

Effect of Grandparent-Grandchild Interaction on Socio-Emotional and Cognitive
Outcomes of Adolescent Grandchildren in Sri Lanka

by

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Thesis submitted in partial fulfillment of
the requirements for the degree of
Master of Science in the Duke Global Health Institute
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ABSTRACT

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Abstract

Background: This study aims to examine the association between grandparent-grandchild relationships and socio-emotional and cognitive outcomes among adolescent grandchildren in Sri Lanka. Methods: This cross-sectional study was conducted within schools, temples, homes and community buildings in Galle District. Adolescent grandchildren 11-17 years old who were conversant in Sinhala or English were eligible. A self-report survey was used to collect data about 394 adolescent participants' demographics, grandparent relationships, empathy, and socio-emotional development. A cognitive test was used to assess adolescents' cognitive development. Summary statistics and bivariate and multivariate linear and logistic regression analyses were used to examine the association between demographic factors, grandparent-grandchild relationships and adolescent outcomes. Grandparent-grandchild relationship variables were 1) relationship closeness 2) interaction frequency and 3) combination (relationship closeness and interaction frequency). Results: Greater maternal grandmother relationship closeness was associated with adolescent empathy levels, greater paternal grandfather closeness was associated with adolescent socio-emotional development, and greater maternal grandfather closeness was associated with better adolescent cognitive development. For the closest grandparent relationship of the four potential grandparent relationships, a close relationship in combination with daily interaction was associated with better adolescent socio-emotional development. Conclusion: Grandparent-

grandchild_relationship closeness and interaction frequency (from the perspective of the adolescent) had an impact on adolescent outcomes. In general, greater relationship closeness was associated with better adolescent outcomes. In contrast, paternal grandmother-grandchild interaction was negatively associated with empathy and cognitive outcomes, while maternal grandfather interaction was positively associated with cognitive outcomes. Future research should identify methods of increasing positive adolescent outcomes through grandparent-related interventions.

Dedication

I dedicate this thesis to my parents, Tom and Maria Saxton, who have always been my greatest supporters and source of love and happiness. I also dedicate this thesis to Michael Murphy, whose help and encouragement was instrumental throughout this process.

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1. Introduction

1.1 Adolescent development

Adolescence is a transitional developmental period between childhood and adulthood that is characterized by more biological, psychological, and social role changes than any other stage of life, except infancy (Williams, Holmbeck, & Greenley, 2002). It is now a basic tenet of developmental psychology, supported by decades of research, that development is influenced by numerous factors at multiple levels, ranging from intrinsic variables to factors related to the family, community and society (Fernando, Miller, & Berger, 2010). It has also long been noted that adolescence is a critical period of maturation with dynamic brain development (Taylor et al., 2015) characterized by psychological, behavioural, and social change (Taylor, Barker, Heavey, & McHale, 2015).

Given the importance of adolescent development, it is not surprising that there are also significant changes in the types and frequency of health problems and psychological disorders during this developmental period, as compared with childhood (Williams et al., 2002). In particular, adolescence is a time of special significance for the emergence or intensification of various forms of emotional and behavioural disorders (Steinberg, 2002).

1.1.1 Socio-emotional development

The transition from childhood to adolescence is a particularly unpredictable time in terms of socio-emotional development due to adolescents' increased desire for autonomy, social acceptance, and personal identity (Martínez, Aricak, Graves, Peters-Myszak, & Nellis, 2011). Socio-emotional development incorporates a range of functions including emotion recognition, empathy, perspective-taking, and the ability to impute a range of mental states including beliefs, desires, and intentions to self and others (Taylor et al., 2015). Behavioural studies report ongoing social-emotional development during adolescence and found socio-emotional development is multidimensional, with different aspects showing different developmental trajectories in adolescence (Taylor et al., 2015).

One dimension of socio-emotional development is empathy. Empathy is currently defined from a perspective that emphasizes emotional responses, a capacity to respond to others, the ability to discriminate between the emotions of one's self and that of others (Garaigordobil, 2009), and the ability to put oneself in the mind of others (Reid et al., 2013). Empathetic ability plays an essential role in understanding social interactions and is considered a necessary prerequisite for both regulating one's own behaviour and behaving in a way that benefits others (Reid et al., 2013). It is influential in determining an individual's acceptance by peers and in the acquisition of morality, which are both important foundations for successful social maturation (Reid et al., 2013).

Empathy has increasingly been implicated in a range of psychopathologies, including autism, conduct disorders, personality disorders, and psychopathy (Reid et al., 2013). In addition, developmental theorists suggest that the development of intimate friendships is accompanied by the maturation of adolescents' empathy and socio-emotional skills (Chow, Ruhl, & Buhrmester, 2013).

1.1.2 Cognitive development

Executive functions initiate, co-ordinate, maintain, and inhibit other cognitive functions (Taylor et al., 2015). During adolescence, some cognitive functions show expanded development, including updating and switching and verbal fluency and planning. In addition, the cognitive development of adolescents is closely linked with their emerging views of self, relationships to others, society, and the world (Lounsbury, Welsh, Gibson, & Sundstrom, 2005).

1.1.3 Adolescent development in Sri Lanka

During childhood and adolescence, the high prevalence of psychiatric disorders, including those related to socio-emotional and cognitive development, such as those mentioned above, is not exclusive to developed societies, although relatively little is known about child and adolescent psychiatric problems and risk factors in developing countries (Syed, Sajida Abdul Hussein, & Mahmud, 2007), such as Sri Lanka. Although the range of disorders seen in adolescents in developing countries is similar to that in developed countries, such as emotional disorders, behavioural disorders,

neuropsychiatric disorders, learning disabilities, and developmental disorders (Syed et al., 2007), it cannot be assumed that the same risk factors associated with adolescent psychopathology operate universally.

Most of the world's adolescents live in developing countries, such as Sri Lanka, and moreover, in a setting that may include a wide range of risk factors, including poverty, malnutrition, infectious diseases, and inadequate schooling (Syed et al., 2007). Available evidence suggests that specific cultural and socio-demographic variables are important in determining the risk of emotional and behavioural problems in any given community (Syed et al., 2007). As many of the changes that occur during adolescence, as described above, vary across ethnicity, gender, temperament, socioeconomic status, and community variables (Williams et al., 2002), it is important to carefully consider contextual factors that impact adolescent development, such as family (and more specifically, GP) relationships.

In Sri Lanka, psychological disorders among adolescents are relatively common compared to adolescents in other parts of the world due to the country's social and economic disparities (B. Perera et al., 2007), as well as the recently ended civil war and the 2004 tsunami. Although it is known that the mental health of children is uniquely impacted by natural disasters, children are often underserved by trauma interventions (Commers, Morival, & Devries, 2014). War and natural disasters do considerably more than merely expose adolescents to potentially traumatic stressors; they also generate

enduring, stressful conditions on daily life (Fernando et al., 2010). In particular, children in Sri Lanka suffered high levels of PTSD and other mental health disorders following the 2004 tsunami (Commers et al., 2014). In light of post-civil war and -tsunami effects, Sri Lankan adolescents have experienced an environment of turmoil, in addition to rapid cultural changes (de Silva, Stiles, Gibbons, & Gibbon, 1992), which may make adolescent development more difficult. Furthermore, daily stressors significantly mediate the relation between exposure to disaster-related stressors and psychological and psychosocial distress among adolescents in Sri Lanka (Fernando et al., 2010). In particular, adolescents experience a number of stressful events in their home and school environments that may predispose them to the development of psychological disorders (B. Perera et al., 2007).

An understanding of adolescents' functioning that takes familial domains into account is particularly salient to Sri Lanka, where general functioning is dependent on social networks, religious beliefs, cultural practices, and family roles (Fernando et al., 2010). In particular, clinical experiences in Sri Lanka reveal that children's reactions to family situations are responsible for the development of emotional problems (De Silva, Nikapota, & Vidyasagara, 1988). Social factors, such as family structure and aspects of family function are clearly implicated in the development and maintenance of mental disorders in adolescents and their extension into adulthood (Syed et al., 2007).

1.2 *The changing role of grandparents in Sri Lanka*

In Sri Lanka and around the world, the role of grandparents (GPs) has changed in response to social, economic (Danielsbacka & Tanskanen, 2012) and demographic factors (Arránz Becker & Steinbach, 2012), which may operate both in favour of or against the relationship between GPs and their grandchildren (GC).

In modern society, several factors have the potential to operate against meaningful ongoing GP-GC relationships (Baranowski, 1982). Theorists have argued that tradition and social expectations have lost much of their capacity to dictate family relationships, including GP-GC relationships (Boon & Shaw, 2007). Now more than ever, familial interactions and obligations are often thought of as occurring primarily within the nuclear rather than extended family (Baranowski, 1982), which may exclude GPs from the lives of their GC. In particular, if children do not live in the same household as their GPs, it is possible that they will not have ample opportunity to engage in an ongoing relationship with their GPs. In addition, increased trends towards residential mobility make it more likely that GPs and their GCs are separated by wide geographical distances (Baranowski, 1982). Furthermore, a “hands off” policy, in which grandparents have neither the responsibility nor obligation to take an active part in the socialization of their GC, could result in detached GP-GC relationships (Baranowski, 1982).

Despite the above factors, there is evidence that close GP-GC relationships exist, possibly because there are certain factors which make close GP-GC ties more likely today than in the past (Baranowski, 1982). A major factor is the shift from high-fertility and -mortality societies to low-fertility and -mortality societies. For instance, the country's crude birth rate was 18.1 in 2005, compared to 36.6 in 1960 (Department of Census & Statistics, Sri Lanka, 2012). This shift has created a potentially increased role of grandparenting (Danielsbacka & Tanskanen, 2012), as the lifetimes of different generations have the opportunity to overlap for two to three decades (Attar-Schwartz, 2015), which is unparalleled in human history (Arránz Becker & Steinbach, 2012). In contrast, the lifetime overlap shared by GPs and GC was a decade or less prior to the mid-20th century (Arránz Becker & Steinbach, 2012). In addition, decreased fertility results in fewer GC per GP, which allows for a more intense GP-GC relationship (Geurts, Poortman, van Tilburg, & Dykstra, 2009). This is important in Sri Lanka, where childbearing begins relatively late and there is a considerable desire among women to control their number of births (Department of Census & Statistics, Sri Lanka, 2012)

A second, related factor are medical, technical, and educational advances (Baranowski, 1982), which have led not only to increased physical health of grandparents, but also improved cognitive outcomes at advanced ages. As a result, GPs are more able to provide active support to their GC, including through engagement in shared activities (Baranowski, 1982).

A third factor is family, economic and societal changes which alter the family structure, such as the prevalence of divorce in the parent generation (King & Elder, 1998). Family and social events such as these prompt grandparents to take on new family roles, including the responsibility of primary caregiver, in some cases (King & Elder, 1998). In Sri Lanka, increased levels of noncustodial (not on a full-time basis) care by grandparents have also been driven by changes (Luo, LaPierre, Hughes, & Waite, 2012) related to the role of women, including better education, career prospects and earning potential (Condon, Corkindale, Luszcz, & Gamble, 2013). In particular, the distribution of median years of education completed by age is now slightly higher for females (Department of Census & Statistics, Sri Lanka, 2012). Similarly, women's labour market participation has increased the need for help from grandparents (Danielsbacka & Tanskanen, 2012), particularly live-in grandparents (Westley & Mason, 1998). These and other social and economic changes have increased the number of parents who need help raising their children, a responsibility which has increasingly shifted to GPs.

1.3 Impact of GP-GC relationships

The specific role of GPs within the family is diverse (Pratt, Norris, Hebblethwaite, & Arnold, 2008). It has been documented that GP-GC relationships form a major part of the familial structure and most studies have found that grandparents perceive their role positively (Arránz Becker & Steinbach, 2012).

GPs may have a direct influence on their grandchildren through their interactions with them (Dunifon & Bajracharya, 2012). In general, GPs can serve as positive role models for their GC, as evident by the observations of improved school performance, increased autonomy in decision-making, and less deviant behaviour by GC raised by their GPs (Hayslip & Kaminski, 2005). Some studies have directly linked grandparent involvement to child well-being (Dunifon & Bajracharya, 2012).

GPs' involvement can also influence GC in indirect ways. For this to happen, the role of parents may be particularly important, as parents can serve as gatekeepers between GPs and GC (Dunifon, 2013). During childhood and early adolescence, parents are most important, as they initiate and facilitate contact with GPs; however, when GCs enter adulthood, the parental influence on the GP-GC relationship may become less important and GC may establish the relationship on their own (Geurts et al., 2009).

Younger GC generally perceive their GPs positively; however, GC's perceptions of GP-GC relationships tend to decrease as they grow into adolescence (Hakoyama & MaloneBeach, 2013). This is at least partly attributable to the various transitions and developments (Baranowski, 1982) that occur during adolescence, which may modify and potentially constrain a GC's relationship with their GPs (Attar-Schwartz, 2015; Baranowski, 1982). For example, adolescents are no longer in need of caretaking in the same capacity that younger children require (Mueller, Wilhelm, & Elder, Jr., 2002).

While it is recognized that close GP-GC relationships promote well-being and mental health among both GPs and GC (Arránz Becker & Steinbach, 2012), little is known about the impact of GP-GC relationships on adolescent GC, specifically (Mueller et al., 2002). It is known, however, that grandchildren who have close relationships with their grandparents at a younger age are more likely to maintain closer relationships in adulthood, which is an indication of the importance of establishing strong relationships in childhood and adolescence (Hakoyama & MaloneBeach, 2013). There is a growing body of research that shows the importance of GPs in the lives of adolescents and their positive contribution to adolescent development and outcomes (Attar-Schwartz, 2015). In addition, the potential positive impact of the GP-GC relationship on the development of adolescents has been increasingly recognized (Attar-Schwartz, 2015), although relatively few studies have directly related the GP-GC relationship to measures of adolescent well-being.

1.4 Study aims

This study aims to examine the association between GP-GC relationships and socio-emotional and cognitive outcomes of adolescent grandchildren aged 11-17 in Sri Lanka.

Specific aims:

1) To assess the extent to which 1) GP-GC relationship closeness and 2) interaction frequency and 3) the combination of GP-GC relationship closeness and interaction frequency are positively associated with socio-emotional and cognitive outcomes of adolescent grandchildren.

Hypothesis: Close GP-GC relationships and frequent GP-GC interaction are positively associated with adolescent (a) socio-emotional and (b) cognitive outcomes.

2) To assess GP-GC relationships and the differences in GP-GC relationships in relation to the four GP types (maternal grandmother, maternal grandfather, paternal grandmother, paternal grandfather).

2. Methods

This cross-sectional study was conducted within schools, temples, homes and community buildings between June and August 2015 in Galle District, Sri Lanka. Participants were adolescents aged 11-17 who had at least one living GP. A self-report survey was used to collect data about the participants' demographic, family and household information, GP-GC relationships, demographic information about their GPs, as well as measures to assess their socio-emotional development, including empathy. A cognitive test was used to assess the participants' cognitive development.

2.1 Setting

The total population of Sri Lanka is 20.2 million, 30% of which are adolescents (below 18 years of age) (Department of Census & Statistics, 2012). Sinhalese constitute the largest ethnic group in the country (Department of Census & Statistics, Sri Lanka, 2012). The country's literacy rate is 95.6% and on average, 2.6 children are born alive to women (Department of Census & Statistics, 2012). Inequality in Sri Lanka, as measured by the Gini coefficient of household expenditure, fell to 0.37 in 2009-2010, but rose back to 0.40 in 2012-2013 (Department of Census and Statistics, Sri Lanka & Poverty Global Practice, World Bank Group, 2015). Despite this, Sri Lanka experienced an average GDP growth rate of 5.5% per year from 2002 to 2013, with the national poverty rate falling from 22.7% to 6.7% (Department of Census and Statistics, Sri Lanka & Poverty Global

Practice, World Bank Group, 2015). Interestingly, the smallest relative reduction in poverty was in Galle District.

Galle District, one of the 25 districts of Sri Lanka, is in Sri Lanka's Southern Province (Department of Census & Statistics, Sri Lanka, 2012). In Galle District, the population is 1.1 million, 86.1% of which is rural (Department of Census & Statistics, 2012). In Galle, the population density is 655 persons/km² (Department of Census & Statistics, 2012). 3.1% of Galle's population has no formal education, 41.4% of the population has attained secondary school level education, and 2.4% of the population has one or more degrees (Department of Census & Statistics, 2012). 50.6% of Galle's population over the age of 15 is economically active, with 46.3% employed (Department of Census & Statistics, 2012).

It is important to note that Galle District, especially its coastal belt, was impacted by the December 2004 tsunami, which was the result of the fifth-largest quake in a century (Department of Census & Statistics-Sri Lanka, n.d.). In the district, over 16,000 building units were damaged, 12,000 of which were houses (Department of Census & Statistics-Sri Lanka, n.d.). Over 53,000 people lived in these housing units, approximately 34% of which were adolescents (Department of Census & Statistics-Sri Lanka, n.d.). More than 1,000 of these adolescents had either one or both parents die as a result of the tsunami (Department of Census & Statistics-Sri Lanka, n.d.).

