Segmentation of Iranian Type2 Diabetes Patients based on the Transtheoretical Model of Behavior Change

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Abstract

Background: Self – care in patient's diabetes inclusive regular taking drug and healthy diet and physical activity, which cause to control complication diabetes. Objectives: The main purpose of study was to assess self–management among patients with Type 2 Diabetes. Methods: In this cross sectional study, 204 patients with type 2 diabetes were recruited from outpatients of clinics of Ardabil, North West of Iran. Information such as medication, healthy food and nutrition and physical activity status was obtained by questionnaire. Results: There was a direct association between age and taking medication (β = 0.079, 95%CI: 0.014 to 0.143 P=0.01). In contrast, inactive physical activity had an inverse relation with taking medication (β = -1.632, 95% CI: -2.779 to -0.485 P= 0.005). Consuming high amount of linolenic fatty acid had a direct relation with Stage of Change in healthy food and nutrition (β = 2.316, 95% CI: 0.469 to 4.163 P= 0.01). Increasing metabolic equivalent task < 600 level had an inverse relationship with Stage of Change in physical activity in maintenance stage of change. Men were in action stage and women in preparation stage of change in Healthy food and Nutrition.

Keywords: Self-Management, Cross-Sectional Studies, Diabetes Mellitus Type 2, Nutritional Status, Exercise.

Introduction

Diabetes is a chronic and epidemic disease that it's prevalence is expected to reach to 552 million cases by 2030 (Lee, et al., 2015; Cho, 2017). Long-term complications of diabetes are hypertension, heart disease, renal disease, neuropathy and blindness (Erickson, 2013; Dobson, et al., 2015; Trento et al., 2010).

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Due to the high social and economic cost of diabetes, it is necessary, to control the complications of this disease (Kamran, 2014).

Self-management in diabetes includes: regular medical therapy, nutrition therapy and physical activity (Nelson et al.,2007; Perko,2008). Encouraging self-management among patients with type 2 diabetes declines glycated hemoglobin (HbA1c) under 7% which prevents the complications of diabetes (Holmen et al.,2016; Traina et al.,2016).

Many factors effect self-management, one of these factors is motivation for self-care (Kjøllesdal et al.,2013). stage of change is one of the constructs of trans theoretical model, that assesses motivation for changing behaviors in self-management (Barbieri et al.,2009; Di Noia, Prochaska, 2010).

The transtheoretical model was used for diabetes care. This theory claimed that individuals reading for changing habits changes over time (Perko,2008).

stage of change is used for assessing behavior changes which consists of five stages: pre action stage is content: pre contemplation; an individual has no intention to take a proposed action within the next 6 months, contemplation; taking action within the next 6 months is intended, preparation; planning to do considered behavior within the next 30 days.

An action stage consists of action and maintenance. Action; patient actually changes his/her behavior. Maintenance; the individuals has changed his/her behavior for more than 6 month (Jones,2003; Di Noia, Prochaska,2010).

Linear development is uncommon and in few individuals relapses to pre action stage (Holmen et al.,2016; Partapsingh et al.,2011; Prochaska et al.,2008). There is less cross sectional studies assessing self-management according to the stages of change of transtheoretical model among diabetic patients (Vähäsarja et al.,2012; Helitzer et al.,2007).

A systematic review study indicated that intervention studies using trans theoretical model are effective in improving self-management specially in physical activity, diet therapy and drug adherence (Holmen et al., 2016; Mohamed Izham et al., 2015)

Objectives

The main purpose of this multi-method study was to assess self-management in a sample of Iranian patients with type 2 diabetes and its association with self-management and stage of change.

Methods

Study population

The present cross - sectional study was conducted using baseline data of an intervention study among patients diagnosed with type 2 diabetes referring to a nutrition clinic in Ardebil Iran, North West of Iran, 2017.

Subjects were recruited by convenience sampling. Inclusion criteria were patients with type 2 diabetes aged 30-70 years, patients using blood glucose lowering drugs and BMI \ge 25 kg/m2. Exclusion criteria were patients with liver and renal diseases, pregnant and nursing female and patients using insulin. Among patients referring to the clinic, 400 cases met the inclusion criteria. After describing the research plan to patients, only 204 patients were willing to cooperate.

