



UNIVERSITI PUTRA MALAYSIA

***EFFECTS OF A LIFESTYLE INTERVENTION MODULE TO REDUCE
RISK FACTORS OF METABOLIC SYNDROME IN POLYCYSTIC
OVARIAN SYNDROME WOMEN IN A PUBLIC UNIVERSITY,
MALAYSIA***

SAREH DASHTI

FPSK(P) 2018 25



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MALAYSIA**

By

SAREH DASHTI

**Thesis Submitted to the School of Graduate Studies, Universiti Putra
Malaysia, in Fulfilment of the Requirements for the Degree of
Doctor of Philosophy**

May 2018

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DEDICATION

To my loving parents, husband, my child (Aseman), my sister and brothers and all supportive family members for their understanding, encouragement and patience



Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Doctor of Philosophy

**EFFECTS OF A LIFESTYLE INTERVENTION MODULE TO REDUCE
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OVARIAN SYNDROME WOMEN IN A PUBLIC UNIVERSITY,
MALAYSIA**

By

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May 2018

Chairman : Professor Latiffah Abd Latiff, PhD
Faculty : Medicine and Health Sciences

Introduction: Metabolic syndrome (MS) is common among women with polycystic ovarian syndrome (PCOS). Lifestyle education is considered a cornerstone for MS prevention. The aim of this study was to determine the effect of a lifestyle intervention module to prevent MS among PCOS patients.

Methods: This study consisted of three phases. Phase one included screening of female UPM staff for PCOS based on the commonly used Rotterdam criteria and MS based on the International Diabetes Federation (IDF). A need assessment study was also performed to determine the educational needs of PCOS subjects. Phase two involved preparation of education module based on information-motivation-behavioral skills model and exercise sessions. Phase three was a randomized controlled trial (RCT) to validate the education module in 85 female UPM staff with PCOS. All participants underwent anthropometric and laboratory measurements at baseline and after 3 and 6 months of the study. Intervention group received education module through booklet and twice-weekly sessions.

Results: The prevalence of PCOS was 12.59% (N=675). The mean BMI and WC of subjects with PCOS was 30.17 ± 1.75 kg/m² and 90.73 ± 13.64 cm respectively. The questionnaires were validated based on face and content validity. The lifestyle intervention module was prepared to reduce MS criteria by reducing weight and abdominal obesity through healthy lifestyle. Intervention resulted in significant reduction in some of the MS criteria including weight ($p < 0.001$), BMI ($p < 0.001$) and

abdominal obesity ($p<0.05$), diastolic blood pressure ($p<0.05$) and the relative risk of MS (RR= 0.62).

Conclusion: This study revealed that the lifestyle intervention module on healthy living can be used by physicians and health care providers to reduce risk factors of MS in Malaysian women with PCOS.

Keywords: Polycystic ovary syndrome, Metabolic syndrome, Lifestyle education, Module, Risk prevention



mengurangkan MS kriteria. Kumpulan intervensi menunjukkan penurunan yang ketara dalam berat badan ($p < 0.001$), BMI ($p < 0.001$), abdominal obesiti ($p < 0.05$), tekanan darah diastolik ($p < 0.05$) dan risiko relative MS (RR= 0.62).

Kesimpulan: Kajian ini mendedahkan bahawa modul intervensi cara-hidup sihat yang telah dicadangkan dapat digunakan oleh pakar perubatan dan penyedia penjagaan kesihatan bagi mencegah atau mengurangkan sindrom metabolic di kalangan wanita PCOS di Malaysia.



I certify that a Thesis Examination Committee has met on 25 May 2018 to conduct the final examination of Sareh Dashti on her thesis entitled "Effects of a Lifestyle Intervention Module to Reduce Risk Factors of Metabolic Syndrome in Polycystic Ovarian Syndrome Women in a Public University, Malaysia" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Doctor of Philosophy.

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Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

**KEBERKESANAN MODUL INTERVENSI CARA HIDUP UNTUK
MENGURANGKAN FAKTOR RISIKO METABOLIK SINDROM DALAM
KALANGAN WANITA MENGALAMI SINDROM POLISISTIK OVARI DI
UNIVERSITI AWAM, MALAYSIA**

Oleh

SAREH DASHTI

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Pengenalan: Prevalen sindrom metabolik dilaporkan tinggi di kalangan wanita Sindrom Polisistik Ovari (PCOS). Pendidikan cara-hidup sihat merupakan faktor yang penting untuk mengelak sindrom metabolik. Tujuan kajian ini adalah untuk mengenal pasti kesan modul intervensi cara-hidup dalam pencegahan sindrom metabolik kepada wanita-wanita PCOS.

