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Original Research

Community intervention trial promote healthy behaviors in farmers in Tianjin, China

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Abstract

Objectives: To assess a community intervention trial promoting healthier lifestyles in rural Chinese farmers using the stage of change health behavior model.
Methods: A community intervention trial utilized an intervention and control village with farmers as study subjects. The intervention village (n= 549) participated in a stage-specific interventions while the control village (n=557) received general health education messages. Farmers in both villages were initially categorized using the stage of change model and observed for attitudinal and behavior changes over one year. Data collection included dietary habits, physical activity, anthropomorphic measures, and biomarkers at baseline, mid-point, and study termination.
Results: The intervention group demonstrated greater progress in moving from awareness to the action stage in their adoption of healthier behaviors. Total cholesterol, homocysteine, blood pressure and urine sodium decreased while blood and urine folic acid increased in intervention subjects only.
Conclusions: The first documented use of the stage of change model in rural Chinese farmers was successful at increasing healthier eating and physical activity in an infrequently studied population. Given China's escalating burden of chronic diseases, the stage of change model should further be evaluated in promoting healthier behaviors and addressing lifestyle related illness in the world's most populous nation.

INTRODUCTION

The rapid development of China's economy has resulted in dramatic improvements in the standard of living and health status of many of its inhabitants [1]. This unprecedented economic development has also been accompanied by an increased adoption of unhealthy lifestyles characterized by high calorie diets and physical inactivity which have become increasingly common in residents of China [2-4]. Not surprisingly, the related burden of chronic diseases and deaths attributed to chronic diseases continues to grow in both metropolitan and rural regions, particularly amongst farmers who comprise 80% of China's population [5]. Therefore, it is especially important for China to investigate and implement effective methods for disseminating health information to farmers that encourage lifestyle changes to reduce risk for chronic diseases.

The evaluation of most public health programs in China involve administration of knowledge-attitude-practice questionnaires prior to broad dissemination of health education materials, followed by an assessment of their impact through measurement of change in the target groups' awareness. These approaches are limited in

assuming that the application of similar methods in different populations or among diverse individuals with varying levels of health awareness will lead to comparable outcomes. However, the use of an inflexibly standardized methodology can result in wasted resources, decreased effectiveness of the intervention, and may not accurately reflect an individual's (or groups') progression from early contemplation to eventual maintenance of a healthy behavior.

Use of the stage of change (SOC) model for categorizing the steps involved in behavior change related to health education is becoming more frequent in developed countries like the United States, England and Japan [6-17]. The SOC model places subjects into five different stages based on their awareness of, and actions related to, their health as follows: Stage 1--Pre-contemplation: unaware of an unhealthy behavior and not considering a change; 2--Contemplation: aware of an unhealthy behavior and considering a change; 3--Preparation: intention to change a behavior and plans made to do so; 4--Action: initiate change in unhealthy behavior but not consistently so; and 5--Maintenance: successful change of an unhealthy behavior for six months or more with ongoing efforts to sustain the change. The study utilized the SOC model to allow for multiple interventions targeted to each stage of behavior change with the intent of increasing the probability of achieving that change. The subjects in the study were classified into the five aforementioned categories[14]. Thus, strategies that increase awareness of an unhealthy behavior are thought to be most useful in the pre-contemplation stage by encouraging individuals to begin thinking about the benefits of change, while action-oriented and supportive methods likely work better for those in the latter stages of the SOC model. The anticipated advantage of the SOC model is that it allows for development of tailored interventions for individuals in different stages and promotes a progression from awareness to belief to action [18-23].

Delivery of education on the importance of good nutrition and physical activity is a high priority for China's public health system as the population burden of chronic diseases grows. A previous survey of farmers in Tianjin, China found the prevalence of hypertension in adults was over 33%, the average daily consumption of fruits and vegetables was less than 300 grams, the average intake of salt was over 12 grams, sedentary lifestyles were becoming much more common, and only 12% of the population engaged in daily physical exercise [24]. As is increasingly evident to many visitors, it has now become more popular for the Chinese people, including farmers, to take a car rather than walk or ride a bike. However, only a small number of surveys have attempted to evaluate the Chinese population regarding their knowledge about the relationship between increased consumption of fruits and vegetables and daily exercise, and the potential for reductions in risk of certain chronic diseases. And the authors are aware of very few studies which have examined the Chinese population's awareness of more complex dietary relationships between elements like potassium and folic acid. Potassium and folic acid are beneficial in the control of blood pressure and lowering cardiovascular disease risk, and decreases in levels of homocysteine, which is a de-methylation product of the amino acid, methionine [25-30] through which this relationship is partially mediated.

