THE FEASIBILITY OF HIGH INTENSITY INTERVAL TRAINING (HIIT) IN THE WORKPLACE OBESITY MANAGEMENT PROGRAM

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ABSTRACT

Introduction: Community-based health promotion program “KOSPEN” was officiated in 2013 and expanded to all workplace settings under Ministry of Health Malaysia in 2017 as known as “KOSPEN PLUS”. The program was recognized to reduce modifiable lifestyle risk behaviours for non-communicable diseases including obesity. The sedentary working population are at increased risk of obesity related diseases. Therefore, present workplace health program funded by KOSPEN PLUS was aimed to determine the feasibility of High Intensity Interval Training at workplace.

Methodology: A total of 108 participants from a research institute aged between 25 - 59 years old with abnormally high body mass index were recruited in the workplace program-based project “Health Is Wealth” employing a pre-post design. The 10 weeks of High Intensity Interval Training (3 times a week, 30 minutes each time) was conducted. Anthropometric parameter (Weight, BMI, Waist circumference) and Biochemical profile (Fasting serum lipid and glucose) were compared pre and post intervention. The dropped out rate was documented 38% and 3.7% with irretrievable data.

Results: Among 63 remaining participants, there were significant reduction on mean body weight 1.8 (95% CI: 1.1, 2.4), BMI 0.9 (95% CI: 0.4, 1.3), and fasting serum cholesterol 0.16 (95% CI: 0.01, 0.31).

Conclusion: The present workplace program-based project observed positive beneficial changes in mean body weight, BMI and fasting total cholesterol following the HIIT protocol for ten weeks. However, the long term effects of program together with its combination with nutritional care need further exploration.

Keywords: feasibility, 10 weeks, High Intensity Interval Training, Workplace, obesity program
1.0 Introduction

The Global Survey Report on Non-communicable Disease 2010 had ranked Malaysia as top country for having overweight and obese citizens among ASEAN countries. Prevalence of obesity among Malaysian adults increased drastically and documented as 4.4% in 1996, 14.0% in 2006, 15.1% in 2011 and shot up to 17.7% in 2015 (National Health Morbidity Survey, Malaysia, 2015).

The Ministry of Health Malaysia has officially launched a nationwide community-based program, “Komuniti Sihat, Pembina Negara” (KOSPEN) in 2013 with the aim to minimize risk factors of Non-Communicating Diseases (NCD) through the promotion of healthy eating, active lifestyle, obesity management, smoke-free habit and health screenings in the community. The KOSPEN was a collaboration between Ministry of Health and Ministry of Rural and Regional Development Malaysia in congruent with the policy statement of the National Non-Communicable Disease under National Strategic Planning (NSP) (Ministry of Health Malaysia, 2010). The value and positive impacts of KOSPEN was observed. As a result, KOSPEN was expanded from community setting when all facilities under the Ministry of Health Malaysia were required to implement the KOSPEN PLUS program since 2017. The KOSPEN PLUS obligated all workplace to maintain a healthy workplace as well as promote healthy lifestyle among the workforce. It consisted of 8 well-structured elements: healthy diet, smoke-free habit, active lifestyle, body weight management, NCD screening, healthy mind, healthy work environment and alcohol free workplace (Ministry of Health Malaysia, 2017).

In line with KOSPEN PLUS, an annual workplace NCD screening in an research Institute had revealed 29.8% of working population with abnormally high BMI (overweight and obese). The nature of daily tasks performed by the employees are classified as sedentary type. Inactive lifestyle is well-recognized risk factors that accelerate obesity while obesity is an important driver of production loss associated with absenteeism, sick leave, disability and healthcare claims (Sharifian, Aminian, Kolahi, Zadeh & Mohseni, 2017). Worker’s health is a fundamental element in determining the long-term success of an organization. Therefore lifestyle changes especially an effective program should emphasis specific physical fitness component besides feasible.

