American Journal of Psychology and Behavioral Sciences
2017; 4(3): 10-19
http://www.openscienceonline.com/journal/ajpbs
ISSN: 2381-5957 (Print); ISSN: 2381-5965 (Online)

Open Science

The Efficacy of a Competition Intervention to Promote Walking in Low-Active Adults: A Single Blind Randomized Control Trial

Fatmawati*, Andrew Prestwich, Bianca Sykes-Muskett

School of Psychology, University of Leeds, Leeds, United Kingdom

Email address

fatmawati@ar-raniryacid (Fatmawati)

*Corresponding author

To cite this article

Fatmawati, Andrew Prestwich, Bianca Sykes-Muskett. The Efficacy of a Competition Intervention to Promote Walking in Low-Active Adults: A Single Blind Randomized Control Trial. *American Journal of Psychology and Behavioral Sciences*. Vol. 4, No. 3, 2017, pp. 10-19.

Received: April 13, 2017; **Accepted**: May 16, 2017; **Published**: August 2, 2017

Abstract

Physical inactivity might increase the risk of non-communicable diseases (NCDs), particularly among individuals who are unable to reach the minimum standard recommended for good health. Therefore, the objective of this study was to examine the efficacy of a competition intervention to promote walking in adults who were classified as low active. A single-blind randomised control trial was adopted as the study design. Participants were randomly assigned into one of two groups (control and competition group), where each group consisted of 16 participants. All participants were required to try to achieve 10,000 steps per day during the whole study period (2 weeks). For the competition group only, the participants played in the 'Steps Tournament' and received a league table everyday during the second phase of the study (1 week). A validated pedometer was used to measure the number of steps. The results demonstrated that the participants within the competition condition showed a greater number of non-adjusted and adjusted steps compared to the participants in control condition. The findings supported the previous evidence that competition intervention is effective for increasing the physical activity in the low-active populations. For future study, specific criteria of participants need to be considered, especially age and gender. Besides, longer study period and adding health measurements would also beneficial.

Keywords

Walking, Competition, Low-Active Adults

1. Introduction

Insufficient physical activity may lead people to the risk of having non-communicable diseases (NCDs) [1]-[3]. This fact has been clarified in many public health researches, for instance a previous study conducted mentioned that 5.3% of the 57 million deaths occurred in 2008 were due to physical inactivity which caused coronary heart diseases, stroke, cancer, and type 2 diabetes [4]. In the UK alone, UK analysis of the Global Burden of Diseases found that low physical activity contributes to the greater prevalence of premature death, and this spent government financial cost as much as £900 million in 2009-2010 [5].

The standard health recommendation suggests that adults should spend 150 minutes per week for moderate physical activity [6]. However, from statistical data, 1 in 4 adults is not active physically and more than 80% of adolescent population is insufficiently physically active in the world [6]. In England, health survey discovered that only 6% of men population and 4% of women population met the standard health recommendation for physical activity, and unfortunately, those who low-active have been predicted to face premature death three until five years earlier [7].

Physical inactivity is caused by several factors, such as passive modes of transportation, high pollution, and lack of sport facilities [6]. Therefore, in order to increase the percentage of people meeting the good health requirement, the professional health practitioner are trying to promote several forms of affordable exercise, including walking [8]-[9]. As the results, hopefully, if all people in England are active, all the cause of premature deaths –involving 6,735

cases of breast cancer, 4,719 cases of colorectal cancer, and 294,730 cases of diabetes –can be prevented [7].

Walking has been found to be the most favorite physical activity in the world as it is free and associated with fewer physical injury compared to other types of exercise [10]. Furthermore, walking also suitable for all ages, including children and elderly people (only 4% of people in the world who need help to walk or cannot walk at all) [11]-[12]. For health benefits, walking is called as "amazing exercise" as it contributes for many physical and psychological advantages [7]. According to National Health System (NHS), walking minimum 10,000 steps per day can burn 400 calories, so it will be very helpful for people with obesity [14]. However, the prevalence of walking has declined significantly, in the UK, its percentage has decreased from 62% to 50% between 1989 and 2004 [13].

1.1. The Role of Theory on Behaviour Change Intervention

The health advantages from regular physical activity are well-established and undoubted, yet more than half people fail to meet the standard recommendation guidelines [1], [2], [3], [14]. This might be occurred because the initiation and maintenance of physical activity are influenced by several factors, including psychological, social, and environment issues [15], thus, comprehending these causes is a very important strategy in order to improve the intervention effectiveness [16]. Intervention aiming to change health-related behaviour is complex and challenging as it contains many components which are related to one another [17], however, it may contribute to the positive outcomes through facilitating people with a set of techniques that lead to the behaviour change [18], [19].

Several meta-analyses and systematic reviews have been performed in order to identify the potential ingredients which add to an effective intervention [20]. Currently, a meta-analysis with meta-regression method discovered that the combination between self-monitoring and self-regulation (goal review) was associated with the intervention effectiveness [17]. Moreover, a recent systematic review also mentioned that more than 20 behaviour change techniques are effective for changing health-related behaviour, including social support, prompt rewards, and self-monitoring [21]. Hence, these can be understood that behaviour change techniques which are supported by strong theoretical basic may help establish the applicable and appropriate intervention design.

1.2. Competitive Intervention

Lack of motivation is one of the internal barriers which inhibit people from increasing their daily steps. In accordance with a research finding, the basic way to improve motivation in physical activity is by setting-up the realistic goals, in which people can see and monitor their progress towards the goals that have been formulated [22]. Moreover, competition is also effective to be applied as it may increase the tendency to achieve the goal when people are put in the competitive situation [23].

