

Jacobs Journal of Physiotherapy and Exercise

Research Article

Be Well: An Exercise and Nutrition Pilot Intervention Impacting Blood Measures

Alexis Coulourides Kogan, PhD¹, Jorge Gonzalez, BS², Bonnie Hart, RD³, Nancy Gibbs, MD⁴, Skip Halloran, MSG⁵, and Susan Enguidanos, PhD⁶

¹*Keck School of Medicine of USC, Department of Family Medicine and Geriatrics, Alhambra, CA;*

²*Partners in Care Foundation, San Fernando, CA;*

³*Food and Nutrition Management Services, Inc., North Hollywood, CA;*

⁴*Kaiser Permanente, Southern California Medical Group, Pasadena, CA;*

⁵*City of Inglewood, Inglewood, CA;*

⁶*University of Southern California, Davis School of Gerontology, Los Angeles, CA*

**Corresponding author: Dr. Alexis Coulourides Kogan, Keck School of Medicine of USC, Department of Family Medicine and Geriatrics, 1000 S. Fremont Ave., Unit 22, Bldg A-6, Ste. 6420, Alhambra, CA 91803, Phone: (626) 457-4204, Fax: (626) 457-4090,*

Email: acoulour@usc.edu

Received: 09-28-2015

Accepted: 10-12-2015

Published: 02-08-2016

Copyright: © 2016 Alexis

Abstract

Although older adults are at greater risk for poor health, obesity, and inactivity, few interventions target this group. Moreover, even fewer studies target ethnic minorities, who are at elevated risk for poor outcomes. This study aimed to test the effectiveness of an exercise and nutritional education intervention with peer support for diverse, chronically ill, community-dwelling older adults. This pilot study used a pre/post cohort study design with four-month follow-up. Sixty-two individuals aged 60 and older, with two or more chronic conditions, and who had been admitted to the hospital or emergency department within the previous six months were enrolled. Participants received 16 weeks of exercise and nutritional counseling (32, bi-weekly sessions), provided in a group environment, with homework that included eating and exercise assignments and encouraged connecting with classmates between class sessions. At the end of the 16-week course, significant reductions in weight ($p < .001$), body mass index ($p < .001$), waist circumference ($p = .046$), systolic ($p = .003$) and diastolic blood pressure ($p < .001$), and total cholesterol ($p = .042$) were observed. Results add to growing evidence suggesting that multidisciplinary models may be effective in improving physical and clinical health of chronically ill older adults. Additionally, our study suggests ethnically diverse older adults can be effectively engaged in exercise and nutritional programs.

Keywords: Exercise; Nutrition; Older adults; Chronic disease; Ethnically diverse

Introduction

An estimated 87% of Americans age 65 and over have one or more chronic condition [1] which contributes to greater risk for acute hospitalizations, physician visits, prescription medication use, and physical limitations [1]. Accordingly, these conditions stimulate an increase in healthcare costs, accounting for the majority of total U.S. spending on private and public healthcare [2]. Nevertheless, research has shown that lifestyle changes, such as changes in diet and exercise regime, may both prevent and alleviate many of these ailments [3].

Older adults are at greatest risk for multiple chronic conditions as well as for obesity. According to the CDC, more than one-third of adults over the age of 64 are obese. Moreover, these rates are higher for ethnic minorities. As compared with whites, African American females between the ages of 65 and 74 have a 27.8% higher rate of obesity and Latinas a 19.8% higher rate [4]. Among men, in the last decade there has been a statistically significant increase in the portion of obese older adults [4]. Given the growing prevalence of chronic conditions with age [5] and the rising proportion of diverse older adults in the U.S., identifying effective programs that facilitate lifestyle changes for older, ethnically diverse individuals with multiple chronic conditions is imperative. The health of aging Americans has a significant influence over the country's medical, social, and economic systems [6]. Thus, policy makers have taken an interest in programs and strategies that promote healthy aging and facilitate the reduction of chronic conditions; many of which have focused on prevention through social services and programs that endorse lifestyle changes among older adults to promote physical activity, healthy diet, and decreased obesity prevalence [7,8]. Reductions in visceral fat often precede beneficial changes in fasting glucose and convalescence in insulin resistance [9]. Weight loss by means of physical exercise and reductions in overconsumption of calorically-dense, nutritionally-poor, rapidly absorbable, processed phytochemical-depleted foods—that makes up much of the westernized diet—have been shown to reduce lipid variables, LDL-C, and total cholesterol; improve insulin sensitivity, and decrease early all-cause mortality in the 60 and over population [10]. Although research has demonstrated the effectiveness of lifestyle interventions for patients at risk for developing chronic conditions, many of the interventions are not based on multifaceted frameworks which incorporate a combination of exercise, nutritional counseling, and peer support [11,12]. Furthermore, subjects recruited for the majority of these studies tend to be relatively healthy, high functioning older adults without chronic conditions [13,14] and therefore, not at increased risk for hospitalization or health service use. Also, few programs have targeted an ethnically diverse group of chronically ill older adults. Finally, many of the studies lack evidence for the improvement in biomarkers specific to the development of chronic disease [15-17].

