Preventing Cardiovascular Diseases by Salt Intake Reduction in India

Master of Public Health Integrating Experience Project

Problem Solving Framework

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Abbreviations

APP	Application
BP	Blood pressure
CASH	Consensus action on salt and health
CDC	Centers for Disease Control and Prevention
COMBI	Communication for behavioral impact
CSIK	Cardiological Society of India, Kerala
CVD	Cardiovascular disease
FAO	Food and agriculture organization
FSA	Food Standards Agency
HTN	Hypertension
IHD	Ischemic heart disease
ISFC	International society and federation of cardiology
KAP	Knowledge, attitude and practice
KCl	Potassium chloride
LMIC	Low- and middle-income country
MOH	Ministry of health
NHLBI	National Heart, Lung, and Blood Institute

NCDs	Non-communicable diseases
NFHS-4	National Family Health Survey
NHF	National heart foundation
NIN	National Institute of nutrition
NIP	Nutrition information panel
QALYs	Quality-adjusted-life-years
SES	Socio-economic status
SHAKE	S- surveillance, H - harness industry, A - adopt standards for labeling, K - knowledge, E - environment
UNICEF	United Nations Children's Fund
UK	United Kingdom
WHF	World Heart Federation
WHO	World health organization

Executive Summary

Cardiovascular diseases (CVDs) are in the group of heart-related diseases which affect the heart and blood vessels. According to the World Health Organization (WHO), in 2015, CVDs led to 17.7 million deaths out of which about 75% of deaths occurred in LMICs. In India, CVD related mortality was 272 deaths per 100,000 in 2010, which was more than the average world mortality of 235 per 100,000 for the same year and mortality is expected to increase by about 111% by 2020. Hypertension (HTN) is one of the main causes of CVD, and according to WHO 2013 report, HTN caused 9.4 million deaths annually, which are more than the combined deaths from infectious diseases. In 2014, about 378.5 million Indian adults suffered from HTN which is 20% more compared to 2000. High salt consumption is one of the main cause of HTN. Although the recommended level of salt intake by WHO is 5g/day, in India the salt intake is about 13.8g/day.

The factors, which affect the salt intake in India include: addictive nature of salt, inadequate labeling, misleading advertisements, wide availability and accessibility of salt, no salt restrictions by food manufacturers, lack of public knowledge and awareness, lack of access to healthy food, consumer behavior that could be influenced by consumers' age, gender, income, occupation and SES. This is a complex social and medical issue which will require multiple strategies to be implemented. Potential interventions which may lead to a decrease in salt intake among Indians include: a) conducting comprehensive awareness raising campaign focusing on spreading awareness regarding the detrimental effects of high salt consumption through advertising, social media, and face-to-face sessions at the population level; b) comprehensive and consumer-friendly salt labeling legislation; c) enforcing taxation on food items with high sodium content; d) reformulating food products which contain a high amount of salt and persuading food manufacturers to decrease the high salt content in their products; e) engaging with the stakeholders (government, civil society, and media) for the implementation of the national salt reduction efforts; f) screening for HTN and body sodium content, annually, by health care workers will be helpful to monitor and provide feedback with the help of blood pressure (BP) measuring instruments and 24-hour urine salt analysis; and g) using salt substitutes like potassium chloride (KCl).

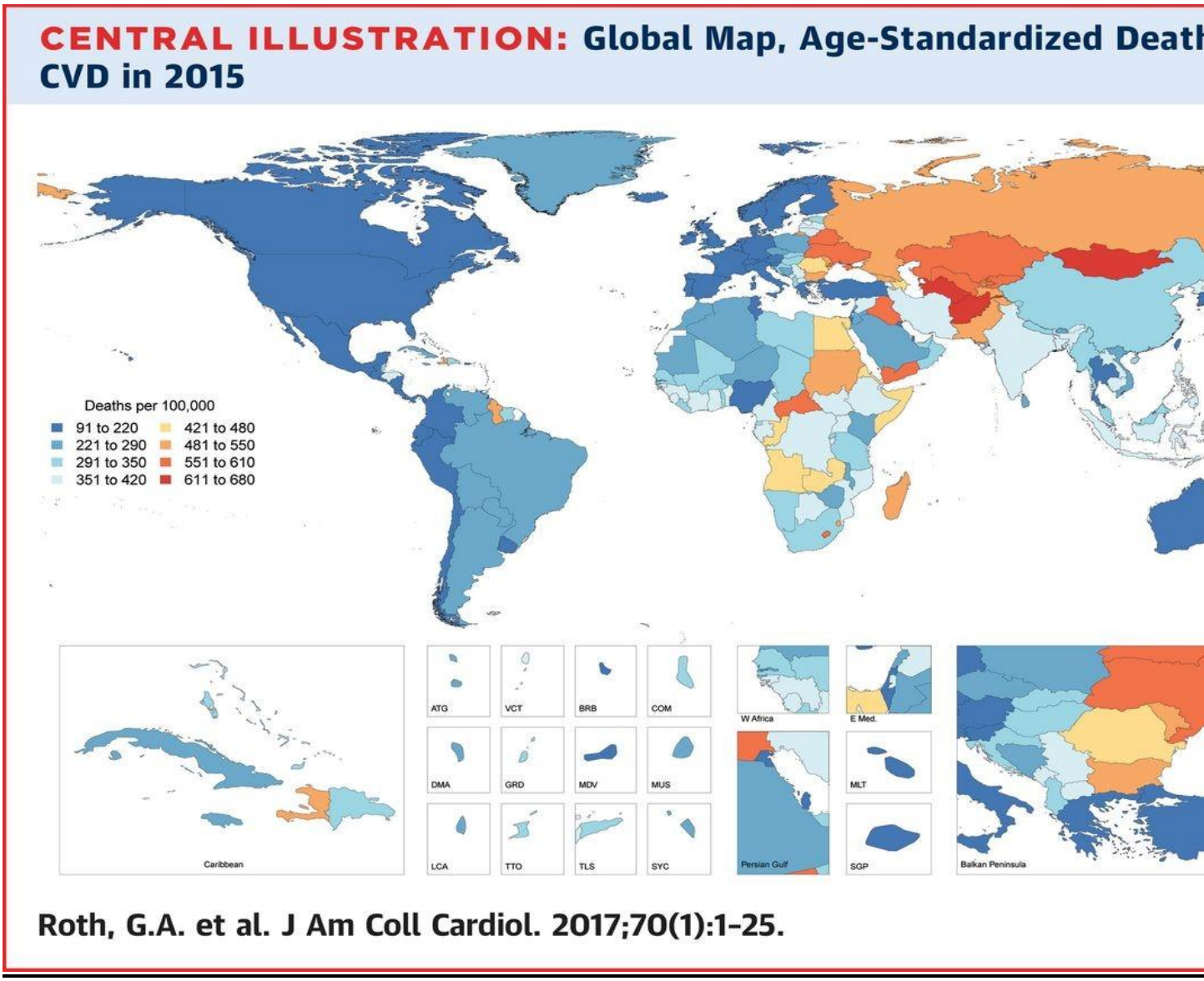
Based on priority setting, the recommended course of action includes three strategies: a) comprehensive awareness raising campaign; b) food labeling; and c) product reformulation.

For the measurement of the recommended strategies, the short term outcome will be assessed with the help of knowledge, attitude, and practice (KAP) questionnaires administered at the baseline and six months after the comprehensive educational campaign. For the assessment of the long-term impact, random urine samples will be collected to measure sodium content in urine with the help of twenty-four-hour urine analysis by healthcare professionals at baseline and annually for five years.

Problem definition and magnitude of the problem

According to the World Heart Federation (WHF), cardiovascular diseases (CVDs) are in the group of heart-related diseases which affect the heart and blood vessels.[1] CVD is a general term, often used to address heart diseases. CVD includes stroke, arrhythmia, hypertension (HTN), ischemic heart disease (IHD) and heart failure.[2,3]

Seventy percent of all the deaths per year are due to non-communicable diseases (NCDs); among these NCDs, CVD accounts for the most NCD deaths.[4] CVDs are the leading cause of death all over the world.[1] Globally, in 2015, CVDs led to 17.7 million deaths out of which about 75% of the deaths occurred in low- and middle-income countries (LMIC).[1] (***Figure 1***: **Age-standardized death rates for cardiovascular disease (CVD) globally in 2015**[79]



illustrates the age-standardized death rates for CVD globally in 2015.

