Live Video Diet and Exercise Intervention in Overweight and Obese Youth: Adherence and Cardiovascular Health

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Objective To evaluate adherence of overweight and obese adolescents to a live video lifestyle intervention. The impact on vascular and functional health was also assessed.

Study design Twenty adolescents 14.5 ± 2.1 years of age with body mass index z-score 1.94 ± 0.43 were enrolled. The 12-week intervention included 3-times-weekly videoconference sessions with a trainer and weekly diet consultations. Adherence was evaluated by completion rate and percentage of sessions attended. Vascular health indices and traditional cardiovascular risk factors were obtained at baseline and study end.

Results Seventeen participants (85%) completed the intervention. The participants attended 93 ± 11% of scheduled sessions. Reasons for absences included illness/injury (23%), school activities (21%), holidays (18%), forgetting the appointment (8%), Internet connectivity issues (7%), and family emergency (7%). Significant changes were observed in waist-hip ratio (0.87 ± 0.08 vs 0.84 ± 0.08, $P = .03$), total (159 ± 27 vs 147 ± 23 mg/dL, $P = .004$) and low-density lipoprotein cholesterol levels (91 ± 20 vs 81 ± 18 mg/dL, $P = .004$), volume of inspired oxygen per heartbeat at peak exercise (69 ± 16 vs 72 ± 15%, $P = .01$), and functional movement score (13 ± 2 vs 17 ± 1, $P < .001$). Participants with abnormal vascular function at baseline showed improvement in endothelial function and arterial stiffness indices ($P = .01$ and $P = .04$, respectively).

Conclusions A 12-week live video intervention promotes adherence among overweight and obese adolescents and shows promise for improving vascular and functional health. Integrating telehealth into preventive care has the potential to improve cardiovascular health in the youth at risk. *(J Pediatr 2015;167:533-9)*.

Atherosclerosis is associated with several risk factors that have been increasing in prevalence among children and adolescents.[1] There are now validated tools for noninvasive measurement of early atherosclerotic disease in pediatrics including endothelial function testing, arterial stiffness testing, and ultrasound imaging of the carotid wall. These modalities are useful for the study of treatment efficacy in children and adolescents because this population does not reach hard cardiovascular endpoints before adulthood.[2]

Lifestyle interventions are reported to improve cardiovascular risk profile[3] as well as measures of endothelial function[4,5] and vascular stiffness[6] in children and adolescents. However, the success of these interventions in practice is constrained by limited feasibility and low adherence. A survey of pediatric obesity clinics found that caregiver work hours, transportation, and having to miss school were among the most commonly reported barriers to follow-up.[7]

Telehealth is a promising strategy for engaging adolescents in health-related interventions because the approach may eliminate many of the barriers to clinic programs, but there are limited data on its effectiveness in the pediatric population. Live videoconferencing-based interventions have been used to improve health and modify behavior in children and adolescents with diabetes[8] and asthma.[9] Several studies have evaluated the effects of web-based weight management programs on children and adolescents,[10] but no studies incorporated live training. The purpose of this study was to evaluate the adherence of overweight and obese youth to a live video diet and exercise intervention and the effect of the program on measures of cardiovascular health. We hypothesized that subjects would attend greater than 80% of diet and exercise sessions.

AIx_{75bpm}	Aortic augmentation index adjusted to a standard heart rate of 75 beats per minute
BMI	Body mass index
HR_{max}	Maximum heart rate
PWV	Pulse wave velocity
RHI	Reactive hyperemia index
VO_{2max}	Maximum volume of oxygen consumed
VO_{2pulse}	Volume of oxygen consumed per heartbeat

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Methods

Overweight and obese youth were recruited from a pediatric weight program and online community listing (www.craigslist.org) from June 2012 to November 2013. Subjects were eligible for the intervention if they met the following criteria: (1) age: 10-19 years; (2) body mass index (BMI) ≥85th percentile; (3) Internet access; and (4) presence of an adult at home during exercise for participants <14 years of age. Subjects were excluded if they had: (1) latex allergy; (2) acute illness; and (3) ongoing treatment for a significant medical condition, including hypertension and diabetes. Consent was obtained from subjects ≥18 years of age or a parent of subjects <18 years of age, and assent was obtained from subjects <18 years of age. The protocol was approved by the Stanford University Institutional Research Board.

