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Effect of Volunteering on Risk Factors for Cardiovascular Disease in Adolescents

A Randomized Controlled Trial

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Importance: The idea that individuals who help others incur health benefits themselves suggests a novel approach to improving health while simultaneously promoting greater civic orientation in our society. The present study is the first experimental trial, to our knowledge, of whether regular volunteering can reduce cardiovascular risk factors in adolescents.

Objective: To test a novel intervention that assigned adolescents to volunteer with elementary school-aged children as a means of improving adolescents' cardiovascular risk profiles.

Design: Randomized controlled trial, with measurements taken at baseline and 4 months later (postintervention).

Setting: Urban public high school in western Canada.

Participants: One hundred six 10th-grade high school students who were fluent in English and free of chronic illnesses.

Intervention: Weekly volunteering with elementary school-aged children for 2 months vs wait-list control group.

Main Outcome Measures: Cardiovascular risk markers of C-reactive protein level, interleukin 6 level, total cholesterol level, and body mass index.

Results: No statistically significant group differences were found at baseline. Postintervention, adolescents in the intervention group showed significantly lower interleukin 6 levels (\log_{10} mean difference, 0.13; 95% CI, 0.004 to 0.251), cholesterol levels (\log_{10} mean difference, 0.03; 95% CI, 0.003 to 0.059), and body mass index (mean difference, 0.39; 95% CI, 0.07 to 0.71) compared with adolescents in the control group. Effects for C-reactive protein level were marginal (\log_{10} mean difference, 0.13; 95% CI, -0.011 to 0.275). Preliminary analyses within the intervention group suggest that those who increased the most in empathy and altruistic behaviors, and who decreased the most in negative mood, also showed the greatest decreases in cardiovascular risk over time.

Conclusions and Relevance: Adolescents who volunteer to help others also benefit themselves, suggesting a novel way to improve health.

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SOcial factors play a central role in determining adolescent health.¹ The social determinants of adolescent health are widely acknowledged to include supportive connections at the family, school, and neighborhood level.¹ Historically, prevention efforts with adolescents in these domains have targeted risky behaviors such as substance use,^{2,3} with little known about whether such interventions can also have direct effects on chronic disease risk.

The present study tested a novel approach for a social intervention aimed at improving risk profiles for cardiovascular disease in adolescents. Rather than

using traditional social interventions that provide support to at-risk adolescents, we tested whether getting adolescents engaged in giving support, through volunteering, could be beneficial to their own health. There are known mental health benefits to volunteering, such as increased positive affect and reduced depression.^{4,5} Observational studies document links between volunteering and reduced mortality risk, fewer health problems (eg, hypertension), fewer functional limitations, and better self-reported health.^{4,6-8} However, the question of whether randomized assignment to volunteering, in which adolescents provide help to younger children on a weekly ba-

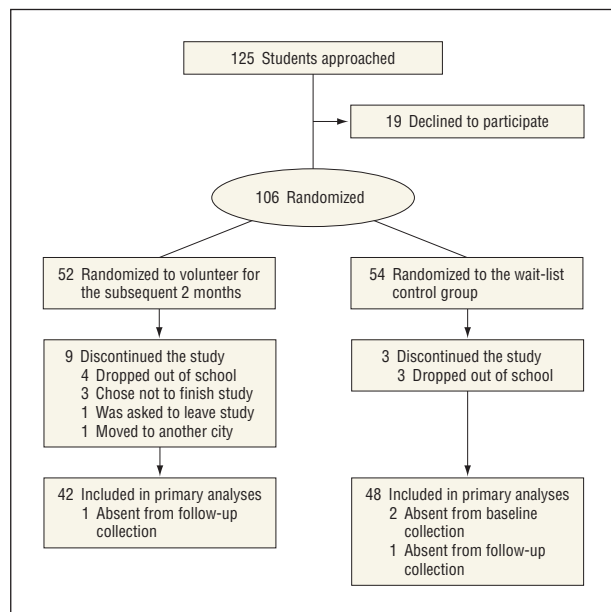


Figure. Flow of participants through study.

sis, can alter adolescent cardiovascular risk profiles remains unanswered.

