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Title: Perceived sufficiency of physical activity levels among adults at high risk of type 2 diabetes. The FIN-D2D study

Year: 2012

Version:

Please cite the original version:

Vähäsarja, K., Salmela, S., Villberg, J., Rintala, P., Vanhala, M., Saaristo, T., Peltonen, M., Keinänen-Kiukaanniemi, S., Korpi-Hyövälti, E., Moilanen, L., Niskanen, L., Oksa, H., & Poskiparta, M. (2012). Perceived sufficiency of physical activity levels among adults at high risk of type 2 diabetes. The FIN-D2D study. International Journal of Behavioral Medicine, 21(1), 99-108. https://doi.org/10.1007/s12529-012-9285-7

International Journal of Behavioral Medicine

Perceived sufficiency of physical activity levels among adults at high risk of type 2 diabetes. The FIN-D2D study

--Manuscript Draft--

Manuscript Number:	IJBMe405R2
Full Title:	Perceived sufficiency of physical activity levels among adults at high risk of type 2 diabetes. The FIN-D2D study
Article Type:	Full length manuscript
Keywords:	physical activity; exercise; Type 2 diabetes; prevention; perception; awareness; sufficiency; behaviour change; lifestyle intervention; FIN-D2D
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Abstract:	Purpose. This study assessed the determinants of perceived physical activity levels (PALs) among adults at high risk of diabetes, and the associations with self-reported physical activity. Methods. In total, 10,149 adults participated in the FIN-D2D lifestyle intervention at baseline. Opportunistic screening was used in identifying high risk individuals. Physical activity and perceived PAL sufficiency were assessed and compared. Key risk factors for diabetes and psychosocial and demographic characteristics were analyzed as determinants using logistic regression. Results. PAL sufficiency was rated realistically by 73% of men and 75% of women. Perception of sufficient PAL was more likely among individuals with a smaller waist circumference, a higher level of perceived fitness, and no exercise intention. In men, a higher age, and in women, a lower education, and a lower occupational status, also

	increased the likelihood of perceiving PAL as sufficient. Out of all the participants, 65% of men and 66% of women were inactive. Among the inactive participants, 20% (men) and 16% (women) overestimated their PAL sufficiency. In both genders such overestimation was predicted by dyslipidemia, a lower waist circumference, a higher level of perceived fitness, and no exercise intention; also (among men) by a higher age and a family history of diabetes, and (among women) by a lower occupational status, and a lower BMI. Conclusions. In diabetes prevention, it is important to recognize the groups that perceive their PAL as sufficient, since they may not see increased PAL as a tool for decreasing their risk of diabetes.
Response to Reviewers:	Dear Editor and Reviewer #1, Thank you for your comments regarding our manuscript. We are pleased to hear the manuscript is ready to be accepted with minor changes. We have made the corrections as suggested, please see below; 1) The last referee comment (item 9) about content and presentation of Table 2 have only partly been corrected. The content is now OK, but there is still in my view two p-values that are redundant (presentation). I refer to the bottom of the table in the level of "Stage of change" under men's column where the text (<.001) seems to be redundant, and also (<.001) in the level of "Contemplation-maintenance" in the women's column. Authors' comment: The redundant p-values have now been removed 2) On page 10, first para, line 12: A reference is included [34], but the reference list only contains 33 references. Please check the reference list. Authors' comment: We have now checked the reference list and corrected the reference numbers. Associate Editor - could the authors please add the total N of participants in each category of each independent variable, for both men and women, to Table 2 (i.e., two new columns preceding the % columns, indicating the number of participants in each category). Authors' comment: We have now added new columns with the total N of participants (men and women) in each category. To be more reader-friendly, we have now also defined family history of diabetes, hypertension, dyslipidemia, waist-circumference in the footnotes of each table.

Covering page

Present study provides new information on individuals' physical activity perceptions. There are few studies that have previously studied how people perceive the sufficiency of their physical activity with regard to their self-reported physical activity levels and/or recommended physical activity levels. Existing literature have shown, that overestimations of one's physical activity level is a common phenomenon. However, the studies have covered only Dutch and English populations with rather small samples and only two studies have previously examined the issue among individuals at high risk of cardiovascular disease / diabetes. Previous studies have provided important information on determinants of overestimation of one's physical activity level. However, several important factors determining individual's perception of a sufficient physical activity level are still unexamined. Present study adds current literature by assessing the gender differences among the determinants, and also by suggesting new significant determinants of a perceived PAL sufficiency, examined for the first time. These findings can provide further understanding for predicting change in physical activity behaviour, which is very important in the view of health education and diabetes and cardiovascular disease prevention.

