

## Controlled Clinical Trial of how Mobile Health Applications Affect Unemployed Men's Physical Health as Well as Thoughts and Actions in Relation to their Own Physical Health

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### Abstract

Unemployed men with low or no education have both the lowest average life and no research has been conducted with mobile health applications (m-Health) as health promotion interventions for this target group. This Controlled clinical trial wants to contribute with knowledge about how m-Health ("Health" and "Google Fit") affect the level of physical activity amongst unemployed men (aged 19 - 62 year) as well as the frequency of how often they think and do something for their own physical health. The men were allocated to an intervention group (n = 40) or a control group (n = 35). Baseline and effect measurement were carried out in both groups. During the intervention period of six months the intervention group used a m-Health that recorded number of steps, and they received a health promoting text message every other week. The men texted their recorded number of steps per week as well as visual analogue scale (VAS) thinking and doing in a selected week every 4 weeks. Significantly result in the intervention group: fitness rate, from 30,0 mL/min/kg to 33,0 (P < 0,001); oxygen absorption in the fitness test, from 2,06 to 2,80 L/min (P < 0,001); VAS, how often the men do something to improve their own physical health, from 7,00 to 8,00 (P = 0,009). Significantly result in the control group: muscle mass, from 62,96 kg to 64,64 kg (P = 0,043), fat percentage from 19,97% to 17,08% (P = 0,001) and body age from 40 year to 36 year (P = 0,001). This study has shown that unemployed men with low or no education are interested in their health and with acknowledging information and follow-up on their physical health, they can improve their physical health, both with and without m-Health. The improve on frequency of thinking and doing something for their health is especially noticeable for the intervention group using m-Health.

**Keywords:** Physical Health; Unemployed; Men with Short or No Education; m-Health; CCT

### Introduction

It is well-known that men report illness and health problems less than women and evaluate their own physical and mental health more positively than women. In addition, the average life expectancy in Europe is 77,9 years for men and 83,3 years for women [1]. A high degree of social inequality is reflected in men's average lifespan when considering length of education and income [1-3].

For public health purposes, high-risk populations may be of special interest. Several studies confirmed that unemployment is associated with poorer physical and mental health together with an elevated risk for premature mortality [4-6]. Particularly, men are affected by the negative consequences of unemployment to health: they are more often smokers and spend less time with sports than employed men [7].

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Mobile phone use and the adoption of m-Health are rapidly proliferating. Apps focused on health promotion are quite common: more than 100.000 health apps are available in the iTunes and Google Play stores [8]. Several studies show that the main users of m-Health are younger people who have higher education, higher income and who, in advance, assess their health as excellent. App use was associated with intentions to change diet and physical activity and meet physical activity recommendations [9]. For the unemployed, it is important that health interventions are not associated with high costs [10].

A previous study has investigated how m-Health affects the physical health of men with low or no education, and the frequency to think and do something to promote their physical health. This study showed significant effects on men's muscle mass and oxygen uptake and how m-Health positively promoted the frequency they thought and did something to promote their physical health [11,12].

### **Purpose and Research Questions**

The purpose of the trial was to contribute knowledge about how m-Health influence the physical activity level of unemployed men with low (here considered as primary or lower vocational school) or no education as well as the frequency of how often they think and do something for their own physical health. The results and knowledge from the trial could be used by the municipal job agency, healthcare system and politicians, and since the intervention requires minimal professional contact, it would also be cost-effective.

The preliminary literature search in relation to the current knowledge of unemployed men's health, m-Health and physical activity has limited the trial to the following research areas:

- (I) To investigate what impact m-Health, have on unemployed, with low or no education, men's thoughts and actions regarding their own physical health;
- (II) To investigate how m-Health, influence the level of physical activity of unemployed men, with low or no education;
- (III) To investigate the effect of m-Health at fitness, resting heart rate (RHR), resting blood pressure (BP), distribution of body fat and muscle mass on unemployed, with low or no education.

