UNIVERSITI PUTRA MALAYSIA

PREVALENCE OF METABOLIC SYNDROME AND FACTORS ASSOCIATED WITH IT AMONG WOMEN IN FELDA PALONG, GEMAS, NEGERI SEMBILAN

AZIZAH BTE MAT HUSSIN

FPSK(M) 2006 9

06 AUG 2008

PREVALENCE OF METABOLIC SYNDROME AND FACTORS ASSOCIATED WITH IT AMONG WOMEN IN FELDA PALONG, GEMAS, NEGERI SEMBILAN

AZIZAH BTE MAT HUSSIN

MASTER OF SCIENCE

UNIVERSITI PUTRA MALAYSIA

2006

PREVALENCE OF METABOLIC SYNDROME AND FACTORS ASSOCIATED WITH IT AMONG WOMEN IN FELDA PALONG, GEMAS, NEGERI SEMBILAN

By

Azizah Bte Mat Hussin

Thesis Submitted to the School of Graduate Studies University Putra Malaysia in Fulfilment of the Requirement for the Degree of Master of Science

December 2006

UPM

Dedicated to:

My beloved parents (Mat Hussin B Anal and Wan Aminah Bte Wan Yaacob) for their love and care throughout my Master study.

My lovely siblings (Asma, Azlina, Aminudin, Azmanida) for their encouragement and understanding.

My supportive family members

My dearest Hafazli Burhan

And

My wonderful friends for their assistance.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirements for the degree of Master of Science

PREVALENCE OF METABOLIC SYNDROME AND FACTORS ASSOCIATED WITH IT AMONG WOMEN IN FELDA PALONG, GEMAS, NEGERI SEMBILAN

By

AZIZAH BTE MAT HUSSIN

December 2006

Chairman: **Associate Professor Rokiah Bte Mohd Yusof, PhD**

Faculty: **Medicine and Health Sciences**

A cross sectional study was carried out to assess the diet, physical activity and the prevalence of metabolic syndrome (MS) of 106 women aged 45 to 60 years old living in Felda Palong 4, 5 and 6, Gemas, Negeri Sembilan. The data collection processes included interviews, anthropometric measurements, blood pressure measurements and blood lipid sample collection. Out of the total sample, 67.0% were Malays, 29.2% were Indians and 3.8% were Chinese. The educational level of respondents (37.7%) was primary school level. Most of the respondents were housewives (70.8%), with a majority of the respondents (60.4%) earning between RM400 and RM699 per month. For the anthropometric measurements, almost half of the respondents (47.2%) were overweight (Body Mass Index (BMI) ≥ 25.0 - 29.9). Majority of the respondents (74.5%) had waist-

hip-ratio (WHR) of more or equal to 0.85 and 81.1% had waist circumferences (WC) equal to or greater than 80 cm. The prevalence of hypercholesterolemia (total cholesterol (TC) ≥ 6.2mmol/L) among respondents was 31.1%. Raised Low Density Lipoprotein- Cholesterol (LDL-C) was found in 43.4% of the respondents while low levels of High Density Lipoprotein- Cholesterol (HDL-C) were evident in 14.2% of the respondents. The prevalence of high blood pressure and high blood glucose were 47.2% and 21.7% respectively. The dietary pattern of the respondents showed that their main sources of carbohydrate were rice and white bread. Their main sources of protein were chicken and fish while their sources of vitamins and minerals were fruits and vegetables. A high percentage of respondents were deficient in nutrients like potassium, vitamin C, fiber and calcium that were found to be lower than the Malaysian Recommended Nutrient Intake (RNI) and Daily Reference Value (DRV). On the other hand, the mean intakes of protein, carbohydrates, total fat, sodium, vitamin A, vitamin E and iron were found to be more than RNI and DRV. For physical activity, the mean kcal spent for physical activity was 1843±355. Most of the respondents (55.7%) were in the category of moderate PAL. By using International Diabetes Federation (IDF) criteria, the prevalence of metabolic syndrome significantly increased from 48.1% (NCEP ATPIII) to 54.7% ($r = 0.724$, $p<0.01$). Respondents with metabolic syndrome had significantly higher mean BMI, WC, WHR, systolic blood pressure (SBP), diastolic blood pressure (DBP), fasting plasma glucose (FPG), LDL-C and lower mean of HDL-C. BMI, WHR, SBP, DBP, FPG,