Regular physical activity brings various health benefits and is proven successful in the prevention of comorbidity such as diabetes mellitus (Frøsig & Richter, 2009; American Diabetes Association, 2014; Cassidy et al.,2016), cardiorespiratory diseases, cancer, obesity (De Feo et al.,2003), hypertension, hyperlipidaemia (Lindhorst, Young, Bagshaw, Hyland & Kisilevsky, 1997; Ostrowski, Schjerling & Pedersen, 2000; Ansell et al.,2003; Aronson et al.,2004; Ouerghi et al.,2014) osteoporosis and depression (Warburton, Nicol & Bredin, 2006). WHO recommended a regime of thirty minutes of moderate intensity physical activity for at least five days in a week in order to achieve optimum health status (World Health Organization,2003; Warburton, Katzmarzyk, Rhodes & Shephard, 2007), however is less practical to the working population as it requires massive commitment in time and effort. In recent years, ample studies reported that high intensity interval training (HIIT) provides similar fitness benefits as continuous endurance workouts but requires shorter duration and therefore more approachable to be employed in the workplace program (Shiraev & Barclay, 2012).

HIIT protocol consisted of repeated all-out short bout and alternated with short relief break, with the duration ranging from 6 seconds up to 4 minutes for each protocol (Boutcher, 2010). HIIT is highly associated with good compliance and adhesion throughout the exercise plan as introducing the submaximal short bouts of exercise to achieve mental stimulus, which will consequently leads to the augmentation of long term compliance to the regular workout as well as mitigates the boring aspects (Kirk & De Feo, 2007).
Limited nationwide research has explored the feasibility of HIIT in workplace health program in the past one decade. Furthermore, there is no similar program being conducted among Malaysian working group employing HIIT protocol. Therefore, this program-based project provided an opportunity to address the gaps, as well as contributed to the body of knowledge by enhancing empirical data on the feasibility of HIIT in a workplace obesity program. In term of practical importance, present information allowed HIIT to be practised as an effective and appropriate tool since it is feasible but provides similar fitness benefits as continuous endurance workouts. The study aims to determine the feasibility of 10 weeks of High Intensity Interval Training (HIIT) in a Workplace Obesity Program, on the pre-post changes of body composition and biochemical profile.

2.0 Methodology

2.1 Program and Participation

This is a workplace program-based project funded by KOSPEN PLUS performed throughout a 10 weeks interval in a research institute. A total of 426 workers had participated in the workplace annual health screening for non-communicable diseases (NCD) as part of the KOSPEN PLUS program.

![Flowchart showing recruitment method]

From the NCD screening, a total of 127 (29.8%) workers with abnormally high body mass index (BMI) of at least 23kg/m² were identified. However only a total of 108 workers aged (range 25-59) years were physically fit to be recruited in the obesity management program with pre-post design. The preliminary assessment employing PAR-Q (Physical Activity Readiness Questionnaire) was
screened to all participants in order to eliminate high risk and unfit individuals. A total of 19 obese or overweighted participants were excluded via PAR-Q assessment based on the exclusion criteria of: underlying medical conditions including stage 2 hypertension and above, cardiovascular instability (NYHA) class III and IV, severe osteoarthritis (grade 3 and above) as well as pregnant female. Throughout the program, 41 among the 108 participants were dropout, yielding a total sample size of 67 who successfully went through the entire program for ten weeks. The dropout rate was documented as 38% (n = 41) due to unsatisfactory participation and unable to give time commitment. All participants who failed to attend the HIIT session for at least three times consecutively were considered as dropout. However, only a total of 63 data were analysed at the end of program after deducted the four irretrievable data (Fig.1). Taking into consideration a much smaller sample size after high dropout, the Effect sizes employing Cohen’s d were measured in order to understand the differences between two means as well to generate a better idea about the practical significance and impact of the statistical result, rather than relying on the p-value alone for the statistical significance level. As a result of the Effect Sizes calculation, the dependent variables which documented medium size of effect (d=0.5) including body weight and BMI, whereas waist circumference, total cholesterol, serum LDL, HDL, TG and fasting blood glucose were all reported a small size of effect (d<0.2).

2.2 Program based Implementation

The physical activity was designed employing HIIT protocol. All participants went through 30 minutes of HIIT session, 3 times a week for 10 weeks duration. Each HIIT session consisted of 5 minutes warm up, 20 minutes of Tabata made up of 5 cycles in which each cycle (4 minutes) includes 20 seconds of high intensity aerobic work-out (jumping jack, lunges, squat, squat-jump, slow jog, knee lift, punch kick, shuffle) followed by 10 seconds of rest, repeated for 8 interval. The session ended with 5 minutes of cool down.