The CVD-related morbidity and mortality have an increasing trend in LMIC, unlike high-income countries.[5] In India, CVD related mortality was 272 deaths per 100,000 in 2010, which was more than the average world mortality of 235 per 100,000 for the same year.[6] There has been a surge in mortality of about 9% due to CVD in the past 23 years in India.[5] According to a study conducted in India in 2016, there will be an increase of about 111% in the deaths due to CVD by 2020.[7] According to the World Health Organization (WHO) report, during the period 2010-

2013, CVD accounted for about 20% deaths in males and 17% deaths in females in India out of 10.5 million deaths annually.[5] WHO stated that, due to CVD, India lost about $237 billion on healthcare costs over the years from 2005 to 2015.[6]

One of the major causes of the CVD is HTN.[8,9] HTN is a leading cause of death and comes as second most common cause of disability, globally, by affecting one billion individuals in 2000, and it is predicted to increase to 1.5 billion by 2025 (see ***Figure 2*****: Global increasing trends in the prevalence of hypertension**).[8] According to the WHO 2013 report, HTN caused 9.4 million deaths annually, which are more than the combined deaths from infectious diseases.[10]

In 2014, about 378.5 million Indian adults suffered from HTN which is 20% more compared to the 2000.[11,12] Studies had shown that South Asians might be hereditarily predisposed to HTN.[13,14] In India, approximately 160,000 people die annually because of HTN, alone, making it the 14th top cause of death in 2017.[15] HTN also increases the risk of stroke by about five times.[16,17] HTN causes around half of the ischemic strokes and increases the risk of hemorrhagic stroke.[18] HTN is the leading cause of 57% of strokes and 24% of IHD deaths in India.[16]

Some of the causes of HTN include smoking, sedentary lifestyle, obesity, genetic predisposition, stress, chronic kidney disease, thyroid, adrenal disorders, sleep apnea, and high salt consumption.[8,19] Salt or the sodium chloride (NaCl) is an inexpensive mineral used in food items to enhance its palatability and preservation.[20] Salt gives long lasting flavor while suppressing bitterness of the food.[20] According to WHO the recommended daily salt intake is about 5g.[21] Evidence shows that every year four million deaths could be obviated, if global salt utilization was decreased to the suggested level.[20] High sodium intake is the 11th leading cause of death globally and seventh leading cause of death in South East Asia region.[22] In India, people consume about 13.8 g/day salt on average; the range between different states is from 7g to 26g

per day.[23] This level of salt consumption is higher than the recommended level in all the states of India. Habitual excess salt consumption in India is unsurprisingly high because of the substantial amount of salt added in food preparation and also at the table in Indian cuisines.[24]

According to the National Family Health Survey (NFHS-4), the top two states in India in terms of high blood pressure (BP) in men are Sikkim and Telangana, while in women the states are Sikkim and Tripura.[25] Sikkim has a salt consumption >8 g/day, Telangana of >10 g/day and Tripura >13g /day.[26] A study conducted in 2016 suggested that one of the reasons for high BP in these states is high salt consumption.[25] Evidence shows that a mere 15% reduction in salt intake in India, would result in a reduction, on average, of 2.6 mmHg mean systolic BP in men and 2.34 mmHg mean systolic BP in women.[23] There is also evidence stating that population-wide 2% decrease in diastolic BP would avert 300,000 deaths in India.[27] Many studies conducted have shown that the salt consumption is more pronounced in rural areas and among people with lower socio-economic status (SES).[28,29] Therefore, interventions are required to aim at reducing sodium intake in all the states.

The largest study to explore sodium consumption was conducted by the "Intersalt" in 1988 in 52 different communities of 32 countries, based on 24-hour urine analysis.[30] The Intersalt study was instigated by the International Society and Federation of Cardiology (ISFC) and was supported by the WHO, the US National Heart, Lung, and Blood Institute (NHLBI), Wellcome Trust, United Kingdom (UK), Heart Foundations of Great Britain, Canada Netherlands and Japan.[31] Intersalt study studied 10,079 men and women of 20-59 years old.[30] This study found a positive relationship of 24-hour urinary sodium excretion with BP and reported that countries like Canada, India, Italy, Poland, Portugal, and Hungary consumed more than 11.7 g/day.[30,31]

Food items that contain high sodium levels are canned meat and beans, potato chips, processed cheese, pizza, bread, spreads, popcorns, soups, soy sauce, ketchup, pickles, breakfast cereal and even cakes.[20,31] In India, some products contain a high amount of sodium, for example, papad (typical Indian appetizer), consists of about 5g of salt per 100g, which is a recommended dose per day by WHO.[26] The evidence demonstrated that papad could be made using much less salt without compromising the taste of the product.[32]

In the last 30 years, there has been a change in diet consumed by the people living in LMIC, as diets are becoming westernized as more convenience food is being consumed.[8,26] In India, the primary source of salt intake comes from adding salt during cooking, however, due to the transition in the dietary habits in recent years, more Indians are opting for convenience food items high in salt content.[32] Moreover, the regulations for labeling in LMIC are making it difficult to get accurate information on the amount of salt in food.[8] Therefore, the burden of morbidity and mortality from HTN (one of the leading cause of CVD) due to high salt intake is quite high and is one of the most urgent public health problems globally.

The study conducted in the UK showed that reduction of salt intake to 6g/day would decrease IHD by 18% and strokes by 24%.[33] This significant decrease in IHD and stroke could avert about 35,000 deaths in the UK, alone, and about 2.5 million deaths, globally.[33]

Another study conducted in the United States postulated that a modest decrease in salt intake (about 10%) would avert a hundred thousand cases of stroke and heart failures and also would spare the expenditure of $32 billion in medical expenses.[8]

A study conducted in 23 LMICs, including India, comparing the effectiveness of a salt reducing intervention and a tobacco-control intervention, showed that a 20% reduction in tobacco smoking could prevent 3.1 million CVD deaths compared to 15% reduction in the salt intake

which would prevent 8.5 million deaths due to CVD[8] (***Figure 3***: **Impact on CVD and estimated cost of implementing, smoking and salt reduction program in 23 Low- and middle-income countries (LMICs**. This study suggested that India and China could prevent the most deaths if they implemented salt intake reduction interventions.[8]

Key determinants

There are many factors, which combine and affect the individual and community's health. Broad terms, which are frequently used to classify determinants, are the agent, host, and environment (***Figure 4*****: The Epidemiological triad of causal factors**).[34] The host (potential consumers), agent (salt) and environment are interrelated with each other. Various factors that promote high salt intake could be biological, behavioral, environmental, cultural and economic.[28,27] The factors, which affect the salt intake in India, are an addictive component of salt itself, inadequate labeling, consumer behavior, misleading advertisements, wide availability and accessibility of salt, no salt restrictions by food manufacturers, lack of public knowledge and awareness, access to healthy food and gender, age, income, occupation and genetic predisposition of the potential consumer.[7,32,35,36,37,38]

This is a complex social and medical issue which will require multiple strategies to be implemented. Potential interventions are discussed in the section below.

Classification of key determinants

The agent of the HTN is salt. Higher salt consumption increases the risk of HTN and CVD.[29] Salt is an inexpensive mineral used by the consumers and food producers in food items to

enhance its palatability, flavor, texture, and preservation.[20] Salt is formed by the two inorganic chemicals, sodium and chloride to form sodium chloride (NaCl).[39] The properties of the salt make the consumers addicted to it. Environmental factors, on the other hand, are the external factors that affect the agent and in this case, it affects the salt consumption of the host (potential consumers). Whereas, a host is a human who can be affected by the factors like age, sex, and their behavior. Further considerations regarding each factor influencing agent, host and, environment are noted below.

Factors related to salt

Addictive component of salt itself - Salt is one of the essential nutrients, however, when not regulated, it has detrimental effects.[7] Salt has addictive properties, and evidence shows that salt is as addictive as tobacco.[40] A study found that amygdala regulates the sodium intake in the sodium-deprived state.[41] It increases the desire to eat more sodium especially in sodium-deprived state and increases the craving for salt.[40,41]

Factors related to environment

Factors related to the environment are misleading advertising of food products, lack of consumer-friendly labeling, easy availability and accessibility of salt, the absence of restrictions on the salt usage by the food manufacturers and geographical area.

