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ORIGINAL ARTICLE

Stage of change and motivation to healthy diet and habitual physical activity in type 2 diabetes

E. Centis · M. Trento · A. Dei Cas · A. E. Pontiroli · P. De Feo · A. Bruno · A. S. Sasdelli · F. Arturi · F. Strollo · S. Vigili de' Kreutzenberg · C. Invitti · P. Di Bonito · M. Di Mauro · G. Pugliese · A. Molteni · G. Marchesini

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Abstract Lifestyle changes to healthy diet (HD) and habitual physical activity (HPA) are recommended in type 2 diabetes mellitus (T2DM). Yet, for most people with diabetes, it may be difficult to start changing. We investigated the stage of change toward healthier lifestyles according to Prochaska's model, and the associated psychological factors in T2DM patients, as a prerequisite to improve strategies to implement behavior changes in the population. A total of 1,353 consecutive outpatients with T2DM attending 14 tertiary centers for diabetes treatment completed the validated EMME-3 questionnaire, consisting of two parallel sets of instruments to define the stage of change for HD and HPA, respectively. Logistic regression was used to determine the factors associated with stages that may hinder behavioral changes. A stage of change favoring progress to healthier behaviors was more common in the area of HD than in HPA, with higher scores in action and maintenance. Differences were observed in relation to gender, age and duration of disease. After adjustment for confounders, resistance to change toward HD was associated with higher body mass index (BMI) (odds ratio (OR) 1.05; 95 % confidence interval (CI) 1.02–1.08). Resistance to improve HPA also increased with BMI (OR 1.06; 95 % CI 1.03–1.10) and decreased with education level (OR 0.74; 95 % CI 0.64–0.92). Changing lifestyle, particularly in the area of HPA, is not perceived as an essential part of treatment by many subjects with T2DM. This evidence must be considered when planning behavioral programs, and specific interventions are needed to promote adherence to HPA.

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Other participants are C. Caselli (Bologna); E. Logullo (Como); I. Carucci, L. Borgia (Roma); A. M. Veronelli (Milano); A. Conti (Milano); A. Avogaro (Padova); I. Zavaroni (Parma); E. Succurro (Catanzaro).

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E. Centis · A. S. Sasdelli · G. Marchesini (✉)
Unit of Metabolic Diseases and Clinical Dietetics, Alma Mater University of Bologna, Policlinico S. Orsola, Via Massarenti, 9, 40138 Bologna, Italy
e-mail: giulio.marchesini@unibo.it

M. Trento
Laboratory of Clinical Pedagogy, Department of Medical Sciences, University of Turin, Turin, Italy

A. Dei Cas
Diabetes Unit, Department of Clinical and Experimental Medicine, University of Parma, Parma, Italy

A. E. Pontiroli
Internal Medicine, University of Milan, Milan, Italy

P. De Feo
Healthy Lifestyle Institute, University of Perugia, Perugia, Italy

A. Bruno
Unified Diabetes Center, Turin, Italy

F. Arturi
Department of Experimental and Clinical Medicine, Magna Graecia University, Catanzaro, Italy

F. Strollo
Diabetes and Nutrition, Santo Spirito Hospital, Rome, Italy

S. Vigili de' Kreutzenberg
Division of Metabolic Diseases, Department of Medicine, University of Padua, Padua, Italy

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Introduction

Lifestyle changes toward healthy diet (HD) and habitual physical activity (HPA) are primary therapeutic interventions in the prevention and treatment for type 2 diabetes mellitus (T2DM) [1]. Several randomized-controlled trials have consistently demonstrated that progression from prediabetes to T2DM is reduced by weight loss and increased physical activity [2], whereas in subjects with T2DM, dietary intervention and physical activity improve metabolic control and reduce the long-term risk of disease-related complications [3–5] at any stage of disease severity [6].

