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Original research article

INFLUENCE OF THE SMART WATCH BAND INTERVENTIONS ON HEALTH PROMOTION IN OFFICE WORKERS

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Abstract. *Objectives: to evaluate the influence of the smart watch band on health promotion of workers. Methods: twenty officer workers were randomly divided into two groups GE and GC that answered questions about demographics, physical activity level (IPAQ) and quality of life (sf-36). Anthropometric data were also collected (BMI, WC, WHR). GE used a watch band for 12 weeks, received feedback from the watch band via e-mail containing numerical information on their performance. Results: there were no statistically significant differences between control and experimental group or among pre and post intervention to physical activity level, anthropometric data and quality of life. Conclusion: although the watch band was well accepted by the workers, the use of the watch band did not affect the physical activity level, anthropometric data and quality of life of the officer workers.*

Key words: *Office workers, Physical activity, E-health, Workplace*

INTRODUCTION

In the last decades there were important changes in the lifestyle of workers due to technological advances and computerization. Many benefits come with technological advancements, but a more sedentary lifestyle is the result of this condition. Workers have spent more time in a sitting position involved in intellectual activities, which requires less energy demand (Lin, Courtney, Lombardi, & Verma, 2105; Parry & Straker, 2013; Pronk & Kottke, 2009). The World Health Organization reported that less than 40% of the world's populations are undertaking adequate amounts of physical activity (Who, s/d). Although Brazilian law (NR-17) recommends a sitting position as the first choice for a workplace setting, this situation is ambiguous and can lead to a sedentary lifestyle and body weight

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increase (Lin, Courtney, Lombardi, & Verma, 2105; Manual de aplicação …, s/d). There is strong evidence that a sedentary lifestyle and obesity are associated with risk of musculoskeletal disorders, diabetes, cardiovascular disease and cancer and all-cause mortality (Berrington de Gonzalez et al., 2010; Thorp, Kingwll, Owen, & Dunstan, 2014; Codogno et al., 2015). In Brazil, the prevalence of insufficient physical activity and obesity in male adults is around 30% and 20%, respectively (WHO, 2016; WHO, 2004). Therefore, interventional strategy to reduce prolonged occupational sitting and sedentary behavior in the workplace is important (Karol & Robertson, 2015; Gao, Neval, Cronin, & Finni, 2015).

Regular physical activity is an intervention strategy to reduce sedentary time and obesity. Physical activity can improve work ability, quality of life and reduce non-communicable diseases (Lee et. al., 2012; Latorre-Roma´n, Martínez & Garcia- Pinillos, 2015; Souza & Guimarães, 2016). Smart phone apps, computer programs, a pedometer and smart watch band with an accelerometer (e-health technology) can be used as feedback and encourage users with physical activity practice. E-health technology is relatively cheap and can be used for most of the population (Waker et al., 2014; Flores Mateo, Granado-Font, Ferré-Grau, & Montaña -Carreras, 2015). However, there are limited studies with low quality data that showed evidence about e-health technology interventions effectiveness in the workplace for increasing physical activity and improving health outcomes (Freak-Poli, Cumpston, Peeters & Clemes, 2013). Additional studies with e-health technology to improve physical activity practice and workers' healthcare are needed. Therefore, the aim of this study was to evaluate whether smart watch band interventions can increase the physical activity level and thereby lead to subsequent health benefits in office workers.

METHODS

This was an interventional study conducted in the administrative sector from a food products (dairy products) company from Brazil. The study was approved by the Research Ethics Committee (CAAE: 41620715.7.0000.5495]). Data collection and the intervention were done from April to July 2014.

Participants

Twenty employees of the administrative sector (office workers) were invited to participate in this study. The participants were divided into two groups at random: ten employees (8 males and 2 females), mean age of 26.3 (SD $\pm$6.9) participated in the control group and ten employees (5 males and 5 females), mean age of 31.6 (SD $\pm$11.5) participated at the experimental group. The control group did not receive any intervention and the experimental group received smart watch bands during twelve weeks. The workers in the experimental group were instructed to keep their smart watch band on during 24 hours.

