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Family-based interventions role in modulating cardiovascular risk in adolescents` central obesity

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Abstract

Background: Central obesity remains a global health challenge. Up to date, there are unclear central obesity management strategic role for family-based interventions in terms of central obesity correlated health risks.

Objective: To assess the efficacy of overall family-based intervention model in modulating cardiovascular risk in adolescents` central obesity with a positive family history of cardiovascular risk.

Patients and Methods: One-thousand, and five-hundred adolescents` with central obesity participants were recruited from eight-hundred families, from Giza Governorate from January 2022 to January, 2026. Participants were aged ≥18 years old, with a positive family history of cardiovascular risk. Randomization codes utilizing a simple random model, and paramedical professionals delivered the comprehensive package of the overall family-based intervention model including annual screening for cardiovascular risk factors, structured lifestyle modification sessions, referral to a primary health care facility for individuals with established risk factors, and active follow-up to evaluate self-care adherence. Weight, body mass index (BMI), waist circumference, and waist-hip ratio were measured at baseline, 2nd year, and 4th years, then all measured parameters were statically compared.

Results: In total, 1500 adolescents with central obesity from 800 families with a positive family history of cardiovascular risk were comparable in mean age, and male to female ratio. In addition, attrition rate at the 2nd year follow-up was 5%. The adjusted population average change attributable to the intervention at the 4th year follow-up were -2.99 kg in weight (95% CI, (-3.02 to -2.96; P <.001), -0.91 kg/m^2 in BMI (95% CI, -0.9 to -0.92), -4.3 cm in waist circumference (95% CI, -5.34 to -3.26), and -4.29 cm in waist-hip ratio (95% CI, -4.46 to -4.27).

Conclusion: The gained adolescents` central obesity modulation across overall family-based cardiovascular risk modulation strategy promotes an obvious public health impact in minimize suspected type II diabetes mellitus.

Keywords: Adolescents` with central obesity, Body mass index, cardiovascular risk, overall family-based intervention model, waist Circumference, Waist-hip ratio

Introduction

Adolescence is a critical time, where lifelong habits are acquired [1]. Almost, 80% of adolescents with obesity will continue to have significant obesity-related co-morbidities. Adolescents' 'central obesity is more likely to be teased by their peers, which may cause growth failure, delayed puberty, iron deficiency anaemia [2]. Central obesity during adolescence leads to later on a number of negative impacts on their overall quality of life either short- and long-term disorders i.e., hypertension, type-II diabetes mellitus pathogenesis across activating insulin resistance, hyperlipidemia, obstructive sleep apnea, psychological distress, even cardiovascular complications [3].

The prevalence of overweight and obesity among Egyptian adolescent females was found to be 20% and 10.7%, respectively [4]. Furthermore, adolescents` central obesity addressed numerous endocrinological nature comorbidities that shown to be associated with metabolic syndrome, cardiovascular disease, stroke, as well breast cancer, and sleep apnea [5].

A national Egyptian specific well-recognized focus on prevention of weight gaining beyond healthy parameters recently addressed [6]. Since availability of numerous multifaceted weight management strategies i.e. lifestyle modifications, dietary changes, physical activity, behavior modification, and sometimes medical interventions. No specific well-recognized evidence based therapeutic intervention for preventing central obesity beyond healthy limits that not addressed central obese individual [7]. Traditionally, the critical timing of addressing central obesity depends on various factors, including the individual's age, overall health status, and the presence of any central obesity-related complications [8].

Worldwide health decision-makers had failed to prioritize the most suitable interventions for efficient central obesity management at adolescent` level. No doubt lack of focus on managing the rising central obesity prevalence at the population level will increase the noncommunicable disease burden on the already strained public health system [9]. Up on that, there was a substantial rise in death and illness during productive life years.

In addition, the associated adolescents` central obesity risk prevention strategies almost focus on individuals` own approaches i.e., various dietary modifying systems, lifestyle modulating, pharmacotherapy, even surgical interventions [10, 11].

On the other hand, family-based interventions provide potential adolescents` central obesity management in terms of correlated health risk modulation. In addition, family-based interventions often target the entire family

environment to promote healthier behaviors. The effectiveness of those strategies in low- and middle-income countries, however, remains largely unexplored [12].