For this study, a SOC-based health education intervention was implemented in rural farming communities in Tianjin, China. A wide variety of methods and activities were used, focusing on increased consumption of fruits and vegetables, decreased salt intake, and increased levels of exercise. This paper analyzes the outcomes of the intervention and discusses the possible benefits to the control and prevention of chronic diseases in China.

SUBJECTS AND METHODS

Subjects

The research objectives of this study were to use the SOC model to provide nutrition and physical activity education to rural Chinese farming communities in order to increase knowledge about the relationship between healthy eating and exercise, and long term chronic disease risk reduction,[31] and to assess whether a decrease in unhealthy behaviors occurred during the one-year intervention.

Two rural communities in the Tianjin district of China were initially selected in November 2007 with one to serve as the intervention and the other as the control site. The two communities are separated by 60 kilometers, have similar cultural and economic backgrounds with comparably sized populations. Study participants were limited to healthy farmers aged 18 to 65 who were permanent local residents and were without pre-existing severe health conditions (i.e. serious diseases of heart, liver, kidney and hemopoiesis system; pregnant).The consent form signed by study subjects indicated the serious conditions which were exclusionary for participation, which is standard practice in China when consenting to enroll in a study. A total of 1106 farmers were recruited to participate in this study. This included an oversampling of approximately 10% to account for anticipated loss to follow up.

Between November 2007 and January 2009, the intervention community received a SOC-based nutrition and physical activity intervention utilizing a wide variety of methods and activities including individualized guidance during home visits, material distribution, cooking demonstrations, health club enrollment, personal nutrition consultation, didactic lectures, and participation in healthy cooking competitions. The control site received general health education messages about nutrition and the importance of physical activity. This study was approved by The Ethics Committee of Tianjin Centers for Disease Control and Prevention.

Data Collection and Analysis

Interviewers in this project were required to complete a standardized training course and pass a certifying exam prior to initiation of the study. During the home visit, three-day food intake was weighed and a questionnaire was administered collecting the following data elements: demographic information, an awareness-belief-action questionnaire used to establish SOC categories [10], a 24-hr diet record, and anthropometric measurements (i.e. height, weight, waist and hip circumference, and blood pressure). A randomized sample of half (50%) of the study participants had biomarker tests performed including blood glucose, blood lipid, blood folic acid, and urine potassium and sodium levels; a randomized sample of 25% of the study participants also had blood homocysteine level taken. The study subjects only reported exercise for health and did not include occupationally-related work.

Data collection occurred three times during the study; at baseline, at the mid-point of the study, and again at study termination. The collected data was double input, then checked and sorted for quality assurance prior to analysis. Food intake information was analyzed based on the China Food and Nutrient Database (2004). Nutrient intakes were calculated based on the 24 hour record; oil and salt intake were calculated using 3-day weight records. Statistical analysis consisted of the Wilcoxon's signed ranks test and Mann-Whitney U test for means comparison and chi-square test for rates comparison between participant groups; and liner regression to test for the relationship between fruits and vegetables (FV) intake and blood homocysteine level. All data in this study were analyzed using SPSS version16.0 with statistical significance established at $\alpha < 0.05$ level [32, 33].

Intervention Activities

A wide variety of methods and activities were used with study participants in the intervention community to promote increased daily consumption of fruits and vegetables and to encourage the performance of at least 30 minutes of exercise a day. Once or twice a month, study participants received individualized guidance during a home visit by village doctors that also included distribution of health education materials explaining the Chinese food pyramid. The study provided training lectures to the village doctors and also provided course materials to them based on the *China Guidelines and Norms for Nutrition Work*. The village doctors were required to pass a training exam and receive certification prior to joining the study. This study also paid an allowance to the village doctors for their work on the study.

