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1 **Title: Sex Differences in the Association of Psychological Status with Measures of Physical Activity**
2 **and Sedentary Behaviour in Adults with Type 2 Diabetes**

3
4 **Short title:** Psychological Status and Physical Activity in Type 2 Diabetes

5
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27 **ABSTRACT**

28 **Aim** – To assess the association of psychological variables on leisure time physical activity and
29 sedentary time in men and women with type 2 diabetes mellitus (T2D).

30 **Methods** – In this cross-sectional study, we evaluated 163 patients with T2D, consecutively recruited
31 at the Diabetes Centre of the Verona General Hospital. Scores on depression and anxiety symptoms,
32 psychosocial factors (including self-efficacy, perceived interference, perceived severity, social
33 support, misguided support **behaviour**, spouse’s positive **behaviour**), physical activity and time spent
34 sitting were ascertained using questionnaires responses to the Beck Depression Inventory-II, Beck
35 Anxiety Inventory, Multidimensional Diabetes Questionnaire, International Physical Activity
36 Questionnaire.

37 **Results** – Physical activity was significantly associated with higher social support in women, and with
38 increased self-efficacy in men. Sedentary time was significantly associated with higher perceived
39 interference, anxiety and depressive symptoms, and with reduced diabetes self-efficacy in women,
40 while it was associated solely with anxiety in men. Depressive symptoms and self-efficacy in women
41 and anxiety symptoms in men were independent predictors of sedentary time when entered in a
42 multivariable regression model also including age, BMI, hemoglobin A1c, diabetes duration,
43 perceived interference and self-efficacy as covariates.

44 **Conclusions** – Lower self-efficacy and higher symptoms of depression were closely associated with
45 increased sedentary time in women, but not in men, with T2D. It is possible that individualized
46 behavioral interventions designed to reduce depressive symptoms and to improve diabetes self-
47 efficacy would ultimately reduce sedentary **behaviours**, particularly in women with T2D.

48
49 **Keywords (5):** *Diabetes; Depression; Anxiety; Physical Activity; Sedentary Behaviour*

50

51 **INTRODUCTION**

52 Depression is diagnosed in about 15-20% of adults with type 2 diabetes (T2D), with women twice as
53 likely to be affected as men [1]. Depression interferes with diabetes self-management and metabolic
54 control [2-4] and may increase the risk of complications [5], cognitive decline [6] and mortality[7].

55 According to Mezuk *et al.* [8], diabetes and depression appear to share a bi-directional relationship,
56 with depression increasing the risk of incident diabetes and diabetes increasing the risk of
57 depression. However, according to recent meta-analyses [9, 10], the prevalence of depression
58 appears to be higher in individuals with known diabetes, than in those with impaired glucose
59 regulation or newly diagnosed diabetes, an observation also confirmed by a recent report from a
60 large cross-sectional study in Chinese individuals [11]. Moreover, a study from the English
61 Longitudinal Study of Aging (ELSA) database, found higher incident depressive symptoms in younger
62 older adults with diabetes than their non-diabetic counterparts (<65 years) but not in those 65 years
63 and older [12]. These studies suggest that the presence of T2D alone is not sufficient to increase the
64 prevalence or incidence of depression. Rather, they suggest that psychological factors are likely to
65 play a role in developing depression among people with diabetes but that it is the burden of living
66 with and having to care for diabetes especially in the presence of diabetes complications and the
67 stresses of a working life that increases the risk of developing depression [13].

68 Several studies have shown that increased physical activity levels are associated with lower
69 symptoms of depression, stress and anxiety [14]. The evidence provided by the Diabetes Prevention
70 Program and other landmark trials [15, 16] strongly support the benefits of physical activity to
71 prevent T2D and relent its progression. Indeed, a general increase in daily physical activity is
72 included among the first-line intervention of current structured programs for diabetes prevention
73 and care [17, 18].

