

A Framework for Prioritizing the Effectiveness of Anti-smoking Strategies using Enhanced Analytic Hierarchy Process

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ABSTRACT

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This paper presents a framework for prioritizing the effectiveness of anti-smoking strategies in Malaysia. The framework structuring the tobacco problem into hierarchy was designed using prioritization approach namely Enhanced Analytic Hierarchy Process (EAHP). The framework highlighted the use of EAHP to prioritize the effectiveness of anti-smoking strategies by ensuring the consistency of the overall judgement is less than 0.1. There are five anti-smoking strategies that have been implemented in Malaysia namely packaging and labelling, pricing and taxation, advertising, smoke-free legislation and education and support. The implementation of an effective anti-smoking strategies should be considered towards the endgame of tobacco by the year 2045 as outlined by the government. The findings in turn can provide insights and guidelines for researchers as well as policy makers to assess the effectiveness of anti-smoking strategies towards a better policy planning decisions.

Keywords: *Anti-smoking strategies; Prioritization; Enhanced Analytic Hierarchy Process*

1. INTRODUCTION

Tobacco usage has become a controversial topic in recent years. It all begins with the tremendous increase in the numbers of premature mortality and morbidity worldwide, associated with smoking-related diseases [1]. The escalating numbers of premature mortality due to smoking-related diseases caused seven death per minute [2]. There is a growing concern related to the high number of premature mortality cases in Malaysia. The main cause of this cases is the drastic increase of smoking-related diseases which originated from high smoking prevalence [1,3].

The World Health Organization (WHO) Framework Convention on Tobacco Control (FCTC) was developed due to the increase of tobacco epidemic globally [4]. The WHO FCTC is the world's first public health treaty which addresses the global tobacco epidemic through a variety of measures [5]. To diminish the burden of tobacco-related illness and death, Malaysia has resolved to actualize tobacco control approaches as outlined by the FCTC. Preceding to the FCTC, the Malaysian government ratified The Control of Tobacco Products Regulation 1993 which is strengthened in 2004. The purpose of the regulation is to ban tobacco product advertisement and sponsorship, restrict smoking in designated areas, ban sale to minors, and to control the labelling, packaging, and sale of tobacco products. In 2005, Malaysia has

established the basis in executing more grounded and more exhaustive tobacco control strategies upheld by national against tobacco campaigns.

Despite the various anti-smoking strategies such as increasing cigarette price and tax, imposing smoke-free legislation, and restricting tobacco advertising that have been implemented, the smoking-related diseases is deemed as the most inevitable cause of death [1,6]. There are issues arise when people keep smoking while anti-smoking strategies have been implemented. This situation begs the questions, “If various strategies have been implemented, why do many people still smoke? Which are the most effective strategies to be implemented and should be emphasized?”. Effectiveness has become a challenge due to the obligation to promote strategies with limited resources available. In line with that, the use of prioritization approach to measure effectiveness has gained wider recognition in healthcare settings [7]. Therefore, the aim of this paper is to develop a conceptual framework to evaluate the effectiveness of anti-smoking strategies using Enhanced Analytic Hierarchy Process (EAHP) approach.

The next section discusses on the anti-smoking strategies and prioritization issues. Next, a framework is proposed as a guideline for evaluating the effectiveness of tobacco control policies. The framework is presented as a preliminary step in identifying the most effective strategies as well as the most influential factors of smoking. Finally, the conclusion and future works are presented.

2. A BRIEF OF LITERATURE REVIEW

2.1 Effectiveness of Anti-Smoking Strategies

There are abundance of studies have been conducted to study the effectiveness of the anti-smoking strategies For example, several studies found that the implementation of packaging and labelling as outlined by the WHO FCTC appear to have significant impact in reducing tobacco usage [8-12]. Specifically, the impact of cigarettes packaging pictorial warning labels provide greater impacts on cognitive and behavioural factors of smokers compared to warning in text form [8]. Besides, considerable amounts of literature have been published on the impact of pricing and taxation of tobacco products [13-16]. These studies revealed that increased in tax and cigarettes prices contributes significantly towards reduction in the number of tobacco usage, increases the number of attempts to quit, promotes cessation, and prevents initiation. In addition, among the recommended measures for tobacco advertising, promotion and sponsorship are bans on cross-border advertising, promotion and sponsorship, display of tobacco products at point of sale, tobacco product vending machines, internet sales, and attractive packaging and product features [17].