This study is important also by it's approach. The data is based on the large implementation project of a national type 2 diabetes prevention programme, which adapted successful clinical trial, Finnish Diabetes Prevention Study, into the real life settings. Implementation project covered a population of 1.4 million (total population of Finland is 5,5 million), of which data was collected from over 10 000 men and women who participated in the lifestyle intervention aiming to prevent diabetes during 2004-2008. Present study reports the baseline findings of this community-based study.

Perceived Sufficiency of Physical Activity Levels among Adults at High Risk of Type 2 Diabetes. The FIN-D2D Study

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Abstract

Purpose. This study assessed the determinants of perceived physical activity levels (PALs) among adults at high risk of diabetes, and the associations with self-reported physical activity.

Methods. In total, 10,149 adults participated in the FIN-D2D lifestyle intervention at baseline. Opportunistic screening was used in identifying high risk individuals. Physical activity and perceived PAL sufficiency were assessed and compared. Key risk factors for diabetes and psychosocial and demographic characteristics were analyzed as determinants using logistic regression.

Results. PAL sufficiency was rated realistically by 73% of men and 75% of women. Perception of sufficient PAL was more likely among individuals with a smaller waist circumference, a higher level of perceived fitness, and no exercise intention. In men, a higher age, and in women, a lower education, and a lower occupational status, also increased the likelihood of perceiving PAL as sufficient. Out of all the participants, 65% of men and 66% of women were inactive. Among the inactive participants, 20% (men) and 16% (women) overestimated their PAL sufficiency. In both genders such overestimation was predicted by dyslipidemia, a lower waist circumference, a higher level of perceived fitness, and no exercise intention; also (among men) by a higher age and a family history of diabetes, and (among women) by a lower occupational status, and a lower BMI.

Conclusions. In diabetes prevention, it is important to recognize the groups that perceive their PAL as sufficient, since they may not see increased PAL as a tool for decreasing their risk of diabetes.

Keywords: physical activity, prevention, lifestyle intervention, perception, awareness, type 2 diabetes, FIN-D2D

Introduction

Physical activity substantially reduces the risk of type 2 diabetes [1-4]. No precise amount of physical activity has been determined for the prevention of diabetes, beyond general physical activity recommendations for the adult population [5, 6], since the physical activity needed is likely to differ in different population groups [3]. However, any increase from a low level of physical activity reduces the risk of diabetes, and the protective effect of physical activity is actually strengthened among individuals at the highest risk [3].

The *precaution adoption process model* suggests that an awareness of the health risk must be present if health behavior is to change [7], as exemplified in a recent study showing higher physical activity levels (PAL) among women with diagnosed type 2 diabetes as compared to women who were unaware of having diabetes [8]. According to the model, one must be aware (i) that a change in PAL will decrease the risk of diabetes, and (ii) that the risk of diabetes is greater because of one's current PAL. [7] This means that if high-risk individuals misjudge either of these aspects, it may be unreasonable to expect them to increase their PAL, since they may not perceive the need to change their behavior, and may therefore have no intention to increase their PAL [9-14]. All in all, a lack of awareness of one's PAL insufficiency may act as an essential obstacle to health behavior processes, especially at the early stages, when one is deciding whether or not to act [7,14].

Inactive people often misperceive the sufficiency of their PAL for health [9-13]. Previous studies have suggested that as many as 46%–61% of *inactive* high-risk participants misperceive themselves as active [11, 12]. These studies found that people with a more favorable anthropometry profile [11], a lower level of education, and a higher health perception [12] were more likely to overestimate their PAL. Since any increase in PAL reduces the risk of diabetes, it is important to identify groups of people who are at high risk of diabetes but who, nevertheless, perceive that they are engaging in sufficient physical activity.

This paper aimed to assess factors that determine the perception, and specifically misperception (overestimation), of sufficient PAL among Finnish men and women at high risk of type 2 diabetes. The present article adds to current literature by reporting gender-specific determinants of perceived sufficiency of PAL; it also examines for the first time key risk factors, such as hypertension, dyslipidemia, and family history of diabetes as determinants of perceived sufficiency of PAL.

