

1 **Determinants of physical activity among patients with type 2 diabetes: The**
2 **role of perceived autonomy support, autonomous motivation and self-care**
3 **competence**

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19 **Determinants of physical activity among patients with type 2 diabetes: The**
20 **role of perceived autonomy support, autonomous motivation and self-care**
21 **competence**

22 Based on self-determination theory (SDT), this study investigated, whether the three central
23 SDT variables (perceived autonomy support, autonomous motivation and self-care compe-
24 tence), were associated with engagement in physical activity (PA) among patients with type 2
25 diabetes when the effect of a wide variety of other important life-context factors (perceived
26 health, medication, duration of diabetes, mental health, stress and social support) was con-
27 trolled for. Patients from five municipalities in Finland with registry-based entitlement to a
28 special reimbursement for medicines used in the treatment of type 2 diabetes (n=2866, mean
29 age 63 years, 56% men) participated in this mail survey in 2011. Of all measured explanatory
30 factors, autonomous motivation was most strongly associated with engagement in PA. Auton-
31 omous motivation mediated the effect of perceived autonomy support on patients' PA. Thus,
32 perceived autonomy support (from one's physician) was associated with the patient's PA
33 through autonomous motivation. This result is in line with SDT. Interventions for improved
34 diabetes care should concentrate on supporting patients' autonomous motivation for PA. In-
35 ternalizing the importance of good self-care seems to give sufficient energy to maintain a
36 physically active lifestyle.

37 Key words: Diabetes, physical activity, autonomy support, health care climate, motivation

38

39 **Introduction**

40 Type 2 diabetes is an important and increasing public health problem all over the world
41 (Guariguata et al., 2014; Whiting, Guariguata, Weil, & Shaw, 2011). Aging of the population,
42 unhealthy nutrition, lack of physical exercise and overweight, increase the incidence of this
43 chronic disease (Unwin, Whiting, & Roglic, 2010). The main target in diabetes care is to
44 maintain blood glucose levels in a healthy range. This is essential in order to avoid long-term
45 diabetes complications. Glycemic control is best achieved by good self-management that in-
46 cludes healthy diet, regular physical exercise, weight loss, and pharmacologic therapy when
47 needed (American Diabetes Association, 2011; 2014). Therefore, it is important to know how
48 health care professionals can support patients to engage in long-term health behavior change.

49

50 Self-determination theory (SDT) is a theoretical approach that has been increasingly used in
51 studies aiming to understand how health care professionals can support patients to adopt and
52 maintain a healthy lifestyle (Fortier, Duda, Guerin, & Teixeira, 2012; Ng et al., 2012; Teixei-
53 ra, Carraça, Markland, Silva, & Ryan, 2012). SDT is a general theory of human motivation
54 that emphasizes the extent to which behaviors are relatively autonomous (originating from the
55 self) versus relatively controlled (pressured or coerced by intrapsychic or interpersonal forc-
56 es), (Patrick & Williams, 2012.)

57 SDT explains the social psychological mechanism on how the behavior of health care person-
58 nel influences the patient's motivation for self-care, e.g. physical activity (PA). According to
59 the SDT, people are oriented toward physical and psychological health, and also have psycho-
60 logical needs for autonomy, competence, and relatedness. Health care professionals can en-
61 hance patients' motivation for self-care by satisfying these basic needs (Ryan & Deci, 2000).
62 Autonomy is supported by acknowledging patients' perspectives and emotions before rec-
63 ommendations, by offering choices and options and a rationale for a given advice, and mini-

64 mizing control and judgment. Competence is enhanced by supporting patients' belief for suc-
65 cess, by skills building and problem solving, and by giving feedback in a non-judgmental
66 manner. Relatedness support includes providing an emphatic and warm interpersonal envi-
67 ronment (Patrick & Williams, 2012).

