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

4
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51 **Exploring Malaysia's Expanding Waistlines: the Role of Dietary Public Health Messages**
52 **and Guidelines in Tackling Overweight and Obesity Issues**

53

54 **ABSTRACT**

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

68

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

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90 INTRODUCTION

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

103
104 Malaysia has stated its intent to stop the rise in prevalence of obesity by 2025 (Ministry of
105 Health, 2016). The US\$1-2 billion (RM4.26– 8.53 billion) spent to combat obesity in 2016—
106 including direct and indirect costs—is equivalent to ~10-19% of national healthcare
107 expenditures (Asia Roundtable on Food Innovation for Improved Nutrition (ARoFIIN), 2016).
108 Public health messages around nutrition—such as those issued by the Ministry of Health—
109 are important as one of a range of efforts for health promotion and obesity. Yet, despite all
110 these actions, obesity rates have continued to rise sharply.

111
112 Failure to halt the dramatic increase in the prevalence of overweight and obesity in Malaysia
113 and worldwide has contributed to increased health risks for non-communicable diseases
114 (NCDs) such as diabetes, cardiovascular diseases and cancers and other health issues,
115 leading to higher morbidity and mortality rates. About 8% of total mortality each year is
116 attributed to obesity (Beaglehole *et al.*, 2011). Beyond increased risk of obesity-related chronic
117 diseases and poorer quality of life, the healthcare costs of treating obesity-related disease
118 conditions are rapidly escalating. On average, obese Malaysian males and females lose from
119 6–11 years and 7–12 years of productive life, respectively (ARoFIIN, 2016).

120
121 This paper reviews some of the dietary public health messages, guidelines, and programmes
122 related to overweight and obesity in Malaysia. It identifies possible reasons for the continuing
123 increase in prevalence in the face of abundant public health messages and offers
124 recommendations for a more systemic, place-based approach to slowing and reversing the
125 rise in obesity.

126

127 **Dietary Public Health Messages**

128 ***Public Health Messages Related to Nutrition and Obesity in Malaysia***

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

135
136 Table 1 compares the evolving aims of the three NPANM and the evolution of the main areas
137 of focus and facilitating strategies. In the 1996-2000 version, most targets and goals
138 addressed nutritional deficiencies, with no set target for overweight and obesity. At the time,
139 the prevalence of overweight and obesity were 16.6% and 4.4%, respectively (IPH, 1996). By
140 2003, these had increased to 26.7% and 12.2%, representing nearly two- and three-fold
141 increases, respectively, over just seven years (Azmi et al., 2009). By the launch of the second
142 NPANM in 2006, national prevalence of overweight and obesity among adults was reported at
143 29.1% and 14.1% (IPH, 2006), with prevalence of NCDs also on the rise. The new plan,
144 accordingly, shifted to meet the new needs, aiming to enhance the nutritional status of the
145 entire population and prevent and control diet-related NCDs. NPANM II set a population-level
146 goal of not more than 30% overweight and not more than 15% obese—targets which were not
147 achieved. In view of the current critical situation, the third and most recent NPANM (2016-
148 2025) has adopted a goal of *no further increase* in any obesity-related indicators, taking NHMS
149 2015 data as a baseline. It has also established new indicators, such as abdominal obesity
150 and overweight and obesity among adults above 60 years of age.

151
152 Whereas all three plans have taken on such basic goals as ensuring food quality and safety
153 and promoting appropriate diets and healthy lifestyles, focal areas and facilitating strategies
154 for nutrition have evolved in successive NPANMs (Table 1). For example, NPANM I prioritized
155 the prevention and management of infectious diseases, while NPANM II addressed
156 complementary feeding for children and promoted institution-building strategies to
157 strengthen research, development, and capacity. NPANM III recognises the importance of
158 systemic action and local context, promoting multidisciplinary teamwork that builds
159 capacities and empowers communities, the inclusion of food systems frameworks in
160 nutritional strategies, and the development of targeted guidelines for vulnerable groups.

161
162 The Malaysian Dietary Guidelines are an important strand of public health messages related
163 to nutrition. Aimed primarily at health care providers, they are “intended to act as a tool for
164 healthy eating promotion towards achieving the National Plan of Action for Nutrition Malaysia”
165 (NCCFN, 2010). Established in 1999 with eight key messages designed to prevent nutritional
166 deficiency and chronic diseases, the Guidelines were revised and updated in 2010, splitting

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

171
172 Another strand of promotion of public health nutrition encompasses the visually-oriented
173 Malaysian Food Pyramid and Healthy Plate, aimed at the general public. The Malaysian Food
174 Pyramid, modelled on the United States Department of Agriculture (USDA) Food Guide
175 Pyramid (USDA, 1992), was first introduced in 1997 (Tee, 2011) and was intended as a visual
176 guide to assist the public in planning suitable daily food consumption in terms of choices and
177 quantities. In 2016, the Malaysian Healthy Plate, modelled on the USDA MyPlate (Table 2),
178 was released to supplement and in some ways supersede the Food Pyramid. The Malaysian
179 Healthy Plate was heavily promoted to the public through mass media, with a message of
180 *suku-suku-separuh* (“quarter-quarter-half” in Bahasa Malaysia), referring to fractions of a
181 typical plate: one quarter for meat or fish (protein-based foods), one quarter for grains or
182 carbohydrate-based foods, and half for vegetables and a serving of fruit. The healthy plate
183 concept is highly visual and relatable, and thus easier to understand and put into practice
184 than the more abstract food pyramid.

185

186 ***Public health spending in Malaysia***

187 One way to improve the visibility and impact of public health messages is to increase
188 expenditures. While specific data on spending on public health nutrition messages and the
189 costs of nutrition-related disease are difficult to access, evidence from other sources suggests
190 that Malaysia spends far more on treatment than on prevention. For example, according to
191 providers of health services in Malaysia from 1997 to 2015, expenditures on hospitals,
192 ambulatory health care, medicines, and medical appliances greatly exceed the expenditure on
193 health prevention and promotion services (Table 3). Indeed, expenditure on hospital treatment
194 amounted to 50% or more of total health expenditures (including public and private sectors),
195 while less than 5% was spent on provision and administration of public health programmes.
196 Over the same period, similar trends are seen for total health expenditure by the function of
197 health services (Table 4). About 55-65% of expenditure was for services of curative care,
198 whereas just 4-6% was spent on prevention and public health services (Jackson & Shiell,
199 2017).

