PHYSIOLOGICAL BENEFITS OF VOLUNTEERING AMONG YOUNG ADULTS AND ADOLESCENTS

by

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Abstract

Helping others has been linked to improved well-being in previous research. However, most studies have been observational, have focused only on psychosocial outcomes, and have investigated these relationships primarily among the elderly. The present studies built on previous research by extending the focus on helping others to adolescents and young adults, by investigating physiological outcomes, and most importantly, by using an experimental design, randomly assigning participants to engage in formal or informal volunteering. All outcome variables were assessed prior to intervention and again post-intervention. Specifically, the first study examined the effect of a four week intervention in which primarily low socioeconomic status university students were randomly assigned to engage in either regular family helping behaviors (informal volunteering) or neutral activities. Following the intervention, participants in the intervention condition showed marginally steeper daily cortisol slopes ($F(1, 34) = 3.057$, $p = .09$), but no psychosocial variables explained the relationship between informal volunteering and cortisol slope among those assigned to the intervention condition. The second study investigated the impact of formal volunteering in a public school context, randomly assigning grade 10 students predominantly from low socioeconomic groups to either two months of volunteering in after school programs with elementary school children or to a wait-list control group. Following the intervention, students in the intervention condition had significantly lower body mass index ($F(1, 87) = 5.844$, $p = .02$), lower cholesterol ($F(1, 83) = 3.824$, $p = .05$), and marginally lower levels of C-reactive protein ($F(1, 82) = 2.809$, $p = .10$) and Interleukin-6 ($F(1, 82) = 3.352$, $p = .07$). With the exception of body mass index, various intra-individual and interpersonal variables connecting formal volunteering to improved physiological outcomes

were identified. Implications of these findings, together with suggestions for applying the study findings and directions for future research, are discussed.

Preface

Chapter 3 of the dissertation will be submitted for publication as a manuscript shortly. In this manuscript I will be the first author, and my supervisor Dr. Edith Chen and Dr. Schonert-Reichl, another member of my PhD committee, will be co-authors. I designed the research project, collected the data, and performed data analyses. I drafted the manuscript while feedback from Dr. Chen was incorporated into the final version.

Ethics approval for Study 1 presented in Chapter 2 was obtained from the Behavioral Research Ethics Board of the University of British Columbia (H10-03401). Ethics approval for Study 2 presented in Chapter 3 was obtained from the Clinical Research Ethics Board of the University of British Columbia (H11-00943).

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List of Abbreviations

AUC	Area under the curve
BMI	Body mass index
BP	Blood pressure
CRP	C-reactive protein
DBP	Diastolic blood pressure
EC	Experience Corps
HbA1c	Glycosylated hemoglobin
IL-6	Interleukin-6
SBP	Systolic blood pressure
SES	Socioeconomic Status

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Chapter 1: Introduction

Research on social relationships has traditionally focused on investigating the important influences that receiving support from family and friends can have. It has only been in more recent years that attention has shifted away from solely determining the benefits of receiving support, to examining in greater detail to what extent providing support and helping others may be beneficial to the person providing support. Although this remains a relatively small area of research that is primarily focused on adult populations and psychosocial outcomes, findings linking the *provision* of support to positive outcomes, have begun to accumulate.

Helping Others: Definitions of Formal and Informal Volunteering

Although the concept of volunteering, or volunteer work, is much talked about, finding an appropriate definition that encompasses all aspects and all different types of volunteering has proven difficult. Originally, definitions of volunteering focused on two defining aspects of such work, specifically, the fact that to be characterized as volunteer work it must not involve payment and must be provided to people to whom the worker had no obligations (Tilly & Tilly, 1994). It was these aspects of volunteer work that separated it from other possible areas of work, such as household labour, labour markets, and the informal sector. It should be noted, however, that what at first appears to be the core aspect of any volunteer work, that volunteers not be paid, would exclude organizations such as the American Peace Corps or AmeriCorps, which nonetheless are considered as providing opportunities for volunteer work by many people (Carson, 1999). In addition, Wilson and Musick (1997) have argued more recently that while this initial conceptualization of volunteering provides a good definition of volunteering as a particular type of productive activity it lacked the inclusion of more informal

helping behaviors that large segments of the population, most notably women, engage in on a frequent basis. This informal type of volunteering differs from Tilly and Tilly's (1994) second definition, that volunteer work be provided to people to whom the worker has no obligations (given that it includes help provided to family members). Hence, many people now differentiate between formal volunteering, e.g. donating several hours of work every week to a community organization, and informal volunteering, e.g. helping a neighbour, and consider "Volunteers (to) give their time freely for the benefit of others" (Wilson & Musick, 1997, p. 695).

Wilson and Musick (1997) furthermore list four premises of volunteer work. First of all, all volunteer work is productive, meaning that it goes beyond a leisure time pursuit and requires a particular set of qualifications that allows the workers to properly perform their volunteer work. Second, and this applies more strongly to formal than to informal volunteering, all volunteering involves a certain degree of collective action as it aims to contribute to the collective good, for example by improving or providing facilities and programs available to the public. In addition, people are more likely to make sustained contributions to projects that affect larger groups of people, for example everyone in their neighborhood. The social interactions between people volunteering for the same cause furthermore create obligations and accountability that increase the likelihood of everyone following through with their aspect of the project. Third, the relationships between volunteers and recipients are ethical, that is to say that most people who do volunteer have moral incentives for doing so. Finally, Wilson and Musick suggest that different types of volunteer work are related to each other. Either positively, suggesting that some people are generally disposed to providing help to others through both formal and informal volunteering, or negatively, suggesting that engaging in

formal volunteering may tax individuals' resources, psychological and others, and result in them providing less informal volunteer work. Initial evidence suggests that people who are involved in formal volunteering are more likely to engage in informal helping behaviors as well, but that the opposite is not true (Wilson & Musick, 1997).

Physical and Mental Health Benefits of Receiving Support

Accumulating evidence supports the notion that receiving help from others, or social support, including various dimensions such as emotional and tangible support, is beneficial (e.g., see Langford, Bowsher, Maloney, & Lillis, 1997; Cohen & Wills, 1985; Cohen, 1988). More specifically, a large body of research links receiving social support to a host of positive outcomes with respect to physical health. For example, a meta-analytic review examining the influence of received social support across 122 studies concluded that patients receiving social support, especially practical social support, were significantly better at adhering to their medical regimens (DiMatteo, 2004). In addition, there is evidence to suggest that receiving social support can positively influence self-management behaviors among people with chronic illnesses (Gallant, 2003). Generally speaking, social support has been linked to benefits to the cardiovascular and immune systems (Evans & Steptoe, 2001; Gallo, Smith, & Kircher, 2000; Glass, Matchar, Belyea, & Feussner, 1993; Steptoe, 2000; Uchino, Cacioppo, & Kiecolt-Glaser, 1996) as well as psychological well-being (Hays, Steffens, Flint, Bosworth, & George, 2001; Kawachi & Berkman, 2001; Luszczynska, Sarkar, & Knoll, 2007; Sayal et al., 2002).

However, it is important to remember that receiving social support is not always associated with positive outcomes (Schwarzer & Leppin, 1991) and that the conditions under which support is provided must be taken into account. Several studies have noted paradoxical

findings suggesting that under certain conditions receiving social support can be detrimental, for example when social support is perceived as unhelpful by the recipient (Revenson, Schiaffino, Deborah Majerovitz, & Gibofsky, 1991). Similarly, a daily diary study by Bolger, Zuckerman, and Kessler (2000) showed that 'invisible' support, that is support unnoticed by the receiver, may be more beneficial, possibly because it does not make the receiver believe that they are unable to cope with stressors on their own.

In addition, research increasingly suggests that the effects of giving support may in fact be more positive than receiving support (Deci, La Guardia, Moller, Scheiner, & Ryan, 2006; Piferi & Lawler, 2006; Thomas, 2010), perhaps because the reciprocity of receiving and providing support is important to people (Robinson & Tian, 2009).

Mental Health Benefits of Giving Support

Correlational research. Virtually all studies investigating the relationship between providing support to others, or volunteering, and mental health have focused on older adults and used correlational designs. Evidence from these studies, however, suggests numerous benefits of volunteering.

In general, helping others has been shown to be associated with positive outcomes, for example among recently bereaved elderly participants (Brown, Brown, House, & Smith, 2008). Those participants who, following loss of their spouse, provided support to others in their environment were quicker to recover from depressive symptoms they were experiencing. Similarly, positive influences on mental health were found among a stratified random sample from members of the Presbyterian Church (Schwartz, Meisenhelder, Ma, & Reed, 2003). Data was collected from a random sample of church members between the ages of 13-98 years using

mail-in questionnaires. The authors concluded that being altruistic and providing more help to others was associated with improved overall mental health, even more so than receiving help from others was. Thomas (2010) similarly concluded that, among a national probability sample of older adults in the United States, providing support to others was a much stronger predictor of well-being than receiving support. Specifically, total support provided to others, as well as support given to just friends and children and the number of different types of support that were provided were associated with better affect balance in this sample. Finally, research based on close friend dyads drawn from an undergraduate population also showed that whereas receiving support from a friend predicted greater psychological well-being (measured here as a composite of depressive symptoms, anxiety, self-esteem, and vitality), giving support to a close friend was in fact more strongly related to better psychological well-being (Deci et al., 2006).

General helping behaviors aside, much research has studied the impact of volunteering, both formal and informal. Although volunteering has generally been found to be beneficial to well-being, there are some inconsistencies in terms of whether formal and informal volunteering are equally beneficial. Several studies have linked volunteering to improved affect and positive functioning. For example, among older adults part of the Midlife Development in the US (MIDUS) Study, formal volunteering was associated with greater positive affect (Greenfield & Marks, 2004). Perhaps more importantly, results from this study also indicated that formal volunteering provided a buffering effect for older adults who did not report having many major life roles. Specifically, volunteering appeared to protect these older adults from feeling a lack of purpose in life as a consequence of their major role absences. This suggests

that volunteering may be able to provide older adults with a greater sense of purpose than they might otherwise experience. In line with this, a study comparing older adult volunteers and nonvolunteers living in Israel furthermore found that those who were currently engaged in formal volunteering showed, among other things, evidence of less cognitive malfunctioning, fewer depressive symptoms, and a more positive evaluation of their present life (Shmotkin, Blumstein, & Modan, 2003).

Several other studies have also found strong evidence supporting the positive impact that volunteering may have on depression and depressive symptoms among older adults. For example, Li and Ferraro (2005) have used data from three waves of the Americans' Changing Lives study, a longitudinal study of a nationally representative sample of US adults, and found positive influences of formal volunteering, though not informal helping, on depression. Taking advantage of the multi-wave nature of the data, the authors were further able to show that the effect of engaging in formal volunteering represented more than a selection effect for old adults with low depression symptoms. To the contrary, they showed that depression was associated with a subsequent increase in volunteering among participants, indicating that this may be one route through which older adults can better their psychological well-being. The association between volunteer status and fewer depressive symptoms among older participants of the Americans' Changing Lives study (aged 60 years and older) has also been reported by other authors (Morrow-Howell, Hinterlong, Rozario, & Tang, 2003; Musick & Wilson, 2003). In addition, data from older adults aged 70 years and older (part of the AHEAD survey) who volunteered for 100 hours or more over the previous year suggest that these volunteers experienced slower increases in depression levels when compared to older adults

who did not volunteer (Lum & Lightfoot, 2005). Lastly, another study that has linked the general provision of informal (but not formal) assistance to others among a nationwide sample of older US adults has shown greater feelings of personal control to be a mediator between providing informal assistance and lower levels of depressive symptoms (Krause, Herzog, & Baker, 1992).

The above studies that suggest a positive influence of volunteering among older adults are also supported by qualitative data from older adults who volunteered in schools (Newman, Vasudev, & Onawola, 1985). These older adults reported that volunteering provided them with more structure in their every day life, while enriching their lives in important ways.

Hence, clear associations between volunteering and improved mental health exist. Volunteering also appears to play an important role by buffering volunteers from various negative influences, such as lack of purpose in life. However, the correlational nature of the above studies precludes any assumption of causality.

Experimental research. A more controlled and experimental approach to assessing the potential benefits of volunteering was undertaken through the Experience Corps (EC) Project. This project involved older adults tutoring elementary school children in reading at local schools. Much research focused on the Baltimore site in particular, where inner-city adults were trained to volunteer at local schools for a few hours a week over the course of a year (Glass et al., 2004; Martinez et al., 2006). The program has been shown to be beneficial to the students who were the 'targets' of this volunteering program as well (Rebok et al., 2004).

Taking advantage of EC volunteers from multiple sites, Hong and Morrow-Howell (2010) used a quasi-experimental design to investigate changes among EC volunteers two years after they began to volunteer and compared them to a matched comparison group of older adults

who were part of another national study and did not engage in volunteering. The authors found that after two years as a volunteer in the EC program these older adults showed lower depressive symptoms than people in the comparison group. This provides additional support for a beneficial impact of volunteering among older adults, but fully experimental studies will need to investigate this association further.

Physical Health Benefits of Giving Support

Correlational research. Aside from the above-described benefits to people's mental health and overall psychological well-being, emerging evidence suggests that helping others and volunteering also has a variety of physical health benefits, including, among others, reduced mortality, reduced functional limitations, improved self-reported health and decreased blood pressure. However, much like research documenting the mental health benefits of helping others, virtually none of this research is experimental in nature.

Among the correlational studies, the most striking examples show that helping others is linked to mortality risk. For example, providing instrumental social support to others and emotional support to one's spouse was associated with a decreased five-year mortality risk in a prospective, longitudinal study following older, married couples (Brown, Nesse, Vinokur, & Smith, 2003). Of further interest is the fact that this study too, concluded that the benefits to be gained from providing support to others much overshadowed the effect of receiving support – which no longer influenced mortality once support provision had been taken into account. Other studies have also found an association between volunteering among older adults and mortality risk. This includes data from the Americans' Changing Lives study which showed that adults aged 65 years and older who were volunteering over the past year had a lower likelihood

of dying over the subsequent 7.5 years (Musick, Herzog, & House, 1999). Two studies analyzing data from the American AHEAD survey furthermore found that having volunteered for 100 hours or more over the past year was related with a reduced likelihood of dying over the subsequent years (Lum & Lightfoot, 2005; Luoh & Herzog, 2002). The former study also concluded that having volunteered in excess of 100 hours over the previous year did not provide any additional benefits. This is in line with research investigating whether the amount of time older adults spent volunteering influenced their psychological well-being. One study has found that the benefits of volunteering followed a U-shaped curve and that high volunteering could indeed result in lower psychological well-being (Windsor, Anstey, & Rodgers, 2008). Another study following community-dwelling older adults in California concluded that those who volunteered for two or more organizations had a 63% lower mortality rate compared to those who did not volunteer (Oman, Thoresen, & McMahon, 1999). The mortality rate for these volunteers remained 44% lower after controlling for a host of other variables, including physical functioning, health behaviors, and social support, among others. Two other studies investigating different types of social relationships and mortality also mention volunteering as one of several factors related to decreased mortality risk (Rogers, 1996; Sabin, 1993).

Given the research linking helping others to mortality, it is not surprising that helping others has been found to influence morbidity as well. Brown, Consedine, and Magai (2005) found that, among a large and diverse sample of community-dwelling older adults from New York, those who provided kin and non-kin support had overall lower morbidity, assessed through a comprehensive list of health problems common among older adults, and appeared to be in better health. This was true after taking into account not only a number of demographic

covariates, but after controlling for participants' social network as well. Helping others and volunteering has also been shown to be associated with improved functional ability among older adults, possibly because those who volunteer on a regular basis and help those around them are leading a more active lifestyle. For example, as part of a two-wave panel study that followed 313 women from 1956 until 1986 and investigated roles in women's lives, Moen, Dempster-McClain, and Williams (1992) found that women who volunteered on an intermittent basis between marriage and age 55 still occupied multiple roles in 1986 and also had better functional ability in 1986. The two studies based on data from the AHEAD survey mentioned above in the context of mortality risk have furthermore shown that having volunteered for 100 or more hours in the previous year was associated with fewer daily functioning limitations and better self-reported health and that active volunteers declined more slowly with respect to these outcomes compared to participants who had not volunteered as much (or at all) over the previous year (Luoh & Herzog, 2002).

Three studies have linked volunteering and daily functioning using data from the Americans' Changing Lives study. Of these, Morrow-Howell, Hinterlong, Rozario, and Tang (2003) focused exclusively on a subsample of participants aged 60 years and above and found that volunteering, and more hours of volunteering, was associated with greater overall well-being, which consisted here of self-rated health, functional dependency, and depressive symptomatology. The other two studies took advantage of the full sample of the Americans' Changing Lives study to evaluate the impact of volunteering across different age groups and to see whether effects seen in older adults were comparable to those among younger adults. Specifically, Thoits and Hewitt (2001) found that when considering the full sample, those who

volunteered had better well-being, defined as a composite of life satisfaction, happiness, physical health, depression, self-esteem, and a sense of mastery, three years later. Greater well-being in turn was associated with people investing more hours in volunteer work, suggesting a self-reinforcing cycle between volunteering and well-being. Finally, van Willigen (2000) found that older volunteers in particular appeared to benefit from volunteering, as evidenced by greater increases in life satisfaction as well as self-rated health when compared to younger adult volunteers. However, it should be noted that younger volunteers were able to draw greater benefits from more volunteer hours, whereas the relationship between volunteering and better self-rated health began to decline after 100 hours/year for older adults. These findings are supported by Windsor, Anstey, and Rodgers (2008) who suggested, based on a study of elderly volunteers, that moderate amounts of volunteering may be optimal and maximize the benefits to be gained from volunteering in this age group.

Finally, two studies have investigated the association between volunteering and providing support and blood pressure. Burr, Tavares, and Mutchler (2011) used data from the Health and Retirement Study and found that among older adults a moderately high volunteer commitment was associated with a decreased likelihood of hypertension. One study also assessed the association between providing support and blood pressure, using 24-hours ambulatory blood pressure monitoring in a sample of university undergraduates (Piferi & Lawler, 2006). They concluded that participants with a greater trait-tendency to give support to others experienced lower blood pressure levels in daily life. Their data further suggested that this relationship likely operated through increased self-efficacy which was itself associated with

lower reported stress. This mirrors some of the findings mentioned in the previous section on mental health benefits of volunteering.

Experimental research.

The same quasi-experimental study by Hong and Morrow-Howell (Hong & Morrow-Howell, 2010) described above also found that when EC volunteers were compared to the non-volunteer comparison group, volunteers improved in terms of their functional limitations at a two-year follow-up assessment whereas people in the comparison group had actually worsened. Similar evidence comes from a study that compared a small subgroup of African American women aged 65 and older volunteering for the EC to a group of African American women part of another longitudinal study (Tan et al., 2009). Supporting the idea that volunteering may be associated with a more active lifestyle, the authors found that two years later EC volunteers had increased in terms of physical activity, whereas the comparison group had not.

More evidence comes from a small pilot study for the EC project that took place in Baltimore. Older adults in Baltimore were assigned either to volunteer as part of the EC or to a wait-list control group. Studies evaluating differences between these two groups allow for more definitive conclusions about the value of volunteering in old age. These studies found, for example, that when compared to the wait-list control group whose physical activity levels did not change or even declined, older adults who volunteered for the EC were more physically active after a few months of volunteering, both in terms of self-reported physical activity and kilocalories expanded, and walking speed decreased much less among the EC volunteers (Fried et al., 2004; Tan, Xue, Li, Carlson, & Fried, 2006). It should be noted, however, that this effect

may be limited to older adults who were in the 'low physical activity' group at the beginning of the study and had more room for improvement with regards to their physical activity levels.

Evidence from the same Baltimore EC group, again compared to wait-list controls, furthermore suggests benefits of volunteering with respect to cognitive functioning. For example, with respect to executive functioning and memory, EC volunteers showed improvements at four- and eight-month follow-up assessments, when compared to control participants who experienced slight decreases in these areas between baseline and follow-up (Carlson et al., 2008). This is further supported by another study that investigated brain plasticity among a small subsample of EC volunteers who underwent functional magnetic resonance imaging (fMRI) at baseline and six months later (Carlson et al., 2009). The authors suggest that volunteering is associated with short-term, intervention-specific increases in brain activity in the left prefrontal cortex and the anterior cingulate cortex, both areas involved in cognitive functioning. Volunteers furthermore showed behavioral improvements in executive inhibitory abilities, all of which indicates that volunteering in older age is associated with increased brain plasticity. Hence, the limited experimental evidence available largely supports findings from other, correlational studies that have chronicled the positive effects of helping others and volunteering to date.

Conditions Under Which Volunteering Is Beneficial

Importantly, research to date has also shown that people who volunteer are more likely to benefit from their volunteering activities under certain conditions and that people's motivations for volunteering are especially decisive. For example, Weinstein and Ryan (2010) concluded that prosocial behaviors led to greater benefits for helpers if their motivation for

helping was autonomous. Through a number of studies they concluded that participants showed no signs of improved psychological well-being, for example with respect to positive affect and self-esteem, following prosocial behaviors, in this case sharing money with someone else, unless they had autonomous reasons for doing so. Similarly, when participants were given the choice of sharing their money with someone else they reported benefits to psychological well-being, unlike participants who had not been given the choice but instead had simply been instructed to share part of their money.

Another study assessing the relationship between volunteering and mortality among older adults part of the Wisconsin Longitudinal Study found further support for the importance of underlying motivations (Konrath, Fuhrel-Forbis, Lou, & Brown, 2011). Specifically, the authors found that engaging in volunteering was associated with a reduced mortality risk four years later. However, this was not true among older adults who listed self-oriented reasons underlying their volunteering engagement and this subgroup of volunteers had a mortality risk comparable to that of nonvolunteers. These studies suggest that not all people are likely to benefit from their volunteering experiences and underscore the importance of the variability among motivations that lead different people to seek out volunteering experiences in the first place.

Similarly, research suggests that in addition to the type of motivations that may lead people to volunteer, the number of motivations that people have also influences their actual volunteer experience (Kiviniemi, Snyder, & Omoto, 2002). Following adult volunteers for several months these authors found that volunteers who approached their volunteering position with more than one motivation had a more negative volunteer experience that was

marked by greater stress and greater perceived costs. It is possible that individuals who begin a volunteer commitment with multiple motivations expect to fulfill all of these motivations but are unable to do so, hence perceiving their volunteer experience as less fulfilling or rewarding and more stressful.

Volunteering Among Adolescence

Why adolescence?

The above studies all describe effects of volunteering in adult samples, and so the question remains whether volunteering can be demonstrated to have similar effects during adolescence. Understanding factors that positively contribute to health and well-being during this developmental period is important as adolescent health has long-term implications for adult health, and because the beginnings of certain disease processes, such as atherosclerosis, i.e. hardening of the arteries, have been found to emerge in adolescence (Strong et al., 1999). Consequently, identifying possible routes to better health early on may have long-lasting effects into adulthood.

Transitions during adolescence.

