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Original Article

Readiness for weight change and its association with diet knowledge and skills, diet decision making and diet and exercise barriers in patients with type 2 diabetes

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ABSTRACT

Aims: this study aimed to investigate stages of weight change in type 2 diabetics and its associations with diet knowledge and skills, diet decision making, diet and exercise barriers.
Materials and methods: This was a cross-sectional study of 1139 patients with type 2 diabetes aged>18 years in East Azerbaijan, Iran. Data were collected using the Personal Diabetes Questionnaire (PDQ) and were analyzed using SPSS software (version 22) and descriptive statistics, Chi-square and one-way ANOVA tests.
Results: 48.1% of the patients were in the pre-contemplation stage. 7.5%, 14.6% and 29.8% of patients were in the stages of contemplation, preparation and action, respectively. Patients with a higher score in diet knowledge and skills and diet decision making were more likely to be involved in the action stage of weight loss process, while those who had more eating problems and exercise barriers were less likely to be involved in the action stage of weight loss.
Conclusion: The results of this study showed that a substantial percentage of patients are at the pre-contemplation stage, so proper measures are needed to inform patients about the consequences of obesity and overweight. It is also necessary to focus on people with poor incomes and education status and those living in rural areas. Improve diet knowledge and skills and diet decision making and the reduction of barriers to exercise can help patients to take action to lose weight.

1. Introduction

Diabetes Mellitus (DM) is a highly prevalent chronic disease across the world and one of the most challenging health problems in the present century [1]. The prevalence of diabetes is associated with increased prevalence of risk factors such as excess body weight, physical inactivity, diet and ageing populations [1–3].

Diabetes care requiring regular attention to diet, physical activity, monitoring of blood sugar, medications and foot care to attain positive health outcomes [4] and it has been indicated that adherence to medication and lifestyle recommendations can significantly reduce the morbidity and mortality associated with the disease [5]. Despite the advance in the treatment process, more than half of the diabetic patients fail to achieve the globally

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recognized target A1C levels [6]. The failure to achieve glycaemic stability is often attributed to patient-related factors [7]. Despite the important role of patients with type 2 diabetes mellitus (DM) in managing their disease, the effective adoption of self-management behaviors is often challenging [8].

Diabetes self-management (DSM) is a critical element in the overall management of type-2 diabetes (T2DM) [9,10] and promoting self-management is one of the most effective interventions in decreasing glycated haemoglobin [11]. 'Diabetes self-management (DSM) is defined as the ability to manage the symptoms, treatment, and lifestyle changes inherent in living with a chronic condition [12]. DSM as the cornerstone of treatment to achieve good glycemic control includes modifying health behaviors by incorporating changes in the daily plan, when necessary, to suit treatment regimen and completion of self-care activities including following a regular diet and exercise plan, self-monitoring of blood glucose levels, and taking medications as prescribed [13–15].

However, diabetes self-management relies greatly on health behavior change, representing a difficult endeavor for most people, remaining one of the biggest challenges in modern daily life [16,17]. Some studies indicating self-management in patients with multiple chronic conditions is hardly applied, and a high level of self-reported readiness to change (RTC) predicts engagement in health promotion activities [18,19]. RTC refers to the degree in which a person is motivated to engage with the change process and [20] it is, therefore, considered a prerequisite for responding to treatment [21].

One reason that some people succeed with lifestyle changes may attributable to their change stages in particular behavior [22]. With the aim of combining key concepts that can be utilized in the application of behavior modification in different instances [21], Trans-theoretical model (TTM) of behavior change, developed by Prochaska and Diclemente in the 1980s. TTM is one of the most commonly used individual-level theories for behavior change as well as the most effective theory in the promotion of healthy behaviors [23–26]. The trans-theoretical model (TTM) stages of change describe the process individuals may go through when trying to achieve lifestyle changes [22] and this model shows that change in behavior occurs gradually and recursively along with a series of stages [21]. The model proposes that behavior change is experienced as a series of stages and can be effective in offering an understanding of the extent to which patients are able to make a change [26].

