of Health, Putrajaya.

Mozaffarian D & Forouhi NG (2018). Dietary Guidelines and Health—Is Nutrition Science up to the Task? *BMJ* 360 (March):k822. https://doi.org/10.1136/bmj.k822.

Mozaffarian D (2017). Conflict of Interest and the Role of the Food Industry in Nutrition Research. *JAMA* 317(17):1755–1756. https://doi.org/10.1001/jama.2017.3456.

National Coordinating Committee on Food and Nutrition (2010). *Malaysian Dietary Guidelines*. Ministry of Health, Kuala Lumpur.

National Coordinating Committee on Food and Nutrition (1996). *National Plan of Action for Nutrition of Malaysia 1996-2000*. Ministry of Health, Kuala Lumpur.

National Coordinating Committee on Food and Nutrition (2006). *National Plan of Action for Nutrition of Malaysia 2006-2015*. Ministry of Health, Kuala Lumpur.

National Coordinating Committee on Food and Nutrition (2016). *National Plan of Action for Nutrition of Malaysia 2016-2025*. Ministry of Health, Kuala Lumpur.

Newell B & Siri J (2016). A role for low-order system dynamics models in urban health policy making. *Environmental International* 95: 93-97. https://doi.org/10.1016/j.envint.2016.08.003.

Ng M, Fleming T, Robinson M, Thomson B, Graetz N, Margono C, Mullany EC, *et al.* (2014). Global, Regional, and National Prevalence of Overweight and Obesity in Children and Adults during 1980–2013: A Systematic Analysis for the Global Burden of Disease Study 2013. *The Lancet* 384 (9945):766–781. https://doi.org/10.1016/S0140-6736(14)60460-8.

Novak NL & Brownell KD (2012). Role of Policy and Government in the Obesity Epidemic. *Circulation* 126(19):2345–52. https://doi.org/10.1161/CIRCULATIONAHA.111.037929.

Nurul-Fadhilah A, Teo PS & Foo LH (2016). Ethnic Differences in the Food Intake Patterns and Its Associated Factors of Adolescents in Kelantan, Malaysia. *Nutrients* 8(9). https://doi.org/10.3390/nu8090551.

Patton MQ (2008). *Utilization-Focused Evaluation*. SAGE Publications.

Penney TL & Kirk SFL (2015). The Health at Every Size Paradigm and Obesity: Missing Empirical Evidence May Help Push the Reframing Obesity Debate Forward. *Am J Public Health* 105(5):e38–e42. https://doi.org/10.2105/AJPH.2015.302552.

Peters JC (2003). Combating Obesity: Challenges and Choices. *Obes Res* 11(S10):7S-11S. https://doi.org/10.1038/oby.2003.220.

Rudolph A & Hilbert A (2017). The Effects of Obesity-Related Health Messages on Explicit and Implicit Weight Bias. *Front Psychol* 7 (January). https://doi.org/10.3389/fpsyg.2016.02064.

Sartorius K, Sartorius B, Madiba TE & Stefan C (2018). Does High-Carbohydrate Intake Lead to Increased Risk of Obesity? A Systematic Review and Meta-Analysis. *BMJ Open* 8(2):e018449. https://doi.org/10.1136/bmjopen-2017-018449.

Sbicca J (2012). Growing Food Justice by Planting an Anti-Oppression Foundation: Opportunities and Obstacles for a Budding Social Movement. *Agr Hum Values* 29(4):455–466. https://doi.org/10.1007/s10460-012-9363-0.

SCHEMA (2018). *SCHEMA Case Studies: Applying Systems Thinking to Urban Health and Wellbeing*. Edited by David Tan and José Siri. United Nations University International Institute for Global Health, Kuala Lumpur, Malaysia:

Schulte PA, Wagner GR, Ostry A, Blanciforti LA, Cutlip RG, Krajnak KM, Luster M, Munson AE, O'Callaghan JP, Parks CG, Simeonova PP & Miller DB (2007). Work, Obesity, and Occupational Safety and Health. *Am J Public Health* 97(3):428–436. https://doi.org/10.2105/AJPH.2006.086900.

Singapore Health Promotion Board (2018). *About the Healthier Ingredient Development Scheme*. From https://www.hpb.gov.sg/healthy-living/food-beverage/healthier-ingredient-schemes/about-the-healthier-ingredient-development-scheme [Retrieved 29 October 2018].