Adolescence is a time in the life span during which youth undergo many changes. For example, adolescence is accompanied by puberty, meaning the maturation of the reproductive system, which leads to changes in adolescents' hormones as well as neural circuits, both of which are associated with behavior changes (Rosenfeld & Nicodemus, 2000; Spear, 2000; Sisk & Zehr, 2005) and are important aspects of youth's transition to adulthood.

Physical changes aside, however, adolescence is an important stage of youth's overall social and emotional development. Recent years have seen an increase in research

investigating *positive youth development*, which is marked by a focus on youth's potential and moral development that takes place during the adolescent years, as well as their interactions with the communities they live in (Benson, Scales, Hamilton, & Sesma Jr, 2006; Damon, 2004). Evidence suggests that adolescence is a time during which youth develop a sense of purpose, that is intentions to accomplish tasks that are meaningful to themselves as well as of consequence to their surroundings, and youth who report having a greater sense of purpose tend to be better psychologically adjusted (Damon, Menon, & Bronk, 2003). Furthermore, this is also the period in youth's lives during which other capacities, such as initiative, are developed (Larson, 2000). Although limited research suggests that the best opportunities for youth to develop such capacities are through involvement in structured voluntary activities, such as participating in organizations, such opportunities are, by and large, difficult to come by for youth.

Another psychosocial aspect of youth development that is important to consider in the current context is that of prosocial behaviors, that is voluntary behaviors intended to benefit others (see Eisenberg, Fabes, & Spinrad, 1998). Prosocial behavior has been shown to be associated with better peer reputations (Luthar & McMahon, 1996) but is also likely to influence youth's engagement in extracurricular activities, such as volunteering, as well as in turn likely shaped by such activities. Finally, it is important to keep in mind that the social environmental contexts that youth live in are key contributors to their development, and that broader environmental factors, such as the nature of the neighborhood setting, should be considered (Duncan & Raudenbush, 1999).

Research has shown that youth grow in a variety of ways as they reach adulthood; there also exists evidence suggesting that engaging in extracurricular activities can substantially aid youth development. For example, qualitative research employing focus groups of adolescents involved in community-based activities has found that youth report benefiting from such experiences in a number of ways, through connecting with others and improving their overall social skills but also by being able to develop their personal identities and initiative skills (Dworkin, Larson, & Hansen, 2003). Support for these findings comes from similar research that found that youth who were involved in arts and leadership programs developed their strategic thinking skills in the process (Larson & Angus, 2011) and another study linking organized youth activities to improved social networks and youth initiative, identity exploration and reflection, and emotional learning (Hansen, Larson, & Dworkin, 2003). Other studies have also linked participation in extracurricular activities to overall positive youth development, better educational outcomes, fewer problem behaviors, such as drinking, and lower rates of school dropouts (Eccles, Barber, Stone, & Hunt, 2003; Mahoney & Cairns, 1997). Hence, taking part in extracurricular activities, such as volunteering, has seemingly great potential to further youth's growth and developmental experiences.

However, the above literature has focused on how participation in such organizations and activities benefits psychological aspects of youth development, with little attention paid to health outcomes. Below is a review of the relatively limited literature that has investigated the effects of volunteering, or helping others, specifically on mental or physical health outcomes in adolescence.

Volunteering and helping others among adolescents.

Compared to the existing literature on the benefits of helping others among older adults, relatively few studies have investigated such effects among younger populations. The few studies that have documented the effect that helping others among adolescents can have, however, primarily found evidence supporting the notion that helping others can have a positive impact on adolescents as well (Moore 1996).

Who volunteers and why? More research focusing on volunteering among adolescents has focused on determining which adolescents are most likely to engage in volunteering activities and what adolescents' motivations for volunteering are. Several criteria have been linked to a greater likelihood of youth volunteering. Research suggests that the most important contributors to youth volunteering are the socialization processes youth are exposed to through their families, schools, and churches, all of which may model or emphasize the importance of helping others, thereby leading youth to engage in volunteering themselves (Raskoff & Sundeen, 1994; Raskoff & Sundeen, 1998; Sundeen & Raskoff, 2000). For example, youth from families that place a greater emphasis on community-oriented values are more likely to become volunteers (Janoski & Wilson, 1995) as are youth that have a higher social status to begin with, meaning youth that have more social power, larger social networks, and greater personal competency, all of which may facilitate access to volunteering programs (Sundeen & Raskoff, 2000).

Research regarding youth's motivations for volunteering has shown that, similar to motivations among adults, youth decide to volunteer for a wide variety of reasons including social, altruistic and egoistic motives (Cnaan & Goldberg-Glen, 1991). Overall, adolescent

motivations are similar to those of adults, but a few important differences exist. For example, adolescent volunteers are more likely to place greater emphasis on relationship concerns, rather than service concerns which are more commonly mentioned as motivations for volunteering among adults (Omoto, Snyder, & Martino, 2000). In addition, Schondel and Boehm (2000) suggest that aside from motivations commonly listed by adults, adolescent volunteers are also more likely to mention prosocial behavior, self-actualization, and peer pressure, supporting developmental research on adolescents saying that an important aspect of adolescent development is determining one's personal identity and that peer pressure represents a large influence in this age group.

Effects of volunteering on adolescents. With respect to the limited findings regarding the effects of volunteering on adolescents, a study investigating the effect of prosocial personality traits such as altruism among grade 4-7 students found that students who scored higher on altruism also reported being happier (Lawlor & Schonert-Reichl, 2008). This relationship was mediated by youth's increased sense of relatedness, that is their self-reported relationships with peers, adults, and their school community. This corroborates other research that has documented positive effects of altruism on happiness (Post, 2005) and the important role that altruism can play as a motivating factor for helping behaviors (Staub, 1991). Similarly, volunteering among adolescents has been shown to be associated with small but positive increases in social responsibility, particularly among girls (Hamilton & Fenzel, 1988). In addition, as a consequence of volunteering these youth also learned more about themselves as well as other people in their community. Another study comparing grade 7 students who volunteered throughout the school year to students who did not volunteer also found the effects of

volunteering to be gender-specific, but found boys to benefit more (Switzer, Simmons, Dew, Regalski, & Wang, 1995). Specifically, the authors reported that following several months of volunteering, participating boys showed evidence of improved self-esteem as well as lower depressive affect and fewer behavioral problems.

Research investigating the impact of youth volunteers at the community level also suggests that communities as a whole, not just youth themselves, can benefit from youth participating in community-based activities, as such activities appear to improve connections between youth and adults. This in turn leads to adults holding more positive beliefs about youth, which, presumably, could help to create more positive social community climates (Zeldin & Topitzes, 2002).

Another study moreover suggests potential benefits of volunteering specifically among adolescents coming from disadvantaged neighborhoods (Magen, Birenbaum, & Ilovich, 1992). Youth from such environments who had volunteered for a year were compared to wait-list controls (and youth who were not planning to participate in volunteering activities at all) and found to have developed a stronger sense of coherence in their lives, as well as a greater desire to commit themselves to society and, perhaps most importantly, a greater capacity to experience positive emotions. Hence, this strongly suggests that volunteering interventions might be a potentially useful tool among youth from disadvantaged neighborhoods.

Focusing youth's energy on volunteering activities may also contribute positively to their lives by impacting other highly relevant outcomes. Several studies have examined the impact of the Teen Outreach Program, a program designed to provide high school students with the opportunity to volunteer on a regular basis throughout the school year. Compared to youth in

control or comparison groups, those who were part of the Teen Outreach Program experienced lower rates of teenage pregnancies, behavior problems and academic failure following the program (Allen, Philliber, & Hoggson, 1990; Allen, Philliber, Herrling, & Kuperminc, 1997). This is further supported by other research linking youth volunteering to improved academic performance and fewer problem behaviors as well as pregnancies (Schondel, Boehm, Rose, & Marlowe, 1995; Uggen & Janikula, 1999).

Finally, for many youth helping others takes the form of informal volunteering within their homes and families (Fuligni et al., 2009a). This study found that adolescents who spent time helping out at home (for example, by taking care of their siblings or helping with cooking meals) and derived a sense of role fulfillment from these activities had lower levels of physiological inflammatory markers (C-reactive protein and soluble Interleukin-6 receptors) indicative of cardiovascular risk. While these findings are intriguing, this is currently the only study, to our knowledge, that has investigated *physiological* benefits of helping others among adolescents as well as potential pathways underlying these benefits. Clearly, these associations warrant greater attention.

Why Focus On Low Socioeconomic Status (SES) Individuals?

In the two studies presented here, we focused predominantly on lower SES youth and young adults. While volunteering has been linked to beneficial psychological and physical health outcomes that presumably the large majority of people could profit from, volunteering may be particularly valuable in low SES groups for a number of reasons. First, youth growing up in low SES environments are at an increased risk of experiencing worse long-term health. Second, there is evidence to suggest that individuals living in low SES environments may have

more to gain and may indeed benefit more than high SES individuals when exposed to such interventions.

Risk for poor health outcomes among low SES adolescents.

The gradient between physical health and SES, whereby individuals from lower SES backgrounds tend to have worse physical health, has been well-documented in a number of studies (e.g. Adler et al., 1994; Adler & Newman, 2002). In addition, this relationship has been shown to hold across a range of health outcomes among adults, including cardiovascular disease (Kaplan & Keil, 1993), diabetes (Everson, Maty, Lynch, & Kaplan, 2002), and overall mortality (Feinglass et al., 2007). While most of these studies investigated the relationship between SES and health outcomes among adults, there is strong evidence suggesting that one needs to look more closely at earlier stages of the lifespan to get at the cause of these health disparities. Specifically, researchers now largely agree that the influence of SES on health begins early in life and has lasting influences on youth's health well into their adults years (Chen, Matthews, & Boyce, 2002; Poulton et al., 2002). Hence, understanding SES-based health disparities during the pre-adult years is important, especially since adolescent health impacts adult health. For example, the beginnings of certain disease processes, such as atherosclerosis, begin to emerge as early as during adolescence (Strong et al., 1999).

Biological pathways are important to study in adolescence, because they represent the precursors to later-life disease, and because chronic disease diagnoses are rare in adolescence. Research on adolescent health has primarily focused on risk factors for cardiovascular health, such as blood pressure reactivity, and hormonal profiles, for example cortisol, which can provide information about the potential dysregulation of the hypothalamic-pituitary axis (HPA).

With respect to blood pressure in adolescence, Marin, Chen, and Miller (2008) found that low early life family SES was associated with increased current blood pressure among adolescents. Similarly, McGrath, Matthews, and Brady (2006) reported that lower neighborhood income predicted increased systolic blood pressure during daily life. Metabolic syndrome respresents another outcome of interest and describes a cluster of risk factors for cardiovascular disease. Recent research linking SES to metabolic syndrome suggests that lower parent education is also associated with multiple metabolic risks among adolescents, including higher insulin and glucose, higher low-density lipoprotein cholesterol, waist circumference, and body mass index (BMI), as well as cumulative risks (Goodman, McEwen, Huang, Dolan, & Adler, 2005).

SES has also been linked to inflammatory markers related to coronary heart disease risk, such as fibrinogen, a coagulation protein, and C-reactive protein (CRP). Murasko (2008) reported that low SES adolescents had higher levels of CRP in a sample of US adolescents. However, there are conflicting results in this domain, as other studies have found no relationship between SES and fibrinogen among old children (Cook, Whincup, & Miller, 1999), or higher levels of fibrinogen and CRP among boys from high SES schools (Thomas, Cooper, Williams, Baker, & Davies, 2005).

Finally, some studies have found links between SES and hormonal profiles among adolescents. Results from a longitudinal study (Evans & Kim, 2007) showed that among 13-year olds, those who had been exposed to greater cumulative exposure to poverty over the course of their lifespan had higher levels of overnight urinary free cortisol at the follow-up assessment, after controlling for baseline values. Another study found evidence of increased daily salivary cortisol output among healthy children and adolescents whose parents were less educated

(Wolf, Nicholls, & Chen, 2008). However, some studies have found that the association of low SES with higher salivary morning cortisol is stronger in younger children than in adolescents (Lupien, King, Meaney, & McEwen, 2001).

Evidence that volunteering may be especially beneficial in low SES individuals.

We expected the effects of volunteering on physiological markers to be especially evident among lower SES youth. Given that low SES individuals are more likely to suffer from poor health both currently and in the future, there may be more room for improvement (and prevention) with respect to health outcomes in this group.

Second, there is evidence to suggest that people living in low SES environments may have a stronger orientation towards helping others when compared to higher SES individuals, despite the fact that their every day lives may be less predictable and more challenging than those of people living in higher SES environments (Stephens, Hamedani, Markus, Bergsieker, & Eloul, 2009). In addition, low SES individuals are also more likely to be charitable or generous than their high SES counterparts (Piff, Kraus, Côté, Cheng, & Keltner, 2010). These studies suggest that low SES individuals may be more responsive to an intervention that involves helping others, given that it fits more naturally with their communal orientation in life.

Third, while low SES individuals show a stronger orientation towards helping others, low SES youth are less likely to engage in formal volunteering activities than high SES youth (Sundeen & Raskoff, 1995). Hence, it may be particularly important to provide these youth with opportunities to engage in such activities that they otherwise are less likely to be a part of.

Physiological Outcomes of Interest

The studies presented here investigated the effects of volunteering on the physiological outcomes of BMI, blood pressure, daily cortisol profiles, inflammatory and metabolic markers among adolescents. As mentioned above, low SES adolescents are already at risk for particular cardiovascular risk factors. Hence, the focus of our outcome variables was to primarily assess physiological mechanisms known to contribute to cardiovascular disease risk.

Obesity.

Focusing on outcomes more closely associated with later cardiovascular disease risk, one of the variables assessed in this study was BMI. Older children and adolescents with higher BMIs are at a much higher risk for cardiovascular disease risk factors than their counterparts with normal weight (Goran, Ball, & Cruz, 2003; Janssen et al., 2005; Katzmarzyk et al., 2004). As longitudinal research has shown that even among eight year old children who were followed for seven years, those with an increased BMI at age eight were more likely to show evidence of adverse cardiovascular risk clustering, the negative impact of being overweight or having a higher BMI begins early on (Garnett, Baur, Srinivasan, Lee, & Cowell, 2007). What is more, longitudinal data also suggests that there is a relationship between childhood obesity and coronary heart disease risk factors during adulthood. Data from the Cardiovascular Risk in Young Finns Study show that BMI assessed between the ages of 12 – 18 years was positively associated with carotid intima-media thickness, an indicator of atherosclerosis, 21 years later, even after taking into account current risk factors (Raitakari et al., 2003). This strongly suggests potentially long-lasting adverse effects of adolescent BMI status. Previous research has also shown that psychosocial factors can influence overweight status among adolescents. For

example, longitudinal data from grade 7 through 12 students has shown that depressed mood at baseline was associated with greater likelihood of becoming and staying obese one year later, whereas an opposite association was not found (Goodman & Whitaker, 2002). Furthermore, experiencing greater psychological stress has been cross-sectionally linked to higher overweight and obesity rates (Hamer & Stamatakis, 2008; Lohman, Stewart, Gundersen, Garasky, & Eisenmann, 2009; Roemmich, Smith, Epstein, & Lambiase, 2007).

Blood pressure.

High blood pressure represents another strong predictor of later life cardiovascular disease (Williams et al., 2002). Several studies have shown that both laboratory-based measures of blood pressure as well as ambulatory blood pressure can be affected by psychological stress and support among adults and adolescents alike. This includes as a result of typical laboratory stressors, such as public speaking tasks (Carroll et al., 2001; Chen, 2007; Matthews et al., 2004; Matthews, Salomon, Brady, & Allen, 2003), and in response to real life stressors encountered in one's every day life, for example job stress or discrimination (Brondolo et al., 2008; Matthews, Salomon, Kenyon, & Zhou, 2005; Vrijkotte, van Doornen, & de Geus, 2000).

Conversely, however, data imply that receiving, and in one case providing, social support may buffer people from the adverse effects of psychological stress on cardiovascular reactivity (Christenfeld & Gerin, 2000; Uchino et al., 1996). As with research investigating the influence of stress on blood pressure, the effects of social support on blood pressure have also been found across laboratory-based studies and in real-life situations. For example, when exposing participants to stressful tasks, such as public speaking tasks, in the laboratory, the

presence of a friend significantly lowers participants' cardiovascular reactivity to these stressors (Edens, Larkin, & Abel, 1992; Gerin, Milner, Chawla, & Pickering, 1995; Gerin, Pieper, Levy, & Pickering, 1992; Kamarck, Manuck, & Jennings, 1990; Lepore, Allen, & Evans, 1993). Likewise, greater reported social support was found to be associated with lower ambulatory blood pressure among women (Linden, Chambers, Maurice, & Lenz, 1993), as were more supportive social interactions in another study (Holt-Lunstad, Uchino, Smith, Olson-Cerny, & Nealey-Moore, 2003). One study furthermore found that participants' trait-like disposition towards providing social support was associated with lower 24-hour ambulatory blood pressure among young adults (Piferi & Lawler, 2006).

Inflammatory markers.

Several inflammatory markers, including, for example, CRP and Interleukin-6 (IL-6) also represent risk factors for later cardiovascular disease (Van Lente, 2000). CRP is an acute phase reactant protein considered to be a serum-based marker of systemic inflammation (Lagrand et al., 1999). It is synthesized and secreted in the liver following signals from cytokines such as IL-6. CRP is considered one of the most powerful predictors of cardiovascular disease among healthy men and women (Danesh et al., 2000; Ridker, Buring, Shih, Matias, & Hennekens, 1998; Ridker, Cushman, Stampfer, Tracy, & Hennekens, 1997; Ridker, Hennekens, Buring, & Rifai, 2000a). IL-6 represents another marker of systemic inflammation and is an inflammatory cytokine also considered to play an important role in acute-phase response, in part, as mentioned above, by stimulating the production of CRP from the liver (Van Snick, 1990; Yudkin, Kumari, Humphries, & Mohamed-Ali, 2000). Several studies have linked higher IL-6 concentrations to increased cardiovascular disease risk (Harris et al., 1999; Ridker, Rifai,

Stampfer, & Hennekens, 2000b). Finally, there is pre-existing evidence that various psychosocial factors may influence concentrations of inflammatory markers such as CRP and IL-6. With respect to CRP, studies suggest that acute psychological stress may increase CRP concentrations (McDade, Hawkley, & Cacioppo, 2006; Steptoe, Hamer, & Chida, 2007). In addition, individuals with depression exhibit higher concentrations of CRP (Miller, Stetler, Carney, Freedland, & Banks, 2002). Similar findings exist with respect to IL-6, linking both depression (Maes et al., 1997; Miller et al., 2002) and stress (Steptoe et al., 2007) to higher concentrations, as well as greater psychological well-being to lower levels (Friedman, Hayney, Love, Singer, & Ryff, 2007). IL-6 has furthermore been shown to be lower among cancer patients with greater social support (Costanzo et al., 2005; Lutgendorf, Anderson, Sorosky, Buller, & Lubaroff, 2000) and higher among older women with poorer social ties (Friedman et al., 2005). Higher social support was also found to buffer women from the negative effects of stress on CRP levels (Mezuk, Diez Roux, & Seeman, 2010).

Metabolic markers.

Lastly, two metabolic markers, cholesterol and glycosylated hemoglobin (HbA1c), were outcomes of interest. Cholesterol is a lipid serving several functions inside the body, including the build up of membranes and intracellular transport. Having a larger ratio of low-density lipoproteins (LDL) to high-density lipoproteins (HDL), both lipoproteins responsible for the transportation of cholesterol throughout the body, is associated with worse health outcomes. HbA1c is a longer-term (~3 months) average of blood glucose levels, meaning a measure of blood glucose that does not require fasting prior to assessment and is furthermore unaffected

by short-term changes in diet or blood sugar control. It is frequently used as an indicator of long-term diabetes control.

An association between cholesterol and atherosclerosis can already be found among adolescents and young adults (Group, 1990). Autopsy data from healthy young people between the ages of 15 and 34 years of age who died of accidents, homicides, or suicides further support the notion that LDL and HDL cholesterol are positively and negatively associated with early atherosclerosis, respectively (McGill et al., 2000). In addition, adolescent cholesterol values, particularly from the 12-18 year age group have been found to track well into adulthood, suggesting that adolescents with undesirable cholesterol values are likely to still be at risk when they reach adulthood, potentially predisposing them to cardiovascular disease (Juhola et al., 2011). Cross-sectional and longitudinal data moreover suggest that serum cholesterol is related in a linear fashion to greater risk for cardiovascular disease and mortality resulting from cardiovascular disease and that these relationships hold across several different countries and cultures (Castelli et al., 1986; Klag et al., 1993; Pekkanen et al., 1990; Verschuren et al., 1995). Finally, several small scale studies indicate that acute and long-term stressors may result in elevated cholesterol levels (Muldoon et al., 1995; O'Donnell et al., 1987; Patterson, Matthews, Allen, & Owens, 1995).

Similarly, associations between elevated HbA1c levels and cardiovascular risk have been found. Cross-sectional and prospective longitudinal data suggest that even among individuals free of diabetes and clinically relevant cardiovascular disease, higher levels of HbA1c are associated with mortality due to cardiovascular disease as well as subclinical cardiovascular disease and peripheral arterial disease (Khaw et al., 2004; McNeely et al., 2009; Muntner et al.,

2005), suggesting that elevated HbA1c levels may contribute negatively to long-term cardiovascular health outcomes. However, some studies suggest that the relationship was attributable to other cardiovascular disease risk factors that frequently co-occur with elevated HbA1c levels (Pradhan, Rifai, Buring, & Ridker, 2007). In addition, greater levels of HbA1c have been strongly linked to future risk of diabetes (Edelman, Olsen, Dudley, Harris, & Oddone, 2004; Perry, Shankar, Fineberg, McGill, & Baron, 2001). In turn, there is a well-established relationship between higher levels of HbA1c and increased cardiovascular disease risk among people with diabetes (Heo, Lee, Kim, Kang, & Yoon, 2010; Selvin et al., 2004).

Salivary cortisol.

Lastly, daily cortisol was assessed to investigate whether engaging in volunteering might alleviate stress among volunteers and hence result in altered cortisol profiles among students in the intervention group. Cortisol is a hormone that is secreted by the adrenal cortex in response to activation of the HPA axis, which in some cases can come in response to a stressor. In healthy people cortisol secretion follows a circadian pattern such that the highest levels are released shortly after waking, following which cortisol production decreases throughout the remainder of the day (Van Cauter, 1995). Although cortisol production increases following acute physical and psychological stressors, greater time since exposure to a chronic stressor is associated with lower cortisol activity (Miller, Chen, & Zhou, 2007).

Possible Pathways Connecting Helping Others and Health

A number of different pathways that have the potential to connect helping behaviors to benefits to the 'helper' have been suggested in the literature. Broadly speaking these pathways can be grouped into two categories, those who operate through altering the social connections

between ‘helpers’ and others, that is, interpersonal pathways, and those that focus on the positive changes that helping others may bring about within people, such as an altered sense of purpose in life (intra-individual pathways).

Interpersonal variables.

