DEVELOPMENT OF A NUTRITIONALLY-BALANCED, COST-EFFECTIVE, SOCIALLY ACCEPTABLE AND SUSTAINABLE EMERGENCY FOOD AID DESIGN FOR DISASTER RELIEF AND PREPAREDNESS

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by

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LIST OF ABBREVIATIONS

ANOVA	Analysis of variance
BMI	Body mass index
BW	Body weight
CKD	Chronic kidney disease
CVD	Cardiovascular disease
DBP	Diastolic blood pressure
DDMRC	District Disaster Management and Relief Committee
DID	Department of Irrigation and Drainage
DM	Diabetes mellitus
DRD	Disaster Response Diet
DV	Daily Value
EFA	Emergency food aid
EFB	Emergency food basket
FNS	Food and Nutrition Service
HR	Heart rate
ICRC	International Committee of Red Cross
IDR	Indonesian Rupees
IFR	Immediate food requirement
KCERC	Kidney Community Emergency Response Coalition
MF	Mass feeding
MHLW	Ministry of Health, Labour and Welfare
MM	Muscle mass
MMS	Malaysian Meteorological Services

MSF	Médesins San Frontières
MYR	Malaysian Ringgit
NCCFN	National Coordinating Committee on Food and Nutrition
NDMRC	National Disaster Management and Relief Committee
NHMS	National Health and Morbidity Survey
NNR	Naturally nutrient rich
NZD	New Zealand Dollar
PWD	Public Works Department
QoL	Quality of life
RNI	Recommended Nutrient Intake
SBP	Systolic blood pressure
SDMRC	State Disaster Management and Relief Committee
SFP	Supplementary feeding program
SH	Standing height
SPSS	Statistical Package for Social Sciences
SMART	Special Malaysia Disaster Assistance and Rescue Team
TFP	Targeted feeding program
UNHCR	United Nations High Commission for Refugee
USA	United States of America
USAID	United States Agency for International Development
USD	United States Dollar
USDA	United States Department of Agriculture
WFP	World Food Program
WHO	World Health Organization

LIST OF SYMBOLS

<	Less than
≤	Less than or equal to
>	More than
≥	More than or equal to
%	Percentage
β	Lower case beta
µg	Microgram
µRAE	Micro Retinol Activity Equivalent
χ^2	Chi-square
g	Gram
HbA1c	Glycaeted haemoglobin
kcal	Kilocalorie
kg	Kilogram
kJ	Kilo Joule
mg	Milligram
ml	Millilitre

REKABENTUK BANTUAN MAKANAN KECEMASAN YANG BERZAT DAN SEIMBANG, KOS EFEKTIF, DITERIMA SOSIAL DAN LESTARI UNTUK BANTUAN DAN PERSEDIAAN BENCANA

ABSTRAK

Pengenalan: Menangani keperluan makanan secara segera, mengurangkan kelaparan dan menjamin kelangsungan hidup mangsa bencana merupakan tujuan utama bantuan makanan kecemasan. Kekurangan polisi bantuan makanan kecemasan yang seragam dalam negara telah mengakibatkan pengedaran bantuan makanan kecemasan yang tidak lengkap dari segi jenis makanan, tenaga, komposisi mikronutrient and kos keseluruhan. Kekurangan peraturan tetap operasi berkaitan perolehan, pengedaran dan penyediaan makanan juga meletakkan negera dalam risiko ketika bencana. Peruntukan bantuan makanan untuk pesakit kencing manis, kardiovaskular dan buah pinggang juga kurang dan memerlukan perhatian segera. Objektif kajian ini adalah untuk merekabentuk bantuan makanan kecemasan yang berzat dan seimbang, kos efektif, diterima secara sosial dan lestari. **Metodologi**: Pendekatan metodologi campuran digunakan untuk merekabentuk pelan bantuan makanan kecemasan yang menyasarkan populasi berikut: sihat, pesakit kencing manis (DM), pesakit kardiovaskular (CVD) dan pesakit buah pinggang kronik (CKD). Fasa I tertumpu kepada pembentukan menu makanan kecemasan 3 hari dengan menggunakan prinsip ilmu kaji diet dan perisian Nutritionist Pro untuk menangani tiga senario berikut: keperluan makanan secara segera (IFR); bakul makanan kecemasan (EFB); dan makan secara ramai (CF) di pusat pemindahan. Fasa II tertumpu kepada kajian keratan rentas yang telah dijalankan dalam kalangan mangsa dan bukan mangsa

banjir untuk meneroka pengalaman penerima bantuan makanan kecemasan dan penerimaan menu makanan kecemasan yang baru. Fasa III menekankan pengoptimuman diet melalui linear programming untuk menghasilkan bantuan makanan yang berkos paling rendah dan mengandungi zat yang seimbang. **Hasil**: Menu kecemasan 3 hari yang menyasarkan populasi sihat menyumbang kira-kira 1900kcal/h dengan taburan makronutrien berikut: 50 - 65% karbohidrat, 10 - 20% protein dan 25 - 30% lemak. Sementara itu, menu 3 hari menyumbang kira-kira 1800, 2000 dan 1600kcal/h bagi populasi DM, CVD dan CKD. Daripada tinjauan penerimaan makanan dalam kalangan populasi sihat (n = 307), 97.4% responden menerima semua menu makanan: 94.5% berpuas hati dengan menu IFR manakala 97.8% berpuas hati dengan menu EFB dan menu CF. Dengan mengoptimumkan nutrien terpilih, kos makanan bagi populasi sihat mengikut setiap senario adalah kurang daripada RM 10.00 dengan senario IFR, EFB dan CF masing-masing berharga RM 8.00, RM 7.14 dan RM 6.07/h. Dari segi populasi DM, kos makanan IFR, EFB dan CF masing-masing berharga RM 11.71, RM 10.11 dan RM 5.75/h. Dari segi CVD, kos makanan IFR, EFB dan CF masing-masing adalah RM 12.82, RM 7.64 dan RM 5.65/h. Akhirnya, untuk CKD, jumlah kos/h adalah kurang dari RM 7.00 dengan mengoptimumkan nutrien terpilih. Di antara mangsa banjir (n = 130), 43.8% daripadanya mempunyai BMI yang normal, manakala 31.5% mempunyai berat badan berlebihan. Kebanyakan mangsa banjir (39.2%) menpunyai tekanan darah yang normal. Lelaki mempunyai ketinggian badan, jisim otot dan jisim tulang yang tinggi manakala wanita mempunyai peratusan lemak badan yang lebih tinggi (p<0.001). **Kesimpulan**: Kajian ini menyediakan panduan pemakanan untuk dasar bantuan makanan bencana.

