The effectiveness of a motivated, action-based intervention on improving physical activity level, exercise self-efficacy and cardiovascular risk factors of coronary heart disease patients: A randomized controlled trial

Introduction

Cardiovascular disorders (CVDs) are the leading cause of morbidity and mortality and accounts for 31% of deaths globally (World Health Organization [WHO], 2017). Low and middle-income countries are more vulnerable to this global CVDs death. Coronary heart disease (CHD), the major group of CVDs, is the leading cause of cardiac-associated mortality, causing >9 million death in 2016 (American Heart Association [AHA], 2015; WHO, 2018). The CHD mortality remains high in developing countries, although the global mortality is declining (Nowbar, Gitto, Howard, Francis, & Al-Lamee, 2019).

The global prevalence of obesity, hypertension (HT), diabetes mellitus (DM), and hyperlipidemia among the CHD population were 40.2%, 47.2%, 39.5%, and 32.7% respectively (Alhabib et al., 2020), whereas this prevalence was comparable in Sri Lanka except that higher prevalence of hyperlipidemia (37%) among the CHD population of Sri Lanka (Jayawardena et al., 2016; Ralapanawa et al., 2019). These modifiable risk factors increase the risk of recurrent cardiac events, premature death, and lead to poor prognosis among CHD patients (Zengin et al., 2015).

Cardiac rehabilitation (CR), comprises the six core components namely, health behavior change and education, lifestyle risk factor management, psychosocial health, medical risk management, long-term strategies, and audit and evaluation had shown to be effective in reducing all-cause mortality, cardiac mortality, myocardial re-infarction, and cardiovascular risk factors in high and low and middle-income countries (British Association for Cardiovascular Prevention and Rehabilitation [BACPR], 2017; Turk-Adawi & Grace, 2015). However, providing a center-based CR is particularly difficult in South East Asia including Sri Lanka due to the lack of human resources, space and equipment, and financial support (Ruano-Ravina et al., 2016; Turk-Adawi et al., 2019).

CHD patients have different health needs and challenges such as knowing the healthy diet, physical activity, and cardiac medications, uncertainty of future, communication, self-care, following a healthy lifestyle, and psychological and social support (Blair, Volpe, & Aggarwal, 2014). CHD patients perceived health professionals are the primary and preferred sources of information and the information needs to be provided based on their health status.
and preferences (Vosbergen et al., 2013). CHD patients perceived that they are much unaware of the secondary prevention of CHD especially the need for adequate exercise and a healthy diet (Athbi & Hassan, 2019).

Physical activity

Physical activity is considered any body movement which requires energy expenditure (WHO, 2018). AHA and the American College of Cardiology Foundation (ACCF) recognized that lifestyle modification including physical activity is the class I recommendation for secondary prevention and risk reduction therapy for patients with CHD (Smith et al., 2011). Further, AHA and ACCF recommended the physical activity for CHD patients as moderate-intensity aerobic activity, such as brisk walking, at least 30 minutes, at least 5 days per week (Smith et al., 2011). Also, AHA and ACCF encouraged the patients to increase in daily lifestyle activities such as gardening and household works to improve their cardiorespiratory fitness, bring them physically active, and reduce their potential risk. A Cochrane systematic review and meta-analysis showed that exercise-based CR reduced cardiovascular mortality, hospital admission, and improvement in one or more domains in health-related quality of life (HRQOL) (Anderson et al., 2016).

Even though physical activity enhances health outcomes, many people with CHD do not engage in adequate physical activity in both developed and developing countries. The prevalence of being inadequately physically active among CHD patients in the United States of America (USA), England, and Sri Lanka were 83%, 76%, and 56.7% respectively (British Heart Foundation [BHF], 2017; Matthias, de Silva, Indrakumar, & Gunatilake, 2018; Tang, Patao, Chuang, & Wong, 2013).

Previous studies showed that low motivation and low mood to exercise, negative perception of health after the cardiac event, feeling physical restriction or fearful about exercise, and lack of knowledge on exercise hinder the CHD patients to engage in physical activity (Rogerson, Murphy, Bird, & Morris, 2012). On the other hand, adequate social support, having a reason for exercise, perceived psychological benefits of exercise, and using psychological strategies are the facilitators of physical activity (Rogerson et al., 2012).

Healthy diet

A healthy diet is one of the key factors to prevent CHD and helps for a better prognosis in CHD patients (Bhupathiraju & Tucker, 2011). A longitudinal cohort study evidence that recurrent CHD events and all-cause mortality inversely associated with Mediterranean diet score (high in vegetables, fruits, whole grains, beans, nut and seeds, and olive oil), whereas the Southern dietary pattern (added fats, fried food, eggs, and egg dishes,
organ meats, processed meats, and sugar-sweetened beverages) was adversely associated with all-cause mortality (Shikany et al., 2018). The dietary pattern is closely related to personal and social values, beliefs, and attitudes and environmental factors, health systems, and social structures (Reddy & Anitha, 2015). CHD patients stated that family support, self-control, cultural values, and hope for recovery were the motivators for a healthy diet, however, food beliefs or food for socialization, poverty or free food, cultural or family values, food habits and taste, satisfying hunger were the barriers (Barolia, Petrucka, Higginbottom, Khan, & Clark, 2019).

With the increasing morbidity and mortality from CHD, especially in low and middle-income countries, secondary prevention including exercise-based CR plays an important role to improve the prognosis of CHD patients (Anderson et al., 2016; Zengin et al., 2015). High prevalence of physical inactivity, unhealthy dietary practices, poor control of blood glucose, blood pressure (BP), blood lipid, and body weight (BW) was found among CHD patients in the world as well as Sri Lanka (Cooney et al., 2013; Kotseva et al., 2016; Matthias, de Silva, Indrakumar, & Gunatilake, 2018; Perera & Samarawickrama, 2017). Therefore, it is important to design and implement an appropriate intervention to improve the physical activity level, exercise self-efficacy, and cardiovascular risk factors in CHD patients in Sri Lanka.

Non-pharmacological interventions for improving physical activity and cardiovascular risk factors: Findings of the literature review

A literature review was conducted on Eight English databases (MEDLINE (Ovid), EMBASE (Ovid), PsychINFO (Ovid), Ovid Nursing database, CINAHL Complete (EBSCO), Cochrane Library, Web of Science Core Collection, and Scopus) to identify the randomized control trials (RCTs) which examined the effects of the non-pharmacological intervention (such as lifestyle modification, psychological intervention) on the BW or body mass index (BMI), BP, blood lipid, and/or blood glucose of CHD patients. This review included 26 RCTs published between 2001 and 2020 and reported data of 8103 participants with mean ages ranging from 50.5±10.6 (Jayawardena, Sooriyaarachchi, Punchihewa, Lokunarangoda, & Pathirana, 2019) to 65.9±9.4 years (Zhang et al., 2017) predominantly with acute coronary syndrome (ACS).

