# THE EFFECTIVENESS OF WHATSAPP-BASED INTERVENTION AMONG OBESE PATIENTS WITH TYPE II DIABETES ATTENDING OUTPATIENT CLINICS, HOSPITAL USM

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## LISTS OF ABBREVIATIONS AND SYMBOLS

| | | |
|---|---|---|
| ANCOVA | Analysis of covariance | - |
| BMI | Body mass index | kg/m2 |
| BP | Blood pressure | mmHg |
| BW | Body weight | Kg |
| CG | Control group | - |
| CPG | Clinical Practice Guidelines | - |
| CVD | Cardiovascular disease | - |
| DBP | Diastolic blood pressure | mmHg |
| DM | Diabetes mellitus | - |
| FBS | Fasting blood sugar | mmol/L |
| FLP | Fasting lipid profile | mmol/L |
| HDL | High density lipoprotein | mmol/L |
| HPL | Hyperlipidaemia | mmol/L |
| HPT | Hypertension | mmHg |
| HUSM | Hospital Universiti Sains Malaysia | - |
| LDL | Low density lipoprotein | mmol/L |
| PA | Physical activity | - |
| RCT | Randomised Controlled Trial | - |
| SBP | Systolic blood pressure | mmHg |
| SPSS | Statistical Package for Social Science | - |
| TC | Total cholesterol | mmol/L |
| TG | Triglyceride | mmol/L |
| WC | Waist circumference | cm |
| WHO | World Health Organisation | - |

## ABSTRAK

**Pengenalan:** Kelaziman diabetes mellitus jenis 2 (T2DM) di seluruh dunia semakin meningkat, dengan kebanyakan individu yang mempunyai penyakit itu adalah berat badan berlebihan atau obes. Penurunan berat badan boleh mengurangkan morbiditi dan kematian berkaitan penyakit. Kajian ini bertujuan untuk menilai keberkesanan intervensi pengurangan berat badan menggunakan aplikasi pesanan sosial dalam kalangan pesakit obes dengan diabetes jenis 2.

**Metodologi:** Orang dewasa obes dengan T2DM berumur 18-60 tahun (n=100) adalah rawak ke dalam Kumpulan Intervensi (IG) dan Kumpulan Kawalan (CG) selama 3 bulan program. IG menerima program intervensi pengurangan berat badan melalui WhatsApp dan penjagaan standard, manakala CG menerima penjagaan standard sahaja. Bagaimanapun, hanya 89 peserta yang menamatkan program selama 3 bulan (IG; n=46 manakala CG; n=43). Hasil bagi tahap pengetahuan dan parameter fizikal diukur pada 0, 2 minggu dan 3 bulan program rawatan. Sementara itu, parameter biokimia diukur pada 0 dan 3 bulan program rawatan.

**Keputusan:** Terdapat perbezaan bersih yang ketara dalam IG berbanding CG yang diperhatikan untuk pengetahuan, BMI, WC, SBP, dan DBP pada 2 minggu dan 3 bulan dan FBS pada 3 bulan (semua $P < 0.01$). Profil lipid puasa bertambah baik dalam IG berbanding peserta CG, tetapi tidak ketara. Akibatnya, pengiraan perbezaan min telah dilakukan untuk keputusan yang ketara ini.

**Kesimpulan:** Program intervensi pengurangan berat badan berkesan dalam meningkatkan pengetahuan, BMI, WC, tekanan darah, dan kawalan glisemik. Pendidikan kesihatan melalui aplikasi pesanan sosial (WhatsApp) boleh digunakan dalam program penurunan berat badan.

## ABSTRACT

**Introduction:** The worldwide prevalence of type 2 diabetes mellitus (T2DM) is increasing, with most individuals with the disease being overweight or obese. Weight loss can reduce disease-related morbidity and mortality. This study aimed to evaluate the effectiveness of a weight reduction intervention using a social messaging application among obese patients with type 2 diabetes.

**Methodology:** Obese adults with T2DM aged 18-60years (n=100) were randomized into the Intervention Group (IG) and Control Group (CG) for 3 months program. The IG received the weight reduction intervention program through WhatsApp and the standard care, while the CG received the standard care only. However, only 89 participants completed 3 months program (IG; n=46; CG; n=43). The outcome for the level of knowledge and physical parameters were measured at 0, 2 weeks, and 3 months of the treatment program. Meanwhile, the biochemical parameters were measured at 0 and 3 months of the treatment program.

**Result:** There were significant net differences in the IG versus CG observed for knowledge, BMI, WC, SBP, and DBP at 2 weeks and 3 months and FBS at 3 months (all $P < 0.01$). Fasting lipid profiles improved more in IG than CG participants, but not significantly. Consequently, the mean difference was calculated for these significant results.

**Conclusion:** The weight reduction intervention program was effective in improving knowledge, BMI, WC, blood pressure, and glycaemic control. Health education through social messaging applications (WhatsApp) can be used in a weight reduction program.