Working tasks

All participating office workers performed computer work in a seated position for most of their eight-hour shifts. Computer work most often included using Microsoft Excel and Internet search. The workers also made phone calls and did some hand-writing (mainly notes). The workers had a one-hour long lunch break, other than that they only got up to go to the bathroom, drink water or get coffee. All of the employees (both groups) worked in the administrative sector for at least one year.

Procedures and data collection

The Medical Outcomes Study - SF36 (short form) was used to assessed the quality of life of the participants. The SF-36 questionnaire has 36 questions, distributed into seven domains: functional capacity, physical aspects, pain, general health state, vitality, emotional aspects and mental health. The SF-36 presents the final score between zero and 100, in which zero corresponds to the worst general health state and 100 to the best health state. The SF-36 has adequate psychometric properties, with high reliability (Cronbach's Alpha: 0.90) validity (Ciconelli, Ferraz, Santos, Meinão, & Quaresma, 1999).

The International Physical Activity Questionnaire - IPAQ was used to evaluate the physical activity level in minutes. This questionnaire has twelve questions related to the amount of days and minutes spent in physical activities at work, mobility, housework and leisure time, with reference to the week prior to the interview. The values of these variables are summed and the results are presented in minutes. Based on the criteria of frequency, intensity and duration of activity, physical activity levels were classified: sedentary (less than 10 minutes of continued physical activity per week), insufficiently active (more than 10 minutes of continued physical activity per week), active (150 minutes of physical activity per week) and very active (vigorous physical activity during 30 minutes or more with a frequency of 5 times or more per week). This questionnaire showed good reproducibility with correlation values of Spearman's Rho $r = 0.71$ ($p < 0.01$) (Matsudo et al., 2001).

The anthropometrics data, body mass index (BMIkg/m²) was calculated using weight (kg) and height (m) values measured using a digital scale with a stadiometer (Welmy ®, model W110H, Brazil). The waist-hip ratio (WHR) and waist circumference (WC) was calculated in centimeters (cm) using a tape measure (Fiber-Glass ®) (WHO, 1995).

All of the procedures and data collection were applied on the same day of the week for the control group and experimental group before the smart watch band intervention (pre intervention) and twelve weeks after the intervention (post intervention).

At the end of twelve weeks a brief questionnaire was also applied, developed by the authors with scores from one to five using a Likert scale (a Likert scale is a psychometric scale commonly involved in research in order to quantify the results of the questionnaire) to assess the participants' perception regarding the use of the smart watch band. The questions were about: acceptance of its use; ease of handling; facilitating goal achievement, stimulation for physical activity; increased physical activity; further use of the smart watch band. The score data for the questionnaire: 5 = Yes, totally; 4 = Yes, partially; 3 = Undecided; 2 = Not very; 1 = Definitely not.

Intervention

The workers from the experimental group received the smart watch band (Oregon Scientific™ - Model Ssmart Dynamo PE 128, China). They were monitored 24 hours a day for twelve consecutive weeks. Every week the workers received feedback from the watchband via e-mail containing numeric information about its performance. Pre-set targets were established for physical activity (30 minutes of physical activity, 10,000 steps and 5,000 meters per day) for all the workers from the experimental group. These targets were established during the intervention period. The smart watch band is connected by Bluetooth using the app - OS DYNAMO. The results of the smart watch band, such as the level of physical activity (minutes) and the number of steps are synchronized with the tablet or cell phone and subsequently tabulated on a computer. The workers from the control group did not receive any intervention and they were instructed to continue with their normal activities.

Data analysis

The workers from the experimental group received the smart watch band (Oregon Scientific^{TM} - Model Ssmart Dynamo PE 128, China). They were monitored 24 hours a day for twelve consecutive weeks. Every week the workers received feedback from the watchband via e-mail containing numeric information about its performance. Pre-set targets were established for physical activity (30 minutes of physical activity, 10,000 steps and 5,000 meters per day) for all the workers from the experimental group. These targets were established during the intervention period. The smart watch band is connected by Bluetooth using the app - OS DYNAMO. The results of the smart watch band, such as the level of physical activity (minutes) and the number of steps are synchronized with the tablet or cell phone and subsequently tabulated on a computer. The workers from the control group did not receive any intervention and they were instructed to continue with their normal activities.