The factors that may concur to limit versus to favor the participation in programs aimed at healthy lifestyle change have been the subject of intense research [7]. Self-efficacy and motivation are pivotal for lifestyle changes. Increased self-efficacy has been consistently linked with higher levels of diabetes-related self-care in terms of diet and lifestyle [8]. Following the seminal experience of the Diabetes Prevention Program [9], specific programs have been developed to increase motivation to engage in physical activity in T2DM [10]. The participation in structured physical activity programs was paralleled by an improvement in metabolic control and cardiovascular risk profile [11, 12]. However, a lot of difficulties arise in making people with diabetes change unhealthy behaviors, particularly toward HPA.

The transtheoretical model of Prochaska et al. [13] may provide a cognitive measure of motivation to change. This model integrates key constructs into a comprehensive theory of change that can be applied to a variety of behaviors, populations and settings. It consists of a five-option forced-choice question, with response options reflecting five dimensions: (a) precontemplation, (b) contemplation; (c) preparation; (d) action; (e) maintenance. People in the precontemplation stage are not intending to make any behavior change; they may not even be aware that their behavior is unhealthy or may be frustrated by failed attempts in the past. Subjects in the contemplation stage are starting to think about changing their behavior in the following 6 month, but have not decided yet. Preparation identifies subjects who have decided to make behavior changes, whereas action characterizes people having implemented health-relevant behavioral changes for $<$6 months. People in the final stage (maintenance) have made a change for more than 6 months and are working to keep it up. In summary, the first two stages identify unwillingness/scarce preparation to change toward healthier behaviors, and the last three stages indicate readiness-to-change or active involvement in healthy lifestyle.

This model has proved useful to predict patients' participation in treatment programs and dropout rates [14]. Matching therapeutic approaches to an individual-specific stage of change would be important to explain conflicting results [15] and to maximize the success of treatment [16], as already demonstrated in other conditions [17, 18]. A better understanding of the process of change triggered by an intervention and, in turn, the relative success of its specific elements would help design successful, cost-effective lifestyle programs to prevent disease or reduce complications [19].

In the area of T2DM, it is scarcely defined whether the stages of change for HD and HPA are similar in individual patients and whether the progresses along the stages are driven by similar psychological process [15]. A few studies have shown that small group-based educational programs improve metabolic control and/or prevent T2DM, also improving motivation to change [7, 15].

The aim of the present study was to investigate the stage of change toward healthier lifestyle, and the psychological factors associated with motivation, in T2DM patients attending tertiary centers for the assessment and treatment for diabetes as a prerequisite to improve strategies to implement behavior changes in the population.

Patients and methods

Patients

The study involved 1,353 consecutive outpatients with T2DM attending 14 tertiary diabetes medical centers in different Italian areas (Bologna, Rome, Milan, Turin, Padua, Parma, Como, Catanzaro, Pozzuoli, Perugia and Catania). Inclusion criteria were limited to a diagnosis of T2DM and age $\geq$18. All subjects signed an informed consent to take part in the study that was conducted in accordance with the Helsinki Declaration. The only exclusion criteria were the presence of overt psychiatric

C. Invitti
Department of Metabolic Diseases and Diabetes, Auxological Institute, Milan, Italy

P. Di Bonito
Department of Internal Medicine, Pozzuoli Hospital, Naples, Italy

M. Di Mauro
Diabetes Unit, G. Rodolico, Catania, Italy

G. Pugliese
Department of Clinical and Molecular Medicine, La Sapienza University, Rome, Italy

A. Molteni
Diabetes and Metabolic Diseases, Clinical Institute Villa Aprica, Como, Italy

Table 1 Socio-demographic and clinical characteristics of the population with type 2 diabetes