Characteristics of the intervention

Out of the 26 included studies, 15 studies were multi-faceted and included information provision related to CHD, exercise training, and behavioral changing strategies. The contents of the multi-faceted intervention varied among the included studies and
comprised exercise training, exercise prescription, motivation, education on CHD, psychosocial support, or social support, individualized goal setting, smoking cessation, risk assessment, and feedback, risk factor management, and stress management and counseling.

Out of 15 multi-faceted intervention studies, three studies (Pluss, Karlsson, Wallen, Billing, & Held, 2008; The Vestfold Heartcare Study Group, 2003; Toobert, Glasgow, & Radcliffe, 2000) delivered education with exercise training to enhance the participants' knowledge and physical activity level, 11 studies delivered education with behavioral change strategies (Chair et al., 2011, 2013; Ding et al., 2017; Fernandez et al., 2009; Lumertz Saffi, Polanczyk, & Rabelo-Silva, 2014; Maddison et al., 2019; McHugh et al., 2001; Muñiz et al., 2010; Redfern, Briffa, Ellis, & Freedman, 2008, 2009; Vale, Jelinek, Grigg, & Newman, 2003; Wang, Jiang, He, & Koh, 2016; Zhang et al., 2017), and one study provided exercise training with behavioral change strategies (Lear et al., 2006).

Five studies (Chen et al., 2016; Chow et al., 2015; Cohen et al., 2014; Munoz et al., 2007; Zheng et al., 2019) were categorized as education, in which educational techniques and methods were applied to help the participants to gain knowledge, support for the recovery from disease, and cope with their emotion and reactions whereas four studies provided supervised exercise training as their intervention (Ades et al., 2009; Currie, Bailey, Jung, McKelvie, & MacDonald, 2015; Pal et al., 2011; Raghuram et al., 2020).

Out of four studies that provided exercise training, two studies provided moderate-intensity exercise for six to 12 months (Pal et al., 2011; Raghuram et al., 2020), Currie et al (2015) study provided moderate or high-intensity exercise on the cycle ergometer for six months, the lower-intensity exercise preferred as walking for five months provided in Ades et al (2009) study. The intervention of included studies was categorized into exercise training, exercise training with behavioral change strategies, exercise training with education, education with behavioral change strategies, and dietary management.

**Effectiveness of the intervention**

**Exercise training.** The weekly face-to-face supervised exercise training for 30-40 minutes with low to moderate-intensity for five to 12 months had significant improvement on BMI (Hedges'g =0.3), BW (Hedges'g =0.4), PA (Hedges'g =0.2), SBP (Hedges'g =0.5), DBP (Hedges'g =0.4), TC (Hedges'g =0.4), HDL (Hedges'g =0.8), TG (Hedges'g =0.9) and LDL (Hedges'g =0.3) of CHD patients at 6 months ($p<0.05$), however, the significant improvement only sustained on TG (Hedges'g =0.3), HDL (Hedges'g =0.3), BMI (Hedges'g =0.3) at 12 months (Ades et al., 2009; Pal et al., 2011; Raghuram et al., 2020).
**Exercise training with behavioral change strategies.** Supervised exercise training with behavioral change strategies through face-to-face followed by telephone calls had significant improvement on SBP (Hedges'g =0.3) of CHD patients at 48 months (p<0.05) (Lear et al., 2006).

**Exercise training with education.** Exercise training with education on different aspects of CHD including nature, risk factors, sign and symptoms of CHD via face-to-face had significant improvement on BMI (Hedges'g =0.2), and PA (Hedges'g =0.5) of CHD patients at 24 months (p<0.05) (Toobert et al., 2000).

**Education.** The contents of the education varied among the included studies and comprised of risk factors, signs, and symptoms of CHD, dietary advice, advice to stop smoking and alcohol consumption, stress management, and benefits of exercise. Out of five studies that provided education on different aspects, the study provided education through four weekly personalized text messages for six months showed significant effects on BMI (Hedges'g =0.6), PA (Hedges'g =0.3), SBP (Hedges'g =0.6), DBP (Hedges'g =0.3), TC (Hedges'g =0.3), TG (Hedges'g =0.3) and LDL (Hedges'g =0.2) of CHD patients at 6 months (p<0.05) (Chow et al., 2015), however, other studies did not show any significant improvement on the outcomes.

**Education with behavioral change strategies.** Out of 13 studies, four studies had significant improvement on BW, BMI, LDL, TC, TG, SBP, DBP, and PA of CHD patients (Lumertz Saffi et al., 2014; McHugh et al., 2001; Redfern et al., 2008, 2009; Zhang et al., 2017). Individual goal setting and feedback evaluation, stress management, coping strategies, and health education through monthly telephone calls for 12 months had significant improvement on LDL (Hedges'g =0.08), BMI (Hedges'g =0.07), SBP (Hedges'g =0.3), DBP (Hedges'g =0.3), and BW (Hedges'g =0.1) at 12 months (Lumertz Saffi et al., 2014).

Education with behavioral change strageties such as individual assessment, self-monitoring, counseling on self-care and coping for 30 minutes through face-to-face at participants home in every two weeks for seven months underpinning by the combination of the Omaha system and Pender’s health promotion model showed significant improvement on TG (Hedges'g =0.5), LDL (Hedges'g =0.4), TC (Hedges'g =0.8), BMI (Hedges'g =0.6), SBP (Hedges'g =1.0), DBP (Hedges'g =0.7), FBG (Hedges'g =0.4) in CHD patients at 7 months (p<0.05) (Zhang et al., 2017) whereas individualized case management approach with goal setting, individual risk assessment, self-monitoring and feedback evaluation delivered through a one-hour face-to-face consultation and three 10 minutes telephone calls for three months had significant improvement on LDL (Hedges'g =0.6), TC (Hedges'g =0.8), BMI
(Hedges'g =0.4), SBP (Hedges'g =0.6), DBP (Hedges'g =0.4), and PA (Hedges'g =0.6), in CHD patients at three months \((p<0.05)\) (Redfern et al., 2008), however, greater significant improvement was observed on PA (Hedges'g =0.8) with consistent improvement on other outcomes at 12 months (Redfern et al., 2009).

However, none of the interventions except exercise training showed significant improvement in HDL in CHD patients.