2.1.1 Participants and sampling

Participants were recruited from public schools, temples, local homes, and community buildings throughout Galle District in Sri Lanka. This study was not administered within private schools, as students who attend private schools were more difficult to access. For each participant, the study was conducted at their recruitment location. Although exact numbers of participants at each site were not recorded, approximately 235 participants were recruited at public schools, 80 participants were recruited at temples, 40 participants were recruited at local homes, and 39 participants were recruited at community buildings. The study sample consisted of 394 adolescents. All adolescents aged 11-17 years old who were GC and conversant in Sinhala or English were eligible for inclusion in the study. A snowball sampling strategy was utilized to recruit participants, as local community leaders and members referred us to eligible adolescents within their villages, temples, or schools and organized a meeting between these adolescents and researchers. Furthermore, when surveys were conducted in schools or temples, convenience sampling was utilized, as adolescents who attended school or temple on the day when researchers collected data were invited to take part in the study.

Prior to data collection, researchers obtained permission to conduct the study in schools, temples, houses, and community buildings from school principals, monks, parents and/or guardians and community leaders, respectively.

2.2 Cross-sectional survey

2.2.1 Survey design, translation, pilot study and final study

The structured paper-based questionnaire (provided in Appendix A) was developed in English based on existing GP-GC relationship and adolescent socio-emotional and cognitive development literature. Experts and review boards at Duke University and the University of Ruhuna reviewed the survey to ensure questions were sufficiently clear for adolescents to understand and appropriate for the Sri Lankan context. The informed consent form, assent form and survey were translated into Sinhala by local researchers at the University of Ruhuna. To ensure quality and accuracy of translation, the informed consent form, assent form and survey were also back translated into English by a researcher at the University of Ruhuna who was proficient in both English and Sinhala. Prior to study implementation, a pilot study was conducted among 10 eligible adolescents in Galle. Following the pilot study, questions were refined on the basis of the potential for ambiguity and misinterpretation, given the local context.

The final version of the survey included four sections. The first section examined the participants' demographics, family and household information and grandparent relationships. The second section measured empathy levels among participants with the Toronto Empathy Questionnaire (TEQ). The third section measured socio-emotional development among participants with the Strengths and Difficulties Questionnaire (SDQ). The fourth section measured cognitive development among participants through

the evaluation of executive function and cognitive flexibility by the Dimensional Change Card Sort (DCCS) Border version task.

2.2.2 Data collection procedures

Data collection was conducted from June to August in 2015. This study was administered in Sinhala-speaking settings, although other ethnic groups were able to participate, if conversant in Sinhala. Data was collected from the participants through a confidential self-report questionnaire that was completed individually by each participant in a classroom, temple, community building, or local home. Although each participant completed their own independent questionnaire, data collection was conducted in “sessions,” during which the research team would administer questionnaires to a group of adolescents at once. During a session, the research team would administer the questionnaire to each adolescent and each adolescent would then complete the questionnaire individually. Sessions were most frequently conducted amongst medium-sized (approximately 7-10 adolescents) groups; however on occasion, larger (approximately 20 adolescents) and smaller (3-5 adolescents) group sessions were conducted, depending on the availability and presence of eligible adolescents at a particular location.

During data collection in schools and occasionally in temples, school teachers were present in the classroom to organize students, but generally did not provide any comment related to the study. During data collection in community buildings and

homes, parents and guardians were often present, but did not provide any comment related to the study. In all locations, any questions pertaining to the content of the survey were directed to the research assistant for further clarification or assistance, if necessary.

Prior to any data collection, the study was explained in-depth in Sinhala by the local researcher. Potential participants were informed that participation was completely voluntary and researchers ensured that potential participants fully understood the study and its voluntary nature before data collection occurred. Potential participants and their parents/guardians were given a chance to ask any questions they may have had. Assent forms and informed consent forms were administered to both the adolescents and parents/guardian(s), respectively. The assent and informed consent forms provided consent for both the survey portion of the study and the cognitive test portion. In cases in which the adolescents themselves declined to take part in the study, the adolescent did not complete the questionnaire or cognitive test. After consent was obtained from both the adolescent and their parent/guardian, the questionnaire was administered, followed by the cognitive test. Participants were not permitted to communicate with each other during the survey or cognitive test, which ensured all data was answered independently and accurately for each participant. Completed surveys were collected by researchers immediately following their completion.

Researchers transported raw data from the location of data collection to offices at the University of Ruhuna, in accordance with their policies. Raw data was stored in a locked filing cabinet in offices at the University of Ruhuna. The data were translated and entered into REDCap version 6.5.15 software, an online private database, for storage. To ensure confidentiality, no identifying information was recorded into REDCap. Participants were only identified by a unique record identification number. This data is only accessible by trained study staff. Raw data will be retained at the University of Ruhuna for five years, per their protocols.

2.2.3 Measures

2.2.3.1 Demographic and family and household information

Adolescent demographic characteristics were collected through questions regarding participant's birth date, education level, gender, ethnicity and religion. GP demographic characteristics were collected based on the participants' report of their grandparents' age level, health, and work status. Family and household information, including parental marital status, number of living parents, number of living GPs and household composition were collected.

2.2.3.2 Grandparent-grandchild relationship closeness

Data on GP-GC relationship closeness was collected from the GP-GC section of the questionnaire. 13 questions from the GP-GC section were used to generate a GP-GC relationship closeness score. The possible range of the score is 0 to 13 points. A higher

score is associated with a closer GP-GC relationship. Example questions include “How much can you depend on your grandparent to be there when you really need him/her?” “How much does your grandparent make you feel appreciated, loved, or cared for?” “How happy are you with your relationship with your grandparent?” and “How often does your grandparent help you in important ways by giving you advice and helping solve problems you have?” The 13 questions were chosen based on their specific relevance to the GP-GC relationship.

2.2.3.3 Grandparent-grandchild interaction frequency

Data on GP-GC interaction frequency was collected from the GP-GC section of the questionnaire, based on the question “How often do you see [your grandparent]?” The possible answers are “Daily,” “Once a week,” “Several times a year,” or “Never.”

2.2.3.4 Combination (Grandparent-grandchild relationship closeness and interaction frequency)

Data on the combination of GP-GC relationship closeness and interaction frequency was collected from the GP-GC closeness variable and GP-GC interaction frequency variable for the GP with the highest relationship closeness score.

2.2.3.5 Empathy

The Toronto Empathy Questionnaire (TEQ) was utilized to assess participants’ empathy levels. The TEQ is easily understandable to adolescents (Spreng et al., 2009) and consists of 16 questions, each rated on a five point scale from ‘never’ to ‘often’. The possible range of the score is 0 to 64 points. A higher score is associated with a higher

level of empathy. Example items include “When someone else is feeling excited, I tend to get excited too,” “Other peoples’ misfortunes do not disturb me a great deal,” “It upsets me to see someone being treated disrespectfully,” and “I remain unaffected when someone close to me is happy.” The TEQ conceptualizes empathy as a primarily emotional process (Spreng et al., 2009). For this study, the internal consistency of the TEQ, as measured by Cronbach's alpha, is $\alpha=0.57$

2.2.3.6 Socio-emotional development

The Strengths and Difficulties Questionnaire (SDQ) was utilized to assess participants’ socio-emotional development. The SDQ version used was a questionnaire for self-completion by adolescents. The SDQ asks questions pertaining to 25 attributes divided into five subscales: emotional symptoms, conduct problems, hyperactivity/inattention, peer relationship problems, and prosocial behavior. Example items include “I try to be nice to other people. I care about their feelings,” “I am restless, I cannot stay still for long,” “I get a lot of headaches, stomach-aches or sickness,” and “I get very angry and often lose my temper.” The Total Difficulties (TD) score is calculated based on four subscales (except prosocial behaviour) with a score range of 0 to 40 points. Scores are classified as “Normal” if between 0 and 15, “Borderline if between 16-19 and “Abnormal” if between 20-40. The SDQ for participants’ age group has previously been translated into Sinhala and community level norms for the SDQ have been established for adolescents in Sri Lanka (S. Perera et al., 2013). This questionnaire has been

translated into several languages and has been shown to be reliable in identifying children with clinically-relevant mental health problems in diverse populations, including Brazil, Pakistan, Bangladesh, Israel, Yemen, Thailand, and in the Democratic Republic of Congo (Fernald, Kariger, Engle, & Raikes, 2009). For this study, the internal consistency for the TD score, as measured by Cronbach's alpha, is $\alpha = 0.74$.

2.2.3.7 Cognitive development

The Dimensional Change Card Sort (DCCS) Border version task was utilized to assess adolescent cognitive development. Adolescents were shown two target cards and asked to sort a series of twelve cards according to one dimension, either colour or shape. Switches between dimensions are presented randomly and cued via visual symbols. Participant cognitive development is measured based on accuracy of card sorting. The possible range of the score is 0 to 12 points. Participants are considered to pass this task if they sort nine or more cards correctly out of the 12 test trials (Zelazo, 2006). This direct test adapts cross culturally with minimal training and materials (Zelazo, 2006).

2.3 Data analysis

Data stored in REDCap were transferred into STATA software version 14.0 for analysis.

2.3.1 Main independent variables

Key independent variables were GP-GC relationship closeness and GP-GC interaction frequency, which were generated for each of the four grandparents of each adolescent. Given that each grandchild has four GPs (living or deceased), there were several ways to operationalize GP-GC interaction frequency and relationship closeness. Our primary operationalization was to analyse each GP type (MGM, MGF, PGM, PGF) separately, but in alternative analyses we also operationalized it as an average of all GP interaction frequency or relationship closeness and in relation to only the GP of the closest relationship or most frequent interaction.

The GP-GC closeness variable was generated based on the sum of 13 GP-GC relationship variables from the GP-GC section of the survey. Each variable was assigned equal weight. In the model that operationalized each GP type separately, the GP-GC closeness variable was set treated as categorical. The variable was categorized as “0”, “1-6”, “7-9”, and “10-13.” A higher score corresponds to a higher relationship closeness. The “0” category consisted of GPs who were not living, as well as any living GPs who fell into this category. The remaining categories were divided into tertiles of approximately equal numbers of GPs. In the models that operationalized the average GP-GC relationship closeness and closest GP-GC relationship, the closeness variable was treated as continuous, since it was relatively normally distributed.

The GP-GC interaction frequency variable was also reported in the GP-GC section of the survey. As the relationship between GP-GC frequency interaction and participant outcomes may not be linear, the frequency variable was categorical for the separate and most frequent GP models. For these models, the frequency of GP-GC interaction variable was set as 1 "Never," 2 "Several times a year," 3 "Once a week," and 4 "Daily." Deceased GPs were categorized into the "never" category. For the average model, the GP-GC frequency interaction variable was treated as continuous.

The combination variable of GP-GC relationship closeness and interaction frequency was generated from the combination of the GP-GC relationship closeness score variable and the GP-GC interaction frequency variable for the GP associated with the highest GP-GC relationship closeness score for each adolescent. In the circumstance where two or more GPs were associated with the highest GP-GC relationship closeness score for a particular adolescent, the combination variable was generated for the GP with the most frequent interaction of these GPs. If two or more GPs were associated with the highest GP-GC relationship closeness score for a particular adolescent and these GPs were associated with equal interaction frequencies, then one GP was randomly selected for generation of the combination variable. Both the relationship closeness and interaction frequency components were set as categorical variables. The relationship closeness score component was set as 1 "0-5," 2 "5.1 to 9.9," and 3 "10 to 13." The interaction frequency component was set as 1 "Several times a year," 2 "Weekly," and 3

“Daily.” The possible combinations (relationship closeness component, interaction frequency component) were: (1,1), (2,1), (3,1), (1,2), (2,2), (3,2), (1,3), (2,3), (3,3).

Summary statistics were used to describe the demographic characteristics of the sample population and their living grandparents. Key demographic-related independent variables included participant and GP gender (male, female), participant age (11-17 years), GP age and number of living GPs (1,2,3,4).

2.3.2 Dependent variables

Key dependent variables were TEQ and SDQ TD scores and DCCS Border version task results. One question from the TEQ was not included in analysis, as its translated version did not accurately reflect the meaning of the original question. The TEQ score was a continuous variable that could potentially range from 0 “least empathetic” to 60 “most empathetic.”

The SDQ score used for analysis was the SDQ TD score, which is the sum of scores from the emotional symptoms, conduct problems, hyperactivity/inattention, and peer relationship problems subscales. The SDQ TD score was a continuous variable that could potential range from 0 “most normal” to 40 “most abnormal.” For both the TEQ and SDQ TD score, missing values were replaced by using the average score of other questions.

As the DCCS task results could only take on two states (pass or fail), the DCCS task score was a binary variable set as 0 for “fail” and 1 for “pass.”

2.3.3 Data analysis procedure

A descriptive analysis was conducted at the individual level to describe the demographic characteristics of participants. Descriptive analysis was also conducted at the individual level to describe the demographic characteristics of participants' GPs (as reported by participants).

First, bivariate linear regression was used to estimate the beta coefficient and 95% confidence intervals (CI) between covariates and TEQ and SDQ TD scores. To estimate the odds ratio (OR) and 95% CI between covariates and DCCS Border version task results, logistic regression was used. It should be noted that for the alternative models, GP gender could not be differentiated or documented and therefore, we could not estimate the association between GP gender and participant outcomes for these models. This was not the case for the model that operationalized each GP type separately, as gender could be documented specific to that GP.

Second, bivariate models were constructed using linear regression to estimate the beta coefficient and 95% CI between GP-GC variables (relationship closeness and interaction frequency) and TEQ and SDQ TD scores. To estimate the OR and 95% CI between GP-GC variables and DCCS Border version task results, logistic regression was used.

Third, multivariate regression analysis was performed to assess the association between the independent variable (operationalized as described above) and a variety of

covariates on TEQ and SDQ TD scores and DCCS Border version task results. Covariates that had a p-value of 0.05 or less in any of the bivariate models (as described above) were considered significantly associated with adolescent outcomes and were therefore included in the final multivariate models. Covariates included in the final multivariate models were adolescent age, adolescent gender, number of living GPs, and MGM age. See **Figure 1** for a conceptual depiction of independent variables, dependent variables, and significant covariates.

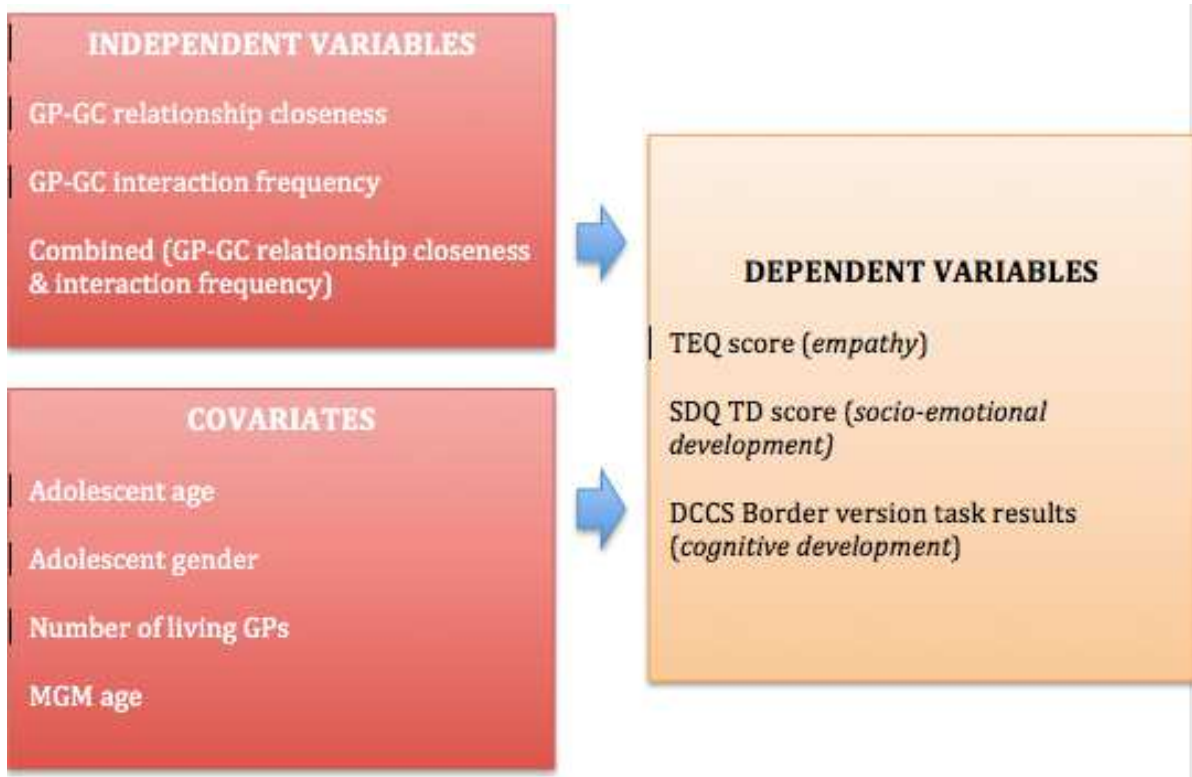


Figure 1. Conceptual depiction of independent variables, dependent variables, and significant covariates.

2.4 Ethics

All study procedures were approved by the ethical review boards at Duke University in the United States and the University of Ruhuna in Sri Lanka. Prior to each adolescents' participation in the study, their parent or guardian was contacted and gave verbal or written consent stating that they agreed for the adolescent to participate in the study. In addition, all adolescents signed an assent form stating their agreement to voluntarily participate in the study.

Participants were compensated 500 Sri Lankan Rupees (approximately 3.51 USD) for their participation in the study. If they decided to discontinue their participation at any time before or during their involvement in the study, they were not compensated. Since their participation in the study took approximately one hour, 500 rupees was determined to be adequate. As this is less than the average daily wage for Sri Lankans, it was not seen as undue incentive to participate. This was confirmed by Sri Lankan research partners familiar with the situation.