The focus in the pre-contemplation group was highlighting the harmful health effects caused by an imbalanced diet and physical inactivity, the provision of dietary informational materials, and carrying out extra frequent home visits (i.e. greater than the other stage groups) by the village doctor twice a week. In the contemplation group, the key health messages were daily consumption of 500-900 grams of fruits and vegetables and exercise of at least thirty minutes per day using examples from successful case histories. The preparation group messaging was directed at developing an individualized plan to promote daily intake of vegetable and fruits, and sequentially increasing physical activity whereas the action group was more focused on problem-solving in realizing actual increases in fruit and vegetable consumption and daily exercise. Finally, the maintenance group was afforded a supportive environment which encouraged ongoing good nutrition and physical activity utilizing activities that included healthy eating in sponsored gatherings of family and friends.

All study enrollees in the intervention site were offered study incentives consisting of oil container with scales, salt spoon, food products such as folic fortified flour, low sodium salt and high fiber foods. Study subjects also had ongoing access to cooking demonstrations, physical activity program offerings, and individual level nutrition consultations by dietitians. These consultations included shopping guidance for healthy food, didactic lectures on health, fitness, and nutrition, and opportunities for participation in cooking competitions featuring healthy foods with prizes awarded for nutrition knowledge. Participants in each of the five SOC categories as assessed at baseline received different information and category-specific guidance. Only general health education messages on appropriate nutrition and exercise were provided to the control community.

RESULTS

The intervention group had 549 subjects of which 49% were male. The mean age of intervention participants was 45.6 $\pm$13.2 years. There were 557 subjects in the

control group, of which 48% (267/557) were male with a mean age was 45.9 years (45.9 ± 13.2). There were no significant differences in age and gender between the control and intervention groups ($p > 0.05$). The total rate of lost to follow up in the study was lower than expected at 1.4%.

Change in SOC stages among participants

This study measured behavior before, during, and after the intervention in the two groups (Table 1) looking for changes in the proportion of study participants who were ultimately categorized into each of the five SOC categories. The proportions of five SOC categories were similar in the two groups at baseline. For nutrition indicators, the progression from awareness ("pre-contemplation" and "contemplation") to belief ("preparation") to action ("action" and "maintenance") categories was significant between baseline and follow-up in intervention group. Specifically, the proportion of participants in the "pre-contemplation" and "contemplation" categories decreased, while the proportion of participants in the "preparation", "action" and "maintenance" categories increased. There was no significant change in the proportion of participants in each SOC category in the control group. (Table1)

Similar to the nutrition indicators, the physical activity indicators also demonstrated a change in behavior in the intervention group. From baseline to termination, the proportion of participants in the "pre-contemplation" and "contemplation" categories were reduced by over 30% and 20%, respectively. The proportion of subjects in the "preparation", "action" and "maintenance" groups all increased substantially, especially in the "action" category which increased over 20 %. The control group maintained a constant distribution of participants in each SOC stage across the baseline, mid-point, and study termination. (Table1)

Table 1. Proportion of study participants in each SOC group by data collection period based on FV consumption and physical activity indicators

