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A Cooking-Centric Approach to Diabetes Education Through Modifying Ethnic Recipes

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Abstract: *Dietary behaviors influence the progression of metabolic diseases. This pilot study investigated the effects of culturally-tailored diabetes workshops on the cooking/eating behaviors and metabolic outcomes of diabetes patients in Iran. Popular ethnic recipes were modified to be healthier using seven cooking techniques/ingredient substitutions. This classification of cooking methods into seven categories streamlined and simplified cooking instructions. A group of 38 adults with diabetes were randomly selected to attend a two-part series of 120-minute, cooking-centric workshops in July 2012. The modified recipes were taught using PowerPoint presentations, cooking videos, a pamphlet, and a cookbook. Follow-up data on participants' clinical measurements were collected in July 2014. The short and long-term effects of the intervention on participants' cooking/eating behaviors were evaluated by self-reported questionnaires and clinical measurements, respectively. Within 16 days, there was a 37-53% increase in people using healthy cooking techniques (p <0.001). Fruit and vegetable consumption increased due to incorporation of those ingredients into taught recipes. Additionally, participants' average fasting blood glucose (FBG) decreased (p <0.001). After two years, participants' follow-up data (n=23) on FBG and hemoglobin A1c (HbA1c) showed improvements when compared to the control group. Results suggest teaching these seven-streamlined cooking techniques to modify local recipes may enable people with diabetes to improve their FBG and HbA1c.*

Keywords: Patient education; healthy-cooking workshops; cooking instructions; type II diabetes; cultural recipes; dietary behavior; eating behavior; metabolic; recipes; diabetic management; education; Iran.

Introduction

Dietary behaviors influence the progression of metabolic diseases such as type II diabetes (Basch, Samuel & Ethan, 2013). Strong evidence shows home cooking contributes to better

health (Polak, Dill, Abrahamson, Pojednic, Phillips, 2014; Wolfson and Bleich, 2015). Using basic ingredients for cooking rather than using premade food items enables people to have maximum flexibility in choosing ingredients, and therefore, to follow dietary recommendations related to salt, saturated fats, and sugar more accurately (Larson, Story, Eisenberg, and Neumark-Sztainer, 2006). However, there is a gap between the intention to eat healthy and the capability to practice this goal. Providing instructions on how to use healthy cooking methods may fill this gap (Caraher and Lang, 1999; Faries, 2016). With growing diabetes rates around the world, healthy cooking lessons may potentially help people with diabetes with controlling their condition. This type of intervention may be particularly useful in the Middle East since diabetes incidence starts at a younger age and is rapidly increasing compared to that of the United States (Esteghamati et al., 2008; Whiting, Guariquata, Weil, and Shaw, 2011; Zabetian, Keli, Echouffo-Tcheuqui, Narayan, and Ali, 2013).

Nearly 8% of Iranian adults between the ages of 25 and 64 have type II diabetes. Furthermore, over 22% of the population aged between 45 and 64 years has impaired fasting glucose levels (Esteghamati et al., 2008; Whiting et al., 2011). Poor dietary practices are partly driving these statistics (Esteghamati et al., 2008; Ghassemi, Harrison, and Mohammad, 2002; Uusitalo, Pietinen, and Puska, 2002). Refined carbohydrate intake has increased due to urbanization, the country's nutrition transition, and governmental subsidies on flour, which increased bread consumption by 25% from 1985 to 1995 (Ghassemi et al., 2002; Uusitalo, Pietinen et al., 2002). Meanwhile, according to a 2007 study, the mean fruit and vegetable intake of Iranian adults is 2.58 servings, considerably lower than the 5 servings/day recommended by the World Health Organization (Esteghamati et al., 2012). Furthermore, Iranian households extensively use hydrogenated oils rich in trans- and saturated-fats in cooking, with an average per-person intake of 14 g per 1000 kcal (Esmaillzadeh and Azadbakht, 2008).

While some experts have proposed the low-glycemic index, vegan, and 500-calorie per day diets to decrease fasting blood glucose (FBG) (Barnard, Scialli, Turner-McGrievy, and Lanou, 2004; Hammer et al., 2011; Rizkalla et al., 2004), these diets are drastic changes from the types of foods Iranian people are used to eating. In other words, these foods are not *culturally relevant* (Davis, Forbes, and Wylie-Rosett, 2009; Uusitalo, Pietinen, and Puska, 2002; Shirinzadeh, Shakerhosseini, and Hoshiyar-rad, 2009). Davis et al. suggest that the best strategy for diet is, 'one that the patient can adopt and follow in the long term.' (2009). Consequently, Persian cuisine, with its high emphasis on white rice, bread, and highly sweetened desserts, is an optimal target for preventive medicine specialists, diabetes educators, and nutritionists to modify by using cooking techniques and ingredient substitutions.