3. Results

3.1 Demographic characteristics

3.1.1 Adolescent characteristics

A total sample of 394 adolescents, including 201 males and 193 females, completed the survey. **Table 1** shows the demographic characteristics of the study participants. The average age was 13.6 (± 0.88), and 383 adolescents were in Grades 5-11, with the remaining 11 students in Grade 12. 94% of participants had both parents living and 87% lived with both their mother and father. Although not shown in the table, 87% of adolescents lived with their mother and father, 7% lived with their mother only, 2% lived with their father only, and the remaining 4% lived with either their grandparent(s), older sibling(s), parent and step-parent, or other.

Table 1: Demographic characteristics of study participants (N=394)

Variable	Frequency	(%)
Gender		
Male	201	51.02
Female	193	48.98
Age (years) Missing=1		
11	71	18.07
12	54	13.74
13	53	13.49
14	73	18.58
15	83	21.12
16	52	13.23
17	7	1.78
Educational level		
Grade 5-11	383	97.21
Grade 12	11	2.79

Ethnicity			
	Sinhalese	383	97.21
	Tamil	10	2.54
	Other	1	0.25
Number of parents living			
	0	2	0.51
	1	1	5.08
	2	372	94.42
Number of living GPs			
	1	90	22.84
	2	115	29.19
	3	109	27.66
	4	80	20.30

3.1.2 GP characteristics

Participants' surveyed had 967 living GPs, including 597 grandmothers and 370 grandfathers. **Table 2** shows the demographic characteristics of the participants' living GPs, as reported by the participants. 703 GPs were not working and 77% of GPs were reported to have 4 or more grandchildren, in addition to the participant.

Table 2. Demographic characteristics of study participants' living GPs (N=967)

Variable		Frequency	(%)
GP type			
	Maternal grandmother	328	33.92
	Maternal grandfather	194	20.06
	Paternal grandmother	269	27.82
	Paternal grandfather	176	18.20
Gender			
	Male	370	38.26

	Female	597	61.74
Age (years)			
Missing=2			
	<50	6	0.62
	50-60	142	14.72
	60-70	303	31.40
	>70	420	43.52
	Unknown	94	9.74
Health status			
Missing=1			
	Very poor	27	2.80
	Poor	191	19.77
	Good	405	41.93
	Very good	298	30.85
	Unknown	45	4.65
Employment status			
Missing=6			
	Not working	703	73.15
	Part-time	118	12.28
	Full-time	99	10.30
	Unknown	41	4.27
Number of other grandchildren			
Missing=7			
	0	12	1.25
	2-3	146	15.21
	4 or more	741	77.19
	Unknown	61	6.35

3.2 Independent variables: GP-GC variables

3.2.1 Relationship closeness

Note: As mentioned in 2.3.1, both deceased and living GPs were included in the analysis. The “0” score category, therefore, includes both deceased GPs and GPs who are living, but have a relationship closeness score of 0 with the participant.

3.2.1.1 MGM

Of the 394 adolescents, 17.26% had a closeness score of 0, 17.51% had a closeness score between 1 and 6, 31.98% had a closeness score between 7-9 and 33.25% had a closeness score of 10-13 for the relationship with their MGM. See **Figure 2** for the score distribution.

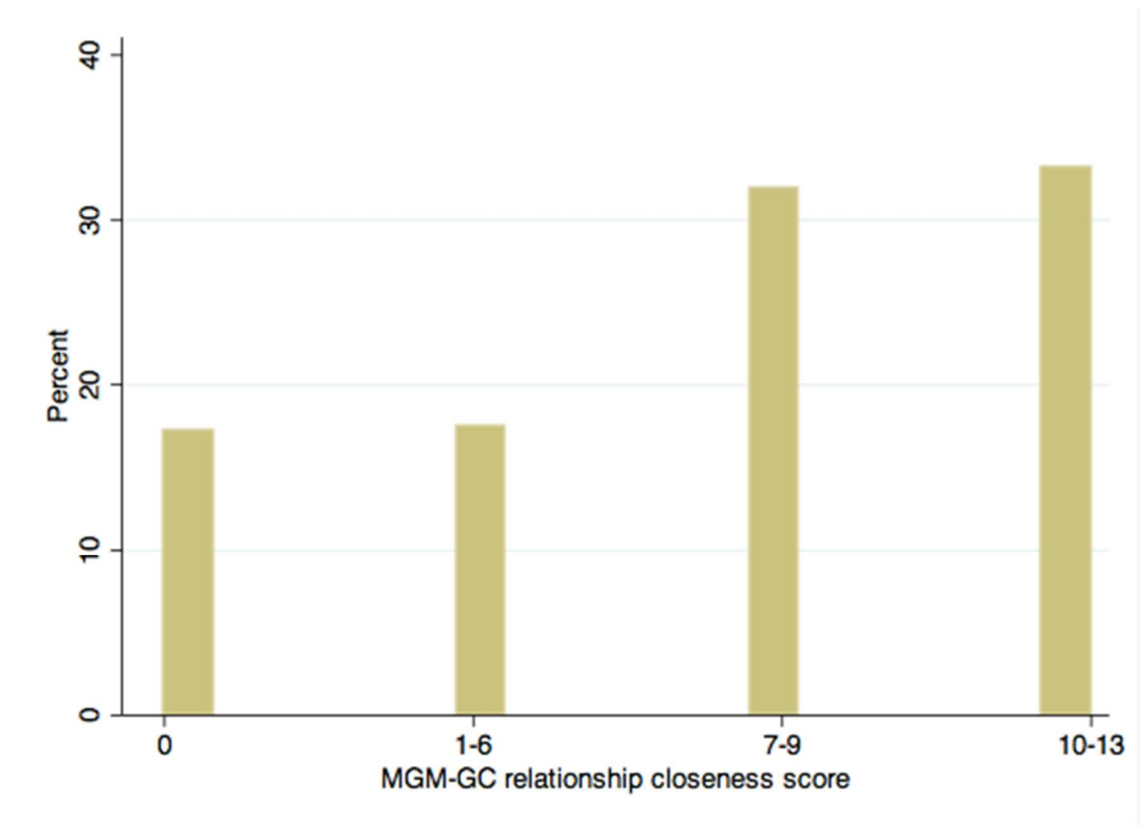


Figure 2. Distribution of MGM relationship closeness scores (n=394)

3.2.1.2 MGF

Of the 394 adolescents, 52.28% had a closeness score of 0, 13.45% had a closeness score between 1 and 6, 17.51% had a closeness score between 7-9 and 16.75% had a closeness score of 10-13 for the relationship with their MGF. See **Figure 3** for the score distribution amongst categories.

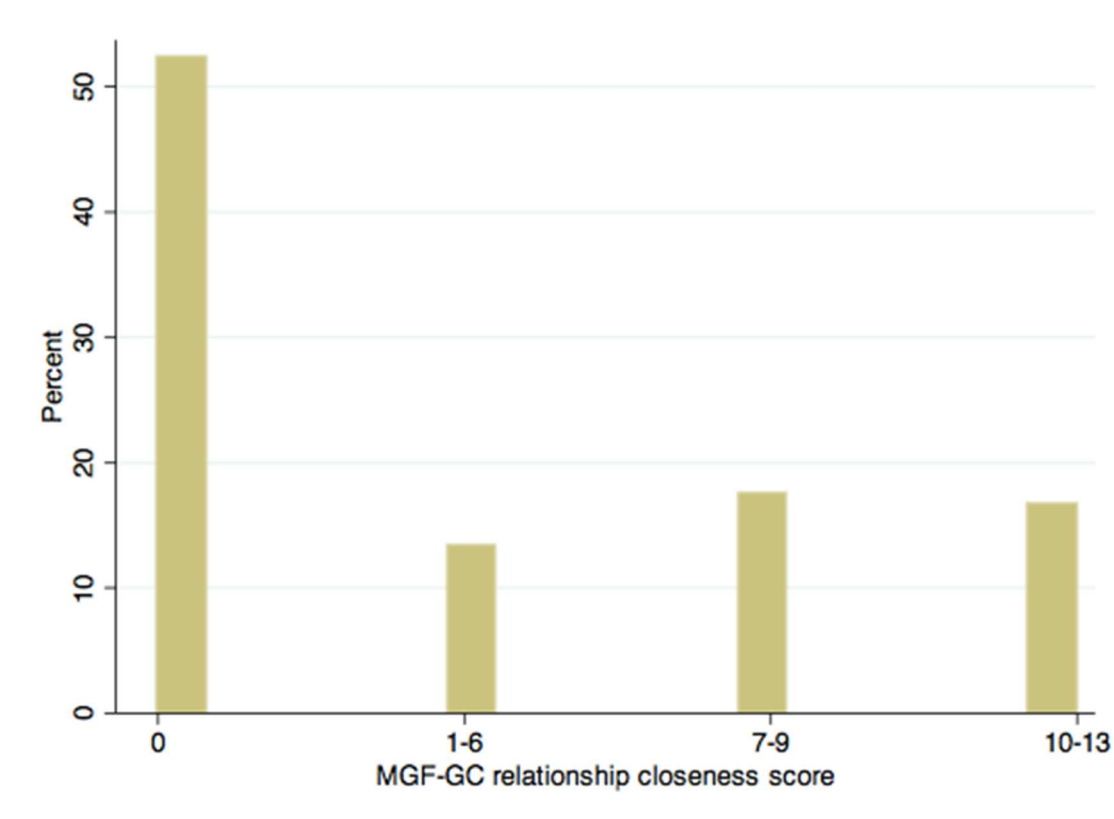


Figure 3. Distribution of MGF-GC relationship closeness scores (n=394)

3.2.1.3 PGM

Of the 394 adolescents, 34.01% had a closeness score of 0, 20.05% had a closeness score between 1 and 6, 24.37% had a closeness score between 7-9 and 21.57% had a closeness score of 10-13 for the relationship with their PGM. See **Figure 4** for the score distribution amongst categories.

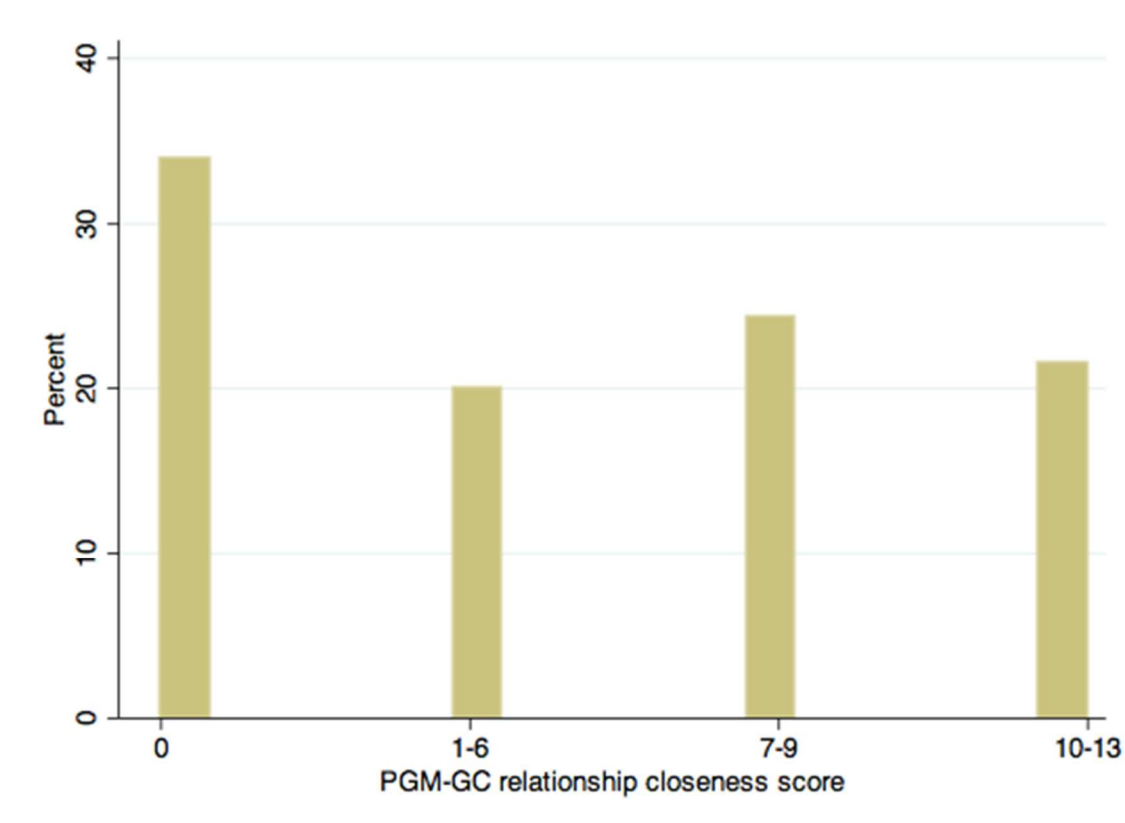


Figure 4. Distribution of PGM-GC relationship closeness scores (n=394)

3.2.1.4 PGF

Of the 394 adolescents, 57.11% had a closeness score of 0, 13.20% had a closeness score between 1 and 6, 14.72% had a closeness score between 7-9 and 14.97% had a closeness score of 10-13 for the relationship with their PGF. See **Figure 5** for the score distribution amongst categories.

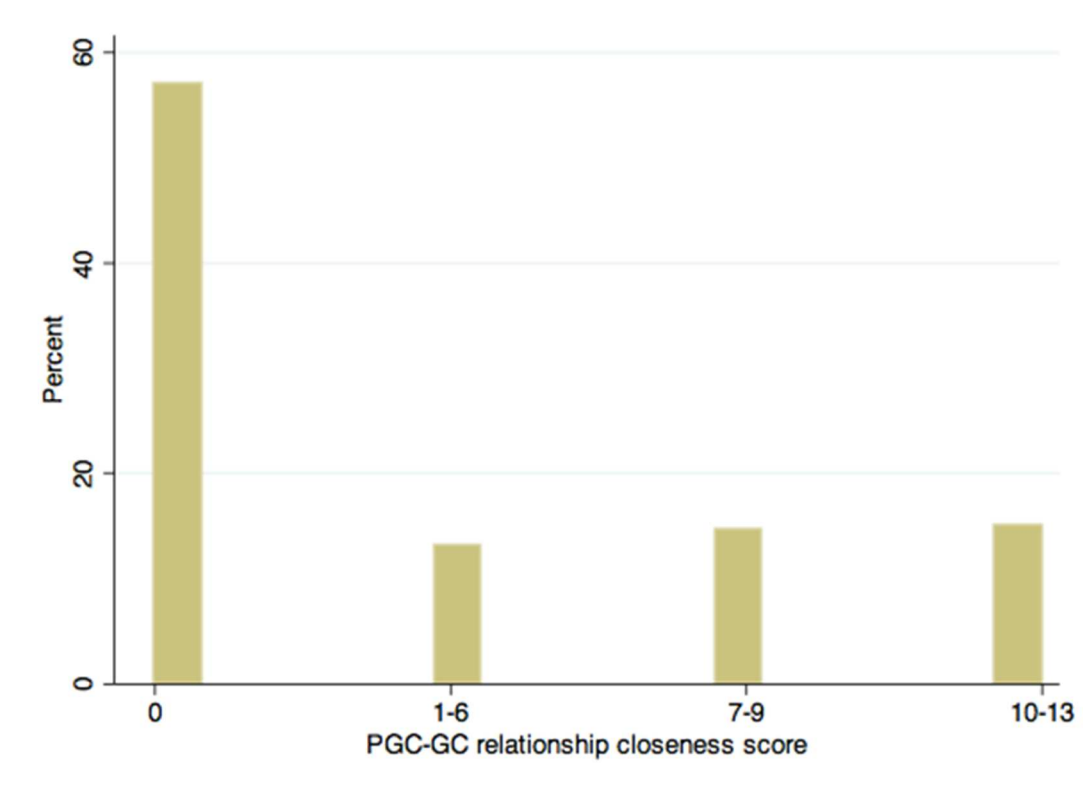


Figure 5. Distribution of PGF-GC relationship closeness scores (n=394)

3.2.1.5 Average GP-GC relationship closeness of all GPs

The mean closeness score for the average of all four GP-GC relationships was 4.86 (± 2.74). See **Figure 6** for the score distribution.