DEVELOPMENT OF A NUTRITIONALLY-BALANCED, COST-EFFECTIVE, SOCIALLY-ACCEPTABLE AND SUSTAINABLE EMERGENCY FOOD AID DESIGN FOR DISASTER RELIEF AND PREPAREDNESS

ABSTRACT

Introduction: Addressing immediate food requirement, alleviating hunger and ensuring survival of the disaster victims remains the primary aim of emergency food aid. The lack of standardised emergency food aid policy in the country has led to the provision of inconsistent emergency food aid in terms of food type, energy and micronutrient content, and overall cost of food aid. The lack of transparent standard operating procedures involving food procurement, distribution and preparation also places the country at risk during disaster. Provision of emergency food aid targeting populations with diabetes mellitus, cardiovascular disease and chronic kidney disease is lacking and requires immediate attention. The objective of the study was to design a nutritionally-appropriate, cost-effective, socially-acceptable and sustainable emergency food aid. **Methodology:** Mixed methodology approach was employed in developing the emergency food aid plan targeting the following population: healthy, diabetes mellitus (DM), cardiovascular disease (CVD) and chronic kidney disease (CKD). Phase I primarily focused on developing 3-day emergency food menu using principles of dietetics and Nutritionist Pro software which addressing three scenarios: immediate food requirement (IFR); emergency food basket (EFB); and congregate feeding (CF) at the evacuation shelters. Phase II focused on cross-sectional survey, conducted among victims and non-victims of flood to explore the experience of

emergency food aid recipients and the acceptance of the newly designed emergency food menu. Phase III emphasised on dietary optimisation by linear programming to create lowest cost and nutritionally-balanced food aid. **Results:** The 3-day emergency menu targeting healthy population contributes approximately 1900 kcal/person/day with the following macronutrient distribution: 50 - 65% carbohydrate, 10 - 20% protein and 25 - 30% fat. Meanwhile, the 3-day menu contributed approximately 1800, 2000 and 1600kcal/person/day for population with DM, CVD and CKD respectively. From the food acceptance survey among healthy population (n = 307), 97.4% of the respondents accepted all the food menus: 94.5% were satisfied with the IFR menu and 97.7% were satisfied with EFB, and CF menu, accordingly. The food cost/person/day targeting general population for each scenario was less than MYR 10.00 by optimising selected nutrients, with the IFR, EFB and CF scenarios costing MYR 8.00, MYR 7.14 and MYR 6.07, respectively. In term of DM population, the food cost of IFR, EFB and CF were MYR 11.71, MYR 10.11 and MYR 5.75, respectively. In term of CVD, the food cost of IFR, EFB and CF were MYR 12.82, MYR 7.64 and MYR 5.65, respectively. Finally, for CKD, the total cost/person/day was less than MYR 7.00 by optimizing selected nutrients. Among the flood victims (n = 130), 43.8% of the flood victims have normal BMI, while 31.5% of them were overweight. Most of the victims (39.2%) manifest normal blood pressure. Men have higher stature, muscle mass and bone mass while women have higher body fat percentage (p<0.001). **Conclusion:** This study provides nutritional guidelines for disaster food assistance policy.

CHAPTER 1

INTRODUCTION

1.1 Background

Disasters primarily comprise of natural disasters, man-made disasters and complex emergencies (overlap of natural and man-made disasters). Common impacts of disasters include injury, death, psychological disorder, damage and destruction of infrastructure, food insecurity and economic loss. Historically, disasters, often large-scale, claimed global attention through mass destruction of properties and human lives. The 2004 South-East Asia tsunami caused approximately 250,000 deaths, followed by the 2005 hurricane Katrina in the United States of America (USA) that caused more than 1,800 deaths (Lumbroso, 2018). The Great East Japan earthquake and tsunami in 2011 also sacrificed approximately 15,000 human lives (Amagai, Ichimaru, Tai, Ejiri & Muto, 2014). The incidence and impact of disaster prompt effective disaster preparedness, mitigation, and response measures.

Humanitarian assistance or emergency aid is intended to provide rapid assistance and distress relief to populations temporarily requiring support after natural disasters, man-made disasters or complex emergencies (Fink & Redealli, 2011). Humanitarian assistance environments engage international relief organizations, host governments, the military, local and regional relief organizations, and private sector companies, each with different interests, mandates, capacity, and logistics expertise (Balcik, Beamon, Krejci, Muramatsu, & Ramirez, 2010). Between the period of 2012 and 2016, international humanitarian assistance has increased steadily from 16.1 billion USD to 27.3 billion USD (Development Initiatives, 2016). The common types of humanitarian assistance include the provision of emergency food, water and

sanitation, health services and shelter (Balcik & Beamon, 2008; Rose, O' Keefe, Jayawickrama, & O'Brien, 2013).

Disaster induced food requirements are classified according to the nature of the disaster. Sudden-onset disasters, particularly floods, wind storms, tsunamis, and tidal waves cause sudden but temporary food requirements by destroying food supplies (Fisher, 2007). Thus, vulnerable population may be partially or completely dependent on emergency food aid. The primary aim of emergency food aid is to alleviate the hunger of the emergency-affected population and to prevent acute protein-energy malnutrition (Barrett & Maxwell, 2007). The importance of emergency food aid was observed as the World Food Program (WFP) shifted the balance of its program toward emergency response and away from sustainable development of food security and nutrition between the period of 1985 and 2000 (Marchione, 2002).

1.2 Problem statement

Flood is the most frequent and severe natural disaster in Malaysia, causing effects such as damages to buildings, disruption of transportation, reduction of income and loss of properties (Gasim, Toriman, & Abdullahi, 2014). The 1996 flood claimed 241 lives and caused more than 97.8 million USD damage, while the December 2006 - January 2007 flood in Johor caused 18 deaths and 489.0 million USD in damage (Chan, 2015). Correspondingly, emergency food aid is the common humanitarian aid provided to the flood victims in Malaysia and it is governed by the Department of Social Welfare in conjunction with the state and district governments. Emergency food aid is provided by the local government and non-governmental organizations in the form of emergency food basket and mass feeding at the evacuation shelters. The common problem reported by the victims was mismanagement of aid during and after floods,

particularly the lack of proper food and water by the donors to the remote areas (Karim, Hazizan, Diah, Tajuddin, & Mustari, 2016).