Family-based intervention model often targets the overall family environment to promote healthier lifestyle. The efficacy of overall family-based intervention model (FBIM) in modulating cardiovascular risk in adolescents` central obesity with a positive family history of cardiovascular risk in line to promote better cardiovascular health. The present clinical trial offered the secondary outcomes of efficacy of overall family-based intervention model related to adolescents` central obesity management.

Materials and Methods

Study Design and Participants

This is a clinical randomized clinical trial that was conducted to evaluate the efficacy of overall family-based intervention model in modulating cardiovascular risk in adolescents` central obesity with a positive family history of cardiovascular risk.

Family members of adolescents` central obesity with a positive family history of cardiovascular risk selected from Outpatient clinics of Central Hospitals, Giza Governorate, Egypt, were enrolled to participate in this clinical randomized trial. The trial included immediate family members (i.e., brothers, sisters, parents, spouses) of participants diagnosed with coronary heart disease. To ensure accurate diagnosis, we reviewed medical records, and angiogram reports of the index individual (Fig. 1). We included adolescents` aged 18 years or older, and excluded bedridden and terminally ill family members. Any family with ≥ two eligible members was excluded from the trial. The trial recruitment was conducted from January 2022 to January, 2026. Data collection occurred at baseline, and annually during the clinical trial along four years.

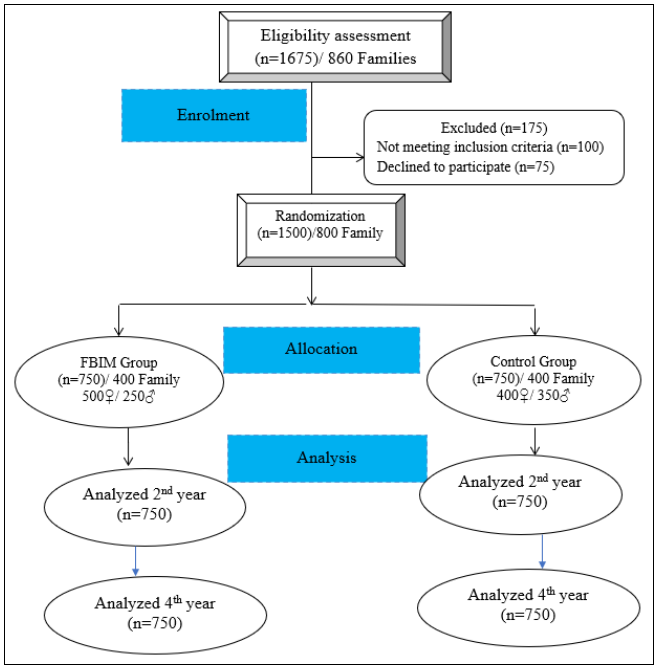

Fig 1: Flow chart for participants` recruitment and allocation

Written informed consent was obtained from all the eligible family members. This study protocol complied with the Helsinki Declaration, the ethical norm of the World Medical Association for human testing. Each participant received a detailed explanation of all procedures of study, and all methods were carried out in accordance with the approved guidelines, as well participants have the ability to withdraw at any moment.

Randomization

Each participated family, serving as the unit of intervention, was randomly assigned to either the therapeutic intervention (i.e., integrated cardiovascular risk management model), or the enhanced traditional management group (i.e., time counseling and annual screening for risk factors) utilizing computer-generated randomization cards at a 1:1 ratio. Randomization was conducted after baseline data collection from all eligible participants in the participated families. An independent individual generated and maintained the randomization codes utilizing a simple random model. Annual assessments included all baseline measurements and were conducted by independent research staff (were not blinded) at 2 nd year and 4th years at the end of the overall family-based intervention model.

Data Collection Tool

The present clinical trial depends on an interviewer-administered questionnaire that was adapted based on World Health Organization's STEP wise approach to surveillance survey tool. It captured data on demographic and general health status, diet patterns, plus physical activity. The questionnaire was administered at baseline, and repeated at 2 nd year and 4 th years at the end of the overall family-based intervention model.

Intervention Group Activities

The present clinical trial utilized the community's existing health care infrastructure to administer structured lifestyle interventions, also offer care coordination at the family level. Trained paramedical professions, mainly accredited social health activists from the family's region, from Outpatient clinics of Central Hospitals, Giza Governorate, Egypt, were responsible about delivered overall family-based intervention.