In 2005, Malaysia has established the basis in executing more grounded and more exhaustive tobacco control methodologies upheld by national against tobacco campaigns. For instance, Malaysia has banned the offer or supply of tobacco products free of charge and further revised the regulations in 2008 to include smoking bans in National Service Training Centres [5]. Additionally, health warning labels and pack descriptors have been implemented in Malaysia over the past 35 years. Nevertheless, it was not a stringent implementation. From 1976 to 2009, health warning labels had one text-only message in Malay and English written on the pack that read: “Amaran Kerajaan Malaysia: Merokok Membahayakan Kesihatan” in Malay and “Warning by the Malaysian Government: Smoking is hazardous to health”. When Malaysia has become one of the signatory to FCTC of WHO, the legal requirement for pictorial health

warnings was implemented. The labels consist of six pictorial health warnings printed in both Malay and English which covers 40% of the front and 60% of the back of all cigarette packs [5]. Other than that, a study examine the impact of cigarette pack warning labels on interest in quitting and subsequent quit attempts among adult smokers in Malaysia and Thailand [18]. Their findings revealed that Malaysian's warning labels have weaker impact compared to Thailand's warning labels. However, Malaysia also experienced some unsuccessful implementations such as national ban on direct advertising of tobacco products was unsuccessful. To date, the tobacco products advertising are still highly visible and accessible among adults and youth in Malaysia. Apart from that, illegal cigarettes are easily obtained despite the increment of pricing and taxation in tobacco products [5].

2.1 Prioritization and Issues Related

In the context of tobacco epidemic, the term prioritization refers to the process of ranking the level of importance of the components in tobacco control system. With this prioritization, policy makers are guided towards informed decisions where they have authority to decide on the components should be given priority compare to others.

In recent years, increasing efforts have been made to study on smoking prevalence and associated factors. In health studies, it is important to understand the associated factors and its level of importance for prevention purpose. Some of the studies on associated factors have been discussed in literatures [2, 19-22]. These studies adopted various statistical approaches such as logistic regression model, Cox regression and non-linear factor, structural equation modelling and cross-sectional analysis. These methods are widely used for exploring due to their simplicity and easy understanding. Even though these methods are precise and less time consuming, however the findings may not reflect the real situation because unimportant factors are less considered. Hence, the effects cannot be justified. The less significant factors should not be omitted since these factors still have an influence in the system as a whole.

On the other hand, Multi-Criteria Decision Making (MCDM) is a sub-discipline of operation research that deals with prioritization issues. These techniques are specifically used for decision making which offers ways to determine the meaningful priority values by calculating consistency value. Among the available methods in MCDM are Analytic Network Process (ANP), Analytic Hierarchy Process (AHP) and Potentially All Pairwise Rankings of All Possible Alternatives (PAPRIKA). These techniques are widely used around the world in their attempts to determine the degree of importance of each factor. MCDM is widely used due to its systematic decision making in analysing the criteria in highly complex problems [22]. As to date, there is a limited tobacco-related study which employs MCDM. However, there is one relevant study that employed AHP to explore the associated factors and prioritized the factors of smoking among teenagers in Korea [23].

The Analytic Hierarchy Process (AHP) was developed by Thomas Saaty, an American mathematician in 1977. AHP is a decision making technique to solve multiple criteria problem in achieving overall best decision by using hierarchy [24]. There are three axioms in AHP namely decomposition, comparative judgments and synthesis of priorities as suggested by Saaty. It requires the decision maker to decompose the problem into hierarchy, provide judgments about the relative importance of each criterion and the output will be a prioritized ranking of the decision alternatives based on the overall preferences expressed by the decision

maker [25]. It has been utilized in various fields to assist decision making, such as manufacturing, construction industry, power and energy industry, transportation industry and healthcare [26]. Saaty highlighted that the advantage of using AHP is twofold [27]. First, the complexity of the problem can be reflected in a hierarchical structure and this will assist decision makers to visualize the problem easily. Second, the judgement process is easy to be understood and it is able to quantify subjective factors in the decision making problem. As mentioned previously, despite all the advantages, one of the obvious limitations is consistency issue. Consistency should be ensured so as to be below 0.1. The idea of consistency is deemed important because inconsistent comparison reflects poor judgment process and the compared elements could not be properly evaluated [27]. However, the inconsistency issues can be overcome as suggested in the enhanced AHP work done by Balhuwaisl [28].