74 However, the achievement of recommended exercise goals is challenging, due to a number of
75 limiting factors, such as individual motivation and accompanying comorbidities [19]. Therefore,
76 despite the clear benefits of physical activity on metabolic control and mental health, many people

77 remain physically inactive [19, 20].

78

79 These observations have recently prompted research efforts to identify the psychological factors
80 associated with leisure physical activity in individuals with T2D [21]. A number of psychological
81 models have been developed to explore the reciprocal interaction of personal and environmental
82 factors as determinants of exercise **behaviour** change. For instance, the Social Learning Theory (SLT)
83 provides a theoretical framework to isolate the psychosocial variables specifically relevant to chronic
84 diseases, such as T2D, by emphasizing the reciprocal interactions occurring at the level of social
85 support, patients' idiosyncratic beliefs and social incentives related to self-care activities [22]. Self-
86 efficacy, defined as a person's belief in his or her own ability to execute a specific **behaviour** [23],
87 candidates among the psychological variables as a major determinant of **behaviour** change. Indeed,
88 low self-efficacy percepts may underlie the difficulties experienced by T2D patients to start and
89 maintain a regular physical activity. In this context, the SLT provides a perspective that emphasizes
90 the role of self-efficacy in driving successful **behaviour** change [23].

91

92 Whereas some studies have investigated associations between psychological variables and leisure
93 physical activity [24], the relationships of the former with sedentary **behaviour** have received much
94 less attention, particularly among people suffering from chronic diseases such as T2D. Notably,
95 sedentary **behaviour** is not the opposite of physical activity, rather it refers to **behaviours** that do not
96 increase energy expenditure above resting levels [25]. Specifically, sedentary **behaviour** is defined as
97 the time spent in non-exercising or reclining pursuits, including screen-time **behaviours** such as
98 watching television or computer use [26].

99 Recent evidence revealed a direct association of daily sitting time and other sedentary habits with
100 all-cause mortality and cardiovascular diseases [27]. Other studies have shown that sedentary
101 **behaviour** *per se* adversely affects individual health, independent of the amount of physical activity
102 in the general population [28] **and in individuals with T2D [29, 30]. These evidences suggest that**

103 sedentary behaviour recognizes specific biological pathways distinct from those elicited by physical
104 activity [31]. Of note, the psychosocial mechanisms leading to sedentary behaviour differ from those
105 leading to physical activity, thus supporting the rationale for testing the hypothesis that sedentary
106 behaviours may recognize specific psychological determinants also in patients with T2D. Moreover,
107 Hamer *et al.* [32] have observed that sedentary behaviour is actually associated with depression and
108 that this relationship remains significant after controlling for physical activity, thus providing
109 compelling evidence that physical activity and sedentary behaviour have distinct and independent
110 associations with depressive symptoms. The direct relationship existing between depressive
111 symptoms and sedentary behaviour has been highlighted by a recent review [33], thus corroborating
112 previous findings by Vallance *et al.* [34] that depressive symptoms are twice as high in adults
113 spending more time in sedentary behaviours.

114 In the light of this evidence, novel approaches to reduce sedentary behaviours are urgently needed,
115 as well as updated public health recommendations increasing awareness of the risk associated with
116 these behaviours. This is particularly relevant for individuals with T2D, as they are exposed to an
117 increased demand of self-care and, simultaneously, they typically display an increased vulnerability
118 to psychological distress [2, 35, 36], which, in turn, is associated with poorer clinical outcomes and a
119 higher occurrence of un-healthy behaviours.

120
121 The research efforts hitherto conducted to unravel the motivational determinants of physical
122 activity engagement in adults have shown that behavioral and cognitive factors (particularly self-
123 efficacy) are crucial for the initiation and long-term maintenance of physical activity. However, it is
124 currently unknown whether the same factors also act on sedentary behaviour. Furthermore, there
125 are no studies that have examined the association between physical activity measures (including
126 time spent sitting and leisure physical activity), psychological distress (depression and anxiety) and
127 psychological factors (e.g. self-efficacy) in individuals with T2D.

