Grandparental help in Indonesia is directed preferentially towards needier descendants: A potential confounder when exploring grandparental influences on child health

Kristin Snopkowski [a, *], Rebecca Sear [b]

[a] *Department of Anthropology, Boise State University, 1910 University Drive, Boise, ID 83725, USA*
[b] *Department of Population Health, London School of Hygiene and Tropical Medicine, Keppel Street, London WC1E 7HT, UK*

A B S T R A C T

A considerable body of evidence has now demonstrated positive correlations between grandparental presence and child health outcomes. It is typically assumed that such correlations exist because grandparental investment in their grandchildren improves child health and wellbeing. However, less is known about how grandparents allocate help to adult children and grandchildren, particularly in lower income contexts. Here we use detailed quantitative data from the longitudinal Indonesia Family Life Survey (data collected in 1993, 1997, 2000, 2007; n = 16,250) to examine grandparental help in a society transitioning both demographically and economically. We test the hypothesis that grandparents direct help preferentially towards those adult children and grandchildren most in need of help. This hypothesis was supported for help provided by married grandparents and single grandmothers, who tended to: provide more help to their adult children when this generation had young children themselves, provide financial help if their adult children were poorer, and provide more household help if their adult daughters worked outside the home. One unexpected result was that help from maternal and paternal grandparents is positively correlated; if one set of grandparents is helping the other set is more likely to help, counter to our predictions. These results provide support for the hypothesis that grandparents preferentially invest in some descendants over others, where married grandparents and single grandmothers tend to invest in those adult children and grandchildren with the most need. Investigating the effect of grandparents on child health outcomes may therefore be confounded by grandparent's preferential investment in needier descendants.

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1. Introduction

The importance of intergenerational transfers is now recognized by a number of disciplines. It is increasingly acknowledged that grandparents can have significant impacts on child wellbeing, and that grandparental help may even be the difference between life and death for some children (Sear and Mace, 2008). In this paper, we take an evolutionary perspective to focus on transfers down generations: specifically, from the grandparental generation down to their adult children and grandchildren. Evolutionary social scientists have recently produced a considerable body of work on grandparents, much of it stemming from their interest in the cooperative breeding hypothesis, which proposes that human mothers *need* help to raise children, since the costs of raising multiple dependent children in our species are too high for mothers to manage alone (Hrdy, 2005, 2009; Mace and Sear, 2005). Evolutionary theory predicts that grandmothers may be an important source of help for their children and grandchildren since post-reproductive women may increase their inclusive fitness by helping adult children produce fit offspring (Hamilton, 1964). Grandfathers may similarly provide help, even though men can continue reproduction until later in life, because in stable, monogamous relationships, a man's reproductive career likely ends with his wife's.

Evolutionary anthropologists have now produced a number of studies which show that the presence of grandparents is positively correlated with the health and wellbeing of their grandchildren (Mace and Sear, 2005; Meehan et al., 2014). The assumption is

typically made in these studies that grandparental investment is driving these correlations, often backed up by qualitative observations that grandparents are providing help in these societies (it is possible that alternative explanations may drive some of these correlations, such as intergenerational transmission of genetic or environmental factors, but are unlikely to fully explain such consistent correlations: see Coall and Hertwig, 2010; Sear and Coall, 2011; Snopkowski and Sear, 2013). Only rarely in such studies is quantitative data collected on the actual helping behavior of grandparents (e.g. Meehan et al., 2013). Further, less is known about which conditions lead grandparents to help. Do grandparents preferentially provide help to some descendants over others and how might this affect the relationship between grandparental presence and grandchild health outcomes? Here we use detailed quantitative data from Indonesia on help provided from the grandparental generation to descendant generations to test the assumption that grandparents provide such downward transfers, and to examine in detail the predictors of such investment. Specifically, we test the hypothesis that grandparents preferentially direct investment towards those descendants most in need of help.

