Motivational Interviewing to Increase Awareness about Healthy Lifestyles for Cardiovascular and Respiratory Health in Primary Care

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Abstract

Cardiovascular (CV) and respiratory disorders (CRDs) together are leading causes of deaths worldwide and associated with many adverse health outcomes. Motivational interviewing can be used by the clinicians to increase clients' awareness about healthy lifestyle to reduce suffering from such conditions. As a proof of concept, patients (n=81) in two primary care settings, were coached and evaluated using a before-and-after study design. Following the coaching sessions, most patients accepted many domains of healthier lifestyles for better management of symptoms and suffering from such conditions with heightened understanding of the risk factors of CRDs. For example, the goal to double the number of participants to accept eating healthy portions of vegetables and fruits was exceeded, that more than triple (85.2% from 27.7% baseline) of participants accepted this healthy lifestyle following the sessions. This study reaffirms that motivational interviewing can improve patients' acceptance of healthy lifestyles in primary care settings as a cost-effective tool to bridge the gaps of knowledge for healthcare consumers. For the coming era of precision-health, motivational interviewing can be added to the individualized risk assessment to prevent progressions of adverse health outcomes for patients with CRDs.

Keywords: motivational interviewing, epigenetic mechanism, healthy lifestyles, primary care settings

1. Introduction

Cardiovascular (CV) and respiratory disorders (CRDs) together are leading causes of deaths accounting for more than 18 million deaths annually worldwide and are associated with many adverse health outcomes for an estimated global cost of over $1,100 billion by year 2030 [1-3]. Multifactorial risk factors including environmental pollutants and unhealthy lifestyles can increase the risk of CRDs [2-4], by increasing the inflammatory responses and increased homocysteine levels [5-10]. Additionally, the accumulation of homocysteine has been associated with cellular toxicity linked to diseases for all organ systems [11-13], especially CRDs involving atherosclerosis and deep vein thrombosis. Hence, these risk factors may compromise health outcomes through epigenetic mechanisms [14].

For healthy lifestyles, sufficient daily intakes of vegetables and fruits that are rich in micronutrients (e.g., folate, betaine, vitamin Bs) play important protective roles against inflammation through detox mechanisms [7,10,15-17]. The healthy intake of fiber-rich diet that are also rich in folate related micronutrients can suppress inflammatory symptoms associated with CRDs, by reversing the toxicity of homocysteine for methionine recycling and detox pathways [18-20]. Contrarily, studies have demonstrated that various factors were associated with increased homocysteine levels including overconsumption of coffee and alcohol intake [9,21-23], psychological stress [15], insulin resistance [24], and sedentary lifestyle [25]. Additionally, tobacco smoking contributes significantly to the level of fine particulate matter (PM) in the air, that would increase homocysteine with systemic inflammation and severe pulmonary arterial remodeling for CRDs [5,6,8,9]. Particularly, fine particles at less than 2.5 μm in diameter ($PM_{2.5}$) can reach the lung's alveoli then circulate in the CV system leading to systemic inflammation [6,26,27], affecting epigenetics of inflammatory mediators, but also DNA replication and repair in the human genome [8,28,29]. Therefore, healthy lifestyles are critical for CRD related health outcomes.

Thus, the aim of the study was to demonstrate the proof of concept on coaching patients with CRDs through motivational interviewing about healthy lifestyles through a better understanding of multifactorial mechanisms of developing CRDs. The coaching content was developed following a thorough review of current literature on the evidence of multifactorial mechanisms of developing CRDs. Motivational interviewing allows for an active, client-centered, and goal-oriented interactive style of communication that facilitates participants' healthy goals and sustainable changes in healthy lifestyles [30-32]. Motivational interviewing facilitates participants to establish and attain health-promoting goals that is active and individualized [31]. The goal of motivational interviewing to prevent disease risks is in alignment with the American Heart Association's impact goal for 2020 [33]. While US Preventive Services Task Force (USPSTF) recently categorized behavioral counseling as "C" recommendation to improve health outcomes in primary care settings [34], there is no current guideline for behavioral counseling from the medical communities. Patient counseling and teaching fall naturally within the scope of practice for the clinicians, with the moral requirement to promote good or *beneficence* being one of the ethical guiding principle for practice [35]. The purpose of this project was also to reduce the gap between individuals' personal knowledge and current scientific discovery on the mechanisms of CRDs [30,31,36].