One of the most commonly mentioned pathways through which helping others may come to positively influence those providing support is that of social integration (Post, 2005). That is, it is speculated that as part of their volunteering activities people broaden their social networks and make additional social connections, thereby improving their overall social integration. The extent to which people are able to connect with others as part of their volunteer activities undoubtedly depends on the type of volunteer activities they are engaged in as some activities are much more focused on interpersonal connections than others. However, helping behaviors and volunteer work that focuses on working closely together with other volunteers as part of a larger organization or alternatively on working for other people is likely to expose volunteers to new potential social contacts and friendships (Eccles et al., 2003; Fried et al., 2004; Musick & Wilson, 2003). These effects are thought to extend beyond improved social contacts to improved overall social capital, meaning people’s connections to those around them, for example in their community and schools (Dworkin et al., 2003). Specifically, this could include connections between volunteers and people within their community who are in charge of organizing a particular neighborhood volunteering program. Most importantly, qualitative research has shown that volunteers see these additional social connections as important and positive contributions to their lives as well (Dworkin et al., 2003).

The relatively large literature supporting the notion that better social networks and social connections may be accompanied by physical health benefits further underscore the plausibility of these variables as potential pathways from volunteering to physical health (Seeman, 1996). For example, simply having more and better quality social relationships has been repeatedly linked to a decreased likelihood of mortality over follow-up periods, even after controlling for a host of other demographic and health-related variables (Berkman & Syme, 1979; House, Landis, & Umberson, 1988). Note, however, that the relationship between social connections and cardiovascular mortality has been found by some studies to exist only in men, and not in women (Kaplan, Salonen, Cohen, Brand, & Leonard, 1988; Schoenbach, Kaplan, Fredman, & Kleinbaum, 1986). Similarly, greater social capital itself has also been linked to reduced mortality (Kawachi & Kennedy, 1997). In addition, individuals with better social networks, may also be better protected from the negative effects of stressors in their life (Cohen & Wills, 1985), suggesting that social networks can serve a buffering effect among people.

Intra-individual variables.

The second type of pathway proposed to explain the effects of volunteering focuses on intra-individual, or within-person, changes resulting from volunteer experiences. For example, research suggests that helping others may help people feel better about themselves, that is, it may increase people's sense of self-esteem and lead them to experience more positive emotions (Post, 2005). This is again mirrored in statements of adolescents and older adults who have volunteered and reported that volunteering was associated with a more positive sense of self (Dworkin et al., 2003; Newman et al., 1985). This may be due to people who help others

experiencing a greater sense of meaning, or purpose, in their life. In addition, people who help others and volunteer on a regular basis may receive direct and immediate positive feedback from the people they were helping, further reinforcing a more positive sense of self.

Greater meaning in life and the experience of more positive emotions would also likely have positive influences on physical health. More specifically, having greater meaning and purpose in life has been linked to more desirable inflammatory profiles, such as lower levels of IL-6 among older women (Friedman et al., 2007). Similarly, personal development and growth, as well as being engaged in purposeful activities has been shown to be associated with lower levels of pro-inflammatory cytokines and cardiovascular risk among older women (Ryff, Singer, & Love, 2004), suggesting the possibility that the personal growth people might experience as a result of volunteering could improve their future health. This is further supported by research showing that greater self-esteem can be protective of cardiovascular and other diseases (Taylor, Lerner, Sherman, Sage, & McDowell, 2003) and that experiencing positive emotions is associated with greater longevity as well as reduced disease risk (Pressman, 2005).

Lastly, as mentioned in previous sections, helping others has been associated with health behaviors and a healthier lifestyle to the extent that those who volunteer have been shown to be more physically active (Fried et al., 2004; Tan et al., 2006; Tan et al., 2009). Lifestyle changes, such as increased physical activity, represent another factor that may shape people's current and future health. For example, being more physically active has been linked to reduced risks of commonly experienced health problems, such as obesity, among adolescents (Patrick et al., 2004). Hence, the various pathways described here provide several possible explanations for how helping others may come to impact physical health. However,

the exact physiological mechanisms underlying these pathways remain poorly understood and understudied.

Gaps in Previous Research

The above-discussed studies strongly suggest that there are benefits to be gained from providing social support to others, either informally, or through more structured activities, such as volunteering. However, it also becomes apparent that the literature investigating this relationship so far suffers from several shortcomings.

First, the large majority of studies that provide a thorough investigation of the impact of helping others have focused on older adults, typically aged 55 years and above. While understanding the influence that volunteering and helping others may have in this age group is certainly important, more research needs to investigate this relationship among younger samples.

Second, the majority of research on this topic has focused on assessing socioemotional outcomes, such as depressive symptoms. Again, while these are important outcomes to consider, physical health benefits must also be assessed in more detail as it is important to understand how people's physical health may benefit as a result of helping others. What is more, the few studies that have considered outcomes relating to physical, rather than mental, health, relied on either self-reported health, global outcomes such as all-cause mortality, or outcomes that apply primarily to older populations, for example physical activity limitations in daily life. Hence, more research should investigate health-relevant outcomes among younger persons and include the measurement of health-related markers at the biological level.

Third, and along similar lines, there has been virtually no investigation of the biological pathways connecting helping others to physical health outcomes. More research is needed to investigate the underlying mechanistic pathways connecting helping others to outcomes such as mortality from cardiovascular diseases. This would involve an examination of common biological factors implicated in such disease processes, such as inflammatory markers found in blood.

Fourth, as the above brief review of the literature has shown, there is a lack of experimental research in this area. Findings from correlational studies converge on the positive effects of helping others, both with respect to mental health and certain indicators of physical health, but experimental research is needed to establish causality between helping others and benefits to the helper.

Fifth, more research is needed that assesses positive outcomes of helping others among disadvantaged groups, such as individuals from low SES environments, for whom engaging in such activities may be particularly relevant and who may be able to benefit the most.

The Present Studies

The studies described here extend previous research on the effects of helping others while also improving on a number of methodological issues in previous research. First, both studies made use of experimental designs in which participants were randomized to either volunteer or not, enabling stronger conclusions about causality. Second, the current studies focused on investigating the effects of helping others among younger samples, adolescents and undergraduate students, as the effects of helping others are less well understood in these age groups. In addition, an effort was made to target participants from low SES backgrounds.

Finally, the described studies aimed to explore several reasons why volunteering might be linked to physiological outcomes. In these studies, blood pressure, salivary cortisol (Studies 1 and 2) and inflammatory and metabolic markers (Study 2) were assessed.

Study 1 focused specifically on the potential effects of informal volunteering, whereas Study 2 focused on the effects of formal volunteering. While these two concepts have much in common, it is possible that they have different effects on adolescents and young adults and they were hence investigated separately. For example, since informal volunteering most frequently takes place within the family, it has the potential to alter the social fabric of the home environment which adolescents and young adults spend significant amounts of time in. Conversely, while formal volunteering may have positive effects through a number of pathways it is less likely to result in changes to the social environment that could lead to more permanent influences on volunteers.

Lastly, another appeal of implementing such interventions is the implication that there could be benefits that extend beyond the study participants themselves. That is, presumably the beneficiaries of the volunteering activities (those whom study participants were helping) benefitted as well. Evidence from the Baltimore Experience Corps project for example, showed that the elementary school children who were the 'targets' of this volunteering intervention benefited from the project (Rebok et al., 2004). Previously described research has also reported an increased sense of social responsibility and increased knowledge about their communities among adolescents as a consequence of volunteering (Hamilton & Fenzel, 1988). Similarly, youth volunteers may help improve the relationships between youth and adults in their

communities (Zeldin & Topitzes, 2002). Hence a single intervention has the potential to improve outcomes across multiple groups, making it appealing from a policy perspective.

Study Overview and Study Hypotheses

Study overview and aims.

The aim of the proposed research was to investigate whether an experimental manipulation to get participants engaging in volunteering could lead to improved physiological outcomes among healthy adolescents and young adults. To this end, two studies were conducted. The first investigated whether university students living at home who were randomized to engage in additional family helping behaviors (informal volunteering) for four weeks would show evidence of improved physiological outcomes when compared to university students who were randomized to engage in mundane every day tasks at home for four weeks.

The second study investigated whether grade 10 students who were randomized to perform formal volunteering on a weekly basis for a two-month period showed improved physiological outcomes when compared to youth who were randomized to a wait-list control group. One hundred and six grade 10 students were randomized into either the intervention group at the beginning of the school year or into a wait-list control group (scheduled to begin volunteering four months later). In both Study 1 and Study 2, relevant physiological outcomes were assessed before and after the intervention and potential psychosocial explanations regarding what types of changes in volunteers might be linked to changes in physiological outcomes were investigated.

Hypotheses. We hypothesized that participants who were randomly assigned to regularly engage in family helping behaviors for four weeks, or to volunteer for two months,

would show evidence of better physiological outcomes than participants who were randomly assigned to the control groups. Specifically, we expected participants in the *volunteering* conditions of the two studies to show evidence of lowered blood pressure at follow-up as well as lower daily cortisol output at follow-up compared to those in the control group. In addition, we expected participants in the *volunteering* condition in Study 2 to show evidence of better metabolic and inflammatory profiles at follow-up compared to those in the control group. We further expected that those who showed the greatest improvements in family relationship quality and social connections, would also show the largest improvements on physiological variables.

Chapter 2: Effects of Family Helping Behaviors Among Young Adults

Traditionally, volunteer work has been understood as work that the worker does not receive payment for and provides for people to whom he or she has no obligations (Tilly & Tilly, 1994). While still considered an accurate definition, it has more recently been criticized for being too narrow in its scope. Wilson and Musick (1997) have argued that this definition lacked the inclusion of more informal helping behaviors that large segments of the population, most notably women, engage in on a frequent basis. This informal type of volunteering differs from Tilly and Tilly's (1994) definition with respect to the idea that volunteer work be provided only to people to whom the worker has no obligations. Wilson and Musick (1997) and others have argued that family behaviors within the home or helping other family members should count as part of volunteering. Hence, most people now commonly differentiate between formal volunteering, e.g. with community organizations, and informal volunteering, e.g. providing help to family and friends. The present study tests whether an experimental manipulation of informal volunteering (family helping behaviors) can have physiological benefits among young adult volunteers.

Known Benefits of Giving and Receiving Support

The benefits of receiving support from others have been widely documented and range from improved cardiovascular and immune outcomes (Evans & Steptoe, 2001; Gallo et al., 2000; Glass et al., 1993; Steptoe, 2000; Uchino et al., 1996) to better psychological well-being (Hays et al., 2001; Kawachi & Berkman, 2001; Luszczynska et al., 2007; Sayal et al., 2002), as well as to improved adherence to medical regimens (DiMatteo, 2004) and self-management behaviors (Gallant, 2003). However, more recently attention has been shifting to the question

of how providing support to others affects the psychological and physical well-being of the support provider. Several studies suggest that the amount of support a person provides is more beneficial with respect to mental health and psychological well-being than the amount of support a person receives (e.g., Schwartz et al., 2003; Thomas, 2010).

Most of this research has examined the effects of giving support and helping others among adults and older adults. Results suggest that among older adults, providing help to others, i.e. engaging in informal volunteering, allows for quicker recovery from depressive symptoms following bereavement (Brown et al., 2008), predicts greater overall well-being (Thomas, 2010), and a greater sense of personal control, which in turn is associated with fewer depressive symptoms (Krause et al., 1992). With respect to physical health outcomes, older adults who support others have been shown to have lowered mortality risks several years later (Brown et al., 2003; Brown et al., 2005).

Less is known about how informal volunteering affects younger individuals, which is the focus of the present study. Adolescents who live at home spend significant parts of their after school time assisting their family, often engaging in family helping behaviors for more time than they spend studying for school (Hardway & Fuligni, 2006).

Two studies have specifically focused on the impact of helping others among young, undergraduate populations. Deci, LaGuardia, Moller, Scheiner, and Ryan (2006) examined the effects of autonomy support on close friendships. Autonomy support refers to support that is based on promoting self-initiation in others and being responsive to others. Not surprisingly they found that greater autonomy support in a friendship was associated with greater perceived relationship quality. However, they also found that both giving and receiving

autonomy support predicted relationship quality. Furthermore, when both variables were entered into the model simultaneously, providing autonomy support more strongly predicted perceived relationship quality compared to receiving autonomy support. This may suggest that many people place great value on being able to contribute adequately to their relationships with those around them.

In addition, one study in university undergraduates also found associations between tendencies to provide support and blood pressure (Piferi & Lawler, 2006). As part of this study participants were asked to complete questionnaires assessing their trait-tendency towards providing support to others, for example how likely they were to call someone they knew to see if they were doing well. In addition, participants were outfitted with an ambulatory blood pressure monitor assessing their blood pressure throughout the day. Results suggested that a greater trait-tendency to give support was associated with lower blood pressure levels in every day life in this sample of healthy undergraduate students. The authors speculated that this relationship was mediated by an increased sense of self-efficacy experienced by those higher in trait support provision. However, it is also important to note that all of the above studies employ correlational research designs and hence that conclusions about causality are difficult to draw.

Research in younger, adolescent populations has revealed some mixed findings with respect to informal volunteering, such as helping family. On the positive end, one study comparing European, Mexican, and Chinese adolescents found that adolescents who spent more time providing family assistance generally reported feeling happier (Telzer & Fuligni, 2009b). This was especially true for help with siblings or in the household, although not for

helping parents with work. This may be because adolescents' assistance with parents' work is indicative of larger family struggles. Helping with parents' work is also likely to put more pressure on adolescents, making it a less relaxed and enjoyable helping experience. Conversely, helping out with siblings and other household chores may give youth more opportunities to feel that they are contributing in a meaningful way to the family. This is supported by the finding that a greater sense of role fulfillment mediated the relationship between family assistance and greater psychological well-being. Finally, neither this study, nor an earlier one found evidence of family assistance leading to psychological distress among youth (Fuligni, Yip, & Tseng, 2002).

One further study used functional magnetic resonance imaging (fMRI) to investigate neural activity in response to family assistance among White and Latino college students (Telzer, Masten, Berkman, Lieberman, & Fuligni, 2010). During the fMRI measurements participants were asked to distribute money to their families or themselves. Interestingly, participants from a Latino background showed more neural activity in the reward system of the brain, the mesolimbic area, when giving money to their family and not themselves, whereas the opposite was true for White participants. What is more, participants who, two years earlier, had reported greater role fulfillment in response to providing family assistance also showed greater neural activity in the reward system when allocating money to their families as opposed to themselves.

However, daily family assistance has also been reported to have some negative effects on academic achievement among adolescents from Mexican or Chinese (though not European) backgrounds (Telzer & Fuligni, 2009a). Specifically, increases in proportion of days spent helping

the family led to subsequent poorer academic achievement among these adolescents, although neither changes in study time nor school problems were able to explain this relationship.

Finally, among 12th graders of European and Hispanic descent who spent time helping around the home, adolescents who reported gaining a greater sense of role fulfillment from their helping behaviors at home showed evidence of lower levels of inflammatory markers, CRP and soluble IL-6 receptor, both of which are indicative of greater inflammation and risk factors for cardiovascular disease in later life (Telzer & Fuligni, 2009b). These findings suggest that if adolescents derive meaning from their helping behaviors, there are beneficial effects on physiological markers.

A Focus on Potential Benefits to Low SES Youth

It may be particularly important to investigate the physiological effects of informal volunteering among groups that show heightened vulnerability to disease. One group at particular risk is those who come from low SES backgrounds. A wealth of evidence suggests that low SES individuals are at greater risk of developing cardiovascular disease (Galobardes, Smith, & Lynch, 2006; Kanjilal et al., 2006; Kaplan & Keil, 1993; Winkleby, Jatulis, Frank, & Fortmann, 1992). Furthermore, even in adolescence low SES is associated with cardiovascular risk. For example, adolescents from low SES backgrounds have heightened levels of metabolic symptoms (Goodman et al., 2005; Goodman, Daniels, & Dolan, 2007) and inflammatory markers, such as CRP and fibrinogen (Murasko, 2008), although there are some conflicting results (Thomas et al., 2005). Nonetheless, if volunteering has beneficial effects on cardiovascular risk profiles, this could be especially important among those already at greatest risk.

Physiological Outcomes of Interest

The present study investigated the effects of volunteering on the physiological outcomes of blood pressure and cortisol among youth. High blood pressure, for example, is one of the strongest predictors of later life cardiovascular disease (Williams et al., 2002). Blood pressure has furthermore been shown to be affected by psychological stress and social support. Specifically, several studies have linked a variety of laboratory stressors, for example public speaking tasks, to increased blood pressure among both adolescents and adults (Carroll et al., 2001; Chen, 2007; Matthews et al., 2003; Matthews et al., 2004). These laboratory-based findings are moreover supported by studies employing measures of ambulatory blood pressure. Data based on participants' blood pressure throughout the day have shown that experiencing stressors, such as work stress or discrimination, in one's everyday environment, also leads to increased blood pressure among adolescents and adults alike (Brondolo et al., 2008; Matthews et al., 2005; Vrijkotte et al., 2000).

Encouragingly, however, social support has also been linked to cardiovascular reactivity, providing buffering effects during times of stress (Christenfeld & Gerin, 2000; Uchino et al., 1996). A number of laboratory-based studies have established that social support, for example the presence of a friend, significantly lowered cardiovascular reactivity in response to acute stressors (Edens et al., 1992; Gerin et al., 1992; Gerin et al., 1995; Kamarck et al., 1990; Lepore et al., 1993). Similarly, social support has been linked to cardiovascular reactivity in every day life when ambulatory blood pressure measurements were being used (Holt-Lunstad et al., 2003; Linden et al., 1993). Finally, in one study participants' trait-tendency towards providing social support was linked to lower ambulatory blood pressure (Piferi & Lawler, 2006).

The hormone cortisol is secreted in response to activation of the HPA axis, e.g. in response to stress, and follows a typical circadian pattern such that in a healthy person the highest levels of cortisol are released in the morning shortly following waking with decreasing levels throughout the remainder of the day (Van Cauter, 1995). Cortisol production typically increases in response to acute stressors but the longer a stressor goes on for, the lower a person's cortisol secretion (Miller et al., 2007). It is possible that informal volunteering may alter daily patterns of cortisol.

Why Would Informal Volunteering be Associated with Physiological Profiles?

Previous research points to several psychosocial and behavioral explanations of why helping others may come to benefit the helper. Some factors that have received large amounts of attention revolve around social integration and new relationships and social contacts built through volunteering (Fried et al., 2004; Post, 2005). With respect to informal volunteering and providing family assistance in the home this might translate into improved quality of family relationships. To our knowledge, no studies have investigated the role of adolescents' family helping behaviors on parent-child relationships. However, research does suggest that parent-child relationships are important contributors to children's mental health, for example in that family stress is a significant contributor to psychological distress among youth (Chung, Flook, & Fuligni, 2009).

Furthermore, helping others may lead to improved health outcomes through changes within helpers. For example, there is evidence suggesting that helping others may lead to greater psychological well-being, such as a more positive sense of self and increased self-esteem (Dworkin et al., 2003; Post, 2005), in other words, may lead people to feel better about

themselves. Increased self-esteem and a positive sense of self have in turn been linked to lower cardiovascular risk among adults (Ryff et al., 2004). In addition, research cited above has already shown that volunteering and helping others may relieve depressive symptoms (e.g., Thoits & Hewitt, 2001). This is notable as depression has been linked to an increased risk for cardiovascular disease (Carney, Freedland, Miller, & Jaffe, 2002; Miller et al., 2002) and helping others may consequently help to reduce these effects by improving depressive symptoms among helpers.

Finally, helping others may decrease one's own perceptions of stress. While it seems plausible that the increased time spent on family helping behaviors may contribute to existing stressors in the helper's life, possibly overburdening him or her, it is also possible that through their contribution to the household, family helping behaviors make helpers feel better about themselves and as a result experience less stress. Indeed, this is supported by previous research on adolescents that suggests that engaging in family helping behaviors does not increase perceived psychological distress among these adolescents (Fuligni et al., 2002) but may instead even increase subjective ratings of happiness and positive mood (Telzer & Fuligni, 2009b). Similar to the impact of depression on cardiovascular disease risk, perceived stress has also been identified as a risk factor for cardiovascular disease (Cohen, Janicki-Deverts, & Miller, 2007) and people could hence benefit from reduced levels of stress.

The present study aimed to investigate the impact of an experimental manipulation that randomly assigned young, healthy adults to engage in either regular family helping behaviors or mundane every day tasks over a four week follow-up period on physiological outcomes, specifically blood pressure and salivary cortisol. In addition, potential psychosocial variables

that might explain changes in physiological measures within the intervention group were evaluated. It was hypothesized that engaging in family helping behaviors would result in lower blood pressure at follow-up and decreased secretion of, as well as steeper slopes of, cortisol compared to engaging in mundane every day activities.

Methods

Participants.

Thirty-nine undergraduate students from the University of British Columbia were recruited through flyers posted on campus and advertisements in campus newsletters. To be eligible for this study participants had to be between the ages of 19 to 25 years old, fluent in English, free of chronic illness, not currently be taking any prescribed medications, and living at home with their families. First generation university status, i.e. having parents without university degrees, was used as a proxy for low SES among undergraduate students, and these students were preferentially recruited. The sample was primarily low SES, with 31 participants (79%) having both parents without university degrees, 5 participants (13%) having one parent with a university degree, and 3 participants (8%) having two parents with a university degree. The sample was 54% female (n = 21) and predominantly East Asian. Specifically, 87% (n = 33) of participants self-identified as East Asian, 5% (n = 2) as “Other Asian” and 8% (n = 3) as Caucasian. Twenty students were randomly assigned to the intervention group, and the remaining nineteen participants to the control group. One participant in the control group did not return for the follow-up visit and is excluded from all analyses below, resulting in a final sample size of 18 participants in the control group. See Table 2.1 for sample descriptive statistics.

Intervention.

Participants randomized into the intervention group were asked to engage in additional family helping behaviors at home, above and beyond help they might typically provide at home. Participants were instructed to engage in some type of helping behavior at least three times per week for the subsequent four weeks. During the first laboratory session, the experimenter and participant discussed what specific helping behaviors the participant would do, to ensure that the participant was performing an appropriate helping behavior and to ensure that the participant was not choosing tasks they already performed around the house on a regular basis. This could be the same helping behavior on three separate occasions each week, or different helping behaviors. The most common helping behaviors that participants in this study chose to engage in included providing help cleaning the house, getting groceries, cooking meals, and helping siblings and parents with school or work, respectively.

Participants assigned to the control group were asked to engage in additional activities three times a week for the subsequent four weeks. This allowed us to equalize the amount of time spent doing new activities across the two groups. To make sure that their activities resembled the ones engaged in by the intervention group as closely as possible (with the exception of the helping component) participants were asked to select activities which a) they did not typically engage in, b) they could do inside the home, c) they could do alone, and d) did not focus primarily on physical exercise, i.e. working out. The most common activities selected by control group participants included reading for leisure, crafts, playing musical instruments, and staying informed about current affairs.

As part of the intervention, participants in the control group spent an average of 22.3 ± 19.0 hours on their assigned activities over the four week study period. Participants in the intervention group spent an average of 20.73 ± 18.0 hours on their assigned family helping behaviors over the four week study period.

