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Effectiveness of Ten Weeks Community-Based Multicomponent Exercise Program on Physiological Health of Elderly Women

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ABSTRACT

Background: The advancement of technology and medical science has prolonged the longevity of humans, compelling each individual to deal with old age. New health issues are cropping up, especially since lifestyle has become sedentary. Regular physical exercises are the only option for healthy aging. **Purpose:** The study observed the effect of 10 weeks planned community-based multicomponent exercise program (CBMCEP) on selected physiological variables of elderly women in the Indian sub-urban area. **Methodology:** A quasi-experimental investigation was carried out in 2019 with 30 sedentary women volunteer of 55-65 years from the middle socio-economic class who were purposively assigned into experimental group (n=15) and control group (n=15). The experimental group was given 10 weeks- 4 days/week of CBMCEP in a progressive manner that included brisk walking, resistance exercise, balance, flexibility exercise and recreational activities of 80-90 minutes duration. The control group was not exposed to such a program. Pre and post-test were conducted on physiological variables like Resting Heart Rate (RHR), Resting blood pressure (Systolic- SDP; Diastolic- DBP), Postprandial Blood Sugar level (BSpp), and Haemoglobin concentration (Hb) by the registered medical practitioner. The obtained data were statistically analyzed by independent t-test for baseline differences between the groups and paired sample t-test to obtain the CBMCEP effect on dependent variables. **Result:** Statistical analysis revealed 10 weeks of CBMCEP can significantly reduce the RHR (p=0.003), SBP (p=0.039), DBP (p=0.052), BSpp level (p=0.015), and Hb concentration (p=0.009). **Conclusion:** The CBMCEP can promote significant improvement in the physiological health of elderly women. Further, it was noted that fitness experts may implement such cost-effective CBMCEP to ensure the healthy aging of a nation.

Key words: Aging, Exercise Program, Women, Sedentary, Health

INTRODUCTION

Death might be inevitable but good health and vitality need to be maintained. With advancing age and a sedentary lifestyle, the aged are more prone to diseases (Vijg & Le Bourg, 2017). There are significant differences in the life span of men and women. In developed countries, the lifespan of women, on average, is six to eight years longer than men's(Crimmins, 2015). Longer lives may not necessarily ensure healthier living. During the menopausal and post-menopausal periods, women suffer from hormonal imbalance, especially the deficiency of estrogen, which results in osteoporosis, heart disease, diabetes, hypertension, incontinence, dementia and arthritis as compared to men (Dalal & Agarwal, 2015). Apart from the physiological deterioration, the pace of aging is influenced by factors like lifestyle, socioeconomic condition, food habits and place of living.It is well evident that exercise is beneficial for older adults. Research has revealed that participation in physical activity on a regular basis can delay the biological aging process and can lead to a reduction in mortality rate, chances of obesity, hypertension, heart disease, respiratory problem, colon cancer, and can improve mental wellness (Booth et al., 2012; Warburton, 2006). The particular benefits include improvement in aerobic power and cardiovascular fitness (McPhee et al., 2016), improvement in physical performance (Bandyopadhyay, 2020), and decline in resting systolic and diastolic blood pressure(Oliveira Gonçalves et al., 2019). Although physical activity provides many benefits to the elderly population, the previous study pointed out that across the globe, the rate of participation in physical activity of the elderly population is declining. Physical inactivity was reported by 29.9% of adults aged 65-74 years in the United States, 50% of adults aged 65-74 years in the United Kingdom, and 62% of individuals aged 65 and over in Canada(Patel et al., 2020). Another study conducted on an Indian population investigated the pattern of physical activity and revealed that 57% of the population mean age of 41.4±13.4 years, are either inactive or do not participate in the physical activity regimen recommended by