The importance of matching treatment approaches with the individuals' needs, attitudes and resources toward change have been shown by some studies [27]. There are many results regarding the extent to which stage based care leads to improved health care outcomes for patients with chronic conditions, but authors have identified it as being useful for individualizing care plans and improving patient-provider communication [28].

Almost all adults with diabetes are overweight; more than half are obese [29]. Risk of type 2 diabetes increased progressively and significantly with increasing levels of initial BMI and also with the duration of overweight and obesity. According to some studies, overweight and obesity, particularly of long duration are associated with an increased risk of developing type 2 diabetes and exacerbation of blood glucose. It has been shown that weight loss in diabetics improves glycemic control. Further, observational studies also support a likely link between weight loss and reduced mortality in people with diabetes [30–33]. Achieving this level of weight loss requires rigid interventions such as energy restriction, regular physical activity, and frequent contact with health professionals and most lifestyle weight-loss interventions in overweight or obese adults with type 2 diabetes may not be a realistic primary treatment strategy for improved glycemic control [34]. So this study aimed to investigate the stage of weight change and its association with diet knowledge and skills, diet decision making and diet and exercise barriers in patients with type 2 diabetes.

2. Materials and methods

2.1. Study design, populations and sampling

This was a cross-sectional study conducted on 1200 patients with type 2 diabetes aged >18 years and without any physical and mental disabilities in East Azerbaijan province in 2019. Patients who referred to educational hospitals (Imam Reza and Sina's educational and therapeutic centers and Asad Abadi clinic in Tabriz, Iran), Endocrinologist office, health centers and Sheykh Al-Raees Clinic were included in this study using consecutive sampling method.

2.2. Data collection tools

Data collected using the Personal Diabetes Questionnaire (PDQ). This questionnaire is a brief, yet the comprehensive measure of diabetes self-care behaviors, perceptions and barriers which includes diabetic eating habits, medicines, blood glucose testing, and physical activity. The PDQ was developed to address both needs for comprehensiveness to guide clinical assessment and brevity to facilitate feasibility of administration and minimize the burden on the person with diabetes and clinician. The PDQ functions as a self-report tool to help diabetes care providers in various settings and organizations in the identification of areas attributable to self-management that can be targeted for improvement through education and support so as to improve self-care, clinical outcomes and quality of life. The Development and initial evaluation of the psychometric properties of the PDQ questionnaire were assessed by Stetson et al. Subscales demonstrated good internal consistency (Cronbach$\alpha = .650–.834$) and demonstrated significant associations with BMI ($p \leq .001$) and HbA1c ($p \leq .001$) [35].

2.3. Subscale description and scoring

We used part B (Weight Change Readiness) for Readiness to change for attempting weight loss; "Pre-contemplation" if B2 = 3 or B1 = 3; "contemplation" if B2 = 2; "preparation" if B2 = 1; "action" if B1>1 or B2 = 4, part C (Diet Knowledge and Skills): Dietary practices regarding the type of diet information utilized to guide eating behavior; Sum C1–C9 (Higher score indicates greater knowledge and skill), part E (Diet Decision Making): General diet-specific decision-making strategies used; For individuals on insulin: Sum E1-E6. For individuals not on insulin: Sum E1-E4 and E6 (Higher score indicates more frequent use of strategies), part F (Eating Problems): Eating behavior patterns that interfere with self-management; Sum F1–F3 (Higher score indicates more frequent problems), part G (Diet Barriers): Environmental, social, and emotional factors interfering with attempts to adhere to regimen; Sum G1-G7 (Higher score indicates more frequent barriers), part L ((Physical Activity): recommendations and level of current lifestyle and programmatic activity; individually inspected items, part M (Exercise Barriers): Environmental, social and emotional factors interfering with attempts to adhere to regimen; Sum M1-M7 (Higher score indicates more frequent barriers).