RESULTS

The physical activity levels measured by the IPAQ are presented in table 1. Although the level of physical activity was slightly higher in the control group than the experimental group and there was a reduction in the time of physical activity in the pre to post period, there were no statistically significant differences between the control group and experimental group or among the testing sections (pre vs. post).

Table 1 Mean and standard deviation of the physical activity level (IPAQ) in minutes/week in different conditions (work, mobility, home, leisure time and total) for the control and experimental group; between the pre and post intervention.

Variables	Control		Experimental		p value
	Pre	Post	Pre	Post	
Work	456 (1380)	263 (773)	54 (108)	88 (145)	0.4185
Mobility	1003 (1515)	438 (488)	612 (581)	243 (194)	0.2439
Home	335 (485)	576 (813)	557 (443)	263 (225)	0.4240
Leisure	160 (181)	337 (389)	192 (194)	141 (250)	0.2863
Total	1954 (2213)	1615 (1307)	1415 (854)	736 (443)	0.2405

There were no statistically significant differences between the control and experimental group or among pre and post intervention for the anthropometric data (Table 2).

Table 2. Mean and standard deviation of the weight, body mass index (BMI) and waist-hip ratio to control and experimental group; between the pre and post intervention.

Variables	Control		Experimental		p value
	Pre	Post	Pre	Post	
Weight - Kg	75.2 (14.6)	75.3 (15.5)	72.1 (19.1)	71.3 (19.0)	0.6277
BMI - Kg/m^2	24.6 (4.1)	24.5 (4.1)	24.8 (3.7)	24.5 (4.0)	0.9153
Waist-hip ratio	0.84 (0.07)	0.83 (0.07)	0.79 (0.09)	0.82 (0.09)	0.4671

There were no statistically significant differences between the control and experimental group or among pre and post intervention for quality of life in terms of domains and in general (Figure 1).

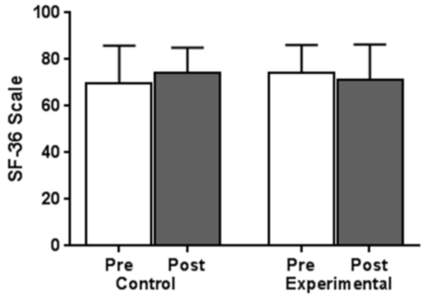

Fig. 1 Mean and standard deviation of the quality of life in general (SF-36) for the control and experimental group; among the pre and post intervention.

The data from the smart watch band showed little variation in terms of step and physical activity levels during the twelve-week intervention in the experimental group. Although they tended to be slightly higher in the first week (step = 11.497 ± 2.238; physical activity = 10.5 ± 5.5) than in the last one (step = 8.215 ± 6.143; physical activity = 7.2 ± 5.4), no statistically significant differences were found between the weeks in terms of the experimental group. The results from the smart watch band are presented in figure 3.

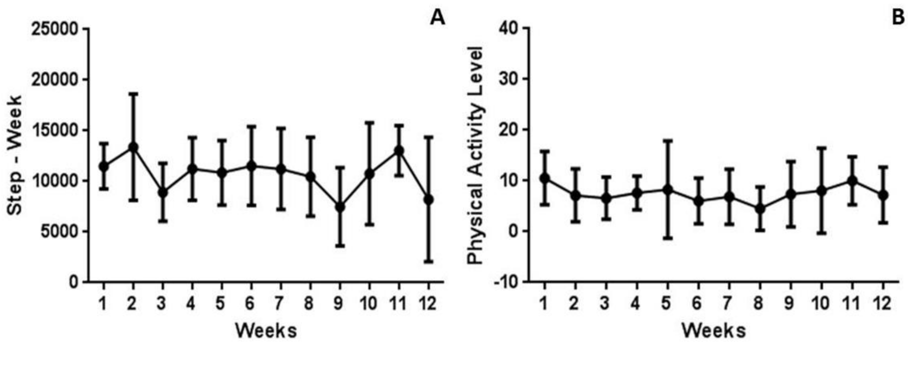

Fig. 2 Mean and standard deviation of step/week (figure 3A) and physical activity level (figure 3B) from the smart watch band for the experimental group during 12 weeks.