2. Methods

2.1. Study Design

We conducted a proof-of-concept pilot project using before-and-after study design to enhance and evaluate participants' acceptance of healthy lifestyles from before to after the health coaching sessions through motivational interviewing. Following the guidelines of Standards for QUality Improvement Reporting Excellence (SQUIRE 2.0) [37], we report the effectiveness of a quality project for patients with CRDs, using motivational interviewing to enhance the acceptance of healthy lifestyles through a better understanding of multifactorial mechanisms in the development of CRDs.

2.2. Setting and Sample

The project was approved for a Human Subjects project by an appropriate University's Institutional Review Board (IRB). Informed consents were obtained from the eligible participants prior to their participation in the study. The participants were recruited from two large areas, high-altitude and low-altitude cities, in southern California. Four sessions were conducted, two each at clinics located in a high-altitude city Big Bear Lake, which is located at 6,752 feet above the sea level in the San Bernardino mountains, and Victorville, a low-altitude city at 2,726 feet above the sea level also located in southern California. The difference of altitudes between two locations was collected to explore the potential influences of altitudes in living environment that may influence the symptoms associated with air quality and oxygen density for the development of CRDs.

To qualify as human participants for this project, participants of both genders had to: a) be between the ages of 20 to 70 years, b) be able to read and write English, and c) have diagnoses of at least one CRD. The exclusion criterion was cognitive impairment. Based on the data from the Centers for Disease Control and Prevention (CDC) [38], only 27.7% of Californians consumed the recommended servings of vegetables (3 cups) and fruits (2 cups) per day. Based on this data, we set a goal of doubling the proportion of our sample, to 55.4% of participants to accept eating the recommended servings of vegetables and fruits. For that magnitude of change, a power calculation revealed that we needed a sample size of 39 to reach a statistical power of 0.80 and α of .05 for type I error [39].

2.3. Procedure and Evaluation

The educational coaching sessions using motivational interviewing included a brief introduction, followed by a 20-minute session to sign the informed consent and complete the pretest questions. The 20-minute session was provided by a clinician, to the participants for a better understanding of the multifactorial mechanisms of developing CRDs to enhance their acceptance of healthy lifestyles. The instruments used in this project to evaluate the participants' acceptance of healthy lifestyles were developed following the framework of My Own Health Report [40]. The MOHR project included a web-based survey with the list of health metrics including healthy lifestyles. The intent of MOHR project was to harmonize the U.S. national health metrics databases with a minimum dataset in the primary care settings. For this project, the elements of these health metrics included in the MOHR project were included to evaluate healthy lifestyles.

The clinician recommended the clients on their acceptance of healthy lifestyles by decreasing body's inflammation and multifactorial risk factors including (a) consumption of at least 5 servings of vegetables (3 servings) and fruits (2 servings), (b) drinking sufficient (8 cups or

more) water or fluid, (c) limiting coffee intake [9,21,22] (added in this project, for its relevance to the multifactorial mechanisms, in addition to the list from the MOHR project), (d) limiting alcohol intake, and (e) eliminating smoking. After the session, participants were given ample opportunity to ask questions and to complete the after-session questions, aided with interviews to ensure the completeness of responses.

2.4. Data Analysis

Data were analyzed using JMP® Pro version 13.0.0 (SAS Institute, Cary City, North Carolina). The characteristics between groups of participants at two altitudes were compared using t-tests for continuous variables and Chi-square test for the categorical variables. Symptoms among CRD group conditions were compared using non-parametric Fisher's exact Chi-square tests to adjust for disproportionate distributions of case numbers among the groups. And pre- to post-tests on the acceptance of healthy lifestyle were also compared using the Chi-square tests for categorical variables.