Misleading advertising - In India, health is not on the radar for many fast food companies.[36] It is easy for companies to evade from regulatory oversight, after adding a high quantity of salt in

food products, since there is no law on regulating the amount of salt added in processed food items in India.[36] Misleading advertisements, stating food products high in salt as healthy since, they contain some beneficial amount of nutrients is a standard practice.[35] Moreover, in India, there is no provision for corrective advertisement.[42]

Labeling - In India, 25% of products are unable to meet the required nutrition information labeling guidelines set by the "Food Safety and Standards Authority of India", and two out of three products fail to depict the salt on the panel of nutrition information and fail the International Codex Alimentarius (food code) requirements.[32] Codex Alimentarius is defined as a "collection of codes of practice, internationally recognized standards, guidelines, and other recommendations relating to foods, food production, and food safety."[43]

Availability/Access - India is the third largest salt harvesting country in the world.[44] Salt is cheap and easily accessible.[44] Wide usage of salt in food products and low price encourages the overconsumption of the salt.[45] According to WHO, the availability and affordability of the processed food products, rich in sodium content, are increasing around the globe.[46]

Access to healthy food/food desert - There is a positive association between the increased cost of healthy food and decrease in its consumption, due to the low affordability of healthy food products primarily in LMIC.[47] Food desert is defined as "an area, especially one with low-income residents, that has limited access to affordable and nutritious food."[48,49,50] A study was conducted in 18 countries including India, across income levels to find the affordability, availability, and consumption of vegetables and vegetables and showed that households in low-income countries, such as India spend about half of their income on food, while households in high-income countries spend only 13%.[47] In India, for 57% of individuals, the daily recommendation of three servings of vegetable and two servings of fruits per day was not

affordable.[47] Due to low accessibility and affordability of healthier food products, many potential consumers are forced to buy and consume cheaper available such as processed food products rich in sodium.

Lack of restrictions on the salt usage by the food industries - Food manufacturing companies in India can get away with producing products with high amounts of salt because there is no regulation regarding salt addition in processed foods.[36] Also, there are no restrictions on the salt usage by the food industries in India.[36] Manufactures use abundant amounts of salt to enhance, taste and palatability and, sometimes, for preservation. However, the sums utilized frequently surpass the required amounts.[51]

Geographical area - A trend of more salt consumption was seen in the coastal regions of India, especially in the eastern coastal region.[26] One of the main reason for higher salt consumption in this region is the extensive accessibility of the salt.[27]

Factors related to potential consumers

Knowledge level - Studies have shown that there is an association between the knowledge level and salt intake.[28,16] Individuals are often not aware of the detrimental effects of high salt intake on health, especially in LMICs.[7] In a community based, cross-sectional study conducted by Cardiological Society of India, Kerala (CSIK), about the IHD and its Risk Factor Prevalence (CSIK-CRP), demonstrated that out of about 5,100 individuals screened, 20% were receiving treatment for hypertension and about 28% of those people receiving treatment were unaware of the importance of salt restriction in managing their BP.[7] A cohort study conducted in Nigeria

reported that participants who went through a training on how to reduce their salt intake during cooking by half, showed reduction of sodium level in their body and blood pressure.[28]

Training campaigns can play a vital role in sustaining changes in consumer behavior in compliance with the low sodium diet.[35] To decrease the salt addition during cooking, the public should be educated about the detrimental effects of excessive salt intake.[35] Consumers also lack the appropriate knowledge to differentiate between the food items containing high salt from the ones with less salt content and consumer training could help to address this issue.[35]

Gender - Studies have revealed that males tend to consume more salt than females.[38,52] A study conducted in Brazil, to determine the relationship between the salt consumption measured by 24-hour urine analysis and BP, showed that, on average, males consume 11.9 g of salt, compared with women about 8.8g of salt.[52] This difference reflected the higher food, energy intake and the discretionary salt intake by men.[31,53] In addition, preferences of certain food products high in salt content by men is also one of the reason for high salt intake by men compared with women.[20]

Age - When a person's age increases, the ability to taste and smell decreases as a process of aging or disease.[54] This has shown an association of why aged people tend to consume more salt than others.[54] A study conducted in Korea on determining the factors related with high sodium consumption, based on 24-hour urinary sodium excretion measurement, showed that people who aged more than 70 years had a sevenfold risk of 24-hour urinary sodium excretion than those who aged 19-29 years.[37]

Behavior - Studies have shown that people face difficulty in altering their behavior regarding the high salt intake.[55] They face many perceived barriers to adherence to a low salt regime. A qualitative study on the perceived barriers and support strategies among the patients with chronic kidney disease, for reducing sodium consumption, stated that often patients have difficulty in

complying with the low salt diet due to the bitter taste in lower sodium foods and perceive lifestyle modifications as an enormous burden.[55] Moreover, consuming food products high in salt content regularly suppresses the salt taste receptors and making consumers habitual consumers of highly salted food products.[35]

Socioeconomic status (SES) - Several studies have shown that household incomes are negatively related to salt intake; this means people with higher income consume less salt.[29,37,56] Low-income households tend to consume more unhealthy food containing an abundant amount of salt, compared with high-income households.[57] A study in Korea concluded that occupation also plays a role in salt consumption.[37] The study indicated that Korean agricultural workers and laborers had higher salt consumption than other occupational workers like managers.[37] SES is usually measured by the occupation of the head of the house and education level.[37] Agricultural workers and laborers have low SES.[37] Many studies have shown that there is a significant association between low SES and high salt intake.[20,29,58]

Proposed prevention/Intervention strategies

There are currently no existing strategies implemented in India. However, potential evidence-based strategies that consider the key determinants, that may lead to a decrease in salt intake among Indians include:

- Raising the awareness regarding the detrimental effects of high salt consumption and the importance of monitoring and reducing daily salt intake (e.g., learning how to read food labels and choosing food items containing less salt) through media efforts.[23]
- Comprehensive and consumer-friendly salt labeling legislation.[23]

- Developing and reinforcing a law to limit the amount of salt used in food processing industries[59] and monitor the salt added by the food industries.[23]
- Conducting comprehensive educational programs, focusing on spreading awareness through advertising, social media, face-to-face sessions at the population level, regarding the health risks of excessive salt intake in specific settings like schools, hospitals, and workplaces.[23]
- Enforcing taxation on food items with high sodium content.[20]
- Engaging with the stakeholders (government, civil society, medical and health sectors, and media) for the implementation of the national salt reduction efforts.[59]
- Increasing accessibility, and availability of the healthier food options.[23] Promoting a healthy lifestyle by offering a discount on the purchase of healthy food items.[23,28]
- Reformulating food products which contain a high amount of salt and persuading food manufacturers to decrease, gradually, the high salt content in their products.[23]
- Screening of HTN and body sodium content annually by health care workers will be helpful to monitor and provide feedback with the help of BP measuring instruments and 24-hour urine salt analysis.[31]
- Using salt substitutes like potassium chloride (KCl).[23]

In addition to the strategies outlined above, WHO proposed SHAKE package and stated as a best buy strategy (highly effective and efficient) to reduce population salt intake.[35] SHAKE is an acronym for "S - surveillance (measure and monitor salt use), H - harness industry (promote the reformulation of foods and meals to contain less salt), A - adopt standards for labeling and marketing, K - knowledge (educate and communicate to empower individuals to eat less salt), E - environment (support settings to promote healthy eating)."[35] SHAKE is the combination of the strategies which are highly effective.[35]

Out of all these potential strategies, the most promising interventions are discussed below:

1. **Comprehensive awareness raising campaign**

A comprehensive awareness-raising campaign can include an educational and media components. An educational program in spreading awareness about the relationship between salt and health, introduced in Finland, was successful in the reduction of salt intake by 5g, on average, per day at the population level.[51,60] A similar strategy in which different comprehensive consumer educational campaigns can be conducted in India; the campaigns will explain to viewers that consuming more salt than the recommended level is detrimental to their health. In campaigns, people will be taught that they should consume less than 5g of salt per day, the amount of "hidden salt" they are consuming from the processed food, and how they can monitor and reduce their daily salt intake.

A study conducted in India showed that reducing the salt intake will increase the risk of iodine deficiency by just <0.0001%.[61] In India, iodine deficiency is mostly due to insufficient access to iodized salt and not because of low intake of iodized salt.[61] It is imperative to explain this to consumers and reveal the truth about the myth that reducing the salt intake leads to iodine deficiency. At the end of the educational campaigns salt restriction spoons of 2g capacity can be promoted and distributed, similar to what was implemented among the Chinese population.[62] A modeling study in China on the prevention of cardiovascular disease by salt restrictions showed that if the salt restriction spoon campaign (in which free 2g spoons will be distributed) is successfully implemented and with 75% compliance to the salt restriction spoon program, about 50,000 deaths from CVD could be averted, 137,000 new cases of CVD could be prevented, and 301,000 quality-adjusted-life-years (QALYs) could be gained.[62]

Media has a vital role in decreasing the amount of sodium intake especially in countries like India and China, where salt is added during household food preparation.[63] Finland was successful in reducing the salt intake from 14 g/day to about 9 g/day, with the support of media campaigns and the food industry's cooperation.[8] Constant delivery of messages, through advertisements, that high salt intake can lead to premature death is required for the sensitization and compliance of the consumers to the low salt intake.[55] The UK Food Standards Agency (FSA) with the help of media campaigns, was successful in reducing salt consumption at the national level, in these campaigns viewers were told that:

a) It is imperative to consume less than 6 g/day of salt.

b) Intake of too much salt is detrimental to health.

c) Packaged food items contain an abundant amount of salt.