Measures.

Outcome measures. Outcome measures of physiological markers were collected, including blood pressure and salivary cortisol.

To assess systolic and diastolic blood pressure, blood pressure readings were taken from participants after they had been comfortably seated in a chair and rested for five minutes. Four blood pressure readings were then taken, spaced two minutes apart, using an automated oscillometric device (BPM-100, VSM MedTech, Coquitlam, BC). The first reading was automatically discarded and readings two through four were averaged.

Participants collected saliva samples for two days following each laboratory visit. Participants were instructed to collect samples 1, 4, 9, and 11 hours after waking, as recommended by the MacArthur Foundation Research Network on Socioeconomic Status and Health (www.macses.ecsf.edu). Samples were collected by participants placing a sterile cotton dental roll (Salivette, Sartstedt Corp.; Nümbrecht, Germany) in their mouth for 60 seconds. Cotton rolls were then placed in a plastic tube and returned to the lab within the week. Compliance was monitored by asking participants to time-stamp each saliva collection on the salivette labels using a provided stamper (DYMO Datemark) whose time-date function was password protected and could not be changed by the participants. Participants' adherence to the saliva sample completion was excellent, resulting in 566 of 608 (93.1%) usable samples

being returned to the laboratory for analyses. Samples were refrigerated until the end of the study and subsequently sent to the laboratory of Drs. Jutta Wolf and Nicolas Rohleder at Brandeis University where they were stored at -30°C until assay. At this point, samples were spun at 2000 g for 5 minutes and 4°C. Salivary free cortisol concentrations were then measured using commercial chemiluminescence immunoassay (CLIA; IBL-International, Toronto, Canada). Intra- and inter-assay CVs were below 10%.

Cortisol values were log-transformed to reduce skewness. Total daily cortisol output was computed by calculating the area under the curve (AUC) statistic using the trapezoidal rule. Specifically, for each day and each participant a line depicting cortisol values at each of the four time points of data collection was plotted, and the AUC value was calculated as the sum of the areas of the four trapezoids below that line. Higher numbers reflect greater cortisol release throughout the day. In addition, cortisol values were averaged across two days to increase stability and the regression line (cortisol values/corresponding time since wakeup) computed. Steeper slopes indicate rapidly declining salivary cortisol measures throughout the day, and flatter slopes indicate a slower decline over the course of the day.

Psychosocial measures. Psychosocial variables, including participants' mood and psychological well-being, and the quality of participants' family environment, were assessed using self-report questionnaires.

Depressive symptoms were assessed using the 10-item version of the Centre for Epidemiological Studies – Depression Scale (CES-D; Radloff, 1977). This questionnaire assesses the frequency of various behaviors, such as feeling hopeful about the future, over the past week (from 0 = *less than one day* to 3 = *5-7 days*). The CES-D is not a diagnostic instrument but

assesses depressive symptoms; it has been shown to have an excellent internal consistency of α = .85 in the general population. Higher scores indicate more depressive symptoms. Internal consistency in the present sample was α = .83.

To assess changes in perceived stress as a further possible connection between helping behaviors and better physiological outcomes, perceived stress was assessed. Participants were asked to complete the short, 4-item version of the Perceived Stress Scale (PSS; Cohen, Kamarck, & Mermelstein, 1983). This questionnaire assesses the frequency of behaviors, such as feeling confident in one's ability to handle personal problems, over the past month on a five-point scale (from 0 = *never* to 4 = *very often*). Internal reliability of the PSS has been found to be very good, with αs between .84 and .86. Higher scores indicate greater perceived stress. Internal consistency in the present sample was α = .79.

To assess whether engaging in family helping behaviors improved participants' psychological well-being they were asked to complete the short version of the Brief Psychological Well-Being scale (BPWB; Ryff, 1989). This scale consists of six subscales, autonomy, environmental mastery, personal growth, positive relations with others, purpose in life, and self-acceptance, each of which is assessed through three questions answered on a scale from 1 = *strongly disagree* to 6 = *strongly agree*. Higher scores indicate greater psychological well-being. Six-week test-retest reliability for the full-length scale has been shown to be > .80 for all subscales and internal consistency estimates for individual subscales of the full-length version are all between α = .86-.93. Higher scores suggest more positive psychological functioning. Internal consistency ranged from α = .32 to .74 in the present sample. This is quite low, however, it is comparable to previous estimates of internal

consistency of the brief version of the scale. Because of time constraints and because participants were already required to complete a number of other questionnaires, we nonetheless decided to use the short form of the Psychological Well-Being scale.

Aspects of participants' family environment that may have changed in response to the intervention were also assessed. Participants were asked to complete the Family Environment Scale (FES; Moos & Moos, 1994), consisting of 18 statements that are indicated to be either true or false by participants. The scale consists of two subscales, specifically conflict (e.g., "Family members rarely become openly angry") and cohesion (e.g., "There is a feeling of togetherness in our family"). Internal consistency reliability for these subscales are acceptable and have been reported by Moos and Moos (1994) to be between α = .69-.78. Higher scores indicate greater conflict and cohesion. Internal consistency in the present sample was α = .85 and .72 for the cohesion and conflict subscales, respectively.

Additional Factors (for determining group equivalence). To check for baseline differences, a number of additional variables were assessed, including participants' personality, received support, health behaviors, levels of helping behaviors, and SES.

Participant personality was assessed using the Big Five Inventory (BFI; John & Srivastava, 1999). This is a 44-item scale on which participants indicate their agreement or disagreement with each item by rating it on a five-point scale ranging from 1 = *disagree strongly* to 5 = *agree strongly*. The scale consists of five subscales, assessing extraversion (e.g., "I see myself as someone who is talkative"), agreeableness (e.g., "I see myself as someone who tends to find fault with others"), conscientiousness (e.g., "I see myself as someone who does a thorough job"), emotional stability (e.g., "I see myself as someone who is depressed, blue"), and

openness to experience (e.g., "I see myself as someone who is original, comes up with new ideas"). The BFI has been validated against other commonly used personality measures and the subscales have very good internal reliability estimates ranging from α = .79 to α = .88 across the five subscales. Higher scores indicate greater extraversion, etc. Internal consistency ranged from α = .71 to .86 in the present sample.

To assess participants' health behaviors, which could influence physiological outcomes, participants completed the Health Behavior Questionnaire (HBQ; Kann et al., 1993) to provide information about their general health behaviors. The HBQ is a 14-item questionnaire, assessing common health behaviors including information on past and current smoking behavior, exposure to second-hand smoke, as well as alcohol and drug use.

Participants' baseline helping behaviors and time spent on helping behaviors were assessed through a brief checklist and 5 questions, modeled on the approach by Fuligni et al. (2009a) in a study of older adolescents who performed family helping behaviors. Specifically, participants were asked to check all family helping behaviors they had engaged in over the past week on the following list: took care of siblings, helped clean the home, helped cook meals, ran errands, helped siblings with homework, helped family at work or with official business, took care of grandparents. Subsequently participants indicated how much time they spent helping their family over the past week. In addition, participants were asked how many times over the past week they had helped a friend, how much time they spent doing this, and in what way they helped their friend(s).

Finally, participants' early life and current family SES was assessed using a brief semi-structured interview. This interview included questions about current and early life parental

education and occupation, the family's early life and current housing arrangement (i.e. number of bedrooms and people living in the home) and current annual gross family income.

Procedure.

Participants came to the lab, reviewed and signed the consent form and asked any questions they may have had about the study. Next, their blood pressure was measured. Participants then completed the in-lab questionnaires. Subsequently, participants' SES background was assessed and the nature of the take-home component of the study explained, which included brainstorming activities that participants would engage in for the next four weeks as well as explaining the saliva collection procedure. All participants completed a saliva sample in the lab to ensure that they understood the procedure. Participants collected saliva samples for the two days following the visit and subsequently returned them to the lab. They engaged in additional (helping) activities over the course of the four weeks separating the initial and second laboratory visits.

One, two, three, and four weeks following their initial laboratory visit participants received a brief follow-up questionnaire via email. Participants were asked to indicate which activities they had engaged in over the past week (referred to as 'family helping behaviors' in the case of the intervention group and 'new activities' in the case of the control group), how many times they engaged in each of these activities over the past week and how much time they spent engaging in each of these activities over the past week. In addition, an open-ended question asked participants to indicate how they felt about engaging in these activities and how other family members responded to the things they did (intervention group) or what they had learned as a result of engaging in new activities (control group).

Four weeks after the initial visit to our laboratory participants came back for a follow-up visit that was identical to the first visit and also followed by two days of saliva collection. At the end of the second laboratory visit participants received a debriefing form.

Participants were reimbursed for their time and effort. They received $10 following each laboratory visit and each time they returned their completed saliva samples, resulting in a total payment of $40 if the study was completed in its entirety. This study was approved by the Behavioral Research Ethics Board of the University of British Columbia.

Analyses.

Independent group t-tests were used to investigate possible differences between participants randomly assigned to the intervention and control groups with respect to baseline variables, demographics, and outcome measures. In the second step, multiple one-way 2-group (intervention group versus control group) Analyses of Covariance (ANCOVAs) were used to test the main hypotheses, that is to investigate group differences in physiological outcomes at follow-up, covarying baseline levels. All analyses controlled for ethnicity (given the ethnicity differences by group, see below), and baseline values of the physiological outcomes of interest. Finally, in a third step multiple linear regression analyses were conducted within the intervention group only to investigate whether changes in the psychosocial measures predicted change in cortisol slope. To investigate change, time 2 variables were regressed onto time 1 variables (e.g., time 2 cortisol slope regressed onto time 1 cortisol slope). Standardized residuals were saved, and were entered into regression equations. For example, residualized cortisol slope scores were regressed onto residualized family conflict scores. All regression analyses controlled for sex and ethnicity.

Results

Means and standard deviations for all psychosocial and outcome variables are presented in Table 2.2.

Baseline differences.

Potential baseline differences between participants in the control and intervention groups were examined with respect to demographics, dependent variables and psychosocial variables to ensure that random assignment was successful. With respect to demographics, there was no difference between participants randomly assigned to the intervention and control groups with respect to sex, age, parent education, and family income (all *p*s > .10). However, ethnicity was not equally distributed among groups ($t(36) = 2.20$, $p = .04$) and consequently ethnicity was included as a covariate in all analyses described below.

In terms of dependent variables of interest, there was no difference between participants in the control and intervention groups with respect to diastolic blood pressure and cortisol slope (both *p*s > .10). However, at baseline participants in the intervention group had significantly lower systolic blood pressure than participants in the control group ($t(37) = 2.075$, $p = 0.05$). In addition, at baseline participants in the intervention group had marginally greater cortisol output as indicated by the area under the curve statistic ($t(37) = -1.788$, $p = .08$). Analyses detailing the effect of the intervention on SBP and cortisol output are detailed below for the sake of completeness as specific a priori hypotheses regarding the effect of family helping behaviors on these outcomes were made. However, given that baseline values of SBP and overall cortisol output were not independent of group in spite of random assignment to

groups, results of these particular sets of analyses must be interpreted with caution as spurious effects may occur (Wildt & Ahtola, 1978).

There were no baseline differences between groups with respect to big five personality traits, self-reported drug use, and importantly time spent helping family over the past seven days, and time spent helping friends over the past seven days (all *p*s > .10). Participants assigned to the intervention group did however report consuming marginally more alcoholic beverages per occasion of alcohol consumption ($t(30) = -1.920$, $p = .064$). Finally, participants in the intervention group reported significantly more depression symptoms at baseline ($t(37) = -2.039$, p = .05) as well as marginally more stress ($t(37) = -1.823$, p = .08).

Intervention effects.

Multiple one-way 2-group (intervention group versus control group) Analyses of Covariance were used to investigate the impact of the intervention on participant health outcomes with respect to blood pressure and cortisol output. All analyses controlled for ethnicity and baseline values of the outcome variables of interest. Results suggest that following the four week intervention, there was no effect of experimental condition on participants' systolic blood pressure ($F(1, 34) = .000$, $p = .99$) and diastolic blood pressure ($F(1, 34) = .015$, $p = 0.90$). With respect to cortisol outcomes, there was no effect of experimental condition on participants' overall cortisol output ($F(1, 34) = .594$, $p = .45$). However, the effect of experimental condition on participants' cortisol slopes was marginally significant ($F(1, 34) = 3.057$, $p = .09$, $d = .41$). Specifically, participants in the control group showed marginally 'flatter' daily cortisol slopes after the four week intervention compared to participants in the intervention group. See Figure 2.1.

Psychosocial variables.

We next explored – in the intervention group only – how changes in psychosocial variables related to changes in cortisol slope.

Self-reported time spent volunteering over the past month, number of helping behaviors over the past month, and the number of hours spent on assigned family helping behaviors were not related to cortisol slope (all *p*s > .10).

Results further indicated no influence of environmental mastery (B = -.065, SE = .241, *p* = .79), personal growth (B = -.031, SE = .242, *p* = .90), positive relations with others (B = -.064, SE = .244, *p* = .80), purpose in life (B = -.150, SE = .240, *p* = .54), self-acceptance (B = -.283, SE = .231, *p* = .24), family cohesion (B = -.150, SE = .246, *p* = .55), perceived stress (B = -.018, SE = .253, *p* = .95), or depressive symptoms (B = -.156, SE = .285, *p* = .59) on daily cortisol slope. Whereas participants' sense of autonomy (B = -.345, SE = .228, *p* = .15) and reported family conflict (B = .347, SE = .228, *p* = .15) also were not significantly related to daily cortisol slopes, their relative strength in the predicted direction (greater autonomy associated with steeper cortisol slopes, and lower family conflict associated with steeper cortisol slopes) compared to other variables suggests that these variables may warrant further investigation.

Discussion

The current study investigated the effects of an experimental manipulation of family helping behaviors on physiological outcomes, specifically blood pressure and salivary cortisol, among a sample of predominantly low SES undergraduate students. It was found that while there was no significant difference between the control and intervention group with respect to blood pressure, there was a small to medium effect such that experimental condition did

predict a marginal difference in cortisol slope at follow-up. Results showed that students who had been randomly assigned to engage in family helping behaviors for four weeks had marginally steeper daily cortisol slopes compared to students in the control group. In general, flatter diurnal slopes are often assumed to be indicative of a less healthy cortisol rhythm (Caplan, Cobb, & French, 1979; Carroll, Curtis, & Mendels, 1976; Heim, Ehlert, & Hellhammer, 2000). However, it is also important to acknowledge that the health implications of a certain directionality with respect to cortisol are difficult to draw (Miller et al., 2007). The small sample size of the current study means that such conclusions cannot be drawn with certainty but have to remain speculative, and tested again in a larger sample.

We also emphasize that the current study includes marginal findings for the effect of informal volunteering on cortisol slope but not on overall daily cortisol output, making the effect of cortisol slope in the absence of differences in cortisol output difficult to interpret. In addition, the interpretation of findings regarding cortisol responses often varies widely (see Miller et al., 2007). For example, different studies have argued that either increases or decreases in cortisol output following experiences of stress are associated with undesirable outcomes.

To our knowledge, only a single study has investigated the effect of support provision on cortisol. Smith, Loving, Crockett, and Campbell (2009) assigned college undergraduates to provide support to same-sex strangers who were undergoing an acute laboratory-based stressor task. They report that following support provision both male and female 'support providers' experienced an acute decrease in cortisol production. Moreover, this decrease was found to be steeper among male participants. Although this study is based in the laboratory

and examined acute cortisol responses, it was conducted using a sample similar in age to the current one and provides evidence that support provision may be associated with cortisol outcomes, even if support is aimed at strangers. This study provides a complement to the present study, which focused on daily diurnal profiles of cortisol in the context of informal volunteering.

There is more research supporting the idea that receiving social support can impact daily cortisol production. For example, social support in the form of a present friend or by way of video commentary has been shown to result in a lower salivary cortisol response to laboratory-based stressors (Heinrichs, Baumgartner, Kirschbaum, & Ehlert, 2003; Thorsteinsson, James, & Gregg, 1998). Some studies suggest, however, that the extent to which support from close others or strangers has positive effects may vary depending on gender (Kirschbaum, Klauer, Filipp, & Hellhammer, 1995). In addition, research investigating the potential buffering effects of social support on cortisol outcomes has shown that different types of support have opposite effects on people of Asian and European heritage, such that social support is only beneficial to people if the type of social support is in line with cultural expectations of support (Taylor, Welch, Kim, & Sherman, 2007). Hence, the marginal findings in this study, although tentative, potentially complement research suggesting that social support has the potential to influence cortisol outcomes in the general population.

A preliminary investigation into the possible reasons why informal volunteering might be linked to physiological outcomes suggested that there may be value in further examining changes in family conflict and individuals' sense of autonomy. Due in part to sample size restrictions and the resulting power limitations in the present study, no statistically significant

findings were obtained. However, findings for these two variables most closely approached significance. These findings indicated that among those who participated in the intervention, greater decreases in family conflict over the intervention period were associated with steeper declines in cortisol slope (though not significantly). They also suggested that greater increases in autonomy were associated with steeper declines in cortisol slopes among those who participated in the intervention (though not significantly). Future research should further investigate these and other potential explanations. It is possible that through regularly engaging in family helping behaviors at home these young adults positively contribute to the overall family climate or provided additional support to other family members, thereby easing the burden of household chores on them. This in turn may translate into reduced levels of family conflict in the home, which could have positive ramifications on students' overall stress levels and allow them to better focus on other important tasks at hand, such as their school work. This is consistent with research suggesting that conflict between adolescents and their parents has a significant impact on emotional distress among adolescents (Chung et al., 2009). To our knowledge, no previous studies have investigated whether providing social support or engaging in informal volunteering is associated with subsequent reductions in interpersonal conflict with family or friends.

Similarly, it is possible that the act of regularly contributing to household chores around their home improves aspects of young adults' psychological well-being, specifically leading them to be more autonomous. Perhaps the feeling of contributing to the family in a more regular way than usual makes students feel better about themselves taking on additional roles in their home. This would be in line with other research that has found that personal control

increased among older adults who were involved in informal volunteering (Krause et al., 1992). This in turn mediated the relationship between informal volunteering and lower depressive symptoms. Hence it is conceivable that a similar mechanism, increased feelings of autonomy, may be at work within younger adults as well. After all, while older adults may feel they are slowly losing control over certain aspects of their lives, younger people, including older adolescents and young adults, may be aiming to gain more control over various aspects of their lives and become more autonomous. This is supported by findings by Deci, LaGuardia, Moller, Scheiner, and Ryan (2006) who concluded that providing and receiving autonomy support was related to greater perceived relationship quality.

The present study did not find effects for blood pressure, and hence does not support the previous research by Piferi and Lawler (2006) that demonstrated a positive relationship between a trait-tendency to provide support and blood pressure. However, the study by Piferi and Lawler (2006) included a significantly larger sample and, perhaps most importantly, used ambulatory blood pressure measurements rather than relying on one-time assessments before and after an intervention. What is more, this particular study documented a correlational relationship between the two variables rather than utilizing an experimental manipulation of providing support. Burr, Tavares, and Mutchler (2011) also reported beneficial impacts of volunteering on hypertension risk. However they investigated an older sample that would have been at a much greater risk for hypertension to begin with and also used adults' volunteer commitment over the previous 12 months to predict hypertension status.

The present study suffered from a number of limitations, first and foremost the small sample size, which was in part due to the focus on recruiting a lower SES sample of university

students whose parents had not gone to university themselves. It is possible that a clearer relationship between family helping behaviors and physiological outcomes among young adults would have been apparent in a larger sample. Similarly, any conclusions to be drawn from this initial investigation are highly speculative and cannot be seriously considered until they have been tested in larger samples. It should also be noted, however, that other studies have implemented experimental interventions using similar designs and sample sizes (see, e.g., Lyubomirsky, Caldwell, & Nolen-Hoeksema, 1998).

In addition, in spite of random assignment to groups there were several baseline differences with respect to outcome variables of interest, specifically systolic blood pressure and daily cortisol output. This is most likely also a result of the small sample size and would likely be remedied in future studies with larger samples. We did not have significant findings for either one of these outcome variables, but nonetheless results regarding systolic blood pressure and daily cortisol output must be considered with caution.

Moreover, it is possible that the tasks performed by participants in the control group, intended to be mundane, every day tasks, may have been perceived as more pleasant than originally intended. To account for the additional amount of time that those assigned to the intervention group would spend on family helping behaviors, control group participants were instructed to engage in activities they did not usually engage in, on their own and at home. Narrative statements written by participants following each week of engaging in their assigned activities suggested that some of the participants in the control group derived a fair amount of enjoyment and satisfaction from 'taking time for themselves,' as it were, and reading for pleasure or engaging in other activities. Hence, it is possible that the lack of differences

between the intervention and control group could have been due in part to both groups enjoying the new activities they engaged in. Future studies might compare these groups to a second control group that does not engage in any new activities over the intervention period or that engages in different types of activities that are less rewarding.

Finally, our sample was very restricted with respect to ethnicity. Although a largely East Asian sample is not uncommon given the demographic make-up of the undergraduate population from which participants were drawn and given the focus on first-generation university students, this severely limits the generalizability of these findings for a number of reasons. For example, it is possible that the family dynamics between young adults still living at home and their families are quite different among families from different cultural backgrounds. East Asian cultures tend to be more collectivistic (Triandis, Bontempo, Villareal, Asai, & Lucca, 1988). Hence, there may be differences in cultural expectations regarding helping behaviors in the family, suggesting that maybe students who were part of this sample experienced more pressure to contribute to their households or possibly also gained greater satisfaction from doing so. Indeed, Hardway and Fuligni (2006) compared samples of adolescents with Mexican, Chinese, and European backgrounds and reported that youth from Mexican and Chinese backgrounds showed evidence of a stronger sense of family obligation and assistance as part of family connectedness and that this is a result of their ethnic identification (Kiang & Fuligni, 2009). The differences between European and Asian adolescents with regard to perceived obligation about family assistance furthermore cannot be explained by SES or family composition (Fuligni, Tseng, & Lam, 1999). Future research should consider implementing interventions such as this one in samples of different ethnic make-up was well.

Nonetheless, our use of an experimental design that involved randomly assigning participants to either engage in family helping behaviors or mundane, every-day tasks for four weeks, represents an improvement over previous research that is primarily correlational in nature and that has almost exclusively relied on participants' retrospective recall of volunteering or helping behaviors over several months. By asking participants to report on their family helping behaviors every seven days throughout the study period we have furthermore minimized biases in participants' reports of their time spent helping other family members.

In conclusion, the findings of this current study, while preliminary, provide some initial evidence suggesting that randomly assigning healthy, young adults to engage in informal volunteering, in this case family helping behaviors, leads to marginally steeper diurnal cortisol slopes. This is notable because participants did not themselves choose to engage in more family helping behaviors but rather were assigned to do so, and did not know that this was the focus of the present study when they decided to participate. This study is furthermore of interest as it suggests the possibility that physiological benefits of volunteering could be found in younger, healthy populations. It also suggests that helping others may be beneficial among at-risk groups, given the lower SES demographic of this sample. Consequently, encouraging young people to engage in more informal volunteering in their homes may be one possible route to promoting better health in the face of other stressful experiences, while also benefitting other family members at the same time.