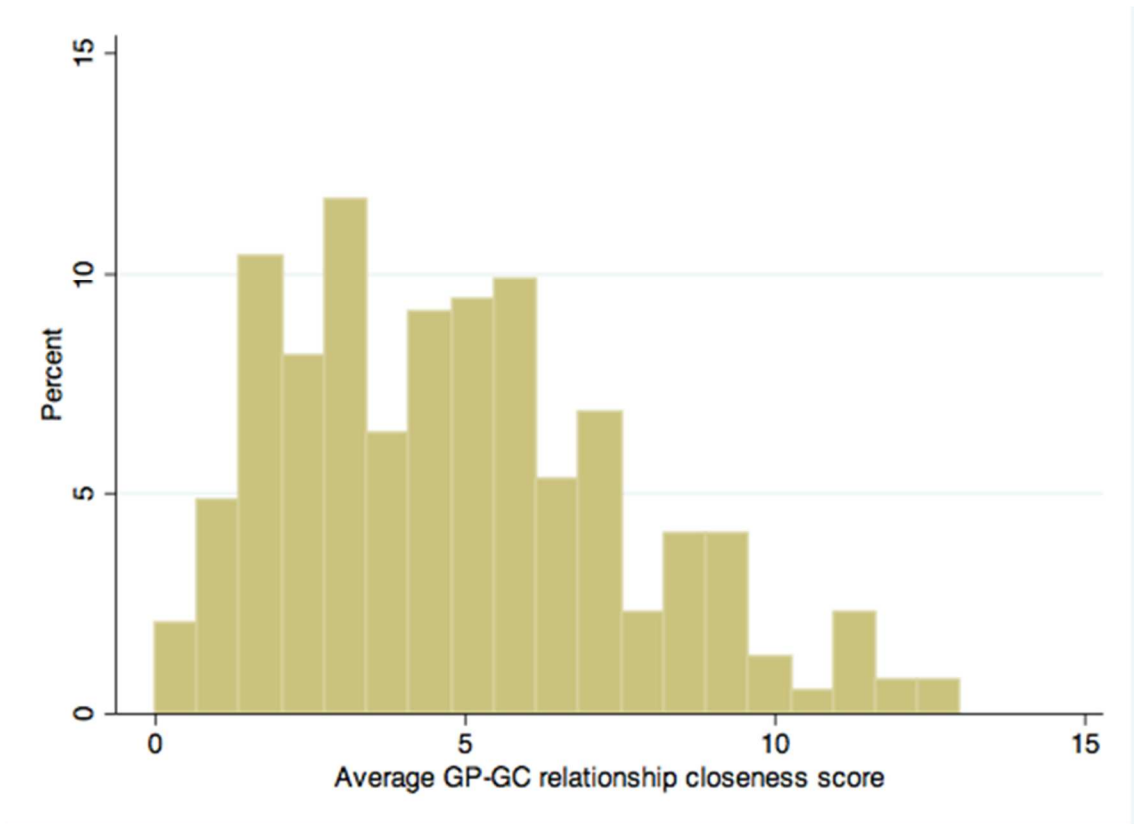


Figure 6. Distribution of average GP-GC relationship closeness scores (n=394)

3.2.1.6 Relationship closeness with most close GP

The mean relationship closeness score for the closest of all four GP-GC relationships was 8.72 (± 2.76) with a range from 0 to 13. See **Figure 7** for the score distribution.

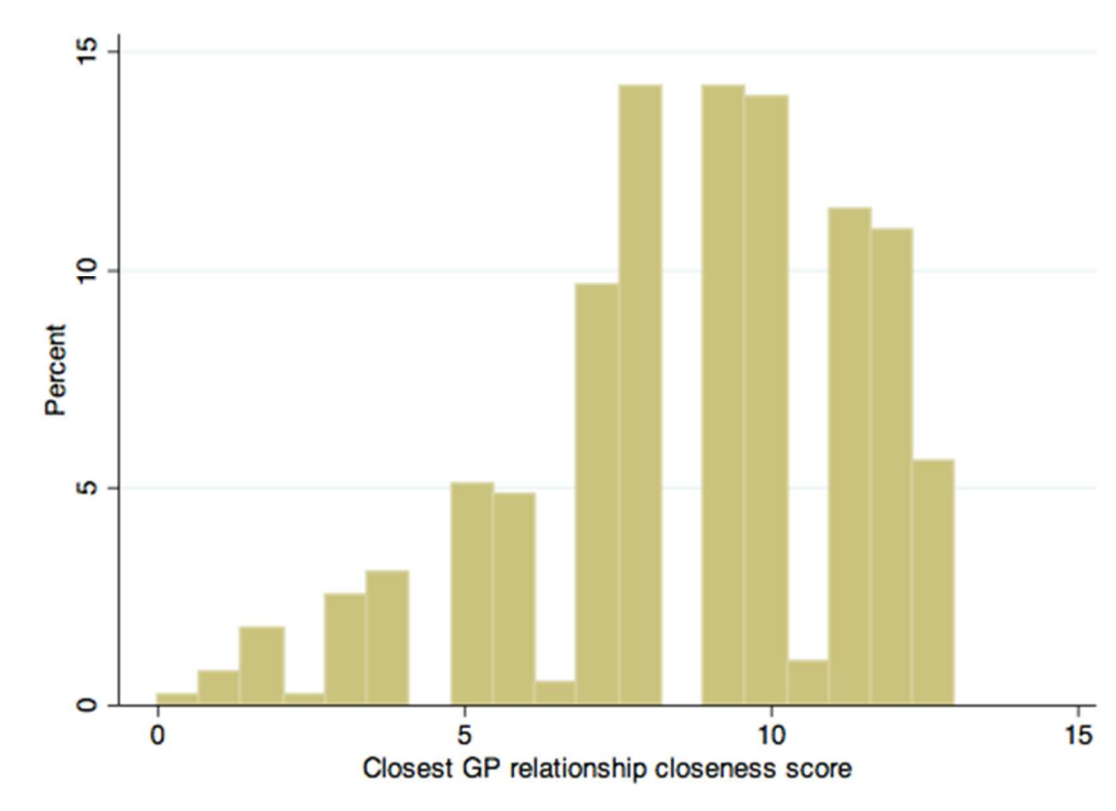


Figure 7. Distribution of closest GP-GC relationship closeness scores (n=394)

3.2.2 Interaction frequency

Note: As mentioned in 2.3.1, both deceased and living GPs were included in the analysis. The “Never” category, therefore, includes both deceased GPs (with whom the adolescent would have no interaction) and GPs who are living, but have no interaction with the participant.

3.2.2.1 MGM

Of the 394 adolescents, 83% had at least some level of interaction with their MGM. 31% of adolescents interacted with their MGM daily, 20% interacted with their

MGM weekly, and 31% interacted with their MGM several times a year. See **Figure 8** for the distribution.

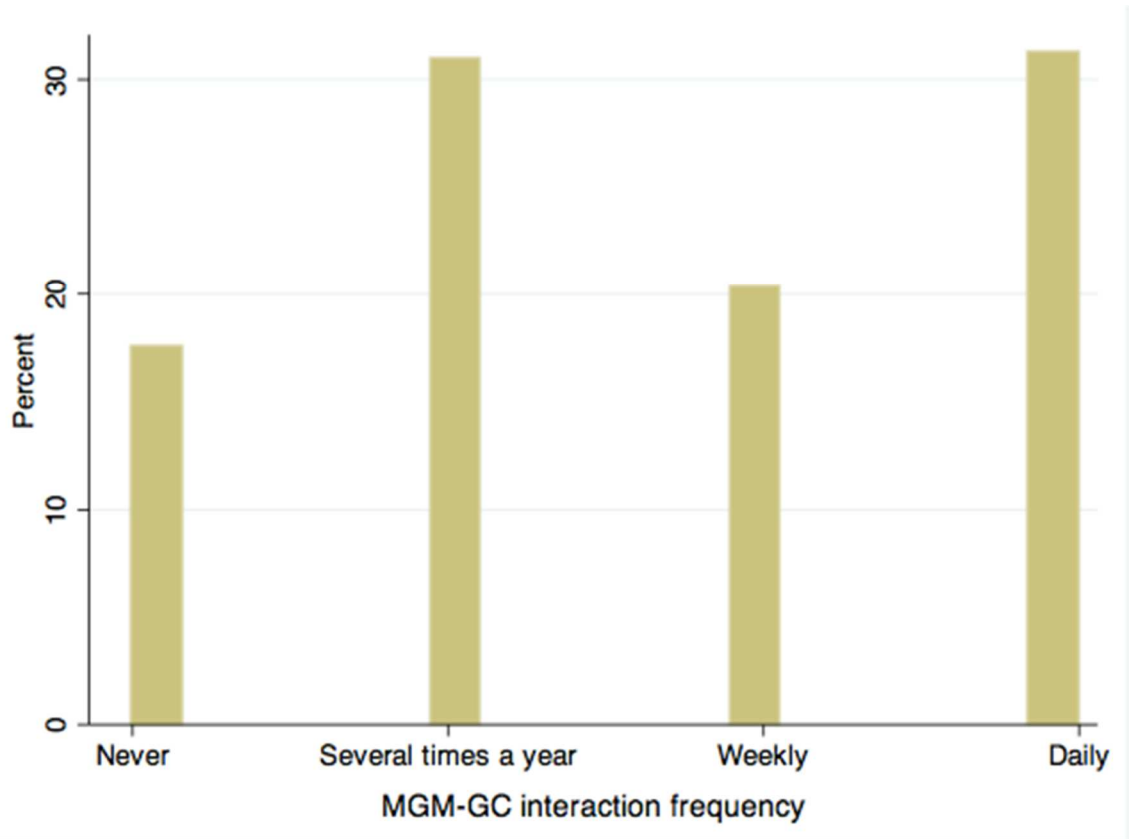


Figure 8. Distribution of MGM-GC interaction frequency (n=394)

3.2.2.2 MGF

Of the 394 adolescents, 48% had at least some level of interaction with their MGF. 18% of adolescents interacted with their MGF daily, 12% interacted with their MGF weekly, and 18% interacted with their MGF several times a year. See **Figure 9** for the distribution.

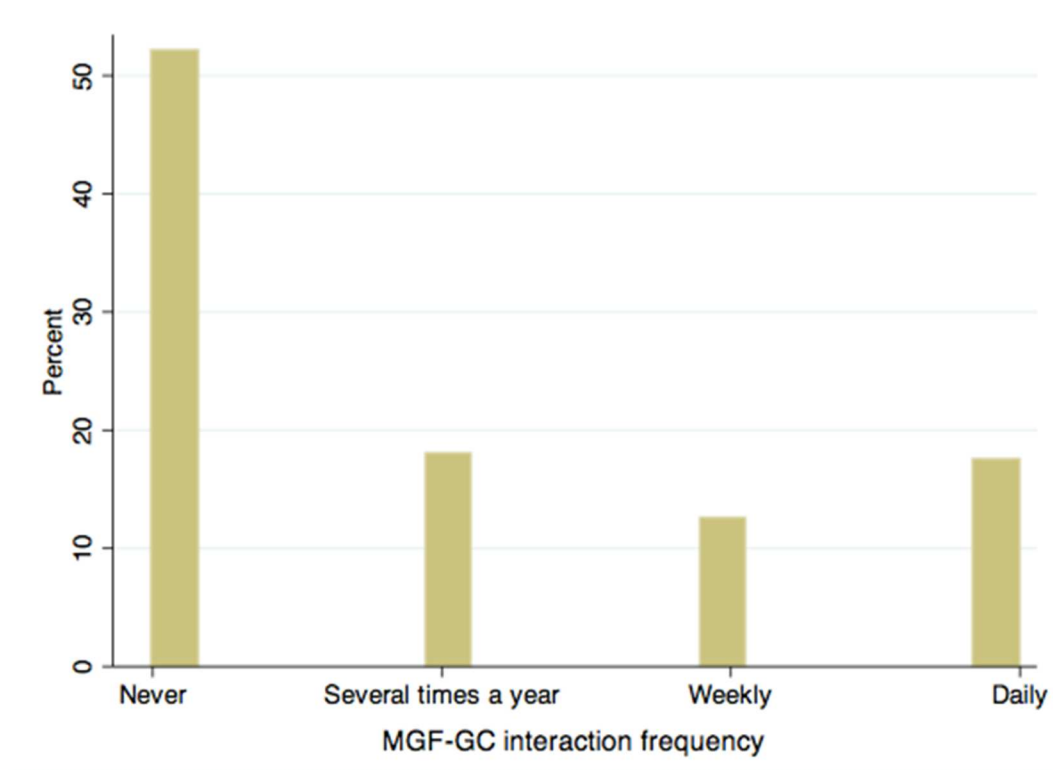


Figure 9. Distribution of MGF-GC interaction frequency (n=394)

3.2.2.3 PGM

Of the 394 adolescents, 67% had at least some level of interaction with their PGM. 14% of adolescents interacted with their PGM daily, 15% interacted with their PGM weekly, and 21% interacted with their PGM several times a year. See **Figure 10** for the distribution.

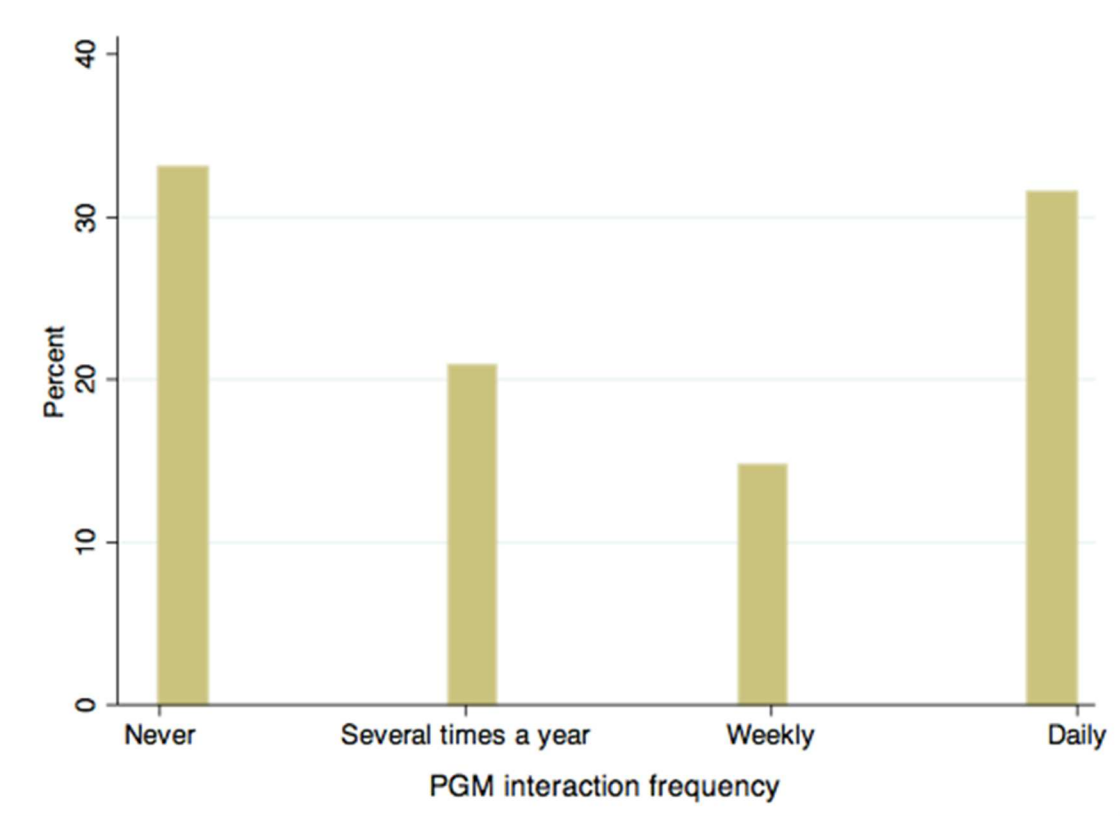


Figure 10. Distribution of PGM-GC interaction frequency (n=394)

3.2.2.4 PGF

Of the 394 adolescents, 43% had at least some level of interaction with their PGF.

21% of adolescents interacted with their PGF daily, 9% interacted with their PGF

weekly, and 14% interacted with their PGF several times a year. See **Figure 11** for the

distribution.

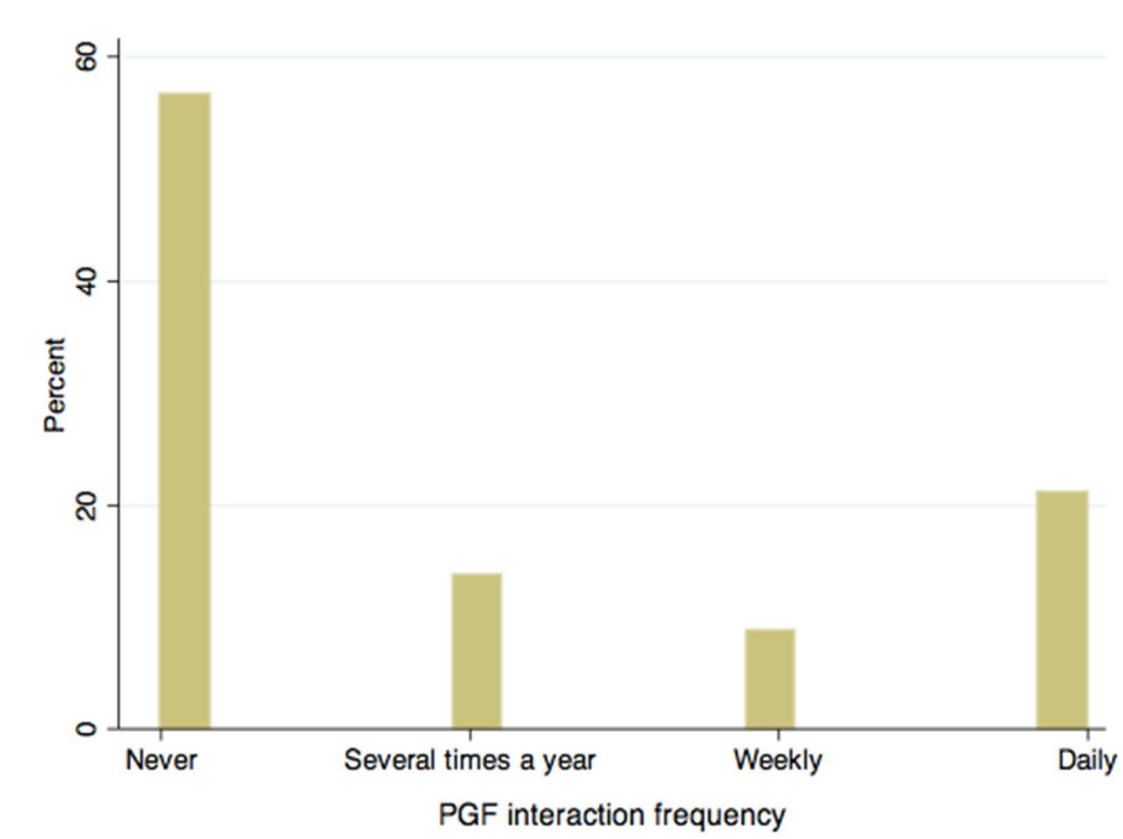


Figure 11. Distribution of PGF-GC interaction frequency (n=394)

3.2.2.5 Average interaction frequency with all GPs

The mode of interaction frequency for the average of all four GPs (both living and deceased) was 2 with a range from 1.25 to 4.