It is generally acknowledged that the major drawback in using AHP is inconsistency issues, where the consistency ratio (CR) is more than 0.1. If the CR value is more than 0.1, then the decision maker needs to revise the pairwise comparison. Therefore, Balhuwaisl [28] deals with this inconsistency by modifying the pairwise comparison procedures in normal AHP by Saaty and recommends a new approach to overcome the inconsistencies by using Enhanced Analytic Hierarchy Process (EAHP). In the pairwise comparison in EAHP, the data is collected using a set of questionnaires specifically designed to ease pairwise comparison as well as overcoming inconsistencies. All the data collected from the respondents will be transformed into a matrix. The matrix is interfered mathematically in order to obtain the weights (refer Step 4 in Section 3.0). The suggested approach by Balhuwaisl [28] is believed to produce a CR value of less than 0.1. Based on the previous discussion, EAHP is deemed suitable to measure the effectiveness of anti-smoking strategies using prioritization with reliable consistency value. Therefore, this study proposes EAHP to prioritize the anti-smoking strategies as well as the influential factors of smoking.

3. PROPOSED FRAMEWORK

The basic idea of the proposed framework was derived from the Enhanced Analytic Hierarchy Process (EAHP). In this study, the research framework includes five main steps which are problem identification, hierarchy development, data collection, pairwise comparison and consistency checking. The steps involve in each step is explained in the Figure 1 below.

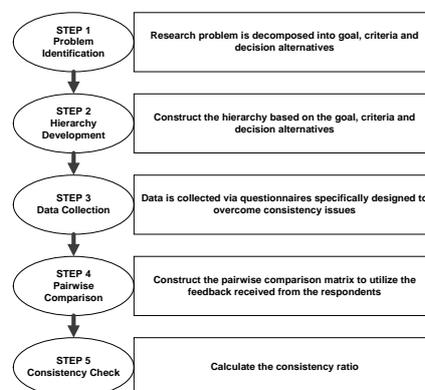


Figure 1: Proposed Framework for Evaluating The Effectiveness of Anti-Smoking Strategies

Step 1: Problem Identification

This step starts with identification of the research problem or initial characterization. Research problem is decomposed into goal, criteria, sub-criteria and decision alternatives. Goal is the overall objective to be achieve. In order to achieve the goal, there are several options to achieve the goal. The options are called decision alternatives. However, the available decision alternatives can be measured based on several criteria and sub-criteria.

In this study, the goal is to choose the most effective anti-smoking strategies. There are five anti-smoking strategies have been implemented in Malaysia namely promote packaging and labelling, increase in pricing and taxation of tobacco products, promoting advertising, imposing smoke-free legislation and promoting education and support. The anti-smoking strategies were set as the decision alternatives. The anti-smoking strategies were measured by the influential factors of smoking which was leveled as criteria and sub-criteria. The first criteria was personal factors and the sub-criteria were personal physiological and personal beliefs and values. The second criteria was social factors and the sub-criteria were family influence and psychosocial influences. The third criteria was environmental factors and the sub-criteria were community norms and tobacco industry. The classification of the criteria was based on the Theory of Triadic Influence as outlined by Flay, Petraits & Hu [29].

Step 2: Hierarchy Development

The graphical representation of the problem is structured in a hierarchy. Such hierarchy consists of four basic levels, which are overall goal, criteria, sub-criteria and decision alternatives. The hierarchy was structured downwards from general to particular. The hierarchy of the problem for this research is illustrated in Figure 2.