PERPUSTAKAAN PERUBATAN & SAINS KESIHATAN
UNIVERSITI PUTRA MALAYSIA

triglycerides and HDL-C were found to be significantly associated with MS. The mean energy intake was 1846±450 kcal for subjects with MS and 1927±521 for subjects without MS, both lower than the Malaysian RNI (2180 kcal for female). Respondents with MS had higher protein, carbohydrate, total fat and sodium intakes whereas respondents without MS had higher energy intake, cholesterol, vitamin A, vitamin C, potassium, fiber, calcium and iron intakes. However, these differences were not statistically significant except for vitamin C ($p<0.05$). The results showed that intake of iron, sodium and total fat were significantly associated with metabolic syndrome while protein, vitamin A, vitamin C, calcium and fiber intake were not significant. In conclusion, this study found that there were associations between anthropometric measurements, blood pressure, fasting plasma glucose and lipid profiles with metabolic syndrome. This study also found that there were associations between certain nutrient intakes and physical activity with metabolic syndrome. Therefore, there is a need to address these problems at national and regional level with the aim of early identification and prevention and appropriate community based intervention program should be reinforced to increase the awareness of the community on healthy living.

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

PREVALENS METABOLIK SINDROM DAN FAKTOR-FAKTOR YANG BERKAITAN DENGANNYA DI KALANGAN WANITA DI FELDA PALONG, GEMAS, NEGERI SEMBILAN

Oleh

AZIZAH BTE MAT HUSSIN

Disember 2006

Pengerusi: **Professor Madya Rokiah Mohd Yusof, PhD**

Fakulti: **Perubatan dan Sains Kesihatan**

Satu kajian keratan rentas dijalankan untuk mengkaji pemakanan, aktiviti fizikal dan prevalens metabolik sindrom (MS). Kajian ini telah dijalankan di kalangan 106 wanita yang berumur di antara 45 hingga 60 tahun dan tinggal di Felda Palong 4, 5 dan 6, Gemas, Negeri Sembilan. Proses pengumpulan data termasuk temubual, pengukuran antropometri, tekanan darah dan pengambilan sampel darah. Kebanyakan responden (67.0%) adalah Melayu, 29.2% India dan 3.8% Cina. Secara purata, tahap pendidikan responden adalah sekolah rendah (37.7%). Majoriti responden (70.8%) adalah surirumah dengan pendapatan isirumah antara RM400 hingga RM699 sebulan. Untuk pengukuran antropometri, hampir separuh dari jumlah responden (47.2%) adalah di dalam kategori berlebihan berat badan (Indeks Jisim Tubuh (IJT) ≥ 25.0 - 29.9). Distribusi nisbah pinggang-