3. Results

3.1. Characteristics of CRDs between High- and Low-Altitude Sites

Forty eligible participants from high altitude and 41 from low altitude settings completed the health metrics before and after the educational sessions. For characteristics of CRDs, 40 (49.4%) participants had CV conditions, 19 (23.4%) had respiratory conditions, and 22 (27.2%) had dual conditions of CRDs. The mean ages of participants averaged in middle ages while ranged from 20 to 70 years old. The mean ages at the high-altitude clinic were 43 and at the low-altitude clinic, 49 years, an average of 6 years younger at the high-altitude than at the low-altitude site (See Table 1). There were more female participants at both sites; 67.5% women and 32.5% men at the high-altitude site, as well as 56.1% women and 43.9% men at the low-altitude site. There were more married, educated and Asian participants than other ethnic groups (all p <0.05) at the low-altitude site than at the high-altitude site (Table 1). The average body mass index (BMI) for both sites were in the overweight ranges with mean BMI of 29 at the high-altitude and 28 at the low-altitude sites.

3.2. Health Conditions per CRD Groups

For health conditions, high cholesterol was the most common diagnosis for participants with CV (65%) and dual CRD conditions (45.5%) (p <0.001) (Table 2). And, both CV and CRD groups had more participants with hypertension and obesity than the participants in the Respiratory group. Asthma was the most common diagnosis for participants with respiratory (52.6%) and dual CRD conditions (40.9%) (p <0.001). More participants in the Respiratory group had chronic obstructive pulmonary disease and chronic bronchitis, and were chronic smokers, than the other two groups. About 34% of participants with respiratory and dual CRD conditions were smokers. The mean number of diagnoses for CV conditions was 1.78, and for respiratory conditions was 1.16. For participants who had both CRD conditions, the mean number of CV conditions was 1.59 and of respiratory conditions was 1.05.

Table 1. Demographic characteristics between two altitude study sites

Parameters	No (%), Mean ±*SD* (range)	High-altitude *N* = 40 (100%)	Low-altitude *N* = 41 (100%)	*p*
Diagnosis				
	Cardiovascular Diseases	19 (47.5)	21 (51.2)	NS
	Respiratory Diseases	9 (22.5)	10 (24.4)	
	Dual	12 (30.0)	10 (24.4)	
	CRDs			
Gender	Male	13 (32.5)	18 (43.9)	NS
	Female	27 (67.5)	23 (56.1)	
Ethnicity	Asian	5 (12.5)	22 (53.7)	<0.001
	African/Black	0 (0)	1 (2.5)	
	Caucasian	23 (57.5)	9 (21.9)	
	Hispanic	12 (30.0)	9 (21.9)	
Age		42.55 ± 15.69 (20 – 70)	48.92 ± 14.37 (23 – 70)	NS
Years of Residency		15.19 ± 10.75 (0.5 – 37)	14.67 ± 9.88 (0.7 – 37)	NS
Height (inches)		64.32 ± 3.86 (56 – 71)	65.00 ± 4.43 (59 – 76)	NS
Weight (pounds)		168.97 ± 36.31 (106 – 251)	166.14 ± 48.96 (99 – 360)	NS
Body Mass Index		28.82 ± 6.64 (18 – 46)	27.17 ± 5.41 (17 – 46)	NS
Marital Status	Single	8 (20.0)	8 (19.5)	0.049
	Widowed	0 (0)	4 (9.8)	
	Living as married	6 (15.0)	2 (4.9)	
	Divorced	5 (12.5)	1 (2.4)	
	Separated	1 (2.5)	1 (2.4)	
	Married	20 (50.0)	25 (61.0)	
Education	Graduate	5 (12.5)	8 (19.5)	0.002
	4 years college	0 (0)	11 (26.8)	
	Associate/Technical	11 (27.5)	5 (12.2)	
	Some college	10 (25.0)	10 (24.4)	
	High School	11 (27.5)	6 (14.6)	
	Less than High School	3 (7.5)	1 (2.4)	
Employment	Retired	4 (10.0)	6 (14.6)	NS
	Disabled	1 (2.5)	4 (9.8)	
	Student	0 (0)	1 (2.4)	
	Homemaker	3 (7.5)	5 (12.2)	
	Unemployed	2 (5.0)	5 (12.2)	
	Employed part-time	2 (5.0)	2 (4.9)	
	Employed full-time	24 (60.0)	17 (41.5)	

CRDs: Cardiovascular and respiratory diseases; NS: not significant.

Table 2. Diagnoses and symptoms associated with the health conditions per diagnoses groups.