128 Hence, the present study aimed at investigating the associations of anxiety, depression and other

129 psychosocial variables with leisure physical activity and sedentary **behaviour** in individuals with T2D.
130 Since the relationship of the psychological variables with the individual sedentary **behaviour** or the
131 attitude at exerting physical activity may vary by sex in the general population [37] and in patients
132 with T2D [38], a secondary objective of the study was to examine these relationships in men and
133 women, separately. We therefore examined associations first in the entire cohort, then for men and
134 women separately.

135

136

137 **METHODS**

138 **Participants**

139 In this cross-sectional study, we report baseline data of 163 individuals with T2D, recruited among
140 the outpatients included in the larger research project “glycemic *CO*ntrOl, *Ps*ychological *distr*Ess and
141 *S*elf-efficacy in *T*ype 2 diabetes” (COPEST), conducted at the Diabetes Centre of Verona City Hospital.
142 As specified elsewhere[2], the COPEST study tested the effect of a self-efficacy oriented
143 psychological intervention on glycaemic control in T2D patients with baseline suboptimal glucose
144 control. The study protocol was approved by the Ethics Committee of the Hospital Trust of Verona.
145 All participants gave written informed consent upon recruitment. Further details on the study design
146 and enrollment criteria are provided as online Supplementary Material.

147

148 **Assessment of depressive and anxiety symptoms**

149 Depressive symptoms were assessed by the validated Italian version of the Beck Depression
150 Inventory-II (BDI-II) [39]. The BDI-II is a 21-item questionnaire assessing the intensity of depressive
151 symptoms as defined by the Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition
152 (DSM-IV). Internal consistency (Cronbach’s alpha) was $\alpha = 0.80$.

153 Anxiety symptoms were assessed by the validated Italian version of the Beck Anxiety Inventory (BAI)
154 [40]. The BAI consist of 21-items developed to assess the severity of anxiety symptoms ($\alpha = 0.89$).

155

156 **Assessment of diabetes psychological adjustments**

157 Diabetes-related cognitive and social factors were assessed by the validated Italian version of the
158 Multidimensional Diabetes Questionnaire (MDQ), which includes three sections [41]. The first
159 section is designed to assess the general perception of diabetes and related social support.
160 Cronbach's alphas for the subscales ranged from 0.81 to 0.92. The second section measures social
161 incentives in relation to self-care activities. Cronbach's alpha for positive and misguided
162 reinforcement **behaviours** was 0.88 and 0.83, respectively. The third section measures self-efficacy
163 and outcome expectancies ($\alpha = 0.84$ and 0.90 , respectively). **In particular, the self-efficacy measure**
164 **stands on a 7-item scale assessing the patients' confidence in their ability to perform behaviours specific**
165 **to diabetes self-care activities including diet, exercise, medication, self blood glucose monitoring and**
166 **general diabetes management. Sample items include "How confident are you/your ability to: (1) follow**
167 **your diet, (2) test your blood sugar at the recommended frequency, (3) to exercise regularly?"**.

168

169 **Physical activity and sedentary **behaviour** measurements**

170 Assessment of leisure physical activity and time spent sitting were assessed using the Italian
171 shortened version of the International Physical Activity Questionnaire (IPAQ) [42]. This version
172 provides information on time spent walking or on sedentary pursuits or being engaged in vigorous-
173 to-moderate intensity over the last 7 days. The IPAQ questionnaire estimates the total weekly
174 physical activity by weighting the reported minutes-per-week within each activity category by an
175 energy expenditure estimate (dubbed as MET, metabolic equivalent, according to Jetté *et al.* [43])
176 assigned to each category of activity (3.3 METs for moderate walking, 4.0 METs for moderate
177 physical activity and 8.0 METs for vigorous physical activity). The weighted MET-min per week
178 ($\text{MET}\cdot\text{min}\cdot\text{wk}^{-1}$) were calculated as duration·frequency·MET intensity, which were summed across
179 activity domains to produce a weighted estimate of total physical activity from all reported activities
180 per week. In terms of sedentary **behaviour**, sitting questions were developed as separate indicators

181 and not as part of physical activity score. Participants were instructed to consider the time spent
182 sitting (hours and minutes per day) at work, at home, while doing course work and during leisure
183 time. Both the leisure physical activity and sedentary behaviour measures assessed by IPAQ are
184 supported by validated data [44, 45].