Emergency food basket involves the transfer of shelf-stable food items to the flood victims to be cooked and consumed at home. However, problems such as food provision considering cooking requirements, quantity of food per person based on energy requirement and frequency of food aid provision depending on the flood severity remain vague in the existing policy. Mass feeding is the provision of cooked food to the victims relocated to evacuation shelters, prepared by the military personnel and voluntary organizations. The cooked food consists of local dishes and often varies among evacuation shelters depending on the availability of food and cooking equipment. The lack of standardised emergency food aid policy in the country has led to the provision of inconsistent emergency food aid in terms of the type of food, energy, and micronutrient content, and the overall cost of emergency food aid. The lack of transparent standard operating procedures involving food procurement, distribution and preparation also places the country at risk at times of disaster. Globally, serious nutritional and health problems among the emergency victims were caused by food shortages, untimely food delivery and provision of inappropriate food types (Marchione, 2002).

According to the National Health and Morbidity Survey (NHMS) 2015 (Institute of Public Health, 2015), the prevalence of non-communicable diseases, particularly diabetes mellitus, hypertension and hypercholesterolemia among population aged 18 years and above were 17.5%, 30.3%, and 47.7%, respectively. Meanwhile, National Kidney Registry (2015) reported that the prevalence of chronic kidney disease with dialysis increased from 415 per million populations in 2003 to 1059 per million populations in 2015. Individuals with diabetes mellitus experience

poor glycaemic control caused by natural disaster, causing increased risk of morbidity and mortality due to diabetic complications (Miller & Arquilla, 2008). Individuals with hypertension experience acute and chronic stress caused by disasters (Kario, Bruce, & Thomas, 2003). Further, missed dialysis session caused by disasters (disruption of infrastructure, shortage of electricity to operate dialysis machine) was observed among individuals with chronic kidney disease on dialysis, leading to cardiovascular disease, breathlessness, and oedema (Palmer et al., 2015). Thus, diet plays a major role in controlling the symptoms and prognosis of the disease during and post-disasters. Currently, provision of emergency food aid targeting the populations is lacking and requires immediate attention for the prevention of further complications.

1.3 Research objectives

General objective:

1. To develop and evaluate the acceptance of emergency food aid for the purpose of disaster relief and preparedness.

Specific objectives of the research are:

1. To develop a nutritionally-balanced, socially-acceptable and cost-effective emergency food aid design targeting the following population: general population, diabetes mellitus, hypertension, hyperlipidaemia and chronic kidney disease
2. To evaluate the acceptance of developed emergency food aid in community settings after flood disaster
3. To explore the receipt of emergency food aid by the flood victims in Malaysia
4. To assess the nutritional status of flood victims in Malaysia in terms of body mass index, body composition and blood pressure

1.4 Significance of the research

Emergency food aid can address food insecurity among victims of disasters in Malaysia. Hunger and acute protein-energy malnutrition can be addressed in the short-term and micronutrient deficiencies may also be prevented in the long-term. This research may also serve as a framework for the government, voluntary organizations and Malaysian population to stockpile emergency food at the national, state and district warehouses and also at the household level. Cost-effective food aid may reduce the economic burden of the country during crisis.

CHAPTER 2

LITERATURE REVIEW

2.1 Disaster

The International Federation of Red Cross and Red Crescent Societies (2018) proposed the following definition:

"A disaster is a sudden, calamitous event that seriously disrupts the functioning of a community or society and causes human, material and economic or environmental losses that exceed the community's or society's ability to cope using its own resources. Though often caused by nature, disasters can have human origin".

Disasters are commonly classified into natural disaster, man-made disaster and hybrid disaster (Mohamed Shaluf, 2007). In terms of natural disaster, the following definitions are summarized by Mohamed Shaluf (2007):

- Natural phenomena beneath the Earth's surface such as earthquakes, tsunamis and volcanic eruptions
- Natural phenomena of complex physical origin on the Earth's surface such as landslides and avalanches
- Metrological or hydrological phenomena such as windstorms, tornadoes, sea surges, floods and droughts
- Biological phenomena such as locust infestations and epidemics.

Contrastingly, man-made disaster is caused by warfare and accidents (Turner & Pidgeon, 1997). Sieges, blockades, vehicular accidents, collapse of buildings are examples of man-made disasters. Meanwhile, hybrid disasters are caused by human errors and natural forces. For example, extensive forest clearing inducing soil erosion and subsequently heavy rain causing landslides (Mohamed Shaluf, 2007).

2.1.1 Disasters in Malaysia

Malaysia is located outside the Pacific Ring of Fire and is unhampered by earthquakes, typhoons, and volcanic eruptions. However, the country is prone to floods, landslides, tsunamis, haze, and man-made disasters (Mohamed Shaluf & Ahmadun, 2006; Chan, 2015). Flood is the most common and severe natural disaster experienced by the country particularly in the east-coast states such as Kelantan and Terengganu. Monsoon and flash floods are common flood types in Malaysia. Annual flooding affects approximately 9% of total land and 22% of population in Malaysia with the total damage cost of MYR 915 million (Khan, Shaari, Bahar, Baten, & Nazaruddin, 2014). Recently, the December 2014 - January 2015 flood was regarded as the worst flood in Malaysian history, displacing 200,000 people and causing 21 deaths (Akasah & Doraisamy, 2015).

Landslides are also frequent in Malaysia with existing record of 600 deaths since 1961 (Rahman, 2014). Negative impacts of landslides include death, injury and property damage. Kuala Lumpur and Selangor are the most landslide prone states followed by Perak and Pahang (Rahman, 2014). Rapid development of land coupled with high intensity rainfall is the primary cause of landslides in the country. Significant landslides incidents in Malaysia were the collapse of Highland Tower luxury condominium in 1993 with 49 deaths, the Genting Highlands landslide in July 1995 with 20 deaths and 23 injured victims, the Pos Dipang landslide with 39 deaths of aboriginal people in August 1996 and the Cameron Highlands landslide causing one death and evacuation of hundreds of people in October 1996 (Chan, 1998).