Methods

Study design and participants

The present study is part of FIN-D2D, an implementation project within a national program for the prevention of type 2 diabetes, conducted by the Finnish Diabetes Association in five Finnish hospital districts covering a population of 1.5 million during the years 2003–2008 [15-17]. The program was conducted in collaboration with the National Public Health Institute and the Ministry of Social Affairs and Health, in cooperation with the FIN-D2D Study Group. The specific aims of the program were to improve the screening of people at risk of diabetes and to detect undiagnosed diabetes. The program included intensified lifestyle interventions with high-risk individuals as part of normal clinical practice within primary health care. The Ministry of Social Affairs and Health in Finland gave permission to the National Institute for Health and Welfare (formerly National Public Health Institute) to collect the data from health care units for evaluation purposes. In addition, the Institutional Review Board (IRB) of the National Institute for Health and Welfare approved the study. Informed consent was not required, since the participants visited primary health care *as part of normal clinical routine*. The participants were given written information on diabetes prevention and on participation in the FIN-D2D project. A detailed study protocol is published elsewhere [18-20].

A modified FINDRISC score [21] (including questions on age, BMI, waist circumference, physical activity, consumption of fruits, vegetables and berries, history of antihypertensive drug treatment and high blood glucose and family history of diabetes) was used in health care centers, pharmacies, and at other public venues and events, such as health fairs and the Internet, for the opportunistic screening processing of individuals at high risk of type 2 diabetes. Individuals were referred to primary care for lifestyle intervention on a voluntary basis, if they met any of the following criteria (i) a FINDRISC test score $\geq$15, (ii) a history of gestational diabetes, (iii) a history of impaired glucose tolerance or impaired fasting glucose, or (iv) a history of coronary heart disease.

The baseline data of the FIN-D2D high-risk cohort were collected in 400 primary health care centers and occupational health clinics between 2004 and 2008. Altogether, 10,149 individuals aged 18–87 participated in the baseline assessments during this period. Out of these, 9,984 individuals, of whom 67% were women, met the criteria for being at high risk. Glucose tolerance [22] was assessed with an oral glucose tolerance test (OGTT) for 8,353 of the participants. Individuals with

type 2 diabetes (previously-diagnosed or screen-detected) were excluded from the analysis, leaving 7,128 individuals in the analysis (Table 1).

Assessments

Participants filled in a baseline questionnaire by their second baseline health check-up. The questionnaire included items on socio-demography, family illnesses, personal health status, and health behavior. Participants' responses concerning health behavior were discussed and checked during the second check-up with the nurse, following the discussion of participants' results from the laboratory tests that were conducted between the two baseline check-ups. A family history of diabetes (mother, father, or at least one sibling) was assessed via a self-report with the response options *yes/no*. Nurses conducted the anthropometric measurements and recorded the results of the laboratory tests during the first two baseline check-ups [16]. Blood pressure (mmHg) was measured to the nearest 1mmHg (readings taken twice from the right arm in sitting position, with at least a 1 min. interval). The mean reading was recorded. Plasma lipids and lipoproteins were determined locally from fasting venous blood samples using enzymatic methods. Height and weight were measured for the calculation of BMI (kg/m²). The participants were classified into two groups by BMI (<30 kg/m^2 and ≥30 kg/m^2). Waist circumference was measured to the nearest centimeter and classified into two groups: (1) normal or elevated (men <102 cm, women <88 cm), and (2) high risk (men ≥102 cm, women ≥88 cm). International definitions [23, 24] were used for the risk factor cut-off points (see Table 1).

The perceived PAL sufficiency was assessed with the question, "Do you consider the level of your physical activity to be sufficient to maintain your physical fitness or health?" The response options were *yes/no*. Moderate/vigorous leisure-time physical activity was assessed via questions similar to validated questions previously used in Finnish population studies [25]: (i) "How many times a week do you engage in leisure-time physical activity that causes at least slight perspiration or shortness of breath?", (ii) "How long do you usually engage in leisure-time physical activity at a time?" The response options for (ii) were: *I do not exercise, less than 15 minutes, 15–29 minutes, 30–59 minutes, 1 hour or more*. Here the respondents were asked to exclude household and commuting physical activities. Thereafter, the respondents described how much physical activity was included in their leisure activities during a normal week. Here the response options ranged from *inactivity* (watching TV, reading), to *moderate* (walking, gardening) and *vigorous* (running, swimming, competitive sports) physical activities. Participants were classified as *active* if they

performed leisure-time physical activity for at least 30 minutes on three or more days a week, and if they described the intensity of their usual leisure activity as at least moderate. The others were classified as *inactive*. The participants' awareness of their PAL was assessed by comparing the perceived sufficiency of their physical activity with their self-reported leisure-time physical activity.

Physical activity intention was assessed with a question determining the participant's readiness to change[14]: "Have you increased the level of your physical activity during the last year?" Here there were five response options, corresponding to *precontemplation, contemplation, preparation, action,* and *maintenance* stages. Participants also rated their current physical fitness, via the response options *very high, fairly high, satisfactory, fairly low,* and *very low*.