In this study, we investigated risk markers that predict cardiovascular disease later in life and risk markers that also are known to emerge early in life.⁹⁻¹¹ We hypothesized that adolescents who participated in a volunteering program would show lower levels of C-reactive protein (CRP), interleukin 6 (IL-6), and total cholesterol and lower body mass index compared with those who were in a wait-list control group. Second, we conducted exploratory analyses to determine possible explanations for intervention effects, including changes to mood, self-esteem, and altruism.

METHODS

PARTICIPANTS

One hundred six students were recruited from 5 classes at a large, urban public high school in western Canada during the 2011-2012 school year. To be eligible for this study, participants had to be (1) enrolled in 10th grade at the school, (2) fluent in English, and (3) free of chronic illnesses. Approval was obtained from the local school board, the school principal, and the teachers who were involved. We had permission to recruit students through the Planning 10 classes taught by 2 teachers, totaling 125 students (Figure). Approval for this study was also obtained from the University of British Columbia ethics board. Informed consent and assent were obtained from parents and students, respectively.

A requirement of all public high schools in British Columbia, Canada, is that students must complete 30 hours of work or volunteering to graduate. A preexisting program was already in place to help interested students find such opportunities, and we partnered with this program to create volunteering assignments for study participants. We randomly assigned 52 study participants to volunteer in the fall semester (intervention group) or not until the spring semester ($n=54$, wait-list control group). Randomization was done by a coin flip that

assigned each individual to either the intervention or control condition after consent was obtained.

INTERVENTION

Students in the intervention group were assigned to volunteer at a nearby public elementary school from the beginning of October through December (10 weeks) of 1 school year. Intervention group students were placed at 1 of 5 participating elementary schools that had after-school programs. The after-school programs that students volunteered for included homework club, sports programs, science, cooking, cards and games, and arts and crafts. While there was a relatively wide range of programs, all programs were similar in that they involved volunteering with elementary school-aged children. All students in the intervention group took part in a 2-hour training session to prepare them for their upcoming volunteer assignments. Training involved developing leadership and coaching skills and developing connections with the adult mentors overseeing the program. Students were expected to volunteer 1 to 1.5 hours each week as part of this program.

MEASURES

Cardiovascular Risk

Body Mass Index. Participants' height and weight were measured, and body mass index was calculated as weight in kilograms divided by height in meters squared.

Inflammatory Markers. Interleukin 6 was measured using high-sensitivity enzyme-linked immunosorbent assay kits (intra-assay coefficient of variation $<10\%$; detection threshold $=0.04$ pg/mL). C-reactive protein was measured using a high-sensitivity, chemiluminescent technique (inter-assay coefficient of variation $=2.2\%$; detection threshold $=0.20$ mg/L [to convert to nanomoles per liter, multiply by 9.524]).

Metabolic Measure. Total cholesterol was measured using standard enzymatic techniques (interassay coefficient of variance $=0.9\%$). Cholesterol assays were calculated in units of millimoles per liter and were then converted to milligrams per deciliter for presentation of results. Blood was not obtained for 1 student in the intervention group and 4 students in the control group, either because of difficulties with the blood draw or refusal of blood draw.

Psychosocial Questionnaires

Affect. Students completed a measure of negative affect using the child version of the Positive and Negative Affect Schedule.¹² This scale consists of 15 adjectives describing negative emotions, eg, sad and scared. Students indicated on a 5-point scale ranging from "very slightly/not at all" to "extremely" the extent to which they felt each emotion over the past few weeks. The child version of the Positive and Negative Affect Schedule was adapted from the original Positive and Negative Affect Schedule for use specifically in youth. Internal consistency (Cronbach α) ranges from 0.89 to 0.94. Higher scores indicate greater negative affect.

Self-esteem. Self-esteem was assessed using the Rosenberg Self-Esteem Scale.¹³ This measure consists of 10 items, eg, "I take a positive attitude towards myself," each of which is rated on a 7-point scale ranging from "disagree strongly" to "agree strongly." Internal consistency is .88.¹⁴ Higher scores indicate greater self-esteem.