### **Methods**

#### **Study population and selection criteria**

A controlled clinical trial was used to gain knowledge about the effect of m-Health on improving the men's physical activity and the frequency of them thinking and doing something to improve their physical activity.

The sample was recruited over 6 months (August 2017 - January 2018) at two job agencies in Denmark and by Facebook [13]. In 2018, 3,6% of the adult men were unemployed in Denmark [14]. All male job-seekers that showed up for a job agent talk on 21 randomly selected dates were asked to participate in the research project, when they appeared in the waiting area. Inclusion criteria were: male, unemployed at the recruitment time, 19 - 62 years of age, no or low education, being cognitively/physically capable and having enough language/reading skills. A total of 75 unemployed men with low or no education were eligible for study participation.

The selection of the m-Health was based on research on what an application should contain in order to increase the probability of an effect. The application should be simple, free, always active, record the number of steps and allow other physical activity to be registered, and measured in minutes. In addition, it should be possible to read the number of steps and the minutes for the previous 4 weeks. With these criteria, the "Google Fit" app was chosen for Android mobile phones and the "Health" app was chosen for iPhones. Participants with phones able to run application "Google Fit" (Android) or "Health" (iPhone) application were allocated to the intervention group (n = 40);

participants with phones that could not use the selected applications were allocated to the control group (n = 35), as shown in figure 1. Participants that did not accomplish both base line and effector measurements were excluded from the analysis. Participants that were not able to measure or report a variable during the intervention period were not included in the statistical analysis for that particular missing variable.

### **Intervention**

The intervention was carried out in the period august 2017 to august 2018 and included:

- (I) Use of the "Google Fit" or "Health" application;
- (II) A text message with a general health-promoting<sup>1</sup> message every other week. This message was developed with a focus on a low readability index as well as a focus on actions rather than feelings [15,16];
- (III) Checking of the number of steps and reporting visual analogue scale (VAS) scores every 4 weeks.

### **Measurements procedure**

Three indicators of socio-economic position were used: education, unemployment period (1 = 0 - 6 month, 2 = 6 - 24 month, 3 = more than 24 month) and marital status (1 = married, 2 = partner, 3 = single).

Baseline and effect measurements were carried out at the job agencies or at the participants home for both the intervention and control group and included: Standardized electronic measurement of systolic blood pressure (SBP), diastolic blood pressure (DBP) and RHR (apparatus: Microlife BPA100 Plus); VAS scores for how often the participant thought about his own physical health by stating a number between 1 - 10, graded from "never" to "always" (Figure 2A); VAS scores for how often the participant did something for his own physical health by stating a number between 1 - 10, graded from "never" to "always" (Figure 2A); Measuring of fitness rating via computer-controlled step test; Measuring of body mass index, oxygen uptake and distribution of muscle mass (apparatus: TANITA Body Composition Analyzer BC-420MA).

The baseline for the number of steps amongst the intervention group took place at the first intervention week.

At baseline, the intervention group received the VAS (Figure 2A) so that each intervention measurement could assess which number described their actions and thoughts about their own physical health.

To provide knowledge about the effect of mobile health applications over time the men sent the longitudinal measurements to the researchers via text message [12].

The longitudinal measurements were carried out every 4<sup>th</sup> week and included:

- (I) Self-reported number of steps in a chosen week. The specific week was chosen by the researcher and was not known by the men before they received the text message about which week they had to report data from;
- (II) VAS scores of how often the participant thought about his own physical health by stating a number between 1 - 10, graded from "never" to "always" (Figure 2A);
- (III) VAS scores of how often the participant did something for his own health by stating a number between 1 - 10, graded from "never" to "always" (Figure 2A).

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<sup>1</sup>Two examples of health-promoting messages:

"How many steps do you walk daily? - 10,000 steps daily or more keep the body healthy", "Waist - is it something you have as a man? Yep and a waist below 94 cm helps prevent disease"

A total of seven measurements were carried out during the intervention period, the first at baseline measurements and the last at effect measurement point. Participants in the control group also reported VAS-scores at baseline and the effect measurements. Baseline and the effect measurements after 6 months were planned to compare the results between the intervention and control groups.