Table 2.1

Participant Characteristics.

	Control		Intervention	
	n (%)	M (SD)	n (%)	M (SD)
N = 39				
Male	11 (57.9)		7 (35.0)	
Female	8 (42.1)		13 (65.0)	
Age		21.68 (1.80)		21.20 (1.54)
Ethnicity				
Chinese	13 (68.4)		18 (90.0)	
'Other' Asian	5 (26.3)			
Caucasian	1 (5.3)		2 (10.0)	
Parent education (years)		12.68 (2.81)		13.25 (3.04)

Note: Parent education was represented by the higher of parents' years of education.

Table 2.2

Descriptive Data for Relevant Psychosocial and Outcome Variables At Baseline.

	Control	Intervention
	M (SD)	M (SD)
Psychosocial Variables		
Psychological Well-being		
Autonomy	12.26 (2.42)	11.40 (1.98)
Environmental mastery	13.16 (2.73)	12.75 (2.43)
Personal growth	15.42 (2.17)	15.55 (2.91)
Positive relations with others	13.53 (3.24)	13.05 (3.38)
Purpose in life	14.21 (2.62)	15.00 (2.34)
Self-acceptance	14.32 (2.33)	12.95 (3.05)
Family conflict	3.95 (2.15)	4.00 (2.38)
Family cohesion	6.16 (2.79)	5.55 (2.89)
Perceived stress	6.05 (2.74)	7.60 (2.56)^{t}
Depressive symptoms	8.63 (5.30)	12.40 (6.18)*
Outcome Variables		
SBP (mmHg)	105.67 (10.41)	100.08 (5.54)*
DBP (mmHg)	62.44 (7.34)	62.87 (5.34)
Cortisol AUC (nmol/L; log)	6.30 (2.56)	7.67 (13.16)*
Cortisol slope (log)	-.0437 (.0293)	-.0470 (.0287)

* $p < .05$; ^{t} $p < .10$

Table 2.3

Differences in Adjusted Means of Outcome Variables At Follow-Up.

	Control	Intervention
	M (SD)	M (SD)
SBP (mmHg)	103.69 (16.66)	103.73 (15.73)
DBP (mmHg)	63.48 (14.12)	63.22 (13.35)
Cortisol AUC (nmol/L; log)	6.90 (3.93)	7.35 (3.71)
Cortisol slope (log)	-.024 (.08)	-.043 (.06) *

* $p < .10$

Table 2.4

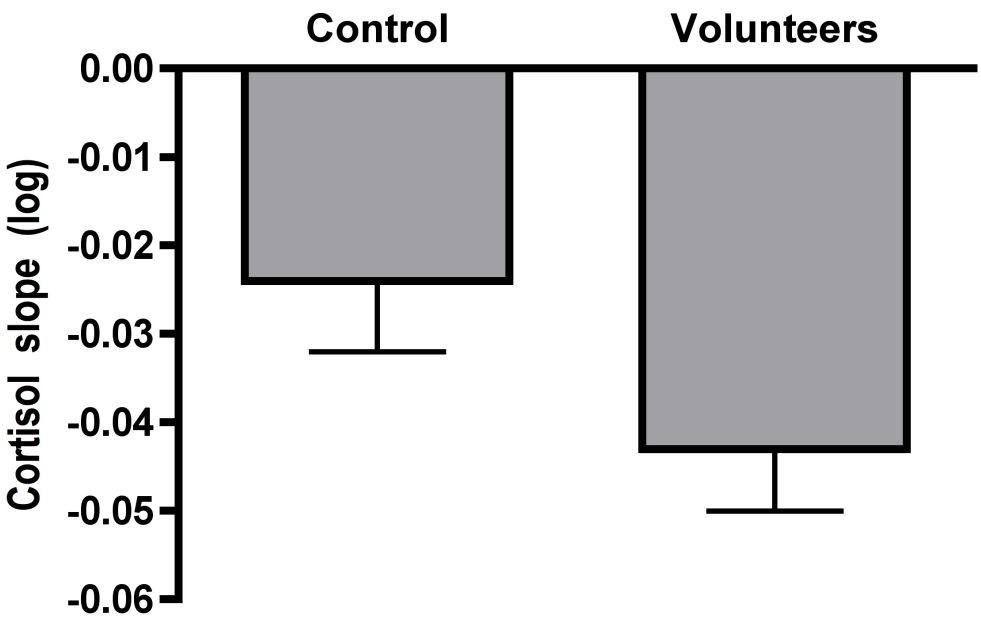
Associations Between Changes in Psychosocial Variables and Change in Cortisol Slopes Within the Intervention Group.

	B	SE	p
Psychological Well-being			
Autonomy	-.345	.228	.15
Environmental mastery	-.065	.241	.79
Personal growth	-.031	.242	.90
Positive relations with others	-.064	.244	.80
Purpose in life	-.150	.240	.54
Self-acceptance	-.283	.231	.24
Family Environment			
Family conflict	.347	.228	.15
Family cohesion	-.150	.246	.55
Perceived stress	-.018	.253	.95
Depressive symptoms	-.156	.285	.59

Note: All analyses control for gender and ethnicity.

Figure 2.1

Adjusted Mean Levels of Daily Cortisol Slope Following the Intervention



Adjusting for baseline cortisol slope, volunteers have marginally steeper cortisol slopes at follow-up compared to control group participants ($F(1, 34) = 3.057$, $p = .09$).

Chapter 3: Effects of Formal Volunteering Among Adolescents

Mounting interest has accumulated around the intriguing question of whether volunteering can have beneficial effects on the psychological well-being and physical health of the volunteer. Traditionally, formal volunteering has been defined as work that is performed without payment and for people to whom the worker has no obligations (Tilly & Tilly, 1994). In addition, formal volunteering must be productive and not simply a leisure time pursuit, and must involve collective action that aims to contribute to the common good (Wilson & Musick, 1997). The present paper examines the question of whether an intervention that engages adolescents in formal volunteering can have beneficial effects on adolescents' cardiovascular risk profiles.

Known Benefits of Formal Volunteering

Recent observational research suggests that providing support to others may be associated with more positive outcomes in the support provider than receiving support (Deci et al., 2006; Piferi & Lawler, 2006; Thomas, 2010). Psychologically, among older adults, engaging in formal volunteering has been linked to greater positive affect (Greenfield & Marks, 2004) and lower depressive symptoms (Li & Ferraro, 2005; Lum & Lightfoot, 2005; Morrow-Howell et al., 2003; Musick & Wilson, 2003). Limited experimental data also supports the notion that formal volunteering among older adults results in lower depressive symptoms (Hong & Morrow-Howell, 2010). This, combined with available longitudinal data, suggests that these findings are not simply the result of healthy older adults (without depression) being more likely to choose to volunteer (a selection effect; Li & Ferraro, 2005).

With respect to the physical health benefits of formal volunteering, research most notably supports the idea that formal volunteering among adults is linked to a decreased mortality risk (Brown et al., 2008; Lum & Lightfoot, 2005; Luoh & Herzog, 2002; Musick et al., 1999; Oman et al., 1999). Other studies have reported effects of formal volunteering on overall lower morbidity (Brown et al., 2005), better functional ability (Luoh & Herzog, 2002; Moen et al., 1992), and greater daily functioning in the form of self-rated health and functional dependency (Morrow-Howell et al., 2003; Thoits & Hewitt, 2001; Van Willigen, 2000). A small number of studies taking advantage of an experimental study design support these findings by linking formal volunteering to increased physical activity (Fried et al., 2004; Tan et al., 2006; Tan et al., 2009) and greater cognitive functioning (Carlson et al., 2008).

Together, these studies suggest benefits of formal volunteering on psychological well-being and a number of relevant physical health outcomes among older adults. It is important to note however, that the biological mechanisms that could explain these connections are not well-understood, and that the health effects of volunteering in younger populations have not been investigated.

Providing Support Among Adolescents

A very limited number of studies has investigated the impact of formal volunteering in adolescent populations. These studies have almost exclusively focused on the socioemotional consequences of volunteering. The research that exists suggests that formal volunteering may also be beneficial among adolescents. For example, adolescent volunteers involved in varying volunteer activities show small but significant increases in social responsibility, particularly girls (Hamilton & Fenzel, 1988). Another study found that compared to non-volunteers, adolescent

boys (but not girls) who engaged in volunteering showed improved self-esteem as well as less depressive affect and fewer problem behaviors (Switzer et al., 1995).

One cross-sectional study compared adolescent volunteers to adolescents waiting to volunteer and adolescents not involved in volunteer activities, all from disadvantaged neighborhoods (Magen et al., 1992). Compared to youth who had not been actively involved in volunteer activities over the past year, current volunteers reported a greater sense of coherence in their lives, showed greater interest in contributing to society, and experienced more positive emotions.

Two studies have evaluated the effects of adolescent volunteering on outcomes outside of the socioemotional realm, specifically on academic failure and teenage pregnancies. Comparing a nation-wide U.S. sample of adolescents who either had been assigned to volunteer for the Teen Outreach program or to a control group, it was found that high school students who volunteered throughout the school year experienced lower rates of pregnancy, academic failure (i.e. self-reported failure of any school courses), and suspensions from school (Allen et al., 1990; Allen et al., 1997).

Finally, there is encouraging data to suggest that volunteering during adolescence may lead to greater civic involvement later on. Reinders and Youniss (2006) found that adolescents who were required to perform community service as part of their school requirements and who were followed longitudinally, later on were more likely to engage in prosocial behaviors, which in turn increased their likelihood of volunteering again in the future and of voting and being politically active. Hence, encouraging adolescents to engage in formal volunteering may

promote greater prosocial behavior later on. However, studies have not yet investigated the impact of formal volunteering on adolescent physiological outcomes.

Potential Benefits to Low SES Adolescents

It may be particularly important to investigate the physiological effects of formal volunteering among groups that show heightened vulnerability to disease. One group at particular risk is those who come from low SES backgrounds. A wealth of evidence suggests that low SES individuals are at greater risk of developing cardiovascular disease (Galobardes et al., 2006; Kanjilal et al., 2006; Kaplan & Keil, 1993; Winkleby et al., 1992). Furthermore, even in adolescence, low SES is associated with cardiovascular risk markers. For example, adolescents from low SES backgrounds have heightened levels of metabolic symptoms (Goodman et al., 2005; Goodman et al., 2007) and heightened inflammatory markers, such as C-reactive protein (CRP) and fibrinogen (Murasko, 2008), although there are some conflicting results (Thomas et al., 2005). Hence, if volunteering can have beneficial effects on cardiovascular risk profiles, this might be especially important to promote among those at greatest risk.

In addition, findings from previous research suggest that low SES individuals have a stronger tendency to help others (Stephens et al., 2009). For example, Piff, Kraus, Côté, Cheng, and Keltner (2010) have demonstrated across a series of four studies that low SES individuals are not only more helpful, but also more generous and charitable, compared to high SES individuals. The authors further showed that although low SES individuals face greater hardship in their lives, they are more likely to be helpful and charitable because they are more commited to the ideas of egalitarianism and compassion than high SES individuals. These studies suggest

that low SES youth might be more responsive to a volunteering-based intervention, given that it fits more naturally with their communal orientation in life.

Physiological Outcomes of Interest

The present study investigated whether getting adolescents to volunteer regularly changes their physiological risk profiles, including body mass index (BMI), blood pressure, inflammatory and metabolic markers, and daily cortisol profiles.

Specifically, we examined whether engaging in volunteering can alter risk factors that have established associations with cardiovascular disease, such as obesity (Goran et al., 2003; Janssen et al., 2005; Katzmarzyk et al., 2004), blood pressure (Williams et al., 2002), markers of systemic inflammation, such as CRP (Danesh et al., 2000; Ridker et al., 1997; Ridker et al., 1998; Ridker et al., 2000a) and IL-6 (Harris et al., 1999; Ridker et al., 2000b), and metabolic indicators such as cholesterol (McGill et al., 2000). Previous research provides some limited evidence that providing help to others can have beneficial physiological effects. For example, a greater trait-like disposition towards providing social support is associated with lower 24-hour ambulatory blood pressure among young adults (Piferi & Lawler, 2006). In addition, one study has evaluated the relationship between family helping behaviors among adolescents and inflammatory markers (Fuligni et al., 2009a). The authors report that levels of CRP and of soluble IL-6 receptors were higher among youth who had been providing a greater number of family helping behaviors; however, at the same time, those youth who reported deriving a greater sense of fulfillment from family helping behaviors showed *lower* levels of inflammation. However, this study is limited by its correlational nature.

In this study, daily cortisol was also assessed. Cortisol is a hormone that is secreted by the adrenal cortex in response to signals from the hypothalamic pituitary adrenal (HPA) axis, often times in response to a stressor. Cortisol secretion follows a circadian pattern such that the highest levels are found shortly after waking, and production decreases throughout the remainder of the day (Van Cauter, 1995).

Why Would Volunteering be Beneficial to Physiological Profiles?

In addition to investigating whether volunteering has physiological benefits for adolescents, we also explored several possible reasons for why this relationship might exist. There are a number of psychosocial reasons why volunteering may lead to improved physiological profiles outcomes among volunteers. This includes both intra-individual explanations, that is ones that refer to changes within the volunteer, and interpersonal explanations, referring to changes to volunteers' interpersonal relationships.

Intra-individual variables.

With respect to intra-individual changes, previous research has shown volunteering to be associated with greater psychological well-being, such as a more positive sense of self, and greater purpose in life (Dworkin et al., 2003; Narushima, 2005; Post, 2005; Thoits & Hewitt, 2001). This suggests that volunteering may lead people to feel better about themselves as they are dedicating part of their time to helping others. In turn, greater psychological well-being, including greater purpose in life has been linked to decreased cardiovascular disease risk among a sample of older women as well as to lower levels of chronic inflammation, such as lower levels of soluble receptor for IL-6 (Ryff et al., 2004).

Other research, focusing primarily on older adults, shows that volunteering may have effects by increasing positive affect or decreasing negative affect. Numerous studies have linked volunteering to decreased depression symptoms (Hong & Morrow-Howell, 2010; Li & Ferraro, 2005; Lum & Lightfoot, 2005). Depression itself has long been identified as a contributor to cardiovascular disease, in part through its association with increased levels of inflammatory markers (Carney et al., 2002; Miller et al., 2002). Moreover, previous studies have linked engaging in formal volunteering to an increase in positive affect among older adults who were part of the Midlife Development in the U. S. study (Greenfield & Marks, 2004). In turn, greater positive affect is linked to a lower likelihood of experiencing cardiovascular problems (Pressman & Cohen, 2005).

Alternatively, it is possible that volunteering operates by decreasing stress levels among volunteers. Indeed, research to date suggests that adolescents who spend more time engaging in informal volunteering do not show greater signs of distress (Fuligni et al., 2002) but rather show increased subjective ratings of happiness and positive mood (Telzer & Fuligni, 2009b). Perceived stress is also a well-established risk factor for cardiovascular disease (Cohen et al., 2007).

Finally, volunteering may be beneficial because it makes volunteers adopt a more active lifestyle. Data from adults in the Experience Corps study suggest increased rates of physical activity among older individuals who were experimentally assigned to volunteer (Tan et al., 2006). Moreover, the relationship between greater physical activity and lower risk of cardiovascular disease has long been established among both adults (Abramson & Vaccarino, 2002; Lakka et al., 1994) and youth (Andersen et al., 2006; Raitakan et al., 1994).

Interpersonal variables.

Alternatively, volunteering may be beneficial to health not because of how it changes the individual, but because of how it changes the individual's relationships with others. Most commonly, volunteering is thought to have positive effects on social networks, in particular the acquisition of additional social contacts and overall greater social integration (Fried et al., 2004; Post, 2005). Several studies focusing on older adults have shown that part of the beneficial aspects of volunteering is that it leads to greater social integration. Both Morrow-Howell, Hinterlong, Rozario, and Tang (2003) and Musick and Wilson (2003) report that the effects of volunteering on older adults' well-being and depression was in part the result of increased social integration following volunteering. Along similar lines, volunteering in one's neighborhood may increase one's sense of belonging and connection to one's neighborhood. In fact, volunteering has been shown to lead to improved social capital among volunteers, that is, being more closely connected to one's community (Dworkin et al., 2003).

Greater social integration in turn has been linked to better health outcomes. Previous research has linked a greater number of social connections and greater social integration to overall better health (Cohen & Wills, 1985; Cohen, Doyle, Skoner, Rabin, & Gwaltney, 1997; House et al., 1988) and to a lower risk of mortality due to cardiovascular disease as well as to lower levels of risk factors for cardiovascular disease, including CRP (Ford, Loucks, & Berkman, 2006; Horsten, Mittleman, Wamala, Schenck-Gustafsson, & Orth-Gomer, 2000; Kaplan et al., 1988; Loucks, Berkman, Gruenewald, & Seeman, 2006a).

Study Design and Hypotheses

The present study was designed to investigate the impact of an experimental intervention – specifically, randomly assigning healthy grade 10 students to either volunteer at a nearby elementary school for several months or to a wait-list control group – on physiological outcomes, including blood pressure, salivary cortisol, body mass index (BMI), and inflammatory and metabolic risk markers. We furthermore assessed a number of potential psychosocial variables hoping to identify intra-individual and interpersonal explanations for why volunteering might be associated with physiological outcomes. It was hypothesized that being assigned to volunteer with elementary school children would result in lower blood pressure, steeper cortisol slopes, and lower inflammatory and metabolic risk markers compared to adolescents in the control group. We further hypothesized that these changes would be attributable to improvements in intra-individual and interpersonal variables, such as greater psychological well-being and greater social connectedness among volunteers.

Methods

Participants.

One hundred and six grade 10 students were recruited from five Planning 10 classes at a high school in Western Canada. To be eligible for this study participants had to be: enrolled in Planning 10, fluent in English, and free of chronic illnesses. Prior to study begin approval was sought from the local School Board. The school principal as well as Planning 10 teachers were approached about their willingness and ability to collaborate and assist with the implementation of the present project. Participation rates across the different classrooms were very good. In total, 125 students were approached and told about the study details. Students'

questions and concerns, especially with respect to blood draws, were answered at this point in time. All students then received permission slips/consent forms to take home and review with their parents. Teachers repeatedly reminded students to return consent forms over the course of the following week during which a study representative was also present before and after Planning 10 classes to answer other questions that students might have. Eighty-five percent (n = 106) of students decided to participate in the study and returned signed consent forms.

While students attending this school come from a broad range of socioeconomic backgrounds, this school was chosen in part because many youth attending the school come from low SES backgrounds. The study sample consisted of 52 participants (49.1%) coming from a low SES background (based on both parents falling into low occupational status categories, using the British Standard Occupational Classification system), and 18 participants (17.0%) being medium SES (based on the highest parent occupation in the household following into a medium SES category), and 28 participants (26.4%) being high SES (based on the highest parent occupation in the household following into a high SES category), with parent occupation data unavailable for 8 participants. In addition, the school is very ethnically diverse. Specifically, 44 students (41.5%) self-identified as Chinese, 20 (18.9%) as "other Asian descent", 18 (17%) as Caucasian, 17 (16%) as mixed descent, 3 (2.8%) as Middle Eastern, 2 (1.9%) as East Indian, and 2 (1.9%) as Latin American/Hispanic. Fifty-five (51.9%) recruited students were male, 51 (48.1%) female. Students ranged in age from 14 to 18 years, with an average age of 14.9 ± .63 years. See Table 3.1 for participant descriptives by experimental condition.

As part of a province-wide requirement in British Columbia, all students at secondary schools must complete 30 hours of work or volunteering in order to meet graduation

requirements. Consequently, a program providing interested students with volunteer opportunities was already in place at the school. Taking advantage of this preexisting set-up, we randomly assigned our study participants to volunteer at the beginning of the school year (intervention group) or not until springtime (wait-list control group). Specifically, fifty-four students (50.9%) were randomly assigned to the wait-list control group, 52 students (49.1%) to the intervention group. Twelve students (11.3%) did not complete the study for a variety of reasons. Between the baseline and follow-up assessments, one student's family moved to another city and six students dropped out of school entirely. An additional three students chose to leave the study because of time constraints or because they did not want to volunteer. One additional student was asked by volunteer coordinators to stop volunteering. Finally, one student was absent from school on the days of follow-up data collection.

Intervention.

Students in the intervention group were assigned to volunteer at a nearby elementary school from the beginning of October through December. Students were placed at one of five 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 in after school 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 two hour training session run by the school's volunteer coordinators 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 consistently volunteer approximately 1-1.5 hours each week as part of this program.

Objective data on the number of hours youth volunteered was obtained through the volunteer coordinators who kept a record of weekly hours that student volunteers spent at the local elementary schools.

In addition, coordinators made monthly ratings of each student volunteer, indicating on a 5-point scale ranging from *not at all* to *very much* how much students were enjoying their volunteer experience.

Measures.

All data collection, including collection of physiological measures and questionnaire data, took place on-site at the school.

Outcome measures. Outcome measures were assessed at baseline in September and again in mid-January.

Body mass index (BMI). Participants' weight was measured without shoes and jackets using a standard medical scale. Height was assessed without shoes using a Charder HM200P Portstad Portable Stadiometer (KWS Medical Supplies; North Bend, WA, USA). BMI was calculated as kg/m^2.

Blood pressure. To assess systolic and diastolic blood pressure, blood pressure readings were taken from participants after they had been comfortably seated in a chair and rested for five minutes. Four blood pressure readings were then taken, spaced two minutes apart, using an automated oscillometric device (BPM-100, VSM MedTech, Coquitlam, BC). The first reading was automatically discarded and readings two through four averaged.

Salivary cortisol. To assess salivary cortisol, saliva samples were collected from participants at three time points on two different days. All samples were collected at the school, to maximize adherence to the sample collection schedule. Students were instructed to come and collect saliva samples before school, at the beginning of their lunch break prior to eating, and after school. As part of the collection of morning samples students were asked for their wake-up times. Saliva collection procedures had previously been explained to students during class. At each saliva collection time, students were reminded to place a sterile cotton dental roll (Salivette, Sartstedt Corp.; Nümbrecht, Germany) in their mouth for 60 seconds. Cotton rolls were then placed in a plastic tube and transported back to the laboratory at the end of each day. Samples were refrigerated until the end of both days of saliva collection and subsequently sent to the laboratory of Drs. Jutta Wolf and Nicolas Rohleder at Brandeis University where they were stored at -30°C until assay. At this point, samples were spun at 2000 g for 5 minutes and 4°C. Salivary free cortisol concentrations were then measured using commercial chemiluminescence immunoassay (CLIA; IBL-International, Toronto, Canada). Intra- and inter-assay CVs were below 10%.

At baseline, 75% of all samples were collected across the two days and 82 students (77.3%) provided at least one complete day of saliva samples. At follow-up adherence to the saliva sample collection schedule was slightly improved and 82% of samples were completed. At follow-up 86 (91.5%) of students provided at least one full day of saliva samples.