Currently, competition has broadly used as one of the interventions for physical activity because this approach may increase people's motivation. A study with incorporating an interactive computer game named Fish'and'Steps was conducted to encourage people to be more physically active [24]. The results showed that the competition situation improved the participants' motivation to increase their steps, however, the incentives were provided for those who won the competition. Then, a research which integrated competition intervention to improve the physical activity level was also performed [25]. The results indicated that by performing the steps contest, the participants within competition group successfully achieved 1,000 steps higher compared to control group with the difference reached 10%, but the incentives also offered for the participants who won the contest which might signify that the increase in step numbers was due to the prizes given. Therefore, the efficacy of non-incentives competition intervention would be beneficial to be explored.

Elaboration on the literatures have clearly supported the importance of competition intervention to improve physical activity among adults, however, there are still limited sources which particularly investigate its usefulness of competition intervention on walking behaviour. Therefore, the primary objective of this study was to examine the efficacy of a competition intervention to promote walking in adults who were classified as low active. In order to explore this objective, the hypothesis that would be proposed was "the competition intervention group would significantly increase the average number of pedometer steps per day relative to a control group".

2. Methods

2.1. Participants

In order to take part in the study, each participant had to meet the inclusion criteria that have been decided, such as: (1) be low active, (2) age ranged from 18-65 years old, (3) have sufficient English language, (4) have access with the internet at home, and (5) have a camera for taking the pedometer picture. Besides, as this study was aimed to increase the steps and might cause the change in activity level, therefore, the participants who were pregnant or breastfeeding, and had medical problems which may influence the attempt to increase physical activity level, were ineligible to participate. The participants who have participated in the previous 'Activity Census' study in the School of Psychology, were also excluded to minimize the contamination.

2.2 Measures

The outcome of this study was numbers of pedometer steps that were achieved per day during the whole study period, where the comparison between the two periods (baseline and intervention) would indicate the efficacy of the

competition intervention. The steps were measured by pedometer The Yamax (Yamasa) Power-Walker LITE PZ 270. This Power-Walker Pedometer series has been found to be valid [26] and successfully used for physical activity intervention [27].

Furthermore, for testing the participants' activity level, a screening questionnaire called the International Physical Activity Questionnaire (IPAQ) was administered. This measure asked several questions about the time they have spent for doing any physical activities in the last 7 days and some studies have proved this measure to be valid for measuring habitual physical activity [28]-[30]. The participants would be eligible if they reported vigorous-intensity physical activity with less than 3 days (no more than 20 minutes per day), moderate-intensity physical activity or walking with less than 5 days (no more than 30 minutes per day), or the combination of those activities (vigorous, moderate, and walking) with less than 5 days (total METs/Metabolic Equivalent Tasks-minutes per week no more than 3,000). These criteria enabled them to be classed as 'low and moderate activity level' based on the Guidelines for Data Processing and Analysis of the IPAQ [31].

Figure 1. *The Yamax (Yamasa) Power-Walker LITE PZ 270 Pedometer.*

2.3. Procedures

2.3.1. Screening

Before participating, all participants who expressed their interest were screened by asking them to fill in the screening questionnaire. It contained the questions regarding the inclusion and exclusion criteria, as well as the IPAQ for assessing their physical activity level. If they were ineligible, the researcher would send an email that thanked them for the time and explained them that they did not meet the criteria based on the answers provided in the questionnaire. However, if the participants met the criteria, they would be invited to the School of Psychology at the University of Leeds to attend 3 testing sessions, where each session was 8 days apart.

2.3.2. Session 1

Session 1 was organized by asking the participants to sign up via the doodle poll link. A day prior to this session, a reminder e-mail was sent out for the participants who had the testing session on the following day. On the testing date, the researcher met the participants at the foyer and brought them to the laboratory. After that, the participants were given a sheet contained the information about the study and allowed them to ask several questions. Once everything was clear, they were asked to sign the informed consent and provide the demographic data (age, gender, and occupation). After that, the participants were fitted with a pedometer, they were not required to press any button from this equipment. They were instructed to fasten the pedometer to belt or waistband, wear it during waking hour, and take it out during showering or swimming as it is not waterproof. The participants were also informed how to open the pedometer, so they could check their total steps per day and told them that it would reset automatically at 2 am everyday.

At the end of this session, the participants were asked to book the time for the next testing day which was exactly one week later and remind them that an e-mail would be sent a day before that occasion. They were also welcomed to ask any further inquiries regarding the tools through the study e-mail. Lastly, the researcher brought them back to the foyer and thanked them for the time.

2.3.3. Between Session 1 and 2

During this time, the participants were required to wear the pedometer all the time for one week. Average daily steps were then calculated over the 7 days as the baseline data.

2.3.4. Session 2

A week after the first meeting, the participants returned to the School of Psychology for attending the second testing session. A reminder e-mail was sent 24 hours before this phase for those participants who came on the following day. The researcher waited at the foyer and took them to the laboratory. On arrival, a chance for asking questions was given if they faced any problems during the previous week. After that, the participants were asked to hand in their pedometer and researcher recorded their steps on the separate sheet, then the pedometer reset. The researcher gave back the pedometer and they were randomized into one of two conditions. After that, an additional information sheet was given which contained the task that they needed to do on the next week during the intervention period, based on the group they were assigned to. For the intervention group only, the participants were required to provide the username for league table.