pinggul (NPP ≥ 0.85) dan ukuran pinggang (UP ≥ 80cm) adalah masing-masing 74.5% dan 81.1%. Distribusi hiperkolestrolemia (Jumlah Kolesterol (JK) ≥ 6.2mmol/L) di kalangan responden adalah 31.1%. Paras Kolesterol Lipoprotein Ketumpatan Rendah (K-LKR) yang tinggi didapati di kalangan 43.4% responden sementara paras Kolesterol Lipoprotein Ketumpatan Tinggi (K-LKT) yang rendah terbukti di kalangan 14.2% responden. Distribusi tekanan darah dan glukosa darah yang tinggi adalah masing-masing 47.2% dan 21.7%. Corak pemakanan menunjukkan sumber karbohidrat responden adalah dari nasi dan roti putih manakala sumber protein adalah dari ayam dan ikan. Sayur-sayuran dan buah buahan adalah sumber utama vitamin dan mineral responden. Kajian ini juga menunjukkan peratusan yang tinggi terhadap kekurangan nutrien seperti potasium, vitamin C, serat dan kalsium di mana ia didapati kurang daripada RNI Malaysia dan DRV. Manakala purata protein, karbohidrat, lemak, sodium, vitamin A, vitamin E dan zat besi didapati melebihi RNI Malaysia dan DRV. Untuk aktiviti fizikal, min aktiviti fizikal adalah 1.43±355. Majoriti responden (55.7%) adalah di dalam aras aktiviti fizikal sederhana. Dengan menggunakan kriteria dari *International Diabetes Fedaration (IDF)*, prevalens MS meningkat secara signifikan dari 48.1% (kriteria dari *National Cholesterol Education Program Adult Treatment Panel III (NCEP ATPIII)*) kepada 54.7% ($r=0.724$, $p<0.01$). Responden dengan MS mempunyai perbezaan yang signifikan untuk purata IJT, UP, NPP, tekanan darah sistolik dan diastolik, glukosa darah, K-LKR dan K-LKT. IJT, UP, NPP, tekanan darah, paras glukosa darah,

trigliseride, dan K-LKT didapati mempunyai perkaitan yang signifikan dengan MS. Purata pengambilan tenaga di kalangan responden MS adalah 1846±450 kkal manakala 1927±521 untuk responden bukan MS, kedua-duanya adalah lebih rendah dari RNI Malaysia (2180 kkal untuk wanita). Responden dengan MS mempunyai pengambilan protein, karbohidrat , lemak dan sodium yang lebih tinggi manakala responden tanpa MS mempunyai pengambilan tenaga, kolesterol, vitamin A, vitamin C, potassium, serat, kalsium dan zat besi yang tinggi. Walau bagaimanapun, perbezaan pengambilan nutrien di kalangan responden dengan MS dan tanpa MS adalah tidak signifikan kecuali vitamin C ($p<0.05$). Kajian ini menunjukkan zat besi, sodium dan lemak mempunyai perkaitan yang signifikan dengan MS manakala protein, vitamin A, vitamin C, kalsium dan serat didapati tidak signifikan. Secara kesimpulannya, kajian ini mendapati perkaitan antara pengukuran antropometri , tekanan darah, paras glukosa darah dan profil lipid dengan MS. Kajian ini juga mendapati ada perkaitan antara nutrien-nutrien tertentu dengan MS. Oleh itu, adalah suatu kepentingan kepada pihak berwajib untuk mengenalpasti masalah ini dari peringkat daerah khususnya dan kebangsaan amnya. Pengesanan awal, pencegahan serta program berasaskan komuniti yang bersesuaian perlu dilakukan untuk meningkatkan kesedaran komuniti terhadap kehidupan yang sihat.

ACKNOWLEDGEMENTS

First and foremost, I would like to express my utmost gratitude to God who has been the pillar of my strength as I pursued my Master degree. Without His wills, I would not have been motivated enough to accomplish this research.

From the bottom of my heart, I want to thank my supervisor, Associate Prof. Dr. Rokiah Bte Mohd Yusof, who had been very patient and understanding throughout the process of my research, especially in guiding and correcting my thesis. My sincere thanks also goes out to the members in the supervisory committee: Associate Prof. Dr. Zaitun Bte Yassin and Puan Nawalyah Bte Abd. Ghani for their tutorship, suggestions and advice during my research.

My sincere thanks to Dr Bahaman Bin Abu Samah, Dr Saidi Bin Moin and Dr Hazizi Bin Abu Saad for their guidance in statistical analysis. I also would like to thank the staff from the laboratory of Universiti Malaya for the biochemical analysis of the blood profiles.

My deepest appreciation goes to my loving parents, Mat Hussin Bin Anal and Wan Aminah Bte Wan Yaacob; and my family members for their love, faith and continuous prayers throughout those hard years. I would not have been able to make it without their support.