Kaedah: Kajian ini mempunyai tiga fasa. Fasa pertama adalah membuat saringan PCOS di kalangan kakitangan wanita di Universiti Putra Malaysia (UPM) menggunakan kriteria Rotterdam dan MS berdasarkan kriteria International Diabetes Federation (IDF). Kajian penilaian keperluan dijalankan terhadap wanita PCOS pada fasa pertama untuk menentukan keperluan pendidikan mereka. Fasa kedua melibatkan penyediaan modul intervensi cara-hidup sihat untuk mencegah MS berdasarkan kemahiran informasi-motivasi-sikap dan model sesi latihan. Pengesahan (validasi) bagi modul intervensi cara-hidup sihat dilaksanakan pada fasa ketiga dengan mengadakan kajian terkawal secara rawak (RCT) kepada 85 wanita PCOS. Semua peserta menjalani pengukuran antropometri dan ujian makmal pada perjumpaan pertama, selepas 3 bulan dan selepas 6 bulan. Kumpulan intervensi telah menerima risalah pendidikan dan menjalani sesi bersemuka sebanyak dua kali seminggu dan sesi latihan setiap dua minggu.

Keputusan: Kajian ini telah menunjukkan bahawa prevalen PCOS adalah 12.59%. Purata BMI dan ukur-lilit pinggang masing-masing adalah $30.17 \pm 1.75 \text{ kg/m}^2$ and $90.73 \pm 13.64 \text{ cm}$. Modul intervensi cara-hidup sihat telah disediakan bagi

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LIST OF ABBREVIATIONS

AIDS	Acquired Immune Deficiency Syndrome
ACTH	Adrenocorticotrophic Hormone
ATP	Adult Treatment Panel
ASRM	American Society For Reproductive Medicine
AE	Androgen Excess
BIA	Bioimpedance Analysis
BP	Blood Pressure
BFD	Body Fat Distribution
BMI	Body Mass Index
BDNF	Brain-Derived Neurotrophic Factor
BCAA	Branched Chain Amino acids
VCO ₂	Carbon Dioxide Production
CVD	Cardiovascular Diseases
°C	Celsius
CM	Centimetres
CLIA	Chemiluminescence Immunoassay
CA-PCOM	Chronic Anovulation And Polycystic Ovaries Morphology
CI	Confidence Interval
CVI	Content Validity Index
CAD	Coronary Artery Disease
CRH	Corticotropin Releasing Hormone
CPR	C-Reactive Protein
CM ³	Cubic Centimetre

DF	Degrees Of Freedom
DHEAS	Dehydroepiandrosterone Sulfate
DBP	Diastolic Blood Pressure
DASH	Dietary Approach To Stop Hypertension
ESHRE	European Society Of Human Reproduction And Embryology
EG	Example
EFA	Exploratory Factor Analysis
ECW	Extra-Cellular Water
FBG	Fasting Blood Glucose
FFM	Fat Free Mass
FSH	Follicle Stimulating Hormone
FFQ	Food Frequency Questionnaire
FITT	Frequency, Intensity, Time And Type
GAGS	Global Acne Grading System
OGTT	Glucose Tolerance Test
HR	Hazard Ratio
HBA1C	Haemoglobin A1c
HDL-C	High Density Lipoprotein-Cholesterol
HIIT	High Intensity Interval Training
HDL	High-Density Lipoproteins
HIV	Human Immunodeficiency Virus
H-CA-PCOM	Hyperandrogenism And Chronic Anovulation And Polycystic Ovaries Morphology
H-PCOM	Hyperandrogenism And Polycystic Ovaries Morphology

H-CA	Hyperandrogenism-Chronic Anovulation
GLP-1	Including Glucagon Like Peptide-1
IBM	Information Motivation Behavioural
IMBS	Information Motivation Behavioural Skills
IR	Insulin Resistance
HOMA-IR	Insulin Resistance Index
IASO	International Association For The Study Of Obesity
IDF	International Diabetes Federation
IOFT	International Obesity Task Force
IPAQ	International Physical Activity Questionnaire
IQR	Interquartile Range
ICW	Intra-Cellular Water
I-CVI	Item CVI
KMO	Kaiser-Meyer-Olkin
KG / M ³	Kilogram Per Cubic Meter
KHZ	Kilohertz
LA	Living Active
LDL-C	Low Density Lipoprotein-Cholesterol
LH	Luteinizing Hormone
HR MAX	Maximum Heart Rate
MCH	Melanin-Concentrating Hormone
MET	Metabolic Equivalents
MS	Metabolic Syndrome
M	Meter

MG/G	Milligrams To Grams
MG/DL	Milligrams Per Decilitre
MMHG	Millimeter Mercury
MM HG	Millimeter Of Mercury
MM	Millimetre
MIN/W	Minutes Per Week
MMOL/L	Millimoles Per Litre
MUFA	Monounsaturated Fatty Acids
MF-BIA	Multiple Frequency Impedances
NCEP	National Cholesterol Education Program
NICHD	National Institute Of Child Health And Human Development
NIH	National Institutes Of Health
NCCAH	Non-Classical Congenital Adrenal Hyperplasia
N	Number
OR	Odds Ratio
VO2 R	Oxygen Uptake Reserve
PLS-SEM	Partial Least Squares Structural Equation Modelling Analysis
PCOS	Polycystic Ovarian Syndrome
PCO	Polycystic Ovaries
PCOSQ	Polycystic ovarian syndrome Questionnaire
PUFA	Polyunsaturated Fatty Acids
PAPM	Precaution Adoption Process Model
PAPM	Precaution Adoption Process Model