Ethics approval and consent to participate

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by the Deputy of Research and Ethics Committee of Tabriz University of Medical sciences, Iran. Written informed consent was completed for each participant.

Data collection

In this study, socio-demographic information, medication, food intake and physical activity level were assessed.

Information such as age (years), gender (female, male), marital status, education level, occupation, family history of diabetes (yes, No), following a diet (yes, No), having knowledge about nutrition (yes, No), age of developing diabetes (years), duration of diabetes (years),

dosage of blood glucose lowering drugs (type and number), dyslipidemia (type and number) and hypertension (type and number) were obtained by a structured questionnaire.

Food intake was assessed by one day 24-hour food recall checklist. The macro nutrient composition of foods was calculated using the Nutrition 4 (N4) software.

Physical activity level was evaluated by the short version of the International Physical Activity Questionnaire (IPAQ), which had been previously validated for Iranian samples.

In the current study, metabolic equivalent task (MET) based on minutes per week was calculated to determine total physical activity level (Vigorous, Moderate - Intensity and Walking). Based on total metabolic equivalent task, patients were classified to inactive, minimally active and health enhancing physical activity (HEPA) which is considered as highly active (Committee, 2004).

Anthropometric measurements were administrated out by the researchear. Weight (kg) was measured using a high precision mechanical scale (RASA, Iran) with 100 grams accuracy with light clothing and height was measured by a stadiometer without shoes and with 0.5 cm accuracy. BMI was calculated by dividing weight (kg) to the square of height (m2). Blood pressure (Systolic Blood Pressure and Diastolic Blood Pressure) was measured by a manometer in a sitting position after 5 minutes resting (EmsiG, Germany).

Stage of change

The author designed stage of change questionnaire contained questions regarding medications (blood glucose lowering drugs), healthy food and diet and physical activity level. The validity and reliability of the questionnaire was previously evaluated and determined as satisfying.

All the questionnaires were asked by the researchear by face-to-face interview.

Statistical analyses

The SPSS Version 21 software (SPSS Inc. IL, Chicago, USA) was used for statistical analysis. Categorical and numeric variables were presented as frequencies (percentage) and mean and standard deviation (SD) respectively. Independent sample t-test was used for comparing variables between men and women. The Chi-square test was used for assessing patient's distribution based on stage of change. Ordinal regression test was used for analyzing socio demographic variables, taking medication, healthy food and diet and physical activity level associated with stage of change. P-value less than 0.05 were considered as statistical significance.

Results

Baseline characteristics of sampled participants

Socio demographic status and anthropometric information have been indicated in Table1. In this study, 204 subjects participated (42.2% male and 57.8% female). In this study, 15% of men and 2% of women had university education, 55% of men and 83.1% of women had primary education and 29.1% of men and 14% of women had high school education. Among all participants, 59% of men and 66% of women had family history of diabetes (P= 0.000). Additionally, 82.8% of men and 29.7% of women had BMI in overweight range, while 37.2% of men and 70.3% of women were obese (P= 0.000).

Taking medication

The prevalence of men and women consuming metformin was 31% and 25% respectively. Also, 30% of men and 22.3% of women consumed glibenclamide. 38.8% of men and 52.7% of women consumed more than two types of medicine. Mean intake of blood glucos e lowering drugs was in men 3.4 ± 1.8 and in women 3.5 ± 1.8 , that was not statistically significant.

Stage of change in blood glucose lowering drugs

The number and percentage of participants in stage of change using blood glucose lowering drugs is shown in figure 1.

Ordinal regression results indicated that aging significantly promoted stage of change regarding blood glucose lowering drugs Table 2. Physical activity levels had an inverse relationship with to stage of change in consuming blood glucose lowering drugs by inversely.

Advancing metabolic equivalent task towards inactivity status (MET<600) significantly declined stage of change regarding blood glucose lowering drugs.

Food Intake

In this study, 16.3% of men and 18.6% of women followed of a particular diet.