200

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

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

213

214 ***Evolution and controversy in dietary guidelines***

215 Nutritional and dietary guidelines have evolved significantly over the past century, in parallel
216 with greater understanding of the pathophysiological underpinnings of ill health. Modern
217 nutritional science began with a strong focus on single-nutrient deficiencies and a concern
218 over food shortages (Mozaffarian & Forouhi, 2018). Isolation of Vitamin C as a cure for scurvy
219 in 1932 was followed by the identification of other single-nutrient deficits related with health
220 issues, such as Vitamin A deficiency with night blindness, Vitamin D with rickets, thiamine
221 with beriberi, and niacin with pellagra (Mozaffarian & Forouhi, 2018). These relatively simple
222 successes inspired a reductionist approach to nutritional science, in which the relevant
223 nutrient for a given disease was identified and a target intake established (Messina *et al.*,
224 2001). This information was translated into simple messages for public consumption.

225

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

242

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

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

262

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

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

272

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

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

288
289 Another conspicuous example involves sugar-sweetened beverages (SSBs), a top contributor
290 to overall sugar consumption (Baker & Friel, 2014). In industry-sponsored research on the
291 health effects of SSBs (Bes-Rastrollo *et al.*, 2013) and artificial sweeteners (Mandrioli, Kearns
292 & Bero, 2016), the likelihood of conclusions favourable to the sponsor is higher than in non-
293 industry-sponsored studies. Children and adolescents are frequent targets of SSB marketing
294 strategies. This is critical because taste preferences are formed during youth and
295 adolescence—habitual exposure to SSBs leads to unhealthy lifetime dietary habits (Gostin,
296 2018). Indeed, Brownell and Warner (2009) found that the food industry purposefully targeted
297 youth populations to lock in new generations of consumers, a strategy previously adopted
298 with much success by tobacco companies. SSB consumption is associated with increased
299 waist circumference and other cardiometabolic risk factors independent of physical activity
300 levels and dietary patterns (Loh *et al.*, 2017).

301
302 Even when the food industry promotes healthier foods, it is usually done in ways that rely on
303 reductionist messages that are easy to grasp, and that promise to improve health regardless
304 of dietary and lifestyle context. The boom in the vitamin and dietary-supplement industries
305 relies on such marketing, despite a lack of evidence that these products benefit the general
306 population (Jenkins *et al.*, 2018). Similarly, the benefits of other so-called health foods and
307 diets, including juices and gluten-free diets, have frequently been overstated and taken out of
308 the context of the original research (Freeman *et al.*, 2017). Such messages are further
309 reinforced by dietary advice presented in the media, often based on the weakest forms of
310 evidence, and therefore contributing to public misconceptions about food and health (Cooper
311 *et al.*, 2012).

312
313 **Cross sector approaches in improving dietary public health messages**

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

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

342
343 It is important to consider how health messages feed into the physiological-environmental
344 system that underlies obesity and the conditions necessary for information to be effective in
345 this context. Public health messages aimed at reducing obesity must transcend an implied
346 *information-deficit* model which assumes that supplying basic knowledge on nutrition is
347 enough to achieve change. Rather, such messages are best understood as attempts to
348 convince a very broad, diverse audience to make behavioural and lifestyle changes that are
349 both difficult and at odds with their contextual cues and incentives. This differs from
350 traditional marketing, which delivers uncomplicated, attractive messages to targeted
351 audiences, and it should be no surprise that health messages achieve lower response rates
352 (Kelly & Barker, 2016). This problem is compounded when health sector messages compete
353 against those from commercial food and “health” industries. The latter promote simpler
354 products while also generating profits, allowing the private sector to far outspend the health
355 sector in this context. At present, guidelines for health promotion focus on communication
356 techniques, such as limiting the number of ideas to avoid confusing readers (US Department
357 of Health and Human Services, 2006), reducing jargon and technical language, using active
358 voice and conversational style, and providing concrete examples (Wigington, 2008). Indeed,
359 beyond failing to enable healthier behaviour, poorly crafted messages may contribute to
360 negative self-perceptions and, in the process, generate more pervasive problems (Penney &
361 Kirk, 2015; Rudolph & Hilbert, 2017). Yet, while important, such techniques do not address
362 the broad range of obstacles in the messaging environment.

363
364 Because knowledge is necessary, but not sufficient, to change behaviour (Worsley, 2002;
365 Patton, 2008), messages targeted at individual behaviour need to be accompanied by

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

384

385 Within Malaysia there is such heterogeneity in sociocultural environments that both the
386 message and the way it is communicated must be tailored to local contexts, highlighting the
387 importance of place-based thinking. Indeed, rates of obesity in Malaysia vary by geographical
388 locations and ethnicity (IPH, 2015), and these differences are greater than can be explained
389 by simple urban/rural differentiation. Varied diets and cultures (Nurul Fadhilah, Teo & Foo,
390 2016; Lee, 2017) imply that the changes needed to achieve healthy and socially-acceptable
391 eating habits and lifestyles may be very different for different ethnic and social groups.
392 Similarly, identifying the appropriate form of messages and messengers for a target group is
393 important and requires local knowledge (WHO, 2017). Acquiring and using this knowledge
394 depends on early and consistent community engagement and participation in both research
395 and policy processes, before problems and potential solutions are formulated (Bodison *et al.*,
396 2015). Accounting for the particularities of place will better allow for the development of
397 targeted and tailored messages, programmes, guidelines, and interventions to meet age,
398 gender, culture, socioeconomic, and geographical needs.

399

400 **Recommendations for improving dietary public health messages in Malaysia**

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

405

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,

446 2018). The Malaysian health sector should consider how to engage with such influencers, to
447 encourage them to use messages based on the best available evidence. Direct engagement
448 with the food industry would be beneficial. Indeed, the United States Centers for Disease
449 Control and Prevention (CDC) acknowledged that the food industry’s “expertise, reach, and
450 innovation can help address challenges in food production, formulation, and distribution;
451 facilitate greater innovation for public good; and build capacity” despite the potential for bias
452 (CDC, 2018). Nevertheless, partnerships between the health sector and the food industry
453 must be governed by clear principles to avoid actions and perceptions that would compromise
454 health promotion goals (Mozaffarian, 2017; CDC, 2018; Freedhoff & Hébert, 2011).