SF-36	Quality Of Life Short Form Health Survey
RCT	Randomised Controlled Trials
RCT	Randomized Controlled Trials
SFA	Saturated Fatty Acids
S-CVI	Scale (S-CVI)
SHBG	Sex Hormone–Binding Globulin
SOC	Stages Of Change
SMD	Standardised Mean Difference
SET	Structured Exercise Training
SBP	Systolic Blood Pressure
TSH	Thyroid Stimulating Hormone
TBW	Total Body Water
TC	Total Cholesterol
TTM	Trans-Theoretical Model
TNF-A	Tumour Necrosis Factor-A
T2DM	Type 2 Diabetes Mellitus
UK	United Kingdom
USA	United States Of America
US	United States Of America
UPM	Universiti Putra Malaysia
UPLIFT	Utrecht Police Lifestyle Intervention Fitness And Training
VLDL	Very Low-Density Lipoprotein
WS	Waist Circumference
WHR	Waist To Hip Ratio

WEL	Weight Efficacy Lifestyle
WHO	World Health Organization
PCOS-T	(trained) group
PCOS-UnT	(untrained) group



CHAPTER 1

INTRODUCTION

1.1 Background of Study

Polycystic Ovarian Syndrome (PCOS) is a metabolic syndrome, which is diagnosed in 5-10% of women of childbearing age. Other names for PCOS include Stein-Leventhal Syndrome, the Hyper androgen Anovulation Syndrome, and Functional Ovarian Hyperandrogenism Disease of the Ovary (Eriksen et al. 2013).

The underlying mechanism for PCOS is insulin resistance, which results in hyperinsulinemia and in process of it; the pancreas produces excessive insulin than normal in order to compensate the state of insulin resistance in the body. It was shown that high insulin secretion results in overproduction of other hormones, including sex hormones like testosterone and dehydroepiandrosterone sulphate (DHEAS) and adrenal hormones including androstenedione. This excess production of hormones can induce the presentations of PCOS (Eriksen et al. 2013, Rosenfield, & Ehrmann 2016).

Symptoms of PCOS can include one or all of the following: hirsutism, defined as excessive hair growth on face, chest, abdomen, androgenic alopecia, defined as hair loss, acne, oligomenorrhoea, defined as irregular menses, amenorrhoea, defined as no history of menses, infertility or sub-fertility, obesity and polycystic ovaries. Furthermore, women with PCOS are also prone to hypertension and hyperinsulinemia. Delay in diagnosis and treatment of PCOS can increase the risk for type 2 diabetes mellitus, hyperlipidaemia, cardiovascular disease, including 7.4 times higher probability of myocardial infarction and endometrial cancer (Schoebl, 2008).

Therefore, early diagnosis and holistic treatment of PCOS is beneficial to reduce the risk of other comorbidities. It is crucial to tackle all the symptoms of PCOS during the period of treatment. Treatment for single symptom may only result in temporary improvement of the symptoms and does not prevent long-term serious comorbidities of PCOS. Clinical studies showed a relationship between PCOS alone or in combination of its symptoms and depression and psychological disorders. In order to prevent the serious long-term effects of PCOS and to improve the psychological wellbeing of women with PCOS, prompt diagnosis and holistic treatment of PCOS coupled with close follow-up is also recommended.,

1.2 Statement of Problem

PCOS is thought to affect 1 out of 10 women of childbearing age worldwide (Sirsmans & Kristen 2014). As with other chronic illnesses, women with PCOS often have uncertain prognoses (Sirsmans & Kristen 2014). Awkwardly, the prevalence of PCOS is not reported among Malaysian adults, only one report has assessed the prevalence of PCOS among 180 secondary school girls. The prevalence of PCOS was reported 6.5% among Malaysian secondary school girls (Akmal, 2016). It is reported that 40–60% of women with PCOS have weight problems or are obese; 60–90% of women with PCOS have acne and/or hirsutism; 40– 80% of women with PCOS have insulin resistance; and 40% of those with PCOS will develop type 2 diabetes by the time they are 40 (McCartney & Marshall 2016). Among these comorbidities, obesity has significant effects on clinical manifestations of PCOS (Hart, 2016) including more frequent menstrual/ ovulatory disturbances, higher androgen levels, decreased fertility and increased rate of spontaneous abortion (Pantasri and Norman 2014). The prevalence of metabolic syndrome is reported to be as high as 45% among PCOS patients and is related to cardiovascular diseases (CVD). Single treatment of PCOS is not beneficial in reducing the risk of CVD unless the comorbidities (the most prevalent of which is metabolic syndrome) are treated as well. The best way of reducing the prevalence of metabolic syndrome is to provide strategies to prevent this syndrome. Education is the first line of prevention of diseases as well as metabolic syndrome.