The purpose of this pilot study is to assess the impact of *Be Well*, a fitness and nutrition program that provides low impact exercise classes, nutritional counseling, and weight management assistance to seniors with multiple chronic conditions. We also aimed to determine if it was feasible to recruit and engage older, ethnically diverse, chronically ill primary care patients in an exercise and nutrition study. A previous study of the *Be Well* program [18] found significant improvements for regular exercise, daily walking distance, fitness test performance, and body measurements. In the current study we examine the impact of *Be Well* participation on biological markers that include multiple clinical blood measures, blood pressure, and body composition.

Methods

A pre/post design was used to evaluate the impact of the *Be Well* program. This study was approved by the Institutional Review Boards of the managed care organization (MCO) and the non-profit research organization.

Eligibility Criteria and Recruitment

Eligible subjects were identified by the MCO's electronic medical records as those individuals aged 60 years or older, diagnosed with two or more chronic conditions, and had at least one hospital or emergency department admission within the prior six months. Participants meeting these criteria were contacted via telephone by a research assistant and assessed for nutritional risk using the Nutrition Screening Initiative (NSI) [19]. Individuals with nutritional risk, defined as having a score of six or more out of 21 possible points, were eligible for the study and received an explanation of the study and an invitation to participate. Between the two study sites, 318 potential participants were contacted: 17% were unreachable and unable to be assessed for nutritional risk, 20% were ineligible, and 63% were eligible and invited to participate. Out of those eligible for the study, 31% enrolled (n=62). Reasons for eligible individuals to refuse participation included: a lack of interest (31%), being "too busy" (due to work or caregiving commitments, or frequent medical appointments such as dialysis) (23%), feeling "too sick" to engage in physical activity and group meetings (18%), belief that they "didn't need" an exercise and weight loss opportunity (13%), issues with transportation or feeling like the site was too far away (9%), and already attending/engaging in physical activity class or program (6%). Thus, 62 individuals signed a study consent form to participate and received a medical release from their primary care physician.

Be Well Intervention

Be Well was comprised of a partnership between a private nutritional counseling agency, a non-profit research organization, and a MCO serving two urban, culturally diverse areas

within diverse area within Los Angeles county. Participants attended two-hour *Be Well* classes held in a community setting, bi-weekly for 16 consecutive weeks, where they participated in one hour of low-impact physical activity conducted by certified exercise specialists, followed by one hour of nutrition education with registered dietitians. Exercise difficulty increased progressively from seated routines to standing routines and included low impact movements specifically designed for older adults, and included dancing, yoga, and Tai Chi with musical accompaniment. The nutrition education component began with a one-on-one, individualized consultation to address nutritional issues with respect to individual health conditions, family dynamics, and personal goals, where each participant was given an educational course manual. Subsequent nutrition education sessions were conducted with the group and topics included meal planning, reading food labels, recipe modification, and healthy eating for chronic disease management, among others. Participants were encouraged to engage in physical activity outside of the *Be Well* program and form partnerships with classmates. Participants did not receive monetary compensation or reimbursement, however, items such as water bottles, healthy snacks, pedometers, and MCO educational and promotional materials were provided to promote ongoing attendance. At the end of the 16-week session, participants were invited to attend a program graduation that included a healthy meal donated by a local community organization. Each graduating participant received a certificate.