68 Social environments that satisfy these basic needs are assumed to foster autonomous motiva-
69 tion and self-care competence which further foster adaption and maintenance of a healthy
70 lifestyle (Deci & Ryan, 1985). Feelings of autonomy are supposed to give an experience that
71 the person him-/herself is initiating behaviors, and feelings of competence are supposed to
72 give experience of achieving the outcome (Williams, McGregor, Zeldman, Freedman, &
73 Deci, 2004). Thus, SDT suggests that people are likely to have long-term psychological ener-
74 gy for making and maintaining a healthy change when they perceive themselves to be the ini-
75 tiator of their behavior and they perceive mastering the skills necessary to make and maintain
76 the change. Motivation and energy for change is stronger than in the situations where people
77 feel that they are pressured to change by another person, e.g. a doctor or a family member, or
78 by guilt about not carrying out self-care activities as advised (Williams, McGregor, Zeldman,
79 Freedman, & Deci, 2004).

80 There is growing evidence that patients' motivation for effective self-management may be
81 enhanced by an autonomy supportive health care climate (Fortier et al., 2012; Ng et al., 2012).
82 Studies, based on SDT, have shown that an autonomy supportive health care climate is asso-
83 ciated with patients' self-management behavior regarding medical adherence (Williams,
84 Freedman, & Deci, 1998; Williams et al., 2009) and PA (Fortier, Sweet, O'Sullivan, & Wil-
85 liams, 2007). Exercise intervention trials among patients with type 2 diabetes have demon-
86 strated the importance of autonomous or self-determined motivation for PA: Sweet et al.
87 (2009) showed that autonomous motivation mediated the relationship between barrier self-
88 efficacy (confidence in ability to overcome barriers) and PA, and Fortier et al. (2011) found

89 that self-determined exercise motivation significantly increased as patients progressed through
90 the stages of exercise change from pre-action to maintenance. However, further evidence to
91 support predictions of SDT in the context of diabetes care is needed.

92 Besides an autonomy supportive health care climate, autonomous motivation and self-care
93 competence, also patients' larger life-context may affect their ability and motivation for good
94 self-care, and should be taken into account in studies. Poor physical health and stressful life
95 situations may hinder PA. Depression, which is common among patients with diabetes (Ali,
96 Stone, Peters, Davies, & Khunti, 2006; Pirkola et al., 2005), has been shown to be associated
97 with poor self-management of diabetes including physical exercise (Dirmaier et al., 2010;
98 Egede & Ellis, 2010; Gonzalez et al., 2007; 2008a;b). On the other hand, a strong sense of
99 coherence and autonomy supportive significant others may enhance patients' ability to cope
100 with diabetes (Antonovsky, 1987; Williams et al., 1998).

101 This study adds to previous research by examining whether the three central SDT variables
102 (perceived autonomy support, autonomous motivation and self-care competence) are associat-
103 ed with engagement in PA among patients with type 2 diabetes when the effect of a wide va-
104 riety of other important life-context factors (perceived health, medication, duration of diabe-
105 tes, mental health, stress and social support) are controlled for. In addition, a possible mediat-
106 ing role of autonomous motivation and self-care competence between perceived autonomy
107 support and PA is investigated.

108 We hypothesize that 1) perceived autonomy support (from one's physician), autonomous mo-
109 tivation and self-care competence are positively associated with patients' engagement in PA
110 even after the effect of the other important life-context factors is controlled for, and 2) the
111 effect of perceived autonomy support on PA is mediated by autonomous motivation and self-
112 care competence.

113 **Methods**

114 *Data collection*

115 The sample of the study was collected in 2011 from the register of the Social Insurance Insti-
116 tution of Finland (SII). SII is a Finnish government agency (funded directly from taxation) in
117 charge of settling benefits under national social security programs. SII keeps the register of
118 those persons who have entitlement to a special reimbursement for medicines because of
119 chronic diseases such as diabetes. The sample to the present study was collected among per-
120 sons who fulfilled the following inclusion criteria:

- 121 a) had entitlement to a special reimbursement for medicines used in the treatment of type 2
122 diabetes (ICD-10 code, E11) in 2000-2010, and the right was valid in September 2011 and
123 onward,
- 124 b) born in 1936-1991 (20-75 years), alive and had no safety prohibition at the time of the
125 data collection,
- 126 c) Finnish as native language,
- 127 d) one of the five study municipalities as place of residence.

128

129 A total of 7 575 persons fulfilled the inclusion criteria. Based on power-analysis, a sample of
130 5167 persons was collected: 2000 persons from the two large municipalities and all persons
131 from the three small municipalities. There were 2 962 (57%) men and 2205 women (43%) in
132 the sample, corresponding the rate of sex in the total population of patients with type 2 diabe-
133 tes in the study municipalities.