Statistical Analysis

The analysis was carried out separately for men and women throughout the study. As in previous studies [9-13], participants were classified into four categories according to their awareness of their physical activity level. Standard descriptive analyses were performed and Pearson's Chi Square tests were used to find the associations of personal factors, selected type 2 diabetes risk factors, and psychosocial factors with the perceived PAL sufficiency. A multivariable logistic regression model was used to evaluate the factors (personal, psychological, anthropometric, and clinical risk factors) associated with the perceived sufficiency of PAL among (i) all participants (Table 2), and (ii) *inactive* participants (Table 3). For each determinant, the category at the lowest risk for diabetes was selected as the reference category. Medication for a risk condition was regarded as indicating a risk condition. The results are presented as adjusted odds ratios (OR) and 95% confidence intervals (CI). The *P*-value for statistical significance was defined as $P < 0.05$.

Results

In total, 7,128 individuals (females 64%) were included in the analysis. The mean age of the participants was 55.4 years (SD: 10.2) and the mean BMI 32 kg/m² (SD: 5.2) (Table 1). In total, 65% of men and 66% of women were physically inactive, and 67% of men and 70% of women rated their PAL as insufficient to maintain health and physical fitness.

Overall, 73% of men and 75% of women rated the sufficiency of their PAL realistically (Fig. 1). These percentages included both those who were active and who rated their PAL as sufficient

(*realistically active*: 21% of men, 20% of women), and those who were inactive and perceived their PAL as insufficient (*realistically inactive*: 52% of men, 55% of women). In total, 13% of men and 10% of women overestimated the sufficiency of their PAL, whereas 14% of men and 15% of women underestimated it. Out of the inactive men (n=1,685) and women (n=2,982), 20% and 16% respectively overestimated the sufficiency of their PAL.

Perceived sufficiency of PAL among both active and inactive participants

Men and women who perceived their PAL as sufficient were more likely to have a smaller waist circumference, higher self-rated fitness, and no intention to increase their physical activity. Furthermore, higher age increased the odds of perceiving PAL as sufficient in men (Table 2). Among the occupational groups, retired women were the most likely and women with non-manual jobs the least likely to perceive their PAL as sufficient. In addition, women with low education were more likely to perceive their PAL as sufficient compared to women in the highest educational group.

Overestimation of sufficient PAL among inactive participants only

Among those inactive participants who incorrectly rated their PAL as sufficient (Table 3), overestimation was more likely among both men and women with a smaller waist circumference and with dyslipidemia. In addition, those who rated their fitness higher, and who did not intend to increase their physical activity, were more likely to overestimate the sufficiency of their PAL. Other determinants differed between men and women: among men, being over 65 and having a family history of diabetes both increased the likelihood of overestimation of PAL. Among women, having a BMI<30kg/m^2, being retired, and being a manual worker increased the likelihood of overestimation.

Discussion

In all, two-thirds of the high-risk participants in FIN-D2D were inactive. This was close to the proportion of study participants (69%) who perceived their PAL as insufficient to maintain their health and physical fitness, reflecting the general high awareness of physical activity levels among the Finnish high-risk population. Further analysis showed that (according to the present study criteria) three out of four participants were correctly aware of the sufficiency of their PAL. Out of

all the participants, the sufficiency of PAL was overestimated by 13% of men and 10% of women. The proportions presented here are similar to those found by Lechner et al. [9], taking into consideration the significantly higher number of active participants in their study (67%). However, our numbers differ from findings in other studies, including studies on high-risk populations [11, 12], in which the numbers of overestimators were significantly higher, representing 26%–36% [11-13] of the populations in question. In the present study, the proportion of overestimators among the *inactive* participants (20% of men, 16% of women) was also significantly lower than in previous studies, in which the proportions of inactive overestimators ranged from 46% to 61% [9-13].

The lower proportion of overestimators among the inactive participants in the present data may have several explanations. Firstly, the FIN-D2D participants had recently become aware of their risk of developing type 2 diabetes. In previous awareness studies [11, 12] the risk of diabetes was not as recently or as extensively defined for the participants. Secondly, the nationwide FIN-D2D diabetes prevention program [15, 16] has inevitably increased general awareness of the importance of physical inactivity as a risk factor for type 2 diabetes among the Finnish population. Thirdly, the low percentage of overestimators may be due to the predominantly obese study population. From this and previous studies it appears that overestimation is particularly associated with a lower weight status [9, 11-13, 26]. Thus, a higher weight status may protect the individual from making overestimations. Fourthly, in awareness studies there is variation in the methods of assessing physical activity and self-rated PAL sufficiency, and also in population characteristics; this partly explains the differences between the studies.