2.3 Ethical Consideration

This was a program-based project funded by KOSPEN PLUS with the aim to promote healthy lifestyle at workplace. As the ethical considerations, the written consent was obtained from all participants upon recruitment. Procedure explained verbally and participants are allowed to ask questions. They were then made free decision to participate in the program. On the other hand, individual’s physical fitness was taken into account through the PAR-Q preliminary assessment. High risks participants fulfilling the exclusion criteria were all excluded. The privacy and confidentiality of personal information were maintained. All the investigators have no conflicts of interest related to the content of the program.

2.4 Measurements

Anthropometric measurement (body weight in kilogram, Body Mass Index BMI and waist circumference measured in centimetre) and also biochemistry profile (fasting blood glucose/sugar and serum lipids profile: Total Cholesterol TC, High density lipoprotein HDL, Low density lipoprotein LDL and Triglycerides TG) were measured one week pre and one week post intervention.

2.5 Anthropometric measurements

Body weight and height were measured with calibrated “seca” clinical scale while the participants wearing light clothing with barefoot. Standing body height was measured to the nearest 0.5 cm with their back against a wall-mounted stadiometer while body weight was measured to the nearest 0.1 kg.
c) BMI was calculated with formulae: weight in kilograms divided by height in meters squared (kg/m²). On the other hand, waist circumference was measured on the midpoint in between the inferior border of the lower ribs and the superior edge of iliac crest, during deep expiration. It was recorded in centimetre.

2.6 Serum Biochemistry Profile

A 6-millilitre blood sample obtained by venepuncture after an overnight fast (at least 6 hours). The samples collected were placed on ice, and sent to accredited laboratory for complete biochemical analyses which was being run on the similar day as the collection of blood sample.

2.7 Statistical Analysis

SPSS software version 20.0 was used to perform data analysis. The dependent variables including body weight, waist circumference, BMI, fasting total cholesterol, serum LDL, HDL, TG and fasting venous glucose. Descriptive statistic was employed to describe the socio-demographic component of the data. Normality was checked using Kolmogrov Smirnov normality test. All dependent variables were normally distributed and therefore analyzed with parametric test of paired t-test. Statistically significant level taken at p < 0.05 with 95% confidence interval (CI).

3.0 Results

Table 1: Demographic sand anthropometric characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>n (%)</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 30 years</td>
<td>13 (20.6%)</td>
<td>38.63(±9.31)</td>
</tr>
<tr>
<td>31 – 49 years</td>
<td>37 (58.7%)</td>
<td></td>
</tr>
<tr>
<td>&gt; 50 years</td>
<td>13 (20.6%)</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>9 (14.3%)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>54 (85.7%)</td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malay</td>
<td>52 (82.5%)</td>
<td></td>
</tr>
<tr>
<td>Chinese</td>
<td>2 (3.2%)</td>
<td></td>
</tr>
<tr>
<td>Indian</td>
<td>7 (11.1%)</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>2 (3.2%)</td>
<td></td>
</tr>
<tr>
<td>Height (cm)</td>
<td></td>
<td>157.10(±7.630)</td>
</tr>
<tr>
<td>BMI Category (kg/m²): Asian classification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overweight (23–27.49 kg/m²)</td>
<td>22 (34.9)</td>
<td></td>
</tr>
<tr>
<td>Obese (27.5 kg/m² and above)</td>
<td>42 (65.1)</td>
<td></td>
</tr>
</tbody>
</table>

Table 1 presents demographics and anthropometric characteristics of 63 participants with mean age of 38.6 years. Majority are female (85.7%) and Malay population (82.5%). By employing the Asian BMI classification, most participants were obese (BMI above 27.5 kg/m²) (65.1%), followed by overweighted (BMI 23-27.49 kg/m²) (34.9%).
Table 2: Changes on body composition and selected biochemistry parameters after 10 weeks of intervention