134 The questionnaire was tested by a pilot study (n=50) in May 2011, and after some revisions
135 the questionnaire was mailed to respondents in September 2011. A reminder to non-
136 respondents was sent out in October, and another reminder with a new copy of the question-

137 naire was sent out in November. The final response rate was 56% (range 54-59%, n=2866).
138 Women responded slightly more often (57%) than men (54%). The response rate was highest
139 (63%) in the oldest age group (65-75 years), lower (55%) in the age group of 55-64 years, and
140 lowest (36%) in the age group of 20-54 years.

141 *Ethical issues*

142 The research plan was accepted by the Ethical Committee of the Hjelt Institute, University of
143 Helsinki, and the permission to conduct the study was received from the SII. The sample was
144 collected by the contact person who worked at the SII, and the questionnaires were posted
145 from there. Respondents returned filled questionnaires, provided only by an identification
146 number, directly to the researchers by mail. An identification number was needed in order to
147 check for nonresponse. Identity of respondents was not revealed to the researchers at any
148 stage of the sample or data collection, nor was the content of the questionnaires revealed to
149 anybody else except the researchers.

150 *Respondents*

151 The mean age of respondents was 63 years (standard deviation (SD) 8 years, range 27-75
152 years), and 56% of them were men. Over half (56%) of the respondents were retired because
153 of old age, 60% were married, and 59% had less than higher professional education. The ma-
154 jority (83%) of the respondents had a municipal primary care health center as their primary
155 care place in diabetes care, and 74% used tablets only for diabetes therapy. (Table 1.)

156 Insert Table 1 here.

157 *Measures*

158 Measures used in the study are presented in Table 2. Averaged sum scales for perceived au-
159 tonomy support, autonomous motivation, self-care competence, energy, emotional well-being,
160 sense of coherence, life stress and social support in diabetes were calculated. The respondent
161 was included in the analysis, if she/he had answered at least to 70% of the scale items. The
162 PA sum scale was calculated by summing standardized z-scores of four variables differing in
163 scale length (Metsämuuronen, 2003). A higher z score indicates more PA. Occupational PA
164 was included into the PA sum scale because PA at work may have effect on spare time activi-
165 ty, e.g. physically strenuous work may decrease physical exercise in spare time.

166 Insert Table 2 here.

167 *Statistical procedures*

168 Descriptive statistics were estimated and the baseline associations between independent vari-
169 ables, covariates and dependent variables were tested with Pearson chi²-tests, t-tests or one-
170 way analysis of variance depending on the measurement scale of the variable of interest. In
171 the final analyses, multivariate linear regression analysis was used. The correlations between
172 study variables were explored before the analyses by Pearson correlations. The variables to
173 the regression models were chosen on theoretical and statistical basis. Independent variables
174 that correlated strongly with each other, such as variables measuring mental health or positive
175 personality orientation (energy, emotional well-being, diagnosed depression, sense of coher-
176 ence), were omitted from the regression analyses. Only the variable that correlated most
177 strongly with the dependent variable was chosen to the models.

178

179 In the mediation analyses between perceived autonomy support, autonomous motivation, self-
180 care competence and PA, the instructions reported by Baron & Kenny (1986) were followed.
181 First, the mediator was regressed on the independent variable. Second, the dependent variable
182 was regressed on the independent variable. Third, the dependent variable was regressed on

183 both the independent variable and on the mediator. A mediation exists if the predicted asso-
184 ciations hold on each step of the analysis and if the effect of the independent variable on the
185 dependent variable is less in the third step than in the second step. The mediation is perfect, if
186 the independent variable has no effect when the mediator is controlled. Statistical signifi-
187 cance of the mediation was calculated by the Sobel test (Preacher & Leonardelli, 2003).

188 Statistical analyses were performed using complex samples –procedure, which allows the use
189 of weight coefficients in order to correct bias caused by the different sample collection meth-
190 od in the small (all patients with type 2 diabetes) and big municipalities (a sample). SPSS ver-
191 sion 22 was used.