Regarding the fact that urbanization has increased over 500% in Malaysia for over the past decade and more than 70% of the Malaysian population live in cities, and that female labour force participation has increased to more than 52% over the past decade. It is estimated that a large population of Malaysian women are in the working class of the urban areas (Ghazali, Kusairee, and Tan 2015). Dejectedly, no data is available on the prevalence of PCOS among working classes in Malaysia. However, an almost recent study on 2366 Malaysian individuals identified that the prevalence of metabolic syndrome was higher among urban population compared to rural population (Tan, Dunn, and Yen 2011). On the other hand, the current first line medical treatment options of PCOS is metformin, which is a hypoglycemic medication that has anti obesity effects (Jakubowicz & Seppala 2014). Metformin not only improves glycemia and weight maintenance in women with PCOS, but also can improve fertility and menstrual abnormalities as well as weight reduction. Moreover, lifestyle modification can improve the MS related outcomes of PCOS and fertility respectively (Jakubowicz & Seppala 2014). Based on these findings, non-medical approaches tend to reduce the risk of MS. Therefore, non-medical lifestyle modification can be plausible and more acceptable for women with PCOS. These findings indicate that women with PCOS are a primary target group for education intervention to reduce the risk of MS. Moreover, it could be the Malaysian female working class who comprise a high proportion of employed women and perform sedentary office work (Ghazali, Kusairee, and Tan 2015). To the best of our knowledge, none of the previously published lifestyle education modules included Ramadan diet and healthy lifestyle during fasting months for Muslims. Furthermore, because most of the subjects in the study were Malay and Muslims, the existing

lifestyle education modules neglected the Sunnah diet, which is practiced by most of the Muslim population. It was previously shown in the literature that the acceptability of health recommendations is higher if they come from the cultural and religious origin of the society (Tetty et al. 2016; Hamidi 2018). This acceptability may be in part due to the fact that the target population has previous memories and willingness to follow religious based recommendations and also due to the similarity of the recommendations and the lifestyle of the followers of the religion, in terms of religious foods and rituals (Thomas, Gery & Kinderman 2017). Due to the fact that majority of Malaysian population are Muslims and follow Islamic practices, if the religious healthy eating and lifestyle recommendations are emphasized majority of religious followers would accept these recommendations more easily than the “western-generated” recommendations and would better acclimatize to these healthy living guidelines with religious backgrounds. This module was the first of its kind that provided recommendations for healthy lifestyle during the fasting months and preventing over eating after fasting month and in open house ceremonies as well as healthy recommendations regarding the Sunnah diet based on scientific evidence by using appropriate language which was designed specifically for women with PCOS.

1.3 Research Questions

1. What is the prevalence PCOS in UPM staff?
2. What are the socio-demographic characteristics of metabolic syndrome among PCOS patients in UPM?
3. What are the anthropometric characteristics of female UPM staff with PCOS?
4. Is there a relationship between anthropometric characteristics and PCOS diagnosis among female UOM staff?
5. What are the needs of female UPM staff with PCOS in order to reduce the risk of MS?
6. Are the assessment questionnaires valid and reliable?
7. Is the lifestyle intervention module reliable and valid in reducing the risk of MS among female UPM staff with PCOs?
8. Is the lifestyle intervention module effective in reducing the risk of MS among female UPM staff with PCOs?

1.4 Objectives of study

1.4.1 General objective

To develop, implement and evaluate the effect of lifestyle intervention module, for prevention and improvement of risk of MS among the UPM's staff with PCOS.

1.4.2 Specific objective

To determine the prevalence of PCOS among female UPM's staff with PCOS

1. To determine the prevalence of PCOS among female UPM's staff with PCOS
2. To determine the socio-demographic characteristics of female UPM's staff with PCOS
3. To determine the anthropometric characteristics of female UPM's staff with PCOS
4. To determine the relationship between anthropometric characteristics and PCOS diagnosis among female UPM's staff with PCOS
5. To assess the needs for the development of educational modules to reduce the risk of MS among female UPM's staff
6. To assess the reliability and validity of the questionnaire
7. To develop required nutrition and physical activity knowledge, attitude and practice questionnaires to be used on the female UPM's staff
8. To develop the educational module to improve healthy lifestyle (healthy eating, physical activity) to reduce the risk of MS among female UPM's staff with PCOS
9. To evaluate the reliability and validity of the educational module (healthy eating, physical activity) among PCOS in UPM
10. To determine the effectiveness of the educational module and improve the healthy lifestyle (such as healthy eating, physical activity) in reducing the risk of MS among the female UPM's staff with PCOS