This pilot study investigated the effectiveness of workshops that taught seven cooking techniques applied to popular ethnic recipes on adults with diabetes in Iran. All the taught recipes aimed to reduce carbohydrate, salt, saturated and trans fats, and caloric content while

increasing fiber and nutrient levels. Participants' short-term cooking and eating behaviors, and short- and long-term clinical measurements were evaluated.

Materials and Methods

Intervention studied

A series (16-days apart) of two workshops were held in Mashhad, Iran (population: 2,772,287) during July 2012 (Population, 2017). One workshop series was held in a public diabetes clinic and another workshop series was held in a private diabetes clinic. Each session lasted 120 minutes. For this study, 64 patients with type II diabetes from the above-mentioned diabetes clinics were randomly selected to participate in the workshops. Inclusion criteria consisted of people with diabetes between 30 to 65 years old who had transportation accessibility to and from the workshops. The age range was selected to reflect the group with the highest growth in diabetes rates in the country (Whiting et al., 2011). Patients were contacted by phone and asked if they were willing to participate in two educational workshops and provide feedback by completing questionnaires. Of the 64 patients called, 48 agreed, and 44 patients attended the first workshop, where they gave written consent to participate in the study. Six people were unable to participate in the second workshop or failed to fully complete the questionnaires and were excluded from the results.

The final study population was 38. In each clinic, the intervention group attended the first workshop, filled out questionnaires, and returned for the second workshop 16 days later. The questionnaires were completed at the beginning of each session, meaning the study's short-term post-test measurements reflect the effects of only the first workshop, which consisted of an educational PowerPoint presentation, a cooking video, a pamphlet, and a cookbook that each participant took home. Food samples of some of the taught recipes were served to participants at the end of each workshop session. To clearly guide participants in their cooking efforts at home in following the workshops' instructions, the pamphlet consisted of a summarized table that listed popular ethnic foods in one column and the type of cooking technique that participants needed to apply to that individual food recipe in the column next to it (see Appendix). The first questionnaire gathered data on demographics, cooking behaviors, and eating behaviors. The second questionnaire inquired about each of the seven cooking techniques used in the previous 16 days, eating behaviors in the previous 16 days, and factors that influenced if the participant adopted a healthy diet.

Workshops taught seven cooking techniques and the questionnaires measured the usage of those methods pre- and post-intervention. If participants had applied one of those cooking techniques once or more, they were counted as 'positive' for that specific cooking method (although most participants applied those techniques more than one time to different recipes).

Participants received no financial compensation but received a free cookbook and had their weight, waist circumference, blood pressure (BP), and FBG measured by a registered nurse on the days of the first and second workshops free of charge. FBG was measured using

GLUCOCARD 01 Blood Glucose Monitoring System, the accuracy of which was confirmed by comparing the system's FBG recordings to that of blood tests for five clinic patients. Participants were told to continue taking their medications and following their normal exercise routines throughout the trial. Permission to conduct this study was granted by both clinics and by the University of Michigan Institutional Review Board.

After two years, the most recent data (recorded between March-July 2014) for FBG, blood pressure, and HbA1c for 23 of the participants were collected from their medical files and compared with two-year data (in a similar time period) for a randomized age-controlled, non-interventional control group of 23 patients with diabetes at the same clinics to minimize differences in geographic, socioeconomic, and medication variability. Medical files for the remaining 15 participants were incomplete, resulting in exclusion from the follow-up study. Changes in BMI and weight were not included because studies have shown that these factors are less sensitive in predicting type II diabetes in Iranian population (Babai et al., 2016; Gharipour et al., 2013).