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pre</th>
<th>Post</th>
<th>Mean Difference</th>
<th>t value</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Body composition</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>75.5 ± 14.4</td>
<td>73.7 ± 13.6</td>
<td><strong>-1.8</strong> (1.10, 2.40)</td>
<td>5.363</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Body Mass Index (kg/m²)</td>
<td>30.5 ± 4.8</td>
<td>29.6 ± 4.5</td>
<td><strong>-0.9</strong> (0.43, 1.30)</td>
<td>3.991</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>WC, waist circumference(cm)</td>
<td>90.5 ± 10.6</td>
<td>90.6 ± 9.6</td>
<td>0.1 (-2.08, 1.84)</td>
<td>-0.120</td>
<td>0.905</td>
</tr>
<tr>
<td><strong>Biochemical Profile</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total cholesterol (mmol/L)</td>
<td>5.16 ± 0.9</td>
<td>5.00 ± 0.8</td>
<td><strong>-0.16</strong> (0.01, 0.31)</td>
<td>2.108</td>
<td>0.039</td>
</tr>
<tr>
<td>LDL (mmol/L)</td>
<td>3.27 ± 0.8</td>
<td>3.13 ± 0.7</td>
<td><strong>-0.13</strong> (-0.01, 0.27)</td>
<td>1.873</td>
<td>0.066</td>
</tr>
<tr>
<td>HDL (mmol/L)</td>
<td>1.31 ± 0.3</td>
<td>1.29 ± 0.3</td>
<td>-0.02 (-0.02, 0.06)</td>
<td>0.956</td>
<td>0.343</td>
</tr>
<tr>
<td>TG (mmol/L)</td>
<td>1.27 ± 0.7</td>
<td>1.25 ± 0.6</td>
<td><strong>-0.16</strong> (0.01, 0.31)</td>
<td>2.108</td>
<td>0.648</td>
</tr>
<tr>
<td>Fasting glucose (mmol/L)</td>
<td>5.20 ± 1.7</td>
<td>5.22 ± 1.7</td>
<td>0.02 (-0.23, 0.19)</td>
<td>-0.179</td>
<td>0.859</td>
</tr>
</tbody>
</table>

*Paired t-test
Values are Means ± SD [Mean change (95% CI)]

Paired t-test showed in present program that 10 weeks of High Intensity Interval Training induced a significant reduction in mean body weight 1.8 (95% CI: [1.1; 2.4], p<0.001, BMI 0.9 (95% CI: [0.4; 1.3] p< 0.001, and fasting serum cholesterol 0.16 (95% CI: [0.01; 0.31], p< 0.05. (refer Table 2).

Decline in mean body weight achieved 2.4%. BMI decreased by 3% and fasting total cholesterol reduced by 3.1%. However, Fasting serum LDL, HDL and TG reduced at mean difference of 0.13, 0.02 and 0.16 respectively although not statistically significant. In contrast, mean WC increased 0.1 cm (0.1%) while fasting serum glucose increased 0.02 (0.4%) among the participants.

4.0 Discussion

Present workplace obesity program employing HIIT workout, 3 times a week, 30 minutes each session for duration of ten weeks resulted a desirable significant changes in body weight, BMI and fasting total cholesterol among 63 obese and over weighed participants. However the minor reduction of these three parameters might due to short period of only 10 weeks. Previous studies showed that length of program influences outcome. Helgerud and Burgomaster conducted HIIT protocol for 2 weeks, 6 weeks and 8 weeks respectively, somehow only observed negligible weight loss (1%, 0.03%
and no changes ) (Helgerud et al., 2007; Burgomaster et al., 2008). Employing HIIT program at a longer duration of 20 minutes 3 times a week for 15 weeks, previous study observed a 1.9kg ( 3% ) lowering of body weight, as well as 3.5cm ( 4% ) lowering in waist circumference (Dunn, 2009). Adapting similar methodology, Tjønna examined 32 participants in a 16 weeks program, documented significant reduction in waist circumference at 7.2cm ( 7% ) (Tjønna et al., 2009). Our pre-post examination somehow observed a mean increase of waist circumference by 0.1cm ( 0.1% ). Waist circumference is an indicator of central obesity and directly associated with high cardio metabolic risk. It correlates with the distribution of visceral fat intra-abdominally as well as body fat which is related to age, gender and race (Klein et al., 2007). In current program we did not monitor total body fat and visceral fat percentage, although subcutaneous adipose tissue is best measured by gold standard of magnetic resonance imaging or computed tomography. Intra-abdominal fat mass deeply influenced by daily dietary patterns. This program-based project focused solely on physical activity and the extent of nutrition education was lacking. 43 studies were analysed in a meta-analysis and uncovered that an effective workplace weight-loss program actually targets on the combination of both physical activity and nutritional component (Verweij, Coffeng, van Mechelen & Proper, 2011).