2.4. Data collection

After approving the study protocol in the Ethics Committee of the University, the questionnaires were given to the participants by referring to the centers. First, adequate information was given to

patients regarding the aims of the study and how to complete the questionnaire. Also, Study questionnaires were read to participants and answers were written by the interviewers.

2.5. Statistical analysis

Data were analyzed using SPSS software version 22. Demographic characteristics and readiness to change was defined using descriptive statistics. Chi-square test was used to examine the relationship between demographic and clinical variables with change stages. Between-group differences were assessed using one-way ANOVA tests. Tukey's HSD post hoc tests were applied to elucidate significant ANOVA findings.

2.6. Ethics consideration

The protocol of the study was confirmed by the Ethics Committee of Tabriz University of Medical Sciences (IR.TBZME-D.REC.1397.166). All questionnaires were confidential and unnamed. Verbal informed consent was obtained from all patients and participation in the study was voluntary.

3. Results

Demographic characteristics are presented in Table 1. 42.65% of the patients were over 60 years old. Women constituted 66.3% of samples. Most of the patients (52.5%) had a monthly income of less than 10,000,000 rials and were illiterate (41.5%). 73.1% of patients were overweight and obese. 63% of the patients had a history of diseases for more than 5 years, and only 6.2% of patients relied on a lifestyle change. Nearly two-thirds of the patients had comorbidities and complications and 30.2% of the patients had a history of hospitalization due to diabetes complications during the past year. 48.1 of the patients were within the pre-contemplation stage and only 29.8% of the patients were within the action stage.

The results of Chi-square test showed a statistically significant association between age, body mass index (BMI), disease duration, habitation status, disease severity, the history of hospitalization and the type of current treatment in the stages of readiness to change. Moreover, patients aged 40–60 years, patients with overweight, patients with shorter disease duration, those with higher income and education, those residing in urban areas, patients with social security insurance coverage, those who rated their disease severity as severe, those with a history of hospitalization during the past year and those who had diabetes complications where more likely to be involved in the action stage Table 2.

According to Table 3, a statistically significant association was observed between patients' status in the stages of change, diet knowledge and skills, diet decision making, eating problems as well as exercise barriers except for dietary adherence barriers. Patients within the action stage of weight change had a greater score of dietary knowledge and skills as well as dietary decision making. Also, patients within the action stage of weight change had less score of eating problems and exercise barriers. The mean score of exercise barriers in the contemplation stage was greater than the other stages. Likewise, the mean score of dietary adherence barriers

Table 1
Demographic and clinical profile.

variable	mood	Frequency	percent
gender	Male	384	33.7
	Female	755	66.3
age	<40	127	11.2
	40–60	527	46.3
	>60	485	42.6
Marital status	Married	933	81.9
	Single	206	18.1
Income status	<10 million Rials	397	52.5
	>10 million Rials	359	47.5
Education status	Illiterate	473	41.5
	Reading and writing ability	407	35.7
	Diploma	195	17.1
	Academic education	64	5.6
Type of basic health insurance	Social security insurance	707	64.4
	Iranian health insurance	391	35.6
Supplementary health insurance status	Yes	430	39.1
	No	669	60.9
Habitation status	Rural area	135	11.9
	Urban area	1003	88.1
Smoking status	Yes	121	10.6
	No	1018	89.4
Body Mass Index (BMI)	Normal weight	302	26.9
	Overweight	445	39.7
	Obese	374	33.4
Disease duration	<5 year	421	37.1
	5–10 years	260	22.9
	>10 years	455	40.1
Type of current treatment	Oral agent	619	54.3
	Insulin regimen	449	39.4
	Change in lifestyle (change in diet and physical activity)	71	6.2
Presence of co-morbidity or complications	Yes	867	76.1
	No	272	23.9
The history of hospitalization due to complications of diabetes during the past year	Yes	344	30.2
	No	795	69.8
Weight change readiness stages	Pre-contemplation	543	48.1
	Contemplation	85	7.5
	Preparation	165	14.6
	Action	336	29.8

Table 2
wt change readiness and demographic, socioeconomic and clinical variables.