Data furthermore indicate that the school-based collection times mapped on quite well to the recommended collection schedule of 1, 4, 9, and 11 hours following waking as recommended by the MacArthur Foundation Research Network on Socioeconomic Status and

Health (www.macses.ecsf.edu). Student-reported wake up times suggested that morning, lunch, and after school samples were taken an average of 1.37 ± .57 hours, 4.58 ± .61 hours, and 7.95 ± .57 hours following wake-up at baseline and 1.30 ± .71 hours, 4.55 ± .68 hours, and 8.01 ± .68 hours following wake-up at follow-up, respectively.

Cortisol values were log-transformed to reduce skewness. Total daily cortisol output was computed by calculating the area under the curve (AUC) statistic using the trapezoidal rule. Specifically, for each day and each participant a line depicting cortisol values at each of the four time points of data collection was plotted, and the AUC value was calculated as the sum of the areas of the four trapezoids below that line. Higher numbers reflect greater cortisol release throughout the day. In addition, cortisol values were averaged across two days to increase stability and the regression line (cortisol values/corresponding time since wakeup) computed. Steeper slopes indicate more rapidly declining salivary cortisol measures throughout the day.

Metabolic and inflammatory markers. Students also underwent a blood draw through antecubital venipuncture by trained phlebotomists to allow for the assessment of metabolic and inflammatory outcomes of interest. Half a tablespoon of blood was collected from each student and drawn into BD Vacutainer EDTA and SST cell preparation tubes (Becton Dickinson, Franklin Lakes, NJ). Filled tubes were kept at room temperature for 60 minutes and subsequently cooled to approximately 5° C. Once tubes were transported back to the lab, EDTA tubes were refrigerated further at 5° C and SST tubes were centrifuged for 10 minutes at 1200 rpm. Serum from SST tubes was subsequently pipetted into aliquots and the serum samples together with the whole blood from EDTA tubes sent to the Clinical Chemistry Laboratory at St. Paul's Hospital for analysis. Duplicate serum samples were kept in the laboratory and stored in

aliquots at -30°C until the assessment of IL-6 (see below). Three students declined to undergo the blood draws and 2 students had parents who did not allow their children to undergo a blood draw.

Two metabolic indicators, total cholesterol (from serum), and glycosylated hemoglobin (from whole blood), were assessed in students' peripheral blood. Glycosylated hemoglobin represents a measure of long-term (about three months) blood glucose levels. Total cholesterol levels take into account levels of both low density lipoprotein (LDL) and high density lipoprotein (HDL). Total cholesterol values were not normally distributed and hence log-transformed to reduce skewness.

Two measures of systemic inflammation, IL-6 and CRP, were assessed. IL-6 is a pro-inflammatory cytokine and elevated IL-6 levels have been linked to an increased risk of cardiovascular disease (Bermudez, Rifai, Buring, Manson, & Ridker, 2002; Ridker et al., 2000b; Yudkin et al., 2000). Increased levels of CRP are indicative of greater inflammation and are also associated with an increased risk of future cardiovascular disease (Bermudez et al., 2002; Kivimaki et al., 2005). Both inflammation measures were assessed from serum derived from whole blood collected in SST tubes. Levels of IL-6 were measured in our lab using a high-sensitivity ELISA kit (R&D Systems, Minneapolis, MN; intra-assay CV<10%; detection threshold = .04 pg/ml). CRP assays were conducted at St. Paul's Hospital. Both IL-6 and CRP values were not normally distributed and consequently were log-transformed to reduce skewness. Levels of inflammatory markers found in this study were very similar to those found previously among another sample of healthy adolescents (Fuligni et al., 2009a).

Intra-individual measures. *Affect.* Students completed the child version of the Positive and Negative Affect Scale (PANAS-C; Laurent et al., 1999). This scale consists of 30 adjectives describing positive and negative emotions, e.g. alert, cheerful, and gloomy. Students were asked to indicate on a five-point scale ranging from *very slightly or not at all* to *extremely* the extent to which they felt any given way over the past few weeks. The PANAS-C was adapted from the original PANAS for use specifically in youth. It has been validated among 4th to 8th graders against other commonly used questionnaires. Estimates of internal consistency suggest that it is excellent, with α between .89 and .94 for the two subscales based on data collected from two different samples. Higher scores on the two subscales indicate greater negative and positive affect, respectively. Internal consistency in the present sample was α = .90 and .89 for the positive and negative affect subscales, respectively.

Psychological well-being. Students completed the short version of the Brief Psychological Well-Being scale (BPWB; Ryff, 1989). This scale consists of subscales including purpose in life, personal growth, self-acceptance, autonomy, and environmental mastery – each of which is assessed through three questions answered on a scale from 1 = *strongly disagree* to 6 = *strongly agree*. Higher scores indicate greater psychological well-being. Six-week test-retest reliability for the full-length scale has been shown to be > .80 for all subscales and internal consistency estimates for individual subscales of the full-length version are all between α = .86-.93. Higher scores suggest better psychological functioning. Internal consistency in the present sample ranged from α = .15 and .56 for the subscales, respectively. This is quite low, however, it is comparable to previous estimates of internal consistency of the brief version of the scale. Because of time constraints and because participants were already required to

complete a number of other questionnaires, we nonetheless decided to use the short form of the Psychological Well-Being scale.

Stress. Students completed the 4-item version of the Perceived Stress Scale (PSS; Cohen et al., 1983). This questionnaire assesses the frequency of behaviors, such as feeling confident in one's ability to handle personal problems, over the past month on a five-point scale (from 0 = *never* to 4 = *very often*). Internal reliability of the PSS has been found to be very good, with αs between .84 and .86. Higher scores indicate greater perceived stress. Internal consistency in the present sample was α = .61.

Physical activity. Students completed the adolescent version of the Physical Activity Questionnaire (PAQ-A; Kowalski, Crocker, & Kowalski, 1997). Developed specifically for use among high school students, the PAQ-A assesses general levels of physical activity over the past week among adolescents. The PAQ-A has been shown to have very good convergent validity with other commonly used physical activity measures in adolescents. A summary score was computed, with higher values suggesting a greater physical activity level.

Interpersonal measures. *Psychological well-being.* The Brief Psychological Well-Being scale described above also contains an interpersonal scale assessing positive relations with others (BPWB; Ryff, 1989). This subscale is assessed in an identical manner to the others described above. See above for internal consistency.

Youth development of interpersonal relationships and skills. Those randomly assigned to the experimental condition completed an additional questionnaire at follow-up, the Youth Experiences Survey (YES; Hansen & Larson, 2003) at follow-up. This scale was developed specifically for use among adolescents to assess their experiences with extracurricular activities.

Multiple aspects of students' experience with volunteering are assessed, with the following subscales focusing on interpersonal variables utilized in this study: Interpersonal Relationships (diverse peer relationships); Adult Networks and Social Capital (including integration with family and linkages to community); and Social Skills (leadership and responsibility). These subscales consisted of a total of eleven items, all of which were answered on a four-point scale ranging from *Yes, definitely* to *Not at all*, allowing youth to indicate how much they have had the following experiences while volunteering. Convergent validity has been shown to be good when compared to adult ratings and internal consistency reliability of the six subscales ranges from α = .84 to α = .93 based on a large sample of grade 11 students (Hansen & Larson, 2005). Lower scores indicate greater development in that domain. All αs > .85 for the different subscales.

Additional Factors (for determining baseline group equivalence). To check for differences at baseline between the intervention and control groups, a number of additional variables were assessed, including participants' recent life events, received support, health behaviors, prosocial personality, amount of helping/volunteering participants were already doing, and SES.

Recent life events. To be able to account for the number of stressful life events that adolescents experienced in recent months and that might influence our outcomes, adolescents completed a Life Event Checklist, adapted from a checklist that was previously used in an adolescent sample (Turyk et al., 2008). The number of checked items was summed to indicate the number of stressful life events youth had experienced over the past 6 months.

Received support. To assess perceived support that youth received prior to intervention they completed six items from the Harter Social Support Scale (HSS; Harter, 1986). These six

items came from both the 'Friends' (4 items) and the 'Teacher' (2 items) subscales of the HSS, and included items such as "Some kids have someone who they can tell problems to." Items were answered on a scale from 1 = *really false for me* to 4 = *really true for me*. Two 'Friends' items that were repetitive with 'Teacher' items were replaced. Internal consistency in the present sample was α = .71.

Health behaviors. To be able to account for differences among participants in general health behaviors that may influence outcomes, participants completed the Health Behavior Questionnaire (HBQ; Kann et al., 1993). This is a 14-item questionnaire, assessing common health behaviors, including information on past and current smoking behavior, exposure to second-hand smoke, as well as alcohol and drug use.

Prosocial personality. As volunteering may be a more positive and more rewarding activity for youth who have a more prosocially oriented personality, participants were asked to complete the short, 30-item version of the Prosocial Personality Battery (PSB; Penner, 2002). Participants indicated on a five-point scale from *Strongly disagree* to *Strongly agree* how much any given statement described them. Subsequently, they indicated how often they engaged in any of the listed altruism behaviors on a five-point scale ranging from *Never* to *Very often*. Internal consistency reliability for these subscales ranges from α = .64 to α = .77. Scores were summed to create an index of 'other-oriented empathy' and 'helpfulness.' Higher scores indicate greater empathy and helpfulness. Internal consistency in the present sample ranged from α = .49 and α = .72 for the various subscales.

Baseline formal and informal volunteering. To assess baseline levels of volunteering activities that youth were already involved in during their leisure time participants answered

questions modeled after the approach taken by Wilson & Musick (1999). Participants were asked to list all volunteer positions they currently held, the type of organization they were volunteering with (divided into school group, church/synagogue/other religious organization, political or special cause organization, or other community organization), the hours they spent volunteering at this organization over the past month, how much they enjoyed this volunteer experience (on a seven-point scale) and how likely they were to volunteer for this program again in the future (on a seven-point scale). In addition, to assess baseline levels of informal volunteering, participants answered questions modeled after the approach taken by Fuligni et al. (2009b). Specifically, participants were asked to check all family helping behaviors they had engaged in over the past week on the following list: took care of siblings, helped clean the home, helped cook meals, ran errands, helped siblings with homework, helped family at work or with official business, took care of grandparents. Subsequently participants indicated how much time (in hours) they had spent helping their family over the past week.

Socioeconomic status. Finally, students' family SES was assessed through parents' occupation. Parents' occupations were coded and assigned occupation codes according to the British Standard Occupational Classification system. Codes range from 1-8, with 1-2 indicating a high SES occupation, 3-4 representing occupations indicative of moderate SES, and 5-8 indicating low SES occupations. When all occupations were coded, a single variable was created that consisted of the higher of mother's or father's occupation code which was then used to represent household SES.

Procedure. Participants were recruited from five Planning 10 classrooms. Students were told about the study during one of their Planning 10 classes, questions were answered and

consent forms distributed for students to take home and review with their parents. Informed consent and assent was obtained from parents (or legal guardians) and students, respectively.

All data collection took place at the school, including baseline and follow-up data collection. Baseline data collection took place in September. Baseline questionnaire data was assessed in all five classrooms on two consecutive school days. Questionnaires were completed on the computer and a research assistant was present at all times to answer any questions. Physiological data was collected at school on the subsequent two days. Materials were set up in an empty classroom and students were removed from their Planning 10 classes in small groups to have their height, weight, and blood pressure assessed, as well as to undergo a blood draw through antecubital venipuncture by a trained phlebotomist. Portable screens were set up to ensure students' privacy while health measures were assessed. Blood draws were performed in an adjacent room. Over the course of two consecutive school days following the assessment of physiological measurements, students were asked to collect saliva samples at school, at three separate time points per day, before school, at the beginning of the lunch break and after school.

Following baseline data collection participants were randomized into either the intervention or wait-list control group.

The follow-up data collection in January followed the same protocol as baseline assessments, i.e. online completion of questionnaires and collection of physiological measurements over the course of two consecutive school days each, followed by saliva sample collection on another two subsequent and consecutive school days.

Participants were reimbursed for their time and effort. They received $25 each time they completed questionnaires and physiological measurements and $10 each time they completed the two days of saliva sample collection. This study was approved by the Clinical Research Ethics Board of the University of British Columbia.

Analyses.

Independent group t-tests were used to investigate possible differences between participants randomly assigned to the intervention and control groups with respect to baseline factors, demographics, and outcome measures. In the second step, multiple one-way 2-group (intervention group versus control group) Analyses of Covariance (ANCOVAs) were used to test the main hypotheses, that is to investigate group differences in physiological outcomes at follow-up, covarying baseline levels. All analyses controlled for baseline values of the outcomes (as detailed below, no age, sex, and ethnicity differences between the intervention and control group were found; hence, these variables were not controlled for). Finally, in a third step multiple linear regression analyses were conducted within the intervention group only to investigate whether changes in the intra-individual or interpersonal variables predicted change in outcome variables. To investigate change, time 2 variables were regressed onto time 1 variables (e.g., time 2 IL-6 regressed onto time 1 IL-6). Standardized residuals were saved, and were entered into regression equations. For example, residualized IL-6 scores were regressed onto residualized purpose in life scores. All regression analyses controlled for sex and ethnicity, and for inflammatory measures BMI was also included as a covariate.

Results

Means and standard deviations for all intra-individual, interpersonal and outcome variables are presented in Table 3.2.

Baseline differences.

Baseline differences between participants in the control and intervention groups were first examined to ensure that random assignment was successful. With respect to demographics, there was no difference between participants randomly assigned to the intervention and control groups with respect to sex, age, ethnicity, or parent occupation (all *p*s > .10).

In terms of dependent variables of interest, there was no difference between participants in the control and intervention groups with respect to BMI, systolic and diastolic blood pressure, daily cortisol output, cholesterol, glycosylated hemoglobin, IL-6, and CRP (all *p*s > .10). However, at baseline participants in the intervention group had significantly flatter daily cortisol slopes than participants in the control group ($t(91) = 2.523$, $p = 0.01$). Analyses detailing the effect of the intervention on cortisol slope are detailed below for the sake of completeness as a specific a priori hypothesis regarding the effect of volunteering on cortisol slope was made. However, given that baseline values of cortisol slopes were not independent of group in spite of random assignment to groups, results of these particular sets of analyses must be interpreted with caution as spurious effects may occur (Wildt & Ahtola, 1978).

Furthermore, there were no baseline differences between groups with respect to baseline levels of stressful life events over the past 6 months, received support, health

behaviors, prosocial personality, or time spent doing formal or informal volunteering over the past month (all *p*s > .10).

Finally, there were no group differences with respect to any of the intra-individual or interpersonal psychosocial variables measured at baseline (all *p*s > .10), with the one exception that at baseline, participants in the control group reported significantly higher scores on the positive relations with others subscale of the Psychological Well-Being Scale compared to those randomized to the intervention group ($t(102) = 2.331$, p = .02).

Intervention effects.

Table 3.3 lists differences in adjusted means of outcome variables at follow-up. Multiple one-way 2-group (intervention group versus control group) Analyses of Covariance were used to investigate the impact of the volunteering intervention on participant outcomes with respect to time 2 blood pressure, cortisol output, and inflammatory and metabolic markers. All analyses controlled for baseline values of the outcome variables of interest. Results indicated that following the intervention, there was a significant effect of experimental condition on BMI ($F(1, 87) = 5.844$, $p = .02$, $d = .13$). In addition, there was a marginally significant effect of experimental condition on both markers of inflammation, IL-6 ($F(1, 82) = 3.352$, $p = .07$, $d = .38$) and CRP ($F(1, 82) = 2.809$, $p = .10$, $d = .39$). There was also a significant effect of intervention on cholesterol ($F(1, 83) = 3.824$, $p = .05$, $d = .36$), although not on glycosylated hemoglobin ($F(1, 82) = .773$, $p = .38$). No effects were found for blood pressure (*p*s > .50) or cortisol (*p*s > .40). All significant and marginally significant effects were in the hypothesized direction. Specifically, participants in the intervention group showed lower levels of cholesterol, IL-6, and CRP, and

BMI after the intervention compared to those in the control group. See Figures 3.1-3.4 for graphic representations of these findings.

There were no significant group x gender or group x ethnicity interactions, suggesting that the effects of our volunteering intervention on physiological risk markers were not moderated by gender or ethnicity.

Intra-individual and interpersonal variables.

We investigated several reasons why volunteering would produce changes in CRP, IL-6, cholesterol, and BMI following the intervention. We did this by exploring within the intervention group whether change in any intra- or inter-personal variables predicted change in outcome variables.

With respect to CRP, there was a significant association of the intra-individual variable of negative affect with CRP (B = .431, SE = .156, p = .01) and a marginally significant association of perceived stress with CRP (B = .313, SE = .158, p = .06) in the intervention group. Effects were in the hypothesized direction, such that decreases in negative affect and decreases in perceived stress were associated with decreases in CRP levels among those who participated in the intervention. No interpersonal variables were significant (ps > .10). See Tables 3.4 and 3.5 for details of results.

In terms of IL-6, there was a marginally significant effect of the intra-personal variable of purpose in life with IL-6 (B = -.306, SE = .164, p = .07) among those in the intervention group. This effect was in the hypothesized direction, such that greater increases in purpose in life were associated with decreases in IL-6 levels among those who participated in the intervention. None

of the other intra-individual or interpersonal variables were significant (*p*s > .10). See Tables 3.4 and 3.5.

With respect to cholesterol, there were significant effects of the intra-individual variable of physical activity (B = -.337, SE = .155, *p* = .04) and a significant effect of the interpersonal variable of linkages to community (B = .194, SE = .081, *p* = .02) within the intervention group. These effects were in the hypothesized directions, such that greater increases in physical activity and increases in linkages to the community were associated with decreases in cholesterol levels among those who were in the intervention group. In addition, there was a significant effect of self-acceptance (B = .319, SE = .158, *p* = .05). However, this finding was not in the previously hypothesized direction and suggested instead that greater levels of self-acceptance were associated with higher cholesterol levels among those participating in the intervention. See Tables 3.4 and 3.5.

No variables were found linking effects of the intervention to BMI (*p*s > .10). See Tables 3.4 and 3.5.

Neither volunteer coordinator-based ratings of volunteer enjoyment nor number of hours volunteered predicted change in physiological outcomes (all *p*s > .10).

Discussion

To our knowledge the current study is the first to conduct an experimental manipulation testing the physiological benefits of engaging in formal volunteering among adolescents. We randomly assigned half of our participants, healthy grade 10 students from primarily low SES backgrounds, to volunteer with elementary school children from October – December of a school year, assessing a variety of physiological outcomes four months later at follow-up. We

found small to medium effects suggesting that adolescents in the volunteering condition showed significantly lower BMI and serum cholesterol at follow up, as well as marginally lower levels of CRP, and IL-6 compared to adolescents in the control group. These findings suggest that formal volunteering may in fact reduce important inflammatory and metabolic risk factors for cardiovascular disease even in healthy adolescent populations.

While previous studies have investigated the impact of formal volunteering on adolescent socioemotional development (e.g., Allen et al., 1990; Magen et al., 1992), no studies have investigated the effect of formal volunteering on adolescent physiological profiles even though data from older adults link formal volunteering to mortality (e.g., Musick et al., 1999).

One previous study investigated the effect of informal volunteering, that is family helping behaviors, on inflammatory markers among adolescents. Fuligni et al. (2009a) found that among adolescents from various ethnic backgrounds, those who engaged in family helping behaviors and derived a sense of role fulfillment from doing so had lower levels of CRP compared to other adolescents. However, their study used a cross-sectional design and, most importantly, the psychological consequences of helping at home may be quite different from those of engaging in formal volunteering. Family helping behaviors may come with a certain amount of obligation. In addition, formal volunteering may help connect adolescents more broadly to their community and allow them to feel that they are contributing to society or to their community in ways that family helping behaviors do not entail.

Our data further suggest a number of intra- and inter-personal explanations for why volunteering may have improved metabolic and inflammatory outcomes in our sample. However, it is important to note that no intra-individual or interpersonal variable was linked to

more than one physiological outcome, suggesting that there was no consistent explanation for the effects of the intervention. Alternatively, it could suggest that formal volunteering leads to different physiological outcomes through influencing different psychosocial variables.

Specifically, among those assigned to do formal volunteering, decreases over time in negative intra-personal characteristics, including negative affect and perceived stress, were associated with decreases in CRP. This is consistent with other observational research that has previously shown links between CRP and psychological stress (McDade et al., 2006; Steptoe et al., 2007). In addition, CRP levels have also been linked to psychological disorders marked by negative affect, such as depression (Miller et al., 2002) and research suggests an effect of greater positive affect on lowered CRP concentrations (e.g., Friedman & Ryff, 2012; Steptoe, Leigh Gibson, Hamer, & Wardle, 2007).

Previous research has also found links between volunteering and individual measures related to affect. Greenfield and Marks (2004) reported that volunteering among older adults resulted in greater positive, but not reduced negative, affect. Similarly, Borgonovi (2008) found that among low SES individuals, those who engaged in religious volunteering were less likely to report being unhappy. This study suggests that engaging in formal volunteering may be beneficial to adolescents' inflammatory profiles through lowering experiences of negative affect and perceived stress.

Our within group analyses of intervention participants furthermore indicated that the beneficial effect of volunteering on IL-6 concentrations is in part due to increases in a sense of purpose in life. This is in agreement with previous studies investigating the influence of volunteering among older adults that found that volunteering is associated with increased

feelings of purpose of life (Greenfield & Marks, 2004). Our findings are also in line with previous research that has linked greater purpose in life to lower levels of inflammatory markers such as soluble IL-6 receptor among older women (Friedman et al., 2007; Ryff et al., 2004). Our results are also interesting because adolescence is known as a time during which youth develop a sense of purpose in life (Damon et al., 2003). However, this is the first study to document that increases in purpose in life among those assigned to do formal volunteering are associated with reductions in inflammatory proteins.

With respect to total serum cholesterol levels, this study found that among those in the intervention group, increases in physical activity were linked to decreases in cholesterol levels, and as well, that increases in links to community were also linked to decreases in cholesterol levels. These findings are supported by previous studies that document the effects of physical activity on total cholesterol levels as well as on the ratio of high-density lipoprotein to total cholesterol (Kokkinos & Fernhall, 1999; Lee, Rexrode, Cook, Manson, & Buring, 2001; Raitakan et al., 1994). However, at the same time a meta-analysis reviewing studies on the effect among youth of physical activity-based interventions on cholesterol suggests that most programs have not led to consistent effects of physical activity on cholesterol (Kokkinos & Fernhall, 1999). In the present sample, one additional weekly volunteering session may not seem likely to add significant amounts of physical activity to the lives of adolescents. However, it is possible that engaging in volunteering inspired youth to become more active overall and to integrate other, additional activities into their every day life. We did not, however, find support for physical activity changes being linked to BMI changes among those in the intervention group. It is possible that formal volunteering influenced adolescent BMI through other health behavior

changes such as encouraging a healthier diet or alternatively a reduction of compensatory eating in the face of experienced stress. Unfortunately, variables relating to adolescents' dietary and eating habits were not assessed in the current study. These variables should be investigated in future research.