Before this session finished, the participants were asked to arrange the time for the third session. At the end, the researcher thanked them for the time and brought them back to the foyer.

2.3.5. Between Session 2 and 3

Seven days during this period, the participants were required to achieve 10,000 steps per day and sent the photo

of their daily pedometer reading to study e-mail before midnight. The researcher also sent a reminder email and recorded the steps based on the pedometer photo received every day. Throughout this intervention phase, the competition group received a league table on each day which displayed their current position relative to other participants in the league; this was sent via study e-mail every morning before 10 am. Average daily steps then taken as the intervention data over the 7 full days.

2.3.6. Session 3

A reminder e-mail was sent out a day before the participants attended this session. When they arrived at the foyer, the researcher then brought them to the laboratory and asked them if they had any problems within the last seven days. After that, the pedometer was collected. In the same time, their daily steps during the intervention week were recorded on the separate sheet. When everything done, participants were paid either £15 LoveToShop vouchers or were awarded with 6 participant pool credits, depending on their request, then signed the payment receipt. Before leaving the laboratory, participants were informed that they would be debriefed by e-mail after data collection process completed. Lastly, the researcher accompanied the participants to the foyer and thanked them for taking part in the study.

2.4. Interventions

This study involved two groups, where participants were equally assigned into each group.

2.4.1. Condition 0: Control Group

Participants within this group were asked to achieve 10,000 steps per day and send their daily pedometer reading to study e-mail on each day before midnight. An e-mail was also sent every day during afternoon to remind the participants for sending their pedometer picture.

2.4.2. Condition 0: Competition Group

The same task was also enforced in the competition group, where the participants were required to try to achieve 10,000 steps every day and e-mailed the photo of their pedometer reading before 12 midnight. The researcher sent a daily reminder e-mail during afternoon to ensure the participants remembered for sending the picture of their pedometer.

As an additional task, the participants within this group were also informed that they would compete with other participants in 'Steps Tournament'. Because the intervention period lasted for 7 full days, thus eight participants were included in every steps match. This gave an opportunity for each participant to compete with different person on each day.

However, since the participants booked the time differently for each session, therefore the study was run more than one time which might cause fewer participants participated within the 'Steps Tournament'. Hence, to fulfil this empty slot, the fake participants with the fake pedometer readings were then created. The steps numbers for fake participants were randomly generated from 9,000-11,000 in order to maintain the study objective.

At the end of each day, the step and league table was constructed with the player names displayed were based on the username chosen by the participants. The calculation of this league table was similar to football league table, in which if the participants were within 500 steps of each other, they were given 1 point and counted as a draw. However, if they were not within 500 steps of each other, the participants who got the lowest steps were received 0 point, whereas the participants who reached the highest steps received 3 points and awarded as the winner.

The league table was e-mailed in an excel document every morning before 10 am. This aimed to show the current position of each participant relative to others, so indirectly they were encouraged to achieve more steps than their opponent on the next day. At the end of the intervention week, the participants would see who the winner in the 'Steps Tournament' was. Within this table, the participants might also view their total steps during one week as well as the total number of their opponent steps. At the last two columns, they would find the total points and the average steps they achieved per day within the 7 whole days. The participants who gained the same points would be ranked according to the total steps they had reached. To remain it anonymous, the league table was e-mailed using 'Blind Carbon Copy/BCC' to all participants, so they could not recognize each other.

2.5. Statistical Methods

All the analysis processes within this study were conducted by using IBM Statistics version 22. In order to represent the statistically significant effect for all the results, an alpha level of 0.05 was used.

The analyses performed were divided into three procedures, namely preliminary, main, and ancillary analyses. Preliminary analyses involved several statistical tests, such Multivariate Analysis of Variance (MANOVA) for testing whether each group was equal in age and baseline average steps (non-adjusted and adjusted steps); Chi-Square analysis for comparing the group differences in gender and occupation; and Z-score analysis for checking the outliers (outside the range -3 to +3).

In the main and ancillary analyses, an Analysis of Covariance (ANCOVA) was carried out to test the effect of the competition intervention on participants' average steps (non-adjusted and adjusted) during the intervention period, where condition was inputted as the independent variable and baseline steps (non-adjusted and adjusted) were entered as the covariate.

3. Results

3.1. Participants Flowchart

Below is the figure which shows participant flow through the stages of randomized control trial.