The brief questionnaires indicated good user acceptance of the smart watch band in relation to: acceptance of its use (4.4 ± 0,69 points); easy handling (4.8 ± 0,42 points); facilitating to achievement of the goals (score = 2.6 ± 1,25 points), stimulation for physical activity (3.7 ± 1,31 points); increased physical activity (2.8 ± 1,39 points); further use (3.8 ± 0,99 points) the smart watch band. The absolute values and percentages (score) of the questionnaire are presented in table 3.

Table 3 Absolute values and percentages (score) of the questionnaire answers about acceptance and use of the Smart Watch Band.

Score	Acceptance use n (%)	Easy handling n (%)	Achievement of the targets n (%)	Stimulation for PA n (%)	Increased PA n (%)	Further use the SWB n (%)
5 = Yes, totally	4 (40%)	8 (80%)	0 (0%)	2 (20%)	1 (10%)	4 (40%)
4 = Yes, partially	4 (40%)	2 (20%)	4 (40%)	6 (60%)	3 (30%)	3 (30%)
3 = Undecided	1 (10%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (10%)
2 = Not very	0 (0%)	0 (0%)	4 (40%)	1 (10%)	5 (50%)	1 (10%)
1 = Definitely not	0 (0%)	0 (0%)	2 (20%)	1 (10%)	1 (10%)	1 (10%)

SWB = Smart Watch Band; PA = Physical Activity.

DISCUSSION

Theoretically, the smart watch band can stimulate and encourage the participants to physical activity practice. However, the results of this study showed no statistically significant differences in the level of physical activity in the experimental group compared to the control group. In the same way, we observed no significant differences between the pre and post intervention period with a slight tendency to reduce the level of physical activity between the pre and post period. These results indicate that the smart watch band was not enough to increase the physical activity level of workers. This finding showed the difficulty in the implementation of interventions that require a change in the participants' behavior. Parry & Straker (2013) indicate barriers to implementing interventions in the workplace to improve the physical activity level of the workers because of the need for reorganization in the work, but point out the importance of implementing policies to intervention guides of physical activity at work. Another hypothesis regarding our results is that the participants were excited at the beginning of the study and over time (two months) the workers lost enthusiasm for the study and for the practice of physical activity.

There was no statistically significant difference between the control and experimental groups, as well as between the pre and post intervention moments regarding anthropometric data. These results may be related to the low effectiveness of the smart watch band during the intervention. Another possible explanation for these results may be linked to their normal indices for BMI, waist-hip ratio and waist circumference before the intervention. In addition to reducing anthropometric values it is necessary to consider both long-term physical activity and food intake. Different results were found in a program "sit less and move more" that is an automated web-based intervention that focuses on decreasing occupational sitting time. This study found that an evidence-based intervention successfully encouraged office employees to 'sit less and move more', resulting in the improvement of abdominal fatness (Puig-Ribera et al., 2015). The combination of intervention methods (educational and self-monitoring) appears to be more effective and brought more stability to the individual level physical activity behavior change (Lappalainen, Kankaanpää, Tolvanen, & Tammelin, 2015). It is also important to think of the intensity of physical activity in reducing anthropometric measurements. Physical activity with higher intensity and physical effort (moderate/vigorous) induces a higher caloric expenditure, speeds up the metabolism and induces compensatory physiological mechanisms (dose-response), resulting in decreased body fat percentage and directly affecting anthropometric measures (Rosenkilde et al., 2012).

