Promoting physical activity using an activity monitor and a tailored web-based advice

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SUMMARY

Nowadays, the choice for a sedentary lifestyle seems in most cases more obvious and attractive than the choice for a physical active lifestyle. People in industrialized countries continue to reduce their energy expenditure in their daily life and at work. Especially during adolescence and young adulthood a steep decrease in daily physical activity (PA) is observed. A physically inactive lifestyle is associated with serious health risks such as cardiovascular disease, non-insulin dependent diabetes mellitus, depression, some types of cancer, and all-cause mortality. These health risks are significantly reduced by engaging in regular PA. Adolescents are recommended to perform at least moderate intensity PA with a minimum of one hour a day. Adults are advised to perform at least moderate intensity PA for a minimum of 30 minutes on at least five days of the week. Nevertheless, about three quarters of the Dutch adolescent population and almost half of the Dutch adult population still does not meet the above-mentioned Public Health guidelines for PA. Substantial improvement in public health is possible through encouragement of PA among inactive groups of the population. To achieve public health benefits, we are faced with the task to establish awareness of physical (in)activity and to encourage PA, but also to enable people to include more PA in their daily life.

In 2002 PAM B.V. introduced an innovative concept that is able to monitor PA objectively by an physical activity monitor (PAM) but can also be used to stimulate PA using an expert system on the Internet (PAM COACH system). The PAM is a small instrument (i.e. an accelerometer), easily attached to a belt and worn on the waist. The PAM measures vertical accelerations as a measure of daily PA on a continuous basis and stores these PA data in a memory, which can be uploaded to the PAM COACH via a docking station. The more intense PA is the higher the PA score stored in the PAM. On the other hand when there is no PA there will be no PA stored in the PAM. The PAM COACH shows accumulated PA data over a period of time and interactively formulates PA goals based on the actual PA level and personal preferences (e.g. daily an extra 60 minutes walking or 25 minutes running or 20 minutes playing squash). Users can thus follow and compare their progress with their personal PA goals and receive personally tailored PA advice in reaching their goals. If this PAM-concept works, it is an interesting tool for professionals working in the field of PA promotion

This thesis describes the evaluation of the PAM as a monitoring instrument as well as the feasibility and effectiveness of the PAM-concept as a tool to promote PA among adolescents and young adults in a real-life setting.

PHYSICAL ACTIVITY MEASUREMENTS

Accurate assessment of PA is necessary not only to assess the prevalence of PA in the population, but also to evaluate associated health benefits and to evaluate the effectiveness of interventions aimed at promoting PA. Chapters 2 and 3 describe the measurement properties of the PA measures used in this thesis, i.e. the PAM accelerometer and the Activity Questionnaire for Adults and Adolescents (AQuAA), respectively.

In Chapter 2 we compared the PAM accelerometer with a commonly used accelerometer, i.e. the MTI Actigraph accelerometer, using oxygen consumption as a reference. Oxygen consumption is considered as the gold standard for the measurement of energy expenditure. The study was conducted in 32 adults performing two activities: treadmill walking and stair walking. For both treadmill walking and stair walking, the PAM performed comparable to the MTI Actigraph. We also compared all three instruments in their calculated energy expenditure during the same activities. This comparison showed that both the PAM and MTI Actigraph underestimated actual energy expenditure substantially during treadmill and stair walking. Finally, we observed that PAM data were highly reproducible, using a test on a laboratory shaker at 3 Hertz. We concluded that the PAM is a valid device for ranking subjects in energy expenditure.

A second PA measure used in this thesis is the AQuAA questionnaire. The AQuAA is designed to 1) discriminate between people with high and low levels of PA, and 2) to assess changes in PA and sedentary behavior over time. The AQuAA combines information on intensity, duration, and frequency of both PA as well as sedentary behavior and is applicable for adolescents and adults. In Chapter 3 we compared the time spent on PA as assessed by the AQuAA and the MTI Actigraph among adolescents and adults. Thirty-three adolescents and 47 adults wore the MTI Actigraph during two weeks, and completed the AQuAA at the end of the two week period. Low and non-significant correlations were observed between the AQuAA and the MTI Actigraph.
Time spent on all physical activities was significantly higher according to the questionnaire compared with the MTI Actigraph (except for light intensity activities in adolescents), while time spent on sedentary behaviors was significantly lower.
Furthermore we studied the test-retest reproducibility of the AQuAA. Fifty-three adolescents and 58 adults completed the AQuAA twice, with an interval of two weeks. We observed fair to moderate reproducibility for the time spent on PA among adolescents and adults, except for time spent on vigorous PA in adults, which was poorly reproducible. In summary, we found this self-report PA questionnaire to be modestly reproducible, while the comparison with the accelerometer was poor.