Characteristics	Value
General and anthropometric	
Male/female (%)	58/42
Age (years)*	65 (15)
Age ≤60/60–70/>70 years (%)	32/35/33
Education (primary/secondary/commercial or vocational/degree (%)	31/34/25/10
Body mass index (kg/m^2)*	29.6 (7.0)
Waist circumference (cm)	104 ± 12
Obesity class (normal weight/overweight/obese) (%)	17/37/46
Clinical and biochemical data	
Duration of diabetes (months)*	72 (120)
Diagnosis <1 year/1–10 years/>10 years (%)	8/20/72
Systolic blood pressure (mmHg)	136 ± 17
Diastolic blood pressure (mmHg)	79 ± 10
Treated for hypertension (%)	70
Blood glucose (mg/dL)	143 ± 45
HbA1c (%)*	7.1 (1.8)
HbA1c <7.0 %/7.0–8.0 %/>8.0 % (%)	43/27/30
Total cholesterol (mg/dL)	180 ± 40
HDL cholesterol (mg/dL)	49.4 ± 14.4
Triglycerides (mg/dL)*	123 (78)
Treated with statins/fibrates (%)	49
Creatinine (mg/dL)	0.95 ± 0.38
Aspartate aminotransferase (U/L)*	21 (10)
Alanine aminotransferase (U/L)*	22 (13)
Gamma-glutamyl transpeptidase (U/L)*	25 (22)
Comorbidities (%)[a]	
Coronary artery disease (absent = 0/angina = 1/acute myocardial infarction or bypass or PTCI = 2) (%)	85/7/8
Peripheral vascular disease (absent = 0/intermittent claudication = 1/by-pass = 2) (%)	94/4/2
Cerebro-vascular disease (absent = 0/TIA or evidence of carotid plaques determining a stenosis ≥20 % of the artery lumen = 1/stroke = 2) (%)	93/6/1
Chronic kidney disease (absent = 0/microalbuminuria = 1/macroalbuminuria = 2) (%)	80/18/2
Retinopathy (absent = 0/non-proliferative = 1/proliferative = 2) (%)	77/21/2

Data are presented as mean ± SD or percent or median (IQR)* for highly skewed variables

AMI acute myocardial infarction, *TIA* transient ischemic attack, *PTCI* percutaneous transluminal coronary intervention

[a] Numbers are scores assigned to condition/event in the calculation of the comorbidity score

comorbidities and any condition making it difficult to fill in the questionnaires. In a few centers, the first two outpatients attending the unit each day were selected. Socio-demographic, anthropometric, clinical and biochemical characteristics are reported in Table 1.

All subjects received a comprehensive evaluation of their metabolic and clinical status, and completed the motivational questionnaires. The presence of comorbidities was also considered, and an overall score was calculated comprehensive of coronary artery disease, peripheral vascular disease, cerebro-vascular disease, nephropathy and retinopathy (Table 1).

The study was approved by the local Ethics Committee of the coordinating center (University of Bologna) and by those of other participating units, whenever required. Participation in the study was regulated in accordance with the ethical standards of the responsible committees and with the Helsinki Declaration and all subjects signed an informed consent.

Questionnaire

Motivation to change was tested by the EMME-3 questionnaire for HD and HPA [20], derived from a previously validated tool for individuals with alcohol problems [21].

It consists of two parallel sets of instruments (for diet and physical activity, respectively): (a) an 18-item questionnaire (MAC 2) on a Likert scale from 0 (totally false) to six (totally true) and (b) a set of 6 visual analogue scales (VAS) from 0 to 100. A third part of the test, containing nine brief descriptions (PORTRAITS) of imaginary people, confirmatory of the same motivational components of the MAC 2 questionnaire, was not used in this setting.

The answers to the first ten questions are summed to generate scores providing a profile of the different stages of change according to the Prochaska model [13]. The stage with the highest score was considered as the prevalent stage of change. The remaining eight questions of MAC 2R, combined with the VAS responses, provide scores on discrepancy, self-efficacy, importance and temptation, as well as a confirmatory assessment of readiness-to-change and stabilization-of-change. Discrepancy refers to the contradiction between what one is or behaves like and what one would aim to be or to behave like, related to the personal "image of self," values, goals and expectations [22]. Discrepancy, also named internal fracture, thus reflects concern and dissatisfaction with the present situation, need for change and the perceived importance of change [23].