3.2.2.6 Interaction frequency with GP of most frequent interaction

Of the 394 adolescents, all had some level of interaction with the grandparent who they had the most frequency interactions. 18.0% of adolescents interacted several times a year with the grandparent they most frequently interacted with, 19.0% interacted weekly with the grandparent they most frequently interacted with, and 62.9% interacted

daily with the grandparent they most frequently interacted with. See **Figure 12** for the distribution.

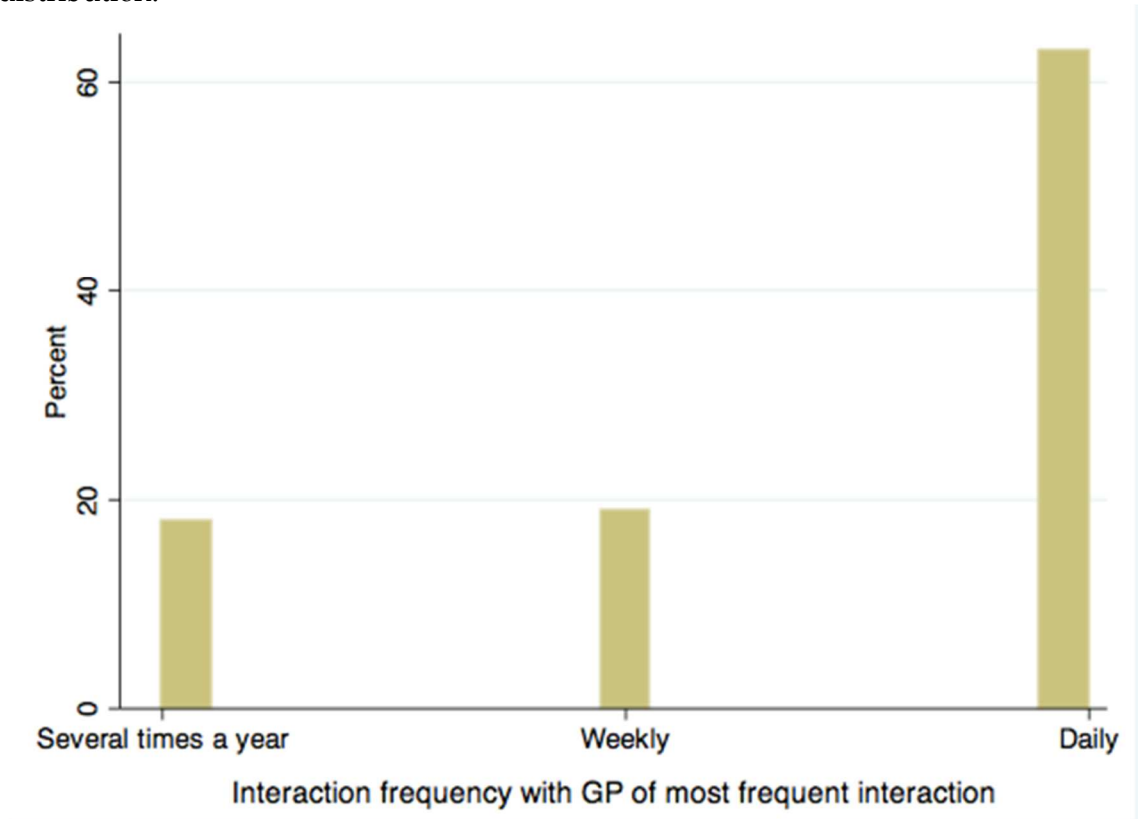


Figure 12. Distribution of frequency of interaction with GP of most frequent interaction (n=394)

3.3 Dependent variables: Participant outcomes

3.3.1 Empathy (measured by TEQ)

Of the 394 participants, 393 completed the TEQ. See **Figure 13** for results. Scores ranged from 21 to 56, with an average score of 41.9 (± 6.86).

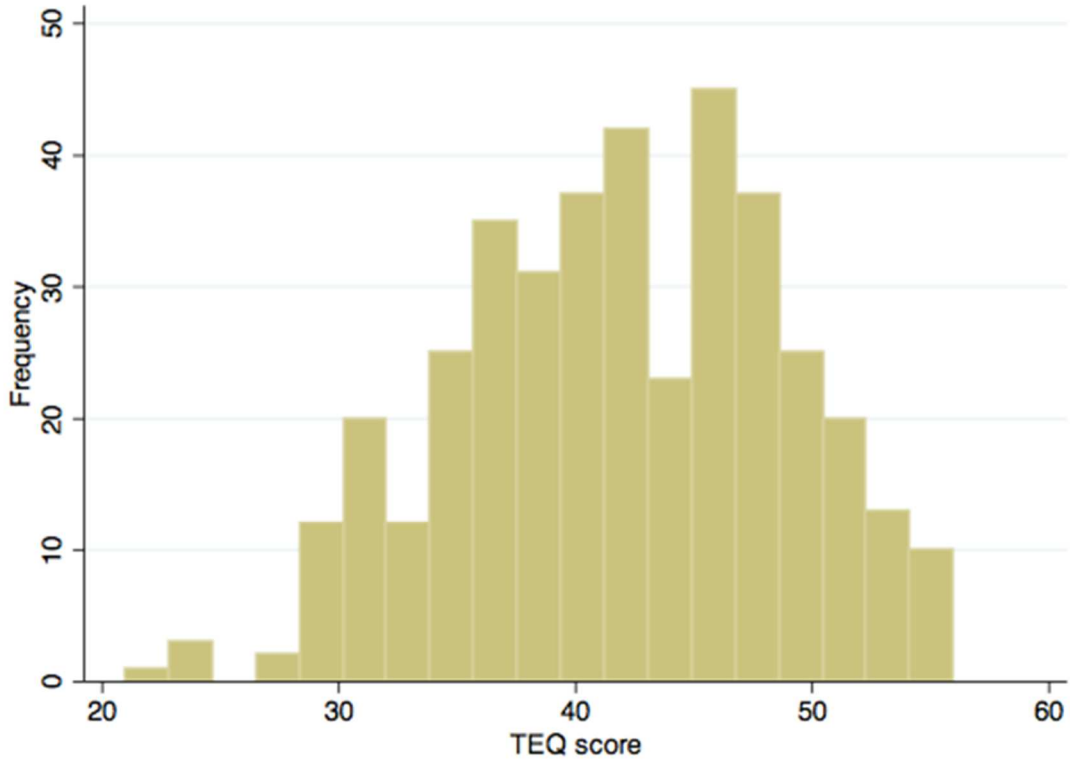


Figure 13. Distribution of TEQ scores (n=393)

3.3.2 Socio-emotional development (measured by SDQ)

All participants completed the SDQ. See **Figure 14** for results. Scores ranged from 1 to 28, with an average score of 12.0 (± 5.38).

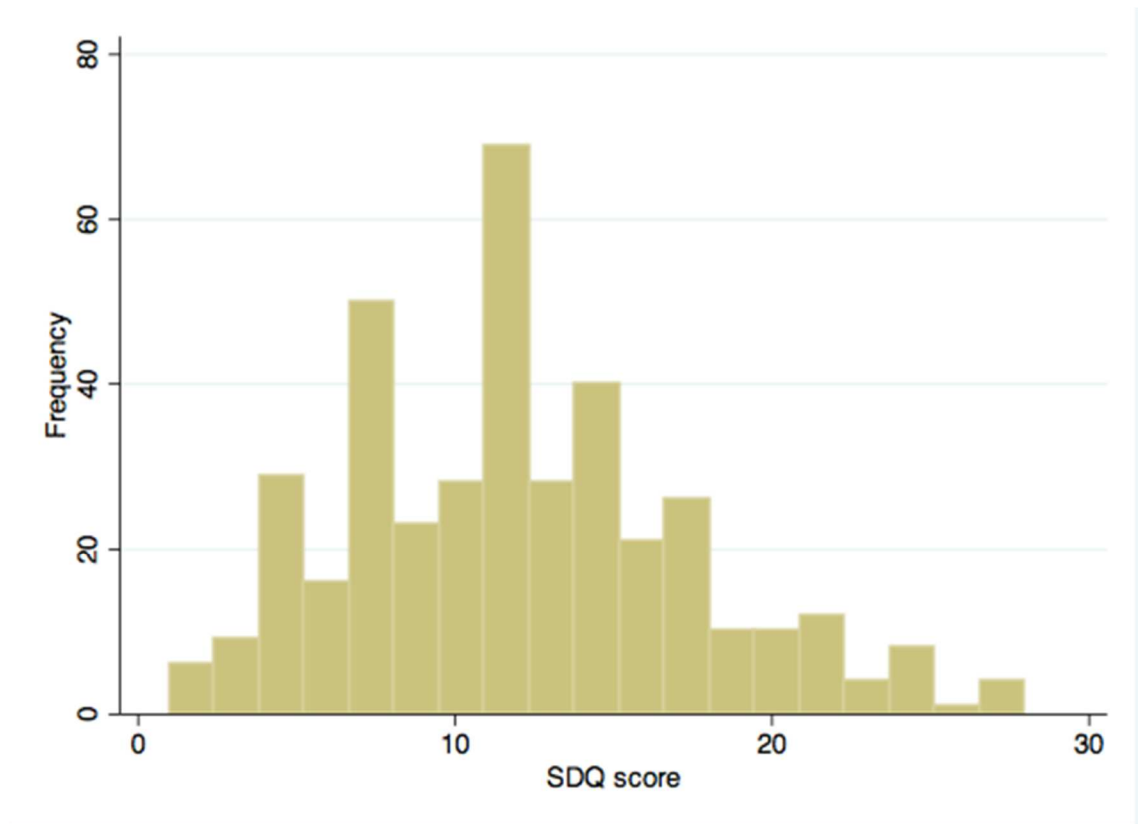


Figure 14. Distribution of SDQ Total scores (n=394)

3.3.3 Cognitive development (measured by DCCS Border version task)

All participants completed the DCCS Border version task. As shown in **Figure 15**, 29.7% (117 adolescents) failed and 70.3% (277 adolescents) passed the task.

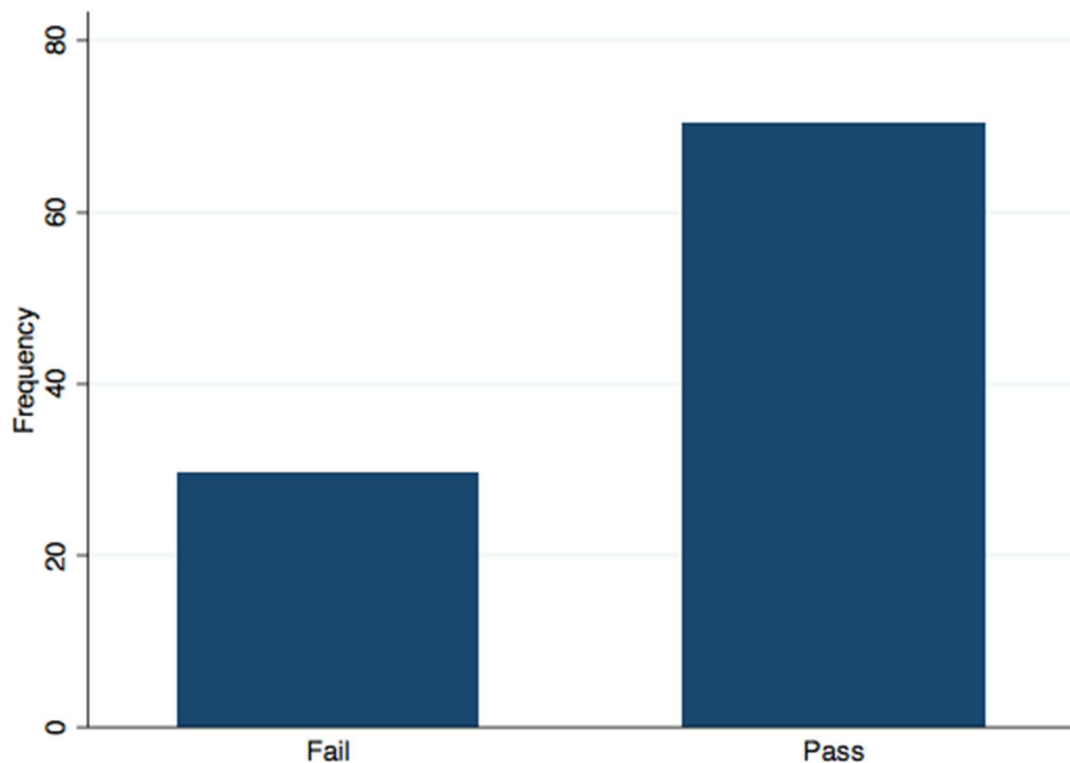


Figure 15. DCCS Border version task results (n=394)

3.4 Association between participant demographic covariates and socio-emotional and cognitive outcomes

3.4.1 Empathy (measured by TEQ)

Bivariate linear regression showed that there was a significant association found between adolescent gender and TEQ score, as female participants scored 2.46 units higher than males (Table 3, column 2). There were no significant associations found between adolescent age or number of living grandparents and TEQ score.

3.4.2 Socio-emotional development (measured by SDQ)

Bivariate linear regression showed that there was a significant association found between adolescent age and SDQ TD score and number of living GPs and SDQ TD score. For every year increase in age, there was a 0.44 unit decrease in SDQ TD score and compared to having 1 living GP, adolescents with 4 living GPs had a 1.60 unit increase in SDQ TD score (**Table 3, column 3**). There were no significant associations found between adolescent gender or number of living GPs and SDQ TD score.

3.4.3 Cognitive development (measured by DCCS Border version task)

Bivariate logistic regression showed there were no significant associations found between adolescent age, adolescent gender, or number of living GPs and DCCS Border version task results.

3.5 Association between GP age and socio-emotional and cognitive outcomes

Bivariate linear regression showed that the only significant GP age was MGM age, as participants with a MGM > 70 years old scored 1.31 units lower on the SDQ compared to participants with a MGM ≤ 70 (**Table 3, column 3**). There were no significant associations found between the age of any type of GP and TEQ scores.

Bivariate logistic regression showed that there were no significant associations between the age of any type of GP and DCCS Border version task results.

Table 3. Results of bivariate analysis of participant and GP demographic covariates and participant outcomes

Independent variable	TEQ score (n=393)		SDQ score (n=394)		DCCS task outcome (n=394)	
	Beta (\pm SE)	p-value	Beta (\pm SE)	p-value	OR (\pm SE)	95% CI
Participant characteristics						
Age	0.14(\pm 0.20)	0.480	-0.44 (\pm0.15)	0.005	1.00 (\pm 0.06)	[0.88, 1.13]
Gender						
Male (ref)						
Female	2.46(\pm0.68)	<0.001	-0.58 (\pm 0.54)	0.286	0.76 (\pm 0.17)	[0.49, 1.17]
Number of living GPs						
1 (ref)						
2	0.41(\pm 0.96)	0.673	0.67(\pm 0.76)	0.38	1.33 (\pm 0.42)	[0.73, 2.47]
3	0.27(\pm 0.97)	0.783	0.75(\pm 0.77)	0.33	1.09 (\pm 0.34)	[0.59, 2.00]
4	-1.95 (\pm 1.05)	0.064	1.61(\pm0.83)	0.05	0.84 (\pm 0.27)	[0.44, 1.59]
GP characteristics						
MGM age (years)						
\leq 70 (ref)						
>70	1.13(\pm 0.75)	0.131	-1.31 (\pm0.59)	0.026	0.87 (\pm 0.21)	[0.55, 1.39]
MGF age (years)						
\leq 70 (ref)						
>70	-0.39 (\pm 0.83)	0.642	0.09 (\pm 0.66)	0.895	1.32 (\pm 0.37)	[0.77, 2.27]
PGM age (years)						
\leq 70 (ref)						
>70	0.55 (\pm 0.75)	0.465	0.41 (\pm 0.59)	0.490	0.81 (\pm 0.19)	[0.51, 1.28]
PGF age (years)						
\leq 70 (ref)						
>70	0.61 (\pm 0.82)	0.458	-0.65 (\pm 0.64)	0.315	0.72 (\pm 0.18)	[0.44, 1.18]

3.6 Associations (crude and adjusted) between GP-GC relationship closeness and TEQ score

3.6.1 Separate GP model

Bivariate (crude) linear regression showed that there was a significant difference in TEQ scores for adolescents with a PGM closeness score of 0 compared to a closeness score of 1-6 and 7-9, as TEQ scores were lower in these latter groups (**Table 4, column 2**); however, these associations were not found in the adjusted model. Crude linear regression showed that there were no significant associations between MGM-, MGF-, or PGF-GC closeness and TEQ scores; however the multivariate (adjusted) model showed that there was a significant association between MGM closeness scores between 10-13 and TEQ score. Compared to a MGM closeness score of 0, a MGM closeness score of 10-13 was associated with a 2.17 unit increase in TEQ score (**Table 5, column 2**).