# CHAPTER 1

# INTRODUCTION

## 1.1 Introduction

Malaysia has the highest rate of obesity and overweight among Asian countries, with 64% of males and 65% of the female population being either obese or overweight(1). Overweight and obesity are important risks of non-communicable diseases (NCDs) such as cardiovascular disease (CVD), hypertension, kidney diseases, type 2 diabetes mellitus (T2DM), malignancies, and conditions including sleep apnoea and osteoarthritis(2). Based on National Health and Morbidity Survey (NHMS) 2015, NCDs are estimated to account for 73% of all death in Malaysia(3). The obesity epidemic is driving the increased prevalence of type 2 diabetes mellitus (T2DM), and the vast majority of patients with T2DM are overweight or obese (4). In a meta-analysis of prospective cohort studies from the United States (US) and Europe, obese men had a sevenfold higher risk of developing T2DM, and obese women had a 12-fold higher risk, compared with individuals in the healthy weight range(5). Excess body weight is associated with the risk of cardiometabolic complications, which are major causes of morbidity and mortality in T2DM. Minimal reduction in weight, for example, 5% can improve patient outcomes, and may act for further changes to maintain weight loss until achieved targeted weight loss. In addition, weight loss will be beneficial in patients with T2DM, not only in terms of glycaemic control but also in other health benefits associated with complications of diabetes(6). There are many risk factors for overweight and obesity. Some risk factors can be modified, such as unhealthy lifestyle habits and environments. Unhealthy lifestyle habits such as lack of physical activity, unhealthy eating patterns, not enough sleep, and high amounts of stress can increase your risk for overweight and obesity.

Therefore, assessing patients' risk, establishing weight loss targets, providing patients with knowledge and treatment, and providing motivation and support to them will help to achieve weight loss and improve their health status.

Obesity is a chronic and lifestyle-related disease. It is better to prevent it at the primary care level. Most obese patients are well, they will not be seen in hospitals but rather seen for other complaints in primary care. There were many weight reduction intervention studies conducted in Malaysia among overweight and obese which involved various target groups. Obesity and T2DM are also closely related since obesity are the largest risk factor for developing T2DM. Most of the intervention involves lifestyle and behavioral intervention to achieve weight reduction. However, some interventions used surgical (bariatric surgery) or pharmacological to achieve weight reduction.

Satoshi et al, 2015 used short consultation as an intervention for weight reduction among patients attending outpatient clinics. However, the results showed no significant difference between the intervention and control groups(5). That study suggested an additional study on simple and easy-to-perform intervention methods in the primary care setting. Meanwhile, Rashidah et al, 2018 used a program called My Body Fabulous and Fit (My BFF) which consists of exercise, individual diet counselling, dietary modification, and self-monitoring tools for weight reduction intervention. The study showed a significant reduction in weight and blood pressure between the intervention and control groups. However, the challenges and limitations of this study are adherents to self-monitoring tools and behaviours.

Azmawati and Farrah et al (2015), evaluate the effectiveness of having internet-based intervention (obeseGO!) toward obesity among adolescents in Kuala Lumpur. This 3-months randomised controlled trial involved 47 students were assigned randomly to the

obeseGO! (intervention) group for internet-based intervention i.e., information on healthy lifestyle and diet were provided via the internet. However, there was no significant reduction in BMI, waist circumference, and the body fat percentage between the intervention and control groups. It is suggested that the size of the sample can be increased to observe a larger effect size in BMI, waist circumference and body fat percentage. They also suggested further research is required to measure the effectiveness of promoting and maintaining a healthy lifestyle and preventing obesity. Maybe the public health practitioner should collaborate with the Ministry of Education and the Malaysian Communication and Multimedia Commission for providing a strong internet-based intervention(7).

In other study, Cavallo et al (2020), examine the feasibility of a social media-based weight loss intervention among low-socioeconomics adults. They conducted a one-group pre-test and post-test pilot intervention study with two groups of low-socioeconomics overweight/obese adults who were enrolled in a 12-week social media-based weight loss intervention using private Facebook group. Overall, the results indicate social media groups as a platform for weight loss intervention delivery among low-socioeconomic adults are feasible and should be studied in larger randomized trials(8).

This study is designed to evaluate the effectiveness of an obesity intervention using social messaging applications among patients with type 2 diabetes. The WhatsApp based intervention is effective in changing lifestyle behaviours and prerequisite for changes in obesity indices and clinical metabolic parameters(9). The World Health Organization (WHO) has also recognized the importance of social resources as a valuable agents for behaviour change in health promotion(10).

# CHAPTER 2

# OBJECTIVES OF THE STUDY

## 2.1 General Objectives

1. To evaluate the effectiveness of a weight reduction intervention using a health belief model and social messaging application among obese patients with type 2 diabetes.

## 2.2 Specific Objectives

1. To compare the mean knowledge score on obesity among obese patients with type 2 diabetes at baseline, 2 weeks, and 3 months post-intervention between intervention and control groups.
2. To compare the mean change of physical parameters among obese patients with type 2 diabetes at baseline, 2 weeks, and 3 months post-intervention between intervention and control groups in terms of:
    i. Body mass index
    ii. Waist circumferences
    iii. Systolic and diastolic blood pressure
3. To compare the mean change of biochemical parameters among obese patients with type 2 diabetes at baseline and 3 months post-intervention between intervention and control groups in terms of:
    i. Fasting lipid profile (total cholesterol, high-density, low-density lipoprotein, and triglyceride
    ii. Fasting blood sugar

# CHAPTER 3

# MANUSCRIPT

## 3.1 TITLE: THE EFFECTIVENESS OF WHATSAPP-BASED INTERVENTION AMONG OBESE PATIENTS WITH TYPE II DIABETES ATTENDING OUTPATIENT CLINICS, HOSPITAL USM

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### 3.2 Abstract

**Introduction:** The worldwide prevalence of type 2 diabetes mellitus (T2DM) is increasing, with most individuals with the disease being overweight or obese. Weight loss can reduce disease-related morbidity and mortality. This study aimed to evaluate the effectiveness of a weight reduction intervention using a social messaging application among obese patients with type 2 diabetes.