**Dietary management.** Out of two studies (Frost, Brynes, Bovill-Taylor, & Dornhorst, 2004; Jayawardena et al., 2019) that examined the dietary intervention, Jayawardena et al (2019) study only showed significant improvement in BW (Hedges'g =0.03) and BMI (Hedges'g =0.003) in CHD patients at three months \((p<0.05)\).

The total duration of the intervention in the included studies ranged from one month (Wang et al., 2016) to 48 months (Lear et al., 2006). This review suggested that a three-month multi-faceted intervention including supervised exercise training, behavioral changing strategies such as risk assessment and feedback, individualized goal-setting, self-monitoring, risk factor management, motivation, and education on the different aspects of CHD could improve the cardiovascular risk factors and physical activity level of CHD patients. To initiate the exercise behavior, this review suggested using the face-to-face approach to train the participant to engage in physical activity and this can be changed to telephone follow-up later. Furthermore, to deliver the education components of the intervention, the use of telephone calls should be considered in addition to traditional face-to-face interaction since this approach results in increased continuous support and improves physical activity and cardiovascular risk factors (Redfern et al., 2008, 2009).

Since CHD is the leading cause of cardiac-associated morbidity and mortality globally, the management of modifiable risk factors is a vital part of secondary prevention. Intervention consist of exercise training, education, and behavioral change strategies that can have beneficial effects on improving physical activity level, and cardiovascular risk factors among CHD patients.

**Limitations**

This review only included studies published in English. The findings of this review should be interpreted with caution since poor methodological quality including failure to blind outcomes assessors and perform allocation concealment has been observed among included studies. The limited number of studies was conducted in the developing countries, lack of theoretical underpinning for intervention, inconsistency in the mode of delivery, duration, number of sessions, frequency of exercise and education of the included studies
warrant further research to establish the effectiveness of the intervention that comprises of exercise training and education in the CHD population.

The direct application of these interventions to Sri Lanka may be challenging since most studies were conducted in western countries where the culture, beliefs, and attitudes towards CHD risk factors, management, and prevention may different from South Asian (Gany, Gill, Ahmed, Acharya, & Leng, 2013). Therefore, developing a culturally specific intervention considering the methodological pitfalls is essential to improve the cardiovascular risk factors and physical activity level in CHD population in Sri Lanka.

**Methodology**

**Study aim and objectives**

This study aims to develop and examine a culturally specific motivated, action-based intervention for improving physical activity level, exercise self-efficacy, and cardiovascular risk factors of CHD patients in Sri Lanka.

The objectives of the study as follows:-

i. To develop a culturally specific motivated, action-based intervention for improving physical activity level, exercise self-efficacy, and cardiovascular risk factors of CHD patients.

ii. To examine the effectiveness of a motivated, action-based intervention on improving physical activity level, exercise self-efficacy, and cardiovascular risk factors of CHD patients.

**Research hypothesis**

1. Participants in the intervention group will have a significantly higher level of physical activity compared with participants in the control group at immediate and one-month post-intervention.

2. Participants in the intervention group will have a significantly higher level of exercise self-efficacy compared with participants in the control group at immediate and one-month post-intervention.

3. Participants in the intervention group will have significantly improved cardiovascular risk factors namely BW, BMI, WHR, BP, lipid levels, and FBG compared with participants in the control group at immediately after the intervention.

4. Participants in the intervention group will have significantly improved cardiovascular risk factors namely BW, BMI, WHR, BP, and FBG compared with participants in the control group at one-month post-intervention.
Study design

An assessor-blinded randomized control trial will be conducted to assess the effectiveness of the motivated action-based intervention on the selected outcomes. The participants will be patients who are admitted to the coronary care unit (CCU) and medical wards of the Teaching Hospital Batticaloa, Sri Lanka with a diagnose of CHD at first instance. A thorough explanation of the study by using the information sheet (Appendix A) will be provided to all eligible participants and informed consent also will be obtained from the participants before the commencement of the study (Appendix B).

Study setting and subjects

The study protocol and implementation will have complied with the principles of Declaration of Helsinki (World Medical Association, 2013). Firstly, ethical approval will be obtained from The Joint Chinese University of Hong Kong – New Territories East Cluster Clinical Research Ethics Committee (The Joint CUHK-NTEC CREC) and the Ethics Review Committee, Faculty of Health Care-sciences, Eastern University, Sri Lanka. Permission also will be obtained from the director of the Teaching hospital Batticaloa, Sri Lanka. Secondly, the purpose of the study, the data collection procedures, the potential risk and benefits, the maintenance of confidentiality, and the voluntary basis of participation will be clearly explained to the participants. Participants will be informed that they have the choice to withdraw from the study at any time if they choose to do without penalty or negative consequence of current health services.

Thirdly, the informed consent will be provided in written and oral form when the research personnel approaches the potential participants. The detailed information and explanation of the nature of the study, the right of participants to withdraw from the study at any time, the anonymity and confidentiality of the participants, contact details of the researcher which participants may contact to obtain further information if they need will be included in the subject information sheet in both English and Tamil version. Fourthly, to maintain the anonymity of the participants, they will be asked not to write their name in the questionnaire, however, the code number will be provided by the researcher. All data will be kept by the principal investigator in a password-protected computer and a locked cabinet to ensure the confidentiality of participants. The participants will be informed that all personal data will only be accessed by the principal investigator and all the collected data will be destroyed five years after the study completion.

This study will be conducted in the Teaching Hospital Batticaloa, Sri Lanka. The study site is a hospital with 1200 beds that serves a population of more than two million in
the Eastern province and adjacent districts in Sri Lanka. The majority of the CHD patients of the eastern part of Sri Lanka will be admitted to this hospital for medical treatment. Study participants will be recruited from the coronary care unit and medical wards of the study hospital. The intervention will be delivered at the cardiology clinic of the hospital. The clinic provides a multidisciplinary service, including cardiologists, physicians, nurses, and other health care workers. Cardiac patients attending other OPD services are also referred to as the cardiac clinic for health assessment and unstructured health education.

**Inclusion and exclusion criteria**

The eligibilities of participants are; adults aged 18 years or above; patients admitted to hospital with CHD for the first time confirmed by electrocardiogram, able to reads and speak Tamil; able to attend clinic follow-up, and obtain a medical clearance from a cardiologist to perform the exercise. The medical records of the CHD patients will be reviewed to screen for their eligibility. In addition, the cardiologist of the participants will be consulted for their suitability to perform the exercise of the intervention.