Data Collection and Measures

Be Well Sessions Attended: The *Be Well* exercise and nutrition staff maintained attendance records for each sessions. Participants were categorized as completers if they completed at least half the sessions.

Clinical Examination Measures: Blood pressure and body measurements were collected by certified *Be Well* staff via in-person assessment at baseline, prior to the intervention, and then again at follow-up, four months after initiation of the program. Measurements included weight (pounds), height [inches (used to calculate BMI according to universal procedures)], waist circumference, and systolic and diastolic blood pressure. Measurements for weight, height, and waist circumference were later converted to international (SI) units for reporting purposes.

Clinical Blood Measures: In an attempt to integrate the program into standard care, clinical lab measures were collected by phlebotomists at the MCO's laboratory used by the subject's primary care physician to determine the influence of the intervention on participants' health status and biomarkers indicative of chronic conditions. Fasting laboratory blood measures included glycated hemoglobin (HbA1c), fasting blood glucose, triglycerides, total cholesterol, high density lipoprotein (HDL-C), and low-density lipoprotein (LDL-C).

Analysis

Descriptive and bivariate statistics were used to examine participant characteristics and baseline measurements for primary outcome variables. Given the lack of normality in the distributions of measures, a Wilcoxon paired test for nonparametric within group analysis was used to assess change in variables before and following the completion of *Be Well*. Because it is necessary to have two scores to compare for each subject, the number of subjects included in the analysis for each variable differed based on the availability of complete baseline and follow-up responses for each measure. Finally, Pearson's Correlation was utilized to assess whether number of sessions attended was related to change in health indicators from baseline to follow-up. SPSS statistical software package version 18.0 was used for all analyses.

Results

Demographics

From October 2006 to June 2008, 62 subjects participated in *Be Well*, the majority (63%) of whom were female (Table 1). Participants ranged in age from 60 to 90+ years, with a mean age of 73.5 years (SD=7.7). The sample included a greater proportion of African Americans (66.1%) than Caucasians (22.6%) and Latinos (11.3%). More than half of subjects (58%) had an annual income below \$39,000, however, 22.6% declined to report this information. Most did not have a college degree (68%), although 87.1% had graduated from high school. Most *Be Well* participants were single (39%), married (26%), or widowed (23%) with only 10% divorced. Our sample was considered overweight, 88.3% had a BMI > 30, and few exercised, with 40.3% reporting they did not engage in any exercise at all. An additional 17.7% reported engaging in exercise of two hours or less per week. Notably, nearly a quarter (22.6%) of our sample had four to six chronic conditions.

Completers vs Non-completers

Over the course of the 16-week program, 70% of participants completed half the sessions, the minimum number of sessions targeted. We examined participant demographics by those who completed the minimum number of sessions (at least half the course or 16 sessions) and those who completed fewer. Among these groups, there was a slight trend for more females to complete as compared with males ($p=.096$), however, this was not a statistically significant difference. There were no other differences found between those who completed successfully and those who did not. See Table 1.

Clinical Outcome Measures

We did not receive outcome lab results for all completers, largely because we relied on participants to return to their physician's office to complete some of these tests. Among par-

participants, follow-up measure completion rates ranged from 52% to 74% of participants. We report these outcomes here.

Table 1. Sample Demographic Characteristics (n=62).