**Methodology:** Obese adults with T2DM aged 18-60years (n=100) was randomized into Intervention Group (IG) and Control Group (CG) for a 3 months program. The IG received the weight reduction intervention program through WhatsApp and the standard care, while the CG received the standard care only. However, only 89 participants completed 3 months program (IG; n=46 meanwhile CG; n=43). The outcome for the level of knowledge and physical parameters were measured at 0, 2 weeks and 3 months of the treatment program. Meanwhile, the biochemical parameters were measured at 0 and 3 months of the treatment program.

**Result:** There were significant net differences in the IG versus CG observed for knowledge, BMI, WC, SBP, and DBP at 2 weeks and 3 months and FBS at 3 months (all $P < 0.01$). Fasting lipid profiles improved more in IG than CG participants, but not significantly. Consequently, the calculation of the mean difference was done for these significant results.

**Conclusion:** The weight reduction intervention program was effective in improving knowledge, BMI, WC, blood pressure, and glycaemic control. Health education through social messaging applications (WhatsApp) can be used in a weight reduction program.

**Keywords:** *obesity, diabetes, weight reduction, WhatsApp*

### 3.3 Introduction

Malaysia has the highest rate of obesity and overweight among Asian countries(1). Overweight and obesity are important risks of non-communicable diseases (NCDs) such as cardiovascular disease (CVD), hypertension, kidney diseases, type 2 diabetes mellitus (T2DM), malignancies, and conditions including sleep apnoea and osteoarthritis(2). Based on National Health and Morbidity Survey (NHMS) 2015, NCDs are estimated to account for 73% of all death in Malaysia(3). The obesity epidemic is driving the increased prevalence of type 2 diabetes mellitus (T2DM), and the vast majority of patients with T2DM are overweight or obese (4). Excess body weight is associated with the risk of cardiometabolic complications, which are major causes of morbidity and mortality in T2DM. Minimal reduction in weight, for example, 5% can improve patient outcomes. In addition, weight loss will be beneficial in patients with T2DM, not only in terms of glycaemic control but also in other health benefits associated with complications of diabetes(6). There are many risk factors for overweight and obesity. Some risk factors can be modified, such as unhealthy lifestyle habits and environments. Other risk factors, such as age, family history and genetics, race and ethnicity, and sex, cannot be modified. Unhealthy lifestyle habits such as lack of physical activity, unhealthy eating patterns, not enough sleep, and high amounts of stress can increase your risk for overweight and obesity.

Obesity is a chronic and lifestyle-related disease. It is better to prevent it at the primary care level. Most obese patients are well, they will not be seen in hospitals but rather seen for other complaints in primary care. There were many weight reduction intervention studies conducted in Malaysia among overweight and obese which involved various target groups. Obesity and T2DM are also closely related since obesity is the largest risk factor for developing T2DM. Most of the intervention involves lifestyle and

behavioral intervention to achieve weight reduction. However, some interventions used surgical (bariatric surgery) or pharmacological to achieve weight reduction.

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This study is designed to evaluate the effectiveness of an obesity intervention using social messaging applications among patients with type 2 diabetes. The app-based mobile intervention is effective in changing lifestyle behaviors, which is an essential prerequisite for changes in obesity indices and clinical metabolic parameters(9). The World Health Organization (WHO) has also recognized the importance of social resources as a valuable agents for behaviour change in health promotion(10).

### 3.4 Methodology

We conducted a randomized controlled trial to assess the effectiveness of the 12-week weight intervention program using social media applications (WhatsApp group) for obese patients with T2DM aged 18-60 years old. The Intervention Group (IG) received a weight intervention module using a narrated PowerPoint presentation, invited into a WhatsApp group, and standard care. The Control Group (CG) received only the standard care. The CG will receive the same program as IG after completion of the programs.

The research design was approved by the Human Ethical Committee of the School of Medical Sciences, University Sains Malaysia. We obtained written informed consent from all participants. Participants received no financial incentives.

#### 3.4.1 Recruitment and participants

Participants were recruited from obese patients with Type 2 diabetes mellitus that attend follow-up at the outpatient clinic, Hospital USM. Those eligible interested applicants were identified and approached. Inclusion criteria were age between 18 and 60 years old, having a BMI ≥27.5 kg/m2, and owning or having access to a smartphone. Exclusion criteria were unstable psychiatric disorders, medically unfit patients, and participation in other weight loss or other health-related programs during this intervention.

Recruitment was conducted from November 2020 to November 2021. We calculated sample size estimation for repeated measures with the command ‘sampsi’ done using STATA vs 9. The sample size was calculated based on the mean (SD) of WC. We found that 100 participants were needed to detect an effect size of 0.5 (medium effect) with 0.9 power ($\alpha = 0.05$).