192 **Results**

193 Almost all (90%) of the respondents reported that they had been advised to exercise regularly.
194 A total of 36% had performed physical exercise at least on five days during the last week, and
195 a total of 27% exercised, on average, four or more times a week at least 30 minutes on each
196 occasion to the extent that they at least slightly lost their breath and perspired.

197 The four variables measuring mental health or positive personality orientation correlated
198 strongly with each other, that is, energy correlated with emotional well-being (0.78, $p < .001$),
199 sense of coherence (0.58, $p < .001$) and depression (-0.38, $p < .001$). Of these four variables,
200 energy correlated most strongly with PA (0.26, $p < .001$). Pearson correlations between emo-
201 tional well-being, sense of coherence, diagnosed depression and PA were 0.15 ($p < .001$), 0.14
202 ($p < .001$) and -0.10 ($p < .001$), respectively. Therefore, energy was included as an independent
203 variable to the multivariate linear regression analysis.

204 The three variables measuring physical health correlated with each other, that is, perceived
205 health correlated with the number of chronic diseases (0.29, $p < .001$) and diabetes complica-
206 tions (0.23, $p < .001$). Of these three variables, perceived health correlated most strongly with

207 PA (-0.24, $p < .001$). Correlations between the number of chronic diseases and diabetes com-
208 plications with PA were -0.13 ($p < .001$) and -0.10 ($p < .001$), respectively. Therefore, perceived
209 health was included as an independent variable to the multivariate linear regression analysis.
210 Table 3 shows that autonomous motivation correlated strongly with PA (0.36), but perceived
211 autonomy support, and self-care competence only moderately (0.09 and 0.14 respectively). In
212 addition, energy and perceived health correlated quite strongly with PA (0.26 and -0.24 re-
213 spectively).

214 Insert table 3 here

215 Table 4 shows that autonomous motivation was strongly associated with PA even after the
216 effect of other important life-context factors was controlled for, but the other SDT variables
217 (perceived autonomy support and self-care competence) were not. Energy, good perceived
218 health and using tablets only as diabetes medication were positively, and higher age negative-
219 ly associated with PA. The associations between independent variables and the dependent
220 variable were similar, but somewhat weaker, when PA across the 7 days prior to completion
221 of the questionnaire was used as the dependent variable (data not shown). When only pen-
222 sioners were included into the analysis, and the item of occupational PA omitted, the results
223 were similar to those in the whole data (data not shown).

224
225 Table 5 shows that the association between autonomous motivation and PA did not diminish
226 after the effect of self-care competence was controlled for. Thus, self-care competence did not
227 mediate the effect of autonomous motivation on PA. Perceived autonomy support was associ-
228 ated with autonomous motivation. Perceived autonomy support was associated also with PA
229 but this association disappeared after the effect of autonomous motivation was controlled for

230 which indicates perfect mediation: perceived autonomy support was associated with PA
231 through autonomous motivation.

232 Insert tables 4 and 5 here

233

234 **Discussion**

235 This study investigated associations between the three central SDT variables (perceived au-
236 tonomy support, autonomous motivation and self-care competence), other important life-
237 context factors, and PA among patients with type 2 diabetes. Finding determinants of PA is an
238 important research question because the results of the study showed, in line with the previous
239 studies by Broadbent, Donkin, & Stroh (2011) and Lin et al. (2004) that only a minority of the
240 respondents performed PA according to the general recommendations given to patients with
241 type 2 diabetes.

242

243 Of all measured explanatory factors, autonomous motivation was most strongly associated
244 with engagement in PA. Other life-context factors also played a role. Younger patients and
245 those with oral medication were physically more active than older patients and those with
246 insulin therapy. In addition, energy and good perceived health were positively associated with
247 PA. Previous studies have shown negative association between depression and PA (Dirmaier
248 et al., 2010; Egede & Ellis, 2010; Gonzalez et al., 2007; 2008a;b). However, in this study en-
249 ergy was a stronger predictor of PA than diagnosed depression. This result is in line with the
250 study by Gonzalez et al. (2007) which showed that continuous depressive symptom severity
251 scores were better predictors of non-adherence to exercise than categorically defined probable
252 major depression.