	Frequency (%)		Total Sample	p-value
	Completers n=43 Completed \geq 50% of sessions	Unsatisfactory Completers n=19 Completed \leq 50% of sessions		
<i>Age^a</i>	74.4 \pm 7.6	71.2 \pm 7.6	73.5 \pm 7.7	0.128
<i>Gender^b</i>				0.082
Female	30 (69.8)	9 (47.4)	39 (63.0)	
<i>Ethnic Background^b</i>				0.387
African-American	29 (67.4)	12 (63.2)	41 (66.1)	
Latino	6 (14.0)	1 (5.3)	7 (11.3)	
Caucasian	8 (18.6)	6 (31.6)	14 (22.6)	
<i>Highest Education^b</i>				0.143
Less than high school	3 (5.3)	1 (5.3)	4 (6.5)	
High school graduate	13 (30.2)	5 (26.3)	18 (29.0)	
Some college	17 (39.5)	3 (15.8)	20 (32.3)	
College graduate	5 (11.6)	6 (31.6)	11 (17.7)	
Post graduate school	3 (7.0)	1 (5.3)	4 (6.5)	
Doctorate	1 (2.3)	0 (0.0)	1 (1.6)	
Did Not Specify	1 (2.3)	3 (15.8)	4 (6.5)	
<i>Marital Status^b</i>				0.775
Married	10 (23.3)	6 (31.6)	16 (25.8)	
Single	18 (41.9)	6 (31.6)	24 (38.7)	
Widowed	9 (20.9)	5 (26.3)	14 (22.6)	
Divorced	5 (11.6)	1 (5.3)	6 (9.7)	
Did Not Specify	1 (2.3)	1 (5.3)	2 (3.2)	
<i>Annual Income^b</i>				0.659
Under \$10,000	6 (14.0)	3 (15.8)	9 (14.5)	
\$10,000 - \$19,000	6 (14.0)	0 (0.0)	6 (9.7)	
\$20,000 - \$29,999	10 (23.3)	4 (21.1)	14 (22.6)	
\$30,000 - \$39,999	4 (9.3)	3 (15.8)	7 (11.3)	
\$40,000 - \$49,999	4 (9.3)	3 (15.8)	7 (11.3)	
\$50,000 or more	4 (9.3)	1 (5.3)	5 (8.1)	
Did Not Specify	9 (20.9)	5 (26.3)	14 (22.6)	
<i>Living Arrangement^b</i>				0.208
Own home/apartment	34 (79.0)	18 (94.7)	52 (83.8)	
Family member's house	2 (4.7)	1 (5.3)	3 (4.8)	

Senior living	3 (7.0)	0 (0.0)	3 (4.8)	
Did Not Specify	4 (9.3)	0 (0.0)	4 (6.5)	
<i>Chronic Conditions^b</i>				
0-3	30 (69.8)	16 (84.2)	46 (74.2)	0.127
4-6	12 (27.9)	2 (10.5)	14 (22.6)	
missing	1 (2.3)	1 (5.3)	2 (3.2)	
<i>Depression (PHQ-9 >9)</i>	6 (14)	5 (26.3)	11 (17.7)	0.288
<i>Attendance^a (sessions)</i>	27.3 ± 4.8	9.1 ± 4.3	21.7 ± 9.6	<.001***

* $p < .05$; ** $p < .01$; *** $p < .001$

^aChi-square test

^bT-test

Table 2. Paired Sample Mean Changes from Baseline to Follow-up.

	<i>Baseline</i>	<i>Follow-up</i>		
	<i>Mean (SD)</i>		<i>Z-value</i>	<i>P-value</i>
Weight (kg)	(n=37)			
	88.5 (23.2)	84.0 (20.3)	-3.89	<.001***
BMI (kg/m ²)	(n=38)			
	31.9 (7.0)	30.8 (6.0)	-3.88	<.001***
Waist circumference (cm)	(n=40)			
	104.4 (18.0)	100.6 (15.0)	-1.99	0.046*
Systolic blood pressure	(n=32)			
	145.1 (17.9)	130.7 (18.5)	-2.92	0.003**
Diastolic blood pressure	(n=32)			
	76.4 (10.5)	69.7 (10.3)	-3.48	<.001***
Glucose	(n=43)			
	117.6 (44.4)	107.5 (24.9)	-1.09	0.276
HbA1c	(n=31)			
	6.6 (1.4)	6.3 (0.7)	-0.14	0.891
Triglycerides	(n=35)			
	126.8 (74.5)	119.9 (58.3)	-0.48	0.631

HDL-C	(n=38)			
		53.9 (14.0)	55.6 (16.2)	-0.67
LDL-C	(n=38)			
		104.4 (34.2)	102.0 (33.0)	-1.86
Total Cholesterol	(n=38)			
		181.9 (38.9)	182.2 (38.7)	-2.03