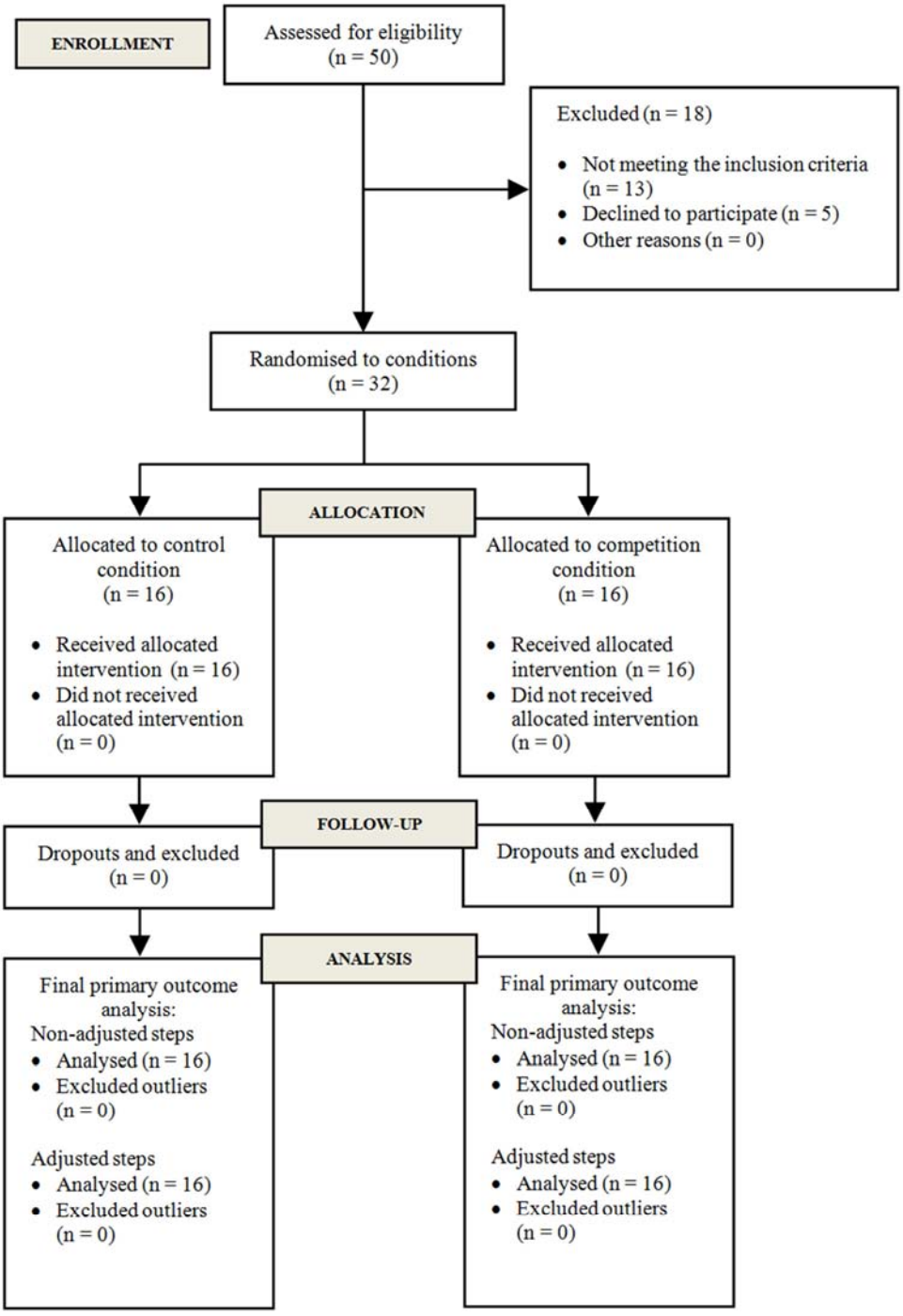

Figure 2. *A Diagram to illustrate participant flow through the study.*

3.2. Preliminary Analyses

Baseline characteristics of the participants for each group are shown in the Table 1. A Chi-Square analysis revealed that there were no significant differences between two conditions in term of gender, $\chi^2(1) = .82$, $p = .37$, and occupation, $\chi^2(1) = .00$, $p = 1.00$. The participants in control and competition groups were dominated by female (81.25%) and university student (75%), with small proportion of male (18.75%) and university employee (25%).

However, a MANOVA using Pillai's trace indicated the marginally significant differences in age and primary outcome (non-adjusted steps and adjusted steps) variables across the two conditions, $V = .43$, $F(8, 23) = 2.19$, $p = .07$. From the separate univariate ANOVAs, those variables included age, $F(1, 30) = .02$, $p = .89$, non-adjusted steps, $F(1, 30) = .00$, $p = .32$, adjusted steps, $F(1, 30) = 1.01$, $p = .96$, were found to be not significant. The results from Z-score analysis using the criterion of $-3 < Z_{score} < 3$ discovered that none of the scores from primary and secondary outcomes were identified as outlier. Therefore, all data were included in the main analyses.

Table 1. *Baseline Characteristics of the Participants.*

Characteristics	Control Condition (n = 16) n (%)/ Mean (SD)	Competition Condition (n = 16) n (%)/ Mean (SD)	*p*-value
Gender			
Male	2 (6.25%)	4 (12.5%)	.37
Female	14 (43.75%)	12 (37.5%)	
Occupation			
Student	12 (37.5%)	12 (37.5%)	
University Employee	4 (12.5%)	4 (12.5%)	1
Other	-	-	
Age	27.69 (9.45)	28.19 (10.02)	.89
Steps Non-Adjusted Steps	6,643.61 (2,417.81)	5,757.16 (2,574.37)	.32
Adjusted Steps	7,122.14 (2,466.77)	7,192.69 (4,272.90)	.96

3.3. Main Analyses (The Change in Average Steps)

The calculation of average steps was divided into two forms, namely non-adjusted and adjusted steps. Non-adjusted steps were accumulated from the average number of steps achieved by the participants without any adjustments with the time when the pedometer was not worn, whereas the steps that were adjusted with the pedometer non-wear time were considered as adjusted steps.

Before performing an ANCOVA to identify the efficacy of the competition on the average steps during the intervention period, descriptive statistics were carried out to investigate any possible tendencies in the data. The table 2 displayed below gave an indication that both groups increased either non-adjusted or adjusted steps from baseline to intervention period. Therefore, the use of an ANCOVA as the further analysis was supported in order to determine a statistically significant difference between control and competition group on the average steps during the intervention period after controlling for baseline average steps.