From evolutionary theory, we expect individuals to optimally allocate resources to maximize fitness (Smith and Fretwell, 1974). Just as parental investment may be allocated unequally to offspring, in order to maximize returns on investment (Clutton-Brock, 1991), so might grandparents invest unequally in descendants, if the returns to investment in each descendant are not equal. For grandparents, they can invest in (a) their own somatic effort; (b) children, grandchildren, and other kin; or (c) mating effort. Hamilton's rule provides predictions on how to allocate resources to different kin. It states that we expect help to be provided if the reproductive benefit (b) to the recipient multiplied by their level of relatedness (r) is greater than the reproductive cost to the donor (c): $rb > c$ (Hamilton, 1964). The components of Hamilton's rule have been studied in the grandparent literature, largely in high-income contexts (as this is where most quantitative data on grandparental helping behavior can be found). Evolutionary researchers, for example, have focused on the level of relatedness, r, and shown that with reduced relatedness, we see reduced investments (Chrastil et al., 2006; Coall et al., 2014; Euler and Weitzel, 1996; Pollet et al., 2006; Smith, 1991). Other researchers have been interested in the costs of helping, c, and have looked at the characteristics of the helper (Albertini et al., 2007; Cao, 2006; Euler and Weitzel, 1996; Gray, 2005; Hank and Buber, 2009; Leek and Smith, 1991; McGarry and Schoeni, 1997; Pashos, 2000). Such research does not typically investigate the direct fitness costs of helping, but instead investigates characteristics of the grandparent, which may be linked to fitness costs. For example, grandparents are more likely to help when they are in good health (Albertini et al., 2007; Cao, 2006; Leek and Smith, 1991), suggesting that in times of bad health, grandparents may invest resources in their own somatic effort to avert the risk of death. The benefits of helping, b, have so far received the least attention, but are also an important part of the equation. Here we examine whether Indonesian grandparents are sensitive to the benefits of helping, by determining whether grandparental help is directed preferentially towards those who are most in "need". Again, we are not directly measuring the fitness benefits of helping; instead we assume that providing investments towards these adult children and grandchildren will result in larger returns on investment (in fitness terms: such as improved survival rates for grandchildren and quicker reproductive rates for adult children) than investing in adult children and grandoffspring with less need. If grandparents provide help to adult children and grandchildren with the most 'need', it implies that need may confound the relationship between grandparental help and child/grandchild outcomes. Simply looking at child outcomes may not provide the full picture of the impact of grandparental help.

1.1. The importance of context

Before describing our analysis, we first consider the role of context in grandparenting behavior. From the existing grandparenting literature, it is clear that context matters for grandparental investment. Grandparents are not always associated with beneficial outcomes for children in all populations, and there is also some variation in which grandparents are most important in which contexts. Broadly speaking, maternal grandmothers appear to invest most in grandchildren and to be most beneficial for grandchildren, but there is some variation around this trend (Euler and Michalski, 2007; Sear and Coall, 2011; Sear and Mace, 2008). A potential problem with comparing across contexts is that the grandparent literature tends to differ across these contexts due to differences in data availability, which are the result of demographic differences. Broadly, we refer in this paper to low-income (high mortality, high fertility, largely pre-demographic transition societies), high-income (low mortality, low fertility, post-transitional societies), and middle-income (those in the process of transitioning both economically from low to high income, and demographically from high to low fertility) contexts. We recognize that there is considerable variation within contexts, and that these are somewhat arbitrary categories, but we do think they are heuristically useful, as there are significant differences between these three contexts in demographic and economic variables of relevance to grandparenting.

High-income contexts are typified by low child mortality rates, long lifespans, low fertility rates, high levels of investment in children, but also pension systems to support elderly individuals, which may free up the older population financially so that they can invest substantially in grandparenting. Research in these contexts, which principally comes from the United States and Europe, has predominantly focused on the helping behavior of grandparents, particularly the characteristics of helpful grandparents, with less emphasis on the impact of grandparents on child outcomes. The impact of grandparents on grandchildren (in terms of health, at least) may be less obvious in wealthy societies, where children are largely in good health. In such environments, grandparental characteristics found to be of importance in predicting help are: relationship to grandchild (Euler and Weitzel, 1996; Pollet et al., 2006; Smith, 1991; Kaptijn et al., 2013; King et al., 2003; Pashos, 2000); ability of grandparent to help (Albertini et al., 2007; Cao, 2006; Coall et al., 2009; Hank and Buber, 2009; Ho, 2013; Hogan et al., 1993; King et al., 2003; Leek and Smith, 1991; McGarry and Schoeni, 1997; Pollet et al., 2006; but see Pashos, 2000); and the need of descendants (McGarry and Schoeni, 1997; Vandell et al., 2003; but see Hogan et al., 1993). For full reviews of the grandparental help literature see Coall and Hertwig (2010) and Euler and Michalski (2007).