### 3.4.2 Randomization, allocation, and blinding

Eligible participants were randomized into the IG or CG groups. They were allocated using computer-generated randomization in the block of four. Treatment was allocated by the first author; the process and methods of allocation were concealed from participants, who were blinded to differences among the programs. Participants in the CG were told they were assigned to the second round of the program and were asked to wait until that round started. It was impossible to blind the researchers to the treatment allocation, but the evaluators who measured BMI, waist circumference, and blood pressure were blinded.

### 3.4.3 Study tools

3.4.3.1. Narrated PowerPoint and WhatsApp-based intervention.

The weight intervention module was developed using the health belief model using narrated PowerPoint for group discussion and a social messaging application (WhatsApp group) as a medium. The content language was in Malay and included video education. The content in the module was reviewed by 3 experts in the field before utilization. The educational content is mostly adapted from the Clinical Practice Guidelines of Obesity and Type 2 Diabetes Mellitus.

The module explained the relationship between obesity and T2DM, the benefits of weight reduction and barriers to weight loss in obese patients with T2DM, and dietary, exercise, and behavioral therapy for weight loss. The weight intervention module was given through a group-based discussion consisting of 7-8 patients per session. The session took about 1 hour including a brief discussion session. After that, the social messaging application (WhatsApp group) was created. There were weekly updates on

WhatsApp groups which they received sharing education or videos regarding dietary intake, exercise recommendations, and behavioral modification that have been taken from the ministry of health website and ‘info sihat’. They were asked to share their weekly food and physical activity diary.

The researcher randomly chooses a day in a week for them to send their food diary (24-hour diet recall) and physical activity diary. The researcher also reviewed and commented on their diet and physical activity. The comments regarding food diary and physical activity were based on the guideline in the obesity module and using applications on calorie counting. These help them to understand their calorie intake and appropriate intensity of physical activity. They also send pictures of their plate of meals and exercise

3.4.3.2. Tools for assessment/data collection

i. Blood Pressure measurement (OMRON Digital Blood Pressure Device)

Omron digital BP device is a digital monitor that we used to measure BP. The participants must adequately rest before the BP measurement. During the procedure, the participants were seated with their arms supported at the heart level. The patients who were hypertensive and on the antihypertensive agent were asked to take medication as scheduled. All measurement was in mmHg. The BP measurement took at baseline, 2 weeks, and 3 months.

ii. OMRON body composition monitor (Model HBF-214-AP)

Omron body composition monitor shows our body weight, body composition measurement of body fat, skeletal muscle, visceral fat, and more. It measured body weight from 2 to 150kg with an increment of 0.1 kg. It also measured BMI from 2.5 to 90.0 with an increment of 0.1 and classified BMI into

4 levels; underweight (-), normal (0), overweight (+), and obese (++). The weight and BMI were measured at baseline, 2 weeks, and 3 months.

iii. Measuring tape (to measure waist circumference)

The measuring tape was used to measure the waist circumference. The measurements were taken at baseline, 2 weeks, and 3 months. During the measurement, the subjects were asked to stand with feet 25 to 30 cm apart while the arms hung on each side of the body. The measurement took at the end of a normal expiration. The measurement was done horizontally midpoint between the inferior margin of the last rib and the iliac crest. The measurement was rounded to the nearest centimeter.

iv. Fasting blood sugar and fasting lipid profile machine (ARCHITECT c8000)

This tool was used to measure fasting blood sugar (FBS) and fasting lipid profile (FLP) at baseline and 3 months post-intervention using a chemistry analyzer. For both tests, blood should be collected after an 8-hour fast (no food or drink, except plain water). Usually, about 2ml of blood was withdrawn from the patient's vein, kept in each plain and blood sugar tube, and sent to the lab for analysis. The FLP consists of a few components; total cholesterol, high-density lipoprotein, low-density lipoprotein, and triglyceride level. All measurements were reported in mmol/L.

v. Questionnaires to assess patients' knowledge

A questionnaire to assess the patient's knowledge of the health risks associated with obesity and diabetes was developed based on the content of the educational module. It was in Malay. There were 30 questions. The questionnaires were reviewed by 3 expert reviewers. The preliminary reliability testing was done among 50 patients with a chronic disease which resulted in Cronbach alpha values

of 0.78 indicating acceptable internal consistency. Reverse scoring was done for negative statements. A higher overall mark means better knowledge of the subject.

vi. Case report form

The case report form consists of socio-demographic data such as age, sex, race, marital status, occupation, current medical illness status, physical parameters (body weight, height, body mass index, waist circumferences, and blood pressure), blood parameters (fasting blood sugar and fasting lipid profile) and questionnaires on knowledge of obesity. The case report forms were completed and filled by the researchers or evaluators at the beginning, during and the end of the study. activities every week for the researcher to review or comment on.

### 3.4.4 Study procedures

Figure 1 shows the construction of the treatment programs. After the participants were recruited and randomized into intervention and control groups. They will be asked to respond to a set of questionnaires asking about their demographic details and the questionnaire on knowledge about obesity will be given to the patient. The questionnaire will take about 15 minutes to complete. The record shall be kept confidential and secure.

For both groups, weight, height, WC and BP were taken during the baseline assessment session. FBS and FLP investigations were taken and sent to a laboratory for analysis. They were arranged to come back in week 2 and month 3 for assessment of the knowledge, measurement of weight, WC, and, BP, and at 3 months for blood investigations; FBS, and FLP. The participants who were unable to attend follow-up at week 2 and month 3 were withdrawn from this study. The participant that withdraws from this study will not be replaced because of limited time.