455

456 ***Complementing Messages with Regulatory and Fiscal Policy***

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

482

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

486 of total energy intake, and advocates a further reduction to below 5% (WHO, 2015). Yet, sugar
487 consumption worldwide exceeds these levels; indeed, Malaysian per-capita sugar
488 consumption is among the highest in the world (11-19 tsp/day) (Swarna Nantha, 2014;
489 Amarra, Khor & Chan, 2016); this is approximately 9-15% of total intake, assuming
490 2000kcal/day. One response has been to tax products with high sugar content, such as SSBs,
491 and this has been effective in some contexts (Colchero *et al.*, 2017; WHO, 2017; Gostin, 2018).
492 Yet, in Malaysia, the price of sugar is perceived to broadly affect food prices, making it an
493 important political issue on a wider scale. In fact, sugar was subsidised until 2013, and
494 Malaysia still maintains a price ceiling on sugar, with politicians continuing to advocate
495 subsidies (anon, 2017) or lowering this ceiling (Ganeshwaran, 2018). At the same time, SSB
496 taxes have been studied by the Ministry of Health in the past, and have been proposed again
497 recently in response to rising diabetes rates (anon, 2018). The contrasting positions on sugar
498 prices and SSB taxes highlight the conflicting priorities between the trade and health arms of
499 the Malaysian Government, illustrating the need for coordinated policy and mainstreaming of
500 health in all government action.

501
502 Subsidies can provide an effective complement to taxation in promoting better nutrition. In
503 neighbouring Singapore, the Health Promotion Board has coupled messages on the
504 consumption of brown rice and other whole grains with subsidises for these staple ingredients
505 in the food service industry (Singapore Health Promotion Board, 2018). High consumption of
506 white rice has been shown to increase Type II diabetes risk, particularly in Asian populations
507 (Hu *et al.*, 2012) but white rice is culturally far more popular, perceived as finer and more
508 desirable. Furthermore, brown rice carries a higher price tag, in part due to economies of
509 scale. This subsidy attempts to shift private sector practice to reinforce health messages on
510 rice consumption. Such strategies are worth exploring in Malaysia, where many consumers
511 have high price-sensitivity, and the direct cost of diabetes alone is estimated at RM 2.04 billion
512 annually (Feisul Idzwan *et al.*, 2017).

513 **CONCLUSION**

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

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

530

531 **List of Abbreviations**

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

541

542

543 **Conflict of Interest**

544 The authors declare that they have no conflicts of interest.

545

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553 **References**

- 554 Abdullah NN, Mazlin MM, Mohd Harriszamani AB & Al-Kubaisy W (2015). Trend on Fast Food
 555 Consumption in Relation to Obesity among Selangor Urban Community. *Procedia -*
 556 *Social and Behavioral Sciences*, ASLI QoL2014 (Annual Serial Landmark International
 557 Conference on Quality of Life) / AQoL 2014 Istanbul (ABRA International Conference
 558 on Quality of Life) (August):505–13. <https://doi.org/10.1016/j.sbspro.2015.08.189>.
 559
- 560 Amarra MSV, Khor GL & Chan P (2016). Intake of Added Sugar in Malaysia: A Review. *Asia*
 561 *Pac J Clin Nutr* 25(2): 227-40.
 562
- 563 Anon (2018). *Govt Considering Soda Tax to Encourage Healthy Living, Says PM*. In Malay Mail.
 564 August 27, 2018. From [https://www.malaymail.com/s/1666339/govt-considering-](https://www.malaymail.com/s/1666339/govt-considering-soda-tax-to-encourage-healthy-living-pm-says)
 565 [soda-tax-to-encourage-healthy-living-pm-says](https://www.malaymail.com/s/1666339/govt-considering-soda-tax-to-encourage-healthy-living-pm-says) [Retrieved November 1 2018].
 566
- 567 Anon (2017). *Selangor PKR Youth Wants Sugar Subsidy Restored*. In: Malay Mail. March 3,
 568 2017. From [https://www.malaymail.com/s/1327357/selangor-pkr-youth-wants-](https://www.malaymail.com/s/1327357/selangor-pkr-youth-wants-sugar-subsidy-restored)
 569 [sugar-subsidy-restored](https://www.malaymail.com/s/1327357/selangor-pkr-youth-wants-sugar-subsidy-restored) [Retrieved November 1 2018].
 570