Diabetes workshops

The presentation materials were based on the nutritional recommendations of the American Diabetes Association and the Joslin Diabetes Center. The language used was Farsi (the local language). The workshops taught ethnic recipes that were made healthier by using seven cooking techniques and ingredient substitutions applied to each Persian dish. Popular traditional recipes were collected by authors prior to the workshops and modified to suit a diabetic diet while retaining good taste and having faster preparation time relative to the original recipes. These modified recipes were approved by a nutritionist and general physician. The resulting low-sugar, fat, and salt recipes were compiled into a cookbook provided to workshop participants (Ashrafzadeh, 2012). In each workshop, a 25-minute cooking video followed the presentation. In addition, participant's sampled two dishes prepared using the methods taught in class. The last five minutes of each session were dedicated towards answering questions.

The primary goal of the second workshop, held 16 days later, was to administer the second questionnaire and obtain a second measurement of participants' clinical values. The attendees were then instructed how to make long-term goals to continue improving their diets. Another 25-minute cooking video showing cooking techniques applied to local dishes was presented and food samples were served.

Statistical Analysis Method

The data were primarily analyzed by comparing individuals' pre- and post-workshop questionnaires. Participants from both clinics were pooled together in this analysis (n=38). Continuous variables such as age, BMI, and food servings were reported using means, standard deviations, and ranges. Categorical variables (i.e. "yes" or "no" questions) were reported as percentages. Paired t-tests (for continuous data given that there were only two

data groups: pre- and post-intervention) and McNemar's test (for categorical data) were used to assess changes in attendees' cooking behaviors, food servings, and clinical measurements before and after intervention. Effect sizes (ES) were calculated for the intervention and control groups. Significance was noted for p-values < 0.05 with a two-sided test. All analyses were conducted using the Statistical Analysis Software version 9.3 (SAS Institute, Cary, N.C.).

Results

The demographic characteristics of the 38 study participants are presented in Table 1. Demographic data were obtained on day 1 of the study.

Table 1. *Baseline Characteristics of Participants in Diabetes Nutrition Workshops (n=38)*

Characteristic	Value	Range
Age	53.0 ±8.7 yrs	31-65 yrs
Sex (Female)	76.92% (30)	
FBG	169.4 ±49.2 mg/dl	99-298 mg/dl
BMI	28.8 ±4.0 kg/m^3	20-36 kg/m^3
HbA1c	8.4 ±1.4 (%)	6.1-12.1 (%)
Average Number of Years with Diabetes	6 yrs	1-20+ yrs
Number of household members	3.3 ±1.5	1-6
Participants with at least one close family member with type II diabetes	87% (33)	
Sufficient income for food	64.1% (25)	
Smoking	10.26% (4)	
Education Level		
Primary School	21% (8)	
Middle School	32% (12)	
High School	29% (11)	
College degree	13% (5)	
No Response	5% (2)	
Clinical Conditions		
High Blood Lipids	40% (19)	
High Blood Pressure	36% (17)	
Heart Disease	9% (4)	

Notes. FBG, fasting blood glucose; BMI, Body Mass Index; HbA1c, Hemoglobin A1c. Continuous variables are reported as mean±S.D. and range, and categorical variables are reported as percentage (count).

Cooking Behavior

The cooking techniques fell under seven categories: baking; steaming; searing; substituting ingredients to replace fat, sugar, and salt in recipes; making salads; making healthy

dressings/sauces; and using less fat by applying oil with a brush, spray, or in combination with water (Table 2). In turn, each specific cooking technique was taught to be applied to one to nine specific Persian dishes. Furthermore, the proposed cooking techniques reduced meal preparation time by simplifying the cooking process and eliminating redundant steps without scarifying good taste (Ashrafzadeh, 2012). Within 16 days, the number of workshop participants who were using modifying cooking techniques increased ($p < 0.05$) as Table 2 presents. The actual change in cooking behavior was large and complex to quantify.

Healthy cooking behaviors such as baking and substituting nutrient-rich ingredients increased four-fold and two-fold, respectively. As Table 2 shows, the changes in all seven cooking behaviors were considered statistically significant ($p < 0.05$).

The workshops' instructions clearly specified the recommended cooking techniques based on each specific ethnic recipe such as kotlet (deep-fried beef and potato patty), kookoo (deep-fried herb omelets), and rice dishes. Before the first workshop, steaming, substituting ingredients, and making healthier dressings and sauces were used by about a third of participants. After the first workshop, the greatest net increase was due to replacement of baking for frying. Steaming and searing, while used less frequently, also increased two-fold and six-fold, respectively. Overall, all cooking techniques taught in workshops increased in use by 37-53%.