**Statistical analysis**

The statistical analysis was performed in SPSS (version 22, IBM software) and the significance level was set to 5%. The statistical work was recorded in an associated logbook.

Descriptive statistics were used to characterize the intervention and control group regarding baseline characteristics. Continuous variables were described by mean values or medians, depending on the distribution of data. Fishers exact test were used to compare status of employment in the intervention and control group between baseline and effect measurements.

One-way repeated measures ANOVA were performed as described [12]. Seven independent measurements were examined for VAS thinking, VAS doing and number of steps using the Greenhouse-Geisser correction. Degrees of freedom were 3,18 in numerator and 92,32 in denominator (VAS Thinking), 3,17 in numerator and 91,98 in denominator (VAS doing) and 3,60 in numerator and 104,40 in denominator (number of steps). Significance did not assume sphericity and was 0,001 (VAS thinking), 0,005 (VAS doing) and 0,003 (number of steps).

Five independent measurements were also examined via one-way repeated measures ANOVA about whether a change occurred in the men's physical activity level (number of steps) during the intervention period.

The final effect of the intervention was investigated by comparing the intervention and control group, where normal distributed data was compared using a t-test and non-normalized data via the Wilcoxon test.

Men's fitness, oxygen uptake, body mass index, muscle mass, blood pressure (BP) and heart rate changes between baseline and effect measurement points were also investigated using a paired t-test or a Wilcoxon test.

**Results**

Since the men's type of mobile phone was used to allocate participants in the control group or the intervention group, allocation was not random.

Both control and intervention groups were not significantly different at baseline regarding general parameters including age, marital status, unemployment time and physical health parameters measured. There was though a significant difference (p = 0,028) at the educational level, where the control group showed a higher number of individuals (62,9%) with no education compared to that of the intervention group (37,5%).

During the intervention period 22,5 % and 31,4 % in the intervention and control group did not complete effect measurements and were excluded from the statistical analysis. In some cases, measurements could not be carried out due to the participants physical or psychological conditions (Figure 1). The individuals that did not complete all measurements were excluded from the statistical analysis.