The exclusion criteria are patients with absolute and relative contradictions to perform the exercise or at high risk for exercise, namely rest ejection fraction less than 40%, history of cardiac arrest or sudden death, complex dysrhythmias at rest or during exercise testing or recovery, complicated myocardial infarction or revascularization procedure, high level of silent ischemia during exercise testing or recovery, presence of abnormal hemodynamics with exercise testing or recovery and presence of angina or other significant symptoms according to the American College of Sports Medicine (ACSM) guideline and American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR) guideline (American College of Sports Medicine [ACSM], 2014); any diagnosis of life-threatening conditions or psychotic disease or unable to perform physical activity independently.

**Randomization:-** A stratified randomization by the sex of the participants will be conducted since sex influences the level of physical activity among CHD patients (Jason, McGannon, Blanchard, Rainham, & Dechman, 2014). The block randomization with a block size of eight will be used for group allocation of participants either to an intervention or control group with a ratio of 1: 1. The random sequencing for group allocation will be generated by an online application (http://www.randmization.com). The group allocation will be put into an opaque sealed envelope by a person who is independent of the study. After the baseline assessment (T₀), the opaque sealed envelope will be distributed to the participants according to their sequence of entry.
Sample size estimation

The sample size estimation is based on the primary outcomes of the study, namely the physical activity level. Referring to the finding of the literature review, the effect size on improving physical activity is 0.5 (Redfern et al., 2008) to 0.8 (Redfern et al., 2009). Therefore, the smallest effect size of 0.5 (Redfern et al., 2008) will be considered to calculate the sample size for this study. To achieve a power of 1-β=0.8 with a significance level of 0.05 (two sides) and account for 14% of attrition rate (Maddison et al., 2019) of the previous study. A total of 150 participants will be recruited in this study.

Development of the motivated, action-based intervention

The motivated, action-based intervention for this study is developed based on the findings of the literature review and the health action process approach (HAPA) for behavioral changes (Schwarzer, 2008). Health behaviour change is fundamental to cardiovascular disease prevention and rehabilitation (BACPR, 2017). A conceptual model that could help to explain behavioral changes is needed for developing an evidence-based intervention to improve the health outcomes of CHD patients.

Self-efficacy refers to an individual’s judgment on their ability to perform the assigned action to deal with a prospective situation (Bandura, 1982) and it is a key determinant of health behavior since it, directly and indirectly, influencing health behaviors (Bandura, 2004). Further, it is one of the focus determinants of physical activity, and a higher level of self-efficacy positively correlates with physical activity (Bauman et al., 2012). The HAPA constructs assess the self-efficacy in the different stages to initiate and maintain the desired health behavior and fill the intention-behavior gap which is the key part of the behavioral change intervention (Schwarzer, 2008). Therefore, HAPA is used as a conceptual framework to initiate and maintain the behavioral changes (physical activity) in CHD population.

Health action process approach (HAPA)

The HAPA is a social-cognitive model specifying motivational and volitional determinants of health behavioral (Schwarzer, 2008) and was used among health education and promotion interventions such as improving physical activity (Lippke, Schwarzer, Ziegelmann, Scholz, & Schüz, 2010), and dietary behaviors (Wiedemann et al, 2009). HAPA comprises two phases namely, the motivation phase and the volition phase which emphasis the initiation, and maintenance of health behaviors. Individuals choose what to do in the motivation phase, whereas they try to act and maintain the formed behavior in the volitional phase.
Motivational phase

The motivational phase is the initial part of the HAPA framework in which the individual chooses what to do for changing their behavior. The intention is the initial step in the motivational phase to change individual health behavior and can be developed by enhancing risk perception, improving outcomes expectancies, and increasing the action self-efficacy of an individual (Schwarzer, 2008). Risk perception refers to individual beliefs on their health problems experienced and higher perceived risk on disease experienced could motivate the individuals to adopt a health-protective behavior. The outcome expectancies refer to an individual’s belief that a specific behavior will lead to desired outcomes and it could enhance the individual’s action self-efficacy. Action self-efficacy refers to an individual’s judgment on their ability to perform the assigned action and can be developed or increased by performance accomplishments, social modeling, improving physical and emotional status, and verbal persuasion (Rajati et al., 2014). Good planning helps the formed intention in the motivation phase (goal-setting phase) translates into action in the volition phase (goal pursuit phase) (Zarski et al, 2018).

Volition phase

To result in behavior change, the developed intention has to be taken into action. The individual capability to deal with barriers that arise during behavioral action is called maintenance self-efficacy (Luszczynska, & Schwarzer, 2003) and it helps the individual to plan the action. The formed intention could be transformed into the proposed action through planning. The individual has to plan when, where, and how to act on the formed intention (action planning) and developed coping strategies to deal with anticipating difficulties or barriers (Coping planning) that might hinder the implementation of one's behavioral intention (Sniehotta, Scholz, & Schwarzer, 2005). Recovery self-efficacy refers to one’s confidence in being capable of resuming a difficult behavior after an interruption and help to continue the achieved desired behavior (Schwarzer, 2008).

Study intervention

Participants in the intervention group will receive the motivated action-based intervention in addition to the usual care. Meanwhile, those who are in the control group will only receive the usual care provided by the cardiology clinic of the study hospital. The motivated action-based intervention and usual care will be described as follows.

Control group

The control group will receive the usual health care services for CHD patients provided in the study hospital included an unstructured health education conducted by a nurse
on a healthy lifestyle (exercise, heart-healthy diet, stress management, and smoking cessation) will be given once a month for one year after discharge through face-to-face. During the first visit of CHD patient to the cardiology clinic two weeks after discharge, the cardiologist assesses the patient's condition and giving brief unstructured health education on their conditions, focusing on the risk factors management and stress management for 10-15 minutes. The patients are also instructed to visit the cardiology clinic every month for medical follow-up.

**Motivated action-based intervention (Intervention Group)**

Based on the findings of the literature review, the essential components of the intervention to improve cardiovascular outcomes included individual risk assessment and feedback, individualized goals setting and an action plan, supervised exercise training, education on lifestyle modification, nature, risk factors, sign and symptoms, medication management and adherence for CHD. To initiate and maintain these behavioral changes of CHD patients, the motivated action-based intervention is developed according to the HAPA model. The motivated action-based intervention comprises two phases, namely the face-to-face preparatory phase and a 12-week intervention phase. The intervention will be delivered by a researcher who has experience in clinical teaching and patient education.

**Face-to-face preparatory phase**

The preparatory phase includes one individualized health counseling for 60 minutes will be conducted by the researcher at the cardiology clinic at the hospital within three months after the CHD event. During this session, the participant’s health needs will be recognized by assessing the health condition, facilitate the participants to review their daily activities and explore the discrepancy between activity level and the recommended exercise guidelines, identify the three desired outcomes (achievable and observable), form individualized exercise goals and a behaviorally specific action plan for behavioral changes. In addition, knowledge and overview of the programme and real success stories will also be shared with participants.