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WHO (Podder et al., 2020). Several studies were conducted to find out the benefits of exercise on different age groups but very limited studies were done on the elderly sedentary women population of India while they are in maximum need of community-based program. It has been observed that in a community, few women participate in only morning or evening walk either to maintain an active lifestyle or to follow doctor's advice. Though it is evident that walking is beneficial, the pace is also important. The sedentary elderly women, specially community dwellers of rural or suburban areas, do not have much awareness regarding the exercise regimen recommended by organizations WHO, ACSM. So an initiative to make elderly women aware of proper exercise protocol, which can keep them healthy and active, should be taken from micro level- from the community. Keeping in mind this concept, community-based exercise program was adopted for the present research. In a survey, the barriers for participation in physical activity, as reported by elderly women, were household chores, lack of time, motivation and interest, social and cultural norms and the researcher opined, based on this survey, that interventions for physical activity promotion in the community would work best (Mathews et al., 2016). The community-based exercise programs not only provide the elderly women an opportunity to stay active and healthy but also help them to remain engaged, productive and socially interactive (Fien et al., 2022). Even for the elderly urban population, community-based programs are space effective and can be conducted in a small community hall or in a gymnasium. Researchers are increasingly emphasizing multicomponent exercise programs to provide various physical benefits to the elderly. Multicomponent exercise protocol is designed in a way to combine exercises for all bio-motor abilities like endurance, strength, balance, flexibility and coordination which may provide benefits to geriatric health, fitness and wellness (Leitão et al., 2021). A10 weeks of CBMCEP was adopted with the purpose to observe its impact on the physiological potential of sedentary elderly women. The community-based multicomponent exercise protocol is a very novel concept specially for elderly sedentary women community dwellers. The CBMCEP for present study was planned in such a way that it included all well-known and simple exercises for cardiovascular endurance, strength, flexibility, balance and coordination which can be executed even in sub urban or rural set up.

METHODS

Study Design

A quasi-experimental investigation was carried out in a semi-urban place called Burdwan in West Bengal, situated in the eastern part of India, from October to December 2019. The study was conducted in three steps: (i) Pre-test; (ii) Implementing the specific training program; and (iii) Post-test. To ensure the subjects' participation in CBMCEP, participants were thoroughly checked by the registered medical practitioner. Before conducting the pre-test, subjects were informed in writing about the intervention protocol, pre-test and post-test procedures, and pros and cons of the entire intervention. Participants' duly signed consent was obtained in a written form. All participants of the present study underwent a pre-test and post-test on selected physiological parameters by a registered medical practitioner. A pre-test was conducted three days prior to the commencement of experimental intervention. The measurements of RHR, SBP and DBP were taken on the first day around 7 a.m., and the blood samples were taken on the same day for testing BSpp and Hb two hours after lunch. After completion of 10 weeks of CBMCEP, the post test was conducted after three days following the same procedure in an almost identical environment. The ten weeks of CBMCEP was imposed on the experimental group and the subjects of the control group followed their normal daily work. During the intervention period, all subjects were advised to maintain their usual lifestyle, including food and daily activities. The detail of study design is depicted in Figure 1. The research was approved and supervised by the Departmental Research Committee, Physical Education, University of Kalyani, India (Ref No.-Ph.D./Reg./Phy.Edn./NBN/05; Reg. no.-KU/PG-00300 of 2014-2015, dated 1st October, 2019).

Participants and Sample Size Determination

Before implementing the exercise intervention to determine its effect on a targeted population, it was necessary to calculate the sample size. The present study used priori power analysis with the help of G*Power 3.1.9.7 software (Gasibat et al., 2022; Sankar Ghosh et al., 2022) for paired sample t-test. To estimate the minimum sample size for this research,