185

186 **Statistical analysis**

187 Data are presented as mean and standard deviation (SD) or median and interquartile range [IQR],
188 unless otherwise indicated. Standard normal distribution of the variables was assessed by the
189 Kolmogorov-Smirnov test. Variables deviating from the Gaussian distribution (leisure physical
190 activity, anxiety, depressive symptoms, perceived interference) were naturally log-transformed to
191 improve normality before analysis. Data analysis was conducted firstly in the overall cohort and
192 thereafter separately for men and women. The comparisons of clinical, socio-psychological and
193 physical activity parameters between women and men were conducted by Student's *t*-test. Simple
194 correlations (expressed as Pearson's *r*) were calculated to explore the relationship of sedentary
195 behaviour and physical activity with depressive and anxiety symptoms, diabetes-specific self-efficacy
196 and other psychological variables. Partial correlations controlling for age, BMI, diabetes duration and
197 HbA1c were also calculated. We then explored whether symptoms of depression and anxiety, self-
198 efficacy and perceived interference were independent predictors, alone or in combination, of
199 sedentary behaviour and physical activity by entering these variables in linear regression models
200 with age, BMI, diabetes duration, HbA1c and sex (coded as female=1; male=0) as covariates. The
201 latter was then excluded in the analyses by sex subgroups. All covariates were selected for inclusion
202 in the partial correlations and regression models if significant in univariate analysis or according to
203 their biological plausibility. All statistics were carried out with IBM SPSS 22.0® software. Statistical
204 significance was declared at two-tailed *P*-value <0.05 for all comparisons.

205

206

207 **RESULTS**

208 **Table 1** summarizes the clinical, socio-demographic and psychological characteristics of the study
209 cohort ($N = 163$). The study participants included marginally more men (59.5%); age (mean \pm SD) was
210 62.7 ± 7.6 years, while diabetes duration and HbA1c were 11.1 ± 8.6 years and 7.6 ± 1.3 %, respectively.
211 The majority of patients was on oral hypoglycemic agents (OHA, 70.3%), while a smaller number of
212 them were prescribed a combination therapy (OHA + insulin, 18.8%) or insulin alone (10.9%). No
213 sex-differences were found for any of the clinical study variables, with the only exception of BMI,
214 which was significantly higher in men than in women (32.0 ± 4.3 vs. 30.6 ± 3.6 Kg/m², $p < 0.05$).
215 Compared to men, women reported higher levels of anxiety but lower social support, spouse's
216 misguided support **behaviour** and spouse's positive reinforcing **behaviour**. However, these
217 differences reached statistical significance only after adjustment for BMI. Both men and women
218 reported similar physical activity rates, but men spent more time in sedentary **behaviours** than
219 women.

220
221 We considered physical activity and sedentary time as health **behaviour** variables and we calculated
222 their simple correlations (reported as Pearson's r) with the psychological variables. As shown in
223 **Table 2**, higher degrees of physical activity showed a significant relationship with increasing self-
224 efficacy, while no significant figure was apparent in relation to other psychological variables. In
225 contrast, sedentary **behaviour** exhibited an inverse association with self-efficacy and it was related
226 to more severe symptoms of anxiety and depression and with an increased occurrence of misguided
227 support **behaviours**. Hence, in contrast to what observed for physical activity, sedentary **behaviour**
228 appeared to be significantly related to negative emotions.