A growing body of research conducted by evolutionary anthropologists in low-income, often subsistence societies, has shown that grandparental (particularly grandmaternal) presence is correlated with better health and higher survivorship of grandchildren (Meehan et al., 2014; Sear and Mace, 2008). Much less research has directly examined the characteristics that influence the likelihood of providing grandparental help in low-income contexts. Instead, there has been more research on what grandparents (in general) do for adult children and grandchildren; this research has shown that in rural Ethiopia grandmothers help with domestic chores and agricultural tasks (Gibson and Mace, 2005), in northeast India they help with childcare (Leonetti et al., 2005); among the Aka foragers of central Africa grandmothers reduce work energy expenditure of the mother (Meehan et al., 2013); and

among the Hadza, hunter–gatherers in Tanzania, older women likely move based on the needs of their adult daughters (Blurton Jones et al., 2005).

In middle-income populations, which typically are experiencing demographic and economic transition, such as the one we study, there has been substantial research on intergenerational transfers including research on transfers made from adult children to their parents and from grandparents down generations to adult children and grandchildren (e.g. Beard and Kunharibowo, 2001; Knodel et al., 2000; Lee, 2000; Ofstedal et al., 1999; Settles et al., 2009). We expect that grandparents are still an important source of help in these contexts, since the improved health of such populations may allow grandparents to live longer and have healthier post-reproductive periods than in low-income contexts. However, there may also be some differences between grandparental help in transitioning and high-income contexts; for example, the large amount of grandparental help received in post-transitional societies may be partially explained as the result of social welfare programs, as older individuals have more time and money than they would in contexts without pensions (Kohli, 1999). Investigating how grandparents allocate investments to descendants in transitioning societies without social welfare programs may be particularly useful because we can explore the role of grandparents in a labor market context without the increased wealth available to elderly individuals due to pensions.

2. Methods

2.1. Sample and context

We use data from four waves of the Indonesia Family Life Survey (IFLS), which were collected in 1993, 1997, 2000, and 2007 (Frankenberg and Thomas, 2000; Strauss et al., 2009, 2004). This survey provides information at the individual and family level on fertility, education, and employment (http://www.rand.org/labor/FLS/IFLS). The survey represents an area that includes 83% of Indonesia (for further details on sampling method, see Supplementary material). There were 7644 mothers who were eligible to receive help in at least one wave and over the four waves of data collection many women were interviewed multiple times, providing a total sample size of 16,250 interviews. Ethical approval for the Indonesia Family Life Survey was obtained through RAND, the University of Gadjah Mada (IFLS 3 & 4), and the University of Indonesia (IFLS 1 & 2).

Indonesia has a population of approximately 239 million people (United Nations, 2011) and more than 300 ethnic groups with a wide range of marriage norms (Jensen and Suryani, 1992; Rammohan and Johar, 2009). Over the 20th century, there has been considerable demographic and economic change, including a dramatic drop in the fertility rate (United Nations, 2011), rapid improvements in child survivorship and overall life expectancy (Molyneaux and Gertler, 2000) and increases in educational levels (Elias and Noone, 2011). At the same time, Indonesia has nearly universal marriage (97% in the IFLS are married by age 30) and essentially no non-marital fertility (BPS Statistics Indonesia and Macro International, 2008). There are still few social welfare programs in Indonesia, and the most extensive programs have been implemented relatively recently, after most waves of IFLS data were collected (for more details on Indonesia's economy and social welfare policies, see Supplementary material). Indonesia, therefore, is a country in transition, which has seen significant changes in demography and economic development in recent decades, but has few of the extensive social welfare programs which characterize high-income countries and which may have implications for grandparental help.

2.2. Measurement of grandparental help

Since we have three generations of individuals, we will refer to the oldest generation as *grandparents*, the middle (or linking) generation as *parents* or *adult children*, and the youngest generation as *children or grandchildren*.