Diagnoses & Symptoms		CVD *N* = 40 (100%)	Respiratory *N* = 19 (100%)	Dual CRDs *N* = 22 (100%)	*p*
Diagnoses					
CVD	Hypertension	14 (35.0)	0	10 (45.5)	<0.001
	Heart disease	3 (7.5)	0	0	NS
	History of stroke	3 (7.5)	0	1 (4.5)	NS
	Congestive heart failure	1 (2.5)	0	0	NS
	Deep vein thrombosis	2 (5.0)	0	1 (4.5)	NS
	High cholesterol	26 (65.0)	0	10 (45.5)	<0.001
	Obesity	16 (40.0)	0	9 (40.9)	<0.001
	Diabetes	6 (15.0)	0	4 (18.2)	NS
Respiratory	Asthma	0	10 (52.6)	9 (40.9)	<0.001
	Obstructive Pulmonary Disease	0	0	3 (13.6)	0.029
	Chronic bronchitis	0	6 (31.6)	3 (13.6)	<0.001
	Chronic smoker	0	6 (31.6)	8 (36.4)	<0.001
Symptoms					
CVD	Chest discomfort	6 (15.0)	3 (15.8)	6 (27.3)	NS
	Palpitation	6 (15.0)	3 (15.8)	4 (18.2)	NS
	Lower extremities swelling	8 (20.0)	1 (5.3)	4 (18.2)	NS
	Tingling and numbness in hands/feet	13 (32.5)	5 (26.3)	9 (40.9)	NS
Respiratory	Chronic cough	5 (12.5)	3 (15.8)	2 (9.1)	NS
	Shortness of breath	11 (27.5)	4 (21.1)	6 (27.3)	NS
	Frequent upper respiratory infection	3 (7.5)	1 (5.3)	1 (4.5)	NS
	Wheezing	1 (2.5)	2 (10.5)	3 (13.6)	NS
Neurologic	Difficulty concentrating	11 (27.5)	7 (36.8)	7 (31.8)	NS
	Headache	19 (47.5)	6 (31.6)	4 (18.2)	NS
Musculoskeletal	Muscle cramp	14 (35.0)	6 (31.6)	10 (45.5)	NS
	Muscle weakness	11 (27.5)	4 (21.1)	1 (4.5)	NS
	Decreased muscle endurance	15 (37.5)	2 (10.5)	4 (18.2)	NS
Gastro-Intestinal	Constipation	8 (20.0)	1 (5.3)	3 (13.6)	NS
	Diarrhea	5 (12.5)	2 (10.5)	3 (13.6)	NS
	Loss/decreased appetite	3 (7.5)	1 (5.3)	4 (18.2)	NS
	Excessive thirst	5 (12.5)	2 (10.5)	5 (22.7)	NS
	Nausea	6 (15.0)	3 (15.8)	5 (22.7)	NS
Metabolic	Frequent urination	13 (32.5)	2 (10.5)	7 (31.8)	NS
	Weight loss	3 (7.5)	3 (15.8)	0 (0)	NS
General	Dizziness	12 (30.0)	5 (26.3)	6 (27.3)	NS
	Fatigue	24 (60.0)	7 (36.8)	10 (45.5)	NS
	Lack of energy	26 (65.0)	8 (42.1)	13 (59.1)	NS
	Sleeping problem	22 (55.0)	11 (57.9)	8 (36.4)	NS
	Nosebleed	2 (5.0)	2 (10.5)	1 (4.5)	NS
	Somnolence	10 (25.0)	6 (31.6)	6 (27.3)	NS

CRDs: Cardiovascular and respiratory diseases; NS: not significant.

For health symptoms, most participants commonly experienced lack of energy (55.4%), sleeping problems (49.8%), and fatigue (47.4%). Additionally, many participants with dual CRDs experienced muscle cramp (45.5%), as well as tingling and numbness in hands/feet (40.9%). More participants with CVDs than those with other two groups experienced decreased muscle endurance (37.5%)—a difference that was statistically significant (p <0.05) compared to the participants in respiratory (10.5%) and dual CRD conditions (18.2%).