The Framingham risk score (FRS) is a simple and common tool use to assess the risk level of CHD over ten years (Wannamethee, Shaper, Lennon, & Morris, 2005) and its comprise of six coronary risk factors namely, age, gender, TC, HDL, SBP and smoking habits (Sohn, Kim, & Bae, 2012). Furthermore, it can be used for lifestyle modification of patients by identifying their risk level (Wilson et al., 1998). The self-reported risk of CHD will be compared with the calculated FRS to identify the discrepancy in the risk level and for enhancing the risk perception of participants.
Recognizing and addressing outcome expectancies of the patients is one of the important aspects of the behavioral change intervention to adhere to the behavior change (Reesor, Vaughan, Hernandez, & Johnston, 2017). The participants will be asked to list the outcome expectancies (positive and negative) for following a healthy lifestyle such as engaging adequate physical activity, stop smoking, eating a healthy diet, and other risk factor management and not following a healthy lifestyle. Then the researcher will discuss the validity and reality of each expectation and encourage the participants to understand the benefits of healthy behaviour and motivate them to follow healthy behaviour.

Furthermore, the participant's concerns and questions will be addressed in this phase to alleviate their fear and anxiety to perform the exercise and enhance their knowledge of CHD. Ask the participants to list their achievements and appreciation will be given to them to initiate the desired behavior. These strategies will help to initiate the action self-efficacy of HAPA.

**Intervention phase**

The 12-week intervention consists of three monthly group education and center-based group exercise followed by 20 minutes of individualized telephone follow-up at weeks 3, 7, and 11 will be conducted one week after the preparatory phase to transform the intention into action and to maintain the behaviour change.

**Education.** As evidence from the literature review, an educational package will be developed and used in the education sessions to improve the patient’s knowledge of CHD risk and its management. The educational package consists of the following topics: Nature of CHD, risk factors, signs and symptoms of CHD, heart-healthy diet, physical activity, quit smoking, stress management, and medication management and adherence (American Cancer Society, 2020; AHA, 2014; American Psychological Association, 2020; Eckel et al., 2014; Price, Gordon, Bird, & Benson, 2016; Scott et al, 2018; Somasundaram et al, 2013; Somasundaram et al, 2014).

The content of the booklet will be validated by an expert panel consists of registered physiotherapists, registered nutritionists, cardiologists, and the cardiac nurse for their safety and appropriateness for CHD patients in Sri Lanka to provide culturally relevant written resources to encourage the patients to follow the health advice at home. The knowledge gained in the education will help the participants to form the intention by increasing risk perception, positive outcome expectancies, and action self-efficacy in the motivational phase of HAPA. Further, the education will also support the participants to plan the action of
intended behavior and help to maintain self-efficacy throughout the volitional phase in HAPA.

To change individual behavior, three monthly face-to-face group education will be conducted. Group education sessions consist of 10 participants will be delivered as follows at the cardiology clinic of the hospital: Nature, risk factors and signs and symptoms of CHD (30 minutes), heart-healthy diet, and physical activity (30 minutes), quit smoking, and stress management (30 minutes), and medication management and adherence (20 minutes). Further, the participants will be educated on how to complete food, medication, and exercise diaries to visualize their behavioral changes. The education booklet will be provided to the participants and telephone follow-up at weeks 3, 7, and 11 will be made. The participant's concerns and questions will be addressed during each telephone contact to enhance the maintenance self-efficacy, action planning, and coping planning of the HAPA.

**Exercise.** Apart from the group education, a hospital plus home-based heart-healthy exercise will be implemented during these 12 weeks to promote the behavioral change for better health outcomes. The maintenance self-efficacy from HAPA will use to help the patient to overcome the barriers during the exercise program. Music will be used during the exercise sessions to guide the participants to perform the exercise at the prescribed intensity and duration and reduces the rating of perceived exertion (RPE) among cardiac patients (Cheng, & Grove, 2017; Miller & Terbizan, 2017).

The exercise intervention comprised of two elements: (1) three monthly center-based exercise program, and (2) a 12 weeks home-based exercise program

(1) The three monthly hospital-based group exercises consists of eight to ten participants in each group will be implemented with the support of a physiotherapist, registered nurse, medical officer, and researcher. A total of three group exercise sessions once per month for three months will be conducted at the study hospital. During the first two sessions, participants will be guided to perform the exercise (warm-up exercise, brisk walking, and cool-down exercise) with the music and under the supervision of a physiotherapist of the study hospital. As suggested by the cardiologist, the exercise will start at low-intensity with cultural background music (Raravenu Gopabala Instrumental flute version) with a slow tempo (40-60 beats per minute). Before starting the walking exercise, the participants will perform the warm-up exercise for 5 minutes. Then participants will be asked to walk for 20 minutes with the speed paced by the music tempo of Raravenu Gopabala Instrumental flute version. After completing the walking, the participants will perform the cool-down exercise for 5 minutes.
A total of two exercise sessions (brisk walking), 20 minutes/session) one per month will be implemented for the first two months at the hospital. From the third month onwards, the intensity of the aerobic exercise will increase to moderate-intensity and the duration will be increased to 30 minutes/session.

(2) Twelve-week home-based exercise will be conducted between hospital-based exercise sessions. The participants will be asked to continue the exercise performed in the previous week at the hospital with culturally background music for three times per week. An exercise logbook will be distributed to the participants and the researcher will teach the participant how to fill the logbook and how to follow the exercise plan for home-based practice. This exercise log record will allow the participants to self-monitoring and will use to identify the tract in their exercise practice at home will help to maintain the action and coping planning of the HAPA.

**Telephone follow-up.** The researcher will provide a 20-minutes telephone follow-up at weeks 3, 7, and 11 for strengthening the volition of the participant to perform the exercise and follow the healthy diet at home and to enhance problem-solving skills to overcome perceived barriers and to provide reinforcement for any positive changes that resulted. During telephone follow-up, the patient will be instructed to go through a series of self-management steps, including an assessment on current exercise and diet practice, giving feedback on consistency or any discrepancy between the designated plan and current practice, identifying facilitators and barriers for behavioral changes, remind them to follow the educational manual and perform the prescribed exercise, exploring problem-solving strategies, and strengthening confidence and motivation. In each telephone follow-up, the goals and action plan will be reviewed and mutually adjusted as necessary for the next follow-up review.