229 When the same analyses were conducted separately in men and women, we observed that physical
230 activity was associated with social support in women and with diabetes self-efficacy in men. For
231 women, sedentary **behaviour** showed a negative and significant association with diabetes self-
232 efficacy and a positive association with symptoms of depression and anxiety and with perceived

233 interference. In contrast, sedentary time in men was only associated with anxiety symptoms. Thus,
234 in contrast to what observed in men, sedentary **behaviour** in women appeared to be linked with
235 negative emotions and with the impact of diabetes in their lives.

236
237 In order to further investigate the association of these psychological variables with sedentary
238 **behaviour** in light of accompanying confounding variables, we calculated partial correlations by
239 controlling for age, BMI, diabetes duration and HbA1c in the whole sample and separately for men
240 and women. As reported in **Table S1**, the relationship of sedentary **behaviour** with depressive
241 symptoms and self-efficacy in women held statistical significance and effect direction. The same
242 applied to the association of sedentary **behaviour** with anxiety symptoms in men. However, anxiety
243 symptoms and perceived interference in women did not retain statistical significance for the
244 association with sedentary **behaviour** after adjustment for confounders.

245
246 We then explored, in the whole sample, whether symptoms of depression and anxiety, self-efficacy
247 and perceived interference were independent predictors, alone or in combination, of sedentary
248 **behaviour** by entering these variables in a linear regression model with age, BMI, diabetes duration,
249 HbA1c and sex as covariates (**Table 3**). Results showed that lower self-efficacy and increased anxiety
250 symptoms were independent predictors of sedentary **behaviour**. Among the other variables
251 included in the analysis, a clear contribution of sex to the variance of sedentary **behaviour** prompted
252 a stratified analysis separately for men and women. Depressive symptoms ($\beta_{std} = 0.30, p = 0.023$) and
253 diabetes-specific self-efficacy ($\beta_{std} = -0.27, p = 0.041$) were independent predictors of sedentary
254 **behaviour** in women only (adjusted model- $R^2 = 0.21$). Conversely, only anxiety symptoms were found
255 to be independent predictors of sedentary time, when the same model was applied to men ($\beta_{std} =$
256 $0.24, p = 0.023$), despite a negligible overall explained variance (adjusted model- $R^2 = 0.05$).

257
258 The association of physical activity with social support in women and with self-efficacy in men was

259 investigated by applying distinct linear regression models also including age, BMI, diabetes duration
260 and HbA1c as covariates. Social support was found to be the unique predictor of physical activity in
261 women ($\beta_{std} = 0.27, p = 0.027$), with an overall explained variance of 6.1%. The model did not retain
262 self-efficacy, but only BMI ($\beta_{std} = -0.33, p = 0.001$), as a predictor of physical activity in men (adjusted
263 model- $R^2 = 0.10$).

264

265

266 **DISCUSSION**

267 In this study we have examined the relationship of sedentary **behaviour** and physical activity with
268 symptoms of depression and anxiety and with diabetes-specific psychosocial variables in adults with
269 T2D admitted to the outpatient clinic of a major diabetes referral centre.

270 The observation that sedentary **behaviour** and physical activity show distinct associations with the
271 psychosocial variables herein evaluated stands as a key finding of our study. While physical activity
272 showed a significant relationship with increasing diabetes self-efficacy only, the opposite was
273 observed in relation to sedentary **behaviour**, which also appeared to be significantly related with a
274 more articulated combination of psychosocial variables, namely more severe symptoms of anxiety
275 and depression and an increased occurrence of misguided support **behaviours**. More specifically, we
276 observed that women, in contrast to men, were less sedentary and were characterized by a closer
277 relationship of sedentary **behaviour** with negative emotions and with the impact of diabetes in their
278 lives.

279 To date, research has mainly focused on the determinants of physical activity, whereas sedentary
280 **behaviour** has received much less attention. Our study evaluated both of these aspects and provided
281 supporting evidence that, similarly to recent observations in the general population [33], sedentary
282 **behaviour** and physical activity recognize differential psychosocial variables as underlying factors
283 also in individuals with T2D.