Five stages	Intervention Group			Control Group		
	Baseline	Mid-period intervention	Terminal-period intervention	Baseline	Mid-period intervention	Terminal-period intervention
	(n=549)	(n=520)	(n=543)	(n=557)	(n=533)	(n=514)
Fruit and Vegetable Consumption (Percent of participants in each SOC group, 95% Confidence Interval)						
Pre-contemplation	42.4 (38.3,46.6)	33.3* (29.2,37.3)	10.1* (7.6,12. 7)	41.7 (37.6,45.8)	42.8** (38.6,47.0)	42** (37.8,46.3)
Contemplation	29.5 (25.7,33.3)	19* (15.7,22.4)	9.9* (7.4,12.5)	28.5 (24.8,32.3)	29.1** (25.2,32.9)	29** (25.1,32.9)
Preparation	11.8 (9.1,14.5)	21* (17.5,24.5)	26.9* (23.2,30.6)	12.6 (9.8,15.3)	12.4** (9.6,15.2)	12.3** (9.4,15.1)
Action	9.5 (7.0,11.9)	14.8 (11.8,17.9)	30.2* (26.3,34.1)	8.8 (6.4,11.2)	7.3** (5.1,9.5)	8.6** (6.1,11.0)
Maintenance	6.7 (4.6,8.8)	11.9* (9.1,14.7)	22.8* (19.3,26.4)	8.4 (6.1,10.8)	8.4 (6.1,10.8)	8.2** (5.8,10.5)
Physical Activity (Percent of participants in each SOC group, 95% Confidence Interval)						
Pre-contemplation	48.6 (44.5,52.8)	36.3* (32.2,40.5)	13.3* (10.4,16.1)	48.8 (44.7,53.0)	49.7** (45.5,54.0)	49.8** (45.5,54.1)
Contemplation	24.2 (20.6,27.8)	15.6* (12.5,18.7)	10.7* (8.1,13.3)	24.4 (20.9,28.0)	24.4** (20.7,28.0)	24.7** (21.0,28.4)
Preparation	10.9 (8.3,13.5)	22.3* (18.7,25.9)	28.7* (24.9,32.5)	10.8 (8.2,13.4)	11.1** (8.4,13.7)	11.3** (8.6,14.0)
Action	9.7 (7.2,12.1)	14 (11.1,17.0)	30.9* (27.1,34.8)	9.5 (7.1,12.0)	9.8 (7.2,12.3)	8.9** (6.5,11.4)
Maintenance	6.6 (4.5,8.6)	11.7* (9.0,14.5)	16.4* (13.3,19.5)	6.5 (4.4,8.5)	5.1** (3.2,6.9)	5.3** (3.3,7.2)

NOTE: column proportions may not equal 100% due to rounding
*$\chi 2$ test: $p < 0.05$: Compared to baseline within intervention group.
** $\chi 2$ test: $p < 0.05$: Compared control group with intervention group for the same study period.

Change of awareness about nutrition and physical activity

Knowledge about general nutrition, physical activity, and risk for chronic diseases increased among the

intervention participants between baseline and study termination. The awareness of the benefit of using salt low in sodium increased from 28.2% to 96.7%, and of the relationship between salt and hypertension increased from 35.9% to 87.7%.Substantial increases in awareness were also seen with the Chinese Food Pyramid (3.8% to 43.7%), the National Dietary Guideline for Chinese (2.4% to 35.4%), regular exercise as part of a healthy lifestyle (69% to 97.5%), and the daily recommended daily intake of vegetables and fruits (10.7% to 33.9%) amongst others. In the control group, the related awareness levels largely remained static at baseline levels and significantly lower compared to the intervention group at study's end.

Although the intervention and control groups had similar baseline indicators, significant changes in dietary health practice were only observed in the intervention group. Specifically, the intervention group experienced an increase in fruit and vegetable consumption and related nutrients, including ascorbic acid, potassium, and dietary fiber, while exhibiting a decrease in salt intake (Table2). These increases in healthy dietary practice in the intervention group were significant compared to the control group by study's conclusion. Additionally, several other indices improved in the intervention group such as increase in daily physical activity and decreases in BMI and blood pressure. Again, these results were significant for the intervention group relative to controls. (Table 2)

Changes in behavior and physiological indicators

Table 2. Comparison of diet and physical activity at study baseline and termination between intervention and control groups median (q25,q75)

