Diabetes Prevention Program in Youth (Insulin Superheroes Club) Pilot: Improvement in Metabolic Parameters and Physical Fitness After 16 Weeks of Lifestyle Intervention

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Culturally tailored and comprehensive prevention strategies are vital for addressing the epidemic of obesity and rising rates of type 2 diabetes, particularly among ethnic and racial minority youth (1). The Diabetes Prevention Program (DPP) has demonstrated the efficacy of lifestyle modification in adults (2). However, studies on lifestyle programs for diabetes prevention in youth are limited, and none have reported comprehensive physical fitness outcomes (3–5). We conducted a pilot prospective uncontrolled study (ClinicalTrials.gov identifier NCT03042936) evaluating feasibility and changes in metabolic and physical fitness parameters for the Insulin Superheroes Club (ISC) curriculum, a DPP designed for youth from culturally diverse, minority backgrounds.

Youth aged 7–15 years and a parent with impaired glucose tolerance enrolled in the ISC as a supplement to the Centers for Disease Control and Prevention's adult DPP. The ISC is a 12-month, multilevel program that includes 16 weekly (phase 1), 3 biweekly (phase 2), and 6 monthly (phase 3) sessions. Participants attended sessions that included 60 min of physical fitness and 30 min of education. The education portion included interactive teaching of health-related topics (e.g., nutrition, exercise, physiology, mindfulness, and stress reduction) using hands-on learning activities (e.g., cooking, crafts, games, and role-play). All physical fitness activities incorporated moderate-intensity exercises (e.g., push-ups, yoga, basketball, tag, and dance).

Measurements at baseline and 16 weeks included height, weight, waist circumference, manual blood pressure, body composition (InBody 570 multifrequency bioimpedance analyzer), hemoglobin A_{1c} (HbA_{1c}) (A1CNow+), nonfasting lipid profile (Cholestech LDX), and physical fitness (6-min walk test, handgrip strength, sit-and-reach, and shuttle run). Wilcoxon signed rank test (adjusting for household clusters) and generalized estimating equations compared measures at baseline and 16 weeks. $P < 0.002$ was considered significant after Bonferroni multiple comparison correction ($0.05 \div 23 = 0.0022$).

Participants were 33 youth (from 16 households), aged 10.8 ± 2.0 years, 58% female, 88% Hispanic, 24% with overweight, 39% with obesity, 76% receiving government food assistance, and 100% with lower socioeconomic status (Hollingshead score of 4 in 6% and 5 in 94%). Five subjects (15%) were lost to follow-up. The baseline HbA_{1c} of subjects who dropped out were not significantly different from that of completers ($P = 0.13$, Mann-Whitney *U* test). All subjects were included in intention-to-treat analysis. The single imputation method, baseline observation carried forward (BOCF), was used for subjects missing values at 16 weeks.

From baseline to 16 weeks, HbA_{1c} significantly improved, while BMI *z* score, percent body fat, diastolic blood pressure, 6-min walk distance, right handgrip strength, and lower-body flexibility nominally improved (Table 1). The percentage of subjects with $HbA_{1c} \geq 5.7\%$ (39 mmol/mol) decreased from 61 to 15% ($P < 0.0001$) when using BOCF or 8% when analyzing only subjects with HbA_{1c} measurement at 16 weeks.

After 16 weeks of the phase 1 component of the ISC, participants displayed significantly improved metabolic and physical fitness parameters. These beneficial outcomes suggest that a family-based program that involves lifestyle education, behavior modification, and goal-driven

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Table 1—Metabolic health parameters and physical fitness

Variables	Baseline	Post 16 weeks	Paired differences	*P* value
Metabolic parameters				
BMI (kg/m^2)	21.5 (19.1, 26.5)	21.6 (19.0, 26.5)	−0.1 (−0.5, 0.1)	0.08
BMI *z* score	1.23 (0.79, 2.00)	1.13 (0.46, 2.00)	−0.05 (−0.18, 0)	0.003*
Percent body fat (%)	32.8 (28.0, 40.0)	31.6 (23.6, 39.8)	−1.5 (−3.6, 0)	0.008*
Waist circumference (cm)	74.0 (66.5, 83.5)	76.0 (64.1, 83.5)	0 (−2.5, 2.1)	0.91
Waist circumference *z* score	0.13 (−0.13, 0.63)	0.03 (−0.40, 0.69)	0 (−0.26, 0.11)	0.23
Sagittal abdominal (cm)	17.0 (16.0, 19.8)	17.8 (15.3, 19.5)	0 (−1.0, 0.85)	0.21
HbA_{1c} (%)	5.8 (5.6, 5.9)	5.3 (5.1, 5.5)	−0.5 (−0.6, −0.2)	0.0017**
HbA_{1c} (mmol/mol)	40 (38, 41)	34 (32, 37)	−5.5 (−6.6, −2.2)	0.0017**
Triglycerides (mmol/L)#	0.98 (0.81, 1.56)	1.10 (0.73, 1.60)	0 (−0.07, 0.49)	0.41
Total cholesterol (mmol/L)#	3.78 (3.47, 4.03)	3.80 (3.47, 4.16)	0 (−0.10, 0.28)	0.65
LDL cholesterol (mmol/L)#	1.86 (1.66, 2.33)	2.02 (1.66, 2.33)	0 (−0.16, 0.28)	0.57
HDL cholesterol (mmol/L)#	1.22 (0.96, 1.45)	1.16 (0.98, 1.40)	0 (−0.13, 0)	0.06
Non-HDL cholesterol (mmol/L)#	2.43 (2.17, 2.92)	2.56 (2.28, 3.13)	0 (−0.05, 0.26)	0.17
SBP (mmHg)	106 (100, 112)	102 (98, 108)	0 (−8, 0)	0.16
SBP *z* score	0.25 (−0.27, 0.95)	−0.06 (−0.50, 0.18)	−0.07 (−0.82, 0)	0.13
DBP (mmHg)	68 (60, 70)	64 (58, 70)	−2 (−8, 0)	0.01*
DBP *z* score	0.53 (0, 0.88)	0.14 (−0.40, 0.54)	−0.24 (−0.73, 0)	0.01*
Physical fitness				
6-Min walk (m)	647.88 (568.45, 731.95)	685.80 (614.17, 797.33)	30.66 (0, 216.81)	0.01*
Right handgrip (kg)	18.0 (14.0, 26.0)	19.0 (16.0, 26.0)	1.0 (0, 2.0)	0.01*
Left handgrip (kg)	18.0 (14.0, 23.5)	18.0 (15.0, 21.0)	0 (0, 1.0)	0.93
Handgrip combined (kg)	36.0 (28.0, 46.5)	36.0 (30.0, 46.0)	1.5 (0, 3.0)	0.07
Shuttle run (s)	9.083 (9.008, 11.003)	9.057 (8.064, 10.065)	0 (−0.960, 0.035)	0.21
Sit-and-reach (cm)	19.0 (11.5, 27.0)	27.0 (20.0, 31.0)	3.7 (0, 10.8)	0.006*

Median (interquartile range), at baseline and 16 weeks, and paired sample differences shown. DBP, diastolic blood pressure; SBP, systolic blood pressure. *$P < 0.05$ (nominally significant); **$P < 0.002$ (significant after correction for multiple comparisons). #Nonfasting lipid panel.

exercise can be effective in a predominantly Latino, socioeconomically disadvantaged population. The durability of these positive outcomes will be determined at 12-month follow-up of this cohort.

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