**Data collection**

The study outcomes will be assessed at baseline (T₀), upon completion of the 12-weeks intervention (T₁), and one-month post-intervention (T₂) by a trained research assistant (RA) who is blinded for the group allocation. Every participant will receive 230 Sri Lankan rupees (one United States dollar) after completing data collection to compensate for the time spending on data collection. The flow chart for the main study is shown in Appendix C.

**Outcome measures**

The primary outcome of this study is the physical activity level of the participants while the secondary outcomes are cardiac exercise self-efficacy and cardiovascular risk factors namely, BW, BMI, WHR, BP, lipids levels, and FBG. Physical activity level, cardiac exercise self-efficacy, BW, BMI, WHR, BP, and FBG will be measured at baseline, at
immediate post-intervention and on-month post-intervention, whereas lipids profile will be measured at baseline and immediate post-intervention.

Informed written consent will be obtained from the participants before the study commencement. The interview will be conducted to collect the information by a trained RA.

**Socio-demographic and clinical data form:** The socio-demographic characteristics of the participants, including their gender, age, marital status, ethnicity, education level, employment, and family monthly income, will be collected. Furthermore, the clinical characteristics of the participants, including the duration of illness, the medication history, and other comorbidities will be collected (Appendix D).

**Cardiac Exercise Self-Efficacy Instrument (CESEI):** The CESEI is a 16-item instrument developed to assess the individual’s confidence to perform the physical exercise in cardiac patients (Hickey, Owen, & Froman, 1992). Each item is rated on a five-point Likert scale from 1 (very little confidence) to 5 (quite a lot of confidence). Participants will be asked to rate their confidence level in performing exercise in various situations such as “fitting exercise into a busy day,” “exercising without getting chest pain,” “taking own heart rate before and after exercise,” and “enduring light exercise”. The CESEI score range from 16-80 and a higher score indicates that a high level of self-efficacy in performing the exercise. The CESEI demonstrated high reliability with high internal consistency (Cronbach's alpha = 0.9) and test-retest reliability (r = 0.86) and known-group construct validity in exercise self-efficacy between marathon runners and cardiac rehabilitation patients (p = 0.04) (Hickey et al., 1992). The exercise self-efficacy level of participants will be measured using a validated Tamil version of CESEI (Appendix E).

**International Physical Activity Questionnaire Short Form (IPAQ-SF):** IPAQ-SF questionnaire consists of 7 items to assess the physical activity of an individual with various intensities (Craig et al., 2003). The first six questions of IPAQ-SF focus on three specific types of activity in the last seven days, namely walking, moderate-intensity activities, and vigorous-intensity activities. The final question asks about the time “spent sitting” on weekdays. Furthermore, the original version of IPAQ-SF demonstrated high reliability with test-retest reliability (Craig et al., 2003). The validated Tamil version of IPAQ-SF will be used to assess the self-reported time spent in walking, moderate and vigorous-intensity activities, and sitting in this study (Appendix F).

All anthropometric measurements will be performed by a trained research assistant who will be blinded to the group allocation of participants. The weight will be measured with a calibrated mechanical personal scale (model-CAMRY, model number-BS 20140).
Participants will be weighed wearing light clothes, without shoes, and an empty bladder. The height will be measured in a standing position by using a plastic flexible tape (without shoes) and BMI will be calculated as weight in kilograms divided by height squared in meters ($kg/m^2$). WC will be measured using a non-stretchable measuring tape at the approximate midpoint between the lower margin of the last palpable rib and the top of the iliac crest to the nearest 1cm, at end of the normal expiration. Hip circumference will be measured at the widest level over the greater trochanters using plastic flexible tape to the nearest 0.1 cm. WHR will be estimated as waist measurement (cm) divided by hip measurement (cm).

BP in a sitting position will be measured using a mercury sphygmomanometer (Dekamet model Code: 0125). Participants will be asked to rest for 15 minutes and no caffeinated food or drink 30 minutes before the BP measurement. The participants’ lipid profiles and FBG will be obtained from their clinical records at baseline and immediate post-intervention.

**Data analysis**

Data will be analysed using SPSS version 22.0 statistical software with a 5% significance level (two-sided) (SPSSinc., Chicago, II, USA). Data will be analysed using descriptive and inferential statistics. Descriptive statistics with mean, standard deviation, range, frequency, and the percentage will be used to describe the participants’ socio-demographic characteristics and clinical data. The normality of the data will be tested using skewness and kurtosis statistics and graphically by the normal Q-Q plots. While an independent t-test will be used to compare the baseline characteristics of the intervention and control group for continuous variables, the Chi-square test will be used for categorical variables. The generalized estimating equation (GEE) model will be used for hypotheses testing, to determine significant differences across different time points (effect of time, group, and time x group interaction). The intention-to-treat (ITT) analysis will be used as an approach to analyse all participants in the final analysis according to the original assigned group irrespective of treatment received. If these assumptions are not met, the equivalent non-parametric statistics will be used to analyse the data.

**Ethical consideration**

Ethical approval will be obtained from The Joint Chinese University of Hong Kong – New Territories East Cluster Clinical Research Ethics Committee (The Joint CUHK-NTEC CREC) and Ethics Review Committee, Faculty of Health Care-sciences, Eastern University, Sri Lanka. Permission will also be obtained from the director of Teaching Hospital, Batticaloa, Sri Lanka. The study will adhere to the Declaration of Helsinki (World Medical
Association, 2013). Written informed consent of the participants will be obtained before data collection. Participants’ safety in this intervention will be ensured as follows: the medical clearance to participate in this intervention to all eligible participants will be obtained from their cardiologist before participating in the intervention, the brisk walking is a safe and simplest exercise for improving cardiovascular risk factors (Centre for health protection, Department of health, 2020), the exercise sessions will be delivered as supervised brisk walking, and the contact details of the cardiologist and researcher will be provided to all participants to inform if patients develop any discomforts. The purpose of the study, the data collection procedures, the potential risk and benefits, the maintenance of confidentiality, and the voluntary basis of participation will be clearly explained to the participants. The right of participants to withdraw from the study at any time without providing a reason and their refusal to participate and withdraw from the study would not affect the amount of care they receive from the hospital will be reinforced. The name of the participants will be coded, and the code will be stored separately to ensure anonymity. All data will be kept by the principal investigator in a password-protected computer and a locked cabinet. The personal data will only be accessed by the principal investigator. All the collected data will be destroyed five years after the study completion.