3.4.4.1 Intervention Group (IG)

At the beginning of the 3-months program, IG was provided with a weight intervention module. They were arranged for a visit one week later where they received the treatment programs. After that, the social messaging application (WhatsApp group) was created. There were weekly updates on the WhatsApp group which they received sharing education or videos regarding dietary intake, exercise recommendations, and behavioral modification. They also shared their weekly food and physical activity diary using the WhatsApp group.

The participants who were not actively participating (less than 60% submission) in the WhatsApp group in sending their food diary or physical activity diary were identified and given advice for active participation. If the participants failed to do so, they were warned of the possibility of withdrawal from this study.

3.4.4.2. Control group (CG)

The control group received standard care. They received a standard current practice that has been widely used in our clinical setting. They have followed up according to the appointment that has been scheduled by the medical officers. During the clinic follow-up, they will be advised on a healthy diet and encouraged on physical activity suitable for their current condition.

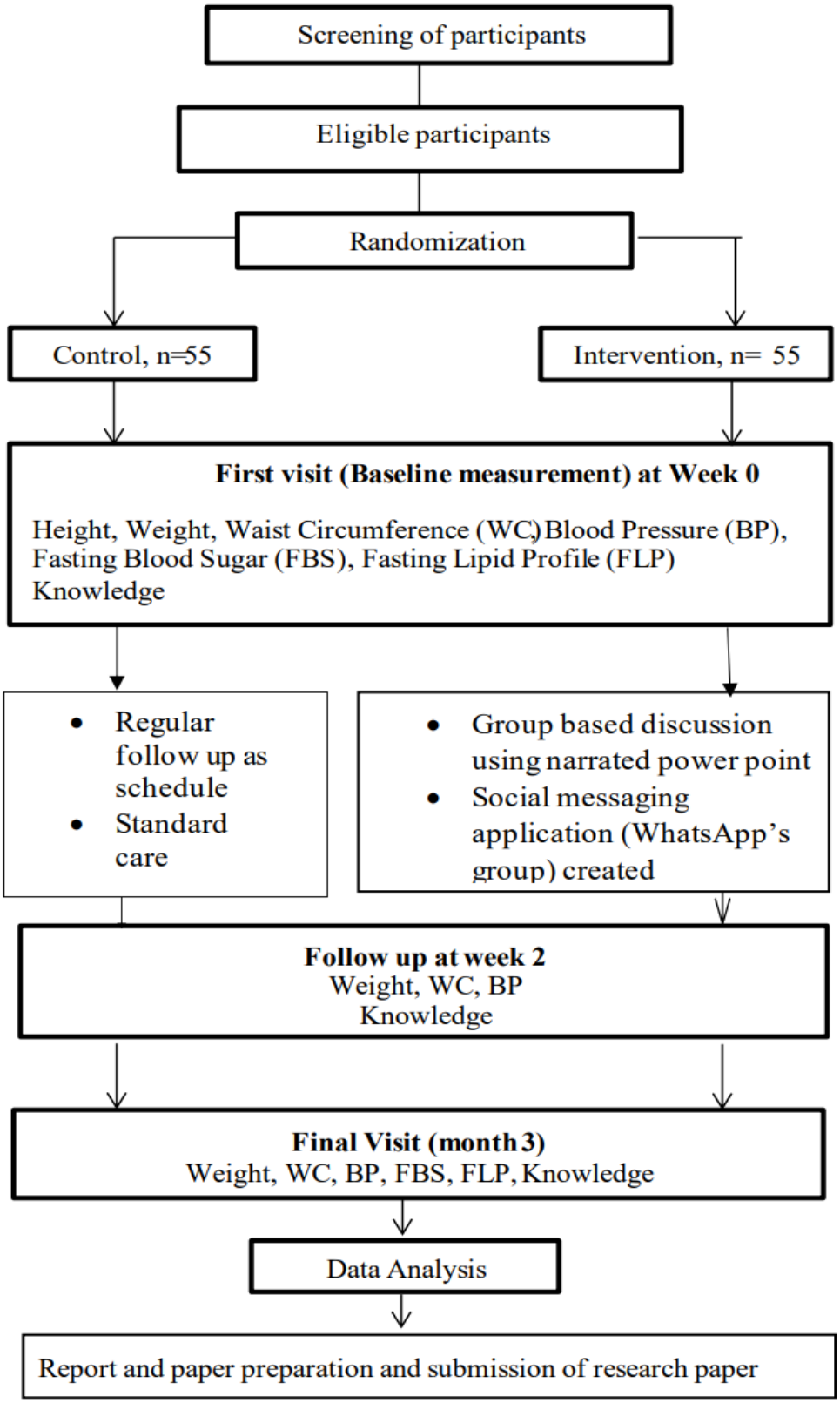


Figure 1: Study Flowchart

### 3.4.5 Statistical analyses

Differences in baseline data between groups were analyzed using one-way analysis of variance (ANOVA) for continuous variables, t-test and chi-square test.

We compared the group (intervention) effects using the principle of intention-to-treat (ITT). The analysis set consisted of participants in IG who received the allocated interventions and standard care and those in CG who received the standard care. A repeated measures ANOVA with a Greenhouse-Geisser determined the mean of BMI, WC, BP, FBS and FLP.