In this study, 8.3% of men and 3.1% of women had nutritional trainings; nevertheless, 91.7% of men and 94.9% of women had no nutritional education. Macro nutrient mean intake is presented in Table 3. Energy acquired of macronutrient (carbohydrates: men, 56% and women, 55%), (Protein: men, 15% and women, 16%), (Fat: 28% each genders), (saturated fatty acid: men, 6.7% and women, 6.8%) and poly unsaturated fatty acid (PUFA): men, 9.3% and women, 7.7%.

Stage of change in Healthy Food and Diet

The number and percentage of participants regarding stage of change in healthy food and diet is shown in figure 2.

According to Table 4, in response to weight gain, increasing diastolic blood pressure and cholesterol intake declined stage of change in healthy food and diet however there was no statistically significant differences.

Increasing systolic blood pressure, saturated fatty acid, linolenic fatty acid intake and BMI in the overweight range promoted level of stage of change in healthy food and diet, which only Linolenic fatty acid was statistically significant.

Physical activity

According to IPAQ results, calculated MET indicated that 36% of men and 21.2% of women had MET less than 600. Also, 48.8% of men and 61% of women had MET between 600-3000, and 15.1% of men and 17.8% of women had MET more than 3000. The differences between men and women were statistically insignificant Table 5.

Stage of change in Physical activity

The frequency of stage of change in physical activity is showed in figure 3.

According to table 6, weight gain, increasing systolic and diastolic blood pressure and family history had inverse relationship with stage of change in physical activity level. However results were statistically insignificant. In contradict, increasing MET less than 600 declined stage of change in physical activity level (P=0.004).

Discussion and Conclusion

According to the results of this study the majority of women were obese and the prevalence of overweight was higher in men in comparison to women. According to the reports of the World Health Organization (WHO) the prevalence of overweight (BMI \geq 25) was 42.8% among Iranian adults and the prevalence of obesity (BMI \geq 30) was 14.2% in the recent years. The prevalence of obesity in women are more than men which is more frequent among 20-60 year olds (OH et al., 2014). Similarly, the majority of participants in this study were in this age range and most of them were women.

Taking medication

The majority of participants were in maintenance level of stage of change in taking medication. However differences were insignificant. Age had an direct association with stage of change in taking medication.

Increasing MET <600 level was with the purpose of maintaining stage of change in taking blood glucose lowering drugs in the precontemplation stage and preventing it from advancing to action and maintain level. In our study the mean intake of drugs was similar to Patel NK, et al's study (Patel, Parchman,2011).

Metformin, a type of biguanide, is the first drug widely used in T2DM. This drug is inexpensive and is immediately prescribed after diagnosis. Metformin, alone cannot maintain HbA1c in desirable range for over 3 months, thus other drugs or eventually insulin may be necessary (Inzucchi et al., 2012).

In this study, the majority of subjects used more than two types of medication because the mean duration of diabetes was more than 7 years, thus they were not able to retain HbA1c under 7 % (Association,2015; Franz,2012). The results of our study indicated that in the majority of participants, increasing age had a direct relationship with maintenance level of stage of change. Also patients that were inactive according to (MET-minute of total physical activity per week) and patients with fewer tendencies in self-management were stationed in the lowest level of stage of change (pre - contemplation, contemplation and preparation). Self-management includes diabetes care programs which are necessary for patients. Implementing these programs forces patients to move towards higher levels of stage of change such as action and maintenance. Older patients had higher information regarding the effects of self-management for controlling the consequences of diabetes and these experiences along with aging led to promotion in the constructs of stage of change in using blood glucose lowering drugs.

Healthy Food and Diet

Most of the participants of this study did not follow a diabetic controlling diet and among those who were following a diet, women were more successful than men. The majority of participants weren't educated in nutrition but a higher percentage of men passed educational trainings.

Mean protein, fat, saturated, poly unsaturated, mono un saturated, oleic and linoleic fatty acid, energy and carbohydrate intake were higher in men in comparison to women.

Increased Linolenic fatty acid intake had significant direct correlation with stage of change regarding healthy food and diet.

Results of another study showed that the majority of participants followed a diabetic diet, most of the subjects were in the maintenance level of stage of change in diet, which was in contradict with the results of our study (Lee et al.,2015).

Perhaps the reason for this difference was because the participants of the current study didn't follow a diabetic diet.

In another study the mean total energy intake was similar to the results of our study. In this study, energy obtained from carbohydrates was lower than our survey but was higher in the case of energy obtained from protein and lipid (Barbieri et al.,2009).