Although the workers of both groups presented good anthropometric values for BMI (within the normal range), the low physical activity level (less than 150 minutes per week) may lead the workers in both groups to an overweight or obesity condition (Kohl et al., 2012). In this sense, the low physical activity level, combined with bad eating habits, may result in higher chances of increased weight and therefore increased BMI, waist-hip ratio and waist circumference and risk of heart attack (Gortmaker et al., 2011; Cecchini et al, 2010). The administrative sector workers who have sedentary behavior are more likely to gain weight and increase the waist circumference when compared with workers in the manufacturing sector (Hofelmann & Blanl, 2009).

We found no significant difference between the control and experimental group, and pre and post-intervention to quality of life. Different results were observed in a study conducted in New Zealand, with sedentary workers' increase in physical activity and improvement in the quality of life in the workplace (Mansi et al., 2015). The difference between the findings can be explained by the diversity in intervention methods such as the electronic device, motivational use of explanatory booklets, educational sessions and counseling (Mansi et al., 2015). Some authors suggest that in addition to the bracelet stimulus, it is important to provide additional auxiliary stimuli, through group meetings, counseling meetings, lectures, educational materials, daily recall and still facilitators (De Cocker, De Bourdeaudhuij & Cardon, 2010; Chan, Ryan 7 Tudor-Locke, 2004).

The results of the data collected by technological smart watch bands showed little variation in step and physical activity during the twelve-week intervention. It was observed that in the first week the data were slightly higher compared to the final week, suggesting that the effect of the stimulus decreased during the intervention. Although our study did not determine any positive encouragement for the physical activity with the electronic device and improvement in the quality of living conditions, it is known that implement strategies that motivate administrative workers to increase the physical activity level, and reduce the chances of emergence of pathologies, bring benefits such as increased satisfaction, well-being, self-esteem, better professional and personal living for workers (Pronk, Katz Lowry & Payfer, 2011; Thorp et al., 2012).

The participants reported good acceptance of its use and easy handling of the smart watch band. The participants reported that the smart watch band arouse curiosity and interest and it is an important tool to promote physical activity. This is in agreement with other studies that reported positive perceptions of electronic devices for administrative workers (Mansi et al., 2015; Maruyama, Kimura, Okumura, Hayashi, & Arao, 2010).

Limitation of the study

The small sample size of the study; difficulty of monitoring and knowing if the workers used the smart watch band every day of the study; subjectivity of the questionnaires that can interfere with the answers of the participants; the study could have collected information about the caloric intake.

CONCLUSION

Although the participants reported the importance of the smart watch band for promoting physical activity, the electronic smart watch band did not affect the physical activity level, quality of life and anthropometric measurements of the office workers.

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UTICAJ SMART RUČNOG SATA NA UNAPREĐENJE ZDRAVSTVENOG STANJA KANCELARIJSKIH RADNIKA

Cilj istraživanja bio je da se ispita uticaj smart ručnog sata na unapređenje zdravstvenog stanja radnika. Ukupno je 20 kancelarijskih radnika podeljeno u dve grupe, GE i GC. Odgovarali su na pitanja o osnovnim demografskim podacima, nivou fizčke aktivnosti (IPAQ) i kvalitetu života (sf-36). Prikupljeni su i antropometrijski podaci (BMI, WC, WHR). GE koristila je smart ručni sat tokom 12 nedelja, dobijala povratne informacije od ručnog sata putem elektronske pošte, u vidu numeričkih podataka o njihovom učinku. Rezultati nisu potvrdili postojanje statistički značajnih razlika između kontrolne i eksperimentalne grupe pre i nakon intervencije u pogledu nivoa fizičke aktivnosti, antropometrijskih podataka i kvaliteta života. Iako je smart ručni sat dobro prihvaćen od svih radnika, njegova upotreba nije uticala na nivo fizičke aktivnosti, antropometrijske podatake ili kvalitet života kancelarijskih radnika.

Ključne reči: *Kancelarijski radnica, Fizička aktivnosti, E-zdravlje, radno mesto.*