Variables	Categories	pre-contemplation	contemplation	preparation	action	x^2	P value
Gender	Male	193 (50.5%)	29 (7.6%)	45 (11.8%)	115 (30.1%)	3.90	.27
	Female	350 (46.9%)	56 (7.5%)	120 (16.1%)	221 (29.6%)		
Age (years old)	<40	55 (43.7%)	11 (8.7%)	19 (15.1%)	41 (32.5%)	24.79	<.0001
	40–60	216 (41.6%)	38 (7.3%)	85 (16.4%)	180 (34.7%)		
	>60	272 (56.2%)	36 (7.4%)	61 (12.6%)	115 (23.8%)		
Marital status	Single	106 (51.5%)	14 (6.8%)	29 (14.1%)	57 (27.7%)	1.19	.75
	Married	437 (47.3%)	71 (7.7%)	136 (14.7%)	279 (30.2%)		
Smoking status	Yes	65 (54.6%)	12 (10.1%)	13 (10.9%)	29 (24.4%)	4.87	.182
	No	478 (47.3%)	73 (7.2%)	152 (15.0%)	307 (30.4%)		
Body Mass Index (BMI)	Normal weight	188 (63.5%)	12 (4.1%)	30 (10.1%)	66 (22.3%)	50.51	<.0001
	Overweight	196 (44.2%)	33 (7.4%)	63 (14.2%)	151 (34.1%)		
	Obese	149 (40.1%)	40 (10.8%)	71 (19.1%)	112 (30.1%)		
Disease duration	<5 years	172 (41.0%)	38 (9.0%)	63 (15.0%)	147 (35.0%)	24.25	<.0001
	5–10 years	118 (45.9%)	17 (6.6%)	47 (18.3%)	75 (29.2%)		
	>10 years	252 (56.1%)	30 (6.7%)	55 (12.2%)	112 (24.9%)		
Education status	Illiterate	256 (54.6%)	35 (7.5%)	69 (14.7%)	109 (23.2%)	27.67	.001
	Reading and writing ability	183 (45.4%)	26 (6.5%)	61 (15.1%)	133 (33.0%)		
	Diploma	82 (42.5%)	14 (7.3%)	28 (14.5%)	69 (35.8%)		
	Academic education	22 (34.4%)	10 (15.6%)	7 (10.9%)	25 (39.1%)		
Job status	Employed	170 (49.3%)	28 (8.1%)	49 (14.2%)	98 (28.4%)	1.31	.97
	housewife	313 (47.9%)	48 (7.3%)	98 (15.0%)	195 (29.8%)		
	Retired	60 (46.2%)	9 (6.9%)	18 (13.8%)	43 (33.1%)		
Income status	<10 million Rials	197 (50.1%)	18 (4.6%)	68 (17.3%)	110 (28.0%)	8.29	.04
	>10 million Rials	166 (46.5%)	30 (8.4%)	46 (12.9%)	115 (32.2%)		
Habitation status	Urban area	464 (46.7%)	71 (7.1%)	153 (15.4%)	306 (30.8%)	11.11	.01
	Rural area	78 (58.2%)	14 (10.4%)	12 (9.0%)	30 (22.4%)		
Basic insurance coverage	Yes	505 (47.8%)	81 (7.7%)	154 (14.6%)	317 (30.0%)	1.06	.78
	No	38 (52.8%)	4 (5.6%)	11 (15.3%)	19 (26.4%)		
Type of basic insurance	Social security	312 (44.4%)	52 (7.4%)	117 (16.7%)	221 (31.5%)	10.93	.01
	Iranian health insurance	207 (53.5%)	33 (8.5%)	46 (11.9%)	101 (26.1%)		
Supplemental insurance coverage	Yes	194 (43.7%)	35 (7.9%)	75 (16.9%)	140 (31.5%)	6.43	.09
	No	349 (50.9%)	50 (7.3%)	90 (13.1%)	196 (28.6%)		
Awareness about cause of type 2 diabetes	Yes	461 (48.0%)	71 (7.4%)	141 (14.7%)	288 (30.0%)	.29	.96
	No	82 (48.8%)	14 (8.3%)	24 (14.3%)	48 (28.6%)		
Disease severity	Sever	353 (53.2%)	47 (7.1%)	87 (13.1%)	176 (26.5%)	22.97	.001
	Moderate	97 (42.5%)	24 (10.5%)	37 (16.2%)	70 (30.7%)		
	Low	93 (39.1%)	14 (5.9%)	41 (17.2%)	90 (37.8%)		
The history of hospitalization due to complications of diabetes during the past year	Yes	211 (61.9%)	23 (6.7%)	37 (10.9%)	70 (20.5%)	38.42	<.0001
	No	332 (42.1%)	62 (7.9%)	128 (16.2%)	266 (33.8%)		
Presence of co-morbidity or complications	Yes	426 (49.7%)	59 (6.9%)	128 (14.9%)	245 (28.6%)	5.78	.12
	No	117 (43.2%)	26 (9.6%)	37 (13.7%)	91 (33.6%)		
Type of current treatment	Change in lifestyle (change in diet and physical activity)	34 (47.9%)	4 (5.6%)	9 (12.7%)	24 (33.8%)	22.38	.001
	Oral agents	260 (42.4%)	46 (7.5%)	105 (17.1%)	202 (33.0%)		
	Insulin	249 (56.0%)	35 (7.9%)	51 (11.5%)	110 (24.7%)		