Prosocial Personality. Participants completed the 30-item version of the Prosocial Personality Battery. Participants indicated on a 5-point scale from “strongly disagree” to “strongly agree” how much each statement described them (eg, “When I see someone being taken advantage of, I feel kind of protective towards them”) and how often they engaged in a list of behaviors (eg, “I have offered to help a handicapped or elderly stranger across a street”), also on a 5-point scale ranging from “never” to “very often.” Internal consistency ranges from .64 to .77.¹⁵ Scores for empathy and altruistic behaviors were calculated, with higher scores indicating greater empathy and altruism.

Procedure

All data collection took place at the school. All study measures were collected both at baseline in September 2011 and again in mid-January 2012. Questionnaires were completed on school computers. Research assistants measured students' height and weight, and antecubital blood draws were performed by trained phlebotomists. Following baseline data collection, those in the intervention condition began their weekly volunteering assignment. The follow-up data collection was identical to the baseline assessment. Participants received an honorarium of \$25 at each point.

STATISTICAL ANALYSES

Inflammatory and metabolic values were not normally distributed and hence were log-transformed to reduce skewness. *t* Tests were used to compare trial arms at baseline. To test intervention effects, we conducted analyses of covariance assessing group differences in cardiovascular risk measures at follow-up, adjusting for baseline levels. Second, we conducted preliminary analyses to investigate whether changes in psychosocial variables were associated with changes in physiological variables over the intervention period. To do this, we conducted linear regression analyses separated by group. Postintervention physiological variables (adjusted for baseline) were regressed onto postintervention psychosocial variables (adjusted for baseline). Standardized β 's are reported for regression coefficients.

RESULTS

Similar demographic, psychosocial, and physiological characteristics were observed across the 2 groups at baseline (**Table 1**). Untransformed means are also presented in the eTable (<http://www.jamaped.com>). The majority of participants identified as members of a minority group and fell into medium or low socioeconomic status groups.

PRIMARY ANALYSES

Students in the volunteering intervention group had significantly lower levels of IL-6 postintervention (adjusted \log_{10} mean difference, 0.13; 95% CI, 0.004 to 0.251). Effects for CRP were in the same direction, but marginal (adjusted \log_{10} mean difference, 0.13; 95% CI, -0.011 to 0.275). Students in the volunteering group also had significantly lower cholesterol levels postintervention (adjusted \log_{10} mean difference, 0.03; 95% CI, 0.003 to 0.059). Finally, students in the volunteering group had significantly lower body mass index postintervention (adjusted mean difference, 0.39; 95% CI, 0.07 to 0.71) (**Table 2** and eFigure).

Table 1. Characteristics of Participants at Study Entry

	Mean (SD)		P Value
	Intervention (n = 52)	Control (n = 54)	
Female, No. (%)	26 (50.0)	25 (46.3)	.71
Ethnicity, No. (%)			
Chinese	24 (46.2)	20 (37.0)	.76
“Other” Asian	9 (17.3)	13 (24.1)	
European	9 (17.2)	9 (16.7)	
Other	10 (19.2)	12 (22.2)	
SES, ^a No. (%)			
High	13 (25.0)	15 (27.8)	.85
Medium	10 (19.2)	8 (14.8)	
Low	23 (44.2)	29 (53.8)	
Age, y	14.84 (0.42)	14.96 (0.78)	.34
Negative affect	29.04 (9.66)	30.08 (10.46)	.60
Self-esteem	48.69 (11.08)	48.08 (11.50)	.78
Empathy	14.02 (2.54)	13.85 (2.48)	.73
Altruism	11.49 (3.82)	11.58 (4.22)	.91
BMI	21.96 (3.91)	22.44 (5.31)	.60
Cholesterol level, mg/dL	116.90 (31.16)	118.74 (39.38)	.80
\log_{10} cholesterol level, mg/dL	2.05 (0.12)	2.05 (0.17)	.84
IL-6 level, pg/mL	1.06 (0.65)	1.25 (1.72)	.46
\log_{10} IL-6 level, pg/mL	-0.04 (0.25)	-0.08 (0.34)	.69
CRP level, mg/L	0.62 (0.76)	0.76 (1.15)	.47
\log_{10} CRP level, mg/L	-0.39 (0.36)	-0.39 (0.42)	.89

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); CRP, C-reactive protein; IL-6, interleukin 6; SES, socioeconomic status.