Preparatory step along 7-10 training days for all involved paramedical professions in line to ensure the same overall family-based intervention model criteria targeted to enhance the interpersonal communication and encouraging family discussions on healthier choices regarding the coronary heart disease risk modulation. All involved paramedical professions had received a refresher session every six-months.

All involved paramedical professions visited their assigned families once every three-months per year. Where, the comprehensive package of overall family-based interventions involved screening for and detecting cardiovascular risk issues, discussing lifestyle alternatives, and providing supervised advices in line to ensure cardiovascular health. The provided supervised advices, and life style modifications were based on each participant`s baseline risk assessed file, plus their recorded family habits.

All participants enrolled within FBIM group received a customized health diary. During each family visit delivered every three-months, the involved paramedical professions utilized the health diary to set lifestyle modulating goals for the next three-months. The lifestyle modulating goals involved;

a. Ensure intake of locally available vegetables and fruits up to 400-500 grams, daily;
b. Minimize average daily salt intake to ≤⅓ tea spoon, daily;
c. Minimize average free sugar intake to ≤2 tea spoon, daily;
d. Maximize daily aerobic training i.e., walking up to 30-60 minutes; plus
e. ensure no smoking role.

The addressed lifestyle modulating goals were verified, and recorded based on agreement and consultation of the participant`s family members. The settled lifestyle modulating goals for each participant were ensured along later on visits based on the present clinical trial model. Those who achieved their lifestyle modulating goals, were encouraged to ensure approved strategies. All participants enrolled within FBIM group received particular notebook includes daily dietary templates, and reviewed every three-months visit, plus an individualized explanation for the FBIM participant`s cardiovascular risk along the four years duration of this trial.

Obesity Outcome Measures

The main outcome measurements were anthropometric parameters of adolescents` central obesity via standard weight and height scale involving the body weight in kilograms, BMI in kilogram per meter square, waist circumference in centimeters, plus waist/hip ratio. All central obesity parameters were recorded at baseline, 2nd year, and 4th years, tabulated then analyzed.

Statistical Analysis

After calculated, recorded, and tabulated the demographic data for FBIM group depending on the means and standard deviations for continuous data, and frequencies and percentages for categorical data. A statistical analysis for adolescents` central obesity tabulated parameters using the statistical package of social sciences (SPSS) version 25. The population average between-group difference in the outcome variables over the present trial four years was evaluated. The power was calculated for a 2-sided test with an α of 0.05 and a ρ or intra-cluster correlation coefficient of 0.10.

Results

Characteristics of the Study Population

Only 75 of 1675 index participants, and their family's declined participation, as well one-hundred did not meet current trial inclusion criteria (Fig1). Ultimately, 1500 participants` of 800 families agreed to participate in the trial. The 800 families were allocated randomly into both trial groups: the FBIM group had 400 families with 750 participants, and the Control group had 400 families with 750 participants. By the end of four-years of follow-up, the whole 750 participants` of the 400 families intervention group participants were available; as well all 750 had complete outcome data for the analysis. In the Control group, 750 participants` of 400 families were available, no drop out.

Up on Table [1], the present trial 1500 populations involved 900 female adolescents, and 600 male adolescents, the overall participants mean age was 22.75 years for female adolescents, and 22.48 years for male adolescents. Where, the FBIM group involves 500 females, and 250 male adolescents. The FBIM group mean age was 22.8 years for female adolescents, and 22.73 years for male adolescents, mean weight was 87.25 kilograms, mean body mass index was 31.35 kilogram per meter square, the mean waist circumference was 117.7 centimeters, plus their mean waist-hip ratio was 127.05 centimeters. While, the Control group mean age was 22.25 years for female adolescents, and 22.37 years for male adolescents, mean weight was 88.3 kilograms, mean body mass index was 31.99 kilogram per meter square, the mean waist circumference was 118 centimeters, plus their mean waist-hip ratio was 127.3 centimeters with no statistical differences.

Table 1: Descriptive participants` statistics, and comparing baseline parameters between groups.