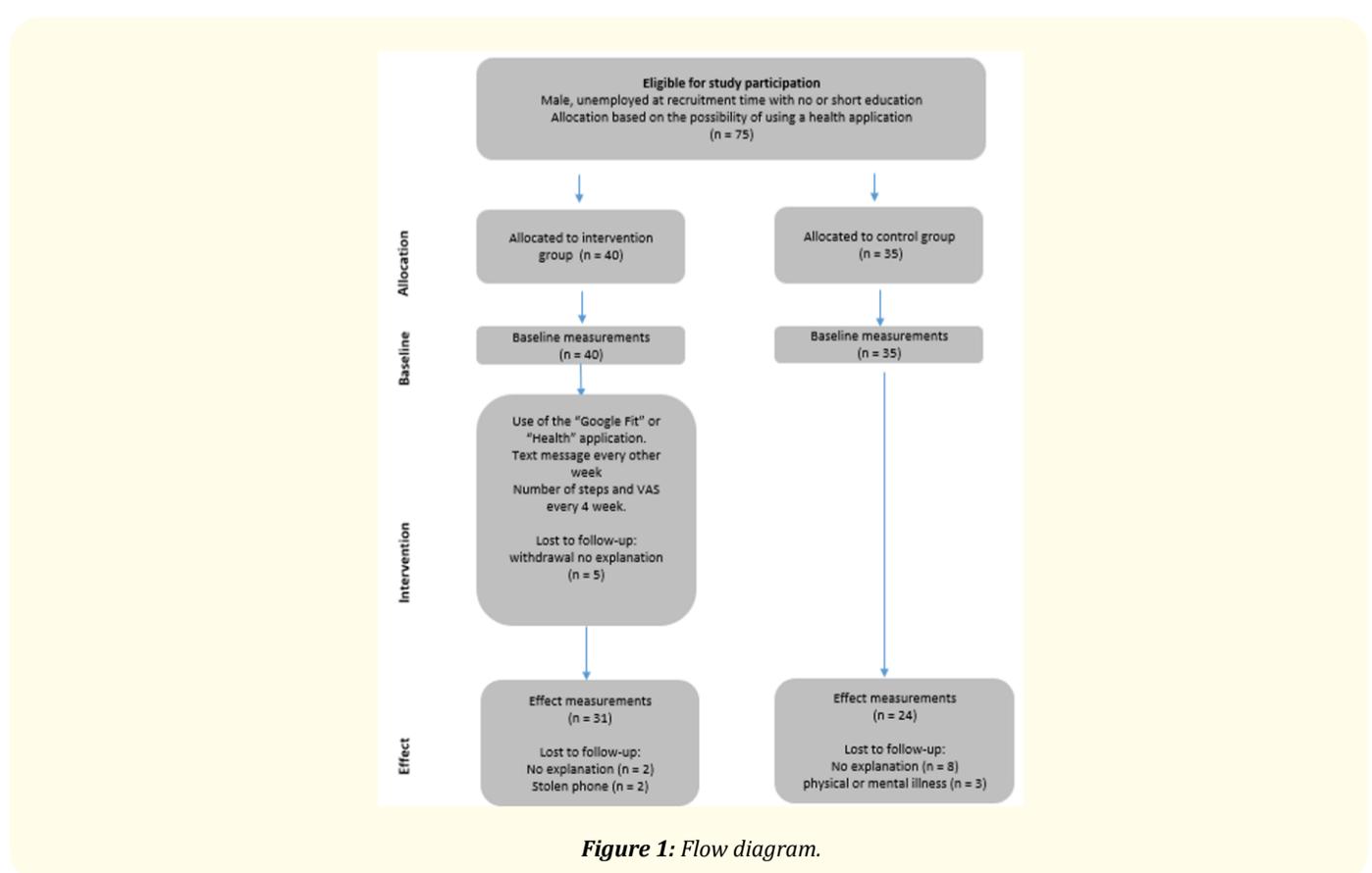
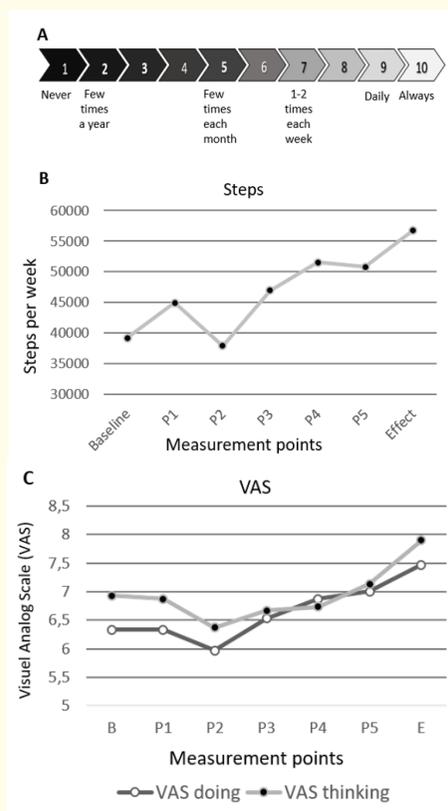


Figure 1: Flow diagram.

**Longitudinal measurements in the intervention group, steps, VAS thinking and VAS doing**

The participants in the intervention group (n = 31) sent text messages for the number of steps and registered VAS doing and thinking in five chosen weeks in the intervention period (Figure 2).