Self-efficacy, as defined by Bandura [24], is the perceived confidence in attaining and maintaining the predefined goals of change. It has been extensively evaluated in the area of alcohol abstinence as a key factor in dealing with high-risk situations to reach the desired target. Importance and temptation are defined as the importance attributed to the new lifestyle and the attractive value of the old lifestyle.

The EMME-3 questionnaires demonstrated good internal consistency with theoretical assumptions, reliability and concurrent validity in a large study of 431 subjects, most of whom were overweight or obese [20].

Clinical, anthropometric and biochemical measurements

The presence of macrovascular complications, microvascular complications and associated diseases was recorded on the basis of patients' history and associated drug treatment. Height and weight were measured on a standard scale at half centimeter and kilogram. Waist circumference was measured with a tape at the midpoint between the lower rib limit and the superior iliac spine. Obesity was diagnosed in the presence of body mass index [BMI, weight (kg)/height^2 (m)] $\geq$30 kg/m^2. Glucose and lipid levels were measured in the fasting state by standard laboratory techniques.

Statistical analysis

Parametric and nonparametric tests were used in the descriptive analysis of the population. The results were also split by gender, age ($\leq$60, 61–70, >70) and disease duration ($\leq$12 months, 1–10 years, >10 years), adjusted for the severity of the comorbidity score. Student's t test for paired data was used to compare the individual motivational profiles toward HD and HPA.

For statistical purposes, subjects having precontemplation or contemplation as their prevalent stage of change (highest score in the EMME-3 questionnaire) in either HD or HPA were merged in a single group considered to have resistance to change (for diet and activity, respectively), whereas determination, action or maintenance were merged to identify a group ready to change. Following this, we tested the factors associated with the probability of resistance to change by logistic regression analysis in two separate models, for HD and HPA, respectively. In this analysis, age, gender, education (primary, secondary, commercial or vocational, degree—graded from 1 to 4), duration of T2DM, therapy (diet, oral agents, oral + basal insulin, intensified insulin—graded from 0 to 3) and comorbidities were considered as independent variables and resistance to change as the dependent variable.

Several scales were considered in the statistical analysis, derived from two questionnaires (for diet and physical activity, respectively), each composed of two parts (MAC and VAS); therefore, the significance limit was set, according to Bonferroni, at $P \leq 0.012$.

Results

Clinical data

The population under study (mean age 68, mean T2DM duration of 8 years) was characterized by slight male prevalence, overweight or obesity and associated metabolic complications, including hypertension and dyslipidemia (Table 1).

Stage of change

The scores for HD were systematically higher than those recorded for HPA, especially in the scales of action, maintenance and stabilization-of-change (Table 2). The prevalent stage of change (highest score in individual profile) is represented in Fig. 1. Notably, also the sum of cases in the precontemplation or contemplation stage (i.e., not planning to change their behavior within the next 6 months), as well as the sum of cases in the determination or action stage (i.e., planning to modify their habits immediately or in the next 6 months), was significantly different ($P < 0.001$ for both) between HD and HPA.

As to HD, 7 % of cases had the highest score in precontemplation, 28 % were in contemplation and the rest being engaged in either determination or action or maintenance. The distribution was considerably different for HPA, with 53 % of cases not intending to change lifestyle, at least within the next 6 months (precontemplation, 8 %; contemplation, 45 %; $P < 0.001$ vs. HD).

In relation to gender (online appendix 1), males scored higher in maintenance, whereas females scored higher in discrepancy ($P < 0.01$) and lower in self-efficacy in both HD and HPA, as well as higher in temptation toward sedentary lifestyles, also expressed by lower stabilization-of-change.

In relation to age (online appendix 2), younger subjects (aged $\leq$60) scored 12 points higher in contemplation when compared to subjects aged more than 70, but also significantly higher in determination and action, in discrepancy, importance, self-efficacy and readiness-to-change toward both HD and HPA. No differences were observed in stabilization-of-change. Subjects aged 61–70 scored between the values of extreme groups in most areas.

