



HAL
open science

Identifying a motivational process surrounding adherence to exercise and diet among adults with type 2 diabetes

Manon Laroche, Peggy Roussel, Francois Cury

► To cite this version:

Manon Laroche, Peggy Roussel, Francois Cury. Identifying a motivational process surrounding adherence to exercise and diet among adults with type 2 diabetes. 2019. hal-02274952

HAL Id: hal-02274952

<https://hal.science/hal-02274952v1>

Preprint submitted on 30 Aug 2019

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

1 **ABSTRACT**

2 *Objectives.* This paper aims to provide physicians with knowledge about the motivational
3 processes surrounding exercise and diet for patients with type 2 diabetes and to offer patient
4 support measures to favor self-management. To respond to this objective, the links between
5 two kind of motivators (i.e., promotion and prevention foci), the Selection, Optimization and
6 Compensation (SOC) self-management strategy, and adherence to exercise and diet of
7 patients with type 2 diabetes were investigated for the first time in the literature.

8 *Method.* A cross-sectional study was conducted with 491 French volunteer participants with
9 type 2 diabetes diagnosed for at least 3 months (Age = 61.66 ± 9.63; BMI = 29.8 ± 5.9).
10 Participants completed an online self-report survey measuring SOC strategy, promotion and
11 prevention foci, and adherence to exercise and diet.

12 *Results.* The main results of path and bootstrapping analysis demonstrated that promotion
13 focus was positively related with SOC strategy ($\beta = .69$, $p < .001$) whereas prevention focus
14 was not ($\beta = -.01$, *ns.*). On the other hand, SOC strategy was positively related with exercise
15 ($\beta = .20$, $p < .05$), general diet ($\beta = .49$, $p < .001$), fruit and vegetable consumption ($\beta = .27$, p
16 $< .001$), and spacing of carbohydrates ($\beta = .40$, $p < .001$), and mediated the positive link
17 between promotion focus and these behaviors (bootstrapped 95% CI: [.11 ; .40], [.52 ; .81],
18 [.22 ; .54], [.37 ; .70], respectively).

19 *Conclusion.* This paper addresses a gap in previous research by evidencing a motivator that
20 promotes self-management for exercise and diet among patients with type 2 diabetes. Our
21 results suggest that physicians should privilege an interaction with patients oriented toward
22 promotional motivation so as to favor their patients' self-management regarding exercise and
23 diet.

24

25 1. INTRODUCTION

26 Diabetes is one of the most common metabolic disorders in the world [1]. In France, there are
27 an estimated 3 million patients with diabetes. The most common is type 2 diabetes,
28 accounting for > 90% of all diabetes cases [2]. Exercise and diet are key aspects of its
29 treatment [3,4]. Indeed, exercise and weight loss have both been shown to decrease insulin
30 resistance and to improve glycemic control [5,6], which in turn is associated with lower risk
31 of short-term complications (e.g., hyperglycemia), long-term comorbid conditions (e.g.,
32 cardiovascular diseases), and mortality [7,8]. However, exercise and diet are perceived as
33 costly in terms of time, organization, and personal investment [9]. Nadeau [10] underlines that
34 “in clinical practice only a small percentage of the population with T2DM is sufficiently self-
35 motivated to undertake a rigorous exercise and diet program” (p.50). While physicians are
36 aware of the importance of the patient’s self-management in his/her treatment, the author
37 stresses the lack of precise information about the motivators that promote exercise and diet in
38 the patient.

39 The overall objective of this paper is thus to provide physicians with knowledge about the
40 motivational processes surrounding exercise and diet for patients with type 2 diabetes and
41 offer methods of support to favor their patients’ self-management (e.g., What message should
42 they privilege? What should be emphasized in patient support?)

