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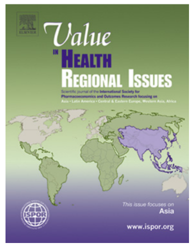


# Cost-Effectiveness Analysis of the Self-Management Program for Thai Patients with Metabolic Syndrome

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ABSTRACT

**Background:** Lifestyle modification programs are partly evaluated for their usefulness. **Objectives:** This study aimed to assess the cost-effectiveness and healthy lifestyle persistence of a self-management program (SMP) for patients with metabolic syndrome (MetS) in Thai health care settings. **Methods:** A cost-effectiveness analysis was performed on the basis of an intervention study of 90 patients with MetS randomly allocated to the SMP and control groups. A Markov model with the Difference-in-Difference method was used to predict the lifetime costs from a societal perspective and quality-adjusted life-years (QALYs), of which 95% confidence intervals (CIs) were estimated by bootstrapping. The cost-effectiveness analysis, along with healthy lifestyle persistence, was performed using the discount rate of 3% per annum. Parameter uncertainties were identified using one-way and probabilistic sensitivity analyses. **Results:** The lifetime costs tended to decrease in both groups. The SMP could save lifetime costs (−2310 baht; 95% CI −5960 to 1400) and gain QALYs (0.0098; 95% CI −0.0003 to 0.0190), compared with ordinary care. The probability of cost-effectiveness was 99.4% from the Monte-Carlo simulation, and the program was deemed cost-effective at dropout rates below 69% per year as determined by the threshold of 160,000 baht per QALY gained. The cost of macrovascular complications was the most influencing variable for the overall incremental cost-effectiveness ratio. **Conclusions:** The SMP provided by the health care settings is marginally cost-effective, and the persistence results support the implementation of the program to minimize the complications and economic burden of patients with MetS.

*Keywords:* cost-effectiveness analysis, metabolic syndrome, self-management program, Thailand.



## Introduction

Metabolic syndrome (MetS) is a cluster of metabolic abnormalities induced by an insulin resistance [1,2]. The major features of MetS include central obesity, hypertriglyceridemia, hypertension, hyperglycemia, and low level of high-density lipoprotein. Thus, MetS increases the risk of type 2 diabetes mellitus (T2DM), cardiovascular disease (CVD) [1,3], and economic burden [4]. The disparity in the prevalence of MetS around the world was reported by Cameron et al. [5]. They suggested that the variation in prevalence may stem from differences in patients' genetic background, population age, sex structure, the level of physical activity, or nutritional status in various countries. Moreover, an increase in the proportion of overweight people, obesity, sedentary lifestyles, and rapid urbanization have been associated with the escalation in the incidence of MetS worldwide [6,7]. MetS is therefore a crucial public health problem nowadays [8].

Regarding MetS management, drug therapy can be used to adjust the metabolic components, for example, blood pressure or glucose, but a bariatric surgery is indicated for some cases [1]. In addition, a lifestyle intervention is required to promote healthy eating habits, suitable exercise, and weight reduction in patients. The lifestyle modification is usually a prime MetS management tool because it improves the insulin sensitivity and simultaneously reduces all metabolic risk factors [1,9]. In addition, many studies [10–12] have pointed out that lifestyle modification programs are not only clinically effective but also cost-effective for patients with MetS in primary care settings. It enables patients to minimize all treatment expenditures and prolong life. Nevertheless, the persistence of healthy lifestyles has not yet been investigated. Failure to keep healthy behaviors results in increased lifetime costs and reduced benefits of the program [13].

In Thailand, the prevalence of MetS for adults aged 35 years and older is 32.6% based on the Third Report of the National Cholesterol Education Program (ATP III) criteria [14]. The

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prevalence of MetS is dramatically increasing on account of sedentary lifestyles and unhealthy consumption behaviors [15–18]. The government sector, that is, the Ministry of Public Health, has been aware of the threat that MetS poses and initiated the Diet and Physical Activity Clinic (DPAC), in collaboration with the Network of Fatless Belly Thais, to be established in public hospitals since 2006 [19]. The objective of the DPAC is to promote healthy behaviors in the Thai population in terms of healthy food, exercise, and emotion or behaviors [20]. Several Thai researchers have already assessed some lifestyle programs for patients with MetS [21–25] and found that they could improve patients' metabolic parameters and reduce CVD risks. The cost-effectiveness issue, however, remained unexplored in these studies.

An extensive literature search revealed no study on the cost-effectiveness and persistence analysis of lifestyle management programs for patients with MetS in Thailand or other countries [10–12]. Hence, this study aimed to assess the cost-effectiveness and healthy lifestyle persistence of the self-management program (SMP), which was a lifestyle alteration program that partly adopted the DPAC procedures.