We use data collected from the parent generation, and analyze help received by the parent from the grandparent. Women who had not reproduced were not included (since there is no grandchild to help) and those with children who were all over the age of 18 were also excluded (since any help is unlikely to benefit grandchildren). Women reported help received by their parents (the maternal grandparents), and their husbands reported help received by their parents (the paternal grandparents). This means that women who are divorced, separated or widowed have no reported information on help received from their previous in-laws. To deal with this bias, analyses *only include married women* so that help from maternal and paternal grandparents can be compared, *except* for the analysis of whether help from maternal grandparents is predicted by a mother's marital status, where separated, divorced and widowed women are included (details below).

Help was only recorded if it occurred within 12 months of the interview and was provided by a non-resident, surviving grandparent. We do not have helping behavior of grandparents living in the same household, which likely reduces our estimates of helping behavior. However, only a minority of women live with their parents (16%) or parents-in-law (9%), so our examination of grandparental help applies to the majority of women in our sample. Indonesia is somewhat unusual compared to many other Asian contexts in that the preferred living arrangement of most older Indonesians is not to co-reside with children (Kreager and Schröder-Butterfill, 2008). Further, a control for co-residence with grandparents is included in all models since co-residence with grandparents may impact helping behavior from the other set of grandparents (we have also run models excluding individuals who co-reside with grandparents, and our substantive conclusions remain unchanged: details available on request from authors). Information on grandparental help was collected for grandparents together if they were both living and still married (hereafter referred to as: married grandparents) and individually if one grandparent had died or grandparents had divorced (referred to as: single grandparents). Respondents were asked, "What type of help did you receive from your mother [your father or both] in the past 12 months?" Interview questions categorized help as financial help or household help. *Household help* includes household chores, providing childcare, or assisting during physical recovery. *Financial help* includes money or loans, tuition, healthcare costs, but also non-monetary material transfers, such as food or other goods, whose approximate monetary value was reported.

2.3. Analysis

We explore the predictors of grandparental help in Indonesia by running random effects logistic regression models in STATA v.13. These models predict whether an individual received help from grandparents; separate models are run to predict help from different types of grandparents and for different types of help. Given that previous empirical work has found differences in patterns of grandparental help between maternal and paternal kin and grandmothers and grandfathers (e.g. Euler and Weitzel, 1996; Pashos, 2000; Smith, 1991), we analyze both paternal/maternal kin and single grandmothers/grandfathers separately. We therefore present separate models which predict help from a) married maternal grandparents, b) single maternal grandmother, c) single maternal grandfather, d) married paternal grandparents, e) single

paternal grandmother, and f) single paternal grandfather. We also analyze our two different types of help, household and financial, separately. This allows us to determine whether the predictors of helping behavior are similar or different across types of grandparent and across types of help. We ran random effects models to account for repeated interviews from some individuals in the sample (as there were multiple waves). Even though only a small proportion of data was missing (less than 3%), we use multiple imputation to impute missing data and present those models below (Royston, 2005) (more details on the missing data and the multiple imputation process are available in Supplementary material). We also ran models without multiple imputation, but this did not change our substantive conclusions (results available on request from authors).

We include as predictors in our random effects models: age of the grandparent, age of the mother, age of the youngest grandchild (categorized as <5 years, 5—9, 10+), the mother's number of living children (categorized as 1, 2, 3—4, 5+), the number of siblings (of the mother for maternal grandparents and of the father for paternal grandparents), the mother's and grandparent's level of education (none, primary, junior secondary, senior secondary, tertiary), mother's and grandparent's work status (currently working or not), and a wealth indicator. The wealth indicator is a factor score of number of rooms in the household, type of floor and outer wall of the house, and whether the house has electricity or a television (in 1993 respondents were asked about a telephone instead of a television). The variable is standardized with a mean of approximately zero and standard deviation of one. Finally, we included information on grandparental health (reported by the adult child), measured on a scale from very unhealthy (1) to very healthy (4); as these data were only collected in the final two waves (2000 and 2007), we present these results in Supplementary material rather than in the main text. For all models, we include controls for whether parents are co-residing with other grandparent(s), and for urban or rural location. Since Indonesia is a heterogeneous country, we control for region and religion throughout.