**Figure 2:** Longitudinal measurement of steps, VAS doing and VAS thinking at seven measurement points.  
A: VAS scale, B: Steps per. week, C: VAS doing and VAS thinking

Number of steps per week was characterized by an initial decrease between measurement points one and two and was followed by a steady increase tendency in number of steps that culminated at the effect point, where the maximum value was reached (Figure 2).

The pattern shown by the number of steps was comparable to those shown by the reported VAS doing and thinking values. The increase of VAS thinking and doing values showed a significant increase of 1.00 between baseline and effect measurements (Table 1).

The number of steps and reported VAS values were analyzed using one-way repeated measures ANOVA and the results confirmed the tendency described above. All three ANOVA analysis showed significant linearity, number of steps (p = 0,005, partial eta squared 24,4%), VAS doing (p = 0,01, partial eta squared 20,7%) and VAS thinking (p = 0,035 partial eta squared 14,5%).

**Baseline and effect points of VAS and physical health**

Table 1 shows that median VAS scores for both thinking and doing were similar in both groups at baseline. In the intervention group we observed a significant increase (p < 0,05) in both VAS thinking and doing between baseline and effect measurements, whereas the increase in the control group was non-significant.

In the intervention group most changes of the physical health parameters measured were not significant.

The intervention group did not register any significant change in most of the physical health parameters measured (muscle mass, body fat, weight, systolic and diastolic blood pressure and BMI) with very similar values at baseline and effect time points. Interestingly, both fitness rate and oxygen uptake had a positive significant increase (p < 0,001) (Table 1).

Variable	Intervention group (n = 31)					Control group (n = 24)				
	n	Missing	Baseline	Effect	p-value	n	Missing	Baseline	Effect	p-value
VAS thinking (NND) - median (IQR)	31 (77,5%)	9 (22,5%)	7,0 (5,0;9,0)	8,00 (7,0;9,0)	0,035*	24 (68,6%)	11 (31,4%)	7,0 (5,0;9,0)	7,50 (6,25;9,0)	0,60
VAS doing (NND) - median (IQR)	31 (77,5%)	9 (22,5%)	7,0 (5,0;8,0)	8,00 (7,0;9,0)	0,009*	24 (68,6%)	11 (31,4%)	7,00 (5,25;8,0)	7,50 (3,25;9,0)	0,92
Fitness rating (ml/min/Kg) (NND) - median (IQR)	25 (62,5%)	15 (37,5%)	30,0 (25,0;34,0)	33,0 (28,5;37,5)	<0,001*	18 (51,4%)	17 (48,6%)	31,0 (27,0;42,5)	37,5 (28,0;47,0)	0,011*
Oxygen uptake (VO <sub>2</sub> ) (l/min) (NND) - median (IQR)	25 (62,5%)	15 (37,5%)	2,60 (2,20;2,85)	2,80 (2,45;3,50)	<0,001*	18 (51,4%)	17 (48,6%)	2,70 (2,18;3,03)	2,75 (2,37;3,55)	0,020*
Muscle mass (kg) (ND) - middel (SD)	31 (77,5%)	9 (22,5%)	63,4 (9,49)	63,8 (8,31)	0,484	24 (68,6%)	11 (31,4%)	62,96 (9,47)	64,64 (11,14)	0,043*
Body fat (%) (ND) - middel (SD)	31 (77,5%)	9 (22,5%)	22,3 (8,73)	22,2 (8,83)	0,865	24 (68,6%)	11 (31,4%)	19,97 (8,36)	17,08 (7,59)	0,001*
SBP (mm Hg) - (nnd) - median (IQR)	31 (77,5%)	9 (22,5%)	134 (126;145)	132 (124;143)	0,161	24 (68,6%)	11 (31,4%)	133 (126;141)	130 (123;138)	0,043*
DBP (mmHg) - (nnd) - median (IQR)	31 (77,5%)	9 (22,5%)	87 (80;91)	84 (76;92)	0,126	24 (68,6%)	11 (31,4%)	83 (78;90)	81 (75;92)	0,212
Body weight (kg) (ND) - middel (SD)	3 (7,7%)	9 (22,5%)	87,6 (19,1)	87,8 (17,5)	0,836	24 (68,6%)	11 (31,4%)	84,2 (17,95)	83,1 (18,01)	0,121
BMI (ND) - middel (SD)	31 (77,5%)	9 (22,5%)	27,4 (6,02)	27,5 (5,71)	0,846	24 (68,6%)	11 (31,4%)	25,3 (4,02)	24,9 (4,05)	0,099
RHR (bpm) (ND) - middel (SD)	31 (77,5%)	9 (22,5%)	76,4 (13,1)	79,0 (14,0)	0,270	24 (68,6%)	11 (31,4%)	74,3 (13,2)	75,0 (12,7)	0,677

