



**UNIVERSITI PUTRA MALAYSIA**

**DIETARY PATTERNS AND OBESITY RISK AMONG ADULTS IN  
MONGOLIA**

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**DIETARY PATTERNS AND OBESITY RISK AMONG  
ADULTS IN MONGOLIA**

**By**

**OTGONTUYA DUGEE**

**Thesis Submitted to the  
School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the  
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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Master of Health Science

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By

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**Chair: Professor, Khor Geok Lin PhD**

**Faculty: Medicine and Health Sciences**

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Cardiovascular diseases (CVD) and associated nutritional risk factors are among the leading causes of mortality and morbidity in both developed and developing countries. Obesity is an independent risk factor for cardiovascular disease. In Mongolia, cardiovascular diseases have consistently been the leading cause of death since 1995. However, there is a lack of study on the relationship between diet and nutritional risk factors of chronic disease among Mongolians. The purpose of this study was to identify major dietary patterns of the Mongolian adults and to examine the dietary patterns as risk factor of overweight and obesity. Dietary intake is an important determinant of obesity. People consume meals with



complex combinations of foods and nutrients. The dietary pattern approach considers the overall diet of persons by taking into account intakes of combined foods and nutrients. This approach is increasingly applied in relations to public health. The cross - sectional study of 420 healthy Mongolian men and women aged 25 years and over was conducted in urban and rural province of Mongolia. This Health and Nutrition survey was carried out jointly by the National Public Health Institute of Mongolia and Kagawa Nutrition University of Japan in 2002 and 2005. Dietary intake was assessed by interview using a semi-quantitative food frequency questionnaire (FFQ) with 68 items. Anthropometric measurements were taken and assessed in accordance with WHO guidelines: weight, height, waist circumference and BMI. Percentage of body fat was measured using a bioelectrical impedance meter. The Principal Component Factor analysis was applied to derive dietary patterns. Twenty one (21) food groups were entered into the factor analysis. Eigenvalue  $>1.25$  criterion and scree plot were used to define the number of factors. Factor scores in all identified factors were calculated for each individual person. Logistic regression analysis was used to calculate odds ratio (OR) and 95% confidence interval (95% CI) for  $BMI \geq 25$ , central obesity and percentage of body fat categories for each quintile of the dietary pattern. An exploratory factor analysis resulted in three types of dietary patterns that accounted for 34.5% of the total variance for the original dietary intake. The Transitional dietary pattern was characterized by higher intake of pork, sausage, cheese, beef, mutton, goat, potato, vegetables and cookies. The Traditional dietary pattern was heavily loaded on milk and milk products, fat and oil, sugar,



confectionery and horse meat, whereas the Healthy dietary pattern was high in egg, barley, whole grain bread, vegetable salad, fruits and rice. Male subjects of urban residence, younger age, having higher education, higher income and practice binge drinking tend to be associated with the Transitional dietary pattern. Meanwhile, a higher score for the Traditional pattern was related to subjects with rural residence, intermediary education and physically active. After adjustment for several confounding factors and total energy intake, the Transitional dietary pattern was significantly associated with an increased risk of BMI (odds ratio of the highest quintile vs lowest, 2.47; 95% confidence interval: 1.04–5.86; P for trend <0.002). For the male adults, the Transitional dietary pattern was significantly associated with an increased risk of central obesity and body fat (OR: 4.08; 95% CI: 1.11–14.97; P for trend <0.034 and OR: 4.35; 95% CI: 1.21–15.58; P for trend <0.024, respectively). As for the Traditional dietary pattern, the higher score was associated with an increased risk of central obesity among the women, after adjustment for confounders (OR: 4.59; 95% CI: 1.58–13.30; P for trend <0.001, and after further adjustment for energy, intake OR: 3.74; 95% CI: 0.92–15.20; P for trend <0.065). On the other hand, the higher score for the Traditional diet was related to a decreased risk of central obesity among the men (Q3vsQ1. OR: 0.26; 95% CI: 0.08–0.79; p<0.018 and Q4vsQ1. OR: 0.29; 95% CI: 0.09–0.95; p<0.041). Meanwhile, the Healthy dietary pattern was significantly associated with a lower risk of BMI (OR: 0.49; 95% CI: 0.25–0.95; P for trend <0.035). In conclusion, this study identified three major dietary patterns and their associations independently with obesity risk among Mongolian adults. Diet,

socio-demographic and lifestyle factors should be taken into consideration when designing community-based obesity prevention interventions. The study findings suggest that public health efforts in Mongolia should be targeted at population subgroups in order to address prevailing specific aspects of the Transitional and Traditional dietary patterns, which were found to be associated with increased risk of cardiovascular disease.



Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai  
memenuhi keperluan untuk ijazah Master Sains

**CORAK PEMAKANAN DAN FAKTOR OBESITI DALAM KALANGAN  
ORANG DEWASA DI DAERAH MONGOLIA**

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Penyakit kardiovaskular (CVD) dan faktor risiko yang berkait dengan pemakanan adalah antara penyebab utama mortaliti dan morbiditi di kedua-dua negara membangun dan sedang membangun. Obesiti adalah faktor risiko yang bebas bagi penyakit kardiovaskular. Di Mongolia, penyakit kardiovaskular merupakan punca utama kematian yang tetap sejak tahun 1995. Walaubagaimanapun, kajian tentang hubungan di antara pemakanan dan faktor risiko pemakanan bagi penyakit kronik di Mongolia masih kurang. Tujuan kajian ini adalah untuk mengenalpasti corak pemakanan utama masyarakat Mongolia dewasa dan mengkaji corak pemakanan sebagai faktor risiko bagi berat badan berlebihan dan obesiti.

Pengambilan makanan adalah penentu utama obesiti. Orang mengambil makanan dengan gabungan yang kompleks makanan dan nutrien. Pendekatan corak pemakanan dianggap keseluruhan pemakanan seseorang dengan mengambil kira pengambilan makanan dan nutrien yang digabungkan. Penggunaan pendekatan ini telah meningkat dalam kaitan dengan kesihatan awam. Kajian keratan rentas ke atas 420 orang Mongolia lelaki dan wanita yang sihat dan berumur 25 tahun ke atas telah dijalankan di wilayah bandar dan luar bandar, Mongolia. Kajian Pemakanan dan Kesihatan ini dijalankan bersama oleh Institut Kesihatan Awam Kebangsaan, Mongolia dan Kagawa Nutrition University, Jepun dari tahun 2002 hingga 2005. Pengambilan diet dinilai melalui temuduga menggunakan soalselidik kekerapan pengambilan makanan (FFQ) separa-kuantitatif dengan 68 perkara/butiran. Pengukuran antropometrik telah dijalankan dan dinilai dengan merujuk kepada garis panduan oleh WHO; berat, tinggi, ukur lilit pinggang dan BMI. Peratus lemak badan diukur menggunakan meter bioelektrikal rintang. Analisis “Principal Component Factor” digunakan untuk menentukan corak pemakanan. Dua puluh satu kumpulan makanan telah dimasukkan di dalam faktor analisis. Kriteria nilai Eigen  $> 1.25$  dan peta tayangan telah digunakan untuk menjelaskan faktor nombor. Mata skor dalam semua faktor yang dikenalpasti telah dikira untuk setiap individu. Analisis logistik kemunduran telah digunakan untuk mengira nisbah ganjil (OR) dan 95% selang keyakinan (95% CI) untuk BMI  $> 25$ , obesiti pusat (central obesity), dan kategori peratus lemak badan untuk setiap quintile corak pemakanan. Keputusan analisis faktor eksplotasi menunjukkan tiga jenis corak pemakanan yang memberikan 34.5% dari



jumlah perbezaan bagi pengambilan pemakanan yang asal. Corak pemakanan Peralihan dicirikan dengan pengambilan daging babi, sosej, keju, daging lembu, daging kambing, ubi kentang, sayur-sayuran dan biskut. Corak pemakanan Tradisi adalah kaya dengan susu, hasilan tenusu, lemak dan minyak, gula, manisan dan daging kuda manakala corak pemakanan Sihat kaya dengan telur, barli, roti bijirin penuh, salad sayur-sayuran, buah-buahan dan nasi. Subjek lelaki di kawasan bandar, muda, dengan pendidikan dan pendapatan yang tinggi dan juga mengamalkan minuman 'binge', berkecenderungan untuk dikaitkan dengan corak pemakanan Peralihan. Manakala, skor yang lebih tinggi untuk corak pemakanan Tradisi dikaitkan dengan subjek dari kawasan luar bandar, mempunyai pendidikan pertengahan dan fizikal aktif. Selepas penyelarasan dibuat untuk beberapa faktor yang tidak disangka dan jumlah pengambilan tenaga, corak pemakanan Peralihan berkait secara signifikan dengan peningkatan risiko BMI (OR: 0.49; 95% CI: 0.25-0.95; p untuk hala <0.035). Untuk lelaki dewasa, corak pemakanan Peralihan berkait secara signifikan dengan peningkatan risiko obesiti pusat dan lemak badan ((OR: 4.08; 95% CI: 1.11-14.97; p untuk hala <0.034 and OR: 4,35; 95% CI: 1.21-15.58; p untuk hala <0.024, masing – masing )). Manakala skor yang lebih tinggi bagi corak pemakanan Tradisi dikaitkan dengan peningkatan risiko obesiti pusat di kalangan wanita, selepas penyelarasan faktor yang tidak disangka (OR: 4,59; 95% CI: 1,58-13.30; p untuk hala <0.001 dan penyelarasan seterusnya untuk pengambilan tenaga OR: 3,74; 95% CI: 0.92-15.20; p untuk hala <0.065). Selain dari itu, skor yang lebih tinggi untuk pemakanan Tradisi dikaitkan dengan penurunan risiko obesiti pusat di