43 To take exercise and follow a diet effectively, type 2 diabetes patients must be capable of
44 making decisions and setting themselves targets appropriate to the constraints they face. This
45 capacity to adapt to constraints and to reduced personal resources refers to a psychological
46 process formalized by the theoretical model of Selective Optimization and Compensation
47 (SOC, [11]). This model proposes that the combined use of four strategies helps individuals to
48 optimally allocate their limited resources [11,12]: elective selection (i.e., developing and
49 committing to a hierarchy of personal goals), optimization (i.e., engaging in goal-directed

50 actions and means), loss-based selection (i.e., changing the goal or the goal system) and
51 compensation (i.e., acquiring alternative means in response to a loss). Several studies have
52 shown that the use of SOC strategy has a positive influence on health behaviors such as the
53 exercise participation of individuals in orthopedic rehabilitation [13] or older women's long-
54 term adherence to a program of exercise [14]. In the light of these works, it could be supposed
55 that the use of this SOC strategy would be favorable to exercise and diet among patients with
56 type 2 diabetes. So far as we know, no study has so far examined the links between SOC
57 strategy and exercise and diet among patients with type 2 diabetes. The first aim of this study
58 is therefore to examine these links in this population.

59 On the other hand, our second aim is to identify for the first time in the literature the
60 motivators which favor the use of this adaptative strategy. Regulatory Focus Theory [15], a
61 well-established motivational model to study health behaviors both among healthy [16,17,18]
62 and patients with type 2 diabetes [19], identifies two kinds of motivational orientations that
63 guide people in their self-care behaviors. The first called "promotion focus" is associated with
64 growth and accomplishment needs [15]. In a health-related context, it is reflected by concerns
65 for improving the health state or attaining health-related gains [16,20]. The second called
66 "prevention focus" is associated with security and safety needs [15]. In a health-related
67 context, it is reflected by concerns for protecting health state or avoiding health-related losses
68 [16,20].

69 In this paper, we consider that promotion focus could be a motivator favorable to the use of
70 the SOC strategy. First, promotion-focused individuals tend to engage a flexible cognitive
71 process [21] which is compatible with the development of new goals in response to
72 difficulties, refinement of goal-relevant means, and acquisition of new skills/resources
73 emphasized by the SOC strategy [12]. Secondly, SOC strategy provides guidance toward
74 success [22], which is a goal congruent with promotion focus [23]. Thirdly, Baltes et al. [22]

75 have shown in a work context that promotion focus is a positive predictor of SOC strategy.
76 On the other hand, we propose that prevention focus would be either not or negatively
77 associated with the adoption of SOC strategy. Prevention-focused individuals tend to engage a
78 rigid cognitive process and not to persist for long in a difficult task [21]. These two
79 inclinations are likely not to be compatible with the flexibility and the tenacity required by the
80 SOC strategy [12]. Finally, given that promotion focus has been found to be a motivational
81 orientation favorable to exercise and diet among both healthy patients [16,17] and patients
82 with type 2 diabetes [19], the following specific mediational hypothesis was tested. We
83 predicted that the positive relation between promotion focus, exercise and diet would be
84 mediated by the use of SOC strategy.

85

86 In sum, in this paper our three main hypotheses are:

87 **H1:** SOC strategy should be positively associated with exercise and diet behaviors.

88 **H2:** promotion focus should be positively associated with SOC strategy whereas prevention
89 focus should be either not or negatively associated with this variable.

90 **H3:** promotion focus should be indirectly positively associated with exercise and diet through
91 SOC strategy

92

93 **2. METHOD**

94 **2.1 Procedure**

95 Data were collected via a cross-sectional online self-report survey. Questionnaires were
96 mailed by a polling institute (Dynata, <https://www.dynata.com>, ISO 20252:2019) to a sample
97 of French adults with type 2 diabetes constituted on a voluntary basis. Participants were
98 treated in accordance with the ethical requirements of the Declaration of Helsinki and the
99 French Psychological Society with respect to consent, confidentiality, and anonymity of the

100 answers. Prior to data collection, all participants signed an informed consent form. They were
101 informed of the goal of the study and of their right to stop their participation at any time. The
102 responses were anonymous, as the individuals were only identified by the day and time of
103 completion of the questionnaire. Prior to data collection, the study was approved by the CNIL
104 (no. 1545711).