The reason for these differences could be due to using discrepancy methods such as 24-hour food recall and stage of change for the consuming red meat and vegetables. In the current survey, 1 day 24-hour food recall was measured, while in Barbieri P, et al's study 3 days 24-hour food recall was calculated. Also, the stage of change questionnaire for healthy food and diet was author designed whereas in Barbieri P, et al's survey, the questionnaire was obtained from Kristal et al's study. Differences in the Software used for calculating nutrient composition of the diet could be one of the reasons for the differences in the results observed.

In another study, most subjects were in the pre-contemplation stage for consuming five or more servings of fruits and vegetables. In the case of consuming less saturated fat and less refined sugar intake, the majority of participants were in the maintenance stage. Patients with greater readiness for self-monitoring of blood glucose (SMBG) also had greater tendency to reduce saturated fat and refined sugar intake; while according to results that the score achieved from stage of change in healthy food and diet men were in the action stage of stage of change and women were in the preparation stage of stage of change. Linolenic fatty acid intake has a direct correlation with stage of change in intake of food (Bawadi et al., 2012).

The reason for this difference was the different questionnaires used and the literacy level of participants. The current study showed that increased PUFA intake accompanied with increased nutrition knowledge lead to promotion in stage of change levels.

According to WHO reports, in 2003 ranges of population nutrient intake for macronutrients and few micronutrients was as following: carbohydrate: 55-75%, Protein:10-15%, Total fat: 15-30%, Saturated fatty acids: <10%, PUFAs: 6-10%, Cholesterol: <300 mg per day (Who, Consultation, 2003).

In the current study, range of participant's macro nutrient intake for men was in WHO range goals and in the case of women whole macronutrient intake was in WHO recommendations except for protein intake. The reason for these differences may be because men were in the action level stage of change but women were in the preparation level of stage of change.

Another reason was that men were in the action stage and most of them had passed nutritional courses.

Physical activity level

In the current study most of the participants were less active (CATEGORY 2). Women achieved higher scores than men in MET moderate-intensity activity. Also significant difference was observed for men in comparison to women in MET walking.

Distribution of participants in stage of change in physical activity indicates that most of the women were in the pre-contemplation, preparation and action level of stage of change and the majority of men were in the contemplation and maintenance level of stage of change.

Similar results were obtained in stage of change of blood glucose lowering drugs showed that inactive individuals had less motivation and were not incentive for self-management.

Being minimally active is considered as having moderate-intensity activity at 5 or more days of the week or walking for at least 30 minutes per day. Thus, most of the men and women of this study were minimally active according to total MET (Committee,2005).

These results indicated that inactive participants were in lower level of stage of change than minimally active individuals.

The results of the current study showed that most of the subjects were minimally active and, so for this reason most of the participants in this study were stationed in the maintenance level of stage of change.

In one study the majority of participants claimed walking as physical activity and vigorous physical activity was mentioned in the lowest level. These findings were similar to the findings of our study. Most of the subjects of Nelson et al s study were in the maintenance level of stage of change which was in agreement with this survey. Perhaps these similarities were due to the same age range (Nelson et al.,2007).

Another survey indicated that the majority of subjects were in the preparation level of stage of change and were inactive, these findings were in contradict with our results (Vähäsarja et al.,2012).

In one study, most of the participants were in the pre-contemplation level of stage of change. Our results were in disagreement Kamran A, et al studies (Kamran,2014).

In Kamran A, et al study, physical activity level was lower than the recommended limit for adults with diabetes (6), while our results were in accordance to the physical activity Guidelines for Americans report range 2008 (Prevention & Promotion, 2008).

Another study showed that the majority of people were in the contemplation stage and PA increased with aging. These results were in disagreement with our results. The reason for the differences was because of the questionnaire used. In the present study the IPAQ was used while in Mahmoodabab SSM, et s study a standardized self-report questionnaire was used (Mahmoodabab et al.,2013).