* $p < .05$, ** $p < .01$, *** $p < .001$

Clinical Examination Measures

All clinical examination measures including weight, BMI, waist circumference, systolic blood pressure, and diastolic blood pressure significantly decreased following the *Be Well* intervention (see Table 2). At enrollment, 88.3% of *Be Well* participants met the BMI classification for being obese, as set by the World Health Organization for classifying adult BMI [20]; however, at follow-up, mean participant BMI was reduced by 1.1 kg/m² ($z = -3.9$, $p < .001$) and weight decreased by 4.4 kg ($z = -3.9$, $p < .001$). Additionally, waist circumference was reduced by 3.8 centimeters following the intervention ($z = -1.99$, $p = .046$). Both systolic and diastolic blood pressure experienced significant decreases following *Be Well*, decreasing by 14.4 mmHg ($z = -2.92$, $p = .003$) and 6.7 mmHg ($z = -3.48$, $p < .001$), respectively.

Clinical Blood Measures

Results of analysis of change in blood measures were mixed. Total cholesterol was reduced on average by 9.2 mg/dL ($z = -2.03$, $p = .042$), whereas reductions in glucose, HbA1c, triglycerides, and HDL-C were not significant. However, LDL-C showed a strong trend toward reductions following the four-month intervention. See Table 2.

Course Attendance

Over half of the subjects (52%) participated in at least 26 out of 32 sessions ($n = 21.7$, $SD = 9.6$). The number of classes attended was not associated with the degree of change over the 16 week intervention for any measure. Correlations between attendance and the change score between pretest and posttest measures for all of the outcome variables was found not to be statistically significant.

Discussion

We found that we were able to successfully recruit ethnically diverse older adults to participate in the *Be Well* program. However, we found that most of our eligible participants de-

clined to participate due to serious health conditions, lack of time, or lack of interest. Despite this, among those agreeing to participate, we found 70% completed at least half the sessions. This finding demonstrates the difficulty in recruiting patients with multiple chronic conditions, however, it also demonstrates that once engaged, many of these patients successfully complete the program.

Participation in *Be Well's* nutrition and exercise intervention was associated with significant improvements in several clinical and blood measures for a culturally diverse group of chronically ill older adults. Reductions in systolic and diastolic blood pressure are especially noteworthy because they highlight a lower risk for both fatal and non-fatal cardiovascular events (i.e. myocardial infarction, cardiomyopathy, angina, etc.) in all age groups, including older adults, which has been well-documented in the literature on exercise interventions and antihypertensive drug therapy trials [21,22]. Our finding is also supported by previous studies demonstrating the effectiveness of exercise in significantly reducing blood pressure for overweight and obese individuals who are hypertensive or have elevated blood pressure [23,24]. For example, a recent small randomized controlled trial of a faith-based physical activity intervention among older sedentary African American women [25] also found reductions in systolic and diastolic blood pressure; however, there were no significant changes in participants' weight. *Be Well's* concurrent association of reduced blood pressure with lowered BMI, weight, and waist circumference [18] provide preliminary evidence for the effectiveness of multifaceted interventions that include a nutrition education component along with group-based physical activity and peer support to maximize healthy reductions in clinical health indicators among participants. Additionally, while weight loss findings like those in *Be Well* have also been observed in other studies, [26] *Be Well* successfully utilized a less rigorous nutrition component based on education, as opposed to others that have utilized more intensive methods such as calorie restriction and food journals [26]. This approach to nutrition may be more feasible and desirable for ethnically diverse participants

to follow on a daily basis. Nevertheless, more research is needed in this area.

Our findings are also consistent with previous research demonstrating that lifestyle interventions which include changes in diet and physical activity are important factors in reducing total cholesterol [27,28]. Although the changes in clinical blood measures such as glucose, HbA1c, triglycerides, HDL-C, and LDL-C were not large enough to reach statistical significance, the small sample may have precluded the ability to see significant changes in these measurements, or the four-month follow-up period may have been too soon to detect change. Further research is needed in this area as other studies have primarily focused on these blood measures individually and often among special populations such as diabetics [29].

Limitations

This study is limited by the study design (pre/post comparison lacking a control group), the limited follow-up clinical data, and the size of the sample used in analysis, which is a risky design that is susceptible to bias and possibly masked significant changes in clinical and behavioral measures resulting from the intervention. Due to the small sample size, lack of a control comparison, and the specific and diverse group targeted, these results may not be generalizable to other older adult populations and may be biased. Additionally, it is possible that chance findings were observed due to the high number of tests among a small sample of participants. Our pilot study relied on patients returning to their primary care office for follow-up laboratory results; this approach limited the available data for our final analyses.