3.3. Acceptance of Healthy Lifestyles

We measured acceptance of healthy lifestyle from before to after the sessions for both altitude sites (Table 3). The acceptance of healthy behaviors and lifestyle were significantly improved from before to after the sessions (p <0.05) on all health measures for the total samples. For each of the health metrics, there were general trend that more participants at the low-altitude site than those at the high-altitude site having healthier lifestyles before the sessions. However, more participants at the high-altitude site than those at the low-altitude site had more relaxed lifestyles such as proper sleep and healthy volume of water intakes.

The following lists significantly improved health metrics after sessions and differences between two altitude sites. There were more smokers (30%) at the high-altitude site compared to the low-altitude site (4.9%) before the sessions. After the sessions, most participants (93.8%, 76/81, 36 at the high-altitude and 40 at the low-altitude sites) of the participants were willing to accept no-smoking. There were more alcohol drinkers (70%) at the high-altitude site compared to the low-altitude site (43.9%) before the sessions. After the sessions, the majority of the participants (86.4%, 70/81, 31 at the high-altitude and 39 at the low-altitude sites) of the participants were ready to accept not drinking alcohol. Only 35.8% (29/81) of participants were having adequate physical activities in 4 to 7 days per week, with 37.5% (15/40) at the high-altitude and 34.1% (14/41) at the low altitude before the sessions. After the sessions, most participants (90.1%, 73/81) accepted to engage in physical activity in 4 to 7 days per week.

More participants (47.5%, 19/40) at the high-altitude experienced difficulties of managing stress levels compared to those at the low-altitude (29.3%, 12/41) before the sessions. After the sessions, majority (85.1%, 69/81) of the participants accepted ways to manage their stress levels except 12 participants (7/40 at the high-altitude and 5/41 at the low-altitude settings). More participants at the low-altitude (70.7%, 29/41) than those at the high-altitude (52.5%, 21/40) sites experienced inadequate sleep before the sessions. After the sessions, many (37%, 30/81) were not ready to accept the proper sleeping lifestyles (11/40 at the high-altitude and 19/41 at the low-altitude sites). After the coaching, the lowest accepted healthy lifestyles were proper and enough sleep as measures by “not sleepy during the days”, especially for participants at the low-altitude site (53.7%, 22/41).

For healthy eating lifestyles, majority (81.5%, 66/81) of the participants did not consume healthy portions of vegetables before the sessions at both altitude sites, 87.5% (35/40) at the high-altitude and 75.6% (31/41) at the low-altitude sites. After the sessions, majority (85.2%, 69/81) of the participants were willing to accept taking healthy portions of vegetables except 12 participants (9/40 at the high-altitude and 3/41 at the low-altitude sites). More participants at the high altitude (72.5%, 29/40) compared to those at the low-altitude sites (65.9%, 27/41) did not consume healthy portions of fruit intakes before the

sessions. After the sessions, majority (85.2%, 69/81) of the participants were willing to accept taking healthy portions of fruits except 12 participants (6 each at both sites). Thus, majority of the participants had accepted eating healthy portions of vegetables and fruits after the sessions. Additionally, most (88.9%, 72/81) participants, 90.2% (37/41) at the low-altitude and 87.5% (35/40) at the high-altitude, did not consume healthy portions of grain intakes before the sessions. After the session, 39.5% (32/81; 42.5%, 17/40, at the high-altitude, and 36.6%, 15/41, at the low-altitude) of the participants were not willing to accept taking healthy portions of grain intakes. For water or fluid intakes, less than half (44.4%, 36/81), 52.5% (21/40) at the high-altitude and 36.6% (15/41) at the low-altitude sites were drinking 8 or more cups of water/fluid before the sessions. After the sessions, majority (87.7%, 71/81) of the participants, 85% (34/40) at the high-altitude and 90.2% (37/41) at the low-altitude sites were willing to drink 8 or more cups of water/fluid daily.