253

254 Associations between independent variables and the dependent variable were stronger when
255 we used the sum scale of average PA as a dependent variable instead of the measure of PA
256 during one week before survey (Toobert, Hampson, & Glasgow, 2000). Average PA may
257 give a more reliable picture of self-management than PA during one week.

258

259 Contrary to our predictions, perceived autonomy support and self-care competence were not
260 associated with PA after controlling for the effect of other explanatory variables. However,
261 perceived autonomy support was associated with autonomous motivation which mediated the
262 effect of perceived autonomy support on PA. Thus, autonomy support was associated with
263 patients' PA through autonomous motivation. This result is in line with the previous studies
264 which emphasize the importance of autonomous motivation for health-related behaviors (Ng
265 et al., 2012) and PA, specifically (Fortier et al, 2007; Teixeira et al., 2012). Self-care compe-
266 tence did not mediate the effect of autonomous motivation on PA. The effect of autonomous
267 motivation on PA was direct. The results of this study support the idea of SDT that internali-
268 zation of the value of good health behavior is necessary for engagement in physically active
269 lifestyle. Health care practitioners can promote patients' PA by supporting their autonomous
270 motivation.

271

272 Strengths and limitations of the study

273 We found the basic information (diagnosis age, duration of diabetes, medication, HbA1c-
274 values, BMI), reported by the patients in this study, highly reliable when compared with regis-
275 ter data from the whole country (Valle et al., 2010) and with the electronic medical records
276 from the municipal primary-care health centers in the study municipalities (Koponen et al.,
277 2013a; 2013b). Another strength of our study was that in the analyses we were able to control
278 the effect of many important confounding factors.

279

280 One limitation of the study was that the cross-sectional nature of the data does not allow for
281 directional or causal inferences. However, 84% of the respondents had been over two years in
282 care in their current and principal primary care health center, and a total of 75% had a family
283 doctor or a “regular” doctor. Thus, it is highly likely that care provided in the health center
284 had influenced patients’ motivation for self-care. Strengths and limitations of the study are
285 discussed further in Koponen et al. (2015). In future, longitudinal intervention studies are
286 needed.

287

288 Conclusion

289 The results of this study emphasize the importance of autonomous motivation for adoption of
290 a physically active lifestyle. Of all measured life-context factors, autonomous motivation was
291 most strongly associated with PA among patients with type 2 diabetes. Health care practition-
292 ers can promote patients’ PA by supporting their autonomous motivation and general well-
293 being.

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410

411 Table 1. Sociodemographic background factors of respondents (corrected by rescaled sam-
 412 pling weight)

	N (estimate)	%
Sex		
Man	1590	55.7
Woman	1266	44.3
Total	2856	100
Age		
27-54 years	353	12.6
55-64 years	1057	37.7
65-75 years	1396	49.7
Total	2806	100
Marital status		
Single	278	9.8
Married	1688	59.5
Cohabiting	190	6.7
Divorced	428	15.1
Widowed	253	8.9
Total	2837	100
Professional education		
Upper secondary education (vocational school) or less	1636	58.8
Higher education (college, polytechnic, university)	1148	41.2
Total	2784	100
Principal activity		
Working	674	24.0
Retired because of chronic illness	383	13.6
Retired because of old age	1567	55.9
Other	181	6.5
Total	2805	100
Diabetes medication		
Tablets	2052	74.3
Insulin	142	5.1
Tablets + insulin	500	18.1
Other	67	2.4
Total	2761	100
Service provider		
Municipal	2236	82.8
Private	464	17.2
Total	2700	100