Diet and nutrients	Intervention Group			Control Group		
	Baseline (n=549)	Terminal-period (n=543)	difference	Baseline (n=557)	Terminal-period (n=514)	difference
Cereal (g/d)	422(342,534)	434(350,542)	-17 (-121 ,91)	492(392,569)	500(434,567)	-17 (125 ,84)
Vegetables (g/d)	189(117,279)	234(167,300)*	-25 (-126 ,50)	217(150,283)	200(150,267)	0 (-75 ,83)**
Fruits (g/d)	126(67,191)	134(84,200)*	-10 (-84 ,67)	100(50,167)	117(67,150)	0 (67 ,100)**
Fish and sea food (g/d)	67(34,100)	67(34,100)	0 (-50 ,39)	50(34,84)	50(50,84)	0 (-17,17)
Meat and poultry(g/d)	53(34,100)	50(34,100)	-2 (-42 ,42)	67(34,100)	67(34,100)	0 (-34 ,44)
Eggs(g/d)	34(20,67)	45(25,67)	0 (-23 ,17)	42(25,67)	49(34,67)	0 (-23 ,17)
Milk(g/d)	84(67,100)	100(84,134)	25 (-52 ,34)	67(34,84)	115(100,134)	-12 (-20 ,33)
Bean and bean product(g/d)	67(40,102)	67(50,100)	-8 (-37 ,34)	67(50,117)	84(50,117)	0 (-38 ,34)
Cooking oil (g/d)	34(30,58)	31(27,59)*	6(-25,30)	45(28,57)	50 (31,56)	-2(-18,18)
Salt (g/d)	8(7,10)	7(6,10)*	1 (-1,3)	8(4,12)	8(6,12)	-2(-6,4)**
Dietary fiber(g)	10(6,16)	25(10,28)*	-11(-19,-1)	9(7,12)	10(8,12)	-1(-4,3)**
Ascorbic acid(mg)	54(32,77)	81(54,97)*	-19 (-51,8)	58 (41,79)	57 (43,77)	0(-25,22)**
Potassium(mg)	1489 (1172,1782)	1598 (1296,1888)*	-102(-494,245)	1419 (1207,1754)	1428 (1223,1791)	-29(375,256)**
Sodium(mg)	2460 (1834,2845)	2169 (1283,2673)*	356(-423,1283)	2595 (1907,2925)	2175 (1593,2976)	143(492,9730)**
Physical activity(min per time)	30 (30,60)	60 (30,113)*	0 (-52,0)	30 (30,60)	40 (30,60)	-10 (-30.,13) **
BMI (Kg/m^2)	24 (22,27)	24(21,26)*	0 (-1,1)	25(23,27)	25(23,27)	0 (-1,0)**
Waistline (cm)	88(80,95)	88 (80,95)	0 (-2,2)	88 (83,96)	88 (83,96)	0 (-0,0)
Hip circumference (cm)	100(95,106)	99 (94,105)*	0 (-1,3)	100 (94,107)	100 (96,107)	0 (-0,.0)
Waist-to-Hip ratio	1(1,1)	1(1,1)*	0 (-0,0)	1(1,1)	1(1,1)	0(0,0)
SBP (mmHg)	120 (110,130)	120 (116,130)*	0 (-6,10)	120 (120,132)	120 (120,132)	0 (-3.,5)**
DBP (mmHg)	80 (70,90)	80 (70,80)*	0 (-4,10)	80 (79,90)	80 (78,90)	0 (-2,6)**

NOTE: * Wilcoxon's matched pairs test: $p<0.05$: within group comparison; baseline vs terminal-period (intervention group only)
** Mann-Whitney U test: $p<0.05$: analyze the difference value (Baseline and Terminal-period) between the groups comparison; intervention vs control group
Mann-Whitney U test: $p>0.05$: between Intervention Group and Control Group in baseline
Difference means: Baseline minus Terminal-period

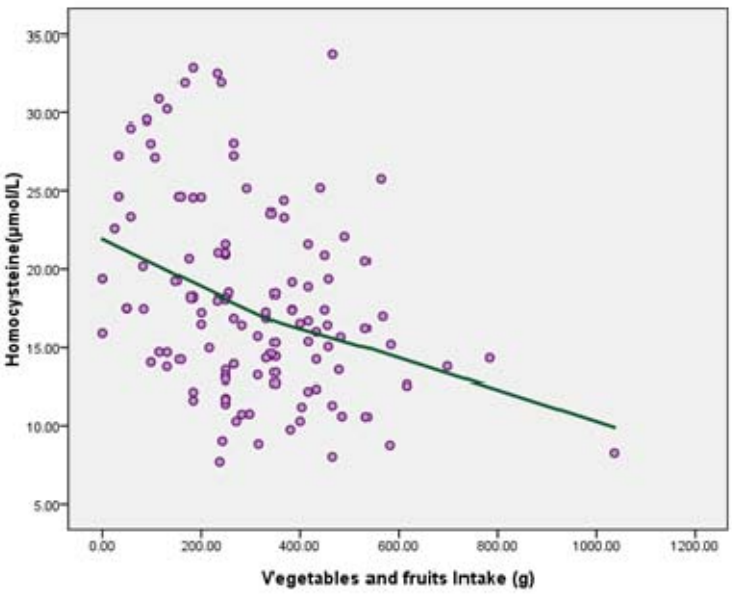
Biomarkers measurement showed that total cholesterol, blood homocysteine and urine sodium decreased while blood folic acid and urine potassium increased within the intervention group and these changes were significant compared to the control group (Table3). There was a negative correlation between fruit and vegetable intake and measured homocysteine levels in the intervention group using liner regression (figure1) such that study subjects' homocysteine levels decreased with increased fruit and vegetable daily consumption (β=-0.35, p<0.01).