Overall determinants of perceived sufficiency of PAL

In the present study the association of perceived sufficiency of PAL with dyslipidemia, hypertension, and family history of diabetes was analyzed for the first time; however, no significant associations were detected in the analysis for the participants in total (but see comments on overestimation below) – a disappointing result in the sense that for the purposes of diabetes prevention it would be desirable that individuals with these conditions would differ from individuals without these conditions in their perceptions of PAL sufficiency. We conducted analysis by using both, self-reported and objective health indicators and received similar associations with PAL sufficiency (values from the objective assessments were finally included in the report).

As in a previous study [26], the present study showed a significant association of perceived PAL sufficiency with weight status and with age. How an individual views his/her weight status, or how fit he/she feels, not surprisingly influences the perception of whether the individual is engaging in enough physical activity. In diabetes prevention, the kind of illusion involved here is worth recognizing: in the first place, a normal weight does not compensate for a lack of physical activity in preventing the disease [27], and secondly, perceived physical fitness can be misleading, since the disease can develop for years without the appearance of symptoms. Having more time available for physical activity in higher age groups and during retirement may lead people (men, in the present data) to think they are engaging in enough physical activity. Moreover, in assessing their personal PAL, people may seek to enhance their self-image by comparing themselves with peers who are less successful – a feature particularly prevalent among those who overestimate their physical activity levels [9]. Less educated women were more likely to regard their PAL as sufficient than others, even though the prevalence of not engaging in regular physical activity is higher among less jeducated Finnish women [28]. This may be related to physically more demanding jobs among the less educated women, lower general health awareness, or to lower personal standards for sufficient PAL [12]. Overall, this would be in line with a tendency for less educated high-risk individuals to have fewer concerns about developing diabetes in the future compared to more educated individuals [29].

Determinants of overestimation of PAL

The present study is the first to indicate that individuals who are at a higher health risk (having dyslipidemia in men and women, and a family history of diabetes in men) are more likely to overestimate their PAL than healthier participants. In previous studies, healthier people (by BMI, waist circumference, smoking, perceived health) were found to be more likely to overestimate their PAL than others [9, 11, 12]. In the present data, this was true of waist circumference and self-rated fitness in both sexes, and also of BMI among women.

Indicators of a higher health risk, such as a family history of diabetes, have previously been shown to be strongly associated with greater concern about developing diabetes [29]. One might expect this to lead to more critical self-assessments of PAL; nevertheless, the present data did not consistently support this assumption. Perhaps the causes of dyslipidemia lie on overestimation of one's PAL sufficiency? Our data are in line with a previous study in which overestimators gave a lower score to *health* as a reason to be physically active than did other awareness groups [9]. An

interesting gender-specific finding, observed in both the present study and another recent FIN-D2D study [30], is that increasing PAL seems to be, for many reasons, more challenging among men with a family history of diabetes than among men without such a family history.

Increased waist circumference (unlike dyslipidemia, hypertension, or a family history of type 2 diabetes) emerges an important health-related determinant causing high-risk individuals to regard their PAL as insufficient. This could be linked to the immediately-apparent nature of waist circumference, as compared to factors that are not readily noticeable, such as dyslipidemia, hypertension, and a family history of diabetes. Hence, this study suggests that obese individuals may not be the persons with the greatest problems in perceiving PAL sufficiency, even if these are the persons who are most frequently advised by health professionals to increase their PAL [31]. This finding has implications for future interventions. A larger weight circumference does not necessarily mean that a person's PAL awareness needs to be increased, since he/she may well be fully aware of his/her PAL insufficiency. The individual might benefit more from concrete professional help in changing behavior, rather than from being badgered on a self-evident matter. In fact, a more useful recommendation would be to pay special attention to perceptions of PAL sufficiency among persons with dyslipidemia, hypertension, and a family history of diabetes.

The association between overestimation of PAL and aging is worth recognizing, since the risk of type 2 diabetes increases in parallel with age [22]. Further examination is required concerning the reasons why – among women only – education and occupational status emerge as determinants of perceived sufficiency and overestimation of PAL. It may be that these associations involve gaps in participants' knowledge concerning how much physical activity is sufficient for health, in which case one is led to ask what causes the gender differences in such knowledge.