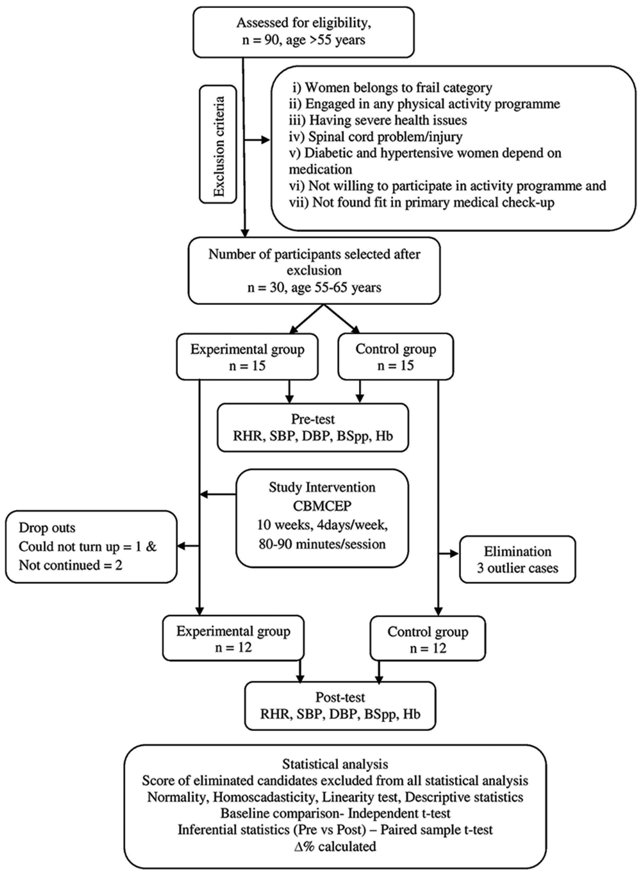

Figure 1. Flow Chart of the Study Design

the effect size was 0.80, $\alpha = 0.05$, power = 0.8 (Faul et al., 2009), which determined the sample size for one group to be 12, df = 11, critical t value = 1.7958. The present study included the control group, so the number of subjects should be 12*2=24. Assuming a 15% to 20% attrition rate, a total of 30 subjects were included in the present study. To get the targeted participants, 90 elderly sedentary women were surveyed in Burdwan, West Bengal, India with the intention of getting basic information. Among those 90 sedentary women, 60 women were excluded on the basis of adopted exclusion criteria and only 30 elderly women volunteers aged 55–65 years were qualified for present research and included as participants. The particular exclusion criteria were adopted for the successful implementation of the particular intervention protocol and to fulfill the objectives of the present study. The exclusion criteria were: i) women belongs to frail category, ii) engaged in any physical activity program, iii) having severe health issues; iv) spinal cord problems/injury; v) diabetic and hypertensive women depending on medication, vi) not willing to participate in an activity program, vii) not found fit in a primary medical check-up. Further, among those 30 elderly women volunteers, the most befitting 15 women (on the basis of interviews found more convenient, able to make their time for participation in a particular place and time for 10 weeks) were assigned to the experimental group and the other 15 women were assigned to the control group.

Assessment Protocol

In the present research based on the feasibility and relevance, the selected physiological variables (RHR, SBP, DBP, BSpp, Hb concentration) were considered as dependent variables and the experimental intervention, i.e., 10 weeks of CBMCEP was considered as independent variable.

The Resting Heart Rate was measured in beats per minute by using the palpatory method at the radial artery in the wrist with the help of a stopwatch after 20–30 minutes of bed rest in the morning. The RHR was measured twice and an average of two readings was recorded(Palatini et al., 2016).

Systolic Blood Pressure and Diastolic Blood Pressure were measured in mmHg by using the Korotkoff method with the help of a sphygmomanometer and stethoscope, where subjects were allowed to sit in a quiet, calm environment with their bare arms placed on a standard table so that the midpoint of the upper arm remains at the chest level, parallel to the heart. The measurement was repeated after 30 seconds and the average of two readings was considered (Perloff et al., 1993).

Blood Sugar (postprandial) was measured in mg/dL by using a Glucometer (one touch basic plus – life scan, Inc 2000, Jonson & Jonson Company; USA) and the blood sample was collected after 2 hrs of their lunch (individual).

Haemoglobin concentration was measured in g/dL by using Sahil's haemoglobinometer and at the time of sample collection, the tip of the finger of each subject was cleaned with spirit and picked by a sharp needle and blood was sucked by the hemoglobinometer pipette up to 20 cubic mm.