105 **2.2 Participants**

106 To be eligible for the study participants had to: (i) be older than 18, (ii) have a history of at
107 least three months of diagnosed type 2 diabetes mellitus, and (iii) have French-reading
108 abilities. A total of 491 participants (311 men) aged from 26 to 86 ($M = 61.7$, $SD = 9.6$) were
109 selected in the study. Most of the participants (93.3%) had completed secondary education,
110 56% were retired, and 67.6% lived with a partner. About 72% of the participants were treated
111 with diabetic oral medications, 22% used insulin, and 30% were not medicated for their
112 diabetes. The average number of comorbidities per participant was 1.48 ($SD = 1.96$); the most
113 common was arterial hypertension (44.8%). The average body mass index of the sample was
114 29.8 ($SD = 5.9$). Demographic characteristics and health condition of the sample are presented
115 in Table 1.

116 **2.3 Measures**

117 *SOC strategy*. Reuter et al.'s [24] questionnaire, a version of Freund and Baltes' [12] original
118 questionnaire adapted for leading a healthy lifestyle, was used to assess participants' SOC
119 strategy. Using a standard "forward-backward" translation procedure, the English-language
120 version of the questionnaire was translated into French. The questionnaire is composed of a
121 total of four items assessing SOC strategy (e.g., "*I have defined my goals exactly and stick to*
122 *them*"). Participants responded on a scale from 1 = "*completely disagree*" to 4 = "*completely*
123 *agree*".

124 *Regulatory focus.* Gomez et al.'s [20] French regulatory focus questionnaire was used to
125 assess participants' regulatory focus. This questionnaire is composed of a total of eight items
126 which assess regulatory focus in the health-specific context: five items assessing promotion
127 focus (e.g., *"I do not hesitate to embrace new experiences if I think they can improve my*
128 *health"*), and three items assessing prevention focus (e.g., *"I frequently think about the health*
129 *problems I may have in the future"*), presented in a random order. Participants responded on a
130 scale from 1 = *"completely disagree"* to 7 = *"completely agree"*. Because a previous study
131 [25] has shown that a prevention focus item (i.e., *"When I implement a health behavior, it's*
132 *because I want to protect myself from getting sick"*) exhibited unsatisfactory psychometric
133 properties, this item was slightly adjusted.

134 *Exercise and diet diabetes self-care behaviors.* The exercise and diet subscales of the
135 Summary of Diabetes Self-Care Activities questionnaire (SDSCA, [26]) were used to assess
136 participants' adherence to exercise and diet. Using a standard "forward-backward" translation
137 procedure, the English-language version of the items was translated into French. Respondents
138 are requested to indicate on how many days of the week (0–7) they performed each activity
139 when they were not sick. Two items assessed adherence to exercise behavior (e.g., *"Did you*
140 *participate in at least 30 minutes of physical activity?"*), two items assessed adherence to
141 general diet (e.g., *"Have you followed a healthful eating plan?"*), and three items assessed
142 adherence to three specific diet behaviors (i.e., *"Did you eat five or more servings of fruits*
143 *and vegetables?"*, *"Did you eat high-fat foods such as red meat or full-fat dairy products?"*,
144 *"Did you space carbohydrates evenly through the day?"*). As recommended by Toobert et al.
145 [26], responses to the item related to high-fat food consumption were reversed (0=7, 1=6,
146 2=5, 3=4, 4=3, 5=2, 6=1, 7=0).