- 571 ARoFIIN (2016). *Tackling Obesity in ASEAN: Prevalence, Impact and Guidance on Interventions*.
572 The Economist Intelligence Unit (EIU) and the Asia Roundtable on Food Innovation for
573 Improved Nutrition (ARoFIIN). From [http://www.arofiin.org/News/tid/54/Tackling-](http://www.arofiin.org/News/tid/54/Tackling-Obesity-in-ASEAN-Prevalence-Impact-and-Guidance-on-Interventions)
574 [Obesity-in-ASEAN-Prevalence-Impact-and-Guidance-on-Interventions](http://www.arofiin.org/News/tid/54/Tackling-Obesity-in-ASEAN-Prevalence-Impact-and-Guidance-on-Interventions) [Retrieved
575 June 1 2018].
576
- 577 Azmi MY, Junidah R, Siti Mariam A, Safiah MY, Fatimah S, Norimah AK, Poh BK, Kandiah
578 M, Zalilah MS, Wan Abdul Manan W, Siti Haslinda MD & Tahir A (2009). Body Mass
579 Index (BMI) of Adults: Findings of the Malaysian Adult Nutrition Survey (MANS). *Mal*
580 *J Nutr* 15(2): 97–119.
581
- 582 Baker P & Friel S (2014). Processed Foods and the Nutrition Transition: Evidence from Asia.
583 *Obes Rev* 15(7):564–77. <https://doi.org/10.1111/obr.12174>.
584
- 585 Beaglehole R, Bonita R, Horton R, Adams C, Alleyne G, Asaria P, Baugh V, Bokedam H, Billo
586 N, Casswell S, Cecchini M, Colagiuri R, Colagiuri S, Collins T, Ebrahim S, Engelgau
587 M, Galea G, Gaziano T, Geneau R, Haines A, Hospedales J, Jha P, Keeling A, Leeder
588 S, Lincoln P, McKee M, Mackay J, Magnusson R, Moodie R, Mwatsama M, Nishtar S,
589 Norrving B, Patterson D, Piot P, Ralston J, Rani M, Reddy KS, Sassi F, Sheron N,
590 Stuckler D, Suh I, Torode J, Varghese C & Watt J (2011). Priority Actions for the Non-
591 Communicable Disease Crisis. *Lancet* 377(9775):1438–1447.
592 [https://doi.org/10.1016/S0140-6736\(11\)60393-0](https://doi.org/10.1016/S0140-6736(11)60393-0).
593
- 594 Bes-Rastrollo M, Schulze MB, Ruiz-Canela M & Martinez-Gonzalez MA (2013). Financial
595 Conflicts of Interest and Reporting Bias Regarding the Association between Sugar-
596 Sweetened Beverages and Weight Gain: A Systematic Review of Systematic Reviews.
597 *PLoS Medicine* 10(12). <https://doi.org/10.1371/journal.pmed.1001578>.
598
- 599 Bodison SC, Sankaré I, Anaya H, Booker-Vaughns J, Miller A, Williams P, Norris K &
600 Community Engagement Workgroup (2015). Engaging the Community in the
601 Dissemination, Implementation, and Improvement of Health-Related Research. *Clin.*
602 *Transl. Sci.* 8(6):814–19. <https://doi.org/10.1111/cts.12342>.
603
- 604 Booth FW, Roberts CK & Laye MJ (2012). Lack of Exercise Is a Major Cause of Chronic
605 Diseases. *Compr. Physiol.* 2(2):1143–1211. <https://doi.org/10.1002/cphy.c110025>.
606
- 607 Brownell KD & Warner KE (2009). The Perils of Ignoring History: Big Tobacco Played Dirty
608 and Millions Died. How Similar Is Big Food? *The Milbank Quarterly* 87(1):259–94.
609 <https://doi.org/10.1111/j.1468-0009.2009.00555.x>.
610
- 611 Byrne E, Kearney J & MacEvilly C (2017). The Role of Influencer Marketing and Social
612 Influencers in Public Health. *Proceedings of the Nutrition Society* 76 (OCE3).
613 <https://doi.org/10.1017/S0029665117001768>.
614
- 615 Centers for Disease Control and Prevention (2018). *CDC's Guiding Principles for Public-Private*
616 *Partnerships: A Tool to Support Engagement with the Private Sector to Achieve Public*
617 *Health*. US Centers for Disease Control and Prevention, USA.
618
- 619 Cheong SM, Mirnalini K, Karuthan C, Chan YM & Hazizi AS (2010). Prevalence of Obesity and
620 Factors Associated with It in a Worksite Setting in Malaysia. *Journal of Community*
621 *Health* 35(6):698–705. <https://doi.org/10.1007/s10900-010-9274-1>.
622
- 623 Cohen DA (2008). Obesity and the Built Environment: Changes in Environmental Cues Cause
624 Energy Imbalances. *Int J Obes* 32(Suppl 7)(December):S137-142.
625 <https://doi.org/10.1038/ijo.2008.250>.
626
- 627 Colchero M, Juan Rivera-Dommarco A, Popkin BM & Ng SW (2017). In Mexico, Evidence Of
628 Sustained Consumer Response Two Years After Implementing A Sugar-Sweetened

- 629 Beverage Tax. *Health Affairs* 36(3):564–571.
 630 <https://doi.org/10.1377/hlthaff.2016.1231>.
 631
- 632 Cooper BEJ, Lee WE, Goldacre BM & Sanders TAB (2012). The Quality of the Evidence for
 633 Dietary Advice given in UK National Newspapers. *Public Understanding of Science*
 634 21(6):664–673. <https://doi.org/10.1177/0963662511401782>.
 635
- 636 Crossley ML (2002). Resistance to Health Promotion: A Preliminary Comparative Investigation
 637 of British and Australian Students. *Health Education* 102(6):289–299.
 638 <https://doi.org/10.1108/09654280210446838>.
 639
- 640 Fardet A & Rock E (2014). Toward a New Philosophy of Preventive Nutrition: From a
 641 Reductionist to a Holistic Paradigm to Improve Nutritional Recommendations. *Adv*
 642 *Nutr* 5(4):430–446. <https://doi.org/10.3945/an.114.006122>.
 643
- 644 Feisul Idzwan M, Soraya A, Mohd Rizal AM, Zanariah H, Nik Jasmin NM, Fatanah I, Azimatun
 645 NA & Goh A (2017). What Are the Direct Medical Costs of Managing Type 2 Diabetes
 646 Mellitus in Malaysia? *Med J Malaysia* 72(5):7.
 647
- 648 Flier JS (2017). What Fuels Fat. *Scientific American* 297(3):72–81.
 649 <https://doi.org/10.1038/scientificamerican0907-72>.
 650
- 651 Food Industry Asia (2012). Government and Industry Come Together to Tackle NCDs. From
 652 <https://foodindustry.asia/government-and-industry-come-together-to-tackle-ncds>
 653 [Retrieved 8 Mar 2018].
 654
- 655 Food Industry Asia (2013). *Malaysia Launches First Responsible Advertising to Children*
 656 *Pledge*. From [https://foodindustry.asia/malaysia-launches-first-responsible-](https://foodindustry.asia/malaysia-launches-first-responsible-advertising-to-children-pledge)
 657 [advertising-to-children-pledge](https://foodindustry.asia/malaysia-launches-first-responsible-advertising-to-children-pledge) [Retrieved 8 Mac 2018].
 658
- 659 Freedhoff Y & Hébert PC (2011). Partnerships between Health Organizations and the Food
 660 Industry Risk Derailing Public Health Nutrition. *Can Med Assoc J* 183(3):291–292.
 661 <https://doi.org/10.1503/cmaj.110085>.
 662
- 663 Freeman AM, Morris PB, Barnard N, Esselstyn CB, Ros E, Agatston A, Devries S, O'Keefe J,
 664 Miller M, Ornish D, Williams K & Kris-Etherton P (2017). Trending Cardiovascular
 665 Nutrition Controversies. *J Am Coll Cardiol* 69(9):1172–1187.
 666 <https://doi.org/10.1016/j.jacc.2016.10.086>.
 667
- 668 Ganeshwaran K (2018). *Pakatan Govt May Lower Ceiling Price of Refined Sugar*. In Business
 669 News The Star Online. From [https://www.thestar.com.my/business/business-](https://www.thestar.com.my/business/business-news/2018/05/25/price-review-may-affect-msm/)
 670 [news/2018/05/25/price-review-may-affect-msm/](https://www.thestar.com.my/business/business-news/2018/05/25/price-review-may-affect-msm/) [Retrieved 24 October 2018].
 671
- 672 González Jiménez E, Aguilar Cordero MJ, García García CJ, García López P, Álvarez Ferre J,
 673 Padilla López CA & Ocete Hita E (2012). Influence of family environment of the
 674 development of obesity and overweight in a population of school children in Granada
 675 (Spain). *Nutricion Hospitalaria* 27(1):177–184. [https://doi.org/10.1590/S0212-](https://doi.org/10.1590/S0212-16112012000100021)
 676 [16112012000100021](https://doi.org/10.1590/S0212-16112012000100021).
 677
- 678 Gostin LO (2018). Tackling Obesity and Disease: The Culprit Is Sugar; the Response Is Legal
 679 Regulation. *The Hastings Center Report* 48(1):5–7. <https://doi.org/10.1002/hast.804>.
 680
- 681 Hafekost K, Lawrence D, Mitrou F, O'Sullivan TA & Zubrick SR (2013). Tackling Overweight
 682 and Obesity: Does the Public Health Message Match the Science? *BMC Medicine*
 683 11(1):41. <https://doi.org/10.1186/1741-7015-11-41>.
 684
- 685 Hamid JJM, Loy SL, Mohd Nasir MT, Norimah AK, Tan SY, Appukutty M, Nurliyana AR,
 686 Thielecke F, Hopkins S, Ong MK, Ning C & Tee ES (2015). Characteristics associated
 687 with the consumption of malted drinks among Malaysian primary school children:

- 688 findings from the MyBreakfast study. *BMC Public Health* 15:1322.
 689 <https://doi.org/10.1186/s12889-015-2666-5>.
 690
- 691 Harcombe Z, Baker JS, Cooper SM, Davies B, Sculthorpe N, DiNicolantonio JJ & Grace F
 692 (2015). Evidence from Randomised Controlled Trials Did Not Support the Introduction
 693 of Dietary Fat Guidelines in 1977 and 1983: A Systematic Review and Meta-Analysis.
 694 *Open Heart* 2(1):e000196. <https://doi.org/10.1136/openhrt-2014-000196>.
 695
- 696 Harcombe Z, Baker JS & Davies B (2017). Evidence from Prospective Cohort Studies Does Not
 697 Support Current Dietary Fat Guidelines: A Systematic Review and Meta-Analysis. *Br*
 698 *J Sports Med* 51(24):1743–1749. <https://doi.org/10.1136/bjsports-2016-096550>.
 699
- 700 Harris JL, Schwartz MB, Munsell CR, Dembek C, Liu S, LoDolce M, Heard A, Fleming-Milici
 701 F & Kidd B (2013). *Fast Food FACTS 2013: Measuring Progress in Nutrition and*
 702 *Marketing to Children and Teens* 128. Yale Rudd Center for Food Policy & Obesity,
 703 Yale.
 704
- 705 Harris JL, Shehan C, Gross R, Kumanyika S, Lassiter V, Ramirez AG & Gallion K (2015).
 706 Rudd Report: Food Advertising Targeted to Hispanic and Black Youth: Contributing to
 707 Health Disparities. Storrs, CT: Rudd Center for Food Policy and Obesity, University of
 708 Connecticut. [http://www.uconnruddcenter.org/files/Pdfs/272-
 709 7%20%20Rudd_Targeted%20Marketing%20Report_Release_081115%5B1%5D.pdf](http://www.uconnruddcenter.org/files/Pdfs/272-7%20%20Rudd_Targeted%20Marketing%20Report_Release_081115%5B1%5D.pdf).
 710
- 710 Hawkes C & Lobstein T (2011). Regulating the Commercial Promotion of Food to Children: A
 711 Survey of Actions Worldwide. *Int J Pediatr Obes* 6(2):83–94.
 712 <https://doi.org/10.3109/17477166.2010.486836>.
 713
- 714 Hill JO & Peters JC (1998). Environmental Contributions to the Obesity Epidemic. *Science*
 715 280(5368):1371–74.
 716
- 717 Hu EA, Pan A, Malik V & Sun Q (2012). White Rice Consumption and Risk of Type 2 Diabetes:
 718 Meta-Analysis and Systematic Review. *BMJ* 344 (March):e1454.
 719 <https://doi.org/10.1136/bmj.e1454>.
 720
- 721 Huang H, Che Wan Jasimah WMR & Jenatabadi HS (2017). Family Environment and
 722 Childhood Obesity: A New Framework with Structural Equation Modeling.
 723 *International Journal of Environmental Research and Public Health*, 14 (2).
 724 <https://doi.org/10.3390/ijerph14020181>.
 725
- 726 Hyun HS & Kim Y (2018). Associations between Working Environment and Weight Control
 727 Efforts among Workers with Obesity in Korea. *Int J Med Res* 46(6):2307–2316.
 728 <https://doi.org/10.1177/0300060518764212>.
 729
- 730 Institute for Public Health (2015). *National Health and Morbidity Survey 2015 (NHMS 2015).*
 731 *Vol. II: Non-Communicable Diseases, Risk Factors & Other Health Problems*. Ministry of
 732 Health, Kuala Lumpur.
 733
- 734 Institute for Public Health (1996). *Second National Health and Morbidity Survey (NHMS 2).*
 735 Ministry of Health, Kuala Lumpur.
 736
- 737 Institute for Public Health (2006). *The Third National Health and Morbidity Survey (NHMS III).*
 738 Ministry of Health, Kuala Lumpur.
 739
- 740 Jackson H & Shiell A (2017). *How Much Does Australia Spend and Is It Enough?* Canberra:
 741 Foundation for Alcohol Research and Education, Australia.
 742
- 743 Jenkins DJA, Spence JD, Giovannucci EL, Kim YI, Josse R, Vieth R, Mejia SB, Viguiliouk E,
 744 Nishi S, Sahye-Pudaruth S, Paquette M, Patel D, Mitchell S, Kavanagh M, Tsirakis T,
 745 Bachiri L, Maran A, Umatheva N, McKay T, Trinidad G, Bernstein D, Chowdhury A,
 746 Correa-Betanzo J, Del Principe G, Hajizadeh A, Jayaraman R, Jenkins A, Jenkins W,

