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Accelerometers and Internet for physical activity promotion in youth? Feasibility and effectiveness of a minimal intervention [ISRCTN93896459]

Sander M. Slootmaker [a], Mai J.M. Chinapaw [a,*], Jacob C. Seidell [b], Willem van Mechelen [a], Albertine J. Schuit [b,c]

[a] EMGO Institute for Health and Care Research, Department of Public and Occupational Health, Body@Work Research Center Physical Activity, Work and Health, TNO-VU University Medical Center, Amsterdam, The Netherlands
[b] Institute of Health Science, Faculty of Earth and Life Sciences, VU University Amsterdam, Amsterdam, The Netherlands
[c] National Institute for Public Health and the Environment, Bilthoven, The Netherlands

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ABSTRACT

Objective. To evaluate the feasibility and effectiveness of a 3-month minimal physical activity (PA) intervention in adolescents.

Methods. A randomised controlled trial, including five secondary schools ($n=87$). In the 3-month intervention (Amsterdam, The Netherlands, 2005) adolescents were provided with a PAM accelerometer, coupled to a web-based tailored PA advice (PAM COACH). Measurements (i.e., PA, determinants of PA, aerobic fitness and anthropometrics) took place at baseline and at 3- and 8-month follow-up.

Results. Sixty-five percent of the participants in the intervention group reported to have worn the PAM frequently and 56% of the PAM users uploaded their PAM scores to the PAM COACH at least once. We found significant differences between groups in favour of the intervention group in moderate intensity PA (MPA) for girls after 3 months (411 min/week; 95% CI: 1; 824; $P=0.04$) and in sedentary time for boys after 8 months (−1801 min/week; 95% CI: −3545; −57; $P=0.04$).

Conclusions. Although the process evaluation suggests that a substantial proportion of the participants did not regularly wear the PAM and did not upload information to the PAM COACH website, our findings suggest promising intervention effects on MPA among girls and sedentary time among boys.

Background

Lack of physical activity (PA) during adolescence has been associated with an increased cardiovascular risk, decreased bone health and decreased psychosocial well-being (Biddle et al., 2004; Ortega et al., 2008). Moreover, limited PA may also predispose youth to developing a sedentary lifestyle later in life (Hallal et al., 2006; Telama et al., 2005). In 2008, only 30% of adolescent boys and 22% of adolescent girls in the Netherlands met the Dutch Public Health PA recommendation of daily 60 min moderate to vigorous intensity PA (Statistics Netherlands, 2008). These low numbers are also found in other Western countries and are of great concern for public health (Brener et al., 2007; Currie et al., 2004). Therefore, effective intervention strategies promoting an active lifestyle are needed.

One promising way to promote PA is by Internet-based self-management interventions (Kroeze et al., 2006; Marcus et al., 2000; Norman et al., 2007; Van den Berg et al., 2007; Vandelanotte et al., 2007). In these interventions, feedback is given based on personal characteristics, personal preferences and individual health behaviour for example by e-mails or on computer screens (Brug et al., 1999; De Vries and Brug, 1999; Kreuter et al., 2000). As a result of the rapid development of the Internet it is now possible to distribute tailored feedback to a wide range of people and settings in a low cost manner.

Inactive subjects are often not aware of the fact that they are insufficiently active (Jans et al., 2004; Ronda et al., 2001). Regular feedback on PA levels may raise awareness of the actual level of PA (Hultquist et al., 2005; Paschali et al., 2005; Rooney et al., 2003). Lubans et al. (Lubans et al., 2009) concluded from their systematic review that pedometers have been used successfully in a variety of ways to promote activity among youth. Thus, the use of a PA monitor that objectively registers and displays the actual PA levels of the user could positively affect PA levels in inactive subjects by increasing awareness. Therefore, an Internet-based program, which automatically provides tailored feedback based on the results of a PA monitor, could be a promising behaviour modification tool for inactive subjects. A number of studies with similar concepts (Hurling et al., 2007; Richardson et al., 2007) have shown that PA can be increased via an automated Internet-based behaviour change system.

* Corresponding author. EMGO-Institute for Health and Care Research, Department of Public and Occupational Health, VU University Medical Center, Van der Boechorststraat 7, 1081 BT Amsterdam, The Netherlands. Fax: +31 20 4448387.
E-mail address: m.chinapaw@vumc.nl (M.J.M. Chinapaw).

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The PAM-concept (PAM B.V., Doorwerth, The Netherlands) combines objectively measured PA by an accelerometer with a web-based tailored PA advice (PAM COACH). The PAM is worn on the hip and produces a cumulative activity score, i.e. PAM score. The PAM score is a proxy measure of total daily PA. Via a docking station connected to the computer, the user can upload his PAM scores to the PAM COACH website any time of the day. The PAM COACH provides the user with short individualised PA feedback based on his current PAM score and additionally provides personally adapted suggestions to promote daily PA.

The objective of the present study was (1) to evaluate the feasibility of providing an activity monitor coupled to online individualised PA advice; and (2) to study the effectiveness of this intervention on the daily PA and its determinants, aerobic fitness and anthropometrics of relatively inactive adolescents in a randomised controlled trial (RCT). We hypothesised that this concept may be attractive to adolescents because it combines the use of the Internet (important communication channel for adolescents) with a new gadget (i.e. the PAM).