Table 2. *Seven Healthy Cooking Techniques Used by the Studied Sample Population for Preparing Meals Before and After Attending Workshops (n=38)*

Cooking Technique	Before	After	*p*-value
Bake	21% (7)	74% (28)	<0.001***
Steam	42% (15)	79% (30)	<0.001***
Sear in hot skillet	11% (4)	63% (24)	<0.001***
Ingredient substitution (specified ingredients)	39% (15)	87% (33)	<0.001***
Dressings/sauces (healthy versions taught)	32% (12)	71% (27)	<0.001***
Eating salad before meal	29% (11)	74% (28)	<0.001***
Minimal oil use methods (brush/mix with water)	16% (6)	66% (25)	<0.001***

Notes. Data are presented in percentages of participants followed by absolute numbers of participants in parentheses for each row.
Data analyzed using two-tailed McNemar test.
*=p<0.05, **=p<0.01, and ***=p<0.001 indicate almost significant, significant, and highly significant, respectively.

Eating Behavior

The data summarized in Table 3 show the changes in eating behaviors post-intervention. After the first workshop, several eating behaviors improved: participants' fruit and vegetable

consumption increased while white rice (a staple food usually consumed daily in Iranian homes), red meat, and hydrogenated oil consumption decreased. This trend may be partially explained by participants following workshops' instructions to cook mixed rice, which replaces half of their plain rice with chopped vegetables or legumes (such as carrots, peas, cauliflower, onion, broccoli, green beans, or lentils).

Table 3. *Food Chart Showing Change in Consumption of Staple Foods by Participants After Attending the First Cooking Workshop (n=38)*

Food Item Consumed	Before Intervention (servings per week)	After Intervention (servings per week)	*p*-value
Bread	22.3	21.0	0.109
White Rice	10.7	8.3	0.005**
Fruits	13.8	16.8	0.014*
Vegetables	8.3	15.7	<0.001***
Red Meat	2.01	1.4	0.009**
Poultry	2.59	1.82	0.018*
Fish	0.43	0.53	0.316
Cheese	6.24	6.16	0.770
Milk	3.12	3.19	0.757
Soft Drinks	0.5	0.29	0.031*
Fruit Juice	0.76	0.32	0.013*
Ice Cream	0.79	0.53	0.031*
Chocolate/ nougat	1.13	0.66	0.022*
Cake/dry cookies	0.68	0.76	0.646
Honey	1.53	0.97	0.024*
Rock Candy	3.08	2.16	0.105
Dates	4.24	3.08	0.188
Raisin/dry fruit	3.76	2.25	0.107
Restaurant/cate red food	0.60	0.47	0.404

Notes. The total consumption of each food item in the studied sample population has been pooled together and averaged and reported as "servings per week." Data analyzed using paired t-test (two-tailed). *=p<0.05, **=p<0.01, and ***=p<0.001 indicate almost significant, significant, and highly significant, respectively.

Metabolic Outcomes

After 16 days, participants' FBG showed a significant decrease of 18.7 mg/dL from 169.4±49.2 mg/dL to 150.7±44.6 mg/dL (p<0.001). Blood pressure, waist circumference, and BMI measurements had no significant change although waist circumference decreased an average 1.4 cm (p = 0.082).

The comparison between the clinical data for the intervention group and control group from 2012 and 2014 is presented in Table 4. After two years, follow-up data showed improvements in the FBG and HbA1c clinical values of the workshop participants when compared to the randomized control group over the same period.

To measure clinical significance of the intervention, the effect sizes for both intervention and control groups were calculated based on each of the measured clinical values (Table 5). Relative to the control group, two-year data showed that the intervention group's HbA1c, FBG, and diastolic blood pressure values decreased while the group's average systolic blood pressure increased.

Table 4. *Comparison of the Clinical Data from 2012 to 2014 for Intervention (23 people) and Control (23 people) Groups*

Clinical data compared in 2 years	Percentage and number of people who improved†		*p*-values
	Intervention Group	Control Group	
Hemoglobin A1c (HbA1c)	87% (20)	52% (12)	0.010*
Fasting blood glucose (FBG)	65% (15)	26% (6)	0.008**
Systolic blood pressure (BP)	74% (17)	61% (14)	0.351
Diastolic blood pressure	83% (19)	70% (16)	0.303

Notes. "Improvement" is defined as measurements that decreased or stayed the same after the two-year period. †*The number of people who lowered their clinical measurements for the intervention and control groups respectively was: HbA1c: 18, 12. FBG: 14, 6. Systolic BP: 6, 7. Diastolic BP: 9, 8.* *=p<0.05, **=p<0.01, and ***=p<0.001 indicate almost significant, significant, and highly significant, respectively.