2.2 Disaster management

The four phases of disaster management are mitigation, preparedness, response and recovery. Coppola (2006) has aptly summarised the disaster management phases as following:

- Mitigation involves reduction or elimination of the likelihood or consequences of a hazard or both
- Preparedness involves equipment of tools to increase the chances of survival and minimise financial and other loses to disaster-impacted people or those with ability to help others impacted by disaster
- Response involves performing actions to reduce or eliminate the impact of disasters or currently occurring, to prevent financial loss, suffering or both
- Recovery involves restoring the lives of the victims back to a normal state following the impact of disaster. This phase begins after immediate response has ended and can persist for a long time

Disaster management in Malaysia is based on top-down government centred machinery (Chan, 2015). The top most government agency responsible for general disaster management is the National Security Division. The National Security Division is adhered to the National Disaster Management Council Directive No.20 through the "Policy and Mechanism on Disaster Relief Management". Disaster management in the country consist of three levels and acts to improve coordination and effectiveness (Aini, Fakhru'l-Razi, & Daud, 2001). Level I is managed by the District Disaster Management and Relief Committee (DDMRC) and focuses localised emergency, provided that local resources are adequate to manage the disaster response. Level II

manages emergencies affecting more than two areas, requiring external support and aid. It is managed by the State Disaster Management and Relief Committee (SDMRC). Finally, Level III manages complex disasters spanning over other states and managed by the National Disaster Management and Relief Committee (NDMRC). Agencies involved in disaster management in Malaysia are the Royal Malaysian Police, Royal Malaysian Army, Special Malaysia Disaster Assistance and Rescue Team (SMART), Malaysian Meteorological Service (MMS), Drainage and Irrigation Department (DID), the Public Works Department (PWD), Social Welfare Department, the local authority, non-governmental organizations (the Red Crescent Society and the Scout society), civil defence department, and international cooperation (Rahman, 2012).

Food shortages may occur in two possible ways. Food stock destruction may reduce the absolute amount of food available or disruption of distribution systems may curtail the access to food even though without absolute shortages. Flooding and sea surges can damage household food stocks and crops, disrupt distribution and cause major local shortages (Noji, 2005). Food may be contaminated with dangerous microbiological agents and chemicals in areas affected by disaster. Floods are frequently followed by diarrhoeal disease but rarely specific outbreaks. Besides associated with unsafe food storage, handling and preparation, food safety risks also arise from cooking conditions due to lack of fuels or facilities and poor sanitation such as lack of safe water and toilet facilities (International Food Safety Authorities Network, 2005).

2.3 Food aid

Often inaccurately defined, food aid commonly refers to the donation of food to recipient individuals and households and consists of the following core characteristics: international sourcing, concessional sourcing and provision of food (Barrett &

Maxwell, 2007). Food aid also consist of the following components: cross border flow of food, cross border flow of cash for food, significant grant element and also food transfers with nation's balance of payment entries. Food aid consists of program, project and emergency food aid. Program food aid is supplied as a resource transfer providing balance of payments or budgetary support; project food aid is usually provided to support specific poverty alleviation and disaster prevention activities; and relief food aid is targeted on and freely distributed to victims of natural and man-made disasters (Organisation for Economic Co-operation and Development, 2018).

According to Devereux (2007), food aid saves lives during emergencies and also addresses underlying vulnerability. Food aid has been effective in reducing household vulnerability in Ethiopia (Krishnan, Dercon, & Krishnan, 2005; Quisumbing, 2003) and important in smoothing consumption and protecting assets of household experiencing food stress (Hoddinott, Cohen, & Bos, 2004). It also can achieve improved nutrition better than cash because more food is consumed for equivalent values of transfer (Edirisinghe, 1998).

2.3.1 History of food aid

The United States of America is the largest donor of emergency and non-emergency food aid. The program originated following World War II, contributed by agricultural surpluses and looming Cold War II to win over emerging nations (Marchione, 2002). The following programs contributed to the world's emergency food aid (Marchione, 2002):

- Title II of Public Law 480 (P.L.480) of 1954 provided by the U.S. Agency for International Development (USAID)
- Section 416 (b) of the Agricultural Act of 1949 provided by the U.S. Department of Agriculture (USDA)

P.L. 480 Title II program procures food from annual congressional appropriation. However, the food quantity derived from the Section 416 (b) is dependent on U.S agricultural surpluses. Over the decade, policies for food energy levels in general rations for emergency-affected populations have evolved significantly (Figure 2.1). The initial recommendation of energy levels contributed by general rations was 1200 - 1800kcal/person/day based on body weight, demographic composition and activity levels of the population in the 1980s. The 1200 - 1800kcal energy levels were envisaged survival or emergency level and calculated using low energy expenditure level. In 1989, a minimum level of 1900kcal/person/day was established replacing the previous energy levels, aimed to provide temporary minimum supply beyond the survival or emergency level. Correspondingly, energy level of 2000kcal/person/day was established with the consideration food supply trading during the unavailability of other economic resources among the destitute people. This consideration increased the energy level to 2400kcal/person/day by the International Committee of Red Cross (ICRC) (Norton & Nathaniel, 1995). Later, the United States Academy of Science recommended 2100 kcal/person/day as a single figure to support the planning of supplies and logistics. This single figure was later endorsed by the United Nations High Commission for Refugee (UNHCR) and WFP in 1997. Recently, the WHO recommended the average of 2100kcal/person/day with a range 1900 - 2300kcal/person/day.