On the other hand, HIIT has been demonstrated a positive impact on serum lipid. 1% reduction in Total Cholesterol (TC) and Low Density Lipoprotein (LDL) may reduce the risk of coronary artery disease by 2%, (Ouerghi et al., 2014). The relationship between HDL, LDL and Coronary Artery Disease are well described by Ansell and Lindhorst (Lindhorst, Young, Bagshaw, Hyland & Kisilevsky, 1997 ; Ansell et al., 2003). In present program, mean LDL only showed non-statistically significant and negligible reduction. Kishali et al concluded association between lipid profile and gender rather than physical activity and reported a lower range of LDL and higher range of HDL among the female group. This discrepancy of plasma lipid level highly associated with ethnicity, drug intake, smoking, alcohol consumption, dietary pattern, timing of blood drawn post exercise blood drawn as well as the environmental characteristics (Kishali, Imamoglu, Kaldirimci, Akyol & Yildirim, 2005). Data on social and drug history as well as environmental factors were not included in current program. In addition, our participants were not being categorized according to underlying medical illness such as diabetes mellitus, hyperlipidaemia, hypertension and other metabolic disorders therefore the discrepancy of the outcome values could have existed. On the other hand, mean HDL and TG pre-program were both falling within normal range therefore there was no significant changes after 10 weeks of HIIT.

Similarly, mean fasting glucose level pre and post program were both lies within normal range ( < 6.1 mmol/L ), although it was increased by only 0.4% after 10 weeks of HIIT workout. The normalization of fasting blood glucose depends on the intensity of workout as well as the program duration. Ren et al. documented a rise in GLUT 4 protein which facilitates glucose transport in skeletal muscle following HIIT workout and 2 weeks of regular HIIT with 90% of maximal capacity was observed to increase GLUT4 content in thigh muscle by 369% among participants with Type 2 Diabetes Mellitus (Ren, Semenovich, Gulve, Gao & Holloszy, 1994). Cellularity, Little et al evidently explained that the mitochondrial function was significantly improved after 2 weeks of HIIT due to the raise in citrate synthase activity. The optimal mitochondrial capacity is known to reduce insulin resistance (Little et al., 2011). However, in contrast to Little et al study, Karstoft et al found that 16 weeks of HIIT training ( 70% of maximal capacity ) among Type 2 Diabetes Mellitus participants did not rise in overall neither GLUT4 protein nor citrate synthase activity (Karstoft et al., 2014). This controversial finding might be due to lower intensity workout employed by Karstoft as well as late conducting of muscle biopsy ( 5-6 days after workout ). In present program, intensity of HIIT workout in term of percentage of maximum capacity as well as diabetes status of all subjects should be clearly identified, in order to compare its efficacy and outcome with other studies and consequently to yield a judicious conclusion. Nevertheless, our program held the nature of program
based design at workplace which may limit its comparison with other studies.

A few limitations of the present workplace obesity management program had been identified. Firstly, the short duration of the program without the combination of nutritional and behavioural approach. Secondly, our small sample size secondary to a dropout rate of 38% might have underpowered the intervention. Attrition in program with pre-post is common. Although the rule of thumb up to 20% of dropout is considered acceptable, literatures had reported the dropout in the obesity management that ranges varying from 10% to 80% depending on the setting and the types of program, with a mean attrition rate of more than 40% within the first 12 months (Colombo et al., 2014). Nevertheless, this was a workplace program rather than a study, with the main aim to examine its feasibility to be conducted as future workplace intervention hence sample size and program duration carried less value. Besides, factors like drug intake, alcohol consumption and underlying medical diseases may have influences on the dependent parameters measured in the program. Future programs are hence high recommended the involvement of cardiovascular fitness indicators such as body fat percentage and blood pressure, besides incorporating nutritional or dietary approach.

5.0 Conclusion

The present workplace weight management program had observed positive beneficial changes in mean body weight, BMI and fasting total cholesterol among the participants following 10 weeks of HIIT protocol. The program feasibility needs further evaluation and adjustment in view of the high dropout rate of 38%, in order to obtain full commitment and support from both employer and workers. Future program with extended duration besides incorporating the nutritional approach and well-structured behavioural-change support program, are highly recommended in order to ensure the efficacy as well as the sustainability of the overall program.

Acknowledgement

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Declaration

The authors declare that no conflicts of interest exist.
Authors’ contribution

Author 1: Heng Pei Pei (program design, data collection, data management and analysis, write up)
Author 2: Nur Izzati Tukiman (data management and analysis)
Author 3: Azra Abdul Aziz (data management and analysis)
Author 4: Lim Kuang Hock (data analysis and write up)
Author 5: Mohd Yusoff Adon (program supervision)

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