**Table 1:** Measurement of VAS thinking and doing, physical- and cardiovascular parameters at baseline and effect measurement.

\* Statistically significant P < 0,05.

SD: Standard Deviation.

IQR: Inter Quartile Range.

ND: Normal distribution, average value, standard deviation (SD) and t-test.

NND: Non-normal distribution, median value, inter quartile range (IQR) and Wilcoxon test.

In contrast, the control group showed a significant improvement in almost every single parameter except diastolic blood pressure,

Occupational status	Intervention group (n = 31)	Control group (n = 24)	P-value*
<b>Week 1-4</b>			1,00
Unemployed	29 (93,5%)	23 (95,8)	
Employed	1 (3,2%)	0 (0%)	
Studing	1 (3,2%)	1 (4,2%)	
<b>Week 5-8</b>			0,88
Unemployed	25 (80,6%)	20 (83,3)	
Employed	4 (12,9%)	2 (8,3%)	
Studing	2 (6,5%)	2 (8,3%)	
<b>Week 9-12</b>			0,38
Unemployed	19 (61,3%)	19 (79,2%)	
Employed	6 (19,4%)	3 (12,5%)	
Studing	6 (19,4%)	2 (8,3%)	
<b>Week 13-16</b>			0,94
Unemployed	16 (51,6%)	14 (58,3%)	
Employed	9 (29,0%)	6 (25,0%)	
Studing	6 (19,4%)	4 (16,7%)	
<b>Week 17-20</b>			0,59
Unemployed	13 (41,9%)	13 (54,2%)	
Employed	12 (38,7%)	6 (25,0%)	
Studing	6 (19,4%)	5 (20,8%)	
<b>Week 21-24</b>			0,94
Unemployed	12 (38,7%)	11 (45,8%)	
Employed	11 (35,5%)	7 (29,2%)	
Studing	8 (25,8%)	6 (25,0%)	

**Table 2:** Occupational status during 6 months of follow up among participants in the intervention and control group.

\*Fisher's exact test.

weight and BMI (Table 1).

Table 2 shows no statistical difference in occupational status between the intervention and control group during the six months of follow-up although the proportion of unemployed was higher in the control group throughout the period.

**Discussion**

This controlled clinical trial shows that the use of m-Health had limited influence on the physical health of unemployed men with no or short education. The physical health improved significantly in fitness rate and oxygen uptake, while other health parameters showed no

statistical change. However, the control group showed a significant improvement in several health parameters (Table 1). When comparing the longitudinal data on number of steps per week, VAS thinking and VAS doing, results shows a significant increase in these values, which could partly explain the improvement in selected health parameters in the intervention group.

In both groups part of the men changed status of employment during follow up, and after 6 months, more than half of the men in both groups had begun studying or got paid employment. There was no significant difference in employment status between the two groups during the 6 months follow-up. A prospective study among unemployed showed that reemployment significantly increased self-rated health and quality of life [17], therefore it is possible that the effect observed in this study may be biased due to re-employment or studying.

Further analysis of data in the intervention group has shown a higher step count among men who were reemployed or began studying compared to those who remained unemployed during intervention (data not shown), and the increase in step count could be partially explained by the movement derived from assisting to classes and showing up to work.