Table 2. *Means and Standard Deviations of Non-Adjusted and Adjusted Steps at Baseline and Intervention Period for Control and Competition Group.*

Condition	Non-Adjusted Steps		Adjusted Steps	
	Baseline Mean (SD)	Intervention Mean (SD)	Baseline Mean (SD)	Intervention Mean (SD)
Control	6,643.61 (2,417.81)	7,054.70 (3,470.43)	7,122.14 (2,466.77)	7,359.46 (3,381.88)
Competition	5,757.16 (2,574.37)	8,810.99 (3,553.52)	7,192.69 (4,272.90)	1,0330.10 (4,968.97)

The test of between-subjects effects in ANCOVA revealed that there was a marginally significant effect of the condition on the non-adjusted steps during the intervention period after controlling for baseline non-adjusted steps, $F(1, 28) = 4.19$, $p = .05$. Furthermore, the results from ANCOVA also found a marginally significant effect of the condition on the adjusted steps during the intervention period after controlling for baseline adjusted steps, $F(1, 28) = 3.82$, $p = .06$. From the descriptive statistics, it could be comprehended that the effect of the condition on the average steps was due to participants in the competition group increased both non-adjusted and adjusted steps relative to control group during the intervention period.

3.4. Ancillary Analyses

This study conducted the sensitivity analyses in order to assess the extent to which results are affected if certain participants were excluded. For this reason, the participants who exceeded the average of 10,000 steps during baseline period were not included in the ancillary analyses. Therefore, 2 participants were removed in the baseline non-adjusted steps, and 5 participants were also omitted in the baseline adjusted steps.

After excluding those participants, the results from ANCOVA found the significant effect of the condition on non-adjusted steps, $F(1, 26) = 5.41$, $p = .03$, and adjusted steps, $F(1,23) = 7.54$, $p = .01$, in the intervention period after accounting for baseline non-adjusted and adjusted steps. From these results, it could be concluded that through sensitivity analyses, the effect of the condition on non-adjusted and adjusted steps became more significant, in which the competition group significantly increased their average steps relative to control group during the intervention period.

4. Discussion

The objective of this study was to investigate the efficacy of the competition intervention to promote walking among low-active adults. ANCOVA found that competition contributed to a marginally significant effect on the average steps (non-adjusted and adjusted steps) during intervention period when baseline average steps were entered as covariates. However, when sensitivity analyses were performed by excluding certain participants who achieved more than 10,000 steps, the significant effect generated by the competition intervention on the average steps changed from marginally significant to statistically significant. This inferred that the hypothesis was partially supported as the significant effect only discovered through the sensitivity

analyses. Furthermore, by conducting this ancillary analysis, it also supported a further explanation that the competition intervention is effective to increase step count among people who are categorized as low active.

The descriptive statistics of average steps showed that the participants within competition and control group increased their step numbers from baseline to intervention period, with the amount ranged from 411-3,053 for non-adjusted steps and 237-3,138 for adjusted steps. This implies that the use of pedometer has given a contribution in increasing steps. As previously discovered in several research findings that pedometer is an evidence-based device which is powerful to increase the moderate-to-vigorous intensity physical activity (MVPA) [32], [33]. Besides, as it provides a feedback on number of steps achieved in daily basis, a pedometer also becomes an effective tool that can encourage people to improve their step everyday [34], [35].

A recent systematic review stated that the pedometer is rarely used as the only measure in physical activity; incorporating it with other additional components –such as group competition– might strengthen the outcomes of health promotion [36]. This is consistent with the outcome of this current study which aimed to investigate the efficacy of competition intervention on promoting walking behaviour by utilizing a pedometer as the objective measure.

The results derived from this present study support the literatures which have previously investigated the effectiveness of the competition in improving physical activity level. Some research findings mentioned that game-based intervention is effective for assisting people to establish a social competition atmosphere which motivates them to increase step numbers [37]. Consistent with this, a study which conducted a step contest also found similar result [25]. The participant who received the intervention increased as much as 1,000 steps or equivalent to 10% increase relative to control group. Therefore, this current study also contributes to the literature as competition intervention was identified to be effective in promoting walking.

5. Study Limitations and Strengths

This current study suffered from several limitations. Firstly, most of the participants were female with the percentage reached 81.25%, which means that the results are not representative for wider population in terms of gender. Another limitation is the participants were mostly students with an average age of 27 years old, meaning that the results also cannot be generalized into adult population as a whole. Additionally, the length of this present study was also very short and no follow-up data were carried out. Finally, no health measures were included before and after the intervention was given, thus the specific health benefits among the participants are unidentified.

In spite of those limitations, this study also has numerous aspects that contribute to its strengths. The most important point is no additional financial incentives offered for the participants in the competition group, except the £15 LoveToShop vouchers or 6 pool credits which was given to all participants after completing the study. This strategy was used in order to avoid the participants from valuing the incentives as the main motivator for increasing their activity level. For instance, based on the previous research finding, competition group successfully increased their steps as much as 1,000 steps compared to control group, and this might be due to the prizes provided for the winning team [25]. Furthermore, the incentives might also decrease the intrinsic motivation [44], thus, the competition element involved in this present study is accurate and valid as the contribution of any other components, such as incentives were removed.