The results of the present and previous studies [11-13] showing that a lack of physical activity intention is associated with overestimation are in line with the transtheoretical stages of change model [14]. According to this model, increasing the individual's awareness is especially important at the *precontemplation* stage of change, i.e. in the period when person is *not* considering change. Our finding provides further understanding of one of the key barriers to embarking on the health behavior change process, namely, being unaware of or unengaged in one's current PAL, as suggested by the precaution adoption process model [7].

This study is limited by its cross-sectional design, and also by the self-reporting measures of physical activity, which can be prone to bias [32]. Hence, the actual prevalence of active subjects among the high-risk population outside the program may have been even lower. Total physical activity assessments, using objective techniques, would undoubtedly improve the estimation of physical activity engagement [12] and assist comparisons between studies. However, the self-reporting measures used here were used in the FIN-D2D study to enable comparisons with other Finnish population studies (using similar measures of physical activity). It may also be noted that the categorization of inactive and active participants was not completely consistent with current physical activity recommendations [5, 6] due to the limitations of the questionnaire. On the other hand, among the predominantly obese population at high risk of type 2 diabetes (for whom any increase in PAL is of great benefit), it seems reasonable to use lower cut-off point for categorizing the participants' PAL [33]. A general point to note is that the results of this study are based on the classification defined in the Methods section and should be interpreted accordingly.

It should further be noted that in the literature, definitions of "sufficient PAL" vary, and that this makes comparisons between studies far from straightforward. Other aspects to bear in mind include the point that something other than a one-item measure for the assessment of perceived PAL sufficiency could improve the reliability of the measure. In addition, the assessment of the readiness to change is limited by a measure not validated in the Finnish population. Finally, one should be aware that selection bias is a possibility limiting the generalizability of the present results, although there seems no obvious reason why the trends observed in the present study with such a large sample size would not be present also in the wider high-risk population.

Conclusions

In this paper, we have reported the determinants of one potential barrier to physical activity behavior change, namely perceived sufficiency of one's PAL. According to our data, increased waist circumference, as the most visible health risk marker, seems to make high-risk individuals consider their PAL to be insufficient, whereas dyslipidemia, hypertension, and a family history of diabetes do not have this effect. Hence, obese subjects do *not* seem to be the persons with the greatest problems in the perception of PAL sufficiency. In future interventions aimed at preventing diabetes, high-risk individuals should be provided with concrete information on *all* the risk factors for diabetes, and on each risk factor relating to insufficient physical activity. Health counselors should be especially aware of the tendency for individuals with dyslipidemia and men with a family

history of diabetes to overestimate their PAL. The study also found gender-specific determinants of perceived sufficiency of PAL; these need to be recognized and further examined.

Acknowledgements

The following individuals contributed to the present study as members of the FIN-D2D Study Group: Ahonen K, Aro E, Eriksson J, Hiltunen L, Himanen O, Huttunen J, Hyytiä A, Ilanne-Parikka P, Jokelainen J, Järvi H, Kallanranta T, Kangas J, Kastarinen M, Keinänen-Kiukaanniemi S, Kesäniemi A, Kiuru S, Kivekäs J, Korpela K7, Korpi-Hyövälti E, Kujala U, Kukkonen-Harjula K, Kunnamo I, Laakso M, Lehmusaho M, Lindström J, Marttila J, Mäkinen O A, Niskanen L, Oksa H, Peltonen M, Pesonen K, Pihlajamäki J, Poskiparta M, Puolakka J, Puska P, Pyylampi H, Pölönen A, Riihelä J, Rimpelä A, Saaristo T, Saltevo J, Sampo T, Saramies J, Sintonen H, Syrjäläinen J, Tuomilehto J, Uusitupa M, Vanhala M and Winell K.

The writing of the present article was funded by the Ministry of Social Affairs and Health, the Social Insurance Institution of Finland, the Diabetes Research Foundation of Finland, the Ministry of Education and Culture, and the Juho Vainio Foundation. FIN-D2D was supported by financing from hospital districts of Pirkanmaa, Southern Ostrobothnia, North Ostrobothnia, Central Finland and Northern Savo; also by the Finnish National Public Health Institute, the Finnish Diabetes Association, the Ministry of Social Affairs and Health in Finland, and Finland´s Slot Machine Association, in cooperation with the FIN-D2D Study Group, and the Steering Committee consisting of Huttunen J, Kesäniemi A, Kiuru S, Niskanen L, Oksa H, Pihlajamäki J, Puolakka J, Puska P, Saaristo T, Vanhala M, and Uusitupa M. The FIN-D2D study has also been financially supported by the Academy of Finland (grant number 129293) and the Commission of the European Communities, Directorate C−Public Health (grant agreement no. 2004310). We thank Donald Adamson, Lecturer in English, University of Jyväskylä, for editorial advice.