For unhealthy eating habits, about half (54.3%, 44/81), 55% (22/40) at the high-altitude and 53.7% (22/41) at the low-altitude sites, were eating fast food at least once weekly before the sessions. After the sessions, majority (86.4%, 70/81) of the participants, 82.5% (33/40) at the high-altitude and 90.2% (37/41) at the low-altitude sites, were willing to reduce eating fast food weekly. Only 25.9% (21/81) of the participants, 25% (10/40) at the high-altitude and 26.8% (11/41) at the low-altitude sites were limiting their salt intake to the recommended limit before the sessions. After the sessions, more than half (55.6%, 45/81) of participants, 55% (22/40) at the high-altitude and 56.1% (23/41) at the low-altitude sites were willing to limit their salt intake. Less than half (42%, 34/81) of the participants, 52.5% (21/40) at the high-altitude and 31.7% (13/41) at the low-altitude sites were coffee drinkers (> 1 cup per day) before the sessions. After the sessions, many (74.1%, 60/81) of the participants, 67.5% (27/40) at the high-altitude and 80.5% (33/41) at the low-altitude sites, were willing to drink 1 cup or less of coffee daily. Lastly, many of the participants (71.6%, 58/81), 70% (28/40) at the high-altitude and 73.2% (30/41) at the low-altitude sites, were drinking 1 cup or less of soda or sugary drinks before the sessions. After the session, majority (93.8%, 76/81) of the participants were willing to drink 1 cup or less of soda or sugary drinks except 5 participants (2/40 at the high-altitude and 3/41 at the low-altitude sites).

4. Discussion

The aim of the project was coaching participants with CRDs to improve their acceptance of healthy lifestyles through a better understanding of multifactorial mechanisms that affect the development of CRDs. As a proof of concept project, 81 participants were interviewed on healthy lifestyles. This project reaffirms the values and effectiveness of motivational interviewing for patients with CRDs on accepting healthy lifestyles with a better understanding of multifactorial mechanisms for the development of CRDs [30,31]. The motivational interviewing can be added to a standard clinic visit as part of patient counseling to address patient-centered risk assessment to prevent the progression of CRDs and adverse health outcomes. Motivational interviewing facilitates participants to establish and attain health-promoting goals that is active and individualized [31]. It can be used as a cost-effective tool to bridge the gaps of knowledge for healthcare consumers [30,31,36].

Table 3. Improved acceptance of healthy lifestyles from before to after educational sessions.

Health metrics	Site	Before *N* = 81 (100%)	After *N* = 81 (100%)	*P*
Tobacco use, none		67 (82.7)	76/81 (93.8)	<0.001
Total		28 (70.0)	36/40 (90.0)	0.001
	High-altitude	39 (95.1)	40/41 (97.6)	0.01
	Low-altitude			
Alcohol intake, none		35 (43.2)	70/81 (86.4)	<0.001
Total		12 (30.0)	31/40 (77.5)	0.006
	High-altitude	23 (56.1)	39/41 (95.1)	NS
	Low-altitude			
Physical activity 4–7 days/week		29 (35.8)	73/81 (90.1)	0.006
Total		15 (37.5)	36/40 (90.0)	0.045
	High-altitude	14 (34.1)	37/41 (90.2)	NS
	Low-altitude			
Stress level managed		50 (61.7)	69/81 (85.1)	<0.001
Total		21 (52.5)	33/40 (82.5)	<0.001
	High-altitude	29 (70.7)	36/41 (87.8)	<0.001
	Low-altitude			
Enough and Proper Sleep, Not sleepy	Total	31 (38.3)	51/81 (63.0)	<0.001
	High-altitude	19 (47.5)	29/40 (72.5)	<0.001
	Low-altitude	12 (29.3)	22/41 (53.7)	<0.001
Dietary intake				
Vegetable $\geq$ 3 servings/day		15 (18.5)	69/81 (85.2)	0.021
Total		5 (12.5)	31/40 (77.5)	NS
	High-altitude	10 (24.4)	38/41 (92.7)	NS
	Low-altitude			
Fruit $\geq$ 2 servings/day		25 (30.9)	69/81 (85.2)	0.002
Total		11 (27.5)	34/40 (85.0)	0.039
	High-altitude	14 (34.1)	35/41 (85.4)	0.018
	Low-altitude			
Grain $\geq$ 3 servings/day		9 (11.1)	49/81 (60.5)	0.002
Total		5 (12.5)	23/40 (57.5)	0.014
	High-altitude	4 (9.8)	26/41 (63.4)	0.049
	Low-altitude			
Water $\geq$ 8 cups/day		36 (44.4)	71/81 (87.7)	<0.001
Total		21 (52.5)	34/40 (85.0)	0.002
	High-altitude	15 (36.6)	37/41 (90.2)	0.049
	Low-altitude			
Fast food < 1/week		44 (54.3)	70/81 (86.4)	<0.001
Total		22 (55.0)	33/40 (82.5)	<0.001
	High-altitude	22 (53.7)	37/41 (90.2)	0.001
	Low-altitude			
Sodium $\leq$ ¾ teaspoon/day		21 (25.9)	45/81 (55.6)	<0.001
Total		10 (25.0)	22/40 (55.0)	<0.001
	High-altitude	11 (26.8)	23/41 (56.1)	<0.001
	Low-altitude			