In terms of feedback, this study constructed the league table which was sent in daily basis, so the participants in competition group could view their position relative to others. League table is one of the feedback elements that commonly used as a nudge-type in promoting physical activity. A study described the use of web-based nudging system named The Physical Activity Loyalty Card Scheme to promote healthy and positive behaviour change; this system is useful in providing the information which enable people to monitor their current physical activity level [45]. Therefore, the league table is worthwhile for encouraging people to improve their walking activity through comparing their step numbers with others.

6. Conclusions and Implications

The results from this present study support the preliminary evidence regarding the effectiveness of competition intervention to promote walking among low-active adults. As this study did not add any external components to increase the efficacy of the competition (financial incentives); thus, it can be said that the increase of steps number among the competition group was due to the intervention itself. Therefore, the findings from this study have the important implications as they can be integrated with health treatment programmes, such as obesity, heart disease, diabetes, or cancer treatment [46]-[48], which may give the contributions in reducing government budgets due to issues caused by physical inactivity.

Recommendations

Future research needs to elaborate on the participants' specific criteria, such as gender and age. A previous research successfully delivered the pedometer-based walking program among men who were interested to regain fitness and lose weight [38]. Within that program, most of male viewed the pedometer as an indisputable technology, which could increase their motivation as well as self-competition. Furthermore, there are several studies that also highlight the importance of physical activity intervention for male. Some findings clearly mentioned that men prioritized work over physical activity due to community context that forced them to fulfil their role as father and community member [39].

This becomes the barriers for men to be more physically active and the intervention targeted to improve this behaviour might be quite useful. Therefore, it may be worthwhile to recruit the equivalent number of female and male in order to gain more comprehensive results in the future intervention. Besides, previous study also discovered that the exercise interventions targeted at improving physical functioning among older adults who had low muscle power were safe and effective [40]. Another study also found that walking intervention was efficient to increase step counts and improve psychological well-being, such as depression and cognitive function amongst older adults living in retirement societies [41]. Hence, this might be a consideration to focus the study on certain stage of adulthood –especially older adults, as previous research findings suggest that walking intervention would give a significant impact in increasing physical activity level if it is directed to a specific population.

Duration of intervention might also considered for future study. According to a systematic review, the duration for physical activity intervention is commonly 12 months or at least 4 weeks [42]. This is to ensure the maintenance of the intervention effects after the study is terminated; therefore, it may be useful to consider a longer study interval with adding the follow-up session in order to identify the effectiveness of the intervention in long-term period. Finally, as the systematic review noticed some benefit effects of walking on heart rate, oxygen consumption, and blood pressure, so incorporating any health measurements in the study might be valuable to investigate the direct impacts of the intervention on health [43].

Acknowledgements

This study was sponsored by Unilever and all procedures in this research received the ethical approval from the School of Psychology Research Ethics Committee at the University of Leeds, with the ethics reference number of 15-0111. Before deciding to participate in the study, participants were informed that they would be joining in a research conducted to increase physical activity level. At the same time, a general volunteer information sheet was also provided in order to give them more detail information regarding the eligibility criteria for taking part, the tasks that they were required to do, as well as the right to withdraw from the study. Once everything was clear, they were asked to sign the informed consent.

References

[1] Graham, D. J., Sirard, J. R., & Neumark-Sztainer, D. (2011). Adolescents' attitudes toward sports, exercise, and fitness predict physical activity 5 and 10 years later. *Preventive Medicine*, *52*(2), 130-132.

[2] Samuels, T. Y., Raedeke, T. D., Mahar, M. T., Karvinen, K. H., & DuBose, K. D. (2011). A randomized controlled trial of continuous activity, short bouts, and a 10,000 step guideline in inactive adults. *Preventive Medicine*, *52*(2), 120-125.

[3] Gilson, N. D., Faulkner, G., Murphy, M. H., Meyer, M. R. U., Washington, T., Ryde, G. C.,... & Dillon, K. A. (2013). Walk @work: An automated intervention to increase walking in university employees not achieving 10,000 daily steps. *Preventive Medicine*, *56*(5), 283-287.

[4] Lee, I. M., Shiroma, E. J., Lobelo, F., Puska, P., Blair, S. N., Katzmarzyk, P. T., & Lancet Physical Activity Series Working Group. (2012). Effect of physical inactivity on major non-communicable diseases worldwide: An analysis of burden of disease and life expectancy. *The Lancet*, *380*(9838), 219-229.

[5] British Heart Foundation. (2015). *Physical activity statistics* 2015. <https://www.bhf.org.uk/-/media/files/publications/research/bhf_physical-activity-statistics-2015feb.pdf> assessed 11 Feb 2017

[6] World Health Organization. (2015). *What is moderate-intensity and vigorous-intensity physical activity?* <http://www.who.int/dietphysicalactivity/physical_activity_intensity/en/> assessed 20 May 2015.

[7] Walking for Health. (2017). *Walking works: Summary report.* <https://www.walkingforhealth.org.uk/sites/default/files/Walking%20works_summary_AW_Web.pdf> assessed 2 Jan 2017.

[8] Marshall, S. J., Levy, S. S., Tudor-Locke, C. E., Kolkhorst, F. W., Wooten, K. M., Ji, M., Macera, C. A., & Ainsworh, B. E. (2009). Translating physical activity recommendations into a pedometer-based step goal: 3000 steps in 30 minutes. *Preventive Medicine*, *36*(5), 410-415.