Steeves A, Martins EPA & Gittelsohn J (2014). Changing the Food Environment for Obesity Prevention: Key Gaps and Future Directions. *Curr Obes Rep* 3(4):451–458. https://doi.org/10.1007/s13679-014-0120-0.

Swarna Nantha Y (2014). Addiction to Sugar and Its Link to Health Morbidity: A Primer for Newer Primary Care and Public Health Initiatives in Malaysia. *Journal of Primary Care & Community Health* 5(4):263–270. https://doi.org/10.1177/2150131914536988.

Tee ES (2011). Development and Promotion of Malaysian Dietary Guidelines. *Asia Pac J Clin Nutr* 20 (3):455–461.

Thiagarajan T (2018). *In: Here's All You Need to Know About The Viral Milo Sugar Controversy - WORLD OF BUZZ.* From https://www.worldofbuzz.com/heres-need-know-viral-milo-sugar-controversy/ [Retrieved 3 November 2018].

United Nations (2015). *Transforming our World: The 2030 Agenda for Sustainable Development.* From: https://sustainabledevelopment.un.org/post2015/transformingourworld/publication

US Department of Agriculture (1980). *Nutrition and Your Health: Dietary Guidelines for Americans*. Home and Garden Bulletin 232. USDA, USA. https://health.gov/dietaryguidelines/1980thin.pdf?_ga=2.102197889.1240267622.1536058546-1520023397.1536058546.

US Department of Health and Human Services (2006). *Quick Guide to Health Literacy*. US Department of Health and Human Services, USA.

USDA Center for Nutrition Policy and Promotion (1992). The Food Guide Pyramid. *Home and Garden Bulletin* 252:17.

Wigington PS (2008). Clear Messages for Effective Communication. *Journal of Environmental Health* 70(10):3.

World Health Organization (2004). *In: Global Strategy on Diet, Physical Activity, and Health*. From http://www.who.int/dietphysicalactivity/strategy/eb11344/strategy_english_web.pdf [Retrieved 12 Mac 2018].

World Health Organization (2018). *In: Obesity and Overweight.* From http://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight [Retrieved 16 Feb 2018].

World Health Organization (2010). *Set of Recommendations on the Marketing of Foods and Non-Alcoholic Beverages to Children.* From http://apps.who.int/iris/bitstream/handle/10665/44416/9789241500210_eng.pdf;jsessionid=1AF2D6B6E1DBDB2A94BDB57361573D7F?sequence=1 [Retrieved 8 Mac 2018].

World Health Organization (2017). *Taxes on Sugary Drinks: Why Do It?* From: http://apps.who.int/iris/bitstream/handle/10665/260253/WHO-NMH-PND-16.5Rev.1-eng.pdf?sequence=1 [Retrieved 8 Mac 2018].

World Health Organization (2015). *WHO calls on countries to reduce sugars intake among adults and children.* From https://www.who.int/mediacentre/news/releases/2015/sugar-guideline/en/ [Retrieved 12 Mac 2018].

World Health Organization (2017). *WHO Strategic Communications Framework for Effective Communications.* From http://www.who.int/mediacentre/communication-framework.pdf [Retrieved 8 Mac 2018].

Worsley A (2002). Nutrition Knowledge and Food Consumption: Can Nutrition Knowledge Change Food Behaviour? *Asia Pac J Clin Nutr* 11 (s3):S579–S585. https://doi.org/10.1046/j.1440-6047.11.supp3.7.x.

Yoon NH & Kwon S (2014). The Effects of Community Environmental Factors on Obesity among Korean Adults: A Multilevel Analysis. *Epidemiology and Health* 36 (December). https://doi.org/10.4178/epih/e2014036.

Table 1. Aims of the National Plans of Actions for Nutrition I, II, and II (1996-2000, 2006-2015, 2016-2025) and the evolution of the main areas of focus and facilitating strategies