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table 1
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Table 1. Characteristics of study participants by sex

	Men (N=2,577)	Women (N=4,551)
	(%)	(%)
Age (years)		
<45	14	13
45-54	32	31
55-65	20	21
>65	34	35
Marital status		
Married/Cohabiting	77	72
Other	23	28
Educational level		
Low	41	39
Intermediate	50	53
High	9	9
Occupational status		
Non-manual work	25	44
Manual work	34	9
Retired	34	35
Not employed	7	13
Family history of diabetes[1]	57	66
Hypertension[2]	74	67
Dyslipidemia[3]	30	40
Body mass index (kg/m$^{2)}$		
<30	43	37
≥30	57	63
Waist circumference[4]		
Normal	8	3
Elevated risk	22	11
High risk	70	87
Self-rated fitness		
High	28	27
Satisfactory	50	49
Low	22	25
No intention to increase physical activity level (PAL)	11	7

[1]*At least one of the first-degree relatives had diabetes (type 1 or 2)*
[2]*Systolic blood pressure ≥130 mmHg and/or diastolic blood pressure ≥85 mmHg*
[3]*HDL < 1.03 mmol/l (men), <1.29 mmol/l (women); LDL ≥3 mmol/l or/and triglycerides ≥1.7 mmol/l, or medication for these lipid abnormalities*
[4]*Normal or elevated risk: m <102cm, w <88cm; high risk; m ≥102cm, w ≥88cm*

table 2

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Table 2. Multivariable logistic regression model for perception of physical activity level (PAL) as sufficient among adults at high risk of diabetes, by selected variables: prevalence rates (%), adjusted odds ratios (OR) and their 95% confidence intervals (CI), and *p* values by sex

	Men (N=2,577)					Women (N=4,551)				
	n	%	OR	(95% CI)	*p*	*n*	%	OR	(95% CI)	*p*
Personal factors										
Age (years)										
<45	57	16	1.00			113	19	1.00		
45-54	212	26	1.19	(0.78-1.82)	.423	336	24	1.16	(0.78-1.54)	.613
55-65	161	32	1.83	(1.16-2.90)	**.009**	272	28	1.11	(0.81-1.65)	.418
>65	423	48	2.23	(1.37-3.62)	**<.001**	625	39	1.10	(0.75-1.59)	.599
Marital status										
Married/Cohabiting	654	34	1.00			934	29	1.00		
Other	191	32	1.21	(0.91-1.61)	.193	402	32	1.10	(0.90-1.36)	.353
Educational level										
High	64	28	1.00			97	24	1.00		
Intermediate	371	29	1.19	(0.75-1.89)	.449	617	26	1.16	(0.81-1.66)	.429
Low	413	40	1.40	(0.87-2.24)	.164	624	36	1.49	(1.03-2.17)	**.035**
Occupational status										
Non-manual work	144	23	1.00			430	22	1.00		
Manual work	253	30	1.28	(0.91-1.79)	.158	123	32	1.99	(1.43-2.77)	**<.001**
Retired	400	46	1.45	(0.99-2.14)	.059	633	40	2.45	(1.84-3.26)	**<.001**
Not employed	43	24	1.05	(0.61-1.81)	.859	136	25	1.61	(1.18-2.19)	**.002**
Anthropometric/clinical factors										
Family hist. of diabetes[1]										
No	308	32	1.00			346	26	1.00		
Yes	423	33	1.20	(0.95-1.51)	.133	789	31	1.04	(0.87-1.26)	.700
Hypertension[2]										
No	201	31	1.00			430	30	1.00		
Yes	616	34	1.19	(0.91-1.56)	.198	867	30	1.06	(0.87-1.29)	.568
Dyslipidemia[3]										
No	469	31	1.00			772	29	1.00		
Yes	292	38	1.27	(0.98-1.65)	.072	574	31	1.20	(0.99-1.44)	.058
Body mass index (kg/^{2}m)										
<30	456	43	1.00			661	40	1.00		
≥30	364	26	0.97	(0.72-1.30)	.832	645	24	0.83	(0.68-1.03)	.084
Waist circumference[4]										
Normal or elevated risk	339	48	1.00			278	49	1.00		
High risk	441	27	0.63	(0.47-.85)	**.003**	984	27	0.59	(0.45-0.78)	**<.001**
Psychosocial factors										
Self-rated fitness										
High	423	59	1.00			705	58	1.00		
Satisfactory	383	30	0.33	(0.26-0.41)	**<.001**	587	27	0.25	(0.21-0.30)	**<.001**
Low	47	9	0.07	(0.04-0.10)	**<.001**	52	5	0.04	(0.03-0.06)	**<.001**
Stage of change										
Contemplation-maintenance	671	30	1.00			1159	28	1.00		
No intention to increase PAL (precontemplation)	174	61	3.71	(2.67-5.16)	**<.001**	176	55	3.54	(2.58-4.85)	**<.001**