Frailty status was checked by the self-reported response on RAND-36 health survey questionnaire (Hays et al., 1993; Linkoko et al., 2019)for obtaining the basic information on participants' general health which comprised of 36 questions under eight scales. Among eight scalesthe physical functioning (item no. 3 to 12), role limitations due to physical health (item no. 13 to 16), energy/fatigue (item no. 23, 27, 29, 31), pain (item no. 21, 22) and general health (item no. 1 and 33 to 36) were considered in the present study.On the basis of their responses and the scoring direction (0-100) the participants were categorized into frail, pre-frail and non-frail. The subjects' occupational and other personal information was collected through handmade questionnaire.

Exercise Intervention

The 10 weeks of CBMCEP imposed on the experimental group was progressive in nature, and followed the WHO guidelines(Taylor, 2014). To make the exercise program multicomponent, it was framed in combination with aerobic exercises, resistance exercises and particular exercises for developing flexibility, coordination and balance (Tarazona-Santabalbina et al., 2016). The CBMCEP was purely planned on the basis of the participants' individual capacity and load intensity was monitored by Borg's perceived exertion scale, CR10 (Williams, 2017). The intervention consisted of 4 sessions/week of approximately 80–90 min, which included a rest period in between the exercises and repetitions/sets. The total intervention period was split into three phases: the first two weeks i.e. Phase-I (P1) for understanding and becoming familiar with the exercise intervention, middle four weeks i.e. Phase-II (P2) with light to moderate intensity of load (slight to moderate, 2-3, CR10 scale) and the last four weeks i.e. in Phase-III (P3), the optimum load was implemented (somewhat severe to severe, 4-6, CR10 scale). The particular planned intervention was structured as (i) Warming-up:10 min warming-up with spot jogging, stretching and simple bending exercises, (ii) Aerobic/cardio-respiratory exercise: 20-30 min of brisk walking, initially in P1 and P2 with slight to moderate intensity (2-3, Borg scale CR 10) and in P3 with gradually to optimum intensity (4-6, Borg scale,CR 10) (iii) Resistance exercise: 8-10 min of resistance exercises included wall push up, half squat, calf raise, half sit up, jumping jacks (10rep/set of 1 set in P1, 7rep/set of 2 sets in P2 and 10rep/set of 2 sets in P3), and lying hip bridges, abdominal exercise (6-15 sec hold of 1 set as per individual capacity in P1, P2 and 2 sets in P3), (iv) Balance exercise: 5 min of balance exercises with back leg raise, tree pose, t scale, (v) Coordination exercise: recreational activities of 8-10 min like badminton, throw ball, flying dish and minor games, (vi) Cooling down:5-10 min.A permissible and necessary rest period was allotted to the participants between the sets of each exercise and in between two exercises.The intensity of aerobic and resistance exercise for each participant was determined by the Borg scale CR 10, which is comprised of 12 stages and designated by numbers i.e. 0, 0.5, 1, 2, 3, and up to 10, and ten descriptors (i.e. 0-no exertion at all; 0.5-very, very slight-just noticeable; 1-very slight, 2-slight, 3-moderate, 4-somewhat severe, 5-severe, 7-very severe, 9- very, very severe- almost maximal, and 10- maximal) which indicates the intensity of exercise monitored by the participant herself as per their feelings and capacity. In aerobic exercise, the pace and in resistance exercise, the repetition and holding time were increased gradually every week as per Borg scale intensity level, i.e., in the first 6 weeks (P1+P2) ranged between 2-3, slight to moderate and the next 4 weeks (P3) ranged between 4-6, somewhat severe to severe (Williams, 2017).

Statistical Analysis

The data from the experimental group and control group were collected twice-before and after the treatment protocol to find out the impact of CBMCEP. These were analyzed by IBM SPSS 23 version software. The linearity, normality and homoscedasticity of the data were checked by the linearity test, the Kolmogorov-Smirnov test and the homoscedasticity test, respectively. Descriptive statistics, such as mean and SD, were calculated from scores obtained during the pre and post-test to describe both the groups. The results of the normality test revealed that the data were almost normal, so the independent t-test was used to observe the differences between the groups at baseline and to compare the pre-test and post-test means of two groups separately, the paired sample t-test was employed. The level of significance was set at $p< 0.05$. Δ% was calculated to determine the extent of changes that occurred due to exercise interventions.