kalangan lelaki (Q3vsQ1. OR: 0.26; 95% CI: 0.08–0.79; p untuk hala <0.018 and Q4vsQ1. OR: 0.29; 95% CI: 0.09–0.95; p untuk hala <0.041). Corak pemakanan Sihat pula berkait secara signifikan dengan penurunan risiko BMI (OR: 0.49; 95% CI: 0.25–0.95; p untuk hala trend <0.035). Kesimpulannya, kajian ini telah mengenalpasti tiga corak pemakanan yang utama dan kaitannya secara bebas dengan risiko obesiti di kalangan masyarakat Mongolia yang dewasa. Faktor pemakanan, sosio-demografik dan gaya hidup perlu diambil kira dalam merangka intervensi mencegah obesiti di kalangan komuniti. Keputusan kajian ini juga mencadangkan usaha kesihatan umum di Mongolia perlu disasarkan pada sub-kumpulan populasi untuk merujuk aspek spesifik yang lazim dalam corak pemakanan. Peralihan dan Tradisi yang mana telah ditunjukkan mempunyai kaitan dengan peningkatan risiko penyakit kardiovaskular.

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I certify that an Examination Committee has met on 21 January 2009 to conduct the final examination of Ogtontuya Dugee on her master's thesis entitled "Dietary patterns and Obesity risk among adults in Mongolia" in accordance with Universities and University Colleges Act 1971 and the Constitution of University Putra Malaysia [P.U.(A) 106] 15 March 1998. The committee recommends that the student be awarded the Master of Science.

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Date: 9 April 2009



## **DECLARATION**

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.

**OTGONTUYA DUGEE**

Date: 1 March 2009

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## CHAPTER 1

### INTRODUCTION

Obesity is global epidemic. About 1.6 billion adults were overweight in 2005 worldwide. Of these, almost 400 million were obese. The World Health Organization (WHO) estimate shows that by 2015, over 2.3 billion people will be overweight and more than 700 million will be obese (WHO, 2006). Obesity is an important risk factor for non-communicable diseases (NCDs) including cardiovascular diseases, cancer and diabetes. Globally, NCDs accounted for 60% of deaths and 47% of the burden of disease (WHO, 2002). High body mass index (BMI) is an important cause of death and disability globally. It causes about 2.5 million deaths and 33 million DALYs (disability adjusted life years) each year. Of this, about one third of BMI-attributable burden occurs in the Asia Pacific region (APCSC, 2004).

The World Health Organization points out that the rising epidemic of obesity reflects changes in society and in behavioral patterns of people over years. In this regard, obesity is a societal phenomenon. Economic growth, urbanization, industrialization and the globalization of food markets have led to significant changes in diet and physical activity patterns (WHO, 2006). Almost all countries are exposed to the “obesogenic environment”. The obesity epidemic is not restricted to industrialized societies, in fact obesity is occurring at a faster rate in developing countries than in the developed world (Schmidhuber & Shetty, 2005).



Dietary intake is an important determinant of obesity (WHO, 2002). Numerous studies have examined relations between single nutrients, particularly dietary fat, and obesity but dietary determinants of weight gain remain controversial (Willett, 1998). This may be due to the complex nature of diet assessed by means of dietary instruments with a large number of food items (Hu, 2002). This complexity of dietary variables in epidemiological studies often requires special methods to ensure whether the exposure measure of diet is proper in relation to particular nutritional health outcome (Martnez *et al*, 1998; Newby *et al*, 2004). Moreover, people don't eat single nutrients. Indeed they consume meals with complex combinations of foods and nutrients (Hu, 2002). The food itself is not an empty vessel carrying single nutrients, but it is the ultimate source of all nutrients which are highly correlated with each other. Thus, analysis of single nutrients in relation to obesity may be confounded by the effects of other compounds in the diet (Jacobs & Murtaugh, 2000).