Assessment visits were completed at baseline and at 12 weeks in the mornings. Subjects were instructed to fast overnight. Operators were blinded to measurements made on prior visits. Sex, race, ethnicity, medical history, recent exposure to tobacco smoke, consumption of alcohol or caffeinated drinks, and use of medication and supplementation was recorded. Subjects were asked to recall food consumed in the previous 24 hours, and portions were queried by modeling standard measurement sizes.

The subject's weight and height were measured (Scale-Tronix electronic scale 5221; Scale-Tronix, White Plains, New York; wall-mounted Seca stadiometer 225; Seca, Columbia, Maryland). BMI was calculated as mass in kilograms divided by height in meters squared, and BMI percentile and z-score were calculated.[11] Waist and hip circumferences were measured with nonelastic measuring tape at the area of smallest circumference and at the widest portion of the buttocks. Four sets of resting brachial blood pressures were measured while seated with the oscillometric method (Dinamap; General Electric, Waukesha, Wisconsin), and the average of the last 3 measurements was used. Blood pressure z-scores were calculated (Boston Children's Hospital normative database, courtesy of Steven D. Colan, MD).

Endothelial Pulse Amplitude Test (Endo-PAT, Itamar Medical Ltd., Caesarea, Israel) was used to assess endothelial function by measuring the increase in peripheral blood flow after temporary ischemia. It has been validated in adults and studied in several pediatric groups.[12,13] The testing protocol has been described previously.[12] The data were analyzed with the software package and the reactive hyperemia index (RHI) was calculated (a lower RHI indicates worse endothelial function).

Pulse wave velocity (PWV) and aortic augmentation index adjusted to a standard heart rate of 75 beats per minute (AIx_{75bpm}) were measured in triplicate using arterial tonometry (SphygmoCor; Atcor-Medical, Sydney, Australia). The testing protocol has been described previously.[14] A higher value of PWV or AIx_{75bpm} indicates stiffer arteries.

Carotid ultrasound examinations with electrocardiography tracings were performed. The right and left common carotid arteries were examined in the transverse plane using high-resolution B-mode gray-scale ultrasonography (M-Turbo Ultrasound System; Sonosite, Inc, Bothell, Washington).[15] Cross-sectional dimensions of the common carotid arteries in systole and diastole were measured in triplicate and averaged to calculate the arterial pressure-strain elastic modulus[16] and stiffness index.[17]

Fasting plasma lipid profiles were measured with standardized methods from the National Heart Lung and Blood Institute. Low-density lipoprotein cholesterol concentration was calculated with the Friedewald equation. C-reactive protein was measured with a high-sensitivity enzyme-linked immunoabsorbent assay. The dietary recall was analyzed using the Food Processor software (v 10.1, Elizabeth Stewart Hands and Associates, Salem, Oregon) to assess intake of selected nutrients.

Subjects underwent cardiopulmonary exercise testing as described previously.[18] Maximum volume of oxygen consumed (VO_{2max}) was taken as the peak volume of oxygen consumed in milliliters per minute. Maximum heart rate (HR_{max}) was recorded as beats per minute. The maximum volume of oxygen consumed per heartbeat (VO_{2pulse}) was calculated as VO_{2max} divided by HR_{max}. VO_{2max}, HR_{max}, and VO_{2pulse} were compared with predicted values from empirically derived formulas[19] and reported as percentages of the predicted values. Maximum volume oxygen consumed indexed by body mass was calculated as the VO_{2max} divided by the subject's weight in kilograms.

Functional movement screening is an assessment tool that evaluates 7 movement patterns for evidence of functional limitations.[20] Each movement was rated on a scale from 0-3, with higher scores indicating greater ability.

Intervention

Exercise training sessions were led by a trained research assistant or a professional trainer using a videoconferencing platform (Skype Communications; Microsoft Corporation, Luxembourg). Participants were given a weighted medicine ball, jump rope, and resistance tubing with door attachment. Sessions lasted 60 minutes and were scheduled 3 times weekly. The program combined aerobic and resistance training in a circuit format. Exercise intensity was self-reported on a scale of 1-10, and the program was adjusted to maintain an intensity of 8.

Subjects were not reminded of upcoming sessions but were contacted if they did not appear online for their appointment. Attendance and active participation were recorded. If a subject missed a previously scheduled appointment or could not participate (eg, if they appeared online but could not conduct exercises because of illness), the appointment was recorded as nonattendance and the reason for nonattendance was documented. Subjects were allowed to make up missed sessions by extending