	National Plan of Action for Nutrition of Malaysia (1996 - 2000) [NPANM I]	*National Plan of Action for Nutrition of Malaysia (2006 -2015) [NPANM II]*	*National Plan of Action for Nutrition of Malaysia III (2016-2025) [NPANM III]*
Main objectives	• Designed to ensure optimal nutritional status of the population for human resource development towards the countries industrialisation process and development of a caring society by the year 2020 • Addresses both under and overnutrition • Nutrition targets and goals were mainly for child survival, protection, and development: malnutrition, anemia, iodine deficiencies, etc.	• Designed to achieve and maintain optimal nutritional well-being of Malaysians • Addresses current and emerging issues in nutrition at that point of time where Malaysia is confronted with the problem of dual burden of malnutrition – underweight and overweight and obesity	• Designed to address food and nutrition challenges in the country • Identified 46 nutrition indicators and set targets to be achieved by 2025 • Aims to strengthen food and nutrition security, enhance nutritional status, and reduce diet-related NCDs
No change/Maintained	*Removed after NPANM I*	*Added into NPANM II*	*Added into NPANM III*
• Incorporating nutritional objectives into development policies and programmes • Improving household food insecurity • Food quality and safety • Breastfeeding • Preventing and controlling specific micronutrient deficiencies • Promoting appropriate diets and healthy lifestyles • Assessing, analysing, and monitoring nutrition situations • Reducing overweight and obesity and other diet-related NCDs	• Preventing and managing infectious diseases	• Complementary feeding practices for young children • Strengthening research and development • Strengthening institutional capacity in nutrition activities • Ensuring nutrition and dietetics are practised by trained professionals	• Maternal nutrition • Sustaining food systems to promote healthy diets • Providing standard nutrition guidelines for various targeted groups • Strengthening community capacity in nutrition activities

Evolution of dietary guidelines in Malaysia
(Malaysia Dietary Guidelines 1999 and 2010)

1. Eat a variety of foods within your recommended intake.
2. Maintain body weight in a healthy range.
3. Be physically active every day.
4. Eat adequate amount of rice, other cereal products (preferably whole grain) and tubers.
5. Eat plenty of fruits and vegetables every day.
6. Consume moderate amounts of fish, meat, poultry, egg, legumes and nuts.*
7. Consume adequate amounts of milk and milk products.*
8. Limit intake of foods high in fats and minimise fats and oils in food preparation.
9. Choose and prepare foods with less salt and sauces.
10. Consumes foods and beverages low in sugar.
11. Drink plenty of water daily.
12. Practise exclusive breastfeeding from birth until six months and continue to breastfeed until two years of age.
13. Consume safe and clean foods and beverages.*
14. Make effective use of nutrition information on food labels.*

*Key messages that were introduced in the Malaysia Dietary Guidelines 2010

Figure 1. Evolution of dietary guidelines in Malaysia

Table 2. Comparison of the Malaysian Food Pyramid and Malaysian Healthy Plate

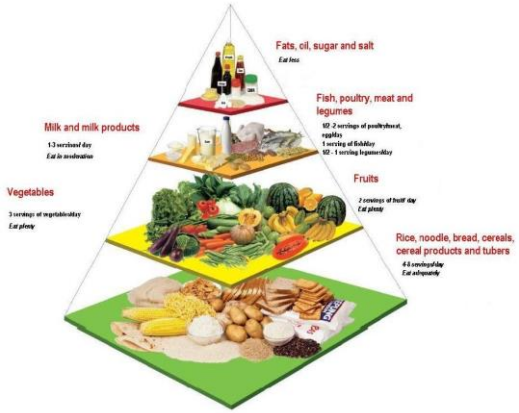
Malaysian Food Pyramid	*Malaysian Healthy Plate 2016*
	
The pyramid consists of four levels (from base to the top of the pyramid): • Level 1 (base) – Cereals, cereal products, and tubers: Eat adequately, 4-8 servings/day • Level 2 - Vegetables: Eat plenty, 3 servings/day Level 2 - Fruits: Eat plenty, 2 servings/day • Level 3 - Milk and milk products: Eat in moderation, 1-3 servings/day • Level 3 - Fish, poultry, meat, eggs, legumes: Eat in moderation, ½ - 2 servings of poultry/meat/egg/day; 1 serving of fish/day, ½ - 1 serving of legumes/day • Level 4 (top) – Fat, oil, sugar, salt: Eat less (no quantity recommended)	"Quarter-Quarter-Half" Concept • Fill a quarter of a plate (round) with rice, noodles, bread, cereals, cereal products, or tubers, preferably wholemeal (carbohydrate-based). • Fill another quarter of the place with fish, chicken, meat, or beans/legumes (protein-based). • Fill half of the plate with vegetables and one serving of fruit. • Complete the meal with a glass of plain water or a non-sweetened beverage, milk, or milk product. Additional recommendations: • Eat three (3) main healthy meals a day. • Eat one to two healthy snack in between mealtimes if needed. • Make at least half of your overall cereal and cereal products intake as wholemeal options. • Eat non-fried and non-coconut milk based dishes everyday. • Eat home-cooked foods more frequently.