Another previous study showed that odds of pre action in stage of change for exercise were higher for females. Women had four times higher odds of being in the pre contemplation stage compared to the contemplation and preparation stage. Patients in the preparation stage aged 40 - 60 years had higher odds compared to subjects older than 60 years. Patients with higher education level had higher odds for the preparation stage and patients with highest income had higher odds for action stage. Our results showed that more female than male were in the pre-action stage, but most of the subjects were in the maintenance level of stage of change which disagreed with Bawadi HA, et al's study (Bawadi et al., 2012).

Physically activity is a complex behavior that is correlated with socio demographic factors.

According to Physical Activity Guidelines for Americans 2008, walking has health benefits. In this study, men had higher walking MET than moderate-intensity MET and vigorous-intensity MET which was similar to the Physical Activity Guidelines for Americans 2008. Perhaps the reason for this difference is because gender is more specific in physical activity.

According to Physical Activity Guidelines for Americans 2008, all adults should avoid inactivity and for substantial health benefits, adults must have at least 150 minute moderate-intensity physical activity per week. The majority of subjects were minimally active (Prevention & Promotion, 2008).

Therefore, since most of our subjects were minimally active, they were stationed in the maintenance stage.

The study population of this study was in maintenance stage of stage of change regarding taking medication and physical activity and most of the men were in the action stage of healthy food and diet and most of the women were in the preparation stage.

In order to improve or maintain participants stage in stage of change and preventing subjects from relapsing to pre action stages, it is necessary to develop training strategies including lifestyle education projects (Regular medication taking, healthy food and diet and physical activity), specially it could be useful for diseases that lead to promotion in stage of change.

Footnote

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		n=204	Mean	SD	95%		
Variables	sex				Lower Bound	Upper Bound	Р
	male	86	53	6.8	-1.1	2.8	0.3
Age, years	female	118	52.1	7.4			
Age of developing diabetes,	male	81	44.5	10.2	-1.2	1.3	0.3
years	female	118	45.8	8.1			
Duration of diabatas years	male	81	7.2	5.2	-0.4	2.3	0.1
Duration of diabetes, years	female	118	6.2	4.5			
W7 1 1 7	male	86	84.6	10.7	0.1	7.1	0.04
weight, Kg	female	118	80.9	13.5			
Height om	male	86	169.9	6.5	0.9	12	0.00
Height, chi	female	118	156	6.1			
BML Ka/m ²	male	86	29.4	3.4	-5	-2.6	0.00
Divit, Kg/iii	female	117	33.2	4.9			
SPD mmUa	male	70	111.2	38.1	-16.7	4.9	0.2
SBF, illiling	female	77	117.1	26.8			
DBP mmHg	male	70	68.7	22	-12.5	-1	0.02
DBP, mmHg	female	77	75.5	12			

Table 1- Characteristics of patients with T2DM in the study

T2DM: Type II Diabetes; SD: Standard Deviation; BMI: Body Mass Index; SBP: Systolic Blood Pressure;

DBP: Diastolic Blood Pressure.

Values are expressed as Mean \pm SD for variables.

P values were calculated using Independent sample t-test, P < 0.05.

Table 2. Ordinal regression between SOC BGLDs with age, age of developing diabetes and total PA as MET classified.

Variables	Estimate		р		
variables	Esumate	Lower Bound	Upper Bound	г	
age	.07	.01	.1	0.01	
Age of developing diabetes	01	06	.03	0.6	
[sMET.q1=1]	-1.6	-2.7	4	0.005	
[sMET.q1=2]	8	-1.9	.1	0.1	
[sMET.q1=3]	O ^a				

SOC: Stage of change; BGLDs: blood glucose lowering drugs PA: Physical Activity;

MET: Metabolic Equivalent Task; CI: Confidence Interval.

P values were calculated using ordinal regression, P < 0.05.