- 747 Kalaichandran R, Kirupaharan G, Manisekaran P, Qutta T, Shahid R, Silver A, Villegas
748 C, White J, Kendall CWC, Pichika SC, Sievenpiper JL (2018). Supplemental Vitamins
749 and Minerals for CVD Prevention and Treatment. *J Am Coll Cardiol* 71(22):2570–2584.
750 <https://doi.org/10.1016/j.jacc.2018.04.020>.
- 751
752 Johnstone L & Lindh C (2018). The Sustainability-Age Dilemma: A Theory of (Un)Planned
753 Behaviour via Influencers. *J Consumer Behav* 17(1):e127–139.
754 <https://doi.org/10.1002/cb.1693>.
- 755
756 Kelly MP & Barker M (2016). Why Is Changing Health-Related Behaviour so Difficult? *Public*
757 *Health* 136 (July):109–116. <https://doi.org/10.1016/j.puhe.2016.03.030>.
- 758
759 Koplan JP, Liverman CT, Kraak VI & Committee on Prevention of Obesity in Children and
760 Youth (2005). Preventing Childhood Obesity: Health in the Balance: Executive
761 Summary. *J Acad Nutr Diet* 105(1):131–138.
762 <https://doi.org/10.1016/j.jada.2004.11.023>.
- 763
764 Kovic Y, Noel JK, Ungemack JA & Burleson JA (2018). The Impact of Junk Food Marketing
765 Regulations on Food Sales: An Ecological Study. *Obes Rev* 19(6):761–769.
766 <https://doi.org/10.1111/obr.12678>.
- 767
768 Kumanyika S, Libman K & Garcia A (2013). *Strategic Action to Combat the Obesity Epidemic:*
769 *Report of the Obesity Working Group 2013*, 48. WISH Obesity Report, Qatar.
- 770
771 Lachat C, Otchere S, Roberfroid D, Abdulai A, Seret FMA, Milesevic J, Xuereb G, Candeias V
772 & Kolsteren P (2013). Diet and Physical Activity for the Prevention of
773 Noncommunicable Diseases in Low- and Middle-Income Countries: A Systematic
774 Policy Review. *PLoS Medicine* 10(6):e1001465.
775 <https://doi.org/10.1371/journal.pmed.1001465>.
- 776
777 Lee RLM (2017). Malaysian Identities and Mélange Food Cultures. *Journal of Intercultural*
778 *Studies* 38(2):139–154. <https://doi.org/10.1080/07256868.2017.1289907>.
- 779
780 Loh DA, Moy FM, Zaharan NL, Jalaludin MY & Mohamed Z (2017). Sugar-Sweetened Beverage
781 Intake and Its Associations with Cardiometabolic Risks among Adolescents. *Pediatr*
782 *Obes* 12(1):e1–e5. <https://doi.org/10.1111/ijpo.12108>.
- 783
784 Mandrioli D, Kearns CE & Bero LA (2016). Relationship between Research Outcomes and Risk
785 of Bias, Study Sponsorship, and Author Financial Conflicts of Interest in Reviews of
786 the Effects of Artificially Sweetened Beverages on Weight Outcomes: A Systematic
787 Review of Reviews. *PLOS ONE* 11 (9):e0162198.
788 <https://doi.org/10.1371/journal.pone.0162198>.
- 789
790 Martin CK, Das SK, Lindblad L, Racette SB, McCrory MA, Weiss EP, DeLany JP & Kraus WE
791 (2011). Effect of Calorie Restriction on the Free-Living Physical Activity Levels of
792 Nonobese Humans: Results of Three Randomized Trials. *J Appl Physiol* 110(4):956–
793 963. <https://doi.org/10.1152/jappphysiol.00846.2009>.
- 794
795 Martin CK, Heilbronn LK, de Jonge L, DeLany JP, Volaufova J, Anton SD, Redman LM, Smith
796 SR & Ravussin E (2007). Effect of Calorie Restriction on Resting Metabolic Rate and
797 Spontaneous Physical Activity. *Obesity* 15(12):2964–2973.
798 <https://doi.org/10.1038/oby.2007.354>.
- 799
800 Mattes R & Foster GD (2014). Food Environment and Obesity. *Obesity* 22(12):2459–61.
801 <https://doi.org/10.1002/oby.20922>.
- 802
803 Messina M, Lampe JW, Birt DF, Appel LJ, Pivonka E, Berry B & Jacobs DR (2001).
804 Reductionism and the Narrowing Nutrition Perspective: Time for Reevaluation and

- 805 Emphasis on Food Synergy. *J Am Diet Assoc* 101 (12): 1416–1419.
806 [https://doi.org/10.1016/S0002-8223\(01\)00342-X](https://doi.org/10.1016/S0002-8223(01)00342-X).
807
- 808 Ministry of Health, Malaysia (2016). *National Strategic Plan for Non-Communicable Disease*
809 *(NSPNCD) 2016-2025*. 2016. Ministry of Health, Putrajaya.
810
- 811 Mozaffarian D & Forouhi NG (2018). Dietary Guidelines and Health—Is Nutrition Science up
812 to the Task? *BMJ* 360 (March):k822. <https://doi.org/10.1136/bmj.k822>.
813
- 814 Mozaffarian D (2017). Conflict of Interest and the Role of the Food Industry in Nutrition
815 Research. *JAMA* 317(17):1755–1756. <https://doi.org/10.1001/jama.2017.3456>.
816
- 817 National Coordinating Committee on Food and Nutrition (2010). *Malaysian Dietary*
818 *Guidelines*. Ministry of Health, Kuala Lumpur.
819
- 820 National Coordinating Committee on Food and Nutrition (1996). *National Plan of Action for*
821 *Nutrition of Malaysia 1996-2000*. Ministry of Health, Kuala Lumpur.
822
- 823 National Coordinating Committee on Food and Nutrition (2006). *National Plan of Action for*
824 *Nutrition of Malaysia 2006-2015*. Ministry of Health, Kuala Lumpur.
825
- 826 National Coordinating Committee on Food and Nutrition (2016). *National Plan of Action for*
827 *Nutrition of Malaysia 2016-2025*. Ministry of Health, Kuala Lumpur.
828
- 829 Newell B & Siri J (2016). A role for low-order system dynamics models in urban health policy
830 making. *Environmental International* 95: 93-97.
831 <https://doi.org/10.1016/j.envint.2016.08.003>.
832
- 833 Ng M, Fleming T, Robinson M, Thomson B, Graetz N, Margono C, Mullany EC, *et al.* (2014).
834 Global, Regional, and National Prevalence of Overweight and Obesity in Children and
835 Adults during 1980–2013: A Systematic Analysis for the Global Burden of Disease
836 Study 2013. *The Lancet* 384 (9945):766–781. [https://doi.org/10.1016/S0140-](https://doi.org/10.1016/S0140-6736(14)60460-8)
837 [6736\(14\)60460-8](https://doi.org/10.1016/S0140-6736(14)60460-8).
838
- 839 Novak NL & Brownell KD (2012). Role of Policy and Government in the Obesity Epidemic.
840 *Circulation* 126(19):2345–52.
841 <https://doi.org/10.1161/CIRCULATIONAHA.111.037929>.
842
- 843 Nurul-Fadhilah A, Teo PS & Foo LH (2016). Ethnic Differences in the Food Intake Patterns
844 and Its Associated Factors of Adolescents in Kelantan, Malaysia. *Nutrients* 8(9).
845 <https://doi.org/10.3390/nu8090551>.
846
- 847 Patton MQ (2008). *Utilization-Focused Evaluation*. SAGE Publications.
848
- 849 Penney TL & Kirk SFL (2015). The Health at Every Size Paradigm and Obesity: Missing
850 Empirical Evidence May Help Push the Reframing Obesity Debate Forward. *Am J*
851 *Public Health* 105(5):e38–e42. <https://doi.org/10.2105/AJPH.2015.302552>.
852
- 853 Peters JC (2003). Combating Obesity: Challenges and Choices. *Obes Res* 11(S10):7S-11S.
854 <https://doi.org/10.1038/oby.2003.220>.
855
- 856 Rudolph A & Hilbert A (2017). The Effects of Obesity-Related Health Messages on Explicit and
857 Implicit Weight Bias. *Front Psychol* 7 (January).
858 <https://doi.org/10.3389/fpsyg.2016.02064>.
859
- 860 Sartorius K, Sartorius B, Madiba TE & Stefan C (2018). Does High-Carbohydrate Intake Lead
861 to Increased Risk of Obesity? A Systematic Review and Meta-Analysis. *BMJ Open*
862 8(2):e018449. <https://doi.org/10.1136/bmjopen-2017-018449>.
863