[9] Hallal, P. C., Andersen, L. B., Bull, F. C., Guthold, R., Haskell, W., Ekelund, U., & Lancet Physical Activity Series Working Group. (2012). Global physical activity levels: Surveillance progress, pitfalls, and prospects. *The Lancet*, *380*(9838), 247-257.

[10] Freeland, A. L., Banerjee, S. N., Dannenberg, A. L., & Wendel, A. M. (2013). Walking associated with public transit: Moving toward increased physical activity in the United States. *American Journal of Public Health*, *103*(3), 536-542.

[11] Hearst, M. O., Sirard, J. R., Forsyth, A., Parker, E. D., Klein, E. G., Green, C. G., & Lytle, L. A. (2013). The relationship of area-level sociodemographic characteristics, household composition and individual-level socioeconomic status on walking behaviour among adults. *Transportation Research Part A Policy and Practice*, *50*, 149-157.

[12] Sugiyama, T., Cerin, E., Owen, N., Oyeyemi, A. L., Conway, T. L., Van Dyck, D.,... & Sallis, J. F. (2014). Perceived neighbourhood environmental attributes associated with adults′ recreational walking: IPEN adult study in 12 countries. *Health and Place*, *28*, 22-30.

[13] Killoran, A., Doyle, N., Waller, S., Wohlgemuth, C., & Crombie, H. (2006). *Transport interventions promoting safe cycling and walking: Evidence briefing*. London: National Institute for Health and Clinical Excellence.

[14] Rhodes, R. E., & Pfaeffli, L. A. (2010). Mediators of physical activity behaviour change among adult non-clinical populations: A review update. *International Journal of Behavioural Nutrition and Physical Activity*, *7*, 37-47.

[15] Bauman, A. E., Reis, R. S., Sallis, J. F., Wells, J. C., Loos, R. J., Martin, B. W., & Lancet Physical Activity Series Working Group. (2012). Correlates of physical activity: Why are some people physically active and others not?. *The Lancet*, *380*(9838), 258-271.

[16] Heath, G. W., Parra, D. C., Sarmiento, O. L., Andersen, L. B., Owen, N., Goenka, S.,... & Lancet Physical Activity Series Working Group. (2012). Evidence-based intervention in physical activity: Lessons from around the world. *The Lancet*, *380*(9838), 272-281.

[17] Greaves, C. J., Sheppard, K. E., Abraham, C., Hardeman, W., Roden, M., Evans, P. H., & Schwarz, P. (2011). Systematic review of reviews of intervention components associated with increased effectiveness in dietary and physical activity interventions. *BMC Public Health*, *11*(1), 119-131.

[18] Lustria, M. L. A., Noar, S. M., Cortese, J., Van Stee, S. K., Glueckauf, R. L., & Lee, J. (2013). A meta-analysis of web-delivered tailored health behaviour change interventions. *Journal of Health Communication*, *18*(9), 1039-1069.

[19] Prestwich, A., Sniehotta, F. F., Whittington, C., Dombrowski, S. U., Rogers, L., & Michie, S. (2014). Does theory influence the effectiveness of health behaviour interventions? Meta-analysis. *Health Psychology*, *33*(5), 465-474.

[20] Hankonen, N., Sutton, S., Prevost, A. T., Simmons, R. K., Griffin, S. J., Kinmonth, A. L., & Hardeman, W. (2015). Which behaviour change techniques are associated with changes in physical activity, diet and body mass index in people with recently diagnosed diabetes?. *Annals of Behavioural Medicine*, *49*(1), 7-17.

[21] Olander, E. K., Fletcher, H., Williams, S., Atkinson, L., Turner, A., & French, D. P. (2013). What are the most effective techniques in changing obese individuals' physical activity self-efficacy and behaviour: A systematic review and meta-analysis. *International Journal of Behavioural Nutrition and Physical Activity*, *10*(29), 1-15.

[22] Duvall, J. (2012). A comparison of engagement strategies for encouraging outdoor walking. *Journal of Physical Activity and Health*, *9*(1), 62-70. <http://www.naspspa.org/AcuCustom/Sitename/Documents/DocumentItem/07_duvduv_JPAH_20090338_62-70.pdf> assessed 15 Aug 2015.

[23] van de Pol, P. K., & Kavussanu, M. (2012). Achievement motivation across training and competition in individual and team sports. *Sport, Exercise, and Performance Psychology*, *1*(2), 91-105.

[24] Lin, J. J., Mamykina, L., Lindtner, S., Delajoux, G., & Strub, H. B. (2006). Fish'n'Steps: encouraging physical activity with an interactive computer game. Paper presented at *UbiComp 2006: Ubiquitous Computing*.

[25] Johannesson, M., Östling, R., & Ranehill, E. (2010). The effect of competition on physical activity: A randomized trial. *The BE Journal of Economic Analysis and Policy*, *10*(1).

[26] Crouter, S. E., Schneider, P. L., Karabulut, M., & Basset Jr, D. R. (2003). Validity of 10 electronic pedometers for measuring steps, distance, and energy cost. *Medicine and Science in Sports and Exercise*, *35*(8), 1455-60.

[27] Yamada, M., Takechi, H., Mori, S., Aoyama, T., & Arai, H. (2013). Global brain atrophy is associated with physical performance and the risk of falls in older adults with cognitive impairment. *Geriatrics and Gerontology International*, *13*(2), 437-442.