Health metrics	Site	Before N = 81 (100%)	After N = 81 (100%)	P
Coffee ≤ 1 cup/day		47 (58.0)	60/81 (74.1)	<0.001
Total		19 (47.5)	27/40 (67.5)	<0.001
	High-altitude	28 (68.3)	33/41 (80.5)	<0.001
	Low-altitude			
Soda & sugary drinks ≤ 1 cup/day		58 (71.6)	76/81 (93.8)	<0.001
Total		28 (70.0)	38/40 (95.0)	0.024
	High-altitude	30 (73.2)	38/41 (92.7)	0.003
	Low-altitude			

NS: not significant.

Most participants in this study were willing to accept healthy lifestyles after the educational sessions. The goal to double the percentages of participants to accept eating healthy portions of vegetables and fruits among participants was exceeded in this project, that more than triple (85.2%, 69/81) of participants (from the starting average of 27.7%) were willing to eat healthy portions of vegetables and fruits after the educational sessions. In a recent study, only 15.5% of the participants were taking healthy portions of vegetables and fruits in primary care settings of U.S., lower than the rates reported for Californian [38] and in this study (18.5% on healthy vegetables and 30.9% on healthy fruit intakes, Table 3). Following the educational sessions, given that participants understood that fiber-rich diet can counteract the toxic effects of pollutants or environmental toxicants, their willingness to accept eating healthy portions of vegetables and fruits were powerful. Specifically, these results were improvements from less than 31% of participants (18.5% in high-altitude and 30.9% in low-altitude settings) who were eating healthy portions of vegetables and fruits prior to the sessions.

While some areas of healthy lifestyles were clearly accepted by majority of the participants following the coaching sessions, few areas were less accepted. These less accepted domains included proper or enough sleep, taking healthy portions of grains, and limiting salt intakes. While we followed recommendations of dosing for each of these health metrics specified with the MOHR project, eating 3-cup servings of multi-grains per day [40-42], these 3-cup servings may reflect higher carbohydrate intake than the average intakes by these participants. Additionally, challenges remain with limiting salt intake with the recommended intakes of less than ¾ teaspoon, as it was accepted by only 55.6% of the participants following the educational session. Getting enough sleep by not experiencing sleepiness during the day was another challenge in modern life, as it was accepted by only 63% of the participants. Furthermore, drinking coffee of 1 cup or less was another challenge, as it was only accepted by 74.1% of the participants. These less accepted areas may be due, in part, by the conflicting and inconclusive research evidence for these domains from epidemiologic studies, compounded with the sustained habits of the participants. These areas might need to be substantiated with further research from multi-level investigations considering gene-environment interactions for interactive genetic and environmental factors.

In summary, we have demonstrated the values and effectiveness of motivational interviewing to the patients with CRDs with a better understanding of the multifactorial mechanisms affecting the development of CRDs. The enhanced acceptance on healthy lifestyles by these CRD patients is a step

forward to demonstrate the feasibility and usefulness of implementing motivational interviewing by introducing multifactorial mechanisms to the patients. Interactive motivational interviewing, partnering with patients to understand multifactorial mechanisms of CRDs, can be a useful platform for the vulnerable populations to reduce adverse health outcomes and unnecessary waste in the healthcare. To prevent long-term adverse health outcomes associated with CRDs, chronic inflammations will need to be monitored over time in future studies following health outcomes [11,12,14]. Future intervention on lifestyle investigations with cohort follow-up design may include associated metabolic changes in the epigenetic pathways as outcome measures to attest for various intervention effects. For the coming era of precision-based healthcare, motivational interviewing can be added to the individualized assessment of risk factors to prevent progressions of adverse health outcomes associated with CRDs [40-42].

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