I have not forgotten my friends especially Nor Ashikeen , Wan Siti Zulaicha, Emmy Hainida, Mohd Nazari, Syed Faisal, Siti Sarah and others, who are too many to be mentioned. Thank you for their encouragement especially at times when I felt like giving up. My special thanks to Roya and Hani for their fellowship, support and prayers. We have shared all the ups and downs, tears and fears throughout the years. We have become friends, and for me friends are forever. "A good friend is like a computer. He 'ENTER' your life, 'SAVES' you in his heart, 'FORMAT' your problems and never 'DELETE' you from his memory".

I am greatly indebted to Pakcik Addnan Bin Abdullah and Makcik Halijah Bte Mohd Jantan for treating me like their own daughter during my stay in their home to complete this research. Not forgetting the manager of Felda Palong 4, 5 and 6; Encik Abdul Aziz, Encik Kamaruddin and Encik Md Mohiyar Ros for giving me the permission to carry out the survey in the village. I would also like to say a note of thanks to all the respondents for their cooperation.

I also wish to express my sincere gratitude and appreciation to Dr Anis Salwa Kamarudin and Dr Mohamed Ismail B Abdul Samad from Ministry of Health for their guidance and support. Lastly, I wish to extend my gratitude to individuals who have helped me in one way or another, in making this study a success.

Azizah Bte Mat Hussin

	Food Items and Food Groups	52
	Cereal and Grain	52
	Fish	53
	Meat	55
	Dairy Product	56
	Fruits and Vegetables	59
	Physical Activity	61
3	**METHODOLOGY**	**64**
	Location of the Study	64
	Study Population	65
	Sample Size	66
	Sample Selection	67
	Data Collection	67
	Explanation of the Study and Getting Informed Consent	68
	Blood Collection	68
	Blood Pressure and Pulse Rate	70
	Anthropometric Measurement	73
	Weight and Height	73
	Waist Hip Ratio (WHR)	74
	Questionnaire	75
	Food Frequency Questionnaire (FFQ)	75
	24-hr Dietary Intake Record	76
	24-hr Diary Physical Activity Record	77
	Data Analysis	77
	Questionnaire	77
	Food Frequency Questionnaire	79
	24-hr Dietary Intake Record	80
	24-hr Physical Activity Record	81
4	**RESULTS AND DISCUSSION**	**83**
	Introduction	83
	Socio-Demografic Characteristic of Respondents	83
	Anthropometric Measurements	86
	Body Mass Index (BMI)	86
	Waist Hip Ratio (WHR) and Waist Circumferences (WC)	87
	Total Lipid Profiles and Fasting Plasma Glucose	90
	Blood Pressure	93
	Health Status of the Respondents	94

Family History of CVD Risk Factors (DM, HBP,CHD, Stroke) 96
Correlation between Anthropometric Measurements, Fasting Plasma Glucose and Lipid Profiles 98
Frequency of Food Intake 100
Food Consumption Frequency Score - Cereal and Grain Products 100
Food Consumption Frequency Score – Fish and Fish Products 102
Food Consumption Frequency Score – Meat and Meat Products 104
Food Consumption Frequency Score –Dairy Products 106
Food Consumption Frequency Score – Vegetables 109
Food Consumption Frequency Score – Fruits 111
Food Consumption Frequency Score – Cooked Food That Were Purchased 114
Nutrient Intake 117
Lifestyle Characteristic 120
Smoking Habit 120
Physical Activity 121
Prevalence of Metabolic Syndrome 123
Independent Sample T-test on Anthropometric Measurement,Blood Pressure, Fasting Plasma Glucose and Lipid Profiles among Metabolic and Non Metabolic Syndrome 129
Association between Sociodemographic, Anthropometric Measurement and Blood Pressure between Metabolic Syndrome and Non Metabolic Syndrome Respondents 129
Association between Fasting Plasma Glucose, Lipid Profiles and Family History among Metabolic Syndrome and Non Metabolic Syndrome Respondents 131
Comparison of Physical Activity Level between Metabolic and Non Metabolic Syndrome. 137
Relationship of Anthropometric Measurements, Blood Pressure , Fasting Plasma Glucose, Lipid Profiles, Selected Nutritional Intake and Physical Activity Level on the Metabolic Syndrome in the Multivariate Model. 139
Discussion 142