Nevertheless, by examining a unique and often overlooked group of subjects, *Be Well* provides evidence of feasibility to engage an older, ethnically diverse population with multiple chronic conditions and nutritional risk into a community-based exercise and nutrition program. Finally, about 30% of those enrolled did not complete at least half of the sessions and limited alternative methods of statistical analysis. However, our comparisons between completers and non-completers did not reveal significant differences between the groups.

The *Be Well* intervention was a symbiotic partnership with a MCO, non-profit research organization, a city aging service, and private nutritional counseling agency that enabled the MCO to identify vulnerable older adults who could potentially benefit from the multifaceted intervention. Our findings of improved clinical measures are consistent with previously reported *Be Well* outcomes that include lowered nutritional risk and improved exercise [18]. Results of this study add to a growing body of evidence suggesting that multidisciplinary models, such as those combining physical activity and nutritional components, may be effective in improving the physical and clinical health of older adults with multiple chronic

conditions [18,30]. However, this study is especially important because it carries additional significance by highlighting an innovative strategy to address the needs of ethnically diverse populations and promote exercise despite chronic illness and advancing age; something that researchers and clinicians support and have been calling for [31,33].

References

1. Partnership for Solutions. Chronic conditions: Making the case for ongoing care. September 2004 update. Johns Hopkins University, Baltimore, MD.
2. Centers for Medicare and Medicaid Services (CMS). Historical overview of national health expenditures, 2012.
3. Yassine HN, Marchetti CM, Krishnan RK, Vrobel TR, Gonzalez F et al. Effects of exercise and calorie restriction on insulin resistance and cardiometabolic risk factors in older obese adults: A randomized clinical trial. *J Gerontol Series A Biol Sci Med Sci.* 2009, 64A(1): 90-95.
4. Fakhouri THI, Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of obesity among older adults in the United States, 2007-2010. Centers of Disease Control and Prevention, National Center for Health Statistics: Washington D.C. 2012, Report number 106.
5. Vogeli C, Shields AE, Lee TA et al. Multiple chronic conditions: Prevalence, health consequences, and implications for quality, care management, and costs. *J Gen Intern Med.* 2007, 22(Suppl 3): 391-395.
6. Yang Z, Hall AG. The financial burden of overweight and obesity among elderly americans: The dynamics of weight, longevity, and health care costs. *Health Serv Res.* 2008, 43(3): 849-868.
7. Wahlqvist ML, Saviage GS. Interventions aimed at dietary and lifestyle changes to promote healthy aging. *Eur J Clin Nutr.* 2000, 54(Suppl 3): S148-56.
8. Gaziano TA, Galea G, Reddy KS. Scaling up interventions for chronic disease prevention: The evidence. *The Lancet.* 2007, 370(9603): 1939-1946.
9. Grundy SM, Brewer HB, Cleeman JJ, Smith SC, Lenfant C. NHLBI/AHA Conference Proceedings. Definition of Metabolic Syndrome. *Circulation.* 2004, 109(3): 433-438.
10. Lerman RH, Minich DM, Darland G et al. Enhancement of a modified Mediterranean-style, low glycemic load diet with specific phytochemicals improves cardiometabolic risk-factors in subjects with metabolic syndrome and hypercholesterolemia in a randomized trial. *Nurt Metab (Lond).* 2008, 5: 29.