Adjusted linear regression showed that there were no significant associations between MGF-, PGM-, or PGF-GC relationship closeness and TEQ scores.

3.6.2 Average GP model

Both crude and adjusted models showed that there were no significant associations between average GP relationship closeness and TEQ score.

3.6.3 Closest GP model

Both crude and adjusted models showed that there was a significant association between closest GP relationship closeness score and TEQ score. Adjusted linear

regression showed that each unit increase in closeness score was associated with a 0.37 unit increase in TEQ score (**Table 5, column 2**).

3.7 Associations (crude and adjusted) between GP-GC relationship closeness and SDQ TD score

3.7.1 Separate GP model

Bivariate (crude) and multivariate (adjusted) linear regression showed that there was a significant difference in SDQ TD score for adolescents with a MGF relationship closeness score of 1-6, as adolescents with a MGF closeness score of 1-6 had a 1.72 unit increase in SDQ TD score compared to adolescents with a MGF closeness score of 0 (**Table 5, column 3**). In addition, crude and adjusted linear regression showed that there was a significant difference in SDQ TD scores between adolescents with a PGF closeness score of 10-13 and adolescents with a PGF closeness score of 0, as adolescents with a PGF closeness score of 10-13 had a 2.70 unit decrease in SDQ TD score compared to adolescents with a PGF closeness score of 0 (**Table 5, column 3**).

Bivariate linear regression showed that there was a significant difference in SDQ Total score for participants with a PGM relationship closeness score of 1-6 compared to a PGM relationship closeness score of 0, as SDQ TD scores were higher in the 1-6 closeness score category (**Table 4, column 3**); however the adjusted model did not show this significance. There were no significant differences in adolescent SDQ TD scores between MGM or PGM closeness scores.

3.7.2 Average GP model

Crude linear regression showed that there were no significant associations between average GP relationship closeness and SDQ TD score; however the adjusted model showed that there was a significant association between adolescent SDQ TD scores and average GP relationship closeness, as each unit increase in average GP closeness was associated with a 0.66 unit decrease in SDQ score (**Table 5, column 3**).

3.7.3 Closest GP model

Crude and adjusted linear regression showed that there was a significant association between closest GP relationship closeness score and SDQ score, as each unit increase in the relationship closeness score was associated with a 0.36 unit decrease in SDQ score (**Table 5, column 3**).

3.8 Associations (crude and adjusted) between GP-GC relationship closeness and DCCS Border version task results

3.8.1 Separate GP model

Bivariate (crude) logistic regression showed that there were no significant associations between MGF relationship closeness score and DCCS Border task results; however, multivariate (adjusted) logistic regression showed that there was a significant difference between DCCS Border version task results for adolescents with a MGF relationship closeness score of 10-13 compared to adolescents with a MGF relationship closeness score of 0, as adolescents with a MGF relationship closeness score of 10-13 had

2.6 times increased odds of passing the task (**Table 5, column 4**). Crude and adjusted logistic regression also showed that there was also a significant difference between task results for adolescents with a PGF closeness score of 7-9 compared to a PGF closeness score of 0, as adolescents with a PGF score of 7-9 had 0.49 times decreased odds of passing the task (**Table 5, column 4**).

Crude logistic regression showed that there was a significant difference in task results for adolescents with a PGM relationship closeness score of 7-9 compared to a PGM relationship closeness score of 0, as participants with a PGM relationship closeness score of 7-9 had increased odds of passing the task (**Table 4, column 4**); however, the adjusted model showed that there was no significant association between PGM relationship closeness score and task results. Both crude and adjusted models showed that there were no significant associations between MGM closeness and task results.

3.8.2 Average GP model

Crude and adjusted logistic regression showed that there was no significant association between average GP closeness and DCCS task results.

3.8.3 Closest GP model

Crude and adjusted logistic regression showed that there were no significant associations between closest GP closeness score and DCCS task results.

Table 4. Bivariate (crude) regression for GP-GC closeness and adolescent outcomes¹

Independent variable	TEQ score ² (n=393)		SDQ score ³ (n=394)		DCCS ⁴ (n=394)		
	Beta (±SE)	p-value	Beta (±SE)	p-value	OR (±SE)	95% CI	
Separate GP closeness model							
MGM							
	0 (ref)						
	1-6	-0.48 (1.17)	0.680	1.64 (0.91)	0.069	1.02 (0.38)	[0.49, 2.11]
	7-9	0.59 (1.03)	0.566	0.37 (0.80)	0.643	0.86 (0.28)	[0.46, 1.62]
	10-13	1.54 (1.02)	0.131	-1.37 (0.79)	0.083	1.38 (0.46)	[0.72, 2.65]
MGF							
	0 (ref)						
	1-6	-1.50 (1.06)	0.156	2.40 (0.82)	0.004	1.25 (0.42)	[0.64,2.43]
	7-9	-1.20 (0.96)	0.211	0.64 (0.74)	0.386	1.21 (0.37)	[0.67,2.19]
	10-13	-0.81 (0.97)	0.406	-0.16 (0.76)	0.836	1.83 (0.61)	[0.95,3.53]
PGM							
	0 (ref)						
	1-6	-2.19 (0.97)	0.024	2.32 (0.76)	0.002	0.63(0.20)	[0.33,1.16]
	7-9	-1.97 (0.92)	0.031	0.95 (0.71)	0.183	0.55 (0.16)	[0.31,0.99]
	10-13	-0.90 (0.95)	0.343	-0.04 (0.74)	0.959	0.56 (0.17)	[0.30,1.02]
PGF							
	0 (ref)						
	1-6	-1.38 (1.05)	0.190	1.30 (0.82)	0.115	1.01 (0.35)	[0.51,1.99]

¹ Bolded type for numbers in table indicates significance

² A higher TEQ score is associated with a higher level of empathy

³ A lower SDQ TD score is associated with a more “Normal” socio-emotional development

⁴ An OR above 1 is associated with increased odds of passing the task

	7-9	-0.66 (1.01)	0.518	-0.31 (0.79)	0.649	0.53 (0.16)	[0.29,0.96]
	10-13	0.85 (1.00)	0.396	-1.62 (0.78)	0.038	0.85 (0.27)	[0.45,1.59]
Average GP closeness model							
Average GP closeness score		-0.02 (0.13)	0.857	-0.14 (0.10)	0.173	0.98 (0.04)	[0.91,1.06]
Closest GP closeness model							
Closest GP closeness score		0.37 (0.12)	0.003	-0.31 (0.10)	0.001	1.01 (0.04)	[0.93,1.09]

Table 5. Multivariate (adjusted) regression⁵ for GP-GC relationship closeness and adolescent outcomes⁶

Independent variable	TEQ score (n=393)		SDQ score (n=394)		DCCS (n=394)		
	Beta (\pm SE)	p-value	Beta (\pm SE)	p-value	OR (\pm SE)	95% CI	
Separate GP closeness model							
MGM							
	0 (ref)						
	1-6	0.60 (1.21)	0.618	1.72 (0.99)	0.083	1.03 (0.41)	[0.47,2.25]
	7-9	1.53 (1.09)	0.159	0.46 (0.90)	0.610	0.91 (0.32)	[0.45,1.81]
	10-13	2.17 (1.08)	0.044	-1.29 (0.89)	0.146	1.50 (0.54)	[0.74,3.05]
MGF							
	0 (ref)						
	1-6	-1.02 (1.13)	0.369	1.72 (0.89)	0.054	1.69(0.64)	[0.81,3.54]
	7-9	-0.49 (1.07)	0.650	-0.07 (0.84)	0.933	1.67 (0.59)	[0.83,3.33]
	10-13	-0.32 (1.08)	0.771	-0.82 (0.85)	0.333	2.61 (1.00)	[1.23,5.52]
PGM							
	0 (ref)						

⁵ All models adjusted for adolescent age, gender, number of living GPs, and MGM age

⁶ Bolded type for numbers in table indicates significance.

	1-6	-1.87 (1.04)	0.074	1.58 (0.83)	0.056	0.59 (0.21)	[0.30,1.17]
	7-9	-1.53 (0.99)	0.121	0.14 (0.78)	0.862	0.52 (0.18)	[0.26,1.04]
	1 0-13	-0.53 (1.06)	0.616	-0.81 (0.83)	0.330	0.52 (0.18)	[0.26,1.04]
PGF							
	0 (ref)						
	1-6	-0.61 (1.19)	0.611	0.22 (0.93)	0.817	1.00 (0.40)	[0.46,2.20]
	7-9	0.70 (1.16)	0.548	-0.91 (0.91)	0.314	0.49 (0.18)	[0.24,1.01]
	10-13	1.95 (1.13)	0.084	-2.70 (0.88)	0.002	0.80 (0.30)	[0.39,1.66]
Average GP closeness model							
Average GP closeness score		0.31 (0.19)	0.100	-0.64 (1.5)	<0.001	1.01 (0.06)	[0.89,1.14]
Closest GP closeness model							
Closest GP closeness score		0.37 (0.12)	0.003	-0.36 (0.10)	<0.001	1.02 (0.04)	[0.94,1.11]

3.9 Associations (crude and adjusted) between GP-GC interaction frequency and TEQ score

3.9.1 Separate GP model

Bivariate (crude) and multivariate (adjusted) linear regression showed that there was a significant difference in TEQ score for participants who interacted with their PGM on a daily basis, compared to adolescents who had no interaction with their PGM, as adolescents who interacted daily with their PGM had a 2.10 unit decrease in TEQ score compared to adolescents who had no interaction with their PGM (Table 7, column 2).

Crude and adjusted linear regression showed that there were no significant associations between frequency of interaction with MGM, MGF or PGF and TEQ score.

3.9.2 Average GP model

Crude linear regression showed that there was a significant difference between the average level of frequency of interaction with all GPs and TEQ scores, as increased average level of interaction frequency was associated with decreased TEQ scores (**Table 6, column 2**); however, adjusted models showed that there was no significant differences.

3.9.3 GP of most frequent interaction model

Crude and adjusted linear regression showed that there were no significant differences between the frequency of interaction with the most frequently interacted with GP and TEQ score.

3.10 Associations (crude and adjusted) between GP-GC interaction frequency and SDQ TD score

3.10.1 Separate GP model

Bivariate (crude) linear regression showed that there was a significant difference in SDQ TD scores for participants who interacted with their PGM several times a year, compared to participants who had no interaction with their PGM, as participants who interacted with their PGM several times a year had a higher SDQ TD score (**Table 6,**

column 3); however the multivariate (adjusted) model showed that there was no significant difference between PGM interaction frequency and SDQ TD score. In addition, crude and adjusted linear regression showed that there were no significant associations between frequency of interaction with MGM, MGF or PGF and SDQ TD score.

3.10.2 Average GP model

Crude and adjusted linear regression showed that there were no significant associations between the average frequency of interaction with all GPs and SDQ TD scores.

3.10.3 GP of most frequent interaction model

Crude and adjusted linear regression showed that there were no significant associations between the frequency of interaction with the most frequently interacted with GP and SDQ TD score.

3.11 Associations (crude and adjusted) between GP-GC interaction frequency and DCCS Border version task results

3.11.1 Separate GP model

Bivariate (crude) and multivariate (adjusted) logistic regression showed that there was a significant difference in results for the DCCS Border version task for participants who interacted daily with their MGF, compared to participants who had no

interaction with their MGF, as participants who interacted with their MGF daily had a 2.82 increased odds of passing the task compared to adolescents who had no interaction with their MGF (**Table 7, column 4**). In addition, the adjusted model showed that compared to adolescents who had no interaction with their MGF, adolescents who interacted with their MGF several times a year had a 2.41 increased odds of passing the task (**Table 7, column 4**). Crude and adjusted models also showed that there was a significant difference in results of the DCCS Border version task for participants who interacted with their PGM daily and weekly compared to never, as those who interacted daily and weekly had a 0.57 and 0.43 decreased odds of passing the task (**Table 7, column 4**), respectively, compared to participants who had no interaction with their PGM.

Crude and adjusted logistic regression showed that there were no significant associations between MGM and PGF interaction frequency and task results.

3.11.2 Average GP model

Crude and adjusted logistic regression showed that there were no significant associations between the average frequency of interaction with all GPs and task results.

3.11.3 GP of most frequent interaction model

Crude and adjusted logistic regression showed that there were no significant associations between the frequency of interaction with the most frequently interacted with GP and task results.

Table 6. Bivariate (crude) regression for GP-GC interaction frequency and adolescent outcomes⁷

Independent variable	TEQ score (n=393)		SDQ score (n=394)		DCCS (n=394)	
	Beta (\pm SE)	p-value	Beta (\pm SE)	p-value	OR (\pm SE)	95% CI
Separate GP frequency of interaction model						
MGM						
Never (ref)						
Several times/year	0.60 (1.04)	0.563	0.81 (0.81)	0.320	1.12(0.36)	[0.59, 2.12]
Weekly	0.77 (1.13)	0.497	-0.48 (0.88)	0.589	0.87(0.30)	[0.44, 1.72]
Daily	0.85 (1.03)	0.410	-0.46 (0.81)	0.566	1.39(0.46)	[0.73, 2.66]
MGF						
Never (ref)						
Several times/year	-0.74 (0.94)	0.431	1.31 (0.74)	0.076	1.61(0.51)	[0.87, 2.99]
Weekly	-0.56 (1.10)	0.613	-0.42 (0.85)	0.621	0.96(0.32)	[0.50, 1.84]
Daily	-1.49 (0.96)	0.118	1.08 (0.75)	0.150	1.99(0.67)	[1.04, 3.83]
PGM						
Never (ref)						
Several times/year	-1.29 (0.96)	0.178	1.91 (0.76)	0.012	0.74(0.24)	[0.39, 1.39]
Weekly	-0.67 (1.08)	0.531	1.43 (0.85)	0.090	0.47(0.16)	[0.24, 0.92]
Daily	-2.42 (0.86)	0.005	0.74 (0.67)	0.274	0.54(0.15)	[0.31, 0.94]
PGF						
Never (ref)						
Several times/year	0.06 (1.04)	0.953	-0.06 (0.82)	0.945	1.19(0.42)	[0.60, 2.37]
Weekly	1.07 (1.26)	0.396	0.73 (0.99)	0.462	0.54(0.20)	[0.26, 1.13]

⁷ Bolded type for numbers in table indicates significance.

	Daily	-1.34 (0.89)	0.131	-0.28 (0.69)	0.687	0.70(0.19)	[0.41, 1.20]
Average GP interaction frequency model							
	Average GP-GC interaction frequency	-1.12 (0.53)	0.034	0.11 (0.41)	0.787	0.88(0.15)	[0.64, 1.23]
GP of most frequent interaction model							
	Several times/year (ref)						
	Weekly	2.14 (1.13)	0.058	-0.63 (0.89)	0.480	0.57 (0.21)	[0.28, 1.16]
	Daily	0.65 (0.92)	0.479	-0.84 (0.73)	0.244	0.85 (0.26)	[0.46, 1.54]

Table 7. Multivariate (adjusted) regression⁸ for GP-GC frequency of interaction and adolescent outcomes⁹

Independent variable	TEQ score (n=393)		SDQ score (n=394)		DCCS Border version task results(n=394)		
	<i>Beta (±SE)</i>	<i>p-value</i>	<i>Beta (±SE)</i>	<i>p-value</i>	<i>OR (±SE)</i>	95% CI	
Separate GP frequency of interaction model							
MGM							
	Never (ref)						
	Several times/year	1.68 (1.10)	0.127	0.73 (0.92)	0.427	1.16(0.42)	[0.58, 2.35]
	Weekly	1.58 (1.20)	0.187	-0.31 (0.99)	0.757	0.94(0.36)	[0.45, 2.00]
	Daily	1.41 (1.07)	0.191	-0.19 (0.90)	0.837	1.47(0.52)	[0.73, 2.96]
MGF							
	Never (ref)						
	Several	0.12 (1.08)	0.915	0.47 (0.85)	0.580	2.41(0.90)	[1.16,

⁸ All models adjusted for adolescent age, gender, number of living GPs, and MGM age.

⁹ Bolded type for numbers in table indicates significance.

times/year							5.00]
Weekly	-0.19 (1.17)	0.874	-0.81 (0.92)	0.378	1.35(0.50)		[0.65, 2.80]
Daily	-0.80 (1.05)	0.443	0.45 (0.83)	0.587	2.82(1.06)		[1.34, 5.90]
PGM							
Never (ref)							
Several times/year	-0.99 (1.07)	0.356	1.11 (0.85)	0.190	0.73(0.27)		[0.36, 1.50]
Weekly	-0.15 (1.15)	0.900	0.83 (0.92)	0.368	0.43(0.16)		[0.21, 0.90]
Daily	-2.10 (0.96)	0.029	0.10 (0.77)	0.895	0.51(0.16)		[0.27, 0.96]
PGF							
Never (ref)							
Several times/year	1.22 (1.20)	0.310	-1.38 (0.94)	0.145	1.20(0.49)		[0.54, 2.67]
Weekly	2.54 (1.39)	0.067	-0.49 (1.10)	0.657	0.51(0.22)		[0.22, 1.20]
Daily	-0.12 (1.03)	0.907	-1.38 (0.81)	0.088	0.69(0.23)		[0.36, 1.31]
Average GP frequency of interaction model							
Average GP-GC interaction frequency	-1.02 (0.80)	0.199	-0.96 (0.63)	0.127	0.91(0.23)		[0.55, 1.51]
GP of most frequent interaction model							
Several times/year (ref)							
Weekly	2.14 (1.13)	0.059	-0.49 (0.90)	0.586	0.56 (0.21)		[0.27, 1.16]
Daily	0.75 (0.93)	0.422	-0.85 (0.74)	0.250	0.85 (0.27)		[0.45, 1.59]

3.12 Associations (adjusted) between combination (GP-GC relationship closeness and interaction frequency) and adolescent outcomes

Adjusted models showed that there was a significant difference in SDQ TD score for participants who had a closeness score between 10 and 13 and interacted with their closest GP daily, compared to a closeness score between 0 and 5 and interacted with their closest GP several times a year. Those who had a closeness score between 10 and 13 and interacted with their GP daily scored 3.04 points lower on the SDQ TD, compared to participants who had had a closeness score between 0 and 5 and interacted with their GP several times a year.