5 CONCLUSION AND RECOMMENDATION 153
Conclusion 153
Recommendation 153
REFERENCES 157
APPENDICES 179
BIODATA OF THE AUTHOR 204

LIST OF TABLES

Table		Page
1	Definitions of the Metabolic Syndrome	16
2	Ethnic Specific Cut Points for Waist Circumferences for IDF Criteria	17
3	Categories of Abnormalities in Glucose Metabolism According to The American Diabetes Criteria (2004)	32
4	Classification of Blood Serum Lipid & Fasting Plasma Glucose Levels	70
5	Classification of Blood Pressure Levels	72
6	Classification of Body Mass Index (BMI)	73
7	Classification of Upper Limit for Waist Circumferences and Waist Hip Ratio (WHR)	74
8	Guildford's Rule of Thumb	78
9	Physical Activity Ratios (PAR) for Different Activity Levels	81
10	Ranges of Physical Activity Levels (PAL) for Different Lifestyles	82
11	Socio-Demographic Background of the Respondents (n=106)	84
12	Mean ± SD for the Anthropometric Measurements between Age Group	89
13	Distribution of Respondents According to Classification of Lipid Profiles and Fasting Plasma Glucose (n=106)	91
14	Mean ± SD for the Total Lipid Profiles and Fasting Plasma Glucose Between Age Group	93
15	Mean ± SD and Distribution of Respondents According to Blood Pressure Classification (n=106)	94
16	Distribution of Respondents with CVD Related Diseases	95

17	Correlation Between Anthropometry, Fasting Plasma Glucose and Lipid Profiles Measurements	99
18	Distribution of Respondents According to Frequency of Intake for Cereal and Grain Products	101
19	Food Frequency Score for Cereal and Grain Products	102
20	Distribution of Respondents According to Frequency of Intake For Fish and Fish Products	103
21	Food Frequency Score for Fish and Fish Products	104
22	Distribution of Respondents According to Frequency of Intake for Meat and Meat Products	105
23	Food Frequency Score for Meat and Meat Products	106
24	Distribution of Respondents According to Frequency of Intake for Dairy Products	107
25	Food Frequency Score for Dairy Products	108
26	Distribution of Respondents According to Frequency of Intake for Vegetables	110
27	Food Frequency Score for Vegetables	111
28	Distribution of Respondents According to Frequency of Intake for Fruits	113
29	Food Frequency Score for Fruits	113
30	Distribution of Respondents According to Frequency of Intake for Cooked Foods That Were Purchased	115
31	Food Frequency of Score for Cooked Foods that Were Purchased	116
32	Percentages of Respondents with Nutrient Intakes at Various Level of Adequacy According to RNI and DRV (n=106)	118
33	Percentages of Protein, Fat and Carbohydrate Intake Among the Respondents	120

UPM

34	Mean Hours per Day Spent for Various Activity Levels of Respondents	122
35	The Prevalence of Metabolic Syndrome and Its Components According to NCEP ATPIII and Modified Asian Criteria	126
36	Mean ± SD for Anthropometric Measurements, Blood Pressure, Total Lipid Profiles and Fasting Plasma Glucose Between Metabolic and Non Metabolic Syndrome	128
37	Chi Square Test of Sociodemographic, Anthropometric Measurements and Blood Pressure Between Metabolic Syndrome and Non Metabolic Syndrome Respondents	130
38	Chi Square Test of Fasting Plasma Glucose, Lipid Profiles and Family History Between Metabolic Syndrome and Non Metabolic Syndrome Respondents	132
39	Mean Intake of Selected Nutrients Among Metabolic Syndrome and Normal Respondents Compared to RNI and DRV	134
40	Chi Square Test of Nutrients Between Metabolic Syndrome and Non Metabolic Syndrome Respondents	135
41	Comparison of Nutrient Intakes of Female Respondents With Other Communities	137
42	Category of Physical Activity Level (PAL) Between Metabolic and Non Metabolic Respondents	138
43	Multivariate Model of Logistic Regression Analysis for Metabolic Syndrome	140