## Methods

This study was approved by the Ethical Committee of Chulalongkorn University in 2014. A cost-effectiveness analysis (CEA) of the persistence of healthy lifestyles was performed between July and November 2014 for the intervention study of Praphasil et al. [23] in Thai patients with MetS attending the SMP. The SMP study was selected because it provided complete clinical data, especially for CVD risks and total cholesterol levels. Based on two patient groups (SMP vs. ordinary care), the original findings revealed favorable therapeutic outcomes with marginal effect sizes ($P < 0.05$), that is, body mass index (BMI), waist circumference (WC), high-density lipoprotein, and systolic and diastolic blood pressure, as presented in Appendix Table A in Supplemental Materials found at http://dx.doi.org/10.1016/j.vhri.2015.10.004, but no economic outcome was reported. A societal perspective was contemplated for the CEA, and a Markov model was used to predict the lifetime costs and quality-adjusted life-years (QALYs) for individual patients starting from week 0 until death. The ages at which men and women died were assumed to be equal to the life expectancies of 72 and 79 years, respectively, based on the Thai statistics report [26]. Details of the methodology are summarized below.

### *Overview of the Intervention Study*

In the intervention study, patients with MetS who met the eligibility criteria were randomly allocated to control and intervention groups (44 vs. 46 patients). The former received ordinary care provided by nurses or doctors as usual, whereas the latter obtained normal care plus self-management activities, as part of the SMP. The SMP was set up in a community hospital and two health promoting centers in Kanchanaburi Province, Thailand. It was run by a nurse and her assistant. The program activities were created on the basis of Creer's self-management theory and Bandura's self-efficacy theory [23]. All patients were required to join in the following activities:

Week 0: The anthropometric data, for example, WC, height, and metabolic indicators, were measured for all patients. They were also requested to complete a self-management questionnaire. The control group then received general advice or ordinary care, such as weight control and exercise, whereas the intervention group participated in an educational session (session 1) to get information about MetS, metabolic control, and self-management skills. After that, patients in the intervention group were asked to attend a nutrition session (session 2) and got the SMP manual.

Week 1: The intervention group took part in an exercise session (session 3).

Week 4: All patients were invited to fill out the self-management questionnaire.

Weeks 6 and 9: Each patient in the intervention group was telephoned by the researcher to check for their retention of healthy behaviors using the self-management skills and for any problems that might have arisen.

Week 12: Patients' anthropometric data and metabolic parameters were measured again, and the self-management questionnaire was also filled again by both groups to identify any changes from the baseline (week 0).

Further details of the intervention study can be found in File 1 in Supplemental Materials found at http://dx.doi.org/10.1016/j.vhri.2015.10.004.

### *Markov Model*

The Markov model that was adapted from Feldman et al. [10] is demonstrated in Fig. 1. The model was checked for face validity by four endocrinologists and one cardiologist. It comprised the MetS state plus six complication states and two types of deaths. The entire model was analyzed using Microsoft Excel 2013 (Microsoft Corp., Bangkok, Thailand). All states were presented by ovals and were mutually exclusive with collective, exhaustive nature. The cycle length of changing from one state to another was determined in 1 year. The assumption for this model was that metabolic parameters at week 12 would be extended to 1 year and then return to baseline (week 0) values before the patients received the SMP intervention or ordinary care again in the following years. The transition probabilities in the model were calculated from the metabolic parameters of individual participants or relevant incidences found in Thailand as summarized in File 2 in Supplemental Materials found at 10.1016/j.vhri.2015.10.004. It should be noted that the sequelae of MetS in SMP and control groups were typically different owing to the diverse metabolic components of each patient group. Because transition probabilities were reported in various studies with specific periods of time, such as 12 years for transitioning from MetS to T2DM, these were converted to yearly probabilities using the following formula [27]:

$$tp_1 = 1 - (1 - tp_t)^{1/t}$$

where $tp_1$ is the yearly transition probability and $tp_t$ is the reported transition probability for the time period ($t$).

From MetS at the outset, it may progress to T2DM, coronary heart disease (CHD), or stroke (ischemic or hemorrhagic types). Patients with T2DM may then develop microvascular complications (*Micro comp*., i.e., retinopathy and nephropathy) or macrovascular complications (*Macro comp*., i.e., CHD and stroke) [28]; neuropathy and peripheral arterial disease were not included because of lack of probability data. If patients with CHD or stroke experienced diabetes mellitus, their health states would be considered as *Macro comp*. (T2DM with macrovascular complications). Because in this study there were patients with MetS with or without T2DM, the model was run from two starting points, that is, MetS and T2DM states. All states, except for MetS and T2DM, could end up with specific death (*Death-specific*) caused by a particular health state or any type of death (*Death-all*).

### *Cost-Effectiveness Analysis*

To analyze the cost-effectiveness of the SMP, the best available incidences, costs, and utility weights from various Thai references [23,26,29–39] were entered into the Markov model (see File