Methods

Study design and study population

This RCT is part of the PAM project, which is described in detail elsewhere (Slootmaker et al., 2005). A convenience sample of apparently healthy adolescents (aged 13–17 years), with differential educational level was recruited from five secondary schools in Amsterdam, The Netherlands. Inclusion criterion was ability to walk without aid. For all schools the same recruitment protocol was used. First, PA levels were monitored for 2 weeks by means of a PA monitor and a PA questionnaire. Based on these 2 weeks, the study population ($n=286$) was divided in an 'active' (most active 50% of the population) and 'inactive' (least active 50%) group. The relatively inactive adolescents were invited to participate in the RCT. To be able to detect a between-group difference of 20% in PA level (80% probability and a significance level of 0.05), two groups of 50 participants were required. Randomisation was performed at individual level using sealed envelopes after the baseline measurements. This study was approved by the Medical Ethics Committee of VU University Medical Center and conducted between September 2004 and November 2005. All participants gave their informed and parental consent.

Intervention

After randomisation, participants in both groups were advised to increase their PA levels. The control group received a single written information brochure with brief general PA recommendations. The intervention group received the PAM and was given access to a web-based tailored PA advice for a 3-month period. Table 1 and the supplemental material show the functionalities and sitemap of the PAM COACH website.

After registration on the PAM COACH the user first answers 12 questions regarding perceived PA barriers. Then the user uploads the PAM score and formulates an activity goal based on this PAM score. If the user does not formulate a goal, a standard goal is set (i.e. PAM score of 40). On every subsequent login, the PAM COACH presents the uploaded PAM scores and goals in orderly graphs. The uploaded PAM scores are automatically accompanied by a tailored PA advice on the computer screen as well as motivational tips ($n=21$) for increasing PA. The advice includes information on how to reach the PAM goal, which is based on 1) user preferred activities e.g. daily an extra 60 min walking, or 20 min playing squash; and 2) user perceived PA barriers. In addition to the short feedback from the PAM COACH, the users can easily monitor their daily PA score on the display of the PAM. The participants received written and verbal instructions and practical demonstrations on how to wear the PAM and how to use the PAM COACH. Participants were instructed to register and upload PAM data in the first week of the intervention, to check if the system worked properly. After that, the participant was allowed to use the PAM and PAM COACH as much as wanted. At all schools at least one computer with PAM software and access to the Internet was available.

Table 1
Contents of the PAM COACH website.

Website section	Description
Homepage	Presentation of the latest PAM week score, hyperlink to complete advice and motivational PA tips.
Goal setting	Setting the PAM goal score, indicated by the deficiency in minutes per day for their preferred activities.
Activity logg	Presentation of all uploaded PAM scores (per day/week/month).
Questionnaire	Twelve questions on perceived PA barriers (yes or no).
Preferred activities	Categories: transport, school activities, in and around the house, individual and team sports.
Individualised PA advice	Translation of PAM goalscore in the deficiency of minutes per day for their preferred activities. Feedback on their answers to the questionnaire. Stimulating feedback. Comparison of users' PAM score to their peers in the intervention group.
Usage information	Information about the use of the PAM and PAM COACH website, including a demonstration.
Project information	The aim of the project and contact information.
FAQ's	Answers to frequently asked questions about the (use of) PAM and PAM COACH website.

The study was conducted in five secondary schools in Amsterdam, The Netherlands (2005).

Measurements

All measurements took place during school hours at the school at baseline and after 3-month intervention. To evaluate possible long-term effects the questionnaire was administered again 5 months after the end of the intervention. Gender, age and educational level were obtained at baseline. Educational level was categorised into low and high educational level, according to the Dutch educational system. A high educational level comprised of secondary schools preparing for college or university.

Primary outcome measures

Level of physical activity

The Activity Questionnaire for Adolescents & Adults (AQuAA) is based on the SQUASH-questionnaire (Wendel-Vos et al., 2003). The AQuAA recalls PA in the past week of light (2–5 metabolic equivalents, MET), moderate (5–8 MET) and vigorous (>8 MET) intensity, as well as time spent sedentary (all activities <2 MET), such as TV viewing and computer use. Activities were divided in five categories 1) transport to school; 2) PAs at school; 3) household chores; 4) leisure time activities, and 5) active sports. Data of a validation study (Chinapaw et al., 2009) show that the test–retest reliability of the AQuAA was moderate in adolescents (intra-class correlations; ranging from 0.30 to 0.59). Spearman correlation coefficients between the time spent on sedentary, light, moderate and vigorous intensity PAs compared to the MTI Actigraph accelerometer were low and non-significant for adolescents (0.23, 0.11, −0.21 and 0.21, respectively).

Secondary outcome measures

Determinants of physical activity

A short questionnaire was developed to assess behavioural intention to promote a physically active lifestyle; attitude, social influences, self-efficacy expectations and personal barriers towards sport, walking and biking, and reducing screentime. For each determinant a selection of two or three relevant questions was made, based on previous studies (Bandura, 1986; Sallis et al., 1987, 1988; Van Sluijs et al., 2005). Answering formats were 5-point Likert scales (very low to very high). Per determinant, multiple items were converted into summary scores.

Awareness of complying with the Public Health PA recommendation was assessed by self-report 'On how many days of the week did you participate in at least 60 min of moderate intensity PA (MPA)?' Subjects' knowledge of the PA recommendation was tested by the question 'How much time per day do you have to spend on physical activity to stay healthy?' According to a method described by Ronda et al. (2001), respondents were allocated to four categories of awareness (under-estimators, over-estimators, realists adequate or realists inadequate), based on their self-rated compliance with