SI conversion factors: To convert cholesterol to millimoles per liter, multiply by 0.0259 and CRP to nanomoles per liter, multiply by 9.524.

^aSocioeconomic status was determined using the higher of the parents' occupation code.¹⁶

EXPLORATORY ANALYSES OF PATHWAYS

We tested several possible psychosocial explanations for the changes in cardiovascular measures over time, including the possibility that the intervention could (1) change students' relationships with their social world by increasing general prosocial behaviors (eg, empathy and altruism); (2) reduce students' experiences of negative mood; or (3) make students feel better about themselves (ie, increase self-esteem). None of the psychosocial variables were associated with physiological variables in the control group. In the intervention group, higher baseline-adjusted follow-up scores on the empathy measure (ie, caring about what happens to others) were associated with lower IL-6 levels at follow-up (baseline adjusted) ($\beta = -0.33$; $P = .04$). In comparison, in the control group, empathy and IL-6 levels were not associated ($\beta = -0.02$; $P = .91$). Similarly, in the intervention group, higher baseline-adjusted follow-up scores on altruism (helping behaviors outside of the intervention itself) were associated with lower cholesterol levels at follow-up (baseline-adjusted) ($\beta = -0.44$; $P = .004$). In the control group, altruism was not associated with cholesterol levels ($\beta = 0.08$; $P = .62$). Finally, in the intervention group, higher baseline-adjusted negative affect at follow-up was

Table 2. Outcomes at Baseline and Postintervention^a

	Mean (SD)		Adjusted Mean Difference ^b (95% CI)
	Baseline	Postintervention	
Log ₁₀ IL-6			
Intervention	-0.04 (0.25)	-0.16 (0.24)	0.13 (0.004 to 0.251) ^c
Control	-0.08 (0.34)	-0.03 (0.34)	
Log ₁₀ CRP			
Intervention	-0.39 (0.36)	-0.54 (0.27)	0.13 (-0.011 to 0.275) ^d
Control	-0.39 (0.42)	-0.38 (0.48)	
Log ₁₀ cholesterol			
Intervention	2.05 (0.12)	2.14 (0.06)	0.03 (0.003 to 0.059) ^c
Control	2.05 (0.17)	2.17 (0.08)	
BMI			
Intervention	21.96 (3.91)	21.91 (3.08)	0.39 (0.07 to 0.71) ^c
Control	22.44 (5.31)	22.52 (5.58)	

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); CRP, C-reactive protein; IL-6, interleukin 6.

^aLog-transformed values were used for variables with non-normal distributions.

^bDifference between the means of the 2 groups postintervention, adjusted for baseline values. For BMI, there were 42 students in the intervention group and 48 in the control group. For IL-6, CRP, and cholesterol, there were 41 students in the intervention group and 44 in the control group because of missing blood samples.

^c $P < .05$.

^d $P < .10$.

associated with higher CRP levels at follow-up (adjusting for baseline) ($\beta = 0.46$; $P = .003$). In comparison, in the control group, negative affect was not associated with CRP levels ($\beta = -0.08$; $P = .61$). Changes to students' views of themselves (self-esteem) did not account for changes in any physiological measures over time in either the intervention group or the control group (all P 's $> .15$).

COMMENT

To our knowledge, this is the first empirical study finding that randomly assigning adolescents to weekly volunteering can change risk markers for cardiovascular disease, reducing systemic inflammation, total cholesterol level, and obesity. These findings are significant because they indicate that youth who engage in volunteering not only help others, but also benefit themselves, suggesting a novel way to improve health while simultaneously making positive contributions to society.

These data are consistent with other previous observational research that has shown that helping behaviors such as assisting family members is associated with lower levels of CRP among those who experience role fulfillment¹⁷ and that giving support to others is associated with greater reductions in mortality than receiving support⁶; however, most previous studies have not been able to use experimental approaches. The few studies that did focused on physical activity and cognitive functioning in older adults¹⁸⁻²⁰ or teen pregnancies and academic failure in adolescents.^{21,22} Hence, the finding that interventions that get adolescents to volunteer can change cardiovascular risk markers has important implications for health in the adolescent years and beyond.