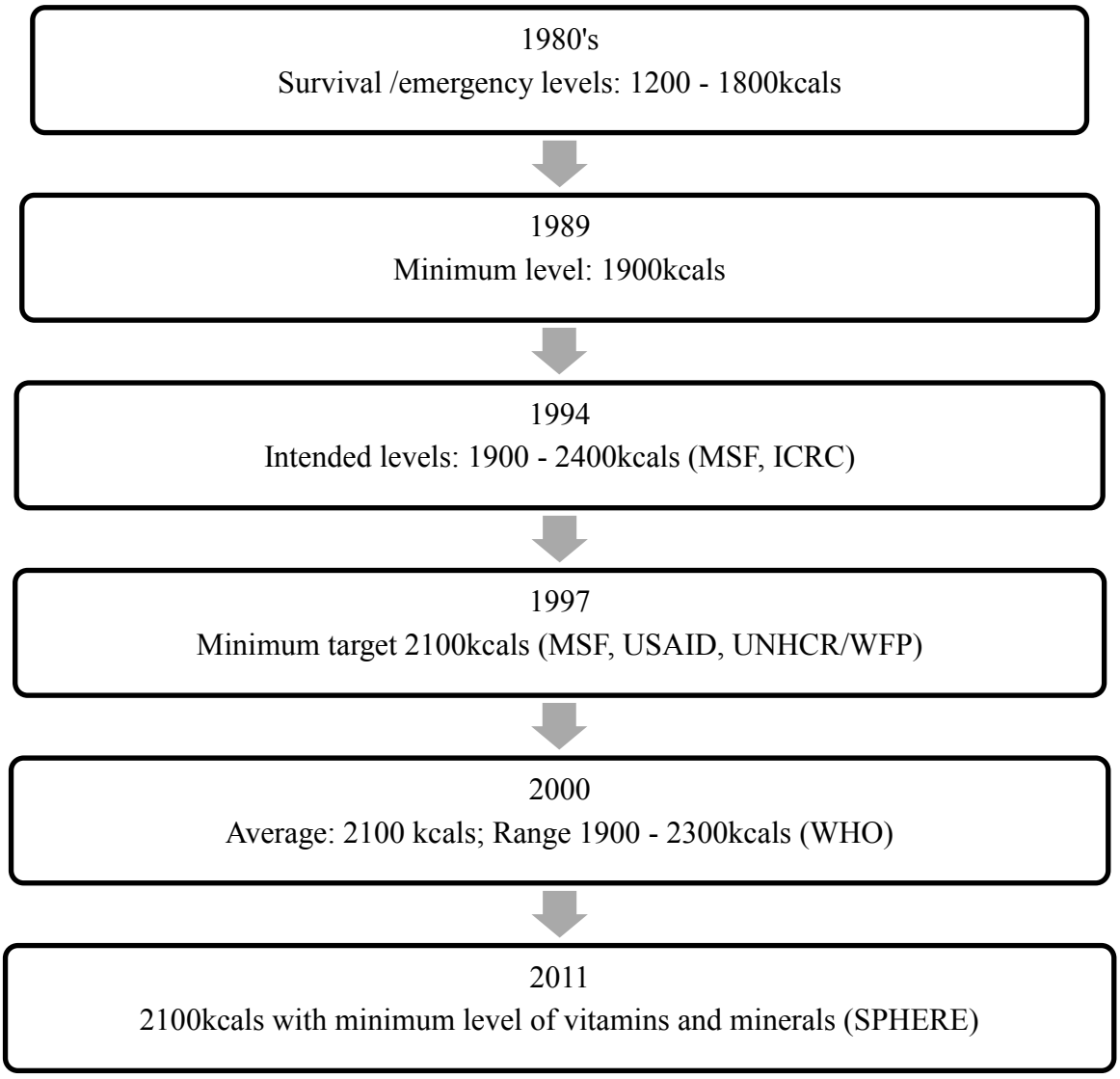

Figure 2.1 Evolution of food energy level in general ration of global food aid (Mason, 2002)

2.4 Emergency food aid

Emergency food aid, also known as relief/humanitarian aid is the free distribution of food to meet the requirements of emergency-affected population. Globally, the term emergency food aid refers to the transfer of food between donor and recipient countries. The classification of emergency food aid as the transfer of food by the local government to its emergency-affected population is still a point of debate because of the lack cross border flow of food. Common problems concerning emergency food aid

are the quantity and quality of foods provided and the coordination of food aid programming with the health and personal care components required to protect the nutrition of people affected by emergencies (Marchione, 2002). In the period of 2008 - 2012, emergency food aid dominated the food aid deliveries compared with project and program food aid (Figure 2.2).

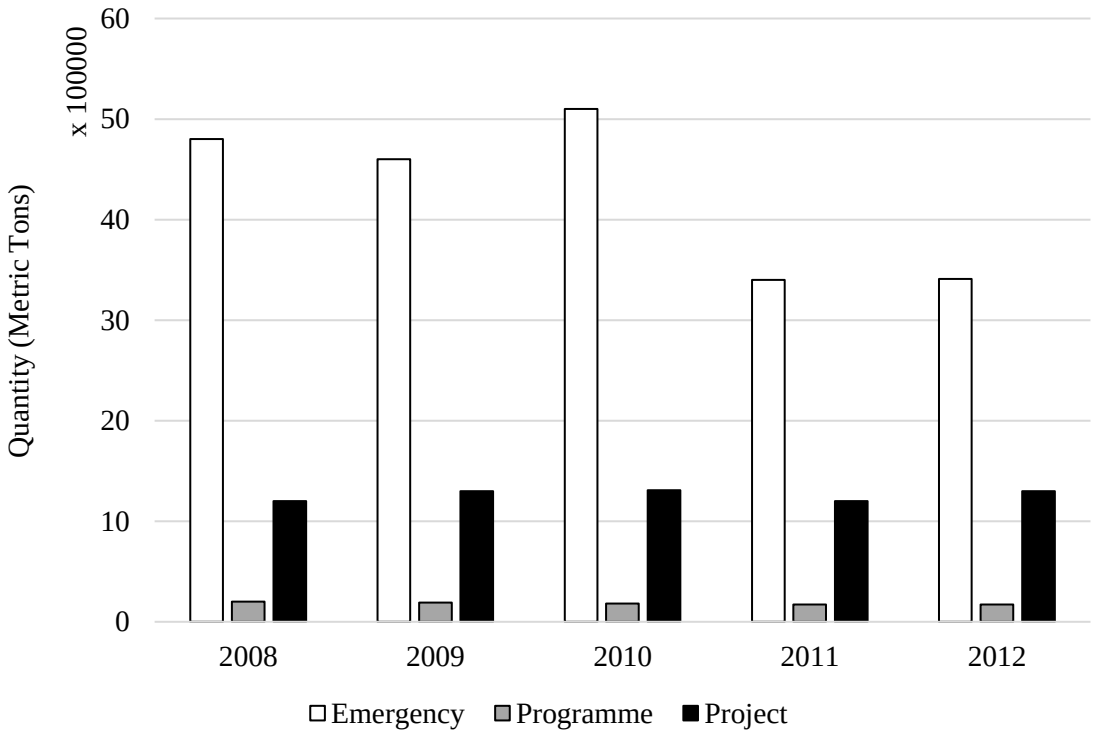

Figure 2.2 Global Food aid deliveries (World Food Programme, 2018)

2.4.1 Types of feeding program

The priority of feeding program is to provide adequate general food ration to the affected population. Figure 2.3 shows the type of feeding programs during emergencies (Mason, 2002). The programs are segregated into the general food distribution and selective feeding programs. Selective feeding programs are categorised into supplementary feeding programs (SFP) and therapeutic feeding programs (TFP). SFP is targeted towards moderately malnourished or moderately malnourished together with other groups. SFP in the broadest context is referred to as

blanket supplementary feeding, targeting specified vulnerable groups such as mothers and young children. Meanwhile, TFP is targeted towards the severely malnourished.