1.5 Null Hypotheses

1. There is no significant relationship between anthropometric characteristics and PCOS diagnosis among female UPM's staff with PCOS
2. The lifestyle intervention module is not effective in reducing the risk of MS among female UPM staff with PCOS
 - a) There are no significant differences in anthropometric measurements of MS among female UOM staff with PCOS between intervention and control groups after the intervention.
 - b) There is no significant difference in laboratory measurements of MS among female UPM staff with PCOS between intervention and control groups after the ntervention.
 - c) There is no significant difference in score of knowledge, motivation, and behaviour for healthy eating among UPM's staff with PCOS between intervention and control groups after the intervention.
 - d) There are no significant differences in score of knowledge, motivation and behavioural for physical activity among UPM's staff with PCOS between the intervention and control groups.

- e) There are no significant differences in score of quality of life UPM's staff with PCOS between the intervention and control group after the intervention
- f) There are no significant differences in anthropometry and laboratory test of UPM's staff with PCOS between the intervention and control groups after the intervention.
- g) The number of subjects with MS criteria is not significantly reduced after lifestyle intervention in intervention group compared to control group.

The research questions, objectives and null hypotheses of this study are tabulated in table (1.1).



Table 1.1 : The research questions, objectives and null hypotheses

Research questions	Objectives	Null hypotheses
1. What is the prevalence PCOS in UPM staff?	1. To determine the prevalence of PCOS among female UPM's staff with PCOS	-
2. What are the socio-demographic characteristics of metabolic syndrome among PCOS patients in UPM?	2. To determine socio-demographic characteristics of female UPM staff	-
3. What are the anthropometric characteristics of female UPM staff with PCOS?	3. To determine anthropometric characteristics of female UPM staff	-
4. Is there a relationship between anthropometric characteristics and PCOS diagnosis among female UOM staff?	4. To assess the needs for the development of educational modules to reduce the risk of MS among female UPM staff	-
5. What are the needs of female UPM staff with PCOS in order to reduce the risk of MS?	5. To assess reliability and validity of questionnaires	-
6. Are the assessment questionnaires valid and reliable?	6. To determine the relationship between anthropometric characteristics and PCOS diagnosis among female UPM's staff with PCOS	1. There is no significant relationship between anthropometric characteristics and PCOS diagnosis among female UPM's staff with PCOS
7. Is the lifestyle intervention module reliable and valid in reducing the risk of MS among female UPM staff with PCOs?	7. To develop required nutrition and physical activity knowledge, attitude and practice questionnaires to be used on the female UPM staff	-
8. Is the lifestyle intervention module effective in reducing the risk of MS among female UPM staff with PCOs?	8. To develop the educational module to improve healthy lifestyle (healthy eating, physical activity) to reduce the risk of MS among female UPM's staff with PCOS	-
9. To evaluate the reliability and validity of the educational module (healthy eating, physical activity) among PCOS in UPM	9. To evaluate the reliability and validity of the educational module (healthy eating, physical activity) among PCOS in UPM	-
10. To determine the effectiveness of the educational module to improve healthy lifestyle (healthy eating, physical activity) among PCOS in UPM	10. To determine the effectiveness of the educational module to improve healthy lifestyle (healthy eating, physical activity) among PCOS in UPM	2. The lifestyle intervention module is not effective in reducing the risk of MS among female UPM staff with PCOS

physical activity) in reducing the risk of MS among female UPM's staff with PCOS

- a) There are no significant differences in anthropometric measurements of MS among female UOM staff with PCOS between intervention and control groups after the intervention.
 - b) There is no significant difference in laboratory measurements of MS among female UPM staff with PCOS between intervention and control groups after the intervention.
 - c) There is no significant difference in score of knowledge, motivation, and behaviour for healthy eating among UPM's staff with PCOS between intervention and control groups after the intervention.
 - d) There are no significant differences in score of knowledge, motivation and behavioural for physical activity among UPM's staff with PCOS between the intervention and control groups.
 - e) There are no significant differences in score of quality of life UPM's staff with PCOS between the intervention and control group after the intervention
 - f) There are no significant differences in anthropometry and laboratory test of UPM's staff with PCOS between the intervention and control groups after the intervention.
 - g) The number of subjects with MS criteria is not significantly reduced after lifestyle intervention in intervention group compared to control group.
-