In relation to disease duration (Fig. 2), subjects with long-lasting T2DM ($\geq$10 years) were much less prone to change their diet, with much lower determination scores, compared to patients with more recently diagnosed disease (on average, -18 points; $P < 0.001$) and to subjects with diabetes duration 1–10 years (-12 points; $P < 0.001$). These differences translated into a lower score in action (-9 points; $P < 0.001$) similar to that of subjects with 1–10 years T2DM, 7-point higher discrepancy ($P = 0.002$), lower self-efficacy (-8 points; $P < 0.001$) and readiness-to-change (-14 points; $P < 0.001$). Similar differences were observed toward HPA, with lower determination and action scores (both, $P < 0.001$), but also lower discrepancy, self-efficacy and readiness-to-change ($P < 0.01$). The presence and the number of comorbidities did not significantly modify the scores of questionnaires.

Table 2 Scores of stages of change and other psychological variables with respect to healthy diet and habitual physical activity in the population with type 2 diabetes

	Healthy diet	Habitual physical activity	Δ score	*P* value *
Precontemplation (%)	39.1 ± 22.2	27.6 ± 22.5	11.5 ± 26.4	<0.001
Contemplation (%)	59.5 ± 23.0	60.7 ± 22.8	−1.2 ± 28.2	0.11
Determination (%)	65.3 ± 24.0	58.8 ± 28.6	6.5 ± 28.2	<0.001
Action (%)	58.2 ± 24.3	40.7 ± 30.9	17.5 ± 31.3	<0.001
Maintenance (%)	58.2 ± 24.8	45.3 ± 30.9	12.9 ± 34.3	<0.001
Discrepancy (%)	45.4 ± 25.4	50.6 ± 26.3	−5.1 ± 30.5	<0.001
Importance (%)	81.9 ± 16.2	79.2 ± 18.7	2.7 ± 17.2	<0.001
Self-efficacy (%)	66.2 ± 20.3	62.2 ± 23.4	4.0 ± 24.8	<0.001
Temptation (%)	55.2 ± 26.8	36.9 ± 26.5	18.3 ± 31.1	<0.001
Readiness-to-change (%)	64.4 ± 32.4	62.7 ± 28.0	1.5 ± 35.6	0.127
Stabilization-of-change (%)	61.4 ± 34.0	54.1 ± 29.3	7.4 ± 38.9	<0.001

Data are presented as mean ± SD

* Paired *t* test

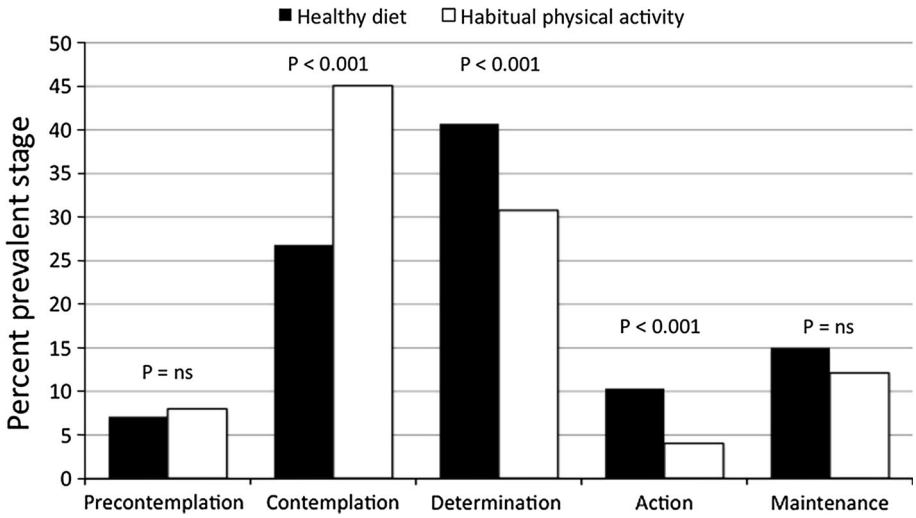

Fig. 1 Comparison of prevalent stage of change toward healthy diet and habitual physical activity in subjects with type 2 diabetes