Table 3. Comparison of biomarkers at baseline and study termination between intervention and control groups median (q25,q75)

Biomarker	Intervention Group			Control Group		
	Baseline (n=)	Terminal-period (n=)	difference value	Baseline (n=)	Terminal-period (n=)	difference value
Triglyceride (mgl/L)	1103.1 (891.2 ,1905.9)	1217.7 (891.2 ,1914.7)	61.8 (-344.1 ,352.9)	1394.1 (723.5 ,2011.8)	1244.1 (917.7 ,2073.5)	-52.9 (-564.7 ,582.4)
Total cholesterol(mg/L)	1980.8 (1815.4 ,2234.6)	1842.3 (1657.7 ,2023.1)*	200.0 (-34.6 ,430.8)	2119.2 (1853.9 ,2438.5)	2092.3 (1957.7 ,2257.7)	69.2 (-280.8 ,357.7)**
High density lipoprotein (mg/L)	560.2 (491.2 ,652.3)	529.5 (491.2 ,629.3)	23.0 (-92.1 ,107.4)	583.3 (487.3 ,698.4)	544.9 (456.6 ,667. 7)	38.4 (-84.4 ,153.5)
Fasting blood-glucose (mg/L)	867.0 (773.6 ,944.1)	917.2 (786.2 ,1015.9)	-16.2 (-181.3 ,100.5)	865.1 (786.2,1032.1)	875.9 (786.2 ,945.9)	-9.0 (-104.1 ,84.4)
Folic acid (ng/ml)	4.4(3.8,5.2)	6.0 (4.9,7.5)*	-1.5 (-3.4,0.0)	4.5(3.5,5.1)	4.5(4.1,4.9)	-0.1(-1.20,.7)**
Urine potassium (mg/L)	1300.8 (1008.0 ,1788.0)	1502.4 (1087.2 ,2927.5)*	-274.6 (-1615.2 ,277.4)	1526.4 (1296.0 ,1766.4)	1257.1 (958.6 ,1777.4)	314.9 (-197.3 ,666.2)**
Urine sodium (mg/L)	3522.1 (3031.8 ,4019.1)	3084.1 (2626.5 ,3495.0)*	357.3 (-235.5 ,1083.5)	3388.7 (2674.9 ,4281.0)	3342. 6 (2762.1 ,3842.5)	55.0 (-814.4 ,1093.5)**
Homocysteine (μmol/L)	18.23 (14.35,24.56) (n=61)	15.23 (12.78 15.61) * (n=58)	3.56 (1.80,14.62)	15.57 (13.22,18.14) (n=54)	15.82 (12.94,18.52) (n=52)	-0.76 -4.67,2.39)**

NOTE: * Wilcoxon's matched pairs test: p<0.05: within group comparison; baseline vs terminal-period (intervention group only)
** Mann-Whitney U test: p<0.05: analyze the difference value (Baseline and Terminal-period) between the group comparison; intervention vs control group

Figure 1. Increased daily consumption of fruit and vegetables correlates to decrease in homocysteine levels



NOTE: Standard Partial Regression Coefficient β=-0.35, P<0.01

DISCUSSION

China faces significant public health challenges in addressing the growing burden of chronic diseases in a rapidly increasing, and aging, population. The impact of chronic diseases on China's population health could potentially be decreased by initiating widespread improvements in health-related lifestyle and behavior change. Maximizing the effectiveness of interventions using health information to improve lifestyle behaviors promoting risk reduction related to chronic disease will ultimately require that they be tested and evaluated in Chinese populations.