Table 3
Diet knowledge and skills, Eating problems, Diet barriers, Exercise barriers, Diet decision making by Weight change readiness stages.

Variables	pre-contemplation	Contemplation	Preparation	Action	F	P value
Diet knowledge and skills	39.41 ± 20.15	42.64 ± 24.38	43.49 ± 27.17	55.95 ± 24.97	35.93	<.0001
Eating problems	19.37 ± 21.03	21.56 ± 20.69	22.69 ± 23.03	16.59 ± 20.50	3.54	.01
Diet barriers	24.35 ± 17.85	24.36 ± 16.76	23.46 ± 19.14	21.60 ± 16.17	1.79	.14
Exercise barriers	22.36 ± 16.51	26.42 ± 23.25	22.89 ± 19.65	15.71 ± 14.02	15.41	<.0001
Diet decision making	32.82 ± 18.72	37.68 ± 23.54	38.90 ± 25.01	50.73 ± 25.88	44.27	<.0001

in the contemplation and pre-contemplation stages was greater than that of preparation stage and was greater in preparation stage than that of action stage, but this difference was not statistically significant. The mean score of eating problems was greater in the action stage than the other stages. By increasing the score of diet knowledge and skill and dietary adherence decision making patients were more likely to move toward change stages.

4. Discussion

This study highlights the effects of diet knowledge and skills, diet decision making, eating problems, dietary adherence barriers and exercise barriers on stages of weight change. The findings demonstrated that nearly half of the patients (48.1%) were within the pre-contemplation stage and only a small proportion of patients were within the action stage of weight loss. Since one of the main aims of self-care in diabetic patients is weight control through adherence to diet and physical activity, diabetic patients in this study were not in a suitable status in terms of the stages of readiness for weight loss, and the majority of them were within the pre-contemplation stage and they did not even think of weight loss as a way to control their diabetes. This illustrates that patients'

awareness regarding the effect of weight loss as a way on better control of blood glucose is poor. Hence, the design of educational measures can be considered as the first action for individuals' awareness of the consequences of obesity and overweight and the positive effect of weight loss on better control of blood glucose. In Bawadi et al. study there was a high degree of readiness to change for dietary, while the very low degree of readiness was regularly reported for self-monitoring of blood glucose and practising physical activity [36]. A study by Holmen et al. indicated that more than half of the patients were in the pre-action stage for physical activity change and 79% in the pre-action stage for dietary change [22].