Similar campaigns can be conducted in India, for the dissemination of the awareness through different media (magazines, newspapers, television, movies, and SMS), distributing brochures, and displaying posters with some examples of patients showing the impact of high salt intake to their health and adverse effects.

2. **Policy development**

To develop policies and implement interventions for the salt reduction program nationwide, the government plays a vital role in it.[30] The National Institute of Nutrition (NIN) in India, implemented a dietary recommendation for salt intake in 2009, but no actions have been taken since then.[23]

Some measures undertaken by a few countries were successful to reduce salt intake nationwide by establishing policies to mandate the food manufacturers to decrease the amount of sodium

added in their food products, support by the government for educational campaigns, establishing salt labeling regulations and monitoring sodium content in food.[31]

The Indian Ministry of Health (MOH), multi-stakeholders and the government can take part in policy-making by undertaking the following efforts:

- Raise the priority of nation salt reduction campaign in preventing cardiovascular diseases by advocating with policy-makers and stakeholders.
- By establishing and enforcing regulatory laws that limit the amount of salt in food items.
- Monitoring of salt intake at the population level can be done through the policy development with the help of examining sodium content in food products. Salt intake can be monitored by using knowledge, attitude, and practice (KAP) questionnaires, the government can organize campaigns annually to check BP free of cost, and all those who are suspected of HTN can undergo 24-hour sodium urine or spot urine analysis.[35] The cost of per 24-hour urine analysis in India is about $ 0.39.[64]
- Development of the new Codex Alimentarius which is defined as a "collection of codes of practice, internationally recognized standards, guidelines, and other recommendations relating to foods, food production, and food safety," and implementing it effectively.

2.1 **Product reformulation**

Product reformulation is the change of components like sugar, salt, trans fatty acids and saturated fatty acids in the product to make it healthier. Salt is added in a high amount to many processed food products and meals by food manufacturers to add flavor and because salt costs less than spices and other ingredients.[35] India ranks fifth, globally, concerning consumption, production, and the export of processed food.[65] Therefore, it is essential to persuade food manufacturers for

product reformulation. There is evidence suggesting that a reduction of 40-50% of salt in food products would not be noticed by consumers and once salt consumption is decreased, people will prefer food products with less salt content.[66]

The Consensus Action on Salt and Health (CASH) was developed in 1996 in the UK and, this program was successful in influencing the food manufacturers to decrease salt content in food.[8] In the UK, due to the product reformulation, in 2005, it was found that there was a decrease of average salt content in grocery purchases (***Figure 5*****: Decrease in salt consumption in the UK due to product reformulation**). Product reformulation will be successful on a nationwide level because consumers do not have to opt for healthier or expensive food items which contain less sodium. Sodium intake of consumers will be decreased passively because consumers will be purchasing same food items, however, these food items would contain less sodium.[51] Constant surveillance is needed for the implementation of this program. In New Zealand, a program called "Pick the Tick" was launched by the National Heart Foundation (NHF) in July 1998.[67] The objective of this program was to reduce the salt level added by the food manufacturers, by applying the logos of a tick on the food items, which consist of a low level of salt.[67] This program resulted in people opting for the food products with a tick logo on it.[67] This program was successful in adopting these ticks on their food products by 59% of shoppers and in one year period removed about 33 tons of salt through reformulation.[67] A similar program can be developed in India for salt intake reduction. Experience from some countries has shown that reduction of salt content in processed food products by product reformulation can be readily achievable and is a feasible strategy.[35] In 2013, Department of Health in South Africa passed the legislation of mandatory salt reduction in processed food.[35] The strategy was implemented in two phases:

- The first phase aimed at reducing the sodium content in processed food by the mandatory approach by 30th June 2016.[35] To ensure the compliance with the legislation of mandatory salt reduction in processed food, penalties and chemical analysis of food were introduced.[35]
- The second phase is to be introduced by 2019, and the aim is to reduce the further sodium content of the processed foods like (maximum limit of sodium in processed meat in 2016 was 850 mg/100g and aimed to reduce till 650 mg/g by 2019).[35,68]

A study conducted during the implementation of legislation of mandatory salt reduction in processed food in South Africa showed that, sodium level was decreased to the limit set by the legislation in 67% of all targeted food products.[68] The South African National Department of Health, allowed the companies to decrease the sodium content in three years. This strategy was successful in decreasing the sodium content in processed food.[68] It is theorized that to enforce mandatory changes in processed food by salt reduction, will likely take 3-4 years to change entrenched industries of India.

2.2 **Taxation of high salt food products**

Taxation of high salt food products can also create strong incentives for the industries to decrease the salt level. It has been shown that taxation on the high salt containing food products decreases the consumption of the salty food items.[20] Countries like Hungary and Portugal successfully implemented the taxation on the high salt products.[38] A study on "Sodium intake and its reduction by food reformulation in the European Union" showed that taxation resulted in 26% reduction in consumption of salty snacks.[20] In many food items, salt content was reduced

up to 85%, due to taxation.[20] Enforcing taxation on the high salted food products could be effective in reducing the salt intake.[20]

2.3 **Food labeling**

Besides regulations aiming to reduce the salt content in the processed food, proper food labeling regulations should also be introduced. Food labels can often be misleading and tricky for the consumers to interpret and detect the right amount of sodium level.[69] According to a US-based study conducted by the "Centers for Disease Control and Prevention" (CDC) in 2009, there are many food items, which are labeled as "heart healthy," that consist of an abundant amount of sodium.[69] Finland's initiated a campaign of spreading awareness about salt's effect on health and implementation of adequate labeling of salt present in the food products which led to a significant reduction (approximately 5g per day) of salt intake.[8] The UK promoted the use of color-coded front-of-pack labeling in 2006, in which red signifies high salt content (over 1.5 g) present in food, amber signifies medium salt (between 0.3-1.5 g) and okay to use and green is low salt content (equal or below 0.3) and a healthier option, (***Figure 6*****: Nutrition traffic light labeling system**[83]) and now 75% of the major grocery chains in the UK use these labels.[35,70] Comprehensive, coherent and straightforward high-salt warnings labels are needed on food items so that potential consumers can track their salt consumption.

3. **Salt substitute**

The use of salt substitutes is a more beneficial strategy than product reformulation because in India consuming salt is primarily through the adding of salt during cooking.[30] China has a similar dietary culture and, according to a study conducted in China showed that using salt substitutes could prevent about 540 000 new CVD cases annually.[62] Using salt substitutes

similar to what is being used in China, consisting of NaCl (65%), KCl (25%) and $MgSO_4$ (10%), is likely to be effective in reducing high levels of salt intake.

4. **Screening of hypertension (HTN) and body sodium content**

Screening of HTN and body sodium content annually by health care workers will be helpful to monitor and provide feedback with the help of BP measuring instruments and 24-hour urine salt analysis.[23] The focus will be trained health professionals and healthcare providers like physicians and nutritionists targeting patients with HTN or those who are in a risk group of HTN; these efforts can help people to maintain their sodium at a low level. This strategy not only focuses on education and awareness but also for the screening of HTN and building the patient and physician relationship.

Twenty-four-hour urine analysis is the best diagnostic method as it detects about 90% of sodium consumption because it not only detects the salt added during cooking but also salt added at the table.[51,31] Product reformulation will also make it difficult to detect the correct amount of sodium uptake because nutrition databases are not frequently updated, which makes 24-hour urine analysis an ideal test to monitor the sodium level.[51] Stratifying the urine samples by sex and age can also help in differentiating which group is more susceptible to HTN because of high sodium intake and needs intensive interventions.

Policy and priority settings

All the suggested strategies noted above, are outlined in ***Table 1*****: Policy and priority setting**, which illustrates advantages and disadvantages of each strategy. Each strategy is assessed for its

feasibility, stakeholder support, political will, and the cost. These three prioritized strategies are important aspects of the WHO proposed SHAKE.[35]

Specific recommendations

For the implementation of interventions, the government, food industry, and medical profession will play important roles. Based on feasibility, stakeholders support, political will and cost considerations, the comprehensive education program is prioritized. In addition to this strategy, two other strategies are appropriate labeling and product reformulation, prioritized as 2nd and 3rd most important strategies.