284 Some studies have previously reported that sedentary **behaviour** is associated with depression

285 independently of extant physical activity levels [32]. On the **other hand**, a recent study by Breland *et*
286 *al.* [46] showed that daily sitting time, but not physical activity, increases the risk of depressive
287 symptoms. Accordingly, in our study, we found no evidence of association between physical activity
288 and symptoms of depression and anxiety. **One possible explanation for the lack of association is**
289 **that, on average, the individuals included in our study did not engage in high intensity exercise and**
290 **they were not formally enrolled in a structured physical activity program. Therefore, although**
291 **physical activity and depression are closely linked [47],), it could be reasonably assumed that low**
292 **levels of unstructured physical activity may have no major effect on mental health.**

293 **Alternatively, the lack of association between physical activity and symptoms of depression and**
294 **anxiety results might be inherent to the instrument employed to evaluate physical activity. Indeed,**
295 **the IPAQ score does not allow to clearly discriminate among different classes of physical activity or**
296 **to clarify whether physical activity is conducted alone or in concert with significant others. For**
297 **example, Teychenne *et al.* [48] observed that only leisure-time physical activity was associated with**
298 **a lower risk of depression.**

299
300 Our results also confirm previous findings [38, 49], in that we observed differential patterns
301 between men and women regarding the associations of psychological variables with sedentary
302 **behaviour** and physical activity. Indeed, diabetes-specific self-efficacy and depressive symptoms in
303 women and anxiety symptoms in men resulted as independent predictors of sedentary time, while
304 social support retained statistically significant association with physical activity in women only.
305 These data may provide rationale for further intervention studies targeting negative mood (anxiety
306 in men; depression in women) and diabetes self-efficacy in women in order to reduce sedentary
307 **behaviours** and, ultimately, to improve the individual cardiovascular risk profile.

308 In contrast with previous studies in T2D individuals [37, 38], we have observed that men and women
309 reported comparable physical activity levels. The potential causes of disparities in physical activity
310 levels between men and women are likely to be multiple. However, most studies (including the

311 present one) investigating this issue have not assessed all sex-specific activities, in particular,
312 activities of lower intensity or more relevant to women's lives. In this regard, Hallal *et al.* [50]
313 showed that, when specific domains of activity practice are considered, no sex differences are
314 observed.

315 Conversely, as compared to men, women showed significantly lower propensity to spend time in
316 sedentary pursuits, an observation that may be amenable to a number of possible explanations.
317 First, it is well known that men and women hold distinct social roles in society. Women are more
318 likely to assume greater domestic responsibilities than men, thus reducing the time spent sitting at
319 home. Second, there is evidence that sex differences in the daily time spent in sedentary activities
320 are more accentuate among people ≥ 60 years of age. Martin *et al.* [51] have demonstrated that
321 older men replace higher-intensity activity with sedentary **behaviour** compared to women, which
322 maintained relatively constant levels of light intensity activities in each age group.

323
324 As for the novelty of our study, we believe that it fills important gaps in the existing literature, as to
325 date no study has specifically and thoroughly explored the association of psychological factors with
326 physical activity and sedentary **behaviours** in men and women with T2D. Indeed, our findings extend
327 previous observations and suggest that the relationship of psychological variables with health
328 outcomes depends on sex-related factors, although the underlying mechanisms yet remain to be
329 completely understood. Taken together, our results and the evidence from other studies suggest
330 that the identification of predictors of healthy **behaviours** by sex is warranted to develop
331 intervention programs suitable for the different needs of women and men with T2D.

332 Nonetheless, we should acknowledge some limitations. First, the generalizability of the study
333 findings is limited, as it was conducted in a single Diabetes Centre and the study **participants** were
334 relatively homogeneous in terms of age, health and educational status. Second, physical activity and
335 sedentary **behaviour** were evaluated by self-assessment measures, which imply inherent
336 inaccuracies in the reported estimates. **Third, the relatively limited sample size and the gender**

337 imbalance towards male participants may have lead to imperfect estimates of the association
338 findings. Finally, the cross-sectional study design precludes any inference of causation: although
339 sedentary behaviour may induce negative emotions, the causal arrow could indeed point the other
340 way, i.e. negative emotions may be responsible for un-healthy behaviour. Therefore, the
341 interpretation of our data should be made with caution and prospective longitudinal and
342 experimental studies are advocated to confirm and expand our results.