1.6 Significance of the study

Not all women with PCOS are obese, but the majority of them have abdominal obesity and excess visceral fat accumulation, which is directly caused by insulin resistance. It was previously shown that diet and physical exercise can improve the endocrine features of PCOS and can prevent the risk of CVD, even if the weight loss is not significant. PCOS has become one of the most common endocrine disorders in the current century and its prevalence is increasing worldwide mainly due to the increased awareness of this condition as well as the increasing prevalence of obesity. As previously reported, PCOS is a heterogeneous disorder. Therefore, its diagnosis is difficult due to lack of a sole diagnostic test or hallmark abnormality. The symptoms of PCOS are common among overweight or obese women, which have similar pathogenesis and management as of PCOS. Regardless of the recent advancements in the management of hirsutism and sub-fertility, these treatments have not resulted in the treatment of the underlying condition, which is increased energy intake and insulin resistance, and may not be beneficial in reducing the risk of other serious comorbidities of PCOS. It is important to take into account that although not all PCOS women have excess weight, the underlying cause, which is insulin resistance, exists in all PCOS patients and therefore, even a small amount of weight loss even in normal weight PCOS patients can result in improvements in the symptoms of PCOS. The association between PCOS and its comorbidities, including type 2 diabetes mellitus and CVD and hormone-related cancers are mainly due to the presence of the MS criteria in a majority of women with PCOS. These criteria include abdominal obesity, glucose intolerance, dyslipidemia, and increased blood pressure. The theoretical framework of the current study is the information, motivation behavioural skill model (IMB) to increase the knowledge of PCOS women and motivate them to change their unhealthy lifestyle to reduce the risks of metabolic syndrome.

The behavioural changes, including eating and physical activity, with the aim of improving the risk of MS in women with PCOS from this study provides information and data, which are useful for scientific literatures, health educators and health promoters because the present data is mainly based on national data in a study performed on Malaysian women. In addition, the educational module can be used for future interventions based on behavioural changes. The findings of this study provide useful information for the policy makers in this area to focus on intervention strategies that will address behavioural changes among women with PCOS.

1.7 Conceptual framework

The conceptual framework is according to the literature review of previous studies to follow the main goal of the study (Dietz et al. 2015; Lee, Young & Chee, 2016; Chen et al. 2017). The purpose of the present study was to develop and evaluate the effect of a novel lifestyle intervention module to reduce the risks of MS among female UPM's staff with PCOS. The current study uses information-motivation behavioural skill (IMB) model examined the effect of intervention on reducing risk

of MS through increasing knowledge, motivation, and behaviour of healthy eating and physical activity. Based on the IMB model presented in the literature review (Chapter 2), increased level of information can result in increasing of motivation. In this study the education is provided with two objectives, first to provide information about the state of the condition (MS) and the risks associated with MS and its effects on the outcome of PCOS. The second education objective was to empower subjects to reduce the risk of MS by acquiring the skills needed to prevent and reduce the risk factors of MS. Increased motivation can be in two directions, firstly in obtaining the required information and skills to set up the behaviour and secondly to practice the acquired skills and form the healthy behaviour. The information provided for improving the skills of the study subjects included information on healthy eating, controlling the craving for extreme food intake and also physical activity session to educate subjects regarding the types and the correct method of exercises that suit their condition. By reaching the action phase and maintaining the behaviour, the outcomes of the behaviour will be apparent. In this study, the outcomes that were aimed to be reduced were the MS criteria, including abdominal obesity, lipid profile and fasting plasma glucose levels along with systolic and diastolic blood pressure. As these risk factors have similar origins to PCOS, these risk factors are also affected by the state of the underlying condition (PCOS). Besides this information, brief information regarding stress management and the importance of sleep in weight management was also provided in order to reduce the risk of failure due to major environmental factors.

Conceptual framework consists of the concepts that are placed within a logical and sequential design. The present study used information-motivation behavioural skill theory and the Interventional programs were developed to reduce risk of MS. This module was expected to improve the knowledge, attitude and behaviour score for healthy eating, physical activity and improve quality of life of UPM's staff with PCOS.

With effective intervention using adequate information and knowledge on healthy eating and physical activity in PCOS women, it is expected that the motivation of subjects improves in terms of nutrition and physical activity decision making in order to maintain a healthy living and thus reduce the risk of MS by opting healthy eating and effective lifestyle and effective physical activity skills (Figure 1.1).