1. **Comprehensive awareness raising campaign** - Knowledge is the key to regulate the salt intake in India, average use of salt in India is 13.8g/day, still in some rural areas where people have a more limited understanding of the detrimental impact of high salt intake like Arunachal Pradesh the salt intake is 42.3g/day.[36]

To disseminate the knowledge and change the behavior of the people regarding high salt consumption, Australia and Vietnam have used the "communication for behavioral impact" (COMBI) intervention.[35] The Food and Agriculture Organization (FAO), the United Nations Children's Fund (UNICEF) and the WHO developed COMBI, for the prevention of outbreak and control measures in community settings.[71] The five components of the COMBI are "administrative mobilization and public advocacy, community mobilization, advertising, interpersonal communication and point of service/sale."[35] In Vietnam, where most salt is primarily consumed by adding it during cooking or eating (like in India), COMBI helped to reduce salt intake by about 15%.[72] In Australia, COMBI planning resulted in a 10% decrease of

salt in urinary analysis over the period of 18 months.[73] A similar COMBI program can be conducted in India, as outlined below:

a) Administrative mobilization and public advocacy - MOH, stakeholders and with the help of health workers support, will initiate the program of salt reduction by conducting a series of meetings, including the political commitment by ministers for salt reduction.

b) Community mobilization - To increase the sustainability of the program, members from various settings of the community like policymakers, health care workers, and physical education teachers from different schools will be engaged to purvey awareness about the detrimental effects of high salt consumption, through meetings and presentations, in different settings like hospitals, schools and workplaces.

c) Media campaign - A series of campaigns regarding salt intake reduction will be conducted in which individuals from the general population will be targeted, especially the susceptible people (mentioned in the key determinants section). Advertising through different media like mass media (radio, television, newspaper, and magazines) and social media (Facebook, Instagram, and Twitter) for public engagement and awareness will be implemented.

"Foodswitch" is an application (app) for smartphones, developed in Australia.[35] This app helps in the scanning of barcodes of packed food items, provides information on the salt content, and gives a list of healthier food option (less salt content).[35] In India, with collaboration with Australian developers, the same app was developed; however, awareness regarding the app is low.[32] With the help of media wide-spread promotion of the app will be implemented.

d) Interpersonal communication - Information stalls will be established in different areas of the districts that have been identified as most crowded of potential consumers like, (food markets, restaurants, workplaces, and public transportation areas) for the interaction of the public

with nutritionists. Interactive sessions conducted in schools and hospitals/medical clinics will inform participants that high salt consumption is detrimental for their health, people should consume less than five grams of salt including the amount of "hidden salt" they are consuming from the processed food.

e) Point of service/sale - Educate the food industry representatives on the accessibility and availability of salt substitutes.

2. Food labeling - Labeling provides information to the consumers, which helps to evaluate products and make right food choices. The evidence shows that attention to the nutrition label lasts for 25 to 100 milliseconds, these milliseconds are crucial and decide whether the consumer will buy the product or not. Therefore, it is imperative that labels be clear, simple and immediately convey the message to the buyer.[35]

This strategy aims to provide adequate labeling of sodium content present in all the food products. Comprehensive, simple, clear, interpretive and accurate front-of-pack labels should be used. Strategies from other countries can be adopted like "traffic lights" labeling method used in the UK.[31,74] In this method labels will be separated into three groups (***Figure 6*****: Nutrition traffic light labeling system**). "A) **Red** - which shows high fat or salt (over 1.5 g) is present in food. B) **Amber** - It says medium salt (between 0.3-1.5 g) and okay to use. C) **Green** - It is low salt content (equal or below 0.3) and a healthier option".[75] "Pick the Tick" program, which aimed to reduce salt level added by the food manufacturers, by applying the logos of a tick on the food items, which consist of a low level of salt, launched in New Zealand was successful in reducing the salt content without compromising the taste or quality of the products and provided a huge range of food products less in salt content to consumers.[67]

Adequate labeling also facilitates and reinforces other salt reduction campaigns, for example in Finland, using the strategy of adequate labeling resulted in a reduction of 20-25% salt level in food products by motivating food manufacturers in reformulating their product to avoid high salt labels.[76] Another example of "Pick the Tick" labeling influencing food industries was illustrated in the product reformulation section.

The four recommended strategies from previous successful programs in different countries are:

a) Mandating color-coded, front-of-pack labeling.

b) High salt content warning labels in food products containing salt above maximum limit.

c) "Pick the Tick" - Tick permitted to display on only those products, which contain a low amount of salt. This will give incentive to the food industry to lower their salt content to achieve tick logo on their products.

d) Combat malpractices of the market like misleading labels.[35,67]

Once food labeling is implemented, a labeling educational outreach effort would be needed for the general population. Educational programs with the help of social media or educational sessions in hospitals, clinics, workplaces, and schools could teach people how to read, understand labels and also assess their daily salt intake. Special sessions will be conducted by physicians or nutritionist for vulnerable population group of older adults, and the educational settings will include nursing homes, parks, and banks. These efforts would become the last component of the COMBI program.

3. Product reformulation - Many companies have successfully reformulated their products, for example, Nestle removed 7,500 tons of sodium, Knorr soups reduced 10% of

sodium in their products and Kellogg's have reduced 38% of sodium in their cereal products.[20] Reformulation will be done in five steps suggested by the WHO and outlined below:[35]

a) **Identify food products high in sodium content for the reformulation.**

b) **Engage with the food industry** - Engaging with the food industry is a vital step of the product reformulation. Officials from the MOH will engage with different food industries, and attend several meetings where the feasibility of salt reduction in specific foods will be discussed. It is vital for officials of the food industries to understand that reformulation is achievable, without compromising the taste and the sale of the product.

c) **Setting salt reduction targets and implement policies**

(i) Use maximum level approach - For each food category set the limit of maximum salt content and make sure all food items consist of salt below the maximum level. This strategy is proven transparent and straightforward.[35] It has benefits for easy administration and monitoring.

(ii) A two-tiered approach, like in Argentina, can be used where mandatory approaches will be legislated for the processed food items to reduce the salt content, and voluntary approaches will be utilized for the local food producers (local bakeries and food restaurants).[35] The evidence shows that mandatory approaches are more cost-effective.[35] Voluntary approaches will be used for local producers after the agreement between the MOH and food industries has been established to decrease the salt level in their food items.

d) **Monitoring salt content of food**

e) **Enforcing taxation on high sodium products.**

Enforcing taxation on high sodium products in Portugal and Hungary was successful in decreasing the salt content in food products.[38,77] In Hungary, the tax was enforced in 2011, on

snacks containing salt >1g/100g and condiments containing salt >5g/100g.[20] The tax rate enforced was about $ 1/kg of salty snacks.[20] A similar strategy can be used in India to enforce tax of about 30 rupees ($ 0.5)/kg in products containing high salt.

Evaluation of the awareness raising program

A study in South Africa revealed that "Rebates of 10% and 25% for healthy foods are associated with an increase in the ratio of healthy to total food expenditure."[78] Therefore, we can develop a strategy in which KAP questionnaires will be administered at baseline and repeated six months after the comprehensive awareness campaigns are implemented. Incentives will be utilized to encourage participation with coupons for a 25% rebate on the purchase of healthier food items provided after completion of both surveys. Randomly selected individuals will be invited to take part in the survey. The survey will include the consent, social demographics, and KAP questionnaire. The KAP scores will be analyzed to assess the impact of the awareness-raising campaign. In addition, KAP scores will help for the assessment of knowledge people gain and what motivates people to opt for healthier food options.

Evaluation of adequate labeling and product reformulation

Systematic monitoring and evaluation will allow the early corrective action of the program. For an intervention like product reformulation, which takes 3-4 years to implement successfully,[35] constant monitoring is required to ensure that targets are achieved in the given time frame. To track the changes in the labeling system, the health agencies will carry out a thorough inspection of food product labels.

For the assessment of the adequate labeling and product reformulation, 10,000 food products will be randomly selected three years post-intervention. Foodswitch app database can be used for the assessment of the nutritional composition of packed foods and also whether the targeted product has adhered to the recommended level of salt. "Foodswitch" is an app for smartphones, developed in Australia and currently being used in India.[35] This app helps in the scanning of barcodes of packed food items, provides information on the salt content, and gives a list of healthier food option (less salt content).[32] If the product is not present in the database, the photograph taken for barcode scanning of nutrition information panel (NIP) is sent to the database, where trained researchers edit the foodswitch database.[68] Foodswitch is an efficient way to assess the change in the sodium content of food products. The 10,000 randomly selected food products will undergo scanning with the help of the foodswitch app and products will be tested for the color-coded front pack and comprehensive labeling, and sodium content analysis of the reformulated product annually for five years.

Short-term outcome: It is anticipated that increased awareness among consumers regarding the salt intake and its detrimental effects on health will lead to consumers checking labels and become diet conscious. All these changes will be assessed with the help of KAP questionnaires administered at the baseline and six months after the comprehensive educational campaigns are implemented. A pre-post test approach will be used for the evaluation of the short-term outcome.