Furthermore, a statistically significant association was revealed between in the stages of change, diet knowledge and skills, diet decision making, eating problems as well as exercise barriers except for dietary adherence barriers. Patients who were within the action stage of weight change had a greater score of diet knowledge and skills as well as diet decision making. Therefore, the promotion of diet knowledge and skills level and diet decision making through designing educational interventions is applied as an effective way to encourage individuals to lose weight and control weight. Chapman-Novakofski and Karduck have shown that patients with higher knowledge were more likely to be involved in the action stage and improvement in knowledge can be instrumental in moving individuals to an action or maintenance stage and in improving self-efficacy [37]. Also in a study by Gordon et al. a significant difference was found among pre-contemplation and contemplation groups in terms of knowledge and attitude [38]. In Holmen et al. study higher scores of self-management were associated with an increased chance of being in the action stage for both dietary and physical activity change [22].

Moreover, patients who were within the action stage of weight change had a lower score of eating problems and exercise barriers, so with a reduction in eating problems and exercise barriers patients are more likely to be involved in the action stage. Eating problems were more common among those within the preparation stage of weight loss while exercise barriers were more common among those within the contemplation stage of weight loss. It seems that although diet knowledge and skills, as well as skills pertaining to diet decision making, can be promoted through education, reduction of exercise barriers require more complex and practical measures. In a study by Knight et al. participants in the action, stage endorsed fewer behavioral dietary barriers, more frequent dietary problem-solving, and greater diabetes self-efficacy than participants in the contemplation and preparation stages [19].

Likewise, individuals' status in the stages of weight loss were significantly associated with demographic characteristics including age, education status, habitation status, variables corresponding to the disease such as BMI, disease duration, the history of hospitalization due to the complications of diabetes, disease severity and the type of treatment that is currently in use. Patients aged 40–60 years, those with higher income and education, those residing in urban areas, those with the social security insurance coverage, those with overweight, those with a shorter disease duration, those who rated their disease severity as severe and those with the history of hospitalization during the past year were more likely to be involved in the action stage of weight loss. In Centis et al. study there was a significant difference between the stages of change for a healthy diet, habitual physical activity and age, as well as gender [39], while another study showed no significant differences between groups were detected with relation to age, gender and education level [38].

Chi-square Test indicated that patients over 60 years of age were less likely to be in the action stage of weight loss than other age groups, and more than half of them were within the pre-contemplation stage. Since most included patients in this study were adults, they may face more barriers for weight loss (especially more barriers for exercise) and be unable to do physical activity as well. In this study, most frequent exercise barriers were respectively related to feeling stressed, anxious, depression, anger and fatigue and feeling pain and discomfort when trying to do exercise or physical activity. Since encouraging diabetic patients to do physical activity for weight loss is difficult, the educational interventions for weight loss should focus more on diet interventions. Moreover, since most of the elderly patients were in the pre-contemplation stage, it seems that providing specific educational interventions in order to inform the elderly about the negative consequences of obesity and overweight and its impact on diabetes can be useful in persuading adults to follow stages of change for weight loss. The results of a systematic review showed that most lifestyle weight-loss interventions among overweight or obese adults with type 2 diabetes resulted in weight loss <5% and did not result in beneficial metabolic outcomes. A weight loss of >5% is necessary for effective effects on HbA1c, lipids, and blood pressure. Achieving this level of weight loss requires vigorous interventions such as energy restriction, regular physical activity, and frequent contact with health professionals. Weight loss for many diabetic patients with overweight or obese may not be a realistic primary treatment strategy for improved glycemic control [34]. In a study by Bawadi et al. a significant association was found between age and the stage of dietary change ($p < .01$) [36].