Both VAS thinking and doing show a significant one-point increase in the intervention group (Table 1). We don't expect VAS thinking and doing to be affected directly by employment status, and data suggests no difference in the increase of VAS-thinking between unemployed and reemployed individuals, while reemployed seemed to have a greater increase in VAS-doing. Among controls we did not observe an increase in VAS thinking among reemployed participants, while a modest increase was observed among those who remained unemployed or began studying.

Results might suggest that the accomplishment of a job or a study alone is not necessarily followed by an increase on either thinking or doing something about health among men with no or short education. In contrast, those that were encouraged by a general health-promoting message and using m-Health seemed to have a positive impact in both thinking and doing something about their health.

Both "Google fit" and "Health" made it possible for the participant to formulate personal goals for their physical activity and receive a motivational feedback message when they had reached their goal [3,15].

We observed that, the longitudinal results of number of steps and VAS thinking and doing in the intervention group are consistent and show a decrease at measurement two (Figure 2), this might indicate a limited effect of using an m-Health over time. A qualitative study shows that tracking data by m-Health technology should be combined with health care partnership to sustain motivation and engagement regarding change of health behavior [18]. In our study we observe, a steady increase in number of steps and VAS thinking and doing between measurement three and the effect measurements (Figure 2), and this might suggest that combining the use of an m-Health with a general health-promoting message every other week, can promote awareness of health and a change in health behavior.

The improvement in health parameters was surprisingly more pronounced among controls. In both groups part of the improvement might be explained by change of occupational status. As results show no statistically significant difference in occupational status between the intervention and control group during follow up this can't explain the pronounced improvement among controls alone. It is likely that men in both groups are affected by baseline measurements of their health status. All men were presented with their results of baseline measurements by a health professional and it is possible that this knowledge could motivate participants to changes their health behavior. There may be several reasons for the health improvements among controls and it could be interesting to investigate how measurements of parameters related to physical health and contact to a health professional can affect behavioral change among unemployed men.

The strengths of this study are the intervention period with 6 months of follow-up with a target group that statistically thinks least of their own health.

### Limitation of the Study

The limitations of the study are that randomization was not possible as it relied on the men's type of mobile phone. However, there was no significant difference between the intervention and control groups with regards to baseline characteristics except for level of education. Limitations also include loss to follow up as respectively 77,5% and 68,6% in the intervention and control group completed effect measurements. For some participants completion was not possible due to physical<sup>2</sup> or psychological<sup>3</sup> conditions, and this might emphasize the vulnerability of the group included in this study.

### Conclusion

The use of m-Health had limited influence on the physical health of unemployed men with no or short education. However, the participation of the control group in this trial improved significantly the individual's fitness rate, oxygen uptake, muscle mass, and systolic blood pressure.

The intervention group improved their number of steps per week, VAS thinking and doing values significantly. The improvement in VAS thinking and doing values was noticeable for those individuals that remained unemployed after the trial period, in contrast with those in the control group.

The results showing that both groups present measurable improvements in several health parameters suggest that this intervention, followed by a follow-up and combined with a general health-promoting message text, could be a cost-effective strategy for unemployed individuals with low or no education to positively affect their physical activity and the way they think or do something about it.

This research is reported and approved by the Data Inspectorate for Personal Data Protection Act § 48.1 complies with the current laws of Denmark. The authors have no conflicts of interest to declare.

### What is known about this topic

- A high degree of social inequality is reflected in men's average lifespan when considering length of education and income.
- Unemployment is associated with poorer physical and mental health and increased risk of premature mortality.
- The use of m-Health and adoption of healthy lifestyles spread rapidly.

### What this paper adds

- Knowledge of how m-Health affects the physical health of unemployed men and their frequency of thinking and doing something to promote their health.

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<sup>2</sup>For example, measuring of fitness rating was not possible due to knee injury.

<sup>3</sup>For example, measuring of fitness rating was not possible due to depression.

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