Long-term impact: Random urine samples will be collected to measure sodium content in urine with the help of twenty-four-hour urine analysis by healthcare professionals at baseline and annually for five years to understand if selected strategies (comprehensive awareness-raising

campaign, product reformulation, and food labeling) resulted in the long-term impact of lowering salt intake.

Conclusion

High salt intake is one of the greatest public health issues. Salty food items increase the BP and, therefore, increases the risk of developing CVD. India has a diverse dietary culture, where salt is extensively used in food. In India, the primary source of salt intake comes from adding salt during cooking; however, due to the transition in the dietary habits in recent years, more Indians are opting for convenience ready food items high in salt content.

Although the recommended salt intake by WHO is 5g/day, however, the consumption of salt intake in India varies from 7.0g/day to even 42.3g/day. Lack of knowledge regarding detrimental effects of salt, poor regulation regarding the salt added in processed food, lack of comprehensive and consumer-friendly salt labeling legislation are some of the main challenges being faced in adhering to low sodium diet. Recommended actions based on the priority settings, included all the aspects of the SHAKE. According to the WHO, this is the best buy strategy (highly effective and efficient) to "SHAKE" the salt habit. WHO has set a "global target of a 30% reduction in salt intake by 2025," which can be easily achieved by implementing SHAKE. Researchers predicted that over the 10 years even 15% reduction of the salt intake in the general population could prevent 8.5 million deaths, and India could save about $237 billion for the health care.

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Table 1: Policy and priority setting

STRATEGIES	ADVANTAGES	DISADVANTAGES	COST	STAKE-HOLDER SUPPO-RT	POLITICAL WILL	FEASIBILITY (Based on Attainability of the strategy)
1. Comprehensive awareness raising campaign In campaigns, viewers will be explained that consuming more salt than the recommended level is detrimental to their health. Also, people will be taught that they should consume less than 5g of salt per day, the amount of "hidden salt" they are consuming from the processed food, and how they can monitor and reduce their daily salt intake. At the end of the educational campaigns, salt restriction spoons of 2g capacity will be promoted and distributed.	Awareness campaigns will help people to understand the detrimental effects of high salt intake. Spreading awareness through media (social and mass media) is the fastest way to disseminate knowledge. It will be easier to disseminate this program nationwide through advertising, social media, face-to-face sessions in medical sites/clinics, hospitals, schools and public institutions (prisons, military service). According to the WHO report, schools are an essential venue for such programs.[31] The UK was successful in decreasing salt content present in the meals of primary schools by 38% since 2002.[31] In addition, people being affected by HTN, due to high salt intake, can be used as role models in T.V, advertisements and social media campaigns. Awareness can be spread through different ways like SMS, newspapers, magazines, and pamphlets.	Constant surveillance needed to assess the knowledge gained. Salt has an addictive component; therefore, it will be difficult for the non-compliance to the behavior of high salt intake. Media is passive, and viewers, especially those who are not exposed to the media campaigns may not be engaged.	$$	✓✓✓✓	✧✧✧	☺☺☺☺

2. Policy development Raising the priority of nation salt reduction campaign in preventing cardiovascular diseases by advocating with policy-makers and stakeholders. Development of the new Codex Alimentarius.	Government is the driver for the national policy development and enforcement. It mandates laws and ensures the availability of the resources.[35]	An abundant amount of time is required for the policy development, lawmaking and enforcing.	$$	✓✓✓	✧✧✧	☺☺☺
2.1 Product reformulation Identify food products high in sodium content for the reformulation. Engage with the food industry. Setting salt reduction targets and implement policies. Monitoring salt content of food.	It is more efficient for the nation-wide population. Product reformulation can be readily achievable and is a feasible strategy.[35] Consumers do not have to opt for expensive food items which contain less sodium, as sodium intake will be decreased passively.[51]	Constant monitoring and evaluation are needed. Immense impact on the food industry. In voluntary approaches, it is possible that only some food manufacturers would lower salt in their products, and only in few products.[51] Reformulation makes the accurate assessment of sodium uptake difficult because nutrition databases are not frequently updated.[51]	$$$	✓✓✓	✧✧✧	☺☺☺
2.2 Adequate labeling Comprehensive, clear, simple, interpretive and accurate front-of-pack labels. "Traffic lights" labeling. Pick the Tick" program, which aimed to reduce salt	Labeling food items will help consumers to understand, adhere to healthy food items and assess their daily sodium intake.	Sometimes labels can be challenging to understand and compare. Changes are costly and time-consuming.	$$$	✓✓✓	✧✧✧	☺☺☺

level added by the food manufacturers, by applying the logos of a tick on the food items, which consist of a low level of salt.						
2.3 Taxation of high salt food products Enforcing taxation on the high salted food products	Examples from other countries have shown that taxation on high salty food products could reduce salt content up to 85%.[20] The massive amount of revenues will be generated, which can be used for further implications.[77]	Immense impact on the food industry. Increased taxation in high salty food products is controversial because, it has been shown an increase in food prices decreases food consumption, hence influencing on health parameters and impacting the profitability of the food industry.	$	✓✓	✧✧✧	☺☺☺
3. Use of the salt substitutes Using salt substitutes, consisting of NaCl (65%), KCl (25%) and $MgSO_4$ (10%).	In India, as the majority of salt is added during cooking, this strategy will help to reduce sodium intake. A study conducted in India showed that salt substitution used to reduce sodium intake could be accomplished at low cost and would result in a reduction of large numbers of cases of hypertension, heart attacks, and strokes.[24]	Most of the salt substitutes consist of KCl, which can cause hyperkalemia, gastrointestinal, and renal problems. Complete replacement of the NaCl is not possible.[20]	$$	✓	✧✧	☺☺
4. Screening of HTN and body sodium content Screening of HTN and body sodium content by health	It will help people with hypertension and those at risk; may aid target population in	The campaign will be for a limited time, and many health workers are required.	$$$	✓✓✓	✧✧	☺☺

care workers to monitor and provide feedback with the help of BP measuring instruments and 24-hour urine salt analysis or spot urine analysis.	reducing or maintaining their sodium level.					

$- Very low cost	$$- Low cost	$$$- Medium cost	$$$$- High cost
✓- Very low support	✓✓- Low support	✓✓✓- Medium support	✓✓✓✓- High support
✧- Very low political will	✧✧- Low political will	✧✧✧- Medium political will	✧✧✧✧- High political will
☺- Very low feasibility	☺☺- Low feasibility	☺☺☺- Medium feasibility	☺☺☺☺- High feasibility

Figure 1: Age-standardized death rates for cardiovascular disease (CVD) globally in 2015[79]