Parameter	Total	FBIM	Control	t-value	P-value
N. Families	850	450	400	1.34	0.23
N. Adolescents	1500	750	750	1.62	0.32
Female	900	500	400	2.34	0.23
Age (years)	22.75 ± 1.37	22.80 ± 1.19	22.25 ± 1.48	2.01	0.14
Male	600	250	350	2.34	0.23
Age (Years)	22.48 ± 1.32	22.73 ± 1.15	22.37 ± 1.63	1.08	0.16
Weight (kg)	-----	87.25 ± 3.46	88.30 ± 3.85	0.62	0.54
BMI (Kg/m (2))	-----	31.35 ± 1.59	31.99 ± 1.30	0.01	0.99
WC (cm)	-----	117.7 ± 11.74	118 ± 10.26	1.38	0.26
WHR	-----	127.05 ± 16.03	127.3 ± 10.31	1.48	0.23

N: Number; BMI: Body mass index; WC: waist circumference; WHR: Waist-hip ratio; Kg: Kilogram; Kg/m(2): Kilogram per meter square. cm: Centimeter; p: probability, η2: partial eta squared. * Data are mean± SD, P-Value < 0.05 indicate statistical significance

Anthropometric parameters

Adolescents` body weight (kg)

The mean body weight at baseline was similar in both FBIM, and Control groups (87.25 kg, and 88.3 kg). Along the trial period, the mean weight in both FBIM, and Control groups increased (Table 2). By the 4 th years, the present trial adolescent`s weight average in-between both FBIM and Control group differs that attributable to FBIM was -2.99 kg (95% CI, -3.02 to -2.96; P <.001).

Adolescents` body Mass Index

The mean BMI at baseline was similar in both FBIM, and Control groups (31.35 kg/m ^{2}, and 31.99 kg/m ^{2}). Along the trial period, the mean BMI in both FBIM, and Control groups increased (Table 2). By the 4th years, the present trial adolescent`s BMI average in-between both FBIM and Control group differs that attributable to FBIM was -0.91 kg/m^2 (95% CI, -0.9 to -0.92; P <.001).

Adolescents` waist Circumference (cm)

The mean WC at baseline was similar in both FBIM, and Control groups (117.7 cm, and 118 cm). Along the trial period, the mean WC in both FBIM, and Control groups increased (Table 2). By the 4th years, the present trial adolescent`s WC average in-between both FBIM and Control group differs that attributable to FBIM was -4.3 cm (95% CI, -5.34 to -3.26; P <.001).

Adolescents` waist-Hip ratio (cm)

The mean WHR at baseline was similar in both FBIM, and Control groups (127.05 cm, and 127.3 cm). Along the trial period, the mean WHR in both FBIM, and Control groups increased (Table 2). By the 4th years, the present trial adolescent`s WHR average in-between both FBIM and Control group differs that attributable to FBIM was -4.29 cm (95% CI, -4.46 to -4.12; P <.001).

Table 2: Alterations in measured parameters between groups.

Parameter	*Date*	*FBIM*	*Control*	*Average*	*ICC (95%CI)*
Weight (kg)	Baseline	87.25 ± 3.46	88.30 ± 3.85	-1.05 (-1.44 to -0.75); 0.54	0.20 (0.13-0.25)
	2 [nd] Year	84.65 ± 1.38	86.62 ± 1.46	-1.97 (-2.05 to -1.89); <.01	0.21 (0.14-0.26)
	4 th Year	80.35 ± 2.32	83.34 ± 1.62	-2.99 (-3.02 to -2.96); <.001	0.31 (0.16-0.34)
BMI (Kg/m [2])	Baseline	31.35 ± 1.59	31.99 ± 1.30	-0.64 (-0.35 to -0.93); 0.99	0.19 (0.13-0.25)
	2 [nd] Year	30.08 ± 1.26	31.06 ± 1.04	-0.78 (-0.76 to -1.2); <.01	0.21 (0.15-0.27)
	4 th Year	29.45 ± 1.02	30.36 ± 1.01	-0.91 (-0.9 to -0.92); <.001	0.28 (0.18-0.32)
WC (cm)	Baseline	117.7 ± 11.74	118 ± 10.26	-0.3 (1.18 to -1.78); 0.26	0.14 (0.09-0.22)
	2 [nd] Year	119.8 ± 11.72	121 ± 11.32	-1.2 (-0.8 to -1.6); <.01	0.17 (0.11-0.28)
	4 th Year	121.7 ± 12.32	126 ± 13.36	-4.3 (-5.34 to -3.26); <.001	0.23 (0.17-0.32)
WHR (cm)	Baseline	127.05 ± 16.03	127.3 ± 10.31	-0.25 (5.47 to -5.97); 0.23	0.17 (0.09-0.22)
	2 [nd] Year	120.03 ± 12.34	124.6 ± 12.64	-4.57 (-4.87 to -4.27); <.01	0.23 (0.14-0.35)
	4 th Year	121.01 ± 13.26	125.3 ± 13.43	-4.29 (-4.46 to -4.12); <.001	0.21 (0.12-0.27)