Table 5. *The Averages and Effect Sizes (ES) for the Measurements of HbA1c, Fasting Blood Glucose (FBG), and Blood Pressure (BP) for Intervention (n=23) and Control (n=23) Groups*

Clinical Measurement	Intervention Average	Control Average	Intervention ES	Control ES
HbA1c 2012 (percent)	8.15	8.55	-0.555	-0.206
HbA1c 2014 (percent)	7.37	8.14		
FBG 2012 (mg/dl)	168.52	186.78	-0.167	0.241
FBG 2014 (mg/dl)	145.69	208.65		
Systolic BP 2012 (mmHg)	127.39	120.22	0.065	-0.273
Systolic BP 2014 (mmHg)	128.48	115.43		
Diastolic BP 2012 (mmHg)	81.96	75.22	-0.340	-0.017
Diastolic BP 2014 (mmHg)	78.91	75.00		

Notes. Effect Sizes that are negative numbers show improvement (decreases) in clinical measures.

Factors that influence cooking behaviors

On the questionnaire, workshop participants selected the barriers that influenced their use of the taught cooking techniques and/or recipes: habits, family, economics, social eating, job, and time limitations. Among the 38 participants, the biggest barriers were old cooking habits (45%, n=17) and having family members who refused to eat modified foods or did not support the participants in changing the method of meal preparation at home (37%, n=14). Other barriers included financial restraints (13%, n=5), social over-eating (13%, n=5), and job requirements and/or time restrictions (8%, n=3).

Discussions and Conclusions

The results of this study suggest that streamlining cooking lessons through the proposed seven-category cooking methods enables individuals with diabetes to easily adopt cooking instructions. In this study, this strategy was associated with improvements in cooking behaviors, in dietary consumption, and in clinical values of participants. With only 18% of participants having college education, educational levels were low, indicating the need for simple-to-understand diabetes education. Participants were more likely to substitute a suggested ingredient in place of an original unhealthy ingredient in a recipe if the suggested ingredient was *familiar* and *affordable*. For example, garlic was familiar to participants, so they started using it more frequently, but flaxseed was expensive and therefore rarely used.

Overall, 16 days following the first workshop, participants' FBG average level decreased while measures that change more slowly, such as blood pressure, BMI, and waist circumference, showed no significant differences. Follow-up data two years after the intervention suggested that patients in the intervention group had marked improvement in their FBG and HbA1c. Although average diastolic BP improved (Table 5), the number of participants who improved their BP did not reach significance when compared to a similar demographic control group (Table 4). Furthermore, although a greater number of people in the intervention group improved their systolic BP measurements when compared to those in the control group, when averaged, the value did not show improvement. This may be due to two participants with markedly large increases in their blood pressures affecting the small sample's average.

Similar to this study's findings, a recent publication has shown that teaching methods for making healthier recipes improved HbA1c glycemic control in people with type II diabetes (Byrne et al., 2017). The use of culturally relevant education for diabetes management has been increasing over the past two decades. This is because the ideas and beliefs of a population implicitly influence people's food and lifestyle habits, which consequently affect metabolic outcomes. Studies investigating culturally competent education for diabetes self-management have placed Mexican Americans, African Americans, and Australian Aboriginals in learning groups that incorporate the beliefs, values, customs, and language of their ethnic group (Abbott, Davison, Moore, and Rubinstein, 2012; Anderson-Lotfin et al.,

2005; Brown, Garcia, Kouzekanani, and Hanis, 2002; Sumlin and Garcia, 2012). However, this study differed from those previous studies by (1) teaching the proposed seven cooking techniques to modify the recipes of a region's commonly-consumed/ethnic dishes (2) providing cooking DVDs to visually show the application of each cooking technique applied to ethnic dishes (this was especially helpful for illiterate participants or those with poor eyesight who were unable to read) (3) measuring cooking and eating behavioral changes quantitatively and (4) investigating the understudied Iranian diabetic population.