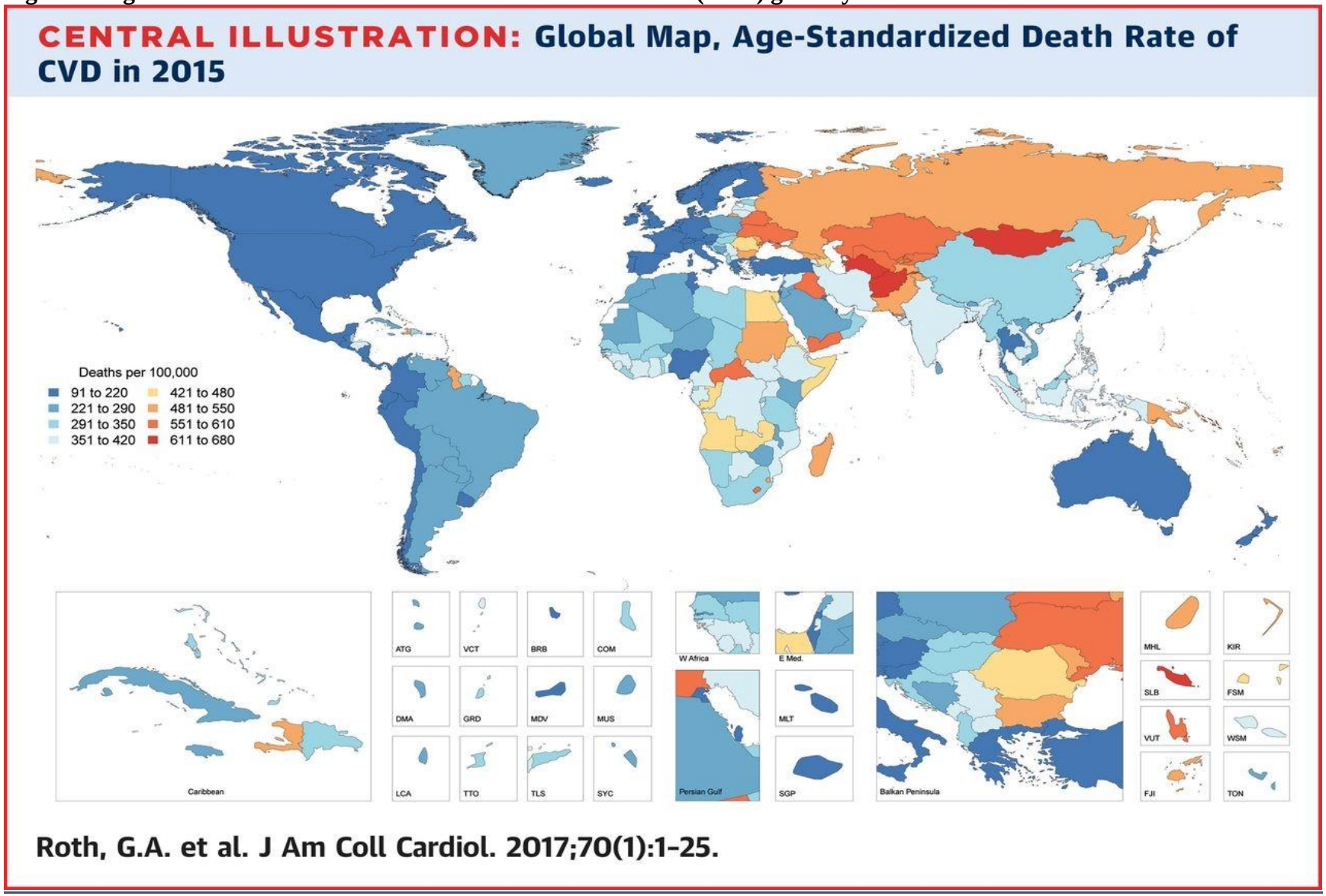

Figure 2: Global increasing trends in the prevalence of hypertension[80]

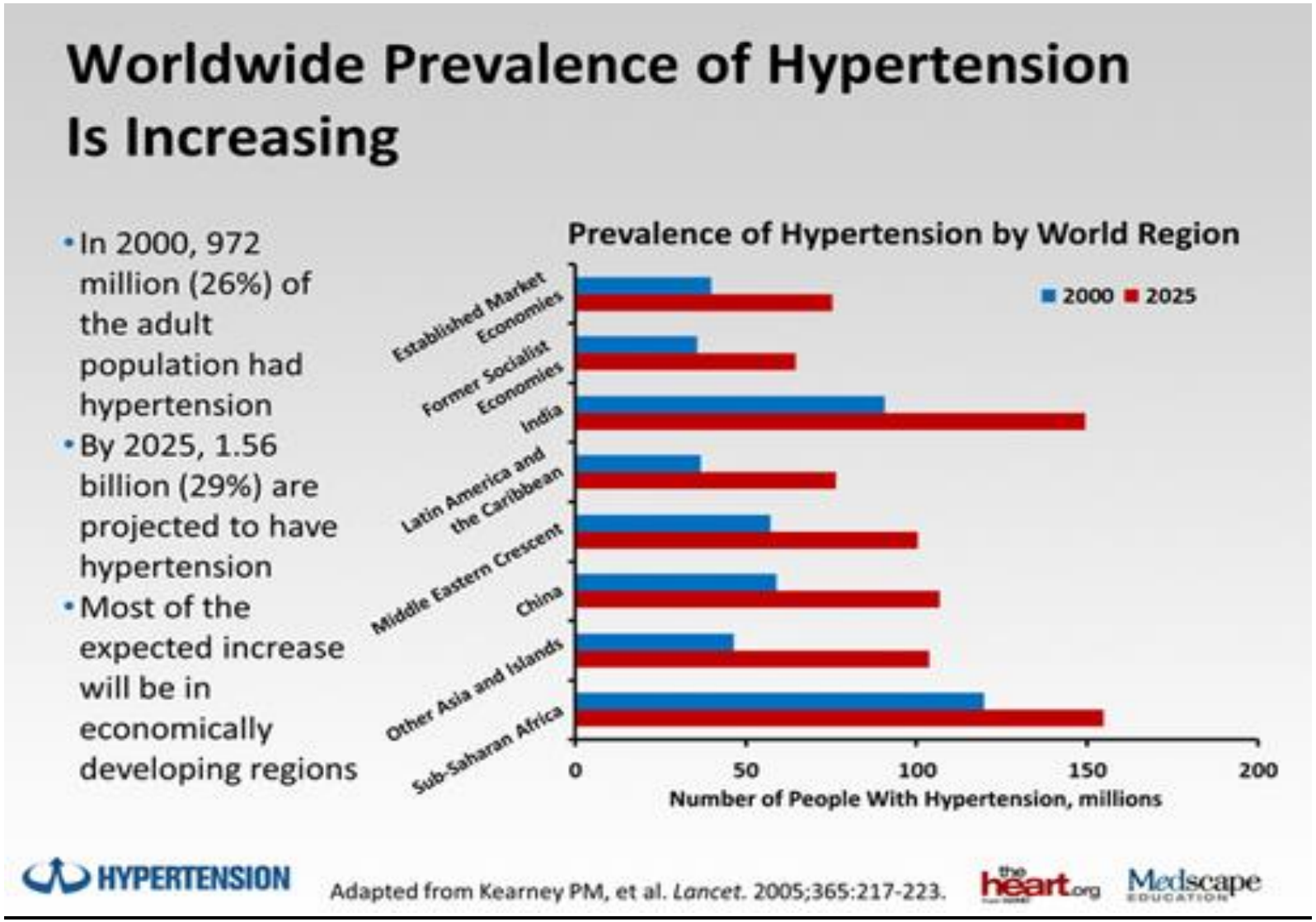

Figure 3: Impact on CVD and estimated cost of implementing, smoking and salt reduction program in 23 Low- and middle-income countries (LMICs)[81]

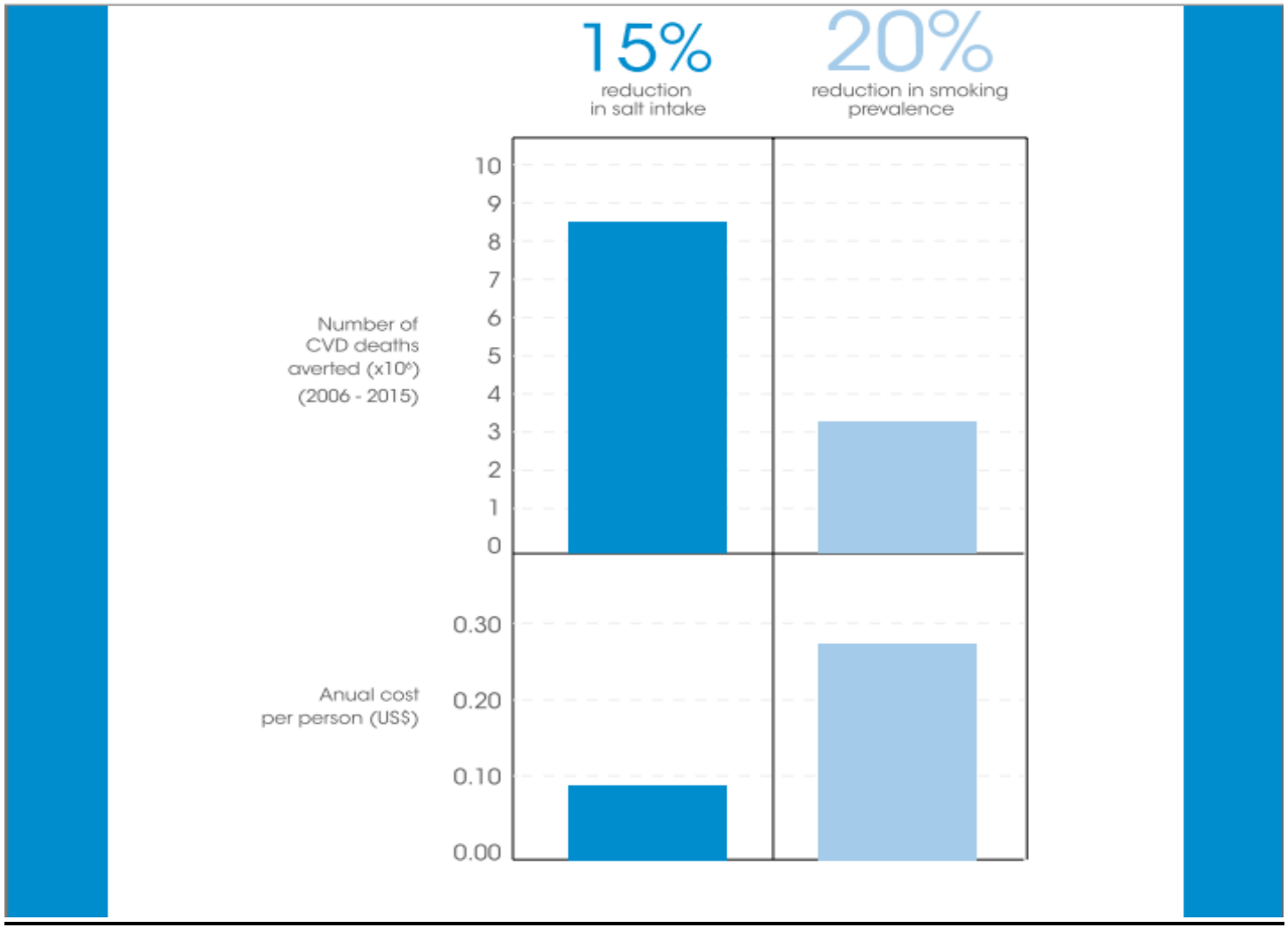

Figure 4: The Epidemiological triad of causal factors[34]