Factors associated with precontemplation or contemplation as prevalent stages of change

In logistic regression analysis, the probability of being in a prevalent precontemplation or contemplation stage for HD was significantly associated with higher BMI (odds ratio (OR) 1.05; 95 % confidence interval (CI) 1.02–1.08), after adjustment for age and sex. Duration of disease, education level, diabetes treatment and the presence of comorbidities were not predictors, whereas the probability was marginally associated with metabolic control (A1c levels: OR 1.13; 95 % CI 1.00–1.27; $P = 0.050$).

Resistance to lifestyle change toward HPA was again associated with BMI after adjustment for confounders (OR 1.06; 95 % CI 1.03–1.10), but it also decreased by 26 % for any increase in education level (OR 0.74; 95 % CI 0.64–0.92). No other predictors were identified.

Discussion

This large analysis shows that stage of change and motivation to adopt a healthier diet and increase their physical activity remain a problem in a large percentage of individuals with T2DM, irrespective of age and comorbidities. Higher motivation to change was recorded in the area of HD, expressed by higher prevalence of determination, action, maintenance and stabilization-of-change, compared to that of HPA. This conclusion supports previous reports that the perceived need to increase physical activity in subjects with metabolic disorders is low [25] and definitely lower than the need for improving dietary habits [26].

We measured stage of change by a questionnaire not forcing subjects into only one stage of change [20], but providing a profile, accounting for the possibility that multiple, frequently adjacent stages may contemporarily be

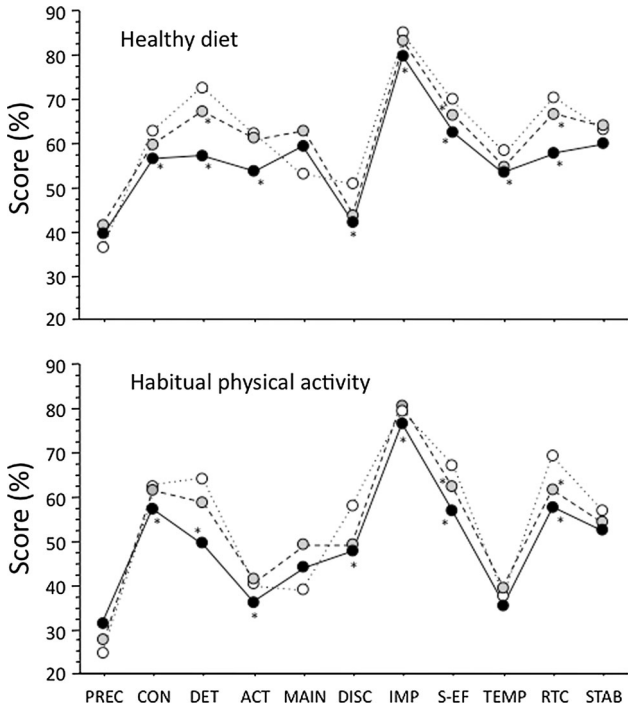

Fig. 2 Differences in the mean score of stage of change and of other psychological variables related to healthy diet and physical activity, in relation to duration of type 2 diabetes. *Open circles* and *dotted lines* indicate subjects with diabetes <1 year. *Gray circles* and *dashed lines* are subjects with diabetes 1–10 years. *Closed circles* and *continuous lines* are subjects with diabetes by more than 10 years. $*P < 0.01$ versus diabetes by <1 year. *PREC* PREContemplation, *CON* CONtemplation, *DET* DETermination, *ACT* ACTion, *MAIN* MAINtenance, *DISC* DISCrepancy, *IMP* IMPortance, *S-EF* self-EFficacy, *TEMP* TEMPtation, *RTC* readiness-to-change, *STAB* STABilization-of-change

present, according to specific issues. This aspect is sometimes considered a limit of the model [27], but a prevalent stage of change may be nonetheless identified, and it adds significantly to the comprehensive assessment of the whole process described by the profile [28].