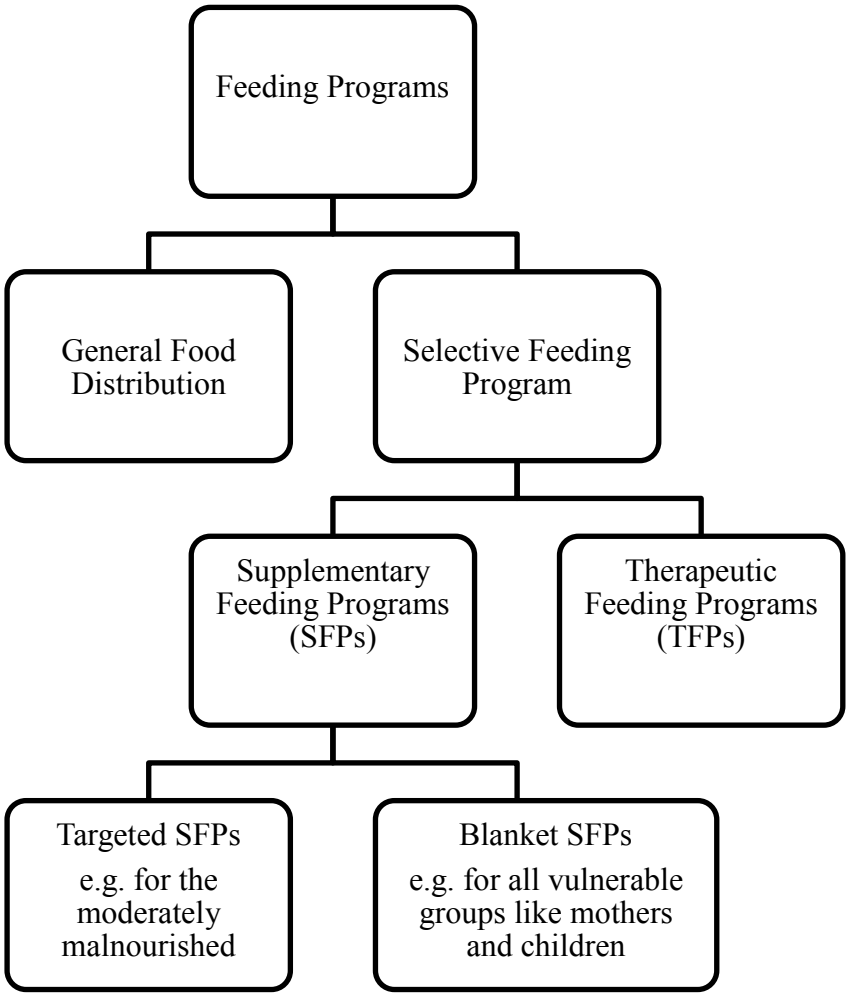

Figure 2.3 Types of feeding programs (Mason, 2002)

2.4.2 Development of emergency food aid

Addressing issues such as hunger and malnutrition underscore the importance of developing food aid plan as a reference guide during emergencies. In the current state, literature focusing on the development of the food aid plan remains scant and prompts future research. These current literatures acknowledge crucial factors in developing the food aid plan such as nutrient requirements of the beneficiaries, the cost of rations, water and heat availability for cooking, cultural preferences of the beneficiaries and

sustainability (Nhung, Mary-Ann, & Wilson, 2012; Wien & Sabaté, 2015). Limited insights are available on the methods used to develop emergency food aid.

In Indonesia, Burtha, Syarief, and Sunarti (2008) employed mathematical method to determine food requirement of population inhabiting disaster regions. The population was categorised into population less than 3 years of age and above 3 years of age. Food items with the following criteria were selected as emergency food: long shelf life, easy distribution, easy preparation with minimal cooking and easy consumption. Population less than 3 years of age were provided with milk formula and milk porridge while population above 3 years of age were provided with rice, instant noodles, canned sardine, corned beef, beef floss and drinking water. The quantity of required food was determined by dividing the total energy requirement of the population (less than 3 years: 735kcal/day and above 3 years: 1800kcal/day) with the energy content of the selected food products. The following assumptions was used in calculating the quantity of food: 50% of milk formula and 50% of milk porridge contributed to the energy requirement of population less than 3 years while 70% of rice and instant noodles and 30% of sardines, corned beef and beef floss contributed to the total energy requirement for population above 3 years. Hence, the quantity of food required/day consist of 668kg milk formula, 721kg milk mush, 33,436kg rice, 23,812kg instant noodles, 12,719kg sardines, 8919kg corned beef, 7677kg beef floss and 358,638.500ml water.

Subsequently, Nhung et al. (2012) used scenario modelling and linear programming to determine the combination of food items with the lowest-cost for emergency storage that meets the nutritional requirement of the population in New Zealand. Food price data and nutritional data from food composition table were used. Then, different scenarios were modelled in *Microsoft Excel* and *R* along with

uncertainty analysis. A collection of low-cost emergency storage food items that meet the following scenarios were identified: (a) achieving daily energy requirement ignoring other nutrients for men (EP-B); (b) no cooking requirement (EP-C); (c) achieving all nutrition recommendations (EP-H) and (d) assumption of zero level spoilage during storage (EP-NS). The cost was cheapest for the scenario with zero level spoilage (NZD 1.93/day) while the cost was the highest for meeting all the nutrient requirements (NZD 7.10/day). In conclusion, purchasing basic emergency food for storage in the current New Zealand setting appears affordable with the list of food products identified and could be considered by the citizens and disaster relief organizations. Table 2.1 shows the food items and the respective weights selected by the optimisation process.