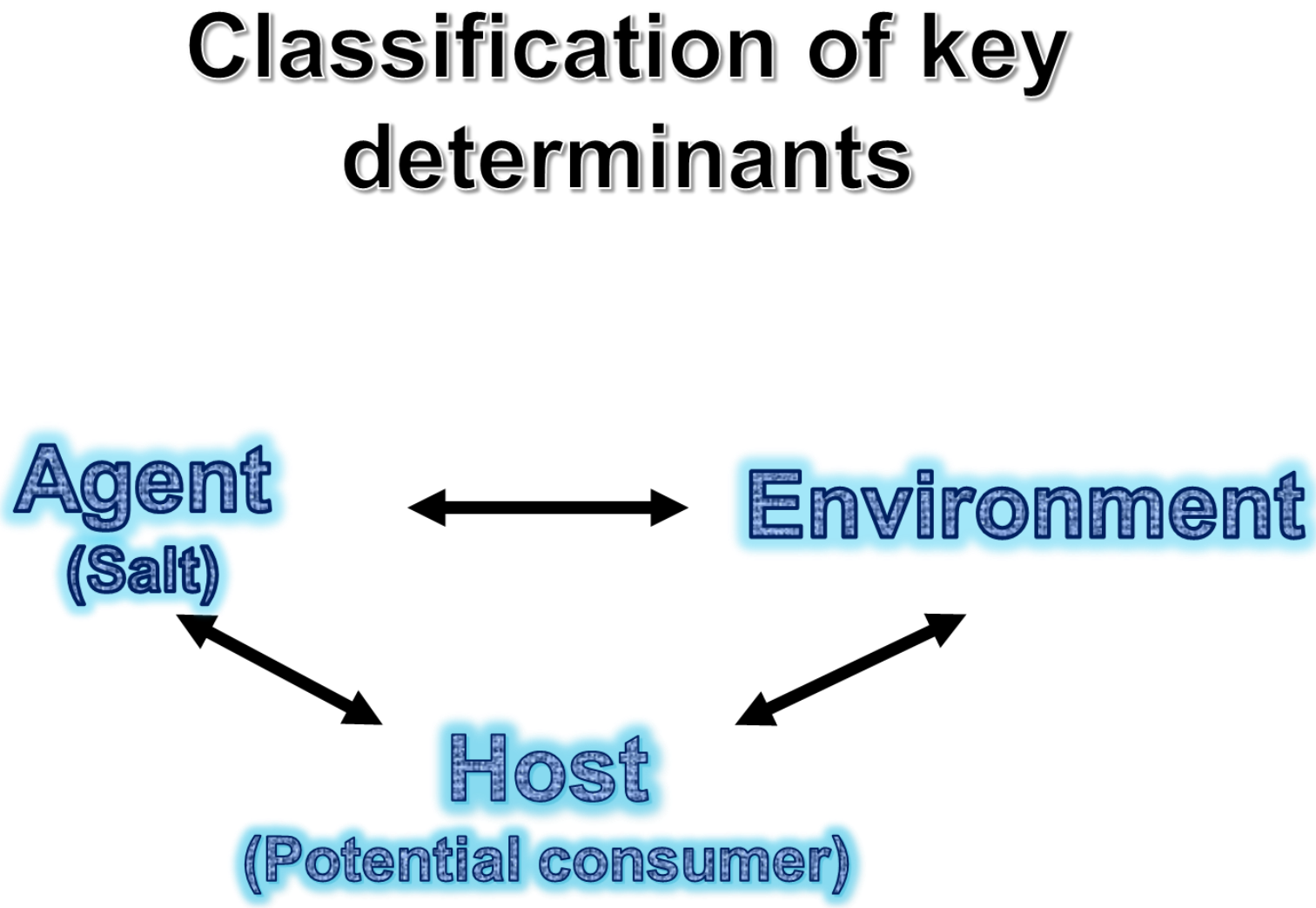

Figure 5: Decrease in salt consumption in the UK due to product reformulation[82]

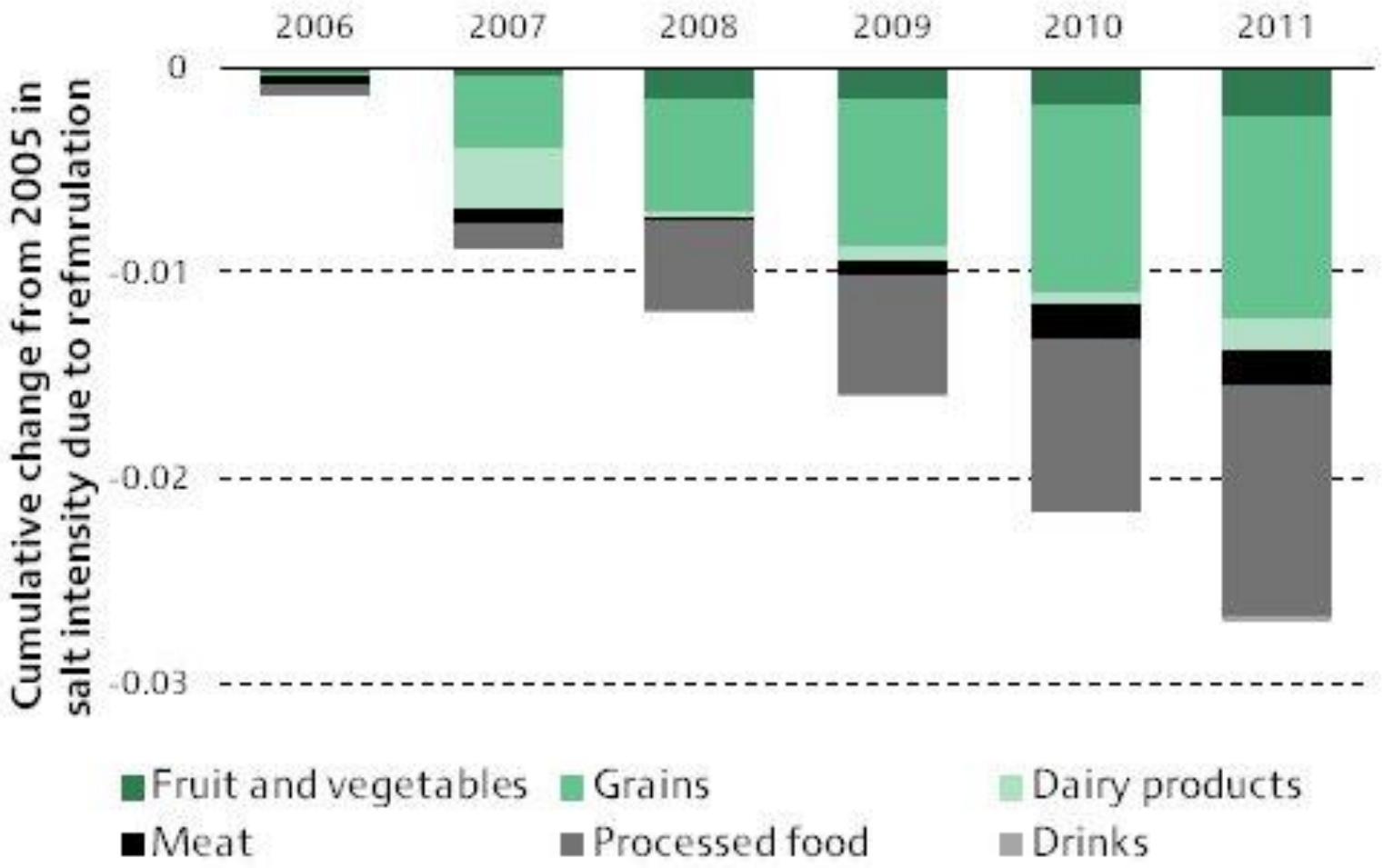

Figure 6: Nutrition traffic light labeling system[83]