Table 3. Total Health Expenditure (Public and Private Sector) to Providers of Health Services, 1997-2015 (RM Million)

	1997 RM Million (%)	*2000 RM Million (%)*	*2003 RM Million (%)*	*2006 RM Million (%)*	*2009 RM Million (%)*	*2010 RM Million (%)*	*2011 RM Million (%)*	*2012 RM Million (%)*	*2013 RM Million (%)*	*2014 RM Million (%)*	*2015 RM Million (%)*
Hospitals[a]	3,990 (48.21)	5,246 (44.84)	7,661 (42.64)	11,247 (47.94)	15,147 (49.18)	16,530 (47.35)	18,304 (48.26)	21,070 (50.59)	22,524 (51.12)	25,704 (52.25)	27,816 (52.87)
Nursing and residential care facilities[b]	2 (0.02)	3 (0.03)	10 (0.06)	12 (0.05)	6 (0.02)	13 (0.04)	16 (0.04)	20 (0.05)	2 (0.00)	2 (0.00)	1 (0.00)
Providers of ambulatory healthcare[c]	1,968 (23.75)	2,612 (22.33)	3,544 (19.72)	5,676 (24.19)	5,526 (17.94)	6,928 (19.85)	7,808 (20.59)	8,665 (20.80)	9,300 (21.11)	10,311 (20.96)	10,753 (20.44)
Retail sale and other providers of medical goods[d]	537 (6.49)	815 (6.96)	1,081 (6.01)	1,669 (7.11)	2,210 (7.18)	2,774 (7.95)	3,193 (8.42)	3,504 (8.41)	3,879 (8.80)	4,604 (9.36)	4,942 (9.39)
Provision and administration of public health programmes[e]	389 (4.70)	439 (3.75)	594 (3.31)	769 (3.28)	1,228 (3.99)	1,009 (2.89)	1,160 (3.06)	1,519 (3.65)	1,125 (2.78)	1,529 (3.11)	1,547 (2.94)
General health administration and insurance[f]	1,026 (12.40)	2,000 (17.10)	3,960 (22.04)	2,780 (11.85)	4,507 (14.63)	5,222 (14.96)	4,638 (12.23)	3,903 (9.37)	3,983 (9.04)	3,764 (7.65)	4,110 (7.81)
Other industries (rest of the Malaysian economy)[g]	104 (1.25)	124 (1.06)	175 (0.97)	203 (0.87)	275 (0.89)	326 (0.93)	389 (1.02)	433 (1.04)	509 (1.15)	554 (1.13)	539 (1.02)
Institutions providing health related services[h]	259 (3.12)	453 (3.87)	933 (5.19)	1,089 (4.64)	1,893 (6.15)	2,030 (5.81)	2,316 (6.11)	2,453 (5.89)	2,636 (5.98)	2,715 (5.52)	2,883 (5.48)
Rest of the world[i]	4 (0.05)	7 (0.06)	11 (0.06)	17 (0.07)	6 (0.02)	75 (0.22)	102 (0.27)	85 (0.20)	6 (0.01)	9 (0.02)	18 (0.03)

Total	8,277 (100.00)	11,698 (100.00)	17,969 (100.00)	23,462 (100.00)	30,796 (100.00)	34,909 (100.00)	37,927 (100.00)	41,652 (100.00)	44,063 (100.00)	49,193 (100.00)	52,609 (100.00)

Source: Malaysia National Health Account Health Expenditure Report 1997-2015, Ministry of Health Malaysia

[a] Public and private hospitals
[b] Nursing care facilities including psychiatric care facilities, residential for mental health, etc
[c] Establishments providing ambulatory health care services directly to non-hospital setting, e.g. medical practitioner clinics, dental clinics, etc
[d] Pharmacies and retail sale/suppliers of vision products, hearing aids, medical appliances
[e] Health prevention and promotion services (public and private)
[f] Overall administration of health (public and private) and health insurance administration
[g] Private occupational health care and home care, etc
[h] Health training institutions (public and private)
[i] Non-resident providers providing health care for the final use residents of Malaysia

Table 4. Total Expenditure (Public and Private) on Health by Functions of Health Services, 1997-2015 (RM Million)