Post-hoc analyses using ANOVA were performed to see the mean difference between groups. Statistical analyses were performed using IBM SPSS version 27.0. Statistically significant was set at $P < 0.05$.

### 3.5 Results

One hundred participants were allocated across the two groups: 50 to IG, and 50 to CG. However, only eighty-nine participants completed the 3-month programs; n=46 in IG and n=43 in CG. 11 participants were dropout from this study. The reasons for not completing the study were 4 participants had medical problems not directed to having diabetes or to program participation, 3 participants were disinterested, and 4 participants were having conflict with work scheduled and unable to comply with WhatsApp based intervention.

Table 1 shows baseline sociodemographic of participants by treatment group. Of the 89 retained participants, average age was 51.02 (SD 7.9) years old and majority of the respondents were Malay with 92.1% respondents. In all, more than half of the respondents were female with 61.8% respondents, having highest education level of secondary school with 55.1% respondents and 57.3% respondents were working. Majority of the respondents with 44.9% respondents were having diabetes mellitus, hypertension and hyperlipidemia. There were no significant differences in characteristics at baseline between treatment groups.

Table 2 shows differences in changes from baseline to 12-week (3 months) based on a repeated-measures ANOVA with a Greenhouse-Geisser analysis. Table 3 shows post-hoc analysis of the ANCOVA. After the 12-week intervention program, a repeated-measures ANOVA with a Greenhouse-Geisser determined that mean knowledge differed statistically significantly between 2 weeks, and 3 months ($F(1.343, 116.850) = 143.993$, $p<.001$). The intervention group has a higher mean score of knowledge compared to the control group. The highest mean difference between the control and intervention groups is at 2 weeks with 4.43 of mean difference of knowledge. There is an increment in the knowledge for all periods.

Table 1: Baseline sociodemographic of participants

| Groups | All participants (n=89) | | IG (n=46) | | CG (n=43) | |
|---|---|---|---|---|---|---|
| Sociodemographic | Frequency | Percentage | Frequency | Percentage | Frequency | Percentage |
| **Gender** | | | | | | |
| Male | 34 | 38.2 | 16 | 18.0 | 18 | 20.2 |
| Female | 55 | 61.8 | 30 | 33.7 | 25 | 28.1 |
| **Race** | | | | | | |
| Malay | 82 | 92.1 | 42 | 47.2 | 40 | 44.9 |
| Chinese | 6 | 6.7 | 4 | 4.5 | 2 | 2.2 |
| Indian | 1 | 1.1 | 0 | 0 | 1 | 1.1 |
| **Education** | | | | | | |
| Primary school | 1 | 1.1 | 0 | 0 | 1 | 1.1 |
| Secondary school | 49 | 55.1 | 23 | 25.8 | 26 | 29.2 |
| Bachelor | 10 | 11.2 | 7 | 7.9 | 3 | 3.4 |
| Degree, Master, PHD | 26 | 29.2 | 16 | 18 | 10 | 11.2 |
| No education | 3 | 3.4 | 0 | 0 | 3 | 3.4 |
| **Marital Status** | | | | | | |
| Single | 6 | 6.7 | 3 | 3.4 | 3 | 3.4 |
| Married | 75 | 84.3 | 39 | 43.8 | 36 | 40.4 |
| Divorce | 2 | 2.2 | 2 | 2.2 | 0 | 0 |
| Widower | 6 | 6.7 | 2 | 2.2 | 4 | 4.5 |
| **Occupation** | | | | | | |
| Not working | 38 | 42.7 | 14 | 15.7 | 24 | 30 |
| Working | 51 | 57.3 | 32 | 36.0 | 19 | 21.3 |
| **Comorbidities** | | | | | | |
| DM | 12 | 13.5 | 7 | 7 | 5 | 5.7 |
| DM, HPT | 14 | 15.7 | 10 | 7.9 | 4 | 8.9 |
| DM, HPL | 10 | 11.2 | 8 | 9.0 | 2 | 8.0 |
| DM, IHD | 2 | 2.2 | 1 | 1.1 | 1 | 1.1 |
| DM, others | 1 | 1.1 | 0 | 0 | 1 | 0 |
| DM, HPT, HPL | 40 | 44.9 | 16 | 18 | 24 | 30.0 |
| DM, HPT, HPL, IHD | 4 | 4.5 | 2 | 2.2 | 2 | 2.2 |
| DM, HPT, HPL, Others | 6 | 6.7 | 2 | 2.2 | 4 | 4.5 |

Table 2: Comparison of mean score of parameters within-between the study groups at different time intervals.