**Significance of the study**

This study will provide evidence on the effectiveness of a motivated, action-based intervention on the physical activity level, cardiovascular risk factors, and exercise self-efficacy of CHD patients in Sri Lanka. Findings from this study could be useful to promote healthy lifestyle behaviors in CHD patients in a low resource setting.
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Appendix A. Subject Information Sheet

The effectiveness of a motivated, action-based intervention on improving physical activity level, exercise self-efficacy and cardiovascular risk factors of coronary heart disease patients: A randomized controlled trial

Dear participants,

I am Mr. Karthikesu Karthijekan, currently studying PhD at Faculty of Medicine, The Chinese University of Hong Kong, Hong Kong SAR. You are sincerely invited to take part in a research study titled “The effectiveness of a motivated, action-based intervention on improving physical activity level, exercise self-efficacy and cardiovascular risk factors of coronary heart disease patients: A randomized controlled trial”.

This study is aimed to enhance the physical activity level, and exercise self-efficacy of CHD patients to improve the health outcomes such as body weight, body mass index, waist circumference, waist-hip ratio, lipid levels, blood glucose, and blood pressure through a hospital plus home-based motivated, action-based intervention that included exercise (brisk walking) and education using the developed exercise protocol and education manual. The findings of this study could provide evidence on an effective and safe strategy to improve the cardiovascular risk factors of CHD patients.

This is an experimental study in which you will be randomly assigned either to the intervention group or control group. If you are assigned to the intervention group, you will receive motivated, action-based intervention that included exercise and education using the exercise protocol and education manual for 12 weeks after discharge from the hospital in addition to the usual care is provided by the hospital. You are asked not to show and share the contents of the exercise protocol and education manual with anyone who has had CHD since others might have some different problem that needs different management and the contents of the manuals might not be suitable for them. On the other hand, if you are assigned to the control group, you will receive the usual care provided by the hospital. All participants will be invited to complete the questionnaires and health check-up at baseline, at immediate post-intervention (12 weeks after study entry), and one-month post-intervention (16 weeks after study entry).

Your participation in this study is voluntary. If you decide not to participate or withdraw from the study, you may do so at any time without loss of medical care or any other available treatment for your illness or condition. Any information obtained in connection with this study will remain strictly confidential and at no time will the participant's name to appear in any report of this study. You are free to ask any questions or to clarify any queries regarding this study at any time from the researcher (Mr. Karthikesu Karthijekan, PhD Student, Contact No: 0772029816, email: jeshikarthi@gmail.com).

Thank you for your support and participation in this study.

Yours faithfully,
Mr. Karthikesu Karthijekan, PhD Student,
Faculty of Medicine,
The Chinese University of Hong Kong,
Hong Kong, SAR.
Appendix B. Informed Consent form

The effectiveness of a motivated, action-based intervention on improving physical activity level, exercise self-efficacy and cardiovascular risk factors of coronary heart disease patients: A randomized controlled trial

In signing this consent, I am giving my consent to participate in the research titled “The effectiveness of a motivated, action-based intervention on improving physical activity level, exercise self-efficacy and cardiovascular risk factors of coronary heart disease patients: A randomized controlled trial” is conducted by Mr. Karthikesu Karthijekan, PhD student of Faculty of Medicine, The Chinese University of Hong Kong, Hong Kong SAR.

I understand that this study will be based on the experimental method that I will be randomly assigned either to the test group or the control. If I am selected for the test group, I will receive the hospital plus home-based motivated, action-based intervention that included exercise (brisk walking) and education using the exercise and education manual for 12 weeks after discharge from the hospital in addition to usual care is provided by the hospital. I have been informed not to disseminate the information about the intervention, not to show and discuss the education manual and exercise protocol with “other CHD patients” since others might have a different problem that the information in the intervention manual might not be suitable for them. I will be asked to follow the exercise and education manual for 12 weeks and to ask for the response to the questionnaires at baseline, 3 months, and 4 months after study entry. On the other hand, if I am assigned to the control group, I will receive the usual care provided by the hospital. Further, I will be also asked to complete the questionnaires independently.

I have been informed that all information that I provided will be kept confidential and will not be given to anyone else. I was guaranteed that all information I provided will be used only for research purposes and will be destroyed after five years from the study completion. I am aware that my participation is voluntary and I am free to withdraw from this study anytime without penalty of any kind.

I confirmed that I have read and have been informed of the study purpose, the procedure that will undergo and, the risk and benefit that I may experience. Alternatives to my participation have also been discussed. All my questions and personal concerns on all the above issues have been asked and fully explained by the researcher. I have read and understood this consent form. Therefore, I agree to give my consent to participate in this study.

Name of the participant: ………………………………………………………………………..

Signature of the participant: ….......................................... Date: ..............................

Name of research personnel: …………………………………………………………………

Signature of research personnel: ….......................................... Date: ..............................
Appendix C. Flow diagram of the study protocol

Fig. 1 Flow diagram of the study protocol
Appendix D. Study questionnaire

Confidential

Date:

Serial No

The data is collected only for the study purpose. Answer all questions. (Please indicate (X) mark in the appropriate box and indicate your answer in the given space.)

Socio-demographic Characteristics

01. Sex:  a) Male   □  b) Female   □

02. What is your age? _______ (In years)

03. What is your marital status?
   a) Single □   b) Married □
   c) Widowed □   d) Divorced/Separated □

04. What is your Ethnicity?
   a) Tamil □   b) Sinhalese □
   c) Moor □   d) Burger □

05. What is your education level?
   a) Never attended school □   b) Primary education □
   c) Secondary education □   d) Diploma □
   e) Degree □   f) Postgraduate □

06. What is your occupation?
   a) Unemployed □   b) Self-employee □
   c) Government □
   d) Nongovernment employee □
   e) Other ___________________________

07. What is your monthly income in Rupees?
   a) Less than 15,000 □
   b) 15,000-29,999 □
   c) 30,000-50,000 □
   d) More than 50,000 □

Risk factors for coronary heart disease (CHD)

08. Have you ever smoked?
   a) Yes □   (go to Q.09)  b) No □   (go to Q.11)

09. Are you currently smoking?
   a) Yes □   (go to Q.10)  b) No □   (go to Q.11)

10. How long you have to be smoking?
   a) Less than 1 year □
   b) 1-3 years □
   c) 4-6 years □
   d) 7-10 years □
   e) More than 10 years □
11. Have you ever drunk?
   a) Yes ☐ (go to Q.12)  b) No ☐ (go to Q.14)

12. Are you currently drinking?
   a) Yes ☐ (go to Q.13)  b) No ☐ (go to Q.14)

13. How long you have been drinking?
   a) Less than 1 year ☐  b) 1-3 years ☐
   c) 4-6 years ☐  d) 7-10 years ☐
   e) More than 10 years ☐

14. Are you?
   a) Vegetarian ☐  b) Non vegetarian ☐

1. Are you regularly using drugs?
   a) Yes ☐  b) No ☐

16. What are the drugs you use?
   ..........................................................
   ..........................................................
   ..........................................................
   ..........................................................