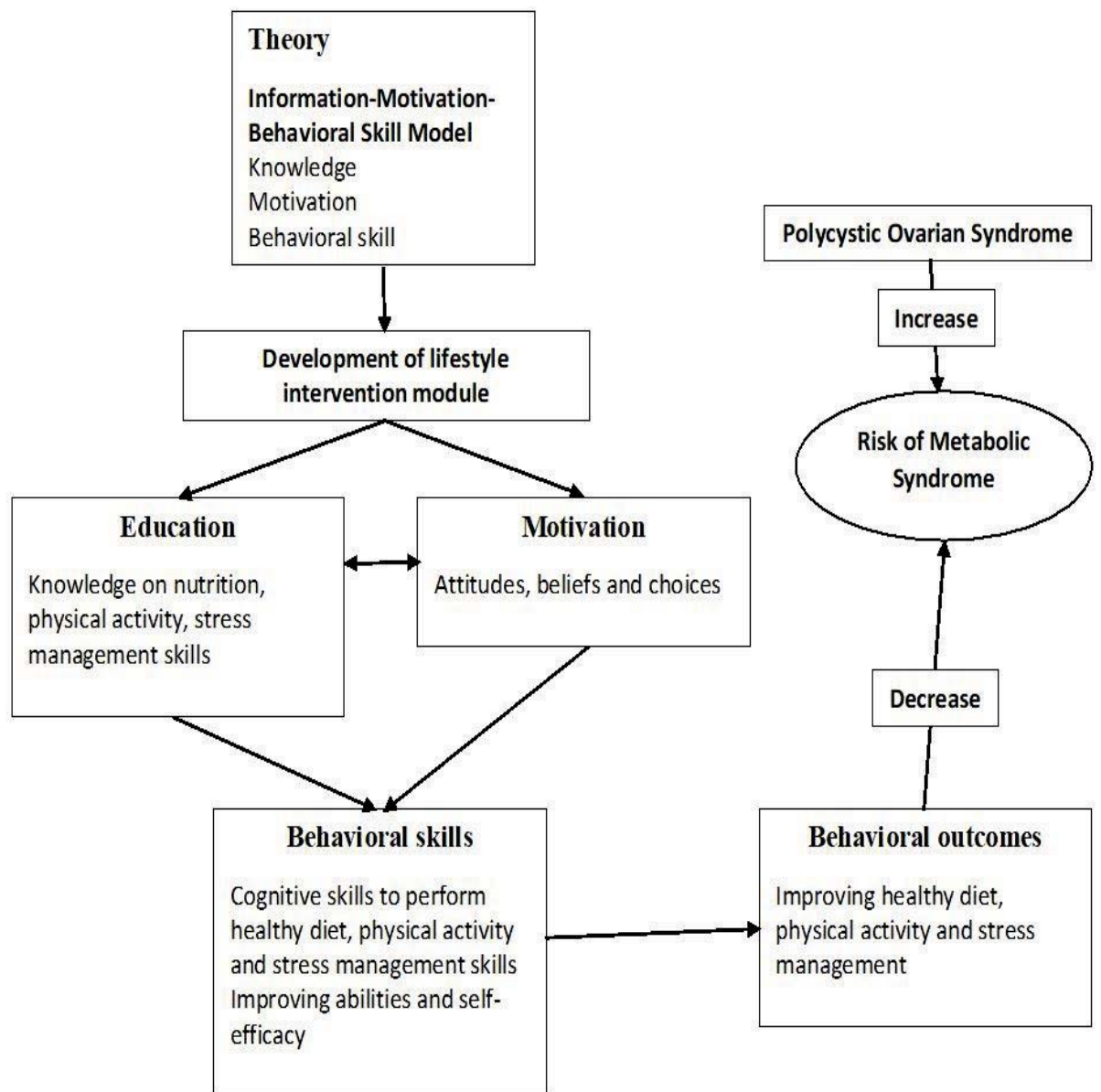


Figure 1.1 : Conceptual framework of the study

1.8 Scope of the thesis

This study comprised of three phases, which will be elaborated in following chapters (Figure 1.2). Chapter 1 describes the problem of study, the objectives as well as the research questions and conceptual framework. In chapter 2, the literature review shows the contextual and theoretical aspects of the research. This chapter provides some information on PCOS and metabolic syndrome among women and its etiology as well as treatment strategies through various interventions using selected theoretical basis.

Chapters 3, 4 and 5 comprise Phases 1, 2 and 3, respectively. Each of these three chapters includes methodology and results presented separately for each phase of the study. Chapter 3 (Phase 1) includes screening, needs assessment study and questionnaire validation to construct the fundamental information and tools which would be required in the development of the educational module. Chapter 4 (Phase 2) offers the development of the educational module comprising healthy diet, physical activity, stress management, and an evaluation of the level of its acceptability by experts. Chapter 5 (Phase 3) shows the implementation of intervention and the effectiveness of the module among adolescents. The study phases were designed to fulfil the objective of the study as shown in Table 1.2.