11. Davidson LE, Hudson R, Kilpatrick K et al. Effects of exercise modality on insulin resistance and functional limitation in older adults: A randomized controlled trial. *Arch Intern Med*. 2009, 169(2): 122-131.
12. Robare JF, Carole Milas N, Bayles CM et al. The key to life nutrition program: Results from a community-based dietary sodium reduction trial. *Public Health Nutr*. 2010, 13(5): 606-614.
13. Wieckowski J, Simmons J. Translating evidence-based physical activity interventions for frail elders. *Home Health Care Serv Q*. 2006, 25(1-2): 75-94.
14. Clark PG, Blissmer BJ, Greene GW, Lees FD, Riebe DA et al. Maintaining exercise and healthful eating in older adults: The SENIOR project II: Study design and methodology. *Contemporary Clinical Trials*. 2011, 32(1): 129-139.
15. Miller GD. Improved nutrient intake in older obese adults undergoing a structured diet and exercise intentional weight loss program. *J Nutr Health Aging*. 2010, 14(6): 461-466.
16. Chalé-Rush A, Guralnik JM, Walkup MP et al. Relationship between physical functioning and physical activity in the life-style interventions and independence for elders pilot. *J Am Geriatr Soc*. 2010, 58(10):1918-1924.
17. Cao ZB, Shima N, Maeda A, Kurata H, Nishizono H. Effects of exercise and nutritional intervention to improve physical factors associated with fracture risk in middle-aged and older women. *Int J Sport Health Sci*. 2007, 5: 147-156.
18. Coulourides Kogan A, Gonzalez J, Hart B, Halloran S, Thomason B Canon. Be-Well: Results of a Nutrition, Exercise, and Weight Management Intervention among At-Risk Older Adults. *Journal of Applied Gerontology*. 2013, 32(7): 889-901.
19. Dwyer JT. Screening older American's nutritional health: Current practices and Future possibilities.1991. Washington, DC: Nutrition Screening Initiative.
20. Centers for Disease Control and Prevention. Overweight and obesity: Defining overweight and obesity.
21. Tsigos C, Bitzur R, Kleinman Y et al. Targets for body fat, blood pressure, lipids, and glucose-lowering interventions in healthy older people. *Diabetes Care*. 2013, 36(Suppl 2): S292-300.
22. Venturelli M, Cè E, Limonta E et al. Effects of endurance, circuit, and relaxing training on cardiovascular risk factors in hypertensive elderly patients. *Age (Dordr)*. 2015, 37(5): 101.
23. Langford HG, Blaufox MD, Oberman A et al. Dietary therapy slows the return of hypertension after stopping prolonged medication. *JAMA*. 1985, 253(5): 657-64.
24. Stamler R, Stamler J, Grimm R et al. Nutrition therapy for high blood pressure: Final report of a four-year randomized controlled trial-the hypertension control program. *JAMA*. 1987, 257(11): 1484-91.
25. Duru OK, Sarkisian CA, Leng M, Mangione CM. Sisters in motion: A randomized controlled trial of a faith-based physical activity intervention. *JAGS*. 2010, 58(10): 1863-1869.
26. Anton SD, Manini TM, Milsom VA et al. Effects of a weight loss plus exercise program on physical function in overweight, older women: A randomized controlled trial. *Clinical Interventions in Aging*. 2011, 6: 141-149.
27. Dekkers JC, van Wier MF, Ariens GAM et al. Comparative effectiveness of lifestyle interventions on cardiovascular risk factors among a dutch overweight working population: A randomized controlled trial. *BMC Pub Health*. 2011, 11(1): 49.
28. Ketola E, Sipila FR, Makela M. Effectiveness of individual life-style interventions in reducing cardiovascular disease and risk factors. *Ann Med*. 2000, 32(4): 239-251.
29. Walker EA, Stevens KA, Persaud S. Promoting diabetes self-management among African Americans: An educational intervention. *J Health Care Poor and Underserved*. 2010, 21(3 Suppl): 169-186.
30. Jarosz PA, Bellar A. Sarcopenic obesity: An emerging cause of frailty in older adults. *Geriatric Nursing*. 2009, 30(1): 64-70.
31. Centers for Disease Control and Prevention. A report of the surgeon general: Physical activity and health: Older adults. U S Department of Health and Human Services. 1999: 1-2.
32. Colberg SR, Albright AL, Blissmer BJ et al. Exercise and type 2 diabetes: American College of Sports Medicine and the American Diabetes Association: Joint position statement. Exercise and type 2 diabetes. *Diabetes Care*. 2010, 42(12): 2282-303.
33. Matthews AE, Laditka SB, Laditka JN et al. Older adults' perceived physical activity enablers and barriers: A multicultural perspective. *J Aging Phys Act*. 2010, 18(2): 119-40.