147 **2.4 Statistical analysis**

148 First, the reliability of each measure was examined. For SOC strategy and Regulatory focus
149 measures, two confirmatory factorial analyses (CFA) were performed on the covariance
150 matrix of the items to examine whether the factorial structures delineated by Gomez et al. [20]
151 and Reuter et al. [24] generated adequate fit with the observed data. A model was considered
152 adequate if the comparative fit index (CFI) and the goodness of fit index (GFI) were greater
153 than or equal to .90, and if the root mean square residual (RMSEA) was lower than or equal to
154 .08 [27]. In addition, for all measures (i.e., SOC strategy, Regulatory focus, and Exercise and
155 diet diabetes self-care behaviors) the internal consistency of the items was examined. The
156 internal consistency could be considered satisfactory when Cronbach alphas $> .65$ [28].
157 Once the reliability of the measurements was verified the descriptive statistics (mean,
158 standard deviation, distribution) and correlations of the key variables were examined. Then, a
159 path model for evaluating the combined contribution (direct and indirect effects) of each
160 variable – SOC strategy, promotion focus, prevention focus – on exercise, general diet, fruit
161 and vegetable consumption, high-fat food consumption, and spacing of carbohydrates was
162 run. In this model, age, gender, number of comorbidities and educational level were included
163 as control variables. This path analysis was conducted by using Lisrel 9.1. The .05 level of
164 significance was used for all statistical hypothesis testing. Beta represents the standardized
165 regression coefficient. As for previous analyzes, the recommendations of Meyers et al. [27]
166 were applied to assess the adequacy of the model (CFI and GFI $\geq .90$; RMSEA $\leq .08$).
167 Finally, using SPSS software 18.0, a bootstrapping method [29] resample set at 5000 samples
168 with bias-corrected 95% confidence intervals was employed to test the significance of the
169 indirect effects. Point estimates of indirect effects are considered significant when zero is not
170 contained in 95% confidence intervals [29].

171

172 **3. RESULTS**

173 **3.1 Reliability of the measures**

174 *SOC strategy*. The results of the CFA showed that the one-factor model delineated by Reuter
175 et al. [24] provided an excellent fit with the data: $\chi^2/df = 1.96$; RMSEA =.04; GFI = 1; CFI =
176 1. Internal consistency was satisfactory ($\alpha =.88$). An average score was thus computed for
177 SOC strategy.

178 *Regulatory focus*. The results of the CFA showed that the two-factor model delineated by
179 Gomez et al. [20] provided a good fit with the data: $\chi^2/df = 4.13$; RMSEA =.08; GFI =.96;
180 CFI =.98. Internal consistency was satisfactory for both the promotion focus ($\alpha =.86$) and
181 prevention focus ($\alpha =.85$) subscales. Average scores were thus computed for each regulatory
182 focus.

183 *Exercise and diet diabetes self-care behaviors*. Internal consistency was satisfactory for both
184 exercise ($\alpha =.68$) and general diet ($\alpha =.96$) subscales. The mean number of days was thus
185 computed for each of these subscales. However, the internal consistency value for the three
186 items of the specific diet subscale was low ($\alpha =.32$). This low consistency did not allow us to
187 average the scores of these three items. This result is similar to that obtained by Toobert et al.
188 [26]. In accordance with these authors' procedure, the items were examined separately in the
189 subsequent analyses.

190

191 **3.2 Descriptive analyses**

192 Means, standard deviations, and Pearson's correlation coefficients for the variables are
193 presented in Table 2. Pearson's correlations showed that (i) SOC strategy was positively
194 correlated with exercise, general diet, fruit and vegetable consumption, and spacing of
195 carbohydrates, and was not correlated with high-fat food consumption; (ii) promotion focus
196 was positively correlated with SOC strategy, exercise, general diet, fruit and vegetable
197 consumption, and spacing of carbohydrates, and was not correlated with high-fat food

198 consumption; and (iii) prevention focus was not correlated with SOC strategy, slightly
199 positively correlated with exercise, general diet, and spacing of carbohydrates, and was not
200 correlated either with fruit and vegetable consumption or high-fat food consumption. The
201 results of the distribution analyses (see Table 3) show that skewness and kurtosis coefficients
202 are respectively $< \pm 2$ and $< \pm 7$ for all the variables. In accordance with the recommendations
203 of Tabachnick and Fidell [30], the normality of the distribution of our sample was thus
204 verified for all the variables. For each variable, the proportion of the sample having checked
205 the minimum of the scale was relatively low. Thus, our participants were relatively concerned
206 by SOC strategy, Regulatory focus, and Exercise and diet diabetes self-care behaviors.