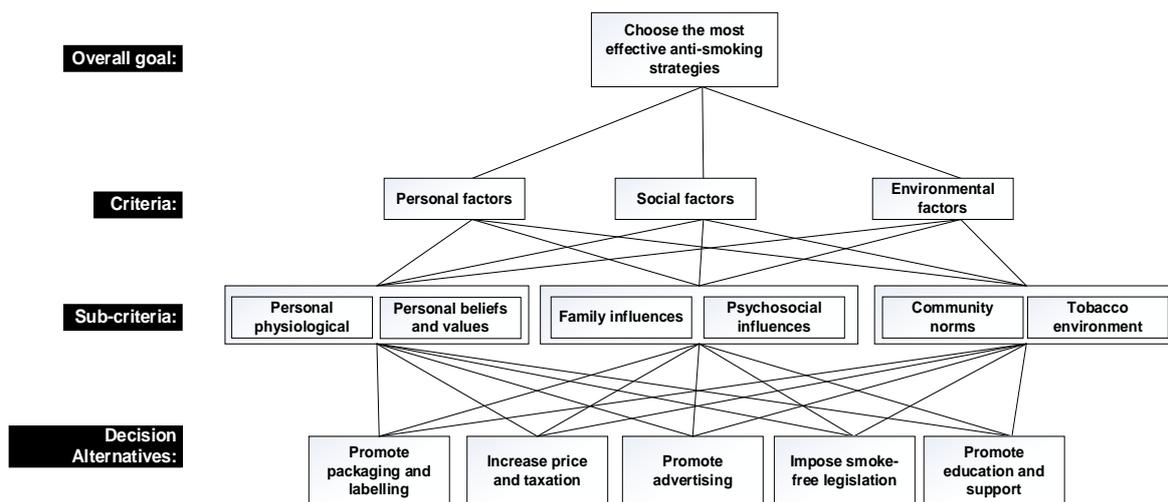


Figure 2: Hierarchical Structure of Prioritizing The Most Influential Factors of Smoking

Step 3: Data Collection

A set of questionnaires is used to obtain the input data. The respondents are the tobacco-related researchers in Ministry of Health. The questionnaire is specifically designed to simplify the tedious pairwise comparison and to overcome inconsistency issues [28].

Step 4: Pairwise Comparison

The essence of the EAHP is the pairwise comparison process. The feedback received from the respondents will be utilized to construct the pairwise comparison matrix, with values between 1 and 9. The interpretation of the values are shown in Table 1.

Table 1: Interpretation of The Values Used in Pairwise Comparison [24]

Importance level	Numerical value
Less influence	1
Less influence to moderately influence	2
Moderately influence	3
Moderately to strongly influence	4
Strongly influence	5
Strongly to very strongly influence	6
Very strongly influence	7
Very strongly to extremely influence	8
Extremely influence	9

The pairwise comparison is formed to obtain the weights for the criteria. The entry in row $i = 1, 2, \dots, j$ and column m of the matrix are labelled with y_{im} to indicate how much more or less important is criterion i as compared to criterion m . Then, the criterion i is rated as a_i and criterion m as a_m . Then,

$$\begin{aligned}
 &\text{if } i \leq m \\
 &\text{let } b = a_i - a_m \\
 &\text{if } b < 0, \text{ then } y_{im} = \frac{1}{1 - b} \\
 &\text{if } b = 0, \text{ then } y_{im} = 1 \\
 &\text{if } b > 0, \text{ then } y_{im} = b + 1 \\
 &\text{where, } y_{im}, \text{ the entries in the matrix.}
 \end{aligned}$$

All the data collected are transformed into a pairwise comparison matrix.

Step 5: Consistency Check

Next, the EAHP provides a measure of consistency for the pairwise comparisons by computing a consistency ratio. This is a crucial process in AHP as this will measure the degree of consistency of the pairwise comparison judgments provided by the decision maker. The values of consistency ratio are determined as follows:

CR > 0.10 → inconsistent
CR < 0.10 → consistent

The CR should be below 0.1 for a reliable result. However, CR > 0.1 indicates that the pair wise judgments are just about random and are completely untrustworthy.

4. CONCLUSION AND FUTURE WORKS

Nowadays, tobacco use is considered as one of the public health issues as it can cause numerous chronic diseases including premature deaths. Therefore, the demand to analyze the effectiveness of anti-smoking strategies is needed. This paper has describes the development of a conceptual framework for prioritizing the effectiveness of anti-smoking strategies. The framework was constructed using EAHP to address the consistency issues. Specifically, the framework highlighted the use of EAHP to prioritize the effectiveness of anti-smoking strategies by ensuring the consistency is less than 0.1. Our next step is to design the questionnaires and to test this framework vis-a-vis real data. This framework will be tested in Malaysia case study. It is expected that this framework is able to fulfil some of the important issues highlighted.

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