The present study also found that among those who participated in the intervention group, greater increases in connections to the community were associated with decreases in cholesterol levels over time. This is in line with previous studies that found that volunteering or helping others is associated with greater perceived social connections. For example, Lawlor and Schonert-Reichl (2008) found that among a sample of grade 4-7 students, altruism was related to greater self-reported happiness because it increased youth's sense of relatedness to others around them. Similarly, Hamilton and Fenzel (1988) reported that adolescent volunteers reported gaining significant knowledge about others in their community as a consequence of volunteering. The fact that Musick and Wilson (2003) found that the relationship between volunteering and reduced rates of depression among older adults was in large part due to greater social integration further accentuates the importance of interpersonal connections and links to community that volunteers may experience as a result of volunteering. However, it should also be noted that traditionally, social integration, at least among adults, has been linked much more strongly to inflammatory markers such as CRP and IL-6, rather than metabolic markers (Ford et al., 2006; Loucks et al., 2006a; Loucks et al., 2006b). Nonetheless, in this study formal volunteering may have provided youth with opportunities to connect with others in their community and neighborhood, perhaps helping to buffer youth from experiences of stress and elevations in cholesterol. Indeed, research has previously linked social

isolation to greater increases in serum total cholesterol following a stress task, suggesting that social integration influences cholesterol as well (Grant, Hamer, & Steptoe, 2009).

We note that it is unclear why there would have been a marginal relationship between increases in self-acceptance and increases in cholesterol among those in the intervention group. This is counter to findings from previous research that link higher, not lower, levels of self-acceptance to desirable health outcomes, such as glycosylated hemoglobin (Ryff et al., 2004). Additional future studies should be conducted to determine if this finding is replicable.

The study found no effects of volunteering on blood pressure, glycosylated hemoglobin and cortisol. With respect to blood pressure, it is possible that conducting this study in the school setting and conducting assessments with small groups of students simultaneously prevented us from accurately being able to capture resting blood pressure.

The lack of findings for glycosylated hemoglobin is not entirely surprising, given the nature of this metabolic indicator. As glycosylated hemoglobin presents an average estimate of blood glucose levels over the preceding three month period, this intervention, with only four months separating the baseline and follow-up assessments, may not have been long enough to detect noticeable differences in glycosylated hemoglobin levels. It is possible that an intervention of longer duration may lead to detectable improvements of glycosylated hemoglobin levels among adolescent volunteers, especially since we did find significant effects of formal volunteering on another metabolic marker, serum cholesterol, as part of this study.

Finally, a possible reason that no findings emerged for cortisol may have been missing samples. In spite of multiple reminders, students did not always remember to do their saliva

samples, and compliance with the saliva portion of the protocol was lower than for the other physiological measures.

The present study had several strengths. First and foremost we were able to use an experimental design and randomly assign healthy adolescents to either volunteer for several months, or to be in a wait-list control group. This allowed us to improve upon previous research that was primarily correlational in nature and that has largely relied on participant self-report and retrospective recall of volunteering behaviors. In addition, we were able to assess a number of relevant physiological outcomes, including more commonly used non-invasive indicators such as blood pressure, BMI, and cortisol in addition to a number of metabolic and inflammatory cardiovascular risk markers. To our knowledge, this is the first study randomly assigning healthy adolescents to volunteer (or a wait-list control group) and subsequently assessing the impact of formal volunteering on the above-mentioned outcomes. In spite of these strengths, however, these findings need to be replicated in larger samples in the future. In addition, longer interventions focusing on formal volunteering should be implemented to evaluate whether these physiological benefits persist in the face of continued volunteering activities, and potentially beyond. The present study could have benefitted from additional data collection after a longer follow-up time to investigate this, however, as, in accordance with Planning 10 classes and school expectations, students assigned to the control group had to be able to volunteer four months following our baseline data collection, we were unable to do this.

In conclusion, the current study provides intriguing evidence that an intervention that involved randomly assigning healthy, primarily low SES adolescents to participate in volunteering activities has the potential to positively influence well-established cardiovascular

risk factors within a relatively short period of time. In addition to previously established effects of improving adolescents' socioemotional well-being and contributing to positive youth development, these findings suggest that engaging youth in volunteering could also have longer-term physiological benefits. Given that this type of intervention also has the potential to benefit others (in terms of the elementary school children these youth helped) and to benefit society (in terms of improving social connections throughout the community and across generations), it may be a worthwhile avenue to explore when designing future interventions, particularly among low SES youth. Encouraging adolescents to volunteer with younger children may represent one possible route to long-term health benefits.

Table 3.1

Participant Characteristics.

	Control		Intervention	
	n (%)	M (SD)	n (%)	M (SD)
N = 106				
Male	29 (53.7)		26 (50.0)	
Female	25 (46.3)		26 (50.0)	
Age		14.96 (.78)		14.84 (.42)
Ethnicity				
Chinese	20 (37.0)		24 (46.2)	
'Other' Asian	13 (24.1)		9 (17.3)	
European	9 (16.7)		9 (17.2)	
Other	12 (22.2)		10 (19.2)	
SES (parent occupation)				
High	15 (27.8)		13 (25.0)	
Medium	8 (14.8)		10 (19.2)	
Low	29 (53.8)		23 (44.2)	

Note: SES was determined using the higher of the parents' occupation code.

Table 3.2

Descriptive Data for Relevant Intra-individual, Interpersonal, and Outcome Variables At Baseline.

	Control	Intervention
	M (SD)	M (SD)
Intra-individual Variables		
Psychological Well-being		
Autonomy	11.45 (2.31)	11.75 (1.93)
Environmental mastery	11.89 (2.53)	11.90 (2.26)
Personal growth	14.60 (2.52)	14.29 (1.96)
Purpose in life	13.17 (3.00)	13.22 (2.63)
Self-acceptance	12.34 (3.11)	13.18 (2.74)
Physical activity	2.30 (.73)	2.24 (.61)
Positive affect	47.87 (11.38)	49.47 (11.00)
Negative affect	30.08 (10.46)	29.04 (9.66)
Perceived stress	6.77 (2.71)	6.25 (2.86)
Interpersonal Variables		
Positive relations with others	12.60 (2.89)	13.80 (2.32)*
Outcome Variables		
BMI	22.44 (5.31)	21.96 (4.0)
SBP (mmHg)	104.98 (12.44)	102.92 (9.77)
DBP (mmHg)	67.42 (14.89)	64.90 (10.20)

	Control	Intervention
	M (SD)	M (SD)
Cortisol AUC (nmol/L; log)	6.29 (1.31)	6.40 (1.47)
Cortisol slope (log)	-.0633 (.0500)	-.0958 (.0727)*
Cholesterol (mmol/L; log)	.46 (.17)	.47 (.12)
Glycosylated hemoglobin (%)	5.35 (.34)	5.33 (.29)
Interleukin-6 (pg/L.; log)	-.08 (.34)	-.05 (.25)
C-reactive protein (mg/L; log)	-.39 (.43)	-.40 (.37)

* $p < .05$

Note: The Youth Experiences Survey was not administered at baseline as it relates specifically to volunteering experiences. Hence, baseline data are not reported here.

Table 3.3

Differences in Adjusted Means of Outcome Variables At Follow-Up.

	Control	Intervention
	M (SD)	M (SD)
Body Mass Index	22.48 (.52)	22.09 (.56) *
SBP (mmHg)	104.58 (5.41)	103.30 (5.79)
DBP (mmHg)	65.20 (5.18)	64.53 (5.55)
Cortisol AUC (nmol/L; log)	6.86 (.88)	7.10 (.88)
Cortisol Slope (log)	-.07 (.03)	-.08 (.03)
Cholesterol (mmol/L; log)	.58 (.04)	.56 (.04) *
Glycosylated Hemoglobin (%)	5.35 (.10)	5.38 (.10)
Interleukin-6 (pg/L.; log)	-.03 (.20)	-.15 (.21) ^{t}
C-reactive Protein (mg/L; log)	-.40 (.23)	-.52 (.24) ^{t}

* $p < .05$; ^{t} $p < .10$

Table 3.4

Associations Between Change in Intra-individual Variables and Change in Physiological Measures Within the Intervention Group.

	B	SE	p
C-reactive Protein			
Perceived Stress	**.313**	**.158**	**.06**
Negative Affect	**.431**	**.156**	**.01**
Positive Affect	-.055	.175	.76
Physical Activity	.031	.169	.86
Psychological Well-being			
Purpose in life	-.084	.164	.61
Personal growth	-.177	.167	.30
Self-acceptance	-.178	.168	.30
Autonomy	.152	.171	.38
Environmental mastery	-.103	.174	.56
Interleukin-6			
Perceived stress	.176	.171	.31
Negative Affect	.271	.176	.13
Positive Affect	-.057	.186	.76
Physical Activity	.158	.173	.37
Psychological Well-being			
Purpose in life	**-.306**	**.164**	**.07**

	B	SE	p
Personal growth	-.151	.176	.40
Self-acceptance	-.207	.169	.23
Autonomy	.087	.187	.65
Environmental mastery	-.241	.181	.19
Cholesterol			
Perceived stress	-.007	.169	.97
Negative Affect	.045	.175	.80
Positive Affect	-.027	.166	.87
Physical Activity	**-.337**	**.155**	**.04**
Psychological Well-being			
Purpose in life	.250	.162	.13
Personal growth	.240	.168	.16
Self-acceptance	**.319**	**.158**	**.05**
Autonomy	-.152	.171	.38
Environmental mastery	.115	.175	.51
Body Mass Index			
Perceived Stress	.065	.136	.64
Negative Affect	-.111	.140	.43
Positive Affect	-.084	.138	.55
Physical Activity	.185	.132	.17

	B	SE	p
Psychological Well-being			
Purpose in life	.200	.135	.15
Personal growth	.047	.140	.74
Self-acceptance	-.068	.136	.62
Autonomy	-.172	.136	.22
Environmental mastery	.068	.136	.62

Note: All analyses control for gender and ethnicity, and for inflammatory measures, also control for BMI.

Table 3.5

Associations Between Change in Interpersonal Variables and Change in Physiological Measures Within the Intervention Group.

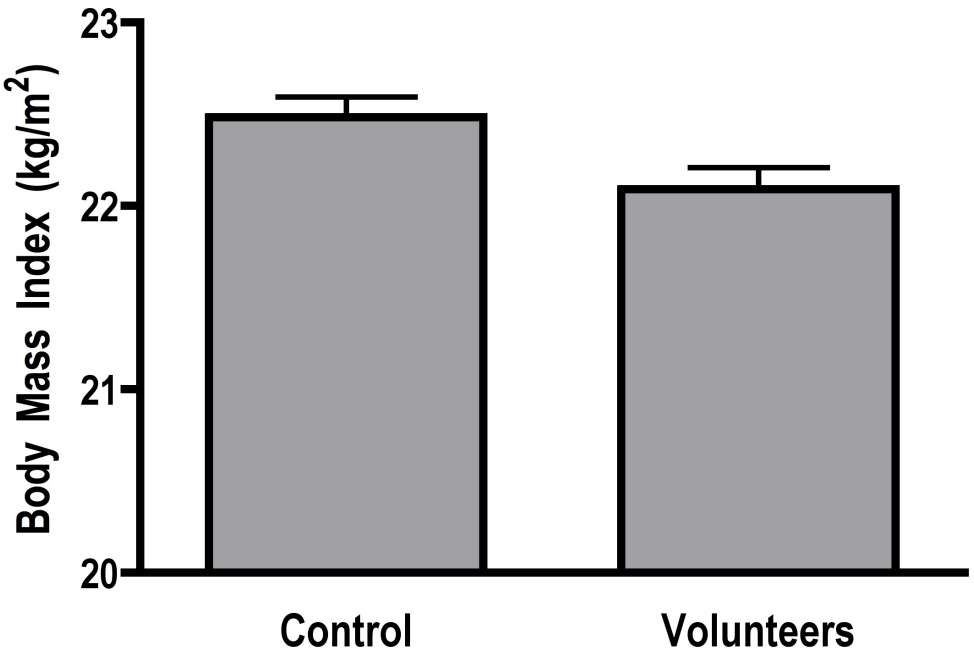
	B	SE	p
C-reactive Protein			
Positive Relations With Others	-.269	.176	.14
Leadership	.028	.056	.63
Integration With Family	.024	.086	.78
Diverse Peer Relationships	-.019	.038	.63
Linkages to Community	.037	.076	.63
Interleukin-6			
Positive Relations With Others	-.204	.183	.27
Leadership	.019	.063	.77
Integration With Family	-.101	.098	.31
Diverse Peer Relationships	-.053	.044	.25
Linkages to Community	-.010	.089	.91
Cholesterol			
Positive Relations With Others	.275	.171	.12
Leadership	.027	.063	.68
Integration With Family	.128	.095	.19
Diverse Peer Relationships	.053	.043	.23
Linkages to Community	**.194**	**.081**	**.02**

	B	SE	p
Body Mass Index			
Positive Relations With Others	-.196	.140	.17
Leadership	.010	.054	.86
Integration With Family	.064	.084	.46
Diverse Peer Relationships	.012	.039	.76
Linkages to Community	-.001	.076	.99

Note: All analyses control for gender, ethnicity, and baseline outcome variable.

Figure 3.1

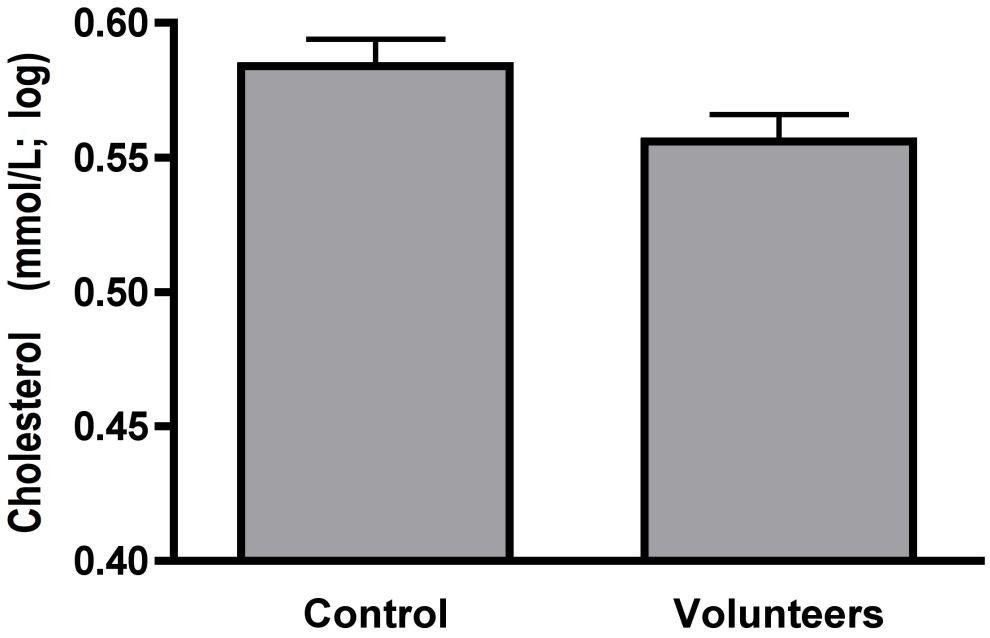
Adjusted Means of Body Mass Index Following the Intervention



Adjusting for baseline BMI, volunteers have significantly lower BMI at follow-up compared to control group participants ($F(1, 87) = 5.844$, $p = .02$).

Figure 3.2

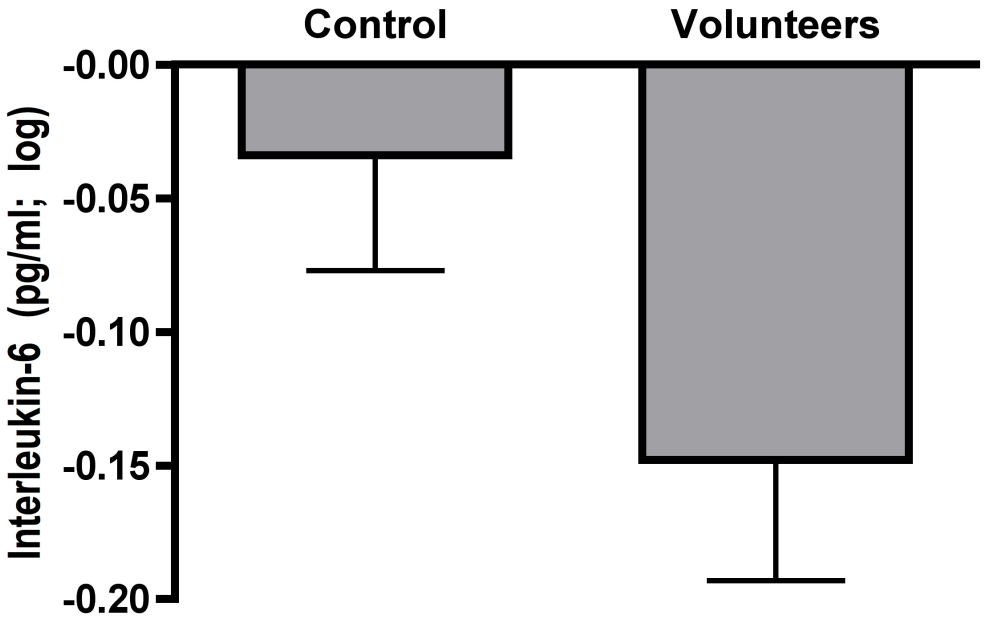
Adjusted Mean Levels of Cholesterol Following the Intervention



Adjusting for baseline levels of cholesterol, volunteers have significantly lower total serum cholesterol levels at follow-up compared to control group participants ($F(1, 83) = 3.824$, $p = .05$).

Figure 3.3

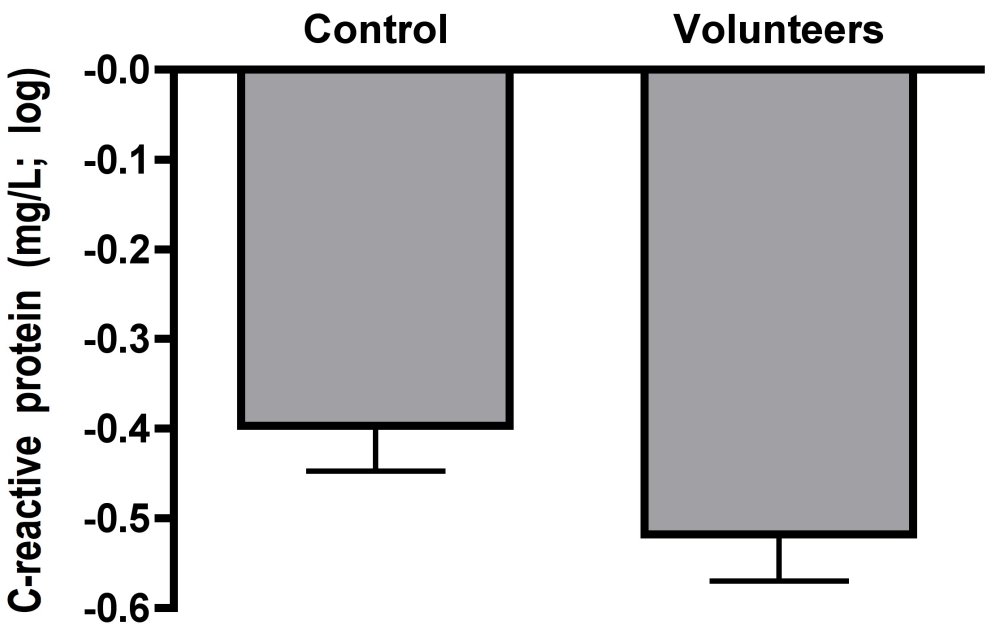
Adjusted Mean Levels of Interleukin-6 Following the Intervention



Adjusting for baseline levels of Interleukin-6, volunteers have marginally lower Interleukin-6 levels at follow-up compared to control group participants ($F(1, 82) = 3.352$, $p = .07$).

Figure 3.4

Adjusted Mean Levels of C-reactive Protein Following the Intervention



Adjusting for baseline levels of C-reactive protein, volunteers have marginally lower C-reactive protein levels at follow-up compared to control group participants ($F(1, 82) = 2.809$, $p = .10$).

Chapter 4: General Discussion

The impact of volunteering has been of interest for researchers for quite some time and researchers have examined the impact of volunteering in a number of different settings. However, the majority of research in this area is correlational in nature, focuses on older adults, and the majority of outcomes that have been investigated fall into the socioemotional domain. While studies examining older adults have found strong correlational links between volunteering and reduced likelihood of mortality and morbidity (Brown et al., 2003; Brown et al., 2005), virtually no studies have examined the impact that volunteering may have on physiological indicators that predict risk for cardiovascular disease. Therefore, the aim of the present set of studies was to use an experimental design and randomly assign healthy adolescents and young adults to engage in either informal or formal volunteering and to assess the impact of this on relevant physiological outcomes. In addition, we examined a number of possible explanations for why volunteering might be linked to physiological outcomes.

Our first goal was to test effects of both informal and formal volunteering among young, healthy samples on physiological outcomes. To this end, UBC undergraduates were instructed to either engage in informal volunteering in the form of family helping behaviors or in mundane everyday tasks over a four-week period (Study 1). To assess the potential impact of formal volunteering, grade 10 high school students were randomly assigned to either volunteer with elementary school children for several consecutive weeks or to a control group (Study 2). Previous studies have examined the impact of volunteering on health outcomes including mortality (Musick et al., 1999), morbidity (Brown et al., 2005), daily functioning (Hong & Morrow-Howell, 2010), physical activity (Tan et al., 2009), and self-reported health (Luoh &

Herzog, 2002) among older adults. However, the present studies sought to determine whether formal and informal volunteering could have a positive impact on additional physiological outcomes that represent risk markers for cardiovascular disease, specifically, inflammatory and metabolic risk markers as well as daily cortisol production, and whether such effects could be found among younger age groups. We had hypothesized that both formal and informal volunteering would lead to beneficial changes among physiological outcomes among participants assigned to our intervention groups when compared to participants in the control groups. We further hypothesized that these changes would at least in part be attributable to improvements in participants' psychological well-being, mood, stress levels, physical activity, and family relationships/social connections.

Results partly supported our hypotheses and were largely consistent with previous research. Specifically, our data suggested that formal volunteering can lead to physiological benefits among adolescents. In addition, our data suggested several psychosocial and behavioral variables that link formal volunteering to physiological benefits among young volunteers. However, links between informal volunteering and physiological outcomes were less strong, perhaps in part due to the small sample size of Study 1. These findings contribute substantially to our understanding of the potential physiological benefits that young volunteers may gain from helping others.

Influences of Informal and Formal Volunteering on Physiological Outcomes

Our primary aim in these studies was to link formal and informal volunteering to physiological outcomes among healthy adolescents and young adults. In particular, we were able to investigate influences on daily cortisol patterns and blood pressure as part of both Study

1 and Study 2. In addition, we examined the impact of formal volunteering on inflammatory and metabolic markers as part of Study 2. In keeping with our hypotheses we found effects in the hypothesized direction for both inflammatory and metabolic risk markers of cardiovascular disease. However, neither study found support for an impact of volunteering on blood pressure. These findings are discussed in more detail in the following paragraphs.