Educational programs may produce a progress through stages of change in subjects with diabetes. People with T2DM who participated in diabetes education advanced through stages of change for self-care behaviors [29], but the implementation of behavior programs and the final outcomes in metabolic control are strictly dictated by readiness-to-change and personal motivation [30]. In order to acquire and maintain healthy lifestyles and reduce excess weight, mere information of the basic requirements of dieting and physical activity programs is not sufficient. Since intrinsic motivation plays a fundamental role in modifying unhealthy habits and lifestyle, a motivational approach is mandatory. In most studies, readiness-to-change toward HD and HPA was tested by separate questionnaires or individual questions. The main strength of the EMME-3 questionnaire is the complete symmetry between questions regarding the two components of behavior, which can be directly tested in individual subjects with the same instrument. The resulting profiles may thus be compared to each other and in relation to factors potentially associated with stage of change, i.e., age, disease duration and comorbidities. We found differences in stage of change according to age and disease duration, which potentially might translate into different attendance to educational sessions [31] and effectiveness of the programs [29]. In general, older age and longer disease duration were associated with lower willingness to adhere to healthier lifestyles, particularly in the area of diet, whereas physical activity was even more neglected, independently of comorbidities.

Of note, the EMME-3 questionnaire also provides a comprehensive analysis of the factors described by Miller and Rollnick [22] as part of motivational interviewing, intimately connected with the components of readiness-to-change, namely discrepancy [32] and self-efficacy [33].

The importance of self-efficacy in the process of change has been extensively investigated and is considered one of the most important drives to success [33]. In our study, self-efficacy was higher in males and decreased steadily with age and longer disease duration. Lower self-efficacy scores in the physical activity area in our population are indicative of the scarce consideration given to exercise as an important component of the treatment strategy. Surprisingly, low levels of temptation were measured in this activity area. Whereas returning to a previous unhealthy diet is perceived as a problem for persons with diabetes, there is no willingness to abandon sedentary habits. This apparent conflict with stage of change and importance can be explained by the relatively low consideration given to physical activity in clinical practice and lack of continuous education by health care personnel [34], which does not prompt avoidance of unhealthy habits. Several barriers hamper targeted activity programs, and specific strategies are needed to increase adherence [35], but both are demanding and time-consuming for health care personnel.

Adherence to exercise is further hindered by physical limitations progressing along with age and disease, and motivation—not very high from the very beginning—further declines, as shown in the present study. To the contrary, a higher educational level is associated with being more physically active, as also reported in other settings [36]. However, any behavior change requires time and tailored interventions to make patients move, and motivational support should be offered to enter reasonable and attainable behavioral programs [37]. In older T2DM individuals and/or in subjects with long-lasting disease or frank obesity, also low-grade, leisure-time physical activity may reduce all-cause mortality [38]. Sedentary behaviors are

indeed more important predictors of poor cardiometabolic health than moderate-to-vigorous physical activity [39].

Strengths of this work include the large patient population derived from several centers and the use of a tool that directly compare readiness-to-change in two different though inter-related areas. Limits of the study are its cross-sectional approach, which rules out the possibility of identifying any cause–effect relationship and the lack of a careful analysis of the cultural differences between the Italian regions involved in the study. To date, it is not clearly defined whether behavioral improvement is dependent on psychological changes in motivation, knowledge, mood and self-efficacy uniquely or in combination. Likewise, it is unclear whether some psychological factors are more important than others in the process of behavior change.

Longitudinal studies are needed to confirm whether adherence to behavior programs and long-term lifestyle changes can be improved by matching specific treatment strategies with different stages of change in T2DM. Such benefits have been recently demonstrated in primary care patients who received motivational interviewing to improve their lifestyles [40] and in an analysis combining data across three randomized trials of dietary intervention [19]. The present results may be used to program future research.

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Conflict of interest None.

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