2.4. Testing predictions

We test our hypothesis that grandparental help will be preferentially directed towards those descendants most in need by testing five specific predictions. Predictions 1, 2, and 5 relate to the *whether* help is received, while predictions 3 and 4 relate to specific *types* of grandparental help:

1) Age of the grandchild is likely a predictor of need. At young ages, investment in grandchildren will likely have larger fitness returns, in terms of grandchild health and survivorship, than a similar investment in an older grandchild. We expect maternal and paternal grandparents to provide more help to parents with young children. Alternatively, if grandparents are more sensitive to reproductive value, we may expect investment in older grandchildren at the expense of younger grandchildren.

To test this hypothesis, we examined the effect of age of youngest grandchild in the random effects logistic regression models described above.

2) If several individuals provide care for an offspring, the behavior of one caregiver can influence the optimal investment from others (Chase, 1980). If maternal grandparents are dead or not providing help, then parents likely need more help from the paternal grandparents, and vice versa. Here, we need to control for the age of grandparents, since the age of grandparents may well be correlated (so that if one set of grandparents has died, the other set might be quite old). We predict an inverse relationship between help from maternal and paternal grandparents.

To test this hypothesis, we include a variable in the above model

to indicate the status of the other grandparents (i.e. the status of maternal grandparents in the paternal grandparent models and vice versa). This was categorized as follows: (1) the other grandparents help (either grandparent provided either type of help), (2) the other grandparents do not provide help (but at least one of them is alive), (3) the other grandparents are co-resident (and therefore we have no information on helping behavior), and (4) both the other grandparents are dead (and therefore cannot provide help).

3) Poorer parents will likely need more financial assistance. It is likely that poorer grandparents are associated with poorer parents, so these grandparents may be less able to provide financial resources, but controlling for socio-economic status of the grandparent, we expect parents with less wealth to receive more financial help from grandparents.

To test this hypothesis, we examined the effect of parental wealth using the above models, but on the receipt of *financial* help only. Since lower income parents may be associated with lower income grandparents, we include two proxies of grandparental wealth as controls: level of education and work status.

4) Mothers with young children who engage in the labor market are more likely to receive childcare help from grandparents. In a transitioning society, where there are few other childcare options, we expect maternal or paternal grandparents to provide childcare for grandchildren when mothers work.

To test this hypothesis, we examine whether women's work status in the above models is associated with receiving *household* help from grandparents. We do not have a measure of childcare help specifically, so we use household help as a proxy for childcare help, as it is subsumed in the measure.

5) Mothers who are divorced, separated, or widowed likely need additional support since they do not have support from a partner (and possibly less help from his kin as well). We expect maternal grandparents to provide more help to mothers who are divorced, separated, or widowed as compared to married mothers.

To test this hypothesis, we ran separate analyses, which included all ever-married women with children under 18 (recall that previous models only examined married women so the effects of paternal and maternal kin could be compared). We conducted a random effects logistic regression model to determine if marital status of the mother predicts whether she receives help of any kind from her parents (note that we could not include help from paternal grandparents here as we have no information on husband's parents from divorced or widowed women). Mothers' marital statuses include: married, divorced, separated, or widowed. We combined separated women with divorced women because the sample size of separated women is small (0.5% of the sample).

3. Results

3.1. Descriptive statistics

In 52% of interviews adult children report receiving help from at least one non-resident grandparent (when one exists). Descriptive statistics showing the distribution of variables and correlation matrices are shown in Supplementary material Table S1 and S2 respectively. Table 1 presents the percentage of parents who report receiving help from maternal and paternal grandparents by type of help. The percentages are only calculated for parents for whom each kind of grandparental help is potentially available, i.e. when each kind of grandparent is still alive and not co-resident. This allows for comparison of percentages across grandparent type, as no group is dependent on the number of surviving grandparents. These percentages show that parents in Indonesia report receiving much more financial help than household help

from non-resident grandparents. Parents report that maternal grandparents provide more help (in each category) than paternal grandparents, single grandmothers provide more help than single grandfathers (of the same lineage) and single maternal grandfathers are quite similar in their helping rates to single paternal grandmothers. An analysis testing whether there are significant differences in helping behavior between lineage (maternal or paternal kin) and type of grandparent (married or single, grandmother or grandfather) after controlling for potentially confounding factors confirms these results (see Supplementary material Table S3).