LIST OF FIGURES

1	Conceptual Framework for Metabolic Syndrome	6
2	Body Mass Index Category Of The Respondents	86
3	Waist Hip Ratio (WHR) And Waist Circumference (WC) Category Of The Respondents	88
4	Family History Of CVD Risk Factor	97
5	The Clinical Parameters Of Respondents With Metabolic Syndrome As Defined By Modified NCEP ATPIII And WHO Criteria	126

LIST OF ABBREVATIONS

AACE	American Association of Clinical Endocrinologists
ADA	American Diabetes Association
AHA	American Heart Association
BMI	Body Mass Index
BMR	Basal Metabolic Rate
BP	Blood Pressure
CHD	Coronary Heart Disease
CVD	Cardiovascular Disease
DBP	Diastolic Blood Pressure
DHA	Docosahexanoic Acid
DM	Diabetes Mellitus
DRI	Dietary References Intake
DRV	Daily Reference Value
EPA	Eicosapentanoic Acid
Etc	Et cetera
FFQ	Food Frequency Questionnaire
FPG	Fasting Plasma Glucose
HBP	High Blood Pressure
HDL-C	High Density Lipoprotein Cholesterol
HOPE	Heart Outcomes Prevention Evaluation Trial
hr	Hour

IDF	International Diabetes Federation
IFG	Impaired Fasting Glucose
IGT	Impaired Glucose Tolerance
IJT	*Indeks Jisim Tubuh*
IR	Insulin Resistance
IRPA	Intensification of Research in Priority Area
EGIR	European Group for the Study of Insulin Resistance
JK	*Jumlah Kolesterol*
JNCVII	7th Joint National Committee
K-LKR	*Kolesterol Lipoprotein Ketumpatan Rendah*
K-LKT	*Kolesterol Lipoprotein Ketumpatan Tinggi*
LDL-C	Low Density Lipoprotein Cholesterol
MS	Metabolic Syndrome
MUFA	Monounsaturated Fatty Acid
NCEP ATPIII	National Cholesterol Education Program Adult Treatment Panel III
NEFA	Non-esterified fatty acid
NHMSI	First National Health and Morbidity Survey
NHMSII	Second National Health and Morbidity Survey
NHMSIII	Third National Health and Morbidity Survey
NO	Nitric Oxide
NPP	*Nisbah Pinggang Pinggul*
OR	Odds Ratio

Ox-LDL	Oxidative modified low density lipoprotein
PAL	Physical Activity Level
PAR	Physical Activity Ratio
PIKAM	*Projek Intervensi Kardiovaskular Malaysia*
PUFA	Polyunsaturated Fatty Acid
RDA	Recommended Dietary Allowance
RNI	Recommended Nutrient Intake
SBP	Systolic Blood Pressure
SD	Standard Deviation
SFA	Saturated Fatty Acid
SPM	*Sijil Pelajaran Malaysia*
SRP	*Sijil Rendah Pelajaran*
STPM	*Sijil Tinggi Pelajaran Malaysia*
TC	Total Cholesterol
TEE	Total Energy Expenditure
TFA	Trans Fatty Acid
TG	Triglycerides
TONE	Trial of Nonpharmacologic Interventions in the Elderly
UP	*Ukuran Pinggang*
VLDL	Very Low Density Lipoprotein
WC	Waist Circumferences
WHO	World Health Organization