207 **3.3 Hypothetical model path analysis**

208 The hypothetical path model provided a good fit to the data ($\chi^2 = 107.1$; $df = 25$; $\chi^2/df = 4.28$;
209 $RMSEA = .08$; $GFI = .96$; $CFI = .93$). The results indicated that when controlling age, gender,
210 number of comorbidities, and educational level, SOC strategy was positively related with
211 exercise ($\beta = .20$, $p < .05$, $R^2 = .15$), general diet ($\beta = .49$, $p < .001$, $R^2 = .24$), fruit and vegetable
212 consumption ($\beta = .27$, $p < .001$, $R^2 = .10$), and spacing of carbohydrates ($\beta = .40$, $p < .001$, R^2
213 $= .18$), and not related with high-fat food consumption ($\beta = -.03$, *ns.*, $R^2 = .02$).

214 On the other hand, promotion focus was positively related with SOC strategy ($\beta = .69$, p
215 $< .001$, $R^2 = .49$) whereas prevention focus was not associated with this variable ($\beta = -.01$, *ns.*).

216 Finally, bootstrapping analyses indicated that promotion focus was indirectly related
217 positively with exercise (point estimate of .07, bias-corrected bootstrapped 95% CI of .11 to
218 .40), general diet (point estimate of .08, bias-corrected bootstrapped 95% CI of .52 to .81),
219 fruit and vegetable consumption (point estimate of .08, bias-corrected bootstrapped 95% CI of
220 .22 to .54), and spacing of carbohydrates (point estimate of .09, bias-corrected bootstrapped
221 95% CI of .37 to .70) through SOC strategy. SOC strategy partially mediated the direct link
222 between promotion focus and exercise ($\beta = .15$, $p < .05$), and totally mediated the direct links

223 between promotion focus and general diet ($\beta = -.03, ns.$), fruit and vegetable consumption (β
224 $=.03, ns.$), and spacing of carbohydrates ($\beta = -.02, ns.$)¹. Significant indirect relations are
225 illustrated in Figure 1.

226

227 4. DISCUSSION

228 The overall objective of this study was to provide physicians with knowledge about
229 motivational processes favoring self-management for exercise and diet among patients with
230 type 2 diabetes. First, as hypothesized, the results show that SOC strategy is positively related
231 with exercise and most diet behaviors (including general diet, consumption of fruit and
232 vegetables and spacing of carbohydrates). For the first time in the literature, these results
233 show thus that SOC strategy is beneficial for exercise and diet in patients with type 2 diabetes
234 and extend the work done on other populations (e.g., patients in orthopedic rehabilitation,
235 [13]; older women, [14]). Furthermore, for physicians, they suggest that the SOC self-
236 management strategy (i.e., selecting and planning one's objectives by order of priority,
237 assigning the necessary time and effort for the fulfilment of those objectives, adapting one's
238 level of demand if difficulties arise) should be privileged in order to promote exercise and diet
239 in this population.

240 Secondly, as hypothesized, the results of this study show that (i) promotion focus is positively
241 related with SOC strategy whereas prevention focus is not and (ii) promotion focus is
242 positively related with exercise and most diet behaviors through the SOC strategy. For the
243 first time in the literature, these results thus identify a motivational determinant of the SOC

¹The effects of diabetes duration and diabetes treatment (no treatment vs. insulin vs. oral medication) were also checked in complementary analyses. The results of structural analyses showed that diabetes duration was not associated with exercise, nor with general diet, fruit and vegetable consumption, high-fat food consumption, or spacing of carbohydrates. On the other hand, the results of ANOVAs showed that diabetes treatment had no effect on exercise, general diet, fruit and vegetable consumption, or high-fat food consumption. However, patients with insulin as diabetes treatment reported more spacing of carbohydrates than patients with oral medication. Given this result, we therefore compared the contribution of promotion focus, prevention focus, and SOC strategy on spacing of carbohydrates in these two sub-groups. The results of these analyses indicated that whatever the group, SOC strategy was positively associated with spacing of carbohydrates, promotion focus was positively associated with spacing of carbohydrates through SOC strategy, and prevention focus was not associated with SOC strategy.