- 864 Sbicca J (2012). Growing Food Justice by Planting an Anti-Oppression Foundation:
 865 Opportunities and Obstacles for a Budding Social Movement. *Agr Hum Values*
 866 29(4):455–466. <https://doi.org/10.1007/s10460-012-9363-0>.
 867
- 868 SCHEMA (2018). *SCHEMA Case Studies: Applying Systems Thinking to Urban Health and*
 869 *Wellbeing*. Edited by David Tan and José Siri. United Nations University International
 870 Institute for Global Health, Kuala Lumpur, Malaysia:
 871
- 872 Schulte PA, Wagner GR, Ostry A, Blanciforti LA, Cutlip RG, Krajnak KM, Luster M, Munson
 873 AE, O'Callaghan JP, Parks CG, Simeonova PP & Miller DB (2007). Work, Obesity, and
 874 Occupational Safety and Health. *Am J Public Health* 97(3):428–436.
 875 <https://doi.org/10.2105/AJPH.2006.086900>.
 876
- 877 Singapore Health Promotion Board (2018). *About the Healthier Ingredient Development*
 878 *Scheme*. From [https://www.hpb.gov.sg/healthy-living/food-beverage/healthier-](https://www.hpb.gov.sg/healthy-living/food-beverage/healthier-ingredient-schemes/about-the-healthier-ingredient-development-scheme)
 879 [ingredient-schemes/about-the-healthier-ingredient-development-scheme](https://www.hpb.gov.sg/healthy-living/food-beverage/healthier-ingredient-schemes/about-the-healthier-ingredient-development-scheme) [Retrieved
 880 29 October 2018].
 881
- 882 Steeves A, Martins EPA & Gittelsohn J (2014). Changing the Food Environment for Obesity
 883 Prevention: Key Gaps and Future Directions. *Curr Obes Rep* 3(4):451–458.
 884 <https://doi.org/10.1007/s13679-014-0120-0>.
 885
- 886 Swarna Nantha Y (2014). Addiction to Sugar and Its Link to Health Morbidity: A Primer for
 887 Newer Primary Care and Public Health Initiatives in Malaysia. *Journal of Primary Care*
 888 *& Community Health* 5(4):263–270. <https://doi.org/10.1177/2150131914536988>.
 889
- 890 Tee ES (2011). Development and Promotion of Malaysian Dietary Guidelines. *Asia Pac J Clin*
 891 *Nutr* 20 (3):455–461.
 892
- 893 Thiagarajan T (2018). *In: Here's All You Need to Know About The Viral Milo Sugar Controversy*
 894 *- WORLD OF BUZZ*. From [https://www.worldofbuzz.com/heres-need-know-viral-milo-](https://www.worldofbuzz.com/heres-need-know-viral-milo-sugar-controversy/)
 895 [sugar-controversy/](https://www.worldofbuzz.com/heres-need-know-viral-milo-sugar-controversy/) [Retrieved 3 November 2018].
 896
- 897 United Nations (2015). *Transforming our World: The 2030 Agenda for Sustainable*
 898 *Development*. From:
 899 [https://sustainabledevelopment.un.org/post2015/transformingourworld/publicatio](https://sustainabledevelopment.un.org/post2015/transformingourworld/publication)
 900 [n](https://sustainabledevelopment.un.org/post2015/transformingourworld/publication)
 901
- 902 US Department of Agriculture (1980). *Nutrition and Your Health: Dietary Guidelines for*
 903 *Americans*. Home and Garden Bulletin 232. USDA, USA.
 904 [https://health.gov/dietaryguidelines/1980thin.pdf?_ga=2.102197889.1240267622.](https://health.gov/dietaryguidelines/1980thin.pdf?_ga=2.102197889.1240267622.1536058546-1520023397.1536058546)
 905 [1536058546-1520023397.1536058546](https://health.gov/dietaryguidelines/1980thin.pdf?_ga=2.102197889.1240267622.1536058546-1520023397.1536058546).
 906
- 907 US Department of Health and Human Services (2006). *Quick Guide to Health Literacy*. US
 908 Department of Health and Human Services, USA.
 909
- 910 USDA Center for Nutrition Policy and Promotion (1992). The Food Guide Pyramid. *Home and*
 911 *Garden Bulletin* 252:17.
 912
- 913 Wigington PS (2008). Clear Messages for Effective Communication. *Journal of Environmental*
 914 *Health* 70(10):3.
 915
- 916 World Health Organization (2004). *In: Global Strategy on Diet, Physical Activity, and Health*.
 917 From
 918 [http://www.who.int/dietphysicalactivity/strategy/eb11344/strategy_english_web.pd](http://www.who.int/dietphysicalactivity/strategy/eb11344/strategy_english_web.pdf)
 919 [f](http://www.who.int/dietphysicalactivity/strategy/eb11344/strategy_english_web.pdf) [Retrieved 12 Mac 2018].
 920