3.2. Predictors of grandparental help in Indonesia

Tables 2a and b present the results of our logistic regression analyses investigating the predictors of grandparental financial and household help respectively, where separate models are run for each type of grandparent. We have only presented the results of household help from married grandparents and single grandmothers because the number of helping events by single grandfathers was too small for the model to converge controlling for necessary covariates. Using a simplified model for single grandfathers (removing covariates until the model would converge), we found no significant predictors of household help by single grandfathers (results not shown). Analyses for each wave separately can be found in Supplementary material Table S4.

3.2.1. Financial help

Results show that the provision of financial help is associated with greater ability of grandparents to provide that help. For married grandparents (both maternal and paternal), having higher levels of completed education is correlated with an increased likelihood of providing financial help. The education level of single grandfathers and single grandmothers is less predictive of providing financial help. The working status of grandparents is significantly associated with financial help across all grandparental types, with working grandparents being more likely to provide such help than those who do not work. The number of grandparent's adult children (referred to as number of parent's siblings in the table) also affects the helping behavior of married grandparents, as they are less likely to provide help if they have more adult children, but the effect is not significant for single grandparents. We controlled for whether parents lived with the other set of grandparents, but this variable is not significant for any grandparent type. In urban areas, less help is received from married grandparents, but urban residence does not significantly predict help received from single grandparents. Grandparental health tends to be associated with more help (see Supplementary material Table S5a since grandparental health was only reported in two waves).

3.2.2. Household help

While fewer variables significantly predict household help than financial help, many predictors are similar. Again, there is some evidence that the ability of grandparents to provide help is correlated with their provision of help; grandparental work status is positively associated with grandparents providing household help, and a greater number of parent's siblings reduces the likelihood of receiving household help from married maternal grandparents. In contrast to financial help, however, grandparental education is not predictive for receiving household help from maternal grandparents, and grandparental health loses its significant association with the provision of help (See Supplementary material Table s5b).

3.2.3. Hypothesis 1: Maternal and paternal grandparents will provide more help to parents with young children

The results presented in Tables 2a and 2b, which include information on age of the youngest child, show support for this hypothesis. The age of the youngest child is a significant predictor of household help received by grandparents, where parents with young children (under age 5) receive more household help than parents with older children across all grandparental categories (see Fig. 1b). In contrast to household help, age of the youngest child is not consistently a significant predictor of financial help from grandparents, though broadly all grandparent categories do provide more financial help to adult children when grandchildren are younger (Fig. 1a); this relationship is significant for single maternal grandfathers and single paternal grandmothers (and marginally significant for married paternal grandparents).

3.2.4. Hypothesis 2: There is an inverse relationship between help from maternal and paternal grandparents

Fig. 2 and Table 2 show the results of our test that helping behavior from one set of grandparents is dependent on helping behavior from the other set. We find no evidence of an inverse relationship between help from maternal and paternal grandparents; instead help from maternal and paternal grandparents is positively correlated. Fig. 2 shows that help is *most* likely from one set of grandparents when the other set helps: this is significant across all grandparent types and across financial and household help. Help is *least* likely from one set of grandparents, when the other set of grandparents are alive, but provide no help.

3.2.5. Hypothesis 3: Poorer parents will receive more financial help after controlling for grandparental wealth

Table 2a shows support for the hypothesis that parental wealth is negatively associated with receiving financial help from grandparents, although this effect is significant only for married grandparents. Comparing this with the grandparental household help analysis (see Table 2b), we see that parental wealth is not predictive of household help (except for single paternal grandmothers).

3.2.6. Hypothesis 4: Women who work in the labor market will receive more household help

Table 2b shows support for the hypothesis in that mother's working status has a significant positive effect on household help received from married grandparents and single paternal

Table 1
Percent (and number) of parents who report receiving help from non-resident maternal and paternal grandparents.

	Maternal			Paternal		
	Married grandparents	Single grandmother	Single grandfather	Married grandparents	Single grandmother	