244 strategy used among patients with type 2 diabetes for exercise and diet. In addition, they
245 extend the study of Avraham et al. [19] by documenting a process in the positive link between
246 promotion focus, exercise and diet among patients with type 2 diabetes. In so doing, they
247 advance knowledge about the consequences of promotion focus, and provides perhaps the
248 most detailed and specific explanation to date of the promotion focus–health behaviors
249 relation. Furthermore, the identification of this motivator favorable to the use of the SOC
250 strategy to promote exercise and diet makes it possible to advise physicians on what should be
251 prioritized in patient support to favor their patients’ self-management. Specifically, physicians
252 can encourage their patients’ self-management by guiding them towards promotion rather
253 than a prevention motivation.

254 Concretely, in terms of methods of support (e.g., arguments to be highlighted in a therapeutic
255 education program, interactions with patients), it first implies that physicians should adopt a
256 positive motivational discourse centered on the health benefits of exercise and diet (e.g.,
257 *“Take exercise and eat healthily to improve your quality of life”*, *“Go ahead with exercise and*
258 *healthy eating”*) rather than an alarmist discourse focused on the risks of complications (e.g.,
259 *“Take exercise and keep to a diet to avoid worsening your state of health”*, *“Keep active and*
260 *eat healthily to avoid complications linked to diabetes”*). Such alarmist discourse may be
261 effective among patients with type 2 diabetes in promoting other self-care behaviors such as
262 medication [20, 18], but it does not favor exercise and adopting a healthy diet. To guide
263 patients towards a motivational orientation promotion, physicians could also encourage them
264 to focus on their progress and success in their exercise and diet (e.g., stressing the progress
265 made, setting new targets for moving forward). By privileging this type of motivation,
266 physicians should enable their patients to be more capable of self-managing in their treatment
267 behaviors and so facilitate their adherence to constraining health behaviors such as exercise
268 and diet.

269

270 **Limitations**

271 Despite the scope of these results, both theoretically and practically, some limitations of the
272 study should be mentioned. First, the cross-sectional design of the study does not allow for
273 causal claims among the variables. Future experimental study should thus confirm the effects
274 of promotion focus on exercise and diet through SOC strategy. In addition, future longitudinal
275 studies on patients with type 2 diabetes could strengthen our study by examining, over a year
276 for example and with different measuring times, the long-term impact of promotion focus on
277 exercise and diet, since these are two health behaviors that are beneficial when practiced over
278 the long term. The question of maintenance over time is therefore essential.

279 Thirdly, the results of this study show that high-fat food consumption was not related either
280 with promotion focus or with SOC strategy. This result is not consistent with those obtained
281 with other items assessing diet (i.e., general diet, consumption of fruits and vegetables, and
282 spacing of carbohydrates). Previous research also did not find the results expected regarding
283 high-fat food consumption [31,32]. Gonzales et al. [31] state that the item of the SDSCA
284 capturing this behavior “is problematic because it gives ‘red meat’ and ‘full-fat dairy
285 products’ as the only two examples of high-fat foods. This item may not capture other sources
286 of high-fat (e.g. fried foods, fast food)” (p.1105). Future research should analyze high-fat food
287 consumption behavior in relation to promotion focus more closely by capturing other high-fat
288 foods. Finally, glycemic control was not measured in this study. A further study examining to
289 what extent regulatory foci and SOC strategy are related to exercise and diet behaviors by
290 controlling the potential effect of glycemic control could complement our present results.