The quick improvement in FBG is consistent with other short-term dietary interventions that have decreased the FBG or HbA1c of people with type II diabetes: Gannon and Nuttall (2004) found that men who ate a high-protein, low-carbohydrate diet reduced their FBG by an average of 72 mg/dL in five weeks; Mayer-Davis et al. (2009) found that an eight-week research-based dietary intervention reduced participants' FBG levels by 24.23±48.24 mg/dL; and Boden et al. (2005) observed that patients with obesity and diabetes placed on a low-carbohydrate diet reduced their mean HbA1c from 7.3% to 6.8% in 14 days. Other researchers showed similar results (Sumlin and Garcia, 2012). However, because the diets used in the above studies were substantially different from Iranians' regular meals, the proposed approach of teaching modified recipes of common local dishes to Iranian people with diabetes may be easier to adopt and to continue.

This study suggests women are a key target population for cooking-based education in Iran. While both genders were recruited, most of the study's attendees were women (30, 77%) and most male participants brought their wives or daughters to the workshops. Women are more likely than men to engage in household activities such as grocery shopping and meal preparation and they tend to carry cultural-based food practices through generations (Sumlin and Garcia, 2012).

Studies have shown developing cooking competency increases the success of diabetes education (Abbott et al., 2012; Anderson-Lotfin et al., 2005; Glazier, Bajcar, Kennie, and Willson, 2006). The workshops focused on teaching cooking techniques *to enable participants to cook* healthier at home rather than only trying to increase their knowledge. Second, the workshops took place in a small group setting that allowed participants to actively ask questions and engage with the material being taught. Third, the workshops were visual, showing participants how to make different dishes through a cooking video and then allowing participants to taste food samples so that they knew how recipes tasted. Additionally, the workshops targeted a younger-aged population that may have been more receptive to the proposed cooking methods (Caraher and Lang, 1999).

This study was limited by several factors, including its short duration and small sample size. Although the intervention showed positive effects in the study sample, these results may not be translatable to the whole diabetic population since those who chose to participate in the intervention may have been more determined to modify their behavior than those who chose not to participate in the study. Additionally, the data on cooking and eating behaviors only evaluated the effectiveness of the first diabetes workshop's education while literature

indicates that long-term behavioral changes often require long-term interventions (L'Abate, 2007; Wing, 1993). Furthermore, this study administered self-reported questionnaires, hence increasing the potential for recall bias: some participants may have reported dietary changes they had aimed for rather than actually implemented. After two years, only 23 of the participants' medical records were retrieved to obtain clinical measurements resulting in loss to follow-up. While examining the cooking practices of the study group after two years would have increased the level of certainty in identifying a causal relationship between the modified recipes and improvements in clinical data, participants were not contacted by phone or other methods after two years to check if they were still following the recipes. This was to avoid receiving biased responses from participants intended to satisfy solicitors' wishes.

Important factors contributing to the increasing rates of obesity and diabetes are lack of time for cooking and the negative feelings of food deprivation if one wants to follow commercial diets to lose weight (Epstein et al., 2007; U.S. Department of Health and Human Services, 2014). The proposed cooking methods have been created to counter these two hindrances in weight control efforts. Due to simplification of the cooking process, food preparation time has been decreased to approximately half of what it takes to follow the original recipes. Thus, while cooking time may be similar or less than the original recipes, the time the person spends in the kitchen to prepare the ingredients is shorter. Additionally, the caloric contents of the foods have been reduced to allow the person to maintain the previous portion sizes without worrying about gaining weight.

Since proposed cooking methods modify individuals' regular meals rather than prohibiting eating those meals, it is likely that at least some participants did and will continue following some techniques taught in the class. As one participant remarked, 'It was incredibly easy and faster to bake rather than fry kotlet, and it turned out delicious. I seldom used my oven but now I know how to.'

This study can serve as a model for other diabetes-management interventions in different communities: health educators can empower patients by teaching them how to modify their cooking methods (Abbott et al., 2012). The cooking-centric approach in workshops should be both visual and written on paper either as pamphlets or recipe books. Classification of cooking methods simplifies and streamlines cooking instructions.

Geolocation Information This study was conducted in the city of Mashhad, Khorasan, in northeast Iran.

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Declaration of Interest The Authors declare that there is no conflict of interest.

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Appendix

Table A. Examples for the proposed seven cooking techniques to streamline the process of systemic modification of recipes to prepare healthier foods (the goal of recipe modification is to eliminate/reduce saturated/trans fats, sugar, salt, and calorie contents of the foods. The instructions are easy to follow. Although what we present here are only traditional Persian dishes, these recipe modification methods are applicable to all types of recipes from around the world to prepare healthier foods).