Like the previous study in Indonesia, Rustiawan and Mansur (2014) have determined the quantity and cost of food required by the population residing in disaster prone area particularly in Sleman district, Indonesia using mathematical calculation. Energy requirement of the total population in disaster prone area was calculated based on the Recommended Dietary Intake (RDI) according to the age group. The population's energy sufficiency obtained was converted into rice and instant noodle servings. Secondary data such as map of disaster area, quantity and composition of population by age and also price of rice and instant noodles was collected from the relevant authorities followed by data analysis using *Microsoft Excel* and *NutriSurvey* software. Results indicated that RDI of the total population was 399,964,150 kcal/day, equivalent to 49.7 tons of rice (IDR 374,250,000) and 2,137 boxes of instant noodles (IDR 102,624,000).

Recently, Wien and Sabaté (2015) used three-phase multidimensional approach to determine specific food groups for developing Disaster Response Diets (DRD) in

USA. Percent daily nutrient intake and Drewnowski's naturally nutrient-rich (NNR) score for individual food or mean composite for one serving of food from 11 specific food group was calculated and the 11 food groups were evaluated and scored based on the following criteria: storage and handling properties, preparation ease and cultural acceptance or individual tolerance. Results indicated that NNR scores ranged from 2.1 for fresh fruits to 28.1 for dry cereals, a higher score indicating higher nutrient density. A score ranging from 7 - 12 was achieved by using the following plant-based food groups: dry cereals, nuts, dried fruits, grains and legumes. Milk inclusive, milk-free, and grab-and-go DRD summarized in Table 2.2 provide approximately 40 - 50% of daily energy requirement and achieve a minimum of 40% DV for at least 9 of the 14 nutrients from NNR score.

Table 2.1 Food items and the respective weights selected by the optimisation process

Food items selected by the optimisation process	**Total food weights suggested per day (g) by Scenario**			
	EP-B Energy achieved, ignoring other nutrients	**EP-C No cooking required**	**EP-H All daily nutrients achieved**	**EP-NS No spoilage considered**
Food that requires cooking:				
White flour	100*	0	0	100
Rice (white)	100	0	0	100
Pasta (dried)	100	0	0	100
Whole meal flour	0	0	200*	0
Food that can be eaten without cooking:				
Peanut butter	100	100	51	85
Sugar	100	100	14	100
Oats (whole grain, raw)	74	100	0	100
Oil (vegetable, blended)	60	30	0	60
Peas (dried)	0	100	200	0
Sultanas	0	100	0	0
Peanuts, raw	0	96	0	0

Breakfast biscuits ("Weetbix")	0	10	0	0
Peaches (canned)	0	0	200	0
Fruit salad (canned)	0	0	200	0
Apricots (canned)	0	0	200	0
Tomatoes (canned)	0	0	200	0
Sardines	0	0	183	0
Tomato sauce	0	0	145	0
Total food weights consumed per day (g) (excluding water)	634	636	1594	645
Number of food items	7	8	10	7
Cost to purchase (NZD)	2.22	3.67	7.10	1.93
Cost (USD) per day	1.46	2.41	4.66	1.27

(Nhung et al., 2012)

Table 2.2 Disaster Response Diet

	Milk-inclusive	**Milk-free**	**Grab-and-Go**
Food Categories	5 Grains[a] 1 Legumes[c] 1 Nuts[d] 1 Dried fruits[e] 1 Dry milk	5 Grains[a] 1 Legumes[c] 2 Nuts[d] 1 Dried fruits[e]	3 Dry cereals[b] 3 Nuts[d] 3 Dried fruits[e]
[a]Grains	Cooked white rice 1/3 cup; saltine crackers 6; cream of wheat or enriched pasta ½ cup cooked		
[b]Dry Cereals	Cornflakes®, Cheerios® ¾ cup; Shredded Wheat® ½ cup; granola ¼ cup		
[c]Legumes	Raw peas, raw soybeans 1 cup; canned kidney beans, cooked chick peas, cooked lentils ½ cup		
[d]Nuts	Almonds, walnuts, cashews, pecans, pistachios 1 ounce		
[e]Dried fruits	Apricots, figs, raisins, apples, dates ¼ cup		

(Wien & Sabaté, 2015)

Table 2.3 Summary of development method of emergency food aid

Author & Year	Method	Strength/ Weakness
Burtha et al. (2008)	Mathematical calculation using energy requirement of the target population	• Excluded micronutrient requirements and food items used requires cooking prior consumption
Nhung et al. (2012)	Diet optimisation using linear programming	• Considered wide range of scenarios: energy and micronutrient requirement and spoilage estimates • Considered cost
Rustiawan and Mansur (2014)	Mathematical calculation using energy requirement of the target population	• Excluded micronutrient requirement • Used only two food items primarily rice and instant noodles • Considers cost
Wien and Sabaté (2015)	NNR score and % DV	• Excluded cost • Considered micronutrient requirement

2.5 Disaster and meal provision

Meals provided at emergency shelters contribute important effect on evacuee's health and physical condition (Tsuboyama-Kasaoka et al., 2014b). Evacuees in evacuation shelters usually receive meals provided by the government, non-governmental and private voluntary organizations. In the USA, the Salvation Army served 5.7 million hot meals and 8.3 million sandwiches, snacks and drinks through 178 canteens and 11 field kitchens in the areas affected by Hurricane Katrina (Rikoski, 2008). Meanwhile, the government of Japan provided 5.5 million meals and 3.2 million bottles of water to the evacuation centres and hospitals in the areas affected by the 2011 earthquake and tsunami (International Federation of Red Cross and Red Crescent Societies, 2011).

2.5.1 Perception and effects of meals served at the evacuation shelters

A preliminary study on meal provision has been conducted by Nakano, Okuda, Taeko Kuragano, Kitao, and Kitao (1996) among 290 victims to determine the responses on meals provided in nine refugee camps of Great Kobe Earthquake in Japan. Based on 270 respondents, the survey revealed that the provided meals were predisposed towards oily food (50.4%), meat products (17.8%), salty food (16.3%), and cooked rice (15.6%). The victims considered the meals as poor and most of the meals were fried or salty, cold (34.1%), monotonous (42.6%) and hard in texture, thus resulting in many leftovers. The menu predominantly comprised of hamburgers, sausages or meat, contrary to the food preferred by victims, particularly vegetables (34.3%) and fishes (20.5%). Overall, the victim's nutritional status was unbalanced due to excessive consumption of fat and protein. The study urged food providers to supply more meals consisting of vegetables, salad, potatoes and beans.