291

292 **5. CONCLUSION**

293 Beyond these limitations, these findings contribute to the literature in health psychology by
294 evidencing for the first time among patients with type 2 diabetes (i) positive links between
295 SOC strategy and adherence to exercise and diet, (ii) motivators of SOC strategy, and (iii) a
296 specific process underlying the link between promotion focus and adherence to exercise and
297 diet. In addition to these theoretical implications, this study also suggests practical steps for
298 physicians about motivators that promote self-management for exercise and diet among
299 patients with type 2 diabetes. Physicians should privilege an approach to patients oriented
300 towards promotional motivation so as to favor self-management regarding exercise and diet.

301

302 **6. REFERENCES**

- 303 1. Guariguata L, Whiting DR, Hambleton I, et al. Global estimates of diabetes prevalence for
304 2013 and projections for 2035. *Diabetes Res Clin Pract.* 2014;103(2):137–149.
- 305 2. Mandereau-Bruno L, Fosse-Edorh S. Prévalence du diabète traité pharmacologiquement
306 (tous types) en France en 2015. Disparités territoriales et socio-économiques. [Prevalence
307 of pharmacologically treated diabetes (all types) in France in 2015. Territorial and socio-
308 economic disparities]. *Bull Epidémiol Hebd.* 2017;(27-28):586–91. French.
- 309 3. Colberg SR, Sigal RJ, Yardley JE, et al. Physical activity/exercise and diabetes: a position
310 statement of the American Diabetes Association. *Diabetes Care.* 2016;39(11):2065–2079.
- 311 4. Evert AB, Boucher JL, Cypress M, et al. Nutrition therapy recommendations for the
312 management of adults with diabetes. *Diabetes Care.* 2013;36(11):3821–3842.
- 313 5. Snowling NJ, Hopkins WG. Effects of different modes of exercise training on glucose
314 control and risk factors for complications in type 2 diabetic patients: a meta-analysis.
315 *Diabetes Care.* 2006;29(11):2518–2527.

- 316 6. Espeland M. Reduction in weight and cardiovascular disease risk factors in individuals
317 with type 2 diabetes: one-year results of the look AHEAD trial. *Diabetes Care*.
318 2007;30(6):1374–1383.
- 319 7. Andersson DKG, Svärdsudd K. Long-term glycemetic control relates to mortality in type II
320 diabetes. *Diabetes Care*. 1995;18:1534–1543.
- 321 8. Klein R, Klein BEK, Moss SE: relation of glycemetic control to diabetic microvascular
322 complications in diabetes mellitus. *Ann Intern Med*. 1996(1_Part_2);124:91–96.
- 323 9. Booth AO, Lowis C, Dean M, et al. Diet and physical activity in the self-management of
324 type 2 diabetes: barriers and facilitators identified by patients and health professionals.
325 *Prim Health Care Res Dev*. 2013;14(3):293–306.
- 326 10. Nadeau DA. Management of type 2 diabetes mellitus in self-motivated patients: optimized
327 diet, exercise, and medication for weight loss and cardiometabolic fitness. *Phys*
328 *Sportsmed*. 2014;42(4):49–59.
- 329 11. Baltes PB, Baltes MM. *Successful aging: Perspectives from the behavioral sciences*. New
330 York (NY): Cambridge University Press; 1990. Chapter 1, Psychological perspectives on
331 successful aging: The model of selective optimization with compensation; p. 1–34.
- 332 12. Freund AM, Baltes PB. Life-management strategies of selection, optimization and
333 compensation: Measurement by self-report and construct validity. *J Pers Soc Psychol*.
334 2002;82(4):642–662.
- 335 13. Ziegelmann JP, Lippke S. Planning and strategy use in health behavior change: A life
336 span view. *Int J Behav Med*. 2007;14(1):30–39.
- 337 14. Evers A, Klusmann V, Ziegelmann JP, et al. Long-term adherence to a physical activity
338 intervention: the role of telephone-assisted vs. self-administered coping plans and strategy
339 use. *Psychol Health*. 2012;27(7):784–797.
- 340 15. Higgins ET. Beyond pleasure and pain. *Am Psychol*. 1997;52(12):1280–1300.