[28] van der Ploeg, H. P., Tudor-Locke, C., Marshall, A. L., Craig, C., Hagströmer, M., Sjöström, M., & Bauman, A. (2010). Reliability and validity of the international physical activity questionnaire for assessing walking. *Research Quarterly for Exercise and Sport*, *81*(1), 97-101.

[29] Kim, Y., Park, I., & Kang, M. (2013). Convergent validity of the international physical activity questionnaire (IPAQ): Meta-analysis. *Public Health Nutrition*, *16*(03), 440-452.

[30] Medina, C., Barquera, S., & Janssen, I. (2013). Validity and reliability of the international physical activity questionnaire among adults in Mexico. *Revista Panamericana de Salud Pública*, *34*(1), 21-28.

[31] IPAQ Research Committee. 2004. *Guidelines for data processing and analysis of the international physical activity questionnaire (IPAQ)-short form*. <http://www.institutferran.org/documentos/scoring_short_ipaq ipaqa04.pdf> assessed 23 June 2015

[32] Lutes, L. D., & Steinbaugh, E. K. (2010). Theoretical models for pedometer use in physical activity interventions. *Physical Therapy Reviews*, *15*(3), 143-153.

[33] Marshall, S. J., Nicaise, V., Ji, M., Huerta, Haubenstricker, J., Levy, S. S.,... & Elder, J. E. (2013). Using step cadence goals to increase moderate-to-vigorous-intensity physical activity. *Medicine and Science in Sports and Exercise*, *45*(3), 592-602.

[34] Patel, A., Kolt, G. S., Schofield, G. M., & Keogh, J. (2014). General practitioner's views on the role of pedometers in health promotion. *Journal of Primary Health Care*, *6*(2), 152-156.

[35] Compernolle, S., Vandelanotte, C., Cardon, G., De Bourdeaudhuij, I., & De Cocker, K. (2015). Effectiveness of a web-based, computer-tailored, pedometer-based physical activity intervention for adults: A cluster randomized controlled trial. *Journal of Medical Internet Research*, *17*(2), 38-65.

[36] Freak-Poli, R. L., Cumpston, M., Peeters, A., & Clemes, S. A. (2013). Workplace pedometer interventions for increasing physical activity. *The Cochrane Library, 2013*(4), 1-78.

[37] Foster, D., Linehan, C., Kirman, B., Lawson, S., & James, G. (2010, October 6th-8th). Motivating physical activity at work: Using persuasive social media for competitive step counting. Paper presented at *14th MindTrek Conference.* <http://core.ac.uk/download/pdf/53330.pdf> assessed 29 Aug 2015.

[38] Hunt, K., McCann, C., Gray, C. M., Mutrie, N., & Wyke, S. (2013). You've got to walk before you run: Positive evaluations of a walking program as part of a gender-sensitized, weight-management program delivered to men through professional football clubs. *Health Psychology*, *32*(1), 57-65.

[39] Griffith, D. M., Gunter, K., & Allen, J. O. (2011). Male gender role strain as a barrier to African American men's physical activity. *Health Education and Behaviour*, *38*(5), 482-491.

[40] Reid, K. F., & Fielding, R. A. (2012). Skeletal muscle power: A critical determinant of physical functioning in older adults. *Exercise and Sport Sciences Reviews*, *40*(1), 4-12.

[41] Rosenberg, D. E., Kerr, J., Sallis, J. F., Norman, G. J., Calfas, K., & Patrick, K. (2012). Promoting walking among older adults living in retirement communities. *Journal of Aging and Physical Activity*, *20*(3), 379-394.

[42] Farahani, L. A., Asadi-Lari, M., Mohammadi, E., Parvizy, S., Haghdoost, A. A., & Taghizadeh, Z. (2015). Community-based physical activity interventions among women: A systematic review. *BMJ open*, *5*(4), 1-12.

[43] Tschentscher, M., Niederseer, D., & Niebauer, J. (2013). Health benefits of Nordic walking: A systematic review. *American Journal of Preventive Medicine*, *44*(1), 76-84.

[44] Charness, G., & Gneezy, U. (2009). Incentives to exercise. *Econometrica*, *77*(3), 909-931.

[45] Hunter, R. F., Davis, M., Tully, M. A., & Kee, F. (2012). The physical activity loyalty card scheme: Development and application of a novel system for incentivizing behaviour change. In P. Kostkova., M. Szomszor., & D. Fowler (Eds). *Electronic Healthcare*.

[46] Demark-Wahnefried, W., Morey, M. C., Sloane, R., Snyder, D. C., Miller, P. E., Hartman, T. J., & Cohen, H. J. (2012). Reach out to enhance wellness home-based diet-exercise intervention promotes reproducible and sustainable long-term improvements in health behaviours, body weight, and physical functioning in older, overweight/obese cancer survivors. *Journal of Clinical Oncology*, *30*(19), 2354-2361.

[47] Hordern, M. D., Dunstan, D. W., Prins, J. B., Baker, M. K., Singh, M. A. F., & Coombes, J. S. (2012). Exercise prescription for patients with type 2 diabetes and pre-diabetes: A position statement from Exercise and Sport Science Australia. *Journal of Science and Medicine in Sport*, *15*(1), 25-31.

[48] Heran, B. S., Chen, J. M., Ebrahim, S., Moxham, T., Oldridge, N., Rees, K.,... & Taylor, R. S. (2011). Exercise-based cardiac rehabilitation for coronary heart disease. *Cochrane Database Systematic Review*, *7*(7), 1-80.