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Variables	SAV	n-204	Mean	SD	95%	Р	
variables	302	11-204	Wiean	3D	Lower Bound	Upper Bound	
Energy Kcol	male	86	2389	899.3	197.1	617.7	0.000
Ellergy, Kcal	female	118	1981.5	623.9			
Carbohydrate, g	male	86	339.6	143.8	28.3	95.3	0.001
	female	118	277.8	99.1			
Protoin a	male	86	90.7	33.8	1.7	19.7	0.01
rioteili, g	female	118	79.9	29.7			
Fat a	male	86	75.5	37.4	3.5	22.6	0.01
rat, g	female	118	62.4	31.8			
DUEA	male	86	24.7	18.6	0.1	10.1	0.04
r ora, g	female	118	19.5	17			
	male	86	19.5	10.3	0.4	5.7	0.02
MOFA, g	female	118	16.4	8.6			
Linolonia Fatty agid a	male	86	.1	.1	-0.05	0.04	0.5
Emolenic ratty actu, g	female	117	.1	.1			
Linoleic Fatty acid a	male	86	22.3	17.6	0.1	9.6	0.03
Emolete Patty actu, g	female	117	17.4	15.6			
Oleic Fet. g	male	86	16.2	9.3	0.2	5	0.02
Oleic Pat, g	female	118	13.5	7.6			
SEA a	male	86	17.8	10.7	0.04	5.7	0.04
ыга, g	female	118	14.9	9.2			

Cholesterol, mg	male	86	207.1	155.6	-8.8	74.5	0.3
	female	118	174.2	139.1			

SD: Standard Deviation; PUFA: Poly unsaturated Fatty acid;

MUFA: Monounsaturated Fatty acid; SFA: Saturated Fatty acid.

Values are expressed as Mean \pm SD for variables.

P values were calculated using Independent sample t-test, P < 0.05.

Table 4. Ordinal regression between SOC in Healthy Food and Diet with weight, BMI, BP, Fat.

variables	Ectimate	95%	D	
variables	Estimate	Lower Bound	Upper Bound	1
weight	008	03	.02	0.5
SBP	.004	01	.02	0.6
DBP	01	04	.02	0.5
SFA	.006	02	.04	0.7
Cholesterol	001	004	.001	0.2
Linolenic Fat	2.3	.4	4.1	0.01
[BMI.q1=1]	.02	7	.7	0.9
[BMI.q1=2]	0 ^a	•		

SOC: Stage of change; BP: Blood Pressure; BMI: Body Mass Index;

SBP: Systolic Blood Pressure; CI: Confidence Interval; DBP: Diastolic Blood Pressure;

SFA: Saturated Fatty acid; BMI: Body Mass Index.

P values were calculated using ordinal regression, P < 0.05.

Та	ble	5.	Mean	values	of	MET	in	participat	tes
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						95% CI	
Variables	sex	n= 204	Mean	SD	Lower Bound	Upper Bound	Р
MET. VI,	male	86	716.9	213	-749.9	720.2	0.9
min/week	female	118	731.7	3181.5			
MET.MI,	male	86	233.3	714.3	-1411.4	-641.8	0.000
min/week	female	118	1260	1703.2			
MET Walking,	male	86	725.2	913.2	190.5	569.7	0.001
min/week	female	118	345.1	433.9			
TMET,	male	86	1675.5	2603.8	-1573.9	251.1	0.3
min/week	female	118	2336.8	3995.9			

MET: Metabolic Equivalent Task; SD: Standard Deviation; MET.VI: MET Vigorous Intensity;

MET.MI: MET Moderate Intensity; TMET: Total MET.

Values are expressed as Mean \pm SD for variables.

P values were calculated using Independent sample t-test, P < 0.05.

Table 6. Ordinal regression between SOC in PA levels with weight, BP, family history and MET.

variables	Estimate	95%	D	
	Estimate	Lower Bound	Upper Bound	1
weight	004	02	.02	0.7
SBP	001	01	.01	0.9
DBP	01	05	.01	0.3
[family history=1]	09	7	.5	0.7
[family history=2]	0^{a}			
[sMET1.q1=1]	-1.4	-2.4	4	0.004
[sMET1.q1=2]	09	9	.7	0.8
[sMET1.q1=3]	0 ^a			

SOC: Stage of change; PA: Physical Activity; BP: Blood Pressure;

MET: Metabolic Equivalent Task; CI: Confidence Interval; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure.

P values were calculated using ordinal regression, P < 0.05.



Blood glucose lowering drugs in SOC

Fig. 1: SOC for blood glucose lowering drugs in participants, n = 204. SOC: Stage of change. Values provided as n (%).







Fig. 3: SOC for PA in participants, n = 204.
PA: Physical Activity; SOC: Stage of change.
Values provided as n (%).