- 921 World Health Organization (2018). *In: Obesity and Overweight*. From
922 <http://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight>
923 [Retrieved 16 Feb 2018].
924
- 925 World Health Organization (2010). *Set of Recommendations on the Marketing of Foods and*
926 *Non-Alcoholic Beverages to Children*. From
927 [http://apps.who.int/iris/bitstream/handle/10665/44416/9789241500210_eng.pdf;](http://apps.who.int/iris/bitstream/handle/10665/44416/9789241500210_eng.pdf;jsessionid=1AF2D6B6E1DBDB2A94BDB57361573D7F?sequence=1)
928 [jsessionid=1AF2D6B6E1DBDB2A94BDB57361573D7F?sequence=1](http://apps.who.int/iris/bitstream/handle/10665/44416/9789241500210_eng.pdf;jsessionid=1AF2D6B6E1DBDB2A94BDB57361573D7F?sequence=1) [Retrieved 8 Mac
929 2018].
930
- 931 World Health Organization (2017). *Taxes on Sugary Drinks: Why Do It?* From:
932 [http://apps.who.int/iris/bitstream/handle/10665/260253/WHO-NMH-PND-](http://apps.who.int/iris/bitstream/handle/10665/260253/WHO-NMH-PND-16.5Rev.1-eng.pdf?sequence=1)
933 [16.5Rev.1-eng.pdf?sequence=1](http://apps.who.int/iris/bitstream/handle/10665/260253/WHO-NMH-PND-16.5Rev.1-eng.pdf?sequence=1) [Retrieved 8 Mac 2018].
934
- 935 World Health Organization (2015). *WHO calls on countries to reduce sugars intake among*
936 *adults and children*. From
937 <https://www.who.int/mediacentre/news/releases/2015/sugar-guideline/en/>
938 [Retrieved 12 Mac 2018].
939
- 940 World Health Organization (2017). *WHO Strategic Communications Framework for Effective*
941 *Communications*. From [http://www.who.int/mediacentre/communication-](http://www.who.int/mediacentre/communication-framework.pdf)
942 [framework.pdf](http://www.who.int/mediacentre/communication-framework.pdf) [Retrieved 8 Mac 2018].
943
- 944 Worsley A (2002). Nutrition Knowledge and Food Consumption: Can Nutrition Knowledge
945 Change Food Behaviour? *Asia Pac J Clin Nutr* 11 (s3):S579–S585.
946 <https://doi.org/10.1046/j.1440-6047.11.supp3.7.x>.
947
- 948 Yoon NH & Kwon S (2014). The Effects of Community Environmental Factors on Obesity
949 among Korean Adults: A Multilevel Analysis. *Epidemiology and Health* 36 (December).
950 <https://doi.org/10.4178/epih/e2014036>.

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

	<i>National Plan of Action for Nutrition of Malaysia (1996 - 2000) [NPANM I]</i>	<i>National Plan of Action for Nutrition of Malaysia (2006 -2015) [NPANM II]</i>	<i>National Plan of Action for Nutrition of Malaysia III (2016-2025) [NPANM III]</i>
<i>Main objectives</i>	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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
<i>No change/Maintained</i>	<i>Removed after NPANM I</i>	<i>Added into NPANM II</i>	<i>Added into NPANM III</i>
<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> Preventing and managing infectious diseases 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> Maternal nutrition Sustaining food systems to promote healthy diets Providing standard nutrition guidelines for various targeted groups Strengthening community capacity in nutrition activities

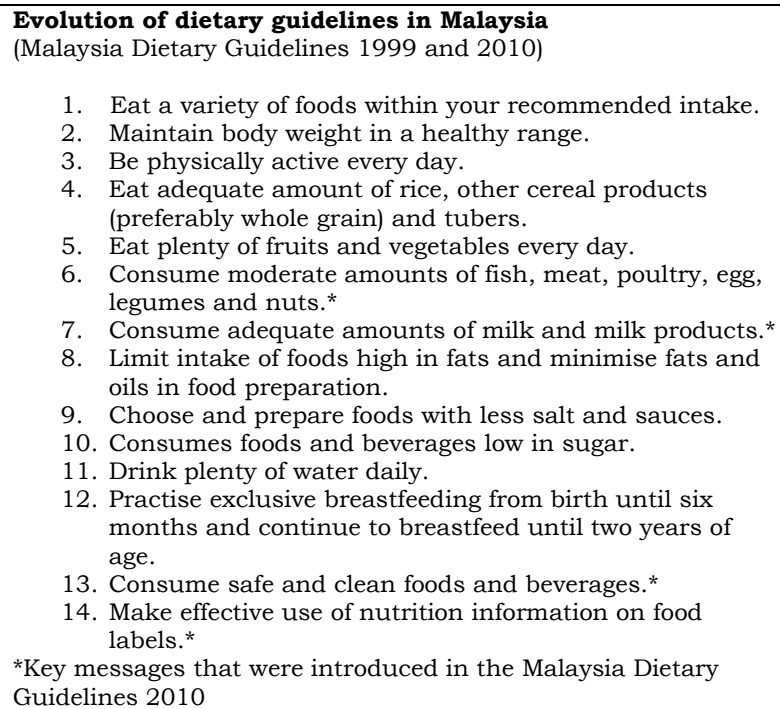
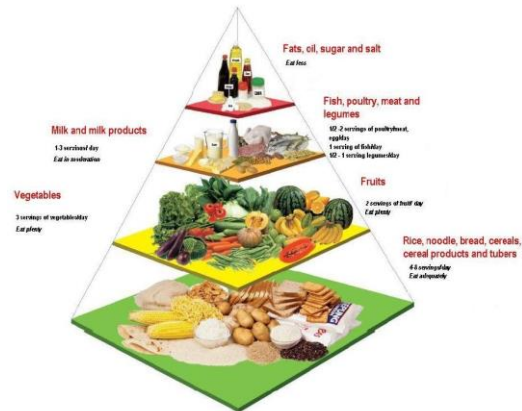


Figure 1. Evolution of dietary guidelines in Malaysia

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

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	11,698	17,969	23,462	30,796	34,909	37,927	41,652	44,063	49,193	52,609
	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(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	2000	2003	2006	2009	2010	2011	2012	2013	2014	2015
	RM	RM	RM	RM	RM	RM	RM	RM	RM	RM	RM
	Millio	Millio	Millio	Millio	Millio	Millio	Millio	Millio	Millio	Millio	Millio
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
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)
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	11,69	17,96	23,46	30,79	34,90	37,92	41,65	44,06	49,19	52,60
	(100.00)	8	8	1	8	8	6	2	3	3	9
		(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(100.00)	(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