Adjusted linear and logistic regression showed that there were no significant differences in TEQ scores (**Table 8, column 2**) or DCCS Border version task results (**Table 8, column 2**) for participants who had a relationship closeness score of 0-5 and interacted with their closest GP several times a year, compared to alternative relationship closeness and interaction frequency combinations.

Table 8. Multivariate (adjusted) regression¹⁰ for combination (GP-GC relationship closeness and interaction frequency) and adolescent outcomes¹¹

Combination variable¹²	TEQ score (n=393)		SDQ score (n=394)		DCCS Border version task results(n=394)	
	<i>Beta</i>	<i>p-value</i>	<i>Beta (±SE)</i>	<i>p-</i>	<i>OR (±SE)</i>	95% CI

¹⁰ All models adjusted for adolescent age, gender, number of living GPs, and MGM age.

¹¹ Bolded type for numbers in table indicates significance.

¹² For relationship closeness score:

1=closeness score of 0-5, 2=closeness score of 5.1-9.9, 3=closeness score of 10-13

For interaction frequency:

1=several times a year, 2=weekly, 3=daily

	(±SE)			<i>value</i>		
(1,1) (ref)						
(2,1)	1.17 (1.76)	0.506	-1.52 (1.38)	0.271	0.36(0.25)	[0.09, 1.41]
(3,1)	2.66 (2.02)	0.187	-2.40 (1.58)	0.129	0.54(0.42)	[0.12, 2.52]
(1,2)	2.17 (2.39)	0.364	-0.25 (1.88)	0.892	0.39(0.34)	[0.07, 2.18]
(2,2)	1.75 (1.90)	0.357	-1.67 (1.49)	0.261	0.27(0.19)	[0.06, 1.11]
(3,2)	3.57 (1.95)	0.067	-1.30 (1.53)	0.397	0.46(0.35)	[0.10, 2.01]
(1,3)	-1.13 (2.12)	0.595	0.13 (1.67)	0.940	0.40(0.32)	[0.08, 1.93]
(2,3)	1.87 (1.65)	0.257	-1.14 (1.29)	0.376	0.38(0.34)	[0.10, 1.41]
(3,3)	2.13 (1.62)	0.188	-3.04 (1.27)	0.017	0.52 (0.34)	[0.14, 1.90]

4. Discussion

The findings of this study suggest that both GP-GC relationship closeness and interaction frequency have a significant impact on adolescent empathy, socio-emotional, and cognitive development. Close MGM relationships and increased closeness to the closest GP were significantly associated with increased empathy in adolescents, while daily PGM interaction was negatively associated with adolescent empathy levels. Close PGF relationships, increased average GP closeness, and increased closeness to the closest GP were significantly associated with normalized (more “Normal” SDQ TD score) socio-emotional development in adolescents, while increased MGF relationship closeness was negatively associated with socio-emotional development. Higher levels of MGF relationship closeness and interaction frequency were both significantly associated with cognitive development, while increased PGF relationship closeness and PGM interaction was negatively associated with cognitive development. These findings are important to the global field of adolescent development, as it indicates that adolescent psychological health outcomes are influenced by family and social determinants, including GP-GC relationships and interactions.

4.1 GP-GC relationship

4.1.1 Relationship closeness

When each GP was analyzed separately, including deceased GPs, the MGM-GC relationship was closest and the PGF-GC relationship was least close, overall. In

addition, the grandmother-GC relationship was closer than the grandfather-GC relationship, on average. Several other studies are consistent with both of these findings (Dunifon & Bajracharya, 2012). Our study found that more grandmothers were alive than grandfathers, which is consistent with past research that shows grandfathers are likely to die before grandmothers (Snopkowski & Sear, 2015). This is one reason why grandfather-GC relationship closeness was lower than grandmother-GC relationship closeness.

4.1.2 Interaction frequency

The pattern of interaction frequency with each GP type similarly reflects the above patterns observed for relationship closeness. When each GP was analyzed separately, MGMs had the most interaction with participants, while PGFs had the least. Although in existing literature MGFs were reported to have the least amount of interaction with GC (Creasey & Koblewski, 1991), both this study and previous studies have found that grandfathers have less frequent interaction with GC, compared to grandmothers. Again, as the interaction frequency included deceased GPs, this result is largely due to the higher amount of deceased grandfathers compared to grandmothers. In terms of daily interaction, participants interacted more with maternal GPs than paternal GPs, which may partly explain why PGMs had the highest proportion of “0” scores (above). This finding is consistent with findings in Indonesia, where maternal grandparents provide more help than paternal grandparents (Snopkowski & Sear, 2015).

4.2 Adolescent outcomes

4.2.1 Empathy

Females scored significantly higher on the TEQ, which suggests that female participants were more empathetic than male participants. This finding is consistent with the literature, as several studies using a wide range of self-report measures of empathy have found significantly higher empathy scores in females compared to males (Garaigordobil, 2009; Heller, Robinson, Henry, & Plunkett, 2006). Furthermore, as a traditional approach to understanding gender socialization involves expressive roles, including the nurturing and caring aspects of interpersonal interactions, empathy is a quality often associated with females (Heller, Robinson, Henry, & Plunkett, 2006).

MGM relationship closeness is most positively associated with adolescent empathy outcomes, as TEQ scores increased with increasing MGM relationship closeness scores. This positive and significant association of this relationship could be due to the relative increased closeness of MGM-GC relationships, compared to other types of GP-GC relationships. The average model showed the same pattern (increased relationship closeness and increased TEQ score); however, this was not significant. This is likely because MGF and PGM have negative associations with TEQ score, which in effect “washes out” the positive effect of MGM and PGF relationships on TEQ score. The

findings also suggest that closeness with the closest GP is significantly associated with improved empathy outcomes, as hypothesized.

This may be because close, open, and communication-centered GP-GC relationships may allow adolescents the ability to share their needs, feelings, and desires with their GPs, and therefore hold potential for fostering forms of adolescent empathy. GP socialization efforts focusing adolescents' attention on the states and feelings of others may also contribute to the development of empathy. Further, GPs that share a close relationship with their GC may directly communicate in ways that encourage attention and responsiveness to the needs and situations of others.

The association between GP-GC interaction frequency and TEQ scores is less clear. In particular, daily PGM interaction is associated with a decrease in TEQ score, compared to no interaction. One reason for this could be that if adolescents interact with their GPs on a daily basis, this could mean that they live together and/or that the GPs are primary caregivers, and therefore, other familial and socio-economic factors that might effect outcomes should be considered. Previous studies show that GPs provide help to those adult children and grandchildren who are more in need of help (Snopkowski & Sear, 2015). For example, studies have found that GP-involvement is highest in single-mother families, compared to step- and biological parent families (Dunifon & Bajracharya, 2012).

4.2.2 Socio-emotional development

As SDQ TD scores ranged from 1-28, some participants scored “Abnormal,” categorized as scores between 20 and 40.

Increased participant age was associated with more a “normal” SDQ TD score, which suggests that older participants had more “normal” socio-emotional outcomes. This finding is consistent with previous studies, which suggest that older adults show greater prosocial behaviour (included in the SDQ TD score) than younger adults (Beadle, Sheehan, Dahlben, & Gutchess, 2015). In addition, participants with an MGM over 70 years old scored 1.31 units lower, compared to participants with an MGM 70 years old or younger. This could also relate to adolescent age, as older adolescents may have older GPs, which could account for the more “normal” score. Also likely to be age-related, participants with 4 living GPs scored 1.61 units higher (less “normal”), which could be because younger participants may be more likely to still have 4 living GPs.

In terms of relationship closeness, a closer PGF relationship was associated with a more normal SDQ TD score. This trend was also reflected in the average and most-frequent models, as increased relationship closeness was associated with significantly more normal SDQ TD scores. This suggests that increased GP-GC relationship closeness normalizes socio-emotional outcomes of adolescents, as hypothesized. One reason for this may be that close GP-GC relationships provide social support to adolescents. For instance, close GPs may be confidantes to their GC and/or functional substitutes for

parents and therefore, may serve to buffer children at risk for maladjustment or socio-emotional distress.

The combination of a GP-GC relationship closeness score between 10 and 13 and daily interaction with the closest GP was associated with a significantly more normal SDQ TD score, compared to a GP-GC relationship closeness score between 0 and 5 and interaction several times a year. This suggests that the combination of a close GP-GC relationship and frequent interactions normalizes socio-emotional outcomes of adolescents.

Similar to empathy, the separate model showed that the association between interaction frequency and SDQ scores is less clear, as there were no significant associations. This suggests that GP-GC interaction frequency is not associated with normalized socio-emotional outcomes, potentially for the same reasons that increased interaction was not associated with increased empathy.

4.2.3 Cognitive development

It was hypothesized that increased GP-GC relationship closeness and interaction frequency would be positively associated with adolescent cognitive outcomes because GPs may support and mentor GC, discuss future plans with them, and impart specific skills. Furthermore, GPs may provide financial assistance for resources for their GC.

In our study, the associations between GP-GC relationship closeness and DCCS Border version task results are much more inconsistent than the associations between

GP-GC closeness and TEQ and SDQ scores. Grandfather-GC relationship closeness had significant associations with results; however, the direction of these associations were opposite for paternal versus maternal grandfathers, as increased MGF closeness was associated with increased odds of passing, while increased PGF closeness was associated with decreased odds of passing. The average model indicates that the odds of passing are approximately equal to the odds of failing, which could be due to the “washing out” effect of MGF (significant increase) and PGF (significant decrease), although this is not a significant association. These findings suggest that there is no clear relationship between GP-GC relationship closeness and adolescent cognitive development.

The associations between GP-GC interaction frequency and task results are similar to above. In particular, MGF-GC interaction daily or several times a year is significantly associated with increased odds of passing the task. Contrastingly, weekly and daily PGM-GC interaction is significantly associated with decreased odds of passing. One explanation for this could be the overall low relationship closeness observed for PGMs, which could lessen the potential positive impact of frequent interaction. Average and most-frequent models are not associated with improved cognitive development, likely due to the same factors that decrease empathy and socio-emotional outcomes as interaction increases.

4.3 Implications for policy and practice

This study has used multiple tools to gather information on adolescent psychological outcomes which could be used to conduct future research to inform health and social policy. In particular, there is an urgent need to study psychological health in developing countries, such as Sri Lanka, where the majority of the world's population lives, but very little research is conducted (Ball et al., 2010). In these countries, planning for mental health can be seen as a low priority by policy makers, as multiple demands must be met, but services are restricted due to limited funding. The implication of this study, which describes the beneficial effect of close GP-GC relationships, may be especially relevant for the introduction of new policies or programs that are low-cost and focus on strengthening already existing GP-GC relationships. In particular, it is suggested that policy makers implement community-based programs to increase the closeness of GP-GC relationships by providing regularly scheduled and easily accessible GP-GC-centered activities.

Given the importance of GPs in the Sri Lankan context, it is important to develop GP-GC relationships in an effective way. Our study suggests that high interaction frequency with GPs (potentially live-in or primary caregiving GPs) may have negative impacts on adolescent outcomes. This finding suggests that it would be advantageous to implement policies or programs that aid GPs in the raising of adolescent GCs.

In addition, there is a pressing need for low-cost interventions to promote mental health among children in the wake of natural disasters. Our study can contribute to this priority, as our findings suggest that strengthening GP-GC relationships may be an effective way to promote empathy and socio-emotional outcomes in Sri Lankan adolescents, many of whom were likely affected by the 2004 tsunami. Similarly, mental health-related studies such as this have particular public health salience due to the high suicide rate (Ball et al., 2010), and the impact of the prolonged civil war in Sri Lanka. As adolescence provides a range of opportunities for health professionals to play a role in interventions, especially those to optimize health in adult years (Tonkin, 2001), it is prudent to capitalize on this critical time for health-related interventions.

Furthermore, given that the proportion of elderly has risen and the old-age dependency ratio has gone up from 8 to 11 since 1981 (Department of Census & Statistics, Sri Lanka, 2012), the findings from this study should be used to contribute to a broad community intervention to improve the mental health of both Sri Lankan elders and their GC.

4.4 Implications for future research

The results of this study warrant future research on the GP-GC relationship and its association with adolescent socio-emotional and cognitive outcomes. As this study was cross-sectional, GP-GC relationship and its impact on adolescent outcomes should

be studied with longitudinal studies to allow for causal inference. In particular, this study found that the type of GP (MGM, MGF, PGM, PGF) could be an important factor in identifying associations. Future qualitative studies should seek to understand the reasons for these unique associations for specific GP types. It is also recommended that future studies enroll a larger sample and utilize more sensitive instruments to increase the generalizability and accuracy of results.

Furthermore, the association between adolescent demographic factors such as age, gender and number of living grandparents suggest future research should focus on further understanding additional important adolescent demographic factors, such as SES, household composition, and number of living parents.

In addition to adolescent demographic factors, our study suggests that further research should also focus on GP-related demographic factors, such as education and SES level. To do so, future studies should include GC-GP dyads that focus on each GP type (MGM, MGF, PGM, PGF) individually, as well as the closest GP. A focus on more detailed GP-related demographic factors, may be particularly salient for attaining a better understanding of how GP-GC relationships are associated with adolescent cognitive outcomes, in particular. This hypothesis is based on existing literature, which suggests that GC with college-educated GPs possess stronger literacy and mathematic skills at the start of formal schooling (Ferguson & Ready, 2011).

The results of this study also suggest that frequent interaction with GPs may not always be associated with positive adolescent outcomes, which indicate that other factors may be important to consider. These factors, such as reasons why the GC lives with the GP (poverty, deceased parents, etc.) should be studied to explain this observation.

4.5 Study strengths and limitations

This research is valuable because it examined the association between GP-GC relationships and their impact on adolescent GC socio-emotional and cognitive outcomes in Sri Lanka, which no previous research has focused on. The measures used in this study were widely accepted, making results comparable to studies of other populations. The measures were culturally relevant and translated, back-translated and tested in Sinhala for use in Sri Lanka. In addition, our sample size was relatively large.

As a cross-sectional study, important limitations need to be considered when interpreting our research findings. A natural limitation of this cross-sectional surveys is the inability to explain the causal relationship of GP-GC relationships and adolescent outcomes. Similarly, it is also impossible to infer causality of adolescent or GP demographic factors on adolescent outcomes.

Our sampling and survey administration methods also have potential limitations. As sampling was not random, generalizability of study findings is reduced.

As the surveys were administered in a group session setting, this could have increased the opportunity for adolescents to “copy” each others’ answers and also to feel performance-related pressure as a result of the classroom-type environment, especially when friends, siblings, teachers, community leaders, monks, and/or parents were present. In addition, data on GP-related factors were based on adolescent responses about their GP, rather than responses from the GPs, themselves. All of these circumstances have the potential to increase the likelihood of dishonest and/or inaccurate answers. Similarly, the information in the survey is self-reported and therefore, is subject to self-report biases, such as recall and social desirability bias.

Another limitation in our study was that we included all adolescents, rather than further categorizing participants according to early, mid- and late adolescence. As particular issues related to adolescent development are often unique to the various stages of adolescence, our categorization of adolescence may have been too broad. For example, declines in self-esteem and academic motivation (Zaslow & Takanishi, 1993), as well as strong peer group connections and less family connectedness (Tonkin, 2001) are characteristic of early adolescence.

Another limitation is that several factors, such as number of living parents, exact household information and SES may also associate with adolescent outcomes, but this information was not considered in the analysis. Number of living parents was not considered as a covariate in the analysis because a sufficient number of participants did

not fall into the groups of having 0 or 1 parent living. Data on household composition was collected; however, this data was found to be too unreliable and inconsistent to include in analysis, given contextual differences in the rural Sri Lankan setting.

Although SES-related data was not specifically collected, local experts confirmed that the locations of data collection and the study participants were of lower and average SES for that region.

5. Conclusion

Given the social-, family-, economic- and health-related factors that have resulted in the possibility of more long-term, meaningful and supportive GP-GC relationships, it is important to thoroughly understand the impact of this relationship on adolescent GCs. In a survey of 394 adolescents, over 20% interacted with at least one GP on a daily basis. As this indicates that GPs are very involved in the Sri Lankan population, this finding warrants future research to better understand the potential effects of the GP-GC relationship.

Relationship closeness had an important impact on adolescent outcomes. In general, increased relationship closeness was associated with improved adolescent outcomes. The overall relationship closeness was highest for MGMs, which signifies the particular importance of this relationship, as reflected by the significant increase in empathy for adolescents who had a very close relationship with their MGMs (score of 10-13). In terms of socio-emotional outcomes, as measured by the SDQ TD score, very close (score of 10-13) PGF relationships were associated with significantly improved socio-emotional outcomes.