RESULTS

Participants' Characteristics, Adherence and Attrition

From initial sample size n=30, 6 subjects were lost, 3 from experimental group, and 3 from control group for appearing in the post-test. Though during the intervention period constant encouragement and personal care was taken to avoid drop outs but still one could not turn up for participation and two subjects left on 5th and 6th week for family reasons in experimental group and in control group, 3 extreme cases (one found anemic, one was detected

Table 1. General Characteristics of Experimental and Control groups

Group	Age (years) Mean±SD	Height (cm) Mean±SD	Weight (kg) Mean±SD	BMI (kg/m²)	Frailty status
experimental	59.08±2.15	153.08±3.40	62.83±6.06	26.76±1.78	Non-frail
control	58.67±2.50	152.25±3.47	63.25±5.10	27.26±1.68	Non-frail

SD = Standard deviation, cm = centimeter, kg/m² = kilogram/meter², BMI = Body Mass Index

Table 2. Baseline Differences, Pre and Post-testing Group Comparisons

Variables (unit)	Period	Experimental group Mean±SD	Control group Mean±SD	Baseline differences, (df=22)
RHR (bpm)	Pre-test	81.42±3.90	81.58±2.75	t (-0.12), P=0.91
	Post-test	79.75±2.73	81.50±1.88	-
	Paired sample t-test	t (3.708*), p=0.003	t (0.266), P=0.795	-
	Δ%	-2.05	-	-
SBP (mmHg)	Pre-test	130.33±10.95	131.33±11.76	t (-0.22), P=0.83
	Post-test	127.33±7.48	132.17±9.37	-
	Paired sample t-test	t (2.345*), P=0.039	t (-0.950), P=0.363	-
	Δ%	-2.30	-	-
DBP (mmHg)	Pre-test	83.58±6.08	82.67±6.17	t (0.37), P=0.72
	Post-test	80.92±2.71	83.17±5.84	-
	Paired sample t-test	t (2.174*), P=0.052	t (-0.761), P=0.463	-
	Δ%	-3.19	-	-
BSpp (mg/dL)	Pre-test	126.50±19.74	134.42±14.78	t (-1.112), P=0.28
	Post-test	118.67±10.80	137.83±17.69	-
	Paired sample t-test	t (2.884*), P=0.015	t (-1.434), P=0.179	-
	Δ%	-6.19	-	-
Hb (g/dL)	Pre-test	10.11±0.71	10.05±0.63	t (0.24), P=0.81
	Post-test	9.91±0.65	10.03±0.62	-
	Paired sample t-test	t (3.191*), P=0.009	t (1.598), P=0.138	-
	Δ%	-1.98	-	-

RHR=Resting Heart Rate, SBP=Systolic Blood Pressure, DBP=Diastolic Blood Pressure, BSpp=Blood Sugar (postprandial), Hb=Haemoglobin concentration, SD=Standard deviation, df=Degree of freedom, * = Significant at 0.05 level, Δ% = percentage of extent of changes, bpm=beats per minute, mmHg=millimeters of mercury, mg/dL=milligrams per deciliter, g/dL=grams per deciliter with diabetes and one developed cardiac ailment) were eliminated from post-test. So finally 12 from each group (experimental group *n*= 12,control group *n*= 12) were tested after intervention period of 10 weeks and eliminated participants' (3 from experimental group and 3 from control group) pre-test scores were excluded for baseline comparison as well as for pre-test and post-test comparison. The 12 participants from experimental group had a minimum of 85% attendance. No adverse event occurred during the intervention period. The general characteristics of experimental and control groups are presented in Table 1.

Table 1 reveals that the mean age and BMI of the participants of experimental group were 59.08 ± 2.15 and 26.76 ± 1.78 and of control group were 58.67 ± 2.50 and 27.26 ± 1.68 respectively. The participants of both groups were of non-frail category.

The statistical procedures employed for the baseline differences (independent t-test) and to compare the mean of pre-test and post-test (paired sample t-test), their interpretations and Δ% are depicted in Table 2.