In recent years, nutrition epidemiologists have studied dietary patterns, or combinations of foods and nutrients in relation to chronic disease risk factors (Hu, 2002). The idea of the dietary pattern approach is that individuals habitually eat in certain patterns, which encompass core staples around which diets of individuals are formed (Kant, 2004). Factor analysis is used as a method to explore the underlying patterns by which variations of how people eat may be explained. The factor analytical method reduces a large number of dietary variables by finding a few meaningful and relatively independent factors that are composed of correlated food items (Moeller *et al.*, 2007). The assumption of the factor analysis in



nutrition epidemiological studies is that dietary variables (food items) included in food frequency questionnaire can be explained, to some extent, by a few number of latent variables (patterns) that reflect individual's food intake patterns (Hu, 2002).

Several epidemiological studies have attempted to define dietary patterns among different populations and to examine their relations to nutritional health outcomes. Across all studies, dietary patterns characterized by higher intake of fruits, vegetables, whole grains, fish and poultry have been shown to be related to favorable health outcomes. This type of dietary pattern is mostly termed as prudent or health conscious pattern (Kant, 2004). Reports from two prospective cohort studies provide an opportunity for evaluating dietary patterns as stronger predictors of nutritional health outcome than a single food component. In the Health Professional Follow-Up Study (HPFS), the relative risk of incident fatal and non fatal myocardial infarction (CHD) was 30% lower among men in the highest quintile of prudent pattern scores (Hu *et al.*, 2000). In the meantime, the Nurses Health (NHS) study reported that the relative risk of incident CHD in the highest quintile of the prudent pattern was lower by 24% among women (Fung *et al.*, 2001).

Dietary patterns have been examined prospectively in relation to annual anthropometric changes. In the Baltimore Longitudinal Study of Aging, the dietary pattern high in reduced fat, dairy products, fruits, cereals, non-white bread, nuts and seed, whole grains was inversely associated with annual change in BMI

( $\beta=-.51$ ; p for trend  $<.01$ ) in women, and inversely associated with annual change in waist circumference ( $\beta=-1.06$ , p for trend  $<.04$ ) in both sexes (Newby *et al.*, 2004).

In cross-sectional studies, the associations between the identified dietary patterns and anthropometric characteristics were in the expected directions generally. The more health conscious patterns were found to be negatively associated with BMI and waist circumference (Togo *et al.*, 2001). However, some specific dietary patterns observed reflect different cultures, food preferences and eating habits of the different populations. Thus, assessing the relationship of overweight and obesity with overall diet or eating patterns is gaining interest in studies in different populations (Kant, 2004).

In Mongolia, there has been a shift in the patterns of disease from infectious diseases to non-communicable diseases since 1990s. Death rates attributable to cardiovascular diseases, cancer and injuries have almost doubled between 1990 and 2005. Cardiovascular diseases have been the number one cause of death of Mongolians since 1995 (DMS, 2005). Meanwhile several studies have shown the growing burden of overweight and obesity among Mongolians. The Risk Factors Survey in 1993 reported 11.0 % of overweight and obese among adults aged 35-64 years. The prevalence reached 26.5% according to the Second National Nutrition Survey (NNS II) in 1999 (MOH, 2000). The most recent nationwide study of STEPS Survey on the Prevalence of NCD Risk factor (STEPS NCD), 2006 found that 31.6% of the males and females aged 15-64 years were



overweight and obese. Out of these 21.8% were overweight and 9.8% were obese (MOH, 2006). On the other hand, Mongolia has experienced a steady reduction in child malnutrition and further decline is expected particularly the severe forms of malnutrition. However, there is a slow decrease in the stunting prevalence (19.6% as of 2004) as compared to the decline for wasting and underweight. Micronutrient deficiency still constitutes a major cause of malnutrition among children (MOH, 2005)

Mongolians have dietary habits that include a preference for a diet high in protein and rich in fatty foods of animal origin. The traditional Mongolian diet is in keeping with the extreme continental climate and nomadic lifestyle. Mongolians have a strong seasonal variation in their food consumption pattern, whereby meat and fatty foods are consumed during the winter, and dairy products are mainly consumed in summer and autumn. However, seasonal variations in food consumption pattern no longer exist in the modern life of Mongolians particularly in urban areas (FAO, 2006).

Reports from the first and second National Nutrition Surveys (MOH 1997, 2000) indicated increasing trends in total fat intake in both urban and rural areas. When compared to the recommended amounts for macronutrients (RDA), average daily intake of fat was 78.3% of RDA in 1994 (MOH, 1997). However, the second nutrition survey in 1999 (MOH, 2000) reported that daily intake of fat already exceeded the RDA (134.2% of RDA). Of the consumed fat, 56.1-81% was from animal sources (MOH, 2000). On the other hand, individuals consumed only 42.1