343

344

345 **CONCLUSIONS**

346 In conclusion, we have shown that, at variance to what observed for physical activity, sedentary
347 behaviour is closely linked to a more articulated pattern of psychological variables, largely
348 influenced by sex-related differences in the individual psychological characteristics. Diabetes is a
349 chronic progressive condition that calls for a profound change in the perception of the individual's
350 health status and demands a pro-active involvement in several self-care activities. While it is
351 possible that interventions to increase physical activity and decrease sedentary time could in turn
352 improve emotional health, our results may indicate depressive symptoms and self-efficacy in women
353 and anxiety symptoms in men as potential targets for tailored interventions that may ultimately
354 benefit the individual health status by reducing the time spent sitting. Further studies are needed to
355 verify whether this approach would ultimately soften the negative effects of sedentary behaviours
356 on glycemic control and other relevant cardiovascular risk factors.

357

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363

364 **Author Contributions**

365 L.I., M.D. and El.B., and researched and analyzed data and wrote the manuscript. L.S. analyzed data.
366 C.N. and V.C. provided care for study patients. A.N., E.B. and PM edited the manuscript and provided
367 substantial contribution to the overall discussion. L.I., M.D. and El.B are the guarantors of this work
368 and, as such, had full access to all the data in the study and take responsibility for the integrity and
369 the accuracy of the data analysis.

370

371 **Conflict of interest**

372 None to disclose.

373

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507

Table 1 – Descriptive characteristics of the study population

Variables	All	Females	Males	<i>P</i> *	<i>P</i> _{adj}
N	163	66	97	-	-
Age (years)	62.7±7.6	63.5±6.5	62.1±8.1	0.24	-
Diabetes duration (years)	11.1±8.6	10.7±9.9	11.2±7.6	0.71	-
BMI (Kg·m ⁻²)	31.5±4.1	30.6±3.6	32.0±4.3	0.02	-
HbA1c_{DCCCT} (%)	7.6±1.3	7.6±1.1	7.5±1.3	0.52	-
HbA1c_{IFCC} (mmol/mol)	59.1±14.5	59.9±12.9	58.5±14.8		
Diabetes medication (%)					
OHA	63.4	70.8	69.8		
Insulin	11.2	9.2	12.5	0.79	-
OHA+insulin	18.6	17.7	20.0		
Education (%)					
Primary school	27.7	35.9	22.1		
Junior high school	31.4	31.3	31.6		
Senior high school	33.3	29.7	35.8	0.11	-
University	7.5	3.1	10.5		
Work status (%)					
Employed	28.4	22.7	32.3		
Unemployed	3.1	3.0	3.1	0.40	-
Retired	68.5	74.2	64.6		
Marital status (%)					
Single	8.0	4.5	10.3		
Widower	11.7	21.2	5.2		
Divorced/separated	4.9	10.7	1.0	<0.001	-
Married	75.5	63.6	83.5		
Leisure Physical Activity (MET·min·wk ⁻¹)	245 [0-525]	332.5 [70-630]	210.0 [0-476]	0.02	0.23
Sedentary Behaviour (hours/day)	6.0 [5-9]	6.0 [4.5-8]	7.0 [5-10]	0.01	0.03
Depression (BDI-II score)	5.0 [1-10]	4.0 [1-10]	5.0 [1-9]	0.22	0.39
Anxiety (BAI-score)	4.0 [1-8]	5.0 [1.8-13.5]	3.0 [1-7]	0.002	0.007
Psychosocial variables (MDQ score)					
Self-efficacy	58.7 [44.2-71.4]	56.4 [43.5-70.4]	60.0 [44.2-72.8]	0.46	0.18
Perceived interference	1.1 [0.2-2.1]	1.1 [0.2-2.4]	1.1 [0.3-2.0]	0.17	0.28
Perceived severity	4.0 [3.0-5.3]	4.3 [2.9-5.6]	3.6 [3.0-5.0]	0.26	0.22
Social support	4.0 [2.5-5.2]	3.5 [2.1-4.6]	4.0 [3.0-5.2]	0.04	0.02
Misguided support behaviour	1.6 [0.2-3.2]	0.5 [0.0-2.5]	2.2 [0.7-3.6]	0.05	0.008
Spouse's positive behaviour	2.7 [1.4-4.2]	2.1 [0.5-3.4]	3.2 [1.7-4.3]	0.05	0.005