THE STUDY DESIGN

Inactive people are often not aware of their inactivity. The use of the PAM in combination with PAM COACH offers the opportunity to provide advice based on the actual PA level in large groups of people. Providing web-based feedback on the actual PA level by the PAM may increase awareness and may stimulate a physically active lifestyle. Chapter 4 presents the design of the study together with an extensive description of the study background, objectives and execution of the project.
The study included two phases: in the first phase, PA was assessed by means of the PAM and AQuAA in a group of adolescents and young adults, mainly office workers (described in Chapter 5). Based on this measurement, inactive subjects were selected and invited to participate in a 3-month randomized controlled PA intervention study.
In the second phase of the study (i.e. the intervention), the feasibility and effectiveness of providing the PAM accelerometer in combination with the PAM COACH system was evaluated (described in Chapter 6 and 7).

MONITORING OF PHYSICAL ACTIVITY

Chapter 5 provides insight in the use of the PAM accelerometer for PA monitoring purposes. In this study the PA level of 236 adolescents (aged 12-18 years) and 301 adults (aged 22-40 years) was monitored during two weeks. All participants wore the PAM during two weeks and completed the AQuAA at the end of this period. Objectively measured time (by PAM) and self-reported time (by AQuAA) spent on PA at moderate (MPA) and vigorous intensity (VPA) were compared among adolescents and young adults in subgroups of gender, education and weight status. We found that self-reported time spent on MPA and VPA was always significantly higher than objectively recorded time by the PAM among adolescents and adults.

Adolescents reported exceptionally more time spent on MPA and VPA than was assessed objectively by the PAM. Furthermore, self-reported time showed that adolescents with a high educational level spent more time on MPA and VPA than adolescents with a low educational level, while the registrations of the PAM showed the opposite. However, since both PA measures are not a gold standard, it is not possible to determine which instrument assessed PA more accurately.

In adults there was moderate agreement between both measurement methods with regard to MPA, but not with regard to VPA. Disagreement in time spent on MPA was largest among men with a low educational level and disagreement in time spent on VPA was largest among overweight adults.

Furthermore, our study showed that cycling was a significant (positive) contributor to the disagreement in time spent on PA between both instruments for adolescents as well as for adults. Nevertheless, analyses for PA with and without cycling showed similar results for all subgroups. Based on these findings, we concluded that there is a clear need for advanced and valid assessment of PA among adolescents.

THE PAM INTERVENTION

One hundred and two adults from eight worksites and 87 adolescents from five secondary schools completed the baseline measurements (chapter 6 and 7 respectively). The participants were randomly assigned to the 3-month PAM intervention or the control group. The participants in the intervention group were provided with the PAM and had access to the PAM COACH website. The participants in the control group received a single written information brochure with brief general PA recommendations. Immediately after the end of the 3-month intervention (short-term effect) and five months after the end of the intervention (long-term effect) follow-up measurements were performed. The effect of the intervention was evaluated on changes in PA level (primary outcome) and behavioral determinants of PA, quality of life, empowerment, aerobic fitness and body composition (secondary outcomes).

FEASIBILITY OF THE PAM INTERVENTION

Chapter 6 shows that the intervention among adults appeared to be feasible for use in a real-life setting; seventy-three percent of the adults in the intervention group reported to have worn the PAM regularly. In addition, all adults uploaded their PAM scores to the PAM COACH website at least once during the intervention with a mean of almost once a week. Seventy-four percent of the PAM-users read the PA advice, 39% of which found the advice appealing. We concluded that attention should be given to the quality and appropriateness of the tailored advice among adults.

The results of chapter 7 show limited feasibility of the PAM intervention among adolescents. Although, 65% of the adolescents in the intervention group reported to have worn the PAM

frequently, only 56% of them uploaded their PAM scores to the PAM COACH website at least once. The few visits to the website and the high drop-out during the intervention suggested that adolescents were not interested in our PA promotion intervention as presented. We propose developing a more attractive activity monitor and a more individually tailored advice to improve feasibility of such an intervention among adolescents.

EFFECTIVENESS OF THE PAM INTERVENTION

The PAM intervention was ineffective in improving awareness of personal PA level among healthy Dutch adolescents and adults. The effects of the intervention on PA levels and the secondary outcomes were limited. Positive intervention effects on PA were observed among small subgroups of adolescents only. In adolescent girls, the PAM intervention was effective in increasing MPA with 411 minutes per week, while in boys sedentary time was reduced with 1801 minutes per week, five months after the end of the intervention. Furthermore we observed a tendency for body weight loss (1.6 kilograms) among low educated adults. More research in a larger population is necessary to investigate the effectiveness of this type of interventions among adolescents, people with overweight and a low socio-economic status.

DISCUSSION OF THE RESULTS

The last chapter (Chapter 8) provides a summary of the main findings of this thesis and discusses some methodological issues (e.g. recruitment, outcome measures, and generalizability) derived from this thesis. Furthermore, it discusses whether the single use of an accelerometer is adequate for assessing or stimulating PA among adolescents and which elements of the PAM-concept are promising for PA promotion. Finally, directions for future research and implications for public health are formulated.

WE CAN CONCLUDE THAT

- using the PAM accelerometer to monitor PA among adolescents and adults is feasible but,
- promotion of PA by providing the PAM coupled to the web-based tailored PA advice given at the PAM COACH website is ineffective among adolescents and adults.

Therefore, the interventions described in this thesis do not give cause for wider implementation of the PAM-concept in its current form among Dutch adolescents and adults.