| Parameters | n | Desc Mean (SE) | | | EMM (95% CI) | | | F stat | P values |
|---|---|---|---|---|---|---|---|---|---|
| | | 0 month | 2 weeks | 3 months | 0 month | 2 weeks | 3 months | | |
| Knowledge | | | | | | | | | |
| Control | 43 | 22.49 (.635) | 23.67 (.492) | 25.00 (.457) | 21.23-23.75 | 22.70-24.65 | 24.09-25.91 | 143.993 | <.001 |
| Intervention | 46 | 25.07 (.614) | 28.11 (.475) | 29.04 (.441) | 23.45-26.29 | 27.16-29.05 | 28.17-29.92 | | |
| BMI | | | | | | | | | |
| Control | 43 | 34.21 (.922) | 34.20 (.922) | 34.25 (.929) | 32.37-36.04 | 32.37-36.03 | 32.41-36.10 | 72.392 | <.001 |
| Intervention | 46 | 33.65 (.892) | 33.40 (.892) | 32.76 (.898)) | 31.88-35.42 | 31.62-35.17 | 30.97-34.54 | | |
| WC | | | | | | | | | |
| Control | 43 | 111.91 (2.001) | 111.94 (2.000) | 111.99 (2.004) | 107.93-115.88 | 107.97-115.92 | 108.00-115.97 | 49.158 | <.001 |
| Intervention | 46 | 111.23 (1.935) | 110.94 (1.934) | 109.72 (1.938) | 107.38-115.07 | 107.09-114.78 | 105.87-113.57 | | |
| SBP | | | | | | | | | |
| Control | 43 | 136.98 (2.249) | 136.30 (1.992) | 135.51 (1.725) | 132.51-141.45 | 132.34-140.26 | 132.08-138.94 | 23.900 | <.001 |
| Intervention | 46 | 135.26 (2.174) | 132.52 (1.926) | 128.74 (1.668) | 130.94-139.58 | 128.69-136.35 | 125.42-132.06 | | |
| DBP | | | | | | | | | |
| Control | 43 | 82.74 (1.253) | 82.23 (1.189) | 82.02 (1.037) | 80.25-85.23 | 79.87-84.60 | 79.96-84.09 | 30.547 | <.001 |
| Intervention | 46 | 86.35 (1.211) | 85.28 (1.150) | 81.35 (1.003) | 83.94-88.76 | 83.00-87.57 | 79.35-83.34 | | |
| | | Desc Mean (SE) | | | EMM (95% CI) | | | F stat | P value |
| Parameters | | 0 month | | 3 month | 0 month | | 3 month | | |
| FBS | | | | | | | | | |
| Control | 43 | 10.42 (.638) | | 10.28 (.575) | 9.15-11.69 | | 9.13-11.42 | 4.139 | .045 |
| Intervention | 46 | 11.03 (.617) | | 8.87 (.556) | 9.80-12.25 | | 7.76-9.97 | | |
| TC | | | | | | | | | |
| Control | 43 | 4.88 (.179) | | 5.13 (.167) | 4.53-5.24 | | 4.80-5.46 | 4.113 | .046 |
| Intervention | 46 | 5.30 (.173) | | 4.64 (.161) | 4.96-5.65 | | 4.32-4.96 | | |
| HDL | | | | | | | | | |
| Control | 43 | 1.20 (.039) | | 1.19 (.038) | 1.13-1.28 | | 1.11-1.26 | 4.517 | .036 |
| Intervention | 46 | 1.22 (.037) | | 1.15 (.036) | 1.14-1.29 | | 1.08-1.22 | | |
| LDL | | | | | | | | | |
| Control | 43 | 2.90 (.155) | | 3.17 (.150) | 2.59-3.21 | | 2.87-3.46 | 1.365 | .246 |
| Intervention | 46 | 3.25 (.150) | | 2.77 (.145) | 2.95-3.55 | | 2.48-3.05 | | |
| TG | | | | | | | | | |
| Control | 43 | 1.82 (.183) | | 1.89 (.158) | 1.46-2.18 | | 1.58-2.20 | 1.259 | .265 |
| Intervention | 46 | 1.92 (.177) | | 1.62 (.152) | 1.57-2.27 | | 1.32-1.92 | | |

The intervention group program was associated with significant decreases in BMI and WC at both 2 weeks and 3 months ($p<0.001$). For BMI, the highest mean difference between the intervention and control groups is at 3 months with a mean difference of -

1.50 where there is a reduction in BMI (Table 3). For WC, at 3 months, it has the highest mean difference of WC between intervention and control groups with a reduction of -2.27 (Table 3). The intervention group was differed statistically significant in reduction SBP and DBP at 0 month, 2 weeks and 3 months ($p<0.001$). In terms of the mean difference of SBP, there is the highest reduction of SBP at 3 months with -6.77. There is a reduction of SBP in all periods. Meanwhile, the mean difference of DBP, there is only a reduction of DBP at 3 months with -0.68 (Table 3).

Table 3: Comparison of mean difference of parameters within-between the study groups at different time intervals.

| Parameters | Period | Group | Mean (SE) | Mean Difference |
|---|---|---|---|---|
| Knowledge | 0 month | Intervention | 25.07 (.487) | 2.58 |
| | | Control | 22.49 (.750) | |
| | 2 weeks | Intervention | 28.11 (.285) | 4.43 |
| | | Control | 23.67 (.638) | |
| | 3 months | Intervention | 29.04 (.278) | 4.04 |
| | | Control | 25.00 (.586) | |
| Body mass index (BMI) | 0 month | Intervention | 33.65 (.759) | -.556 |
| | | Control | 34.21 (1.050) | |
| | 2 weeks | Intervention | 33.40 (.768) | -.80 |
| | | Control | 34.20 (1.042) | |
| | 3 months | Intervention | 32.76 (.773) | -1.50 |
| | | Control | 34.25 (1.05) | |
| Waist circumference (WC) | 0 month | Intervention | 111.23 (1.741) | -0.68 |
| | | Control | 111.91 (2.196) | |
| | 2 weeks | Intervention | 110.94 (1.743) | -1.01 |
| | | Control | 111.94 (2.193) | |
| | 3 months | Intervention | 109.72 (1.755) | -2.27 |
| | | Control | 111.99 (2.189) | |
| Systolic blood pressure (SBP) | 0 month | Intervention | 135.26 (2.015) | -1.72 |
| | | Control | 136.98 (2.412) | |
| | 2 weeks | Intervention | 132.52 (1.789) | -3.78 |
| | | Control | 136.30 (2.132) | |
| | 3 months | Intervention | 128.74 (1.494) | -6.77 |
| | | Control | 135.51 (1.899) | |
| Diastolic blood pressure (DBP) | 0 month | Intervention | 86.35 (1.227) | 3.60 |
| | | Control | 82.74 (1.235) | |
| | 2 weeks | Intervention | 85.28 (1.145) | 3.05 |
| | | Control | 82.23 (1.195) | |
| | 3 months | Intervention | 81.35 (1.018) | -0.68 |
| | | Control | 82.02 (1.021) | |