Traditional Persian Dishes	Cooking Modifications You Can Do Instead to Prepare Healthier Foods	Notes

Ghorme-sabzi	Bake greens rather than frying	Add the chopped greens directly to the stew rather than frying in oil.
Fesenjoon	Substitute sweet fruits for sugar	Substitute ground carrots and prune (plum) for sugar.
Kookoo sabzi	Bake rather than frying	Lightly brush the surface of food with vegetable oil to prevent dryness.
Kotlet	Bake rather than frying	Lightly brush the surface of food with vegetable oil to prevent dryness.
Khoresht bademjoon	Steam eggplants rather than frying	Add eggplants directly to the stew without frying process.
Khoresht gheimeh	Sear in hot skillet rather than frying	Sear the cut pieces of meat and onions in hot skillet.
Piaz dagh	Sear in hot skillet rather than frying	Sear the chopped or sliced onions in a hot pan to caramelize.
Meat or vegetable sandwiches	Add healthy dressings/sauces (healthy versions taught) instead of mayonnaise and other fatty sauces or cheeses to your meat or vegetable sandwiches.	Healthy dressings/sauces (healthy versions taught) can remove the need for salt and oil and add needed moisture and good taste to foods that are low in salt and fat.
Naanaa dagh	Minimal oil use methods (brush/mix with water)	Mix a tbspoon of hot water to the dried herb to minimize the need for oil during frying process.
Zereshk polo	Minimal oil use methods (brush/mix with water)	Mix a tbspoon of hot water to the dried berries to minimize the need for oil during frying process.
Chelo-kabaab	Eating salad before meal to feel full and to reduce the portion size.	Eating lettuce salads before main meals reduces the appetite.

Table B. Examples for ingredient substitution methods to systemically modify recipes to prepare healthier foods: (The goal of recipe modification is to eliminate/reduce saturated/trans fats, sugar, salt, and calorie contents of the foods. The instructions are easy to follow. These recipe modification methods are applicable to all types of recipes from around the world to prepare healthier foods).

What Original Recipe Asks for	What You Can Do Instead to Prepare Healthier Foods	Notes

Deep fry	Bake in the oven	Lightly brush the surface of food with vegetable oil to prevent dryness.
Sugar	Substitute sweet fruits for sugar	Substitutes for sugar: • Apple sauce, mashed ripe banana, or other mashed fresh fruits or ground dried fruits in cake recipes. • Raisins, berries, pieces of dried fruits in: 1. Cookies 2. Fresh salads 3. Puddings
Salt	Substitute other spices or dried herbs for salt	Reduce or eliminate salt in recipes by substituting spices or dried herbs to enhance the taste of foods. Substitute for salt: • Dill seeds and dried mint in bread doughs and rice. • Dried lemon powder in stir fries. • Balsamic vinegar in salads and stir fries. • Lemon juice and dried lemon powder in stews. • Sour drained water out of plain yogurt in rice and bread doughs. • Tomato juice and curry powder in rice.
Butter	Substitute ingredients such as oats, apple sauce, mashed fruits, nut butters, or yogurt for butter	Substitute butter with: • Apple sauce or mashed fresh fruits in cake recipes. • Oats or nut butters in cookie doughs and breads. • Yogurt in cake recipes and bread doughs and rice.
Original recipe for pie crust	Cook chick peas with water completely. Mash	Use mashed cooked chickpea and flour mixture as dough for making

	the cooked chickpeas until smooth in texture. Combine with flour.	crusts used in pies and cheese cakes.
Mozzarella and other high fat cheeses used in macaroni & cheese, lasagna, pizza; cream cheese used for cheese cake.	Substitute drained low-fat yogurt, ground raw cashews, tofu, or white sauce for all or part of cheese in recipes.	Substitute half of the cheese with low fat drained yogurt. Substitute cheese with ground raw cashews mixed with lemon juice, tahini, onion powder, garlic powder, and mustard powder. Substitute cheese with tofu. Also, you can put a tbsp. of flour in a hot pan on stovetop for some minutes to remove the raw flavor of the flour. Then add a cup of skim milk and bring it to a boil to start thickening the sauce. Substitute this white sauce with part of cheese.

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