Abbreviations: BMI, Body Mass Index; OHA, oral hypoglycemic agents; HbA1c_{DCCCT}, Diabetes Control and Complication Trial-Aligned Hemoglobin A1c; HbA1c_{IFCC}, International Federation of Clinical Chemistry-Aligned Hemoglobin A1c; BDI-II, Beck Depression Inventory II; BAI, Beck Anxiety Inventory; MDQ, Multidimensional Diabetes Questionnaire. Data expressed as mean ±SD, median [IQR] or percentage; * Pearson's *P* value for sex-comparison. *P*_{adj}, BMI-adjusted Pearson's *P* value. Statistically significant figures are provided in boldface type.

Table 2 – Simple correlations (Pearson's r) between physical activity, sedentary **behaviour** and psychological variables in the overall cohort and separately in men and women.

	All		Females		Males	
	Physical Activity	Sedentary Behaviour	Physical Activity	Sedentary Behaviour	Physical Activity	Sedentary Behaviour
Depressive symptoms (BDI-II score)	0.02	0.22**	-0.15	0.49**	0.12	0.10
Anxiety symptoms (BAI score)	-0.05	0.20*	-0.11	0.30*	-0.05	0.27*
Self-efficacy (MDQ score)	0.21**	-0.25**	0.20	-0.44**	0.23*	-0.13
Perceived Interference (MDQ score)	-0.08	0.16	-0.11	0.25*	-0.04	0.11
Perceived severity (MDQ score)	-0.06	0.10	-0.03	0.13	-0.05	0.09
Social support (MDQ score)	0.11	-0.03	0.27*	-0.19	0.05	-0.01
Misguided support behaviour (MDQ score)	-0.03	0.23**	0.14	0.19	-0.07	0.14
Spouse's positive behaviour (MDQ score)	-0.04	0.14	0.11	0.20	-0.11	0.01

*Significance at two-tailed $P < 0.05$; ** $P < 0.001$. Statistically significant figures are reported in boldface type

Table 3 - Association of sedentary **behaviour with symptoms of depression and anxiety, diabetes self-efficacy and perceived interference by liner regression analyses in the overall cohort and separately for men and women.**

	All		Females		Males	
	β_{std}	<i>P</i>	β_{std}	<i>P</i>	β_{std}	<i>P</i>
Depressive symptoms	0.06	0.61	0.30	0.02	-0.15	0.31
Anxiety symptoms	0.18	0.03	-0.13	0.44	0.24	0.02
Self-efficacy	-0.20	0.01	-0.27	0.04	-0.09	0.39
Perceived interference	0.05	0.57	0.06	0.66	0.01	0.91
Age	-0.001	0.99	0.01	0.96	0.04	0.74
BMI	0.09	0.25	0.18	0.14	0.04	0.68
Diabetes duration	-0.007	0.93	0.15	0.19	-0.09	0.41
HbA1c	0.006	0.94	0.12	0.32	0.002	0.41
Sex	-0.22	0.006	-		-	
<i>Adjusted model-R²</i>	<i>R²=10.6%</i>		<i>R²=21.2%</i>		<i>R²=4.6%</i>	