The intervention group program was associated with significant decreases in fasting blood sugar (FBS) at 3 months ($p<0.001$). In terms of the mean difference of

FBS, there is the highest reduction of FBS at 3 months with -1.41(Table 4). Both groups did not attain statistical significance of FLP reduction at 3 months. Thus, fasting lipid profiles (TC, HDL, LDL, and TG) did not differ statistically significantly in both groups at 3 months (P = .073) (Table 5).

Table 4: Comparison of mean difference of biochemical parameters; (FBS) within between the study groups at different time intervals.

| FBS Period | Group | Mean (SE) | Mean Difference |
|---|---|---|---|
| 0 month | Intervention | 11.03 (0.638) | 0.61 |
| | Control | 10.42 (0.614) | |
| 3 months | Intervention | 8.87 (0.523) | -1.41 |
| | Control | 10.28 (0.61) | |

Table 5: Comparison of mean difference of biochemical parameters; (FLP) within between the study groups at different time intervals.

| Parameters | Period | Group | Mean (SE) | Mean Difference |
|---|---|---|---|---|
| Total cholesterol (TC) | 0 month | Intervention | 5.30 (.180) | .421 |
| | | Control | 4.88 (.171) | |
| | 3 months | Intervention | 4.64 (.151) | -.493 |
| | | Control | 5.13 (1.16) | |
| High Density Lipoprotein (HDL) | 0 month | Intervention | 1.22 (.035) | .013 |
| | | Control | 1.20 (.041) | |
| | 3 months | Intervention | 1.15 (.035) | -.036 |
| | | Control | 1.19 (.039) | |

### 3.6 Discussion

We examined the effects of weight reduction intervention using social media applications compared to standard care practice for obese patients with T2DM. IG received 12-week treatment programs consist of weight reduction intervention module via narrated PowerPoint presentation and WhatsApp based intervention on weekly updates and sharing of dietary intake and physical activity. Meanwhile, the CG received standard care only. ITT analysis showed that participants in the IG differed statistically significant in knowledge ($p<0.001$) with highest mean differences 4.48 at week 2. Previous studies in Hulu Langat, Selangor, school-based intervention in adolescent participants reported similar knowledge outcome in the intervention groups (11). Other study in USA using social media-based (Facebook group) weight loss intervention for low socio-economics status also reported similar result in dietary knowledge after 12-week programs(12).

In this study, the IG showed reduction in BMI and WC after 12-weeks of treatment. Engagement with social media intervention components has been positively associated with increased weight loss(13). We found that videos and photos from sharing 24-hours diet recall and physical activity's video produced more reactions than links and text-only messages. Previous studies reveal that remote support by telephone is as effective as face-to-face support. The telephone facilitates extemporaneous communication as participants can ask questions regarding methods of behavioral change for weight loss (13).

According to Burke, self-monitoring tools such as diet and PA diaries helped overweight and obese individuals to reduce weight more effectively(14). Weight reduction may occur due to participants' awareness of being involved in an experimental trial; or due to the delivery of more intensive 'usual care' than would be encountered beyond the research context(15). However, the control group also showed improvements

even though not as much as the intervention group. Therefore, standard care during a clinic visit is sometimes beneficial in improving patient outcomes.

Previous research by Azmawati and Farrah et al (2015), evaluate the effectiveness of having internet-based intervention (obeseGO!) toward obesity among adolescents in Kuala Lumpur. The measurement of body mass index (BMI), waist circumference, and body fat percentage was taken at baseline and after 12 weeks of intervention. As the result, there was no significant reduction in BMI, waist circumference, and body fat percentage between the intervention and control groups. The effect sizes of the reduction were too small (0.09, 0.11, and 0.09 for BMI, waist circumference, and body fat percentage)(16).

This study also showed that social messaging applications improved participants' knowledge regarding their disease. Thus, give awareness to them to change. The WHO has also recognized the importance of social resources as valuable agents or behaviour change in health promotion. Social resources are translated at the community level as the support provided by significant others such as family, partners, and peers, in the form of information, material aid, and encouragement(17). The use of social media has been proposed as a platform to deliver weight-loss interventions to influence behaviour change to tackle obesity(18).

Since the study was done during the COVID-19 pandemic, follow-up participants using social messaging applications was very beneficial. Social media has been widely used for health-related purposes, especially during the COVID-19 pandemic. Previous reviews have summarized social media uses for specific health purposes such as health interventions, health campaigns, medical education, and disease outbreak surveillance(19).