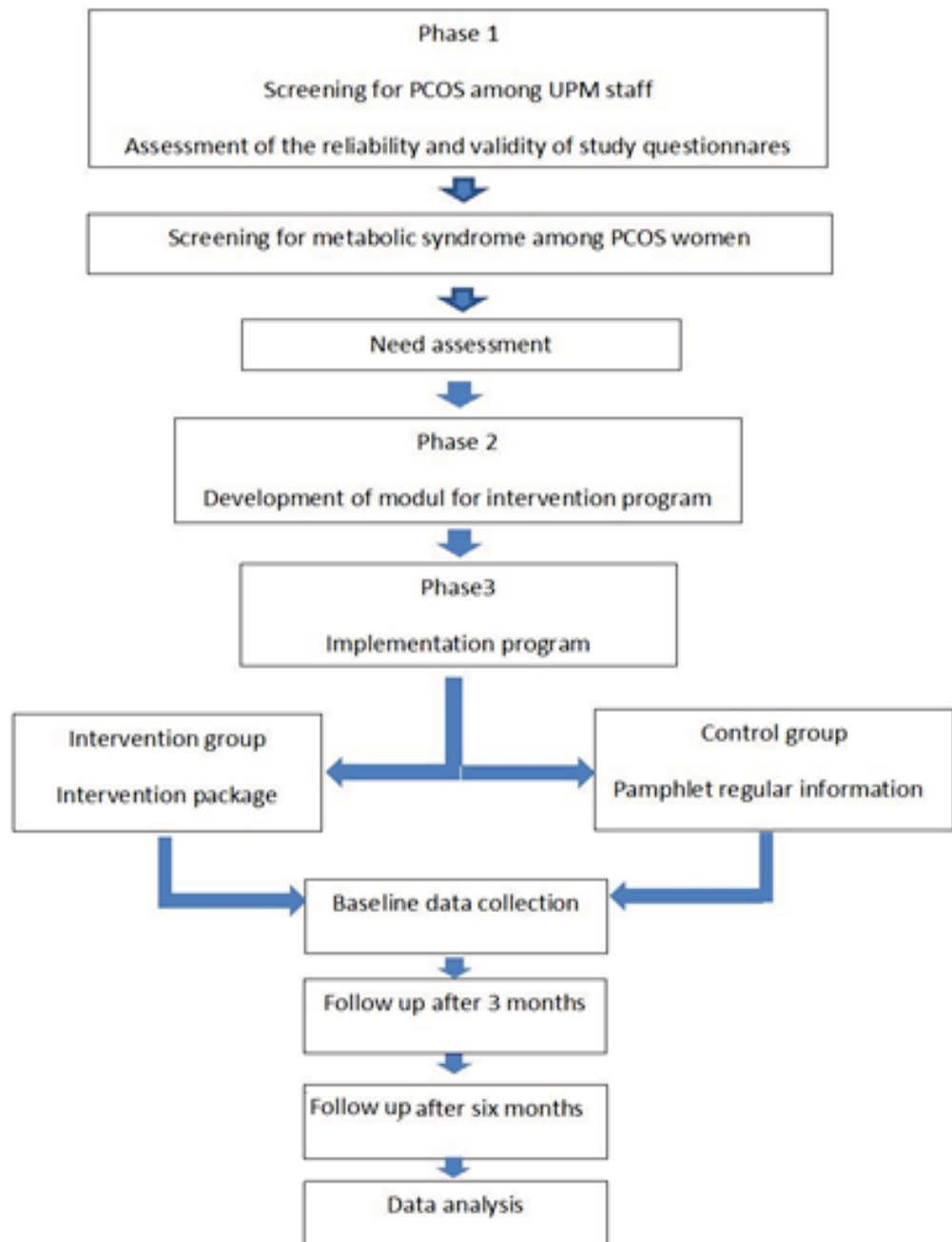


Figure 1.2 : The phases of thesis

Table 1.2 : Phases of the study and the study and their related objectives

Phase	Content	Objectives
Phase 1	Screening Need assessment Questionnaire validation	1. To determine the prevalence of PCOS among female UPM's staff with PCOS 2. To determine socio-demographic characteristics of female UPM staff 3. To determine anthropometric characteristics of female UPM staff 4. To assess the needs for the development of educational modules to reduce the risk of MS among female UPM staff 5. To assess reliability and validity of questionnaires 6. To determine the relationship between anthropometric characteristics and PCOS diagnosis among female UPM's staff with PCOS
Phase 2	Module development	7. To develop required nutrition and physical activity knowledge, attitude and practice questionnaires to be used on the female UPM staff 8. To develop the educational module to improve healthy lifestyle (healthy eating, physical activity) to reduce the risk of MS among female UPM's staff with PCOS
Phase 3	Evaluation	9. To evaluate the reliability and validity of the educational module (healthy eating, physical activity) among PCOS in UPM 10. To determine the effectiveness of the educational module to improve healthy lifestyle (healthy eating, physical activity) in reducing the risk of MS among female UPM's staff with PCOS

RCT= Randomized controlled trial

Based on the IMB model, the first phase of the study was conducted to identify the subjects for the education module as well as to identify the information needs of this population in order to prepare the education module. The module was designed and prepared based on the IMB model. However, it increases the knowledge of the female UPM's staff about MS and skills to prevent MS, which were related to their PCOS condition, and to motivate subjects in performing the skills obtained in their daily life and benefit from the change in their lifestyle in terms of prevention of MS.

Chapter 6 discusses about the finding of all three phases in the context of previous studies. Finally, Chapter 7 concludes the thesis by presenting the strengths and limitations of the current study as well as recommendations for future research.

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