[1] *At least one of the first-degree relatives had diabetes (type 1 or 2)*

[2] *Systolic blood pressure ≥130 mmHg and/or diastolic blood pressure ≥85 mmHg*

[3] *HDL < 1.03 mmol/l (men), <1.29 mmol/l (women); LDL ≥3 mmol/l or/and triglycerides ≥1.7 mmol/l, or medication for these lipid abnormalities*

[4] *Normal or elevated risk*: m <102cm, w <88cm; *high risk*; m ≥102cm, w ≥88cm

table 3
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Table 3. Multivariable logistic regression model for inactive participants perceiving their physical activity levels (PAL) as sufficient by selected variables: adjusted odds ratios (OR), 95% confidence intervals (CI), and *p* values by sex

	Men (N=1,685)			Women (N=2,982)		
	OR	(95% CI)	*p*	OR	(95% CI)	*p*
Personal factors						
Age (Years)						
<45	1.00			1.00		
45-54	0.87	(0.48-1.58)	.654	1.37	(0.83-2.28)	.219
55-65	1.63	(0.88-3.02)	.124	1.33	(0.78-2.28)	.292
>65	2.37	(1.23-4.57)	**.010**	1.50	(0.85-2.66)	.161
Marital status						
Married/cohabiting	1.00			1.00		
Other	1.35	(0.92-2.00)	.127	1.13	(0.86-1.50)	.385
Educational level						
High	1.00			1.00		
Intermediate	1.01	(0.52-1.94)	.456	1.18	(0.68.2.02)	.558
Low	1.28	(0.67-2.47)	.983	1.67	(0.97-2.90)	.067
Occupational status						
Non-manual work	1.00			1.00		
Manul work	1.47	(0.90-2.42)	.124	1.90	(1.20-2.97)	**.005**
Retired	1.53	(0.88-2.67)	.133	2.29	(1.52-3.44)	**<.001**
Not employed	0.99	(0.42-2.30)	.975	1.26	(0.68-2.02)	.317
Anthropometric/clinical factors						
Family history of diabetes[1]						
No	1.00			1.00		
Yes	1.41	(1.02-1.95)	**.039**	0.83	(0.64-1.07)	.151
Hypertension[2]						
No	1.00			1.00		
Yes	1.14	(0.79-1.64)	.481	1.08	(0.81-1.43)	.603
Dyslipidemia[3]						
No	1.00			1.00		
Yes	1.44	(1.02-2.04)	**.039**	1.35	(1.04-1.74)	**.023**
Body mass index (kg/m$^{2)}$						
<30	1.00			1.00		
≥30	0.97	(0.65-1.45)	.855	0.73	(0.54-0.97)	**.029**
Waist circumference[4]						
Normal or elevated risk	1.00			1.00		
High risk	0.56	(0.37-0.85)	**.006**	0.68	(0.47-0.99)	**.044**
Psychosocial factors						
Self-rated fitness						
High	1.00			1.00		
Satisfactory	0.42	(0.30-0.60)	**<.001**	0.30	(0.23-0.39)	**<.001**
Low	0.09	(0.05-0.16)	**<.001**	0.05	(0.03-0.09)	**<.001**
Stage of change						
Contemplation-maintenance	1.00			1.00		
No intention to increase PAL (precontemplation)	5.09	(3.39-7.64)	**<.001**	3.14	(2.09-4.71)	**<.001**

[1] *At least one of the first-degree relatives had diabetes (type 1 or 2)*
[2] *Systolic blood pressure ≥130 mmHg and/or diastolic blood pressure ≥85 mmHg*
[3] *HDL < 1.03 mmol/l (men), <1.29 mmol/l (women); LDL ≥3 mmol/l or/and triglycerides ≥1.7 mmol/l or medication for these lipid abnormalities*
[4] *Normal or elevated risk: m <102cm, w <88cm; high risk; m ≥102cm, w ≥88cm*

line figure 1
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Figure legend:

Figure 1. Participants classified into categories of physical activity awareness by sex.