It is evident from the table 2 that the mean RHR of experimental group during pre-test and post-test was 81.42 ± 3.90 and 79.75 ± 2.73 while 81.58 ± 2.75 and 81.50 ± 1.88 in control group respectively. The mean SBP during pre-test and post-test for experimental group was 130.33 ± 10.95 and 127.33 ± 7.48 and for control group 131.33 ± 11.76 and 132.17 ± 9.37 respectively. For DBP, the mean score of experimental group during pre-test and post-test were 83.58 ± 6.08 and 80.92 ± 2.71 whereas for control group 82.67 ± 6.17 and 83.17 ± 5.84 respectively. The mean BSpp of experimental group during pre-test and post-test was 126.50 ± 19.74 and 118.67 ± 10.80 while 134.42 ± 14.78 and 137.83 ± 17.69 in control group respectively. For Hb concentration, the mean score of experimental group during pre-test and post-test were 10.11 ± 0.71 and 9.91 ± 0.65 whereas for control group 10.05 ± 0.63 and 10.03 ± 0.62 respectively. The independent t-test was conducted to find out the baseline differences between the groups and table revealed there was no significant difference in all physiological variables between the groups. So it can be said that the groups were homogeneous in selected physiological parameters. Further, paired sample t-test was conducted to find out the effect of 10 weeks CBMCEP and the values for experimental group were in RHR t=3.078, p=0.003; SBP t=2.345, p=0.039; DBP t=2.174, p=0.052; BSpp level t=2.884, p=0.015; and Hb concentration t=3.191, p=0.009. However the values for control group were in RHR t=0.266, p=0.795; SBP t=-0.950, p=0.363; DBP t=-0.761, p=0.463; BSpp level t=-1.434, p=0.179; and Hb concentration t=1.598, p=0.138.

DISCUSSION

The current investigation examined the effectiveness of 10 weeks of CBMCEP on sedentary elderly women. Twelve elderly women participated in the exercise program with a minimum of 85% attendance. After the completion of 10 weeks of CBMCEP, it was found that the participants had significantly reduced their RHR of 2.05%, SBP of 2.30%, DBP of 3.19%, BSpp of 6.19%, and Hb concentration of 1.98%, in comparison to their initial state before intervention, while the control group showed no significant change. Though the reduction of RHR, SBP, DBP, and BSpp indicates the improvement of the physiological state of elderly women, the reduction of Hb concentration apparently does not show any improvement of the parameter. It was hypothesized that the current CBMCEP would be effective enough to improve the physiological state of elderly women. In this context, the results of the present study confirmed that the current CBMCEP was indeed effective in improving the RHR, SBP, DBP, and BSpp of the participants.