In contrast to what we hypothesized, our findings suggest that increased GP-GC interaction frequency was not associated with increased socio-emotional (including empathy) or cognitive outcomes. In particular, increased PGM-GC interaction was

significantly associated with decreased empathy scores and increased odds of failing the DCCS task, compared to no PGM-GC interaction.

These results warrant future research into factors that may be associated with daily GP-GC interaction to further understand this finding. In general, the type of GP (MGM, MGF, PGM, PGF) had different impacts on the same adolescent outcome, which suggests that the specific relationship is important to understanding the association between GP-GC relationships and adolescent outcomes. Interestingly, daily PGM interaction was associated with decreased empathy and cognitive outcomes, which warrants further investigation into this specific relationship. In addition, future research could include identifying methods of increasing positive adolescent outcomes through GP-related interventions that benefit both GPs and GCs.

As child mortality declines, the elderly live longer, and family sizes decrease, the contribution of adolescents becomes more important as they become the productive work force of the future (School & Adolescent Health Unit, Family Health Bureau, Ministry of Health, Sri Lanka, 2013). Sri Lanka is in the middle of a non-communicable disease (NCD) epidemic (School & Adolescent Health Unit, Family Health Bureau, Ministry of Health, Sri Lanka, 2013), and as such, the health of its adolescents becomes critical. It has been noted that two thirds of premature deaths due to NCDs, including mental and psychological health issues, could be prevented by intervention during adolescence (School & Adolescent Health Unit, Family Health Bureau, Ministry of

Health, Sri Lanka, 2013). Given the high prevalence of adolescents in Sri Lanka (approximately 30% of the population), the need for psychological health services has been justified in previous studies (De Silva et al., 1988); however, the recognition of this need has not necessarily led to decisions regarding policy or planning. This study highlights the importance of the GP-GC relationship in Sri Lanka and suggests that this relationship could serve as an important tool in the promotion of adolescent psychological health in Sri Lanka.

Appendix A

- A. Informed consent form**
- B. Assent form**
- C. Adolescent questionnaire**

A. Informed consent form

Title of Study: Effect of grandparent-grandchild interaction on socio-emotional and cognitive outcomes of adolescent grandchildren in Sri Lanka

Background/Purpose:

We are doing a research project to learn about grandchildren and grandparents in your community, including how grandparents and grandchildren interact together. The research is being done by researchers from the University of Ruhuna and Duke University and will take place from June 2015 to August 2015. The purpose is to learn more about adolescents and their grandparents so that in the future we can contribute to the development of a community and family based intervention to improve the mental health of both Sri Lankan adolescents and their grandparents. I would like to tell you about the research and ask if you would allow your child to participate. We are including grandchildren ages 11-17.

Procedures:

If you agree to allow your child to participate, we would ask your child to complete an anonymous survey about themselves and their family, especially their grandparents. We will also ask them to complete an activity to assess their cognitive functioning (ability to solve problems). The survey and activity will take about an hour and fifteen minutes. If you agree to allow your child to participate, they will be compensated 500 rupees for their time.

Risks/Discomfort:

It is possible that some of the questions might make your child feel uncomfortable, such as questions about family relationships. If we ask them a question that they do not want to answer, then they do not have to answer. They do not have to answer any questions they do not want to.

Anticipated Benefits:

Your child will not benefit directly from participating. Your child will not receive any services. However, your child will be helping us learn information that will contribute to the development of future community and family interventions.

Confidentiality:

Surveys will be kept in a locked filing cabinet before they are entered into a computer. Only our research team will have access to the passwords on the computer where we keep the answers to the survey. We will not report either your name or your child's name so that no one will know that you participated.

Right to Refuse or Withdraw: You do not have to agree for your child to participate if you do not want to. Your child can also stop at any time and it will not affect any services or programs provided by any other organization that you and your child participate in or that you may want to participate in, in the future.

Contact Information:

If you or your child has any questions or worries about the study, you can contact Dr. Bilesha Perera, Faculty of Medicine, Galle Tel: 0912234017. For information about your child's rights as a research participant, please contact the University of Ruhuna's Ethical Review Committee at 091 2246 872.

Documentation of Consent

Do you agree for your child to participate in this study?

₁ YES, subject agrees to participate.

₂ NO, subject does not agree to participate.

Signature: _____

B. Assent form

Title of Study: Effect of grandparent-grandchild interaction on socio-emotional and cognitive outcomes of adolescent grandchildren in Sri Lanka

[Script, to be read to adolescent]: Hello, my name is *[insert name of research team member]*. We are here to do a research study to learn about grandchildren and grandparents in your community, including how grandparents and grandchildren interact together. I would like to invite you to help us with this study, which will take place from June 2015 to August 2015. If you decide to participate, you will be asked to do a survey and answer questions about yourself and your family, especially your grandparents. You will also be asked to do an activity that will measure your ability to solve problems. The survey and activity will take about an hour and fifteen minutes. We will not share your answers with anyone, including your grandparents. All the answers you provide will be kept in a locked file that only the researchers can look at. When we report information from this study, we will not report your name so that no one will know that you participated. If you have any questions about your rights as a research participant, please contact the University of Ruhuna's Ethical Review Committee at 091 2246 872.

During the survey and other activities, you can tell us you want to stop whenever you want. You do not have to answer any questions that you do not want to. That will be completely fine.

Do you have any questions? *[Research team member to answer any questions]*.

Documentation of Assent

Do you agree to participate in this study?

- ₁ YES, adolescent gives assent to participate.
₂ NO, adolescent does not give assent to participate.

Signature: _____

C. Adolescent questionnaire

Date: 2015/___/___

Start time: ___ : ___ AM/PM (circle one)

Interviewer (print name): _____

Gender

- ₁ Male
₂ Female
-

PART A:

I) Background

PROMPT: First, I'd like to ask you a few questions about yourself

1. What is your date of birth?

___/___/___

2. What is the highest level of education you have completed?

- ₁ No Schooling
₂ Up to Grade 5
₃ Grade 5-11
₄ Grade 12-13

II) Family Information

PROMPT: Now, I'd like to ask you some questions about your family and household.

1. Who do you live with most of the time? Please choose one

- ₁ Mother and father
₂ Mother only
₃ Father only
₄ Mother and step-father or mother's partner
₅ Father and step-mother or father's partner
₆ Grandparents only

- ₇ Older brother or sister
₈ Other (please specify below)
-

2. Have any of the following events happened to your parents? (Choose all that apply)

- ₁ Divorce
₂ Separation
₃ Remarriage
₄ None of the above

Table 1.

Please indicate if any of the following events have happened to your mother and/or father.

Event	Mother	Father
Serious accident		
Serious illness		
Death		

If any boxes were checked from the above table, answer the following, as appropriate. If no boxes were checked from the above table, proceed to question

3. Cause of:

a. Serious accident

Mother	Father	
<input type="checkbox"/>	<input type="checkbox"/>	2004 tsunami
<input type="checkbox"/>	<input type="checkbox"/>	Civil war
<input type="checkbox"/>	<input type="checkbox"/>	Foreign domestic employment
<input type="checkbox"/>	<input type="checkbox"/>	Other
<input type="checkbox"/>	<input type="checkbox"/>	Don't know

b. Serious illness

Mother	Father	
<input type="checkbox"/>	<input type="checkbox"/>	2004 tsunami
<input type="checkbox"/>	<input type="checkbox"/>	Civil war
<input type="checkbox"/>	<input type="checkbox"/>	Foreign domestic employment
<input type="checkbox"/>	<input type="checkbox"/>	Other
<input type="checkbox"/>	<input type="checkbox"/>	Don't know

c. Death

Mother	Father	
<input type="checkbox"/>	<input type="checkbox"/>	2004 tsunami
<input type="checkbox"/>	<input type="checkbox"/>	Civil war
<input type="checkbox"/>	<input type="checkbox"/>	Foreign domestic employment
<input type="checkbox"/>	<input type="checkbox"/>	Other
<input type="checkbox"/>	<input type="checkbox"/>	Don't know

III) Household Composition

1. How many people currently live in this house? ____

2. Please list all those who currently live in this house, as well as their age. Please include all those who live in this house, even if they are not related to you (ex. servants).

Relative	Age
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____
8. _____	_____
9. _____	_____
10. _____	_____
11. _____	_____
12. _____	_____
13. _____	_____
14. _____	_____
15. _____	_____

Table 3

Now, lets talk about how often you visit with your living grandparents and great-grandparents. Under the "Frequency of visits" column, please check only one of the boxes for each grandparent and great-grandparent. Under the "Distance" column, please indicate how far away they live (in kilometers), as best as you can.

	Frequency of visits						Distance (kilometers)
	Daily	Weekly	Monthly	3-4 times/y ear	Annually	Less than annually	
Maternal grandmother							
Maternal grandfather							
Paternal grandmother							
Paternal grandfather							
Great- grandparent(s)							

1. Have you ever lived with your grandparent(s) before (either with or without other family members)?

₁ Yes

₂ No

If you answered Yes to the above question, proceed to question 2. If you answered No to the above question, proceed to PART IV.

2. How old were you when you started to live with your grandparent(s)?
_____ years old

3. Did anybody else live with you?

₁ Yes

₂ No

If you answered Yes to the above question, please fill out the following list. If you answered No to the above question, proceed to Part IV.

Please list all relatives who lived in the house shared by you and your grandparent.

Relative

1. _____

2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____

IV) Grandparents

Can you tell us some things about your grandparents?

	Mother's mother	Mother's father	Father's mother	Father's father
What grandparents do you have living?				
For the following questions, only answer only for those grandparents that are alive.				
1. How often do you see them?				
Daily				
Once a week				
Several times a year				
Never				
2. Where do they live?				
With me				
In the same town/village				
Not in the same town/village but within 10 kilometers				
Further away (in Sri Lanka)				
Further away (overseas)				
Don't know				

3. How old are they?				
Younger than 50 years old				
50-60 years old				
60-70 years old				
Over 70 years old				
Don't know				
4. Do they still work?				
Yes, part-time				
Yes, full-time				
No				
Don't know				
5. How good is their health?				
Very good				
Good				
Poor				
Very poor				
Don't know				
6. How many other grandchildren do they have?				
Just you				
2 or 3				
4 or more				
Don't know				
7. How well does your mother get along with your grandparents?				
Very well				
Well				
Not so well				
Not well at all				
Don't know				
8. How well does your father get along with your grandparents?				
Very well				
Well				

Not so well				
Not well at all				
Don't know				
9. Does your mother encourage you to spend time with your grandparents?				
Yes				
No				
10. Does your father encourage you to spend time with your grandparents?				
Yes				
No				
11. How often do your grandparents look after you?				
Every day				
Once a week or so				
Several times a year				
Never				
12. How much can you depend on your grandparent to be there when you really need him/her?				
Not at all				
A little				
Sometimes				
A lot				
13. How much does your grandparent make you feel appreciated, loved, or cared for?				
Not at all				
A little				
Sometimes				
A lot				
14. How happy are you with your relationship with your grandparent?				

Very unhappy				
Fairly unhappy				
Fairly happy				
Very happy				
15. Compared to other grandchildren, (including your brother and sister), how close are you to your grandparent?				
Less close than some or most				
About the same				
Closer than some				
16. How often does your grandparent help you in important ways by giving you advice and helping solve problems you have?				
Never				
Rarely				
Sometimes				
Often				
17. Do they get involved with things you like, such as sports and other hobbies?				
Usually				
Occasionally				
Never				
18. Do they come to school or other events that are important to you?				
Usually				
Occasionally				
Never				
19. How often do you talk to them about problems you have?				
Usually				
Occasionally				
Never				

20. Do you share things with them that you have not talked to your parents about?				
Usually				
Occasionally				
Never				
21. Can you talk to them about your future plans?				
Usually				
Occasionally				
Never				
22. Do they offer good advice when you have a problem?				
Usually				
Occasionally				
Never				
23. Do they give you money or help in any other way?				
Usually				
Occasionally				
Never				
24. Do they get involved in telling you what you can and cannot do?				
Usually				
Occasionally				
Never				
25. Do you respect what they say?				
Usually				
Occasionally				
Never				
26. To what extent is your grandparent the most important person in				

your life outside your immediate family?				
Most important person				
Important person				
Not very important				
Not at all important				

Please fill out the following chart regarding how often you visited with ALL 4 of your grandparents at different age points.

OPTIONS (choose one for each grandparent):

Daily

Weekly

Monthly

3-4 times per year

Annually

Less than annually

For any age groups that are not relevant (ex. you are not old enough yet), leave that part of the table blank.

Age	Frequency of visitation			
	Mother's mother	Mother's father	Father's mother	Father's father
0-10 years				
10-15 years				
>15 years				

V) Future

Now, I'd like to ask you a few questions about when you are older.

1. How important is it to you to go to university?

- 1 Very important
- 2 Important
- 3 Not very important
- 4 Not at all important

2. How important is it to you to be successful in a job or career?

- 1 Very important
- 2 Important
- 3 Not very important
- 4 Not at all important

3. How important is it to you to have a close relationship with your family when you grow up?

- 1 Very important
- 2 Important
- 3 Not very important
- 4 Not at all important

VI) Demographics

Now, I will ask you a few final questions about yourself

1. What is your ethnicity?

- 1 Sinhalese
- 2 Tamil
- 3 Muslim
- 4 Other → PLEASE SPECIFY _____

2. What is your religion?

- 1 Buddhism
- 2 Hinduism
- 3 Muslim
- 4 Christianity
- 5 Other → PLEASE SPECIFY _____

PART B: Empathy: Toronto Empathy Questionnaire

Below is a list of statements. Please read each statement carefully and rate how frequently you feel or act in the manner described. Circle your answer on the response form. There are no right or wrong answers or trick questions. Please answer each question as honestly as you can.

		Never	Rarely	Sometimes	Often	Always
1.	When someone else is feeling excited, I tend to get excited too	0	1	2	3	4
2.	Other people's misfortunes do not disturb me a great deal	0	1	2	3	4
3.	It upsets me to see someone being treated disrespectfully	0	1	2	3	4
4.	I remain unaffected when someone close to me is happy	0	1	2	3	4
5.	I enjoy making other people feel better	0	1	2	3	4
6.	I have tender, concerned feelings for people less fortunate than me	0	1	2	3	4
7.	When a friend starts to talk about his\her problems, I try to steer the conversation towards something else	0	1	2	3	4
8.	I can tell when others are sad even when they do not say anything	0	1	2	3	4
9.	I find that I am "in tune" with other people's moods	0	1	2	3	4
10.	I do not feel sympathy for people who cause their own serious illnesses	0	1	2	3	4
11.	I become irritated when someone cries	0	1	2	3	4
12.	I am not really interested in how other people feel	0	1	2	3	4
13.	I get a strong urge to help when I see someone who is upset	0	1	2	3	4

14.	When I see someone being treated unfairly, I do not feel very much pity for them	0	1	2	3	4
15.	I find it silly for people to cry out of happiness	0	1	2	3	4
16.	When I see someone being taken advantage of, I feel kind of protective towards him\her	0	1	2	3	4

PART C: Socio-emotional development: *Strengths and Difficulties Questionnaire*

For each item, please mark the box for Not True, Somewhat True or Certainly True. It would help us if you answered all items as best you can even if you are not absolutely certain. Please give your answers on the basis of how things have been for you over the last month.

	Not true	Somewhat true	Certainly true
1. I try to be nice to other people. I care about their feelings	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂
2. I am restless, I cannot stay still for long	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂
3. I get a lot of headaches, stomach-aches or sickness	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂
4. I usually share with others, for example CD's, games, food	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂
5. I get very angry and often lose my temper	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂
6. I would rather be alone than with people of my age	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂
7. I usually do as I am told	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂
8. I worry a lot	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂
9. I am helpful if someone is hurt, upset, or feeling ill	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂
10. I am constantly fidgeting or squirming	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂
11. I have one good friend or more	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂
12. I fight a lot and I can make other people do what I want	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂
13. I am often unhappy, depressed, or tearful	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂
14. Other people my age generally like me	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂
15. I am easily distracted and I find it difficult to concentrate	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂
16. I am nervous in new situations. I easily lose confidence	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂
17. I am kind to younger children	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂
18. I am often accused of lying or cheating	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂
19. Other children or young people pick on me or bully	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂

me	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂
20. I often volunteer to help others (parents, teachers, children)	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂
21. I think before I do things	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂
22. I take things that are not mine from home, school or elsewhere	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂
23. I get along better with adults than people my own age	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂
24. I have many fears, I am easily scared	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂
25. I finish the work I'm doing. My attention is good	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂

1. Overall, do you think that you have difficulties in any of the following areas: emotions, concentration, behavior or being able to get on with other people?

- ₀ No (go to Part D)
- ₁ Yes- minor difficulties
- ₂ Yes- moderate difficulties
- ₃ Yes- major difficulties

If you answered "Yes", please proceed to the following questions about these difficulties. If you answered "No", please proceed to Part D.

2. How long have these difficulties been present?

- ₁ Less than a month
- ₂ 1-5 months
- ₃ 6-12 months
- ₄ Over a year

3. Do the difficulties upset or distress you?

- ₀ Not at all
- ₁ Only a little
- ₂ A medium amount
- ₃ A great deal

4. Do the difficulties interfere with your everyday life in the following areas?

	Not at all	Only a little	A medium	A great deal
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			amount	
Home Life	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃
Friendships	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃
Classroom learning	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃
Leisure activities	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃

5. Do the difficulties make it harder for those around you (family, friends, teachers, etc.)?

- ₀ Not at all
- ₁ Only a little
- ₂ A medium amount
- ₃ A great deal

PART D: Cognitive development: *Dimensional Change Card Sort Border Version*

Score: ____ / 12

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