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414

415 Table 2. Measures used in the study

Perceived autonomy support (from one's physician)	The short 6-item form of health care climate questionnaire (HCCQ, n.d.), (range 1=fully disagree, 5=fully agree, Cronbach's alpha reliability $r=0.95$). Example item: I feel that my physician has provided me choices and options. (http://www.selfdeterminationtheory.org/)
Autonomous motivation	Autonomous regulation (motivation) scale B. Five items from the treatment self-regulation questionnaire (TSRQ, n.d.), (range 1=not at all true, 7=very true, $r=0.83$). Example item: The reason I follow my diet and exercise regularly is that I personally believe that these are important in remaining healthy. (http://www.selfdeterminationtheory.org/)
Self-care competence	The 4-item perceived competence for diabetes scale (PCS, n.d.), (range 1=fully disagree, 5=fully agree, $r=0.93$). Example item: I feel confident in my ability to manage my diabetes. (http://www.selfdeterminationtheory.org/)
Energy	The 4-item scale measuring energy during the last four weeks from the RAND-36-Item Survey, 1.0 (range 0-100%, $r=0.85$). Example item: How much of the time during the past 4 weeks did you have a lot of energy? (Hays, Sherbourne, & Mazel, 1993.)
Emotional well-being	The 5-item RAND-36 scale measuring emotional well-being during the last four weeks (range 0-100%, $r=0.84$). Example item: How much of the time during the past 4 weeks have you felt so down in the dumps that nothing could cheer you up? (Hays et al., 1993.)
Sense of coherence	The short 13-item scale (range 1=weak, 7=strong, $r=.80$, five items reversed). Example item: Do you have feeling that you don't really care about what goes on around you? (1=very often, 7=very seldom or never), (Antonovsky, 1987.)
Depression	Diagnosed depression (1=no, 2=yes).
Life stress	Experienced stress during the last year (12 months) in the 10 life areas e.g. own health and economic situation (range 1=not at all, 4=very much). Based on the Living with Diabetes Study. School of Population Health. University of Queensland. (Donald et al., 2012).
Social support in diabetes	A 12-item scale measuring support and help received from friends, relatives and health care personnel (range 1=fully disagree, 5=fully agree, $r=.75$). Example item: When I feel bored, depressed or desparate, my friends and family are ready to listen to me. (Toljamo, 1999). The scale is based on social support scales by Brandt & Weinert (1981), Goodenow, Reisine, & Grady (1990), Norbeck, Lindsay, & Carrieri (1981; 1983), Stewart & Tilden (1995) and Weinert (1987).
Perceived health	A single-item scale, range 1=very good, 5=poor.
Complications	At least one of the twelve diabetes related complications (e.g. kidney disease or neuropathy) mentioned, 1=yes, 2=no. The list of the complications was based on the Living with Diabetes Study. School of Population Health. University of Queensland (Donald et al., 2012) and Finnish Diabetes Association (n.d.) (http://www.diabetes.fi)
Occupational physical activity (included in the PA sum scale)	How physically strenuous do you consider your work to be on average? range 1=not working, 5=physically strenuous work e.g. including lifting or carrying heavy objects. (Health Behavior and Health Among the Finnish Adult Population, Spring 2012 (HBHAF-questionnaire) http://urn.fi/URN:ISBN:978-952-245-931-2)
Commuting physical activity (included in the PA sum scale)	How many minutes, during a typical day, do you spend walking or cycling to work and other places? range 1=not at all, 5=60

	minutes or more. (HBHAF-questionnaire) http://urn.fi/URN:ISBN:978-952-245-931-2
Leisure time physical activity (included in the PA sum scale)	How much do you exercise and engage in vigorous-intensity activities during spare time? range 1=low-intensity activities only, 4=regular vigorous-intensity activity heading to competition. (HBHAF-questionnaire) http://urn.fi/URN:ISBN:978-952-245-931-2
Intensity of physical activity (included in the PA sum scale)	How often do you exercise physically in your spare time for at least 30 minutes to the extent that you at least slightly lose your breath and perspire?, range 1=I cannot perform exercise due to illness or handicap, 7=daily. (HBHAF-questionnaire) http://urn.fi/URN:ISBN:978-952-245-931-2
Physical activity during the last week	On how many of the last seven days did you participate in at least 30 minutes of physical activity? (Toobert, Hampson, & Glasgow, 2000).