At baseline, the participants of the exercise group showed a little higher mean of RHR (81.42 bpm), SBP (131.33 mmHg) and DBP (83.58 mmHg), but within quite normal physiological limits for this age group. But after 10 weeks of CBMCEP, the means of RHR (79.75 bpm, -2.05%), SBP (127.33 mmHg, -2.30%), and DBP (80.92 mmHg, -3.19%) reduced significantly, which may be considered a definite indication of improvement. Our findings, which were consistent with those of other studies, revealed that 10 weeks of aerobic training of 1 hour sessions with a frequency of three days per week improved RHR and SBP in women over the age of 55 years(Cornelissen et al., 2010). Another 6 months multicomponent exercise program of 48 minutes session with frequency twice/week significantly improved the RHR (Coelho-Júnior et al., 2018). Recording of RHR is a useful test of fitness and indeed an indirect assessment of cardiac stroke volume. RHR varies due to age, sex, nature of activity, physical training, environmental factors and other factors (Danieli et al., 2014). The leading cause of morbidity and mortality in women is cardiovascular disease (CVD). Coronary artery heart disease is the main disease that is responsible for fatal cardiovascular disease (Roth et al., 2020). Rates of the occurrence of coronary heart disease (CHD) increase after the fifties in women. Lack of exercise is one of the main causes of cardiovascular disease among women (Garcia et al., 2016). Kokkinos (2014)and Mairbäurl (2013)reported that physical exercise and conditioning can slow down or even reverse the rise in blood pressure. The pioneer researchers found from their investigations that resistance training has a significant impact on the reduction of SBP in the elderly population (Machado et al., 2020). Oliveira Gonçalves et al. (2019)observed a significant reduction in SBP (-4.42%) and DBP (-6.68%) in older adult experimental subjects after a 26-week multicomponent exercise program of 60 minutes session with frequency twice/week and composed by resistance, balance, coordination, flexibility and aerobic exercises. In comparison to these findings the present CBMCEP has produced better results within a short duration of 10 weeks and that might be resulted from more number of session frequency/week. The increase in SBP can be considered as a marker of the aging process among women. With age, the arteries increase in thickness, become stiffer and lose elasticity. The ejection is impeded and the systolic pressure increases (Lee & Oh, 2010). The prevalence of hypertension, which is a major risk factor for chronic heart stroke, vascular disease, aneurysms and renal failure, increases in aging women. The prevention of an increase in SBP during the transition from the pre-to post-menopausal period of women can have a greater impact on heart disease and mortality (El Khoudary et al., 2020; Kazeminia et al., 2020). Only exercise and active lifestyle can keep the post-menopausal women safe from all these aging issues. The present CBMCEP included aerobic exercise of 20-30 minutes of brisk walking, 8-10 minutes of recreational activity and 8-10 minutes of resistance exercise which were performed by the participants, 4days/week during 10 weeks of intervention which might have significant influence on lowering RHR, SBP and DBP in the experimental group towards normal level and may help to reduce cardiovascular disease. Moreover, as the program was offered within the community, the sedentary women felt motivated and participated in the program spontaneously and wholeheartedly.

In the present study, the postprandial BS was measured and it is evident that 10 weeks of CBMCEP had a profound influence on BSpp level, as a consequence of which the experimental group showed a significant decrement in their BS mean during the posttest (Δ%= -6.19) though the pretest mean (126.50 mg/dL) of the experimental group was within the normal range. The previous study, consistent with our findings revealed significant reduction (-15.92%, $p<0.01$) in blood sugar level of experimental subjects following nine months of multicomponent exercise program of 45min/session with frequency twice/week(Leitão et al., 2021). Normal blood glucose in post-absorptive humans is approximately 100 mg/dL (Dimitriadis et al., 2021). This level of glucose is required for the functions of the central nervous system and other glucose-requiring systems, organs and cells (Chen et al., 2019). With aging, regressive histological changes are found in the pancreatic islets (Kehm et al., 2017). While insulin secretion by the pancreas declines with age that of glucagon secretion remains unchanged (Henquin et al., 2017). As a consequence, aged people tend to experience higher levels of glucose (hyperglycemia) in their blood. In another investigation by Houmard et al. (2004), which was conducted on sedentary men-women above 50 years reported that, insulin resistance arises from a sedentary lifestyle is reduced by physical activity that ranges widely in intensity and volume. On the basis of their findings they suggested more duration of exercise per week would produce better insulin sensitivity. In this context, our CBMCEP consisted of 4 sessions/week (250-300 minutes/week) are not only justified but also beneficial for this particular sedentary age group population.

It was seen in the present investigation that the mean Hb concentration of experimental group during pre-test was 10.11 g/dL, which was the below normal level (12-16 g/dL) as indicated by Collins et al. (2015). After 10 weeks of CBMCEP, Hb concentration was reduced to 9.91g/dL, which was significantly lower than the normal level. Then it apparently seems not beneficial, but the specific reason for this decrement may be due to an increase in plasma volume, as indicated in Physiology of Sport and Exercise book by Wilmore et al. (Shapoorabadi et al., 2016). There were plenty of experimental studies conducted on exercise and Hb concentration revealed inconsistent outcomes. A study among male college students participants had shown that after 8 weeks of aerobic exercise, the total number of red blood cells and Hb concentration increased (Haryono et al., 2020). On the other hand, Çiçek (2018)conducted a study for 16 weeks on women of two groups and found the aerobic exercise group reduced the value of Hb concentration but the reduction was not statistically significant whereas strength exercise group significantly reduced the Hb concentration. Another study reported no significant changes in Hb concentration among healthy older individuals following 6 months of resistance training program. Further, Mairbäurl (2013) reported that aerobic and endurance training increased red blood cell volume, whereas following exercise the Hb concentration does not increase due to an increase in plasma volume. Instead, increased plasma volume exceeding red blood cells causes a decrease in Hb, resulting in hematocrit reduction and creating a relatively lower concentration of Hb called pseudoanemia. In the present investigation, the Hb concentration was reduced by 2.08% after 10 weeks of CBMCEP. However, no such apparent changes in their physical capacity were detected during the exercise intervention program as a result of Hb concentration reduction. The present study has not included other parameters of blood, so it failed to confirm the reason for the reduction and this reduction cannot be concluded as beneficial. So the hypothesis that was adopted may be refuted, in particular this parameter. In this context, it is recommended that further research is needed to investigate the effects of exercise on Hb concentration along with many more parameters of the blood. Furthermore, a better study design is suggested with a larger sample size, longer intervention period, and controlled dietary guidelines.