Findings from Study 2 show that formal volunteering can influence metabolic and inflammatory risk markers of cardiovascular disease among adolescents. Unfortunately, we were not able to assess these same outcomes as part of Study 1. All findings were in the hypothesized direction, indicative of lower cardiovascular risk among volunteers when compared to wait-list control participants following the intervention. Participants in the intervention group evidenced significantly lower levels of cholesterol and BMI and marginally lower levels of Interleukin-6 and C-reactive protein compared to participants in the control group. No difference was found for levels of glycosylated hemoglobin, likely because this represents a long-term indicator of blood glucose levels that was unlikely to change over the four-month period separating baseline and follow-up data collection. These inflammatory and metabolic markers have not previously been the subject of investigation among studies examining the impact of formal volunteering on either adults or adolescents. However, we know that CRP, IL-6, and cholesterol all can be influenced by psychological factors (Patterson et al., 1995; Steptoe et al., 2007), indicating that it is plausible for volunteering to influence these outcomes through various psychosocial pathways. Finally, while BMI has not been examined as an outcome among youth volunteers, data from older adults suggest that volunteering is associated with increased physical activity (Fried et al., 2004; Tan et al., 2006).

Regarding daily cortisol patterns, we found tentative support for the influence of informal volunteering on daily cortisol slope (though not total cortisol output) in Study 1, although the effect was only marginal. We did not find support for potential impacts of formal volunteering on cortisol in Study 2. One possible explanation of these findings relates to the difference in compliance rates to saliva sample collection across the two studies. Although the sample of Study 1 was less than half the size of the sample in Study 2, participants of Study 1 were very compliant to the agreed upon saliva sample collection schedule. In comparison, while compliance rates among the grade 10 students part of Study 2 were also acceptable there was a much greater rate of missing samples among this group, leading to substantially more missing data. In spite of multiple reminders, students were likely to forget about some sample collections, particularly at lunch time and after school. Hence, it is possible that with more complete cortisol data for Study 2, different findings would have emerged.

Alternatively, it is also possible that engaging in informal volunteering in the form of family helping behaviors has a greater impact on cortisol outcomes among youth than formal volunteering does. Data from Study 1 suggests that family helping behaviors may influence youth health outcomes through decreased family conflict (although no statistically significant association between family conflict and cortisol slope was found within the intervention group). Perhaps, even though youth may benefit from engaging in formal volunteering in a number of ways, formal volunteering is not associated with decreases in family-related stressors which represent significant stressors in the lives of youth (Chung et al., 2009). Hence, it may be possible that, at least under some circumstances, formal and informal volunteering may have different consequences for young volunteers. However, given the methodological problems of

the present studies, in particular the small sample size in Study 1 and the missing cortisol data in Study 2, more research is needed to confirm these results.

Overall, the results of Study 1 are in line with findings from previous studies that link receiving support to cortisol outcomes, such as lower cortisol responses following a laboratory stressor (e.g., Heinrichs et al., 2003), and the scant existing evidence that has linked providing support to same-sex strangers undergoing a laboratory stressor to subsequently acute decreases in cortisol (Smith et al., 2009). It is also of interest that we found an effect of informal volunteering on daily cortisol slope, but not on daily cortisol output, suggesting perhaps that engaging in family helping behaviors has a stronger impact on cortisol rhythms across the day rather than overall cortisol output. Future research will have to further investigate possible impacts of support provision, rather than support receipt, on cortisol.

Previous research has not investigated the impact of volunteering on blood pressure outcomes among young volunteers. Two studies suggest a connection between trait-tendency towards helping others and healthier 24-hour ambulatory blood pressure (Piferi & Lawler, 2006) and volunteering to lower risk of hypertension (Burr et al., 2011). However, neither study used an experimental design and one cannot conclude that better blood pressure outcomes were a result of volunteering and helping others. Furthermore, while Piferi and Lawler (2006) studied a sample of college students comparable to our sample in Study 1, they did not investigate the impact of volunteering specifically, but self-reported trait-tendency to help others, which arguably represents a different, albeit related, concept. In contrast, Burr, Tavares, and Mutchler (2011) focused on the impact of volunteering itself, but studied a sample of older adults which would likely include a greater range of blood pressure together with subclinical

cardiovascular disease. Hence, the impact of volunteering on blood pressure may be much more noticeable among such a sample.

Neither study presented here found evidence for an effect of volunteering on blood pressure. It is possible that different assessments of baseline blood pressure would have led to different results. As part of Study 1, blood pressure was assessed in a laboratory setting, and as part of Study 2 in the school setting. In addition, as part of Study 2, students were removed from their classrooms in small groups to undergo physiological assessments. While we tried to minimize the impact of students on each other's resting blood pressure by seating students facing the wall and asking them to wear noise-reduction headphones, we may not have been able to accurately capture resting blood pressure.

The current set of findings is particularly exciting in that adolescents and young adults were randomly assigned to volunteer as part of our studies, meaning that even some youth who would have been unlikely to participate in volunteering activities or programs were part of this research. This implies that even without strong preexisting motivations for volunteering, adolescents may reap physiological benefits from volunteering activities. At the same time, the fact that we found significant physiological benefits following random assignment to volunteering has important ramifications for currently used definitions of volunteering. Specifically, at the core of the definition of volunteering is the idea that volunteer work is provided out of the free will of the volunteer. This part of the definition of volunteering is arguably violated when participants are assigned to engage in volunteering, to a greater or lesser extent depending on the preexisting motivations for volunteering that different individuals may have brought to the study. While this is a valid consideration, it is also

important to note that an increasing number of schools require their students to partake in volunteering activities. In fact, Jones (2000) states that the main reason that youth volunteering in Canada is on the rise, are just these school requirements, suggesting that in practice this core aspect of what it means to volunteer may already be treated more loosely. This issue has been previously addressed by Carson (1999).

Explanations for Why Formal and Informal Volunteering May Improve Physiological Outcomes

Our secondary aim was to assess potential intra-personal and interpersonal variables connecting formal and informal volunteering to physiological outcomes among young and healthy individuals. In particular, we investigated numerous potential intra-individual and interpersonal variables. Our results suggest that, as hypothesized, links between volunteering and physiological outcomes were at least in part attributable to these factors. Data from Study 2 indicate that within the intervention group, changes in all outcomes aside from BMI were linked to changes in various psychosocial or behavioral variables, although notably no variable predicted more than one physiological outcome. Data from Study 1 did not find significant effects for proposed psychosocial variables, likely due to the small sample size.

By and large, our findings were in line with our hypotheses and previous research. For example, regarding the influence of formal volunteering, we found that among those assigned to the intervention group, greater decreases in negative affect and stress were associated with greater decreases in CRP over the intervention period. Links from negative affect and stress to CRP have been previously reported in observational studies (Friedman & Ryff, 2012). Among those in the intervention group, greater increases in purpose in life were associated with

greater decreases in IL-6 over the intervention period. Previous research has demonstrated in observational studies that high levels of purpose in life is associated with lower levels of IL-6 and soluble IL-6 receptor (Friedman & Ryff, 2012; Friedman et al., 2007; Ryff et al., 2004). Among those in the intervention group, greater increases in physical activity were linked to greater decreases in cholesterol over time. Physical activity is known to influence levels of cholesterol (Lee et al., 2001; Raitakan et al., 1994), making this a plausible connection between formal volunteering and cholesterol. Finally, among those in the intervention group, greater increases in community connections were associated with greater decreases in cholesterol over time. To our knowledge, no previous studies have assessed perceived links to community and evaluated its impact on total serum cholesterol levels. Present results suggest that this association may be worthwhile looking into further. Finally, our lack of psychosocial variables associated with changes in BMI may indicate that BMI was altered as a result of changes to other health behaviors such as diet, which were not assessed as part of the current study.

Results were less convincing in terms of psychosocial variables linked to steeper daily cortisol slopes in Study 1. Due perhaps in part to limited power for our statistical analyses we found no significant effects in within group analyses of change in psychosocial variables and change in daily cortisol slope over the intervention period. The (relatively speaking) strongest findings were with autonomy and family conflict (*p*s ≅ .15). This is plausible as family conflict is an important stressor in the lives of youth (Chung et al., 2009) and reduced family conflict in the home may hence be associated with steeper cortisol patterns. However, findings from previous studies suggest that while various aspects of psychological well-being have been

linked to cortisol production, autonomy is not typically one of them (e.g., Lindfors & Lundberg, 2002; Ryff et al., 2006).

Overall, however, it is encouraging to see with respect to the influence of psychological well-being, that other studies that have previously linked psychological well-being as measured through Ryff's (1989) Psychological Well-Being Scale to health outcomes also reported numerous effects for the purpose in life subscale, similar to what was found as part of Study 2. Schwartz, Keyl, Marcum, and Bode (2009), for example, investigated the impact of altruism on the psychological well-being of adolescents and found that altruism was most strongly linked to purpose in life. Furthermore, data from older women show that especially purpose in life has been linked to physiological outcomes (Ryff et al., 2004; Ryff et al., 2006). It is also worth noting, however, that the above mentioned studies support an important role of the positive relations with others subscale. However, in the current studies positive relations with others did not significantly predict any of the physiological outcomes under investigation. This may be because previous research either focused on older adults (Ryff et al., 2004; Ryff et al., 2006) or in the case of adolescents, only found effects among female participants (Schwartz et al., 2009).

Our unexpected findings with respect to self-acceptance in Study 2 are somewhat puzzling. Counter to our hypotheses, results from Study 2 suggested a significant effect of self-acceptance, such that among those who were assigned to the intervention group, those who showed greater increases in self-acceptance over the study period also showed greater increases in cholesterol. In comparison, in Study 1 no significant relationship between self-acceptance and family helping behaviors was evident, however, coefficients were in the hypothesized direction. One possible explanation of these findings is that adolescents who

increased with respect to self-acceptance also became more self-accepting of their physical appearance and consequently placed less emphasis on eating healthily, resulting in a rise in cholesterol levels. Other studies have also reported conflicting findings with respect to helping others among youth and self-acceptance as measured using Ryff's (1989) Psychological Well-being Scale. Schwartz, Keyl, Marcum, and Bode (2009) have previously reported that in their sample of over 400 recent confirmands of the Presbyterian Church, associations between helping others and self-acceptance only existed for boys and not for girls. More intriguingly, both family helping behaviors and helping orientation were positively associated with self-acceptance, suggesting that adolescent boys who help more often are more self-accepting. However, among the same sample of adolescent boys, general helping behaviors (as opposed to family helping behaviors) were equally strongly but negatively related to self-acceptance. These findings, together with data from the present two studies, suggest perhaps that there is something about helping behaviors within the family sphere that makes them more likely to promote greater self-acceptance among youth. This could be a result of family helping behaviors positively influencing people that youth spend significant amounts of time with, as opposed to strangers with whom they may only be in contact during volunteering activities.

Strengths and Limitations of the Present Research

The present research has two main strengths, its use of random assignment to informal and formal volunteering and, in the case of the second study, its assessment of physiological risk markers, that is both inflammatory and metabolic markers, that have not previously been assessed as part of studies interested in the potential benefits of volunteering. These aspects of the present studies represent important improvements over previous research that has

primarily used correlational study designs to investigate the influence of both formal and informal volunteering, and in addition has strongly emphasized assessing socioemotional rather than physiological outcomes. What is more, those studies that have focused on health outcomes most often relied on participants' self-reported health (e.g., Borgonovi, 2008) or other aspects of physical health that can be assessed noninvasively, such as blood pressure (e.g., Burr et al., 2011).

By randomly assigning participants to engage in either formal or informal volunteering we can conclude that our findings are not the result of selection effects or unknown third variables but are in fact the result of our volunteering-based intervention. The possibility of selection effects to date has been a particular concern among studies focusing on older adults as there is a distinct possibility that those who already suffer from more functional limitations or greater depression symptoms may be much less likely to engage in volunteering. Some studies investigating older adults were able to compare volunteers to matched comparison groups (e.g., Hong & Morrow-Howell, 2010). However, almost none of the studies focusing on older adults took advantage of random assignment. What is more, we were able to assess the influence of both formal and informal volunteering among healthy adolescents and young adults. In contrast, much of the previous research focusing on the benefits of volunteering has focused on older adults who are likely to be suffering from a variety of health problems already. This allowed us to examine whether volunteering might be able to produce benefits that over the long-term could potentially be beneficial with respect to risk clinical diseases later in life.

Despite these strengths, the current studies also suffered from a number of limitations. First and foremost, Study 1 involved a relatively small sample size (39 participants) which

resulted in lower power for our analyses, which makes it difficult to interpret effects with any certainty, and which may have reduced our ability to detect existing effects, both with respect to main effects of our intervention but especially with respect to the detection of potential variables that could help explain why those assigned to volunteer showed marginally steeper cortisol slopes post-intervention.

Related to the issue of sample size is the problem that in spite of random assignment both studies had at least one outcome that was not independent of group status. Specifically, following random assignment, both systolic blood pressure and total daily cortisol output were associated with group in Study 1 and cortisol slope was associated with group in Study 2. Consequently, results from analyses investigating these particular outcomes must be interpreted with caution (Wildt & Ahtola, 1978). In addition, in Study 1 ethnicity was not equally distributed across the intervention and control group, resulting in a further qualification of these findings. Presumably, random assignment would be more successful in eliminating baseline group differences if larger samples were being used. The sample of Study 1 also consisted largely of East Asian students, meaning that it is not representative of more ethnically diverse undergraduate populations.

A further limitation of this research with respect to the potential benefits of formal volunteering (Study 2) is the fact that we were only able to assess the influence of one type of formal volunteering program, volunteering at elementary schools' after school programs. Hence, it is unclear whether different kinds of formal volunteering would result in the same physiological benefits among adolescents. While adolescents in this study were assigned to volunteer for different after school programs at local elementary schools, all volunteer

assignments were similar in that they involved working with and supervising elementary school-aged children. In other words, all volunteering assignments contained a strong interpersonal component. It is possible that formal volunteering assignments that do not involve strong interpersonal components are perceived as less rewarding by adolescents. In addition, Hamilton and Fenzel (Hamilton & Fenzel, 1988) reported that youth working with children reported learning a lot about themselves as well as other people in the community, and Omoto, Snyder, and Martino (2000) found that relationship concerns are stronger motivations for adolescent volunteers than for adult volunteers. These findings suggest that strong interpersonal components to formal volunteering activities may be necessary for adolescents to benefit from their experiences. Conversely, it may be the case that formal volunteering activities that include contributions to improving or developing other publicly used facilities or services may nonetheless lead to improvements in physiological outcomes, even in the absence of strong interpersonal components so long as adolescents feel they are making meaningful contributions to their community. As the effect of formal volunteering on physiological outcomes was in part attributable to factors such as physical activity, links to community, and negative affect, it is possible that such volunteering programs may nonetheless lead to similar outcomes.

Finally, we acknowledge that across both studies, numerous analyses were conducted without correction for multiple comparisons. We chose this approach because this was a novel and preliminary study with a relatively small sample size, and because we had theoretically driven hypotheses with directional predictions. The fact that the patterns for physiological outcomes emerged consistently in the same direction across diverse outcomes provides some

reassurance that these are not spurious findings. Nonetheless, future studies will be needed to replicate these results in larger samples with more stringent analytic approaches.

Contributions to the Research Field

In spite of the limitations listed in the previous section, the studies presented here make a number of important contributions to the existing literature on volunteering. Findings from these studies not only support the existence of physiological benefits of volunteering with respect to important cardiovascular risk markers, but in addition do so among young, healthy samples and using a strong experimental design. Consequently, these studies add to previous research by allowing us to draw stronger conclusions about the causality of effects of volunteering activities, and to know that these are not due to selection effects or unknown third variables.

The present research focused on physiological measures, which is not interchangeable with self-rated health. Numerous studies to date have examined the impact of volunteering on self-reported physical health. While some found significant effects on self-reported health (e.g., Morrow-Howell et al., 2003), many others did not (e.g., Borgonovi, 2008). This may in part explain why the focus of volunteer studies still rests largely on socioemotional outcomes. However, based on the studies presented here there appears to be great value in assessing physiological risk markers, particularly ones indicating risk for later cardiovascular disease. In addition, our results suggest that while previous research on informal volunteering has hinted at its potentially negative impact on adolescents (Fuligni et al., 2009a) our results based on an experimental intervention that randomly assigned young adults to provide family helping behaviors suggest that these cross-sectional studies may also be picking up on other influences

at the family level that are associated with an increased need for family helping behaviors from youth, and that conversely benefits of family helping behaviors may be more evident when using experimental designs.

In addition, the current study provides substantial additional evidence with respect to intra-individual and interpersonal factors that might help explain why those in the intervention group improved on physiological outcomes. As previous research has not investigated physiological outcomes following formal volunteering among adolescents, there also has not been a detailed investigation of the potential factors that may connect volunteering to physiological profiles among this age group. Finally, in addition to the novelty of focusing on adolescents and assessing physiological outcomes, we also made a deliberate effort to recruit young adults and adolescents from primarily low SES environments. Our results provide additional support for the potential feasibility of volunteering-based interventions among youth from disadvantaged backgrounds.

Applying the Study Findings

While the present study findings add importantly to existing research they furthermore have the potential to have significant implications for policy makers and health professionals. As we have shown that helping others and volunteering can indeed be beneficial to the physiological profiles of young, healthy individuals, getting young people, even adolescents, involved in regular volunteering activities may represent one possible pathway to improving health in the long-term. This may be especially valuable among youth from under-privileged backgrounds who are at an increased risk of experiencing poor health at all stages of life and whom the present studies have shown to also benefit from a volunteering-based intervention.

There are several further benefits of volunteering-based interventions. First of all, there are potential benefits for the beneficiaries of adolescents' volunteering assignments, in this case elementary school children. Haski-Leventhal, Ronel, York, and Ben-David (2008) investigated a program in Israel as part of which both adolescents and adults were volunteering for at-risk youth. Their data suggest that at-risk youth greatly enjoyed also having volunteers working with them who were closer to them in age than the adult volunteers were. Data from other studies that examined the influence of youth volunteering for youth further support these findings while also indicating that youth beneficiaries from volunteering may find it easier to build trust with other volunteers closer to their age and that youth can gain great satisfaction from volunteering for other youth and feel as though they are making significant contributions through volunteering (Edwards, Safrit, Gliem, & Rudd, 2006; Katan & Etgar, 1998; Kulik, 2007). Similarly, anecdotal evidence suggests that the elementary school children involved in the after school programs that adolescents volunteered for as part of the current study were very appreciative of their adolescent volunteers and enjoyed their presence. Even if an intervention was designed around other tasks, adolescent volunteers would not only be likely to benefit themselves but provide valuable labour and input to various community-based projects and contribute to overall community-building.

Finally, while benefiting with respect to their physiological profiles, youth participating in volunteering activities would likely also benefit from greater emotional and social development. Adolescence is a period of time during which significant emotional and social development is known to take place (Larson, 2000). Moreover, research focusing on socioemotional outcomes of youth volunteering suggests that volunteering contributes to

positive youth development (e.g., Hamilton & Fenzel, 1988; Switzer et al., 1995). In combination with findings from our studies, existing research suggests that youth can benefit in several important ways at once by becoming involved in volunteering.

Future Directions

As part of the present research we have found that engaging in informal volunteering as well as formal volunteering programs can have beneficial effects on daily cortisol patterns and metabolic and inflammatory markers, as well as BMI, respectively, among otherwise healthy young adults and adolescents. These findings contribute to the existing literature on the influence of volunteering. Furthermore, the present studies introduce additional, new questions to be addressed as part of future research.

First, as discussed previously, all of the outcomes investigated as part of the present studies represent important cardiovascular risk markers. This is of particular interest when viewed in conjunction with research among older adults that has found support for the ability of volunteering programs to reduce the likelihood of mortality in this age group (Oman et al., 1999). Research to date has focused on examining various socioemotional explanations that might explain the association between volunteering and mortality. However, to our knowledge no studies have investigated whether formal volunteering can be linked to the types of physiological outcomes examined in the current studies among older adults. Future research should consider assessing inflammatory and metabolic risk markers among older adults as well, as these may represent part of a biological mechanism linking formal volunteering to reduced mortality and morbidity risks among older adults.

Second, we have already discussed as a limitation of the present research the fact that we were only able to test the impact of one particular type of formal volunteering. Future research should investigate whether other forms of volunteering, including programs that involve significant interpersonal contact with individuals from other age groups and also programs that are not designed around interpersonal aspects at all, can lead to similar benefits with respect to physiological outcomes among volunteers. Given the previously documented relationship focus contained with adolescents' volunteering motivations (Omoto et al., 2000) it is possible that volunteering assignments that do not focus on interacting with others may not result in comparable physiological benefits.

Third, our findings suggest that there may be substantial value in designing interventions similar to the current ones but of longer duration, both for studies investigating informal and formal volunteering. This is for the following several reasons. First, following youth volunteers for longer periods of time would allow researchers to test whether sustained volunteering leads to further improvements in physiological outcomes. Second, it would allow researchers to test whether the benefits of volunteering decrease at a certain point. Third, following youth volunteers even after their volunteering assignments have ended will allow researchers to investigate how long following the termination of volunteering activities these physiological benefits may persist for.

Fourth, the current research highlights several points of particular importance for future research aimed at investigating the impact of informal volunteering among adolescents. The present sample was very restricted with regard to its ethnic make-up. However, as previous research has shown that both culture and ethnicity are of crucial importance to family helping

behaviors and support provision (Kiang & Fuligni, 2009), future research should investigate potential benefits of family helping behaviors among samples that include sufficiently large numbers of youth from different cultural and ethnic backgrounds.

Finally, the present studies also raise the exciting question whether inflammatory and metabolic cardiovascular risk markers might be associated with family helping behaviors in an experimental study. As part of Study 2, we found support for both types of risk markers being improved among healthy grade 10 students, following an intervention involving formal volunteering. Unfortunately, these risk markers could not be assessed as part of Study 1. Hence it remains to be determined whether similar effects might exist for family helping behaviors. Fuligni et al. (2009) previously assessed the impact of family helping behaviors on inflammatory markers including CRP and suggested that family helping behaviors were associated with lower levels of CRP among adolescents who reported deriving a sense of role fulfillment from their helping behaviors. Importantly, however, adolescents were not randomly assigned to engage in family helping behaviors. Consequently it remains to be seen whether a study using an experimental design will support these findings.

Overall, findings from the two studies presented here indicate that random assignment to volunteering is associated with lower levels of cardiovascular risk factors. They further show that this is the case among young and healthy samples from primarily disadvantaged backgrounds, setting the stage for exciting possibilities of future interventions revolving around youth volunteering. Our results also put forward a number of potential psychosocial explanations, both intra-individual and interpersonal in nature, through which volunteering may come to impact youth physiological outcomes. Findings from our study regarding the

influence of informal volunteering, i.e. family helping behaviors, are not as conclusive as findings regarding formal volunteering. Nonetheless, taken together, these findings represent an important step in using an experimental design to assess the influence of family helping behaviors on the physiological risk markers in adolescents and young adults which hopefully will be investigated in more detail as part of future research.

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