- 341 16. Ferrer RA, Lipkus IM, Cerully J, et al. Developing a scale to assess health regulatory
342 focus. *Soc Sci Med.* 2017;195:50–60.
- 343 17. Joireman J, Shaffer MJ, Balliet D, et al. Promotion orientation explains why future-
344 oriented people exercise and eat healthy: Evidence from the two-factor consideration of
345 future consequences-14 scale. *Pers Soc Psychol Bull.* 2012;38(10):1272–1287.
- 346 18. Leder S, Florack A, Keller J. Self-regulation and protective health behaviour: how
347 regulatory focus and anticipated regret are related to vaccination decisions. *Psychol*
348 *Health.* 2015; 30(2):165–88.
- 349 19. Avraham R, Van Dijk D, Simon-Tuval T: regulatory focus and adherence to self-care
350 behaviors among adults with type 2 diabetes. *Psychol Health Med.* 2016;21(6):696–706.
- 351 20. Gomez P, Borges A, Pechmann CC: avoiding poor health or approaching good health:
352 Does it matter? Conceptualization, measurement and consequences of health regulatory
353 focus. *J Consumer Psychol.* 2013;23(4):451–463.
- 354 21. Crowe E, Higgins ET. Regulatory focus and strategic inclinations: Promotion and
355 prevention in decision-making. *Organ Behav Hum Decis Process.* 1997;69(2):117–132.
- 356 22. Baltes BB, Wynne K, Sirabian M, et al. Future time perspective, regulatory focus, and
357 selection, optimization, and compensation: Testing a longitudinal model. *J Organ Behav.*
358 2014;35(8):1120–1133.
- 359 23. Higgins ET, Roney CJ, Crowe E, et al. Ideal versus ought predilections for approach and
360 avoidance distinct self-regulatory systems. *J Pers Soc Psychol.* 1994;66(2):276–286.
- 361 24. Reuter T, Ziegelmann JP, Wiedemann AU, et al. Planning bridges the intention–behaviour
362 gap: Age makes a difference and strategy use explains why. *Psychol Health.*
363 2010;25(7):873–887.
- 364 25. Schmalbach B, Spina R, Steffens-Guerra I, et al. Psychometric Properties of the German
365 Version of the Health Regulatory Focus Scale. *Front Psychol.* 2017;8:1–10.

- 366 26. Toobert DJ, Hampson SE, Glasgow RE: the summary of diabetes self-care activities
367 measure: Results from 7 studies and a revised scale. *Diabetes Care*. 2000;23(7):943–950.
- 368 27. Meyers, LS, Gamst, G, Guarino, AJ. *Applied multivariate research*. Thousand Oaks (TO):
369 Sage Publications; 2006.
- 370 28. Nunally JC. *Psychometric Theory*. New York (NY): Mc-Graw-Hill Book Company, 1967.
- 371 29. Preacher KJ, Hayes AF. SPSS and SAS procedures for estimating indirect effects in
372 simple mediation models. *Behav Res Methods Instrum Comput*. 2004;36:717–731.
- 373 30. Tabachnick BG, Fidell LS. *Using Multivariate Statistics (5th edn)*. Boston (MA): Pearson
374 Education; 2007.
- 375 31. Gonzalez JS, Safren SA, Delahanty LM, et al. Symptoms of depression prospectively
376 predict poorer self-care in patients with Type 2 diabetes. *Diabet Med*. 2008;25(9):1102–
377 1107.
- 378 32. Sarkar U, Fisher L, Schillinger D: is self-efficacy associated with diabetes self-
379 management across race/ethnicity and health literacy? *Diabetes Care*. 2006;29(4):823–
380 829.
- 381
- 382