	1997 RM Million (%)	*2000 RM Million (%)*	*2003 RM Million (%)*	*2006 RM Million (%)*	*2009 RM Million (%)*	*2010 RM Million (%)*	*2011 RM Million (%)*	*2012 RM Million (%)*	*2013 RM Million (%)*	*2014 RM Million (%)*	*2015 RM Million (%)*
Services of curative care[j]	5,148 (62.20)	6,791 (58.05)	9,766 (54.35)	14,891 (63.47)	18,352 (59.59)	19,875 (56.94)	23,058 (60.80)	26,161 (62.81)	27,110 (61.53)	30,729 (62.47)	33,093 (62.90)
Services of long-term nursing care[k]	1 (0.02)	3 (0.02)	10 (0.05)	12 (0.05)	5 (0.02)	12 (0.04)	15 (0.04)	19 (0.05)	1 (0.00)	2 (0.00)	1 (0.00)
Ancillary services to health care[l]	2 (0.02)	14 (0.12)	84 (0.47)	197 (0.84)	232 (0.75)	234 (0.67)	335 (0.88)	325 (0.78)	347 (0.79)	676 (1.37)	704 (1.34)
Medical goods dispensed to out-patients[m]	956 (11.55)	1,349 (11.53)	1704 (9.48)	2,612 (11.13)	3,318 (10.77)	4,348 (12.46)	4,836 (12.75)	5,249 (12.60)	5,710 (12.96)	6,754 (13.73)	7,320 (13.91)
Prevention and public health services[n]	483 (5.83)	546 (4.67)	771 (4.29)	1,040 (4.43)	1,328 (4.31)	1,362 (3.90)	1,508 (3.98)	1,798 (4.32)	2,593 (5.88)	2,468 (5.02)	2,653 (5.04)
Health program administration and health insurance[o]	919 (11.10)	1,184 (10.12)	1,936 (10.77)	2,388 (10.18)	3,015 (9.79)	3,162 (9.06)	3,619 (9.54)	3,539 (8.50)	3,528 (8.01)	4,107 (8.35)	4,219 (8.02)
Capital formation of healthcare provider institutions[p]	501 (6.06)	1,357 (11.60)	2,773 15.44)	1,317 (5.61)	2,714 (8.81)	3,831 (10.97)	2,169 (5.72)	2,009 (4.82)	1,808 (4.10)	1,472 (2.99)	1,434 (2.73)
Education and training of health personnel[q]	206 (2.48)	411 (3.52)	850 (4.73)	969 (4.13)	1,781 (5.78)	2,039 (5.84)	2,336 (6.16)	2,478 (5.95)	2,709 (6.15)	2,714 (5.52)	2,887 (5.49)
	1997 RM Million (%)	*2000 RM Million (%)*	*2003 RM Million (%)*	*2006 RM Million (%)*	*2009 RM Million (%)*	*2010 RM Million (%)*	*2011 RM Million (%)*	*2012 RM Million (%)*	*2013 RM Million (%)*	*2014 RM Million (%)*	*2015 RM Million (%)*
All other health related	0 (-)	0 (-)	0 (-)	0 (-)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.00)	1 (0.00)

expenditures[s]											
Total	8,277 (100.00)	11,698 (100.00)	17,968 (100.00)	23,461 (100.00)	30,798 (100.00)	34,908 (100.00)	37,926 (100.00)	41,652 (100.00)	44,063 (100.00)	49,193 (100.00)	52,609 (100.00)

Source: Malaysia National Health Account Health Expenditure Report 1997-2015, Ministry of Health Malaysia

[j] Curative care provider at inpatient, outpatient, day-care, and homecare services (includes hospitals and clinics)
[k] Long term nursing care provider at inpatient, outpatient, day-care, and homecare services
[l] Stand-alone laboratory, diagnostic, imaging, transport, and emergency rescue, etc.
[m] Pharmaceuticals, appliances, western medicines, traditional Chinese medicine, etc.
[n] Health promotion, prevention, family planning, school health services, etc
[o] Administration at HQ, State health dept, local authorities, private insurance, Employees Provident Fund, etc
[p] Administration at HQ, State health dept, local authorities, private insurance, etc
[q] Government & private provision of education and training of health personnel, including admin, etc
[r] Research and development in health
[s] Category to capture all other expenditures that not classified elsewhere