416

417 Table 3. Correlations matrix between study variables

	1	2	3	4	5	6	7	8	9	10	11	12
1. Perceived autonomy support												
2. Autonomous motivation	.24***											
3. Self-care competence	.31***	.40***										
4. Sex (1=man, 2=woman)	-.08***	.11***	-.02									
5. Age	.03	.11***	.12***	.03								
6. Education (1=low, 2=high)	.00	-.03	-.03	-.02	-.09***							
7. Diabetes medication (1=tablets only, 2=other)	-.03	-.03	-.03	-.06**	-.12***	-.01						
8. Duration of diabetes	-.02	-.03	-.01	-.02	.19***	-.02	.17***					
9. Perceived health (1=good, 2=poor)	-.22***	-.19***	-.25***	.03	.06**	-.11***	.11***	.09***				
10. Energy	.26***	.26***	.36***	-.09***	.12***	.01	-.12***	-.04	-.47***			
11. Stress	-.17**	-.08***	-.26***	.23***	-.35***	.06*	.09***	-.02	.23***	-.49***		
12. Social support	.41**	.34***	.33***	.02	.08***	-.05*	-.04*	-.06*	-.22***	.37***	-.28***	
13. Physical activity	.09***	.36***	.14***	.02	-.13***	.03	-.08***	-.07***	-.24***	.26***	-.02	.12***

418

419 **p<.01

420 ***p<.001

Table 4. Multivariate linear regression models on the association of perceived autonomy support, autonomous motivation, self-care competence and other important life-context factors with physical activity. (Corrected with rescaled sampling weight)

	Model 1 Estimate (95% CI)	Model 2 Estimate (95% CI)	Model 3 Estimate (95% CI)	Model 4 Estimate (95% CI)
Perceived autonomy support	.01 ns. (-.07 - .08)	.01 ns. (-.07 - .08)	-.05 ns. (-.12 - .03)	-.05 ns. (-.14 - .04)
Autonomous motivation	.71*** (.64 - .78)	.75*** (.68 - .82)	.70*** (.63 - .78)	.71*** (.62 - .79)
Self-care competence	-.03 ns. (-.14 - .08)	.02 ns. (-.09 - .14)	-.07 ns. (-.19 - .05)	-.14 ns. (-.27 - -.00)
Sex (1=man, 2=woman)		-.08 ns. (-.24 - .08)	-.09 ns. (-.26 - .07)	-.10 ns. (-.28 - .09)
Age		-.05*** (-.07 - -.04)	-.05*** (-.06 - -.04)	-.05*** (-.07 - -.04)
Professional education (1=low 2=high)		.10 ns. (-.06 - .26)	-.02 ns. (-.18 - .15)	-.08 ns. (-.25 - .10)
Duration of diabetes			.00 ns. (-.01 - .02)	.00 ns. (-.01 - .02)
Medication (1=tablets only, 2=other)			-.38*** (-.58 - -.18)	-.36** (-.57 - -.15)
Perceived health (1=good, 2=poor)			-.80*** (-.97 - -.63)	-.46*** (-.66 - -.27)
Energy				.02*** (.01 - .03)
Stress				.21 ns. (-.02 - .45)
Social support				-.18 ns. (-.36 - .01)
R Square	.13	.16	.18	.21
n	2428	2333	2189	1960

ns. $p > .05$

** $p < .01$

*** $p < .001$

Table 5. Mediation analyses between perceived autonomy support, autonomous motivation, self-care competence and physical activity, linear regression model. (Corrected by rescaled sampling weight)

	Estimate (95% CI)	n
1. Autonomous motivation x self-care competence	.27*** (.25 - .29)	2714
2. Autonomous motivation x physical activity	.70*** (.64 - .76)	2541
3. Autonomous motivation x physical activity	.70*** (.63 - .76)	2507
Autonomous motivation x competence	-.01 ns. (-.12 - .09)	
Sobel test: z=-0.12, SE=0.02, p=0.91		

	Estimate (95% CI)	n
1. Perceived autonomy support x autonomous motivation	.27*** (.23 - .30)	2648
2. Perceived autonomy support x physical activity	.19*** (.12 - .27)	2493
3. Perceived autonomy support x physical activity	-.00 ns. (-.07 - .07)	2455
Perceived autonomy support x autonomous motivation	.71*** (.64 - .77)	
Sobel test: z=10.41, SE=0.02, p=0.00		

The bold values indicate mediation which exists if the predicted associations hold on each step of the analysis and if the effect of the independent variable on the dependent variable is less in the third step than in the second step.

1=the mediator regressed on the independent variable

2=the dependent variable regressed on the independent variable

3=the dependent variable regressed on both the independent variable and on the mediator.

ns. $p > .05$

*** $p < .001$