Based on the present investigation, it may be recommended that the designing and implementing of a community-based exercise protocol for the elderly population should be prioritized and it should include some fun activities or recreational activities to motivate the sedentary participants. Behaviour modification sessions may be incorporated along with the exercise program to develop the awareness of active living.

Adherence and Attrition

The participants attended an average of 38±1.81 sessions out of 40 sessions during the 10 weeks of CBMCEP. The participants practiced 3.48±0.17 hours/week and the average attendance was 95±4.52 %. Statistical analysis was limited to participants who had 85% adherence (attended 85% of the exercise program). In spite of taking all preventive measures to reduce the attrition rate still from the baseline to post-test, the attrition rate was 20%.

Limitation

As per the availability and willingness of the participants, a sample size was determined for both the experimental and control groups. The participants' daily activities and food culture were more or less similar, but in this regard, researchers had very little control. Due to CBMCEP, all selected physiological variables of the participants showed a significant reduction. Though the reduction in RHR, SBP, DBP, BSpp is beneficial for an individual, the significant reduction in Hb concentration apparently seems not beneficial as many of the leading researchers found the same results and among them, one researcher reported that this reduction results from an increase in plasma volume. As the present study did not include other parameters of blood as a dependent variable, it failed to provide evidence as to the cause of Hb concentration reduction. So, it is recommended that when Hb concentration would be considered as a dependent variable, many more parameters of the blood should also be considered. However, a larger sample size, a longer intervention period and a controlled dietary pattern could have produced in more effective results. Although informal information was provided during the intervention, no formal awareness or behaviour modification sessions were held in conjunction with the exercise intervention, which would have provided with more information on living an active lifestyle.

Strength and Practical Implication

The aged population is growing rapidly throughout the world and physical activity and an active lifestyle have become international priorities. The government and non-government organizations are adopting strategies to develop exercise programs at gymnasiums, medical clinics and community settings. In this context, the low-cost feasible CBMCEP, which has been developed and implemented in the present study, is very beneficial for middle economic class sedentary women, as they can maintain their active lifestyle on their own. Moreover, when such an exercise program is offered in the local community as per the participants' convenience, women feel motivated to participate to not just remain active but also for social mingling. Our CBMCEP placed a strong emphasis on incorporating various types of exercise that would condition all bio-motor abilities of women, and it is clear that female participants improved their physiological health. The particular exercise protocol of our CBMCEP is so space-effective that it can be conducted for 15-20 women in a very small area within the community. The included exercises are also traditional and simple, and even the participants can perform them on their own after 9–10 supervised sessions.

CONCLUSION

On the basis of the findings and within the limitations of the investigation, it may be concluded that 10 weeks of CBMCEP can benefit elderly women in connection with their physiological capacity. However, if the policies are adopted from micro to national level to offer such programs in the local community, it would obviously ensure the healthy aging of a nation, especially in developing countries where modern technology-based facilities are not available everywhere for general people. Moreover, health care professionals and fitness experts may implement this particular CBMCEP as a model for greater benefits.

CONFLICT OF INTEREST

The authors do not have any conflict of interest.

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