Subsequently, Hirai et al. (1998) studied the meals of 315 victims of Japan's Great Hanshin-Awaji Earthquake living in temporary shelters. Results depicted that

daily fish and coloured vegetable consumption were only 13% and 34%, respectively, while victims who preferred large quantities of coloured vegetable and also fish with the meals were 61% and 59%, respectively. Majority of the victims (41%) were dissatisfied with the cold meals (75%) and limited amounts of vegetables (55%) provided. Further, 34% of the victims considered the food intake were sufficient and 49% of them preferred to cook for themselves and their families. Overall, provision of hot meals with fresh fish or poultry and vegetables was preferred by the victims residing in the evacuation shelters.

Alternatively, the effects of meal provision on health were accentuated by Takechi et al. (2004) by examining the effect of temporary meal provision on blood pressure among the evacuated Hokkaido volcanic eruption victims. Participants without high blood pressure during the first physical examination were recruited. Typical Japanese-style meals (containing 15 - 21g of salt/day) were prepared and delivered to the shelters together with pickles and soups. Salt was also placed on the table for everyone to use freely. Blood pressure, urinary sodium excretion, urinary potassium excretion, plasma and urinary catecholamines of 44 evacuees were examined. Significant positive correlation was found between systolic blood pressure and sodium excretion ($r = 0.311$; $p < 0.05$) and the ratio of urinary sodium to urinary potassium ($r = 0.311$; $p < 0.05$). It could be inferred that the elevation of the evacuee's blood pressure after the acute phase reactions was attributed to be higher sodium consumption. Similarly, Tuomilehto et al. (2001) have indicated high sodium intake as an independent cardiovascular risk factor, supporting the need for dietary sodium restriction of less than 2.4g for the population with normal blood pressure.

2.5.2 Factors governing meal provision at evacuation shelters

Factors influencing meal provision in the evacuation shelters was examined. Tsuboyama-Kasaoka, Hoshi, Onodera, Mizuno, and Sako (2014) have elucidated some important factors that influenced the provision of meals to evacuees by re-examining dietary survey data conducted in emergency shelters one month after the Great East Japan Earthquake. The results showed that 34.8%, 35.8% and 79.1% of the emergency shelters have nutritionally vulnerable individuals, food surplus, and food shortages, respectively. Meal frequency and provision of grains and vegetables were significantly greater in shelters with the possibility of cooking. In addition, restoration of electricity was not associated with the possibility of cooking whereas shelters with gas and water supply provided the possibility of cooking. Gas supply availability was associated with significant increase in twice daily provision of balanced meals (containing grains, vegetables, and meat/fish) while the lower possibility of cooking and limited gas supply were associated with emergency shelters accommodating a large number of evacuees. The study indicated that early improvements to post-disaster meal provision such as the speedy gas supply restoration to enable cooking and limiting the number of evacuees per emergency shelter may sustain the health status of evacuees.

In contrast to the previous study, some evacuation shelters provided the evacuees with better dietary provisions. Similar group of researchers, Tsuboyama-Kasaoka et al. (2014a) have extracted factors influencing better meal provision at evacuation shelters lacking the ability to cook or expect restoration of gas service. The researchers have re-analyzed data from dietary survey conducted in emergency evacuation shelters after the great East Japan Earthquake and extracted additional cases of better meal provision that were sufficiently large in size with appropriate

dietary provision. Shelters with better meal provision were in collaboration with neighbouring emergency evacuation shelters despite the lack of water and gas for cooking. Besides receiving food from the school lunch centre or the Self Defence Force when cooking was impossible, larger size shelters with better meal provision were also better staffed. Both registered and general dieticians oversaw meal provisions in three shelters, the Self Defence Force provided meals by cooking on-site at two shelters and another two shelters received meals cooked externally at the school lunch centre. The study concluded that cooperation among the emergency shelters, meal provisions from external sources and the presence of nutrition professionals in emergency evacuation shelters are key factors for improving dietary circumstances after a disaster.

2.6 Evaluation of nutrition and health status of natural disaster victims

Indicators related to nutritional status are the most vital indicators of well-being during emergencies, thus useful to identify needs, prioritise resources, track changes and prevent the deterioration of the population's nutritional status (Jayatissa, Bekele, Piyasena, & Mahamithawa, 2006). In the common practice, assessment of nutritional status in emergencies involve anthropometric measurements using indicators such as weight-for-height, body mass index (BMI), mid-upper arm circumference (MUAC) and oedema by surveying children under the age of 5 years (World Health Organization, 2000). Since nutrition and health are inextricably linked, the multifactorial influence on nutrition ultimately affects health (Wright & Vesala-Husemann, 2006). Poor nutritional status causes lowered immunity, inducing increased morbidity by measles, malaria and tuberculosis whilst further deteriorate nutritional status via eating inability and/or malabsorption without nutritional intervention and medical care, results in death (Tsuboyama-Kasaoka & Purba, 2014;

Wright & Vesala-Husemann, 2006). Numerous nutritional surveys have been conducted on famines and several nutritional surveillance systems established in different countries to provide information on food-related emergencies (Young & Jaspars, 1995). However, nutritional surveys focusing on victims in evacuation shelters after large-scale natural disasters remain limited. Table 2.4 summarises recent investigations of victim's nutritional and health status assessment.

Magkos et al. (2004) have surveyed a total of 225 volunteers from two temporary camps to assess their nutritional status after the Athens 1999 earthquake. Anthropometric parameters (standing height, body weight and BMI), 24-hours dietary recall, haematological and biochemical profiles (plasma glucose, total cholesterol, high-density lipoprotein cholesterol, total try-acylglycerol, serum albumin, urea and creatinine) were performed. Results revealed that only 2 children and 3 adolescents had weight-for-height below the fifth percentile, though the adults and elderly had increased BMI of 25.0 - 29.9kg/m^2. Both children and adolescent showed no sign of undernourishment, however, adults and the elderly have consumed less energy than needed for long-term maintenance of health. Short-term energy and protein deficits did not threaten the nutritional status of the population. The study inferred that previously well-nourished population have rather low nutritional risks in the acute phase after a major emergency, particularly for younger individuals, probably due to increased provision of the family and community. In contrast, increased risk may be confronted by older persons as the emergency is prolonged. However, the validity of the study was hampered by the small sample size of the elderly population.

Meanwhile, Mokdad et al. (2005) have conducted a rapid nutritional assessment in Banda Aceh and Aceh Besar, Indonesia three weeks after the 2004 Indian Ocean tsunami. Anthropometric measurements and questionnaires on diet and