In this study, no association was found between gender and stage of change for weight loss, whilst a significant association was revealed between gender and exercise barriers, that the mean score of exercise barriers among women (22.27 ± 17.42) was higher than their men (17.88 ± 16.74) counterparts ($P < .0001$, $t = -4.13$). This suggests that cultural barriers and lack of suitable space for public sport is far more among women than men in Iran, and women face more exercise barriers. Hence, it may seem that increased exercise barriers are considered to be a deterrent for physical activity for weight loss. In a study by Swan et al. the prevalence of physical activity and weight loss behavior was low in women living in rural areas and those with a history of GDM, despite a high awareness of diabetes prevention strategies [9]. In a study by Knight et al. women were more likely to be in the preparation stage and beyond ($p < .05$) [19]. In Centis et al. study there was a significant difference between the stages of change for healthy diet, habitual physical activity and age, as well as gender and, males scored higher in maintenance, whilst females scored higher in discrepancy ($P < .01$) and lower in self-efficacy in both HD and HPA, as well as higher in temptation towards sedentary lifestyles, also expressed by lower stabilization-of-change [39]. A study showed a significant association between gender, and the stage of dietary change ($p < .01$) [36].

In addition, the Chi-square test indicated that patients with higher income and education were more likely to be involved in the action stage of weight loss, and those with lower income and education were more likely to be involved in the pre-contemplation stage. Low level of educations and financial barriers are taken into account as important barriers to weight loss. The focus on providing educational interventions and informing patients with a lower level of education about the risks and consequences of obesity can be effective in persuading these individuals to take action to lose weight. Since half of the patients were unable to read and write, attention to individuals' education level while designing educational interventions for weight loss among those with diabetes is necessary. Moreover, it is recommended that educational interventions should be designed tailored to individuals' literacy level and should be rendered in the form of face-to-face education by service providers whether through appropriate channel or mass media such as television programs. Bawadi et al. indicated that

income and education were all associated with the stage of dietary change; decreasing intake of refined sugar and reducing saturated fat ($p < .01$) [36], while another study showed no significant differences between groups were detected with relation to age, gender and education level [38].

In addition, patients residing in urban areas were more likely to be in the action stage of weight loss than those living in rural areas. T-test results indicated that diet adherence barriers ($p = .02$, $t = -2.24$) and exercise barriers ($p = .03$, $t = -2.08$) as two factors influencing in the stages of change for weight loss were higher in rural patients, and this difference was statistically significant. This means that rural patients face more barriers for exercise and diet adherence and weight loss does not be taken into consideration as a way to better control of blood glucose. Further, according to the Chi-square test patients residing in rural areas were more likely to have a lower level of income ($X^2 = 12.80$, $p < .0001$) and education ($X^2 = 19.76$, $p < .0001$) than those living in urban areas. Therefore, in addition to adopting supplementary measures to reduce exercise barriers and diet adherence providing appropriate educational interventions to inform rural patients on the obesity consequences and its negative effect on diabetes management can be effective in guiding rural patients in the weight change process.

The results of Chi-square test for BMI showed that patients with overweight were more likely to be involved in weight change than that of obese patients, and obese patients were more likely to be in the preparation stage of weight change than that of overweight patients. Likewise, One-way ANOVA test indicated that eating problems ($F = 4.66$, $p = 01$) and exercise barriers ($F = 10.17$, $p < 0001$) are greater in obese patients than those with overweight, meaning that due to the more eating problems and exercise barriers in obese patients, these patients were less likely to be involved in the action stage of weight loss than overweight patients. Although both obese and overweight patients were more likely to be in the action stage of weight loss and less likely to be in the pre-contemplation stage compared to those with normal weight, a higher percentage of patients in both groups were in the pre-contemplation stage. This suggests that even with the presence of obesity and overweight the majority of patients did not consider weight loss as a way to blood glucose control. Holmen et al. showed that those with higher BMI would have a higher chance to follow the stages of readiness for dietary change, while BMI was associated with an 8% reduced chance of being in the action stage for physical activity change (OR 0.92, 95% CI 0.86 to 0.99) [22], while in a study by Centis et al. resistance to change toward healthy diet (HD) was greater among those with higher BMI (BMI) [39]. In a study by Gordon et al. no significant differences were revealed between studied groups and BMI [38].