N: Number; BMI: Body mass index; WC: waist circumference; WHR: Waist-hip ratio; Kg: Kilogram; Kg/m^2: Kilogram per meter square. p: probability, η2: partial eta squared. * Data are mean± SD, P-Value < 0.05 indicate statistical significance

Discussion

Up to date, a recent published paper has indicated that around 26.5 % of Egyptian adolescents were classified as overweight, also both overweight and obesity represented nearby 35.3% among Egyptians. Adolescents' obesity as a global epidemic can have a significant negative impact on their quality of life [13]. Such elevated epidemiological ratio reflected into obvious obesity related comorbidities, even mortality [14]. Therefore, current study aimed to assess the efficacy of overall family-based intervention model in adults` weight management.

Current clinical trial stated that the overall family-based cardiovascular risk modulation strategy delivered by the trained paramedical professionals, as a package of FBIM effectively improved weight management in adolescents with a positive family history of premature coronary heart disease.

At the end of the 4th year current trial duration, could observed the clinically valuable modulation of all adolescents` body weight, BMI, waist circumference, and waist-hip ratio values. In addition, clinical participants` level decline in anthropometric measured parameters of central obesity recorded postintervention in current trial can impart substantial public health gains via preventing later on type II diabetes mellitus.

Valuable evidence supports intentional body weight loss for modulating cardiovascular threats. Reduced participants' central obesity measured parameters could avert 27- 33% of type II diabetic incidence in high-risk individuals [15].

Structured lifestyle modulations model was addressed more efficient over pharmacological therapy in restricting type II diabetic incidence among adolescents with central obesity [16]. In the same line, adolescents reported nearby 3-5 years in their life expectancy via delaying diabetic diagnosis by one decade [17]. Therefore, the benefits to total cardiovascular health could be immense in the long-term among adolescents` central obesity with a positive family history of cardiovascular risk adopting the examined structured lifestyle modulations model.

Among adolescents` central obesity individuals, the examined structured lifestyle modulations model for diabetic risk modulation yielded clinically meaningful restrictions in their BMI, waist circumference, and waist-hip ratio. The percent of diabetic risk incidence reduction was relatively better in current overall family-based cardiovascular risk modulation strategy compared with the examined structured lifestyle modulations model delivered at the participants` level across current clinical trial [18].

The adherence to the examined structured lifestyle modulations model is related to the magnitude of gained health benefits. Over four years of current clinical trial, associated paramedical professionals made a median of twelve visits for each participated family. Further, all adolescents` central obesity participated individuals were reviewed their health goals three times along current clinical trial, therefore, could state high engagement level, as well good adherence to studied model. In addition, the overall family-based cardiovascular risk modulation model may help to improve the sustainability of the altered behavior later on.

The role of paramedical professionals in fostering a family from the perspective of improving cardiovascular health, however, is not explored in existing clinical trial. The impact of the examine overall family-based cardiovascular risk modulation model at the adolescents` central obesity individuals' level for the entire population could be tremendous.

The associated paramedical professionals were an appropriate platform for scaling up overall family-based cardiovascular risk modulation model with the help of paramedical professionals, which could significantly affect the population's ability to prevent and manage chronic lesions [19].

Conclusion

Current clinical trial stated that the overall family-based cardiovascular risk modulation model can make adopting health promotion interventions easier in high-risk adolescents. The reduction of anthropometric parameters of central obesity observed post interventions could have a substantial public health impact in preventing later on type II diabetes mellitus.

Author contributions

Nejal Mahmoud Abdul Rahman conceived the main features of this clinical trial. Adnan A. Gharib was involved in data analysis and initial interpretation. Both authors critically reviewed the manuscript and approved the final version.

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Conflict of interest

The authors don`t have any conflict of interest to declare.

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