In exploratory analyses, we examined possible explanations for the intervention effects. Two well-established effects of volunteering include improvements in mood and one's sense of self. Specifically, volunteering is associated with decreases in negative mood or depression, as well as increases in self-esteem^{4,5,23-25}; in turn, both negative mood and self-esteem have been associated with health outcomes such as cardiovascular disease.²⁶⁻²⁸ Alternatively, volunteering could work by having more specific effects on prosocial behaviors (ie, volunteering may facilitate people becoming more empathic and altruistic, with these traits having implications for health). Volunteering is associated with prosocial personality characteristics, including high levels of empathy and helpfulness,¹⁵ and the notion that the altruistic components of volunteering may have physical health benefits comes from previous literature linking altruism with mortality and medical illnesses,²⁹ as well as evidence demonstrating that giving support or help is more strongly related to mortality than is receiving help,⁶ and from studies that have shown that volunteering is associated with mortality over and above related constructs such as social support.³⁰

In the present study, patterns were consistent with both of these possibilities. Among those in the volunteer group, higher postintervention empathic concern and altruistic behaviors were associated with lower levels of cardiovascular risk markers (adjusting for baseline values). Those in the control group showed no such associations.

In contrast, the patterns were not consistent with the notion that volunteering operates via changing a person's sense of self, as indicated by the fact that self-esteem and cardiovascular markers were not associated in the intervention group. At the same time, however, evidence was consistent with the notion that volunteering may have effects on mood, because those in the intervention group who showed the lowest negative mood postintervention also had the lowest CRP levels (and these patterns were not evident in the control group). The results with psychosocial variables are preliminary and speculative, given that we assessed changes over the intervention period at only 2 points. Because psychosocial and physiological variables were assessed simultaneously, we cannot confirm directionality for these findings.

Limitations include the small sample size, because this study sought to demonstrate the feasibility of implementing a randomized trial of volunteering and blood collection procedures in a school setting. We were also not able to do a longer follow-up in this study, because the control group needed to have the opportunity to acquire volunteer hours during the school year. We were not able to conduct the study as a double-blind study, because participants could obviously discern whether they were in the volunteering arm or the control group. In addition, there may be a number of other potential mediators, such as diet or sleep, that account partially for the effects in this study but were not assessed or other unaccounted-for third variables that could have been acting on study variables. There is also seasonal variability in some study mea-

tures. For example, cholesterol level varies seasonally³¹ and is generally lowest in late summer and highest in the winter, which roughly corresponds to our baseline and postintervention assessment periods. While this would contribute to changes over time in physiological measures, it would presumably affect both groups equally. Finally, there were more dropouts in the intervention group compared with the control group, and those who dropped out were either not able to or chose not to complete the postintervention measures; hence, there may be some selection biases in this sample. Future studies should address these issues and also document effects on volunteers and volunteer recipients simultaneously.

This intervention approach has important implications for societal health and well-being. First, volunteering is a desirable activity to promote because it benefits volunteer recipients; for example, children who participate in volunteer programs such as Big Brothers Big Sisters show improvements in academic and well-being outcomes.^{32,33} Second, volunteering is beneficial to our society because it promotes a greater sense of civic orientation and connectedness within communities.³⁴ Finally, in the present study, we document that volunteering can also reduce cardiovascular risk in volunteers themselves, suggesting a novel way to promote health in our society. This intervention was found to be effective in a sample where the majority of adolescents had low socioeconomic status and were from minority groups, indicating an approach that could potentially be used to target health disparities.

These findings suggest a unique approach to improving health in the adolescent years. If we can engage adolescents in volunteering by making it a standard recommendation akin to physical activity or by incorporating it as a regular part of school curricula, we have the potential of reducing cardiovascular risk markers in these adolescents. From a single intervention, then, our society has the potential to synergize benefits across volunteer recipients, volunteers, and the broader community.

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