Patients with shorter duration of disease were more likely to be involved in the action stage of weight loss compared to those with longer duration of disease. Moreover, the chi-square test indicated that younger patients (those with shorter duration of disease) had a higher education level than older ones ($X^2 = 180.48$, $p < .0001$), and their main treatment was lifestyle change ($X^2 = 188.52$, $P < 0001$) and patients with higher levels of education and those whose main treatment strategy was lifestyle change were more likely to be in the action stage of weight loss. So, it seems that concentration on weight control interventions such as diet change, increased physical activity in the early stage of disease diagnosis can be more effective. Parchman et al. indicated that the intervention is more effective for patients with a shorter duration of diabetes and those with diabetes for less than 2 years are significantly more likely to advance at least 1 stage of change for diet and exercise than those with diabetes for more than 2 years [40]. Also, Centis et al. showed a significant difference between the stages of change healthy diet, habitual physical activity and disease duration, and subjects with long-lasting T2DM ($\geq$10 years) were much less prone to change their diet, with much lower determination scores, in comparison with patients with more recently diagnosed disease (on average, −18 points; $P < .001$) and to subjects with diabetes duration 1–10 years (−12 points; $P < .001$) [39].

Results from the study show that patients who rated their disease severity as severe, those with the history of hospitalization due to diabetes complications during the past year and those with diabetes complications were more likely to be involved in the action stage of weight loss. These three factors illustrate the disease severity and, thus, individuals' perception of their own health status and perceived sensitivity regarding the disease severity can act as a stimulus for weight loss. Therefore, diabetic patients training regarding negative consequences of obesity and overweight and its effects on the incidence or worsening the diabetes complications can be effective in changing individuals' perception of diabetes and making more effort towards weight control. Furthermore, patients with a shorter duration of the disease had less history of hospitalization ($X2 = 37.90$, $P < 0001$), rated their disease severity less severe ($X2 = 27.61$, $P < 0001$) and had fewer diabetes complications ($X2 = 50.11$, $P < 0001$). In Centis et al. study a significant association was seen between stages of changes and presence and the number comorbidities [39], while, in Sina et al. study barriers to self-care were significantly more common among those with, than those without, diabetes complications [41].

Patients whose main treatment strategy was based on taking insulin were less likely to be in the action stage of weight loss than those whose main treatment strategy was oral agent-based and lifestyle change. This indicates that individuals could better follow action stages of change for weight loss if the concentration of diabetes treatment process was more on self-care measures and lifestyle modification. Hence, in addition to patient-related factors and disease-related factors, attention to system factors and the pivotal role of service providers are necessary for designing weight loss interventions. In this study, one of the reasons that most patients were in the pre-contemplation stage was that the main treatment strategy of only a small proportion of patients was a lifestyle change (change of diet and physical activity level). It appears that both service providers and patients focus more on taking medication and insulin rather than lifestyle modification. Therefore, the formulation of appropriate strategies is essential in persuading services providers especially physician to more concentration on self-care measures along with drug therapy.

It seems that the variables of education status and the main treatment strategy of individual towards the variables of the history of hospitalization, the presence of diabetes complications and the perceived disease severity would have more effect on individuals' success in the stage of change for adherence to weight loss.

4.1. Limitations

Our study had some limitations. Since the list of all patients was not available, and access to all patients was impossible, random sampling was impossible. Thus, a sequential sampling method was used in this study. Further, the maintenance stage was not investigated in the study due to the cross-sectional design of the study.

Conflicts of interest

The authors declare no conflict of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dsx.2019.07.052.

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