**Anthropometry and Investigation Measures**

17. Weight (Kg): -________  18. Height (cm): -___________ 19. BMI (Kg/m²): _________
20. Waist circumference (cm): -________  21. Hip circumference (cm): -___________
22. Waist Hip Ratio: -________
23. Blood pressure (mmHg) at baseline:
   I. Systolic blood pressure (SBP) - _________
   II. Diastolic blood pressure (DBP) - _________
24. Fasting blood glucose level (mg/dl) at baseline: (check medical record)
   I. - __________
25. Lipid profile at baseline: (check medical record)
   a) Triglyceride level (mg/dl) - ........................................
   b) High-Density Lipoprotein (HDL) (mg/dl) - ......................
   c) Low-Density Lipoprotein (LDL) (mg/dl) - ......................
   d) Total Cholesterol level (mg/dl) - ..................................
   e) HDL: LDL - ................................................................

*Thank you for your cooperation*
Appendix E

The translated Tamil version of Cardiac Exercise Self-efficacy Instrument (CESEI)

| English | Tamil |
|---------|-------|
| 1. The translated Tamil version of Cardiac Exercise Self-efficacy Instrument (CESEI) | இதன உடற்஧னிற்சி சுனசசனல்தி஫ன் அ஭வீட்டு கருவி தனவுசெய்து கீழம கு஫்஧ிடப்஧ட்டுள்஭ செனற்஧ாடுகள஭ செய்யதற்கு ஥ீங்களுற்று எந்த஭வுக்கு தன்மைக்ளக சகாண்டுள்஭ீர்கள் என்஧ளத ஧ிபதி஧஬ிக்கும் இ஬க்கத்ளத சுற்஫ி யட்டநிடுக. | 1 2 3 4 5 |
| 2.  |  |  |  |  |  |
| 3.  |  |  |  |  |  |
| 4.  |  |  |  |  |  |
| 5.  |  |  |  |  |  |
| 6.  |  |  |  |  |  |
| 7.  |  |  |  |  |  |
| 8.  |  |  |  |  |  |
| 9.  |  |  |  |  |  |
| 10.  |  |  |  |  |  |
| 11.  |  |  |  |  |  |
| 12.  |  |  |  |  |  |
| 13.  |  |  |  |  |  |
| 14.  |  |  |  |  |  |
| 15.  |  |  |  |  |  |
| 16.  |  |  |  |  |  |
Appendix F
The translated Tamil version of International Physical Activity Questionnaire Short Form (IPAQ-SF)

கடந்த ஏழு ஥ாட்க஭ில் ப஧ாது ஥ீங்கள் ஈடுப்஧ட்ட உடற்செனற்஧ாடுகள் எந்துமானையும் உடற்செயல்பாடுகள் - குறும்படிவம்

1. கடந்த ஏழு ஥ாட்க஭ில் ப஧ாது ஥ீங்கள் எந்துமானையும் உடற்செயல்பாடுகள் அதறுமான் கங்கா கண்காச தூக்கு யொத்தான்மணா அள்ளுவிக்கவும். நிதநாடு உடற்செயல்பாடுகள் எந்துமானையும் உடற்செயல்பாடுகள் எந்துமானையும் உடற்செயல்பாடுகள் எந்துமானையும் உடற்செயல்பாடுகள் எந்துமானையும் உடற்செயல்பாடுகள் எந்துமானையும் உடற்செயல்பாடுகள் எந்துமானையும் உடற்செயல்பாடுகள் எந்துமானையும் உடற்செயல்பாடுகள் எந்துமானையும் உடற்செயல்பாடுகள் எந்துமானையும் உடற்செயல்பாடுகள் எந்துமானையும் உடற்செயல்பாடுகள் எந்துமானையும் உடற்செயல்பாடுகள் எந்துமானையும் உடற்செயல்பாடுகள் எந்துமானையும் உடற்செயல்பாடுகள் எந்துமானையும் உடற்செயல்பாடுகள் எந்துமானையும் உடற்செயல்பாடுகள் எந்துமானையும் உடற்செயல்பாடுகள் எந்துமானையும் உடற்செயல்பாடுகள் எந்துமானைyum

2. அவ்யா஫ாக் ஒழபதடளயனில் குளந்தது நிதநாடு உடற்செயல்பாடுகள் எந்துமானையும் உடற்செயல்பாடுகள் எந்துமானையும் உடற்செயல்பாடுகள் ?

3. கடந்த ஏழு ஥ாட்க஭ில் ப஧ாது ஥ீங்கள் எந்துமானையும் உடற்செயல்பாடுகள் எந்துமானையும் உடற்செயல்பாடுகள் எந்துமானையும் உடற்செயல்பாடுகள் எந்துமானையும் உடற்செயல்பாடுகள் எந்துமானையும் உடற்செயல்பாடுகள் எந்துமானையும் உடற்செயல்பாடுகள் எந்துமானைyum

4. அவ்யா஫ாக் ஒழபதடளயனில் குளந்தது நிதநாடு உடற்செயல்பாடுகள் எந்துமானைyum

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5. கடந்த ஏழு காலங்கள், எத்தனத்துக்கான நேர்காலத்தில் செய்யப்பட்ட விளக்கங்கள் தெரியும்;

அல்லது புகழ் தெருத்துவிட்டது?



6. அவ்யாபாத காலங்கள் நேர்காலத்தில் செய்யப்பட்ட விளக்கங்கள் தெரியும்;

அல்லது புகழ் தெருத்துவிட்டது?



7. கடந்த ஏழு காலங்கள், முன்னர் நேர்காலத்தில் செய்யப்பட்ட விளக்கங்கள் தெரியும்;

அல்லது புகழ் தெருத்துவிட்டது?



சுருக்கவும் மறுசெய்யவும் கடந்த ஏழு காலங்கள் முன்னரிடமிருந்து அவ்விருந்து விளக்கங்களை வெப்பவிட்டது. ஏனைய காலங்களில் முன்னர் விளக்கங்கள் வெப்பவிட்டது ஐந்து ஆண்டுகளைக் குறைந்து வெப்பவிட்டது. எனவே கடந்த ஏழு காலங்கள் முன்னரிடமிருந்து விளக்கங்களை வெப்பவிட்டது. எனவே தொடர்வாய்ப்புகள் முன்னரிடமிருந்து விளக்கங்களை வெப்பவிட்டது.