This study implemented and evaluated the stage of change health behavior model in Chinese farmers living in rural Tianjin, China, a group that has not been previously studied. This model has been effective elsewhere [8-12, 15-17, 21-23]. The stage of change model for inducing behavior changes was highly effective in reducing unhealthy behaviors among this hard to reach population. Significant increases in the intake of fruits and vegetables, lower intake of salt and cooking oil, and in the time spent on physical activity were observed along with improvements in related anthropometric indices and biomarkers amongst the intervention group. Specifically, average blood pressure declined while dietary potassium and urine potassium increased, and homocysteine, a known risk factor for cardiovascular disease, decreased with increased consumption of fruit and vegetables. A number of studies have shown that folic acid fortified flour can decreases in levels of homocysteine.

Hyperhomocysteinemia is associated with endothelial injuries, thromboses, inflammatory response, and oxidative stress, which can collectively lead to cardiovascular and cerebrovascular disease [34]. The intervention group sample demonstrated a greater than 3μmol/L reduction in homocysteine which roughly translates into an approximate 11% lower risk of cardiovascular diseases according to one published study [34]. The study result is consistent with other studies that used SOC-based interventions to change dietary intake and biomarkers.

Despite improvements in the average daily intake of vegetables amongst farmers in the intervention group, intake still remained only half of that recommended by the Chinese government even though these farmers plant and grow a large number and variety of vegetables. Despite this unfettered access to fresh produce, this study found most farmers are largely unaware of their health benefits. It is important that health information about the dietary benefit of vegetables (and health effects associated with excessive salt consumption) in reducing the risks of hypertension, heart disease, and other chronic illness be targeted to this population and tailored in a manner that is clear and understandable and thus have a greater probability of success in inducing actual health behavior change.

Findings of this research suggest that intervention with the SOC model effectively enhanced general health awareness and action. As such, the SOC model should be further utilized in health education programs which aim to change risk behaviors related to chronic diseases in China. China is currently facing tremendous challenges with overpopulation and limited public health resources, both of which are more acute problems among rural farmers who continue to comprise the majority of the country's population. It seems that an important part of any effective solution to address health issues in this population could be interventions like the SOC model to deliver health information in order to reduce their risk of chronic diseases. The data analysis just focuses on several nutrients relating to cardiovascular diseases. Since subjects voluntarily participated, selection bias may have affected the representation of the study group which may not be generalizable to other groups or individuals in China with respect to effectiveness of health messages, access to healthy foods, and the processes required to prompt behavioral change. However, based on the results of this study, it can likely be effective through application in other parts of China. Since China is home to more than one-fifth of the world's population, the impact on chronic disease reduction worldwide could be potentially enormous.

Many public health programs that focus on improving dietary habits related to chronic disease risk reduction are now being developed in Tianjin. The Tianjin Centers for Disease Control and Prevention presently mobilizing a mass media campaign to disseminate related health information and clearly should consider incorporation of SOC-based targeted interventions. Current plans call for utilizing a variety of medias to deliver the health messages such as public service advertisements on television and articles in main-stream newspapers. These health communications will need to be combined with educational activities in communities, schools and other settings so that persons in different stages of behavior change will receive information they need to adopt healthier behaviors. Public health's active promotion of greater health awareness and healthier behaviors will help reduce the growing risk for chronic diseases in China and may best be accomplished using a model that permits targeting of the message to individual stages of behavior.

IMPLICATIONS FOR RESEARCH

There were still some limitations in this study. Some in

the intervention may have received more or less instruction depending on the frequency of the doctors' visits, or their stage category. The positive outcomes of this study show the effect of SOC model to promote health behavior and can be spread to the more broad population in the future. In fact, there are more jobs we need to do in the future, for example, the relationship between other nutrients and chronic diseases, the prevention and decreasing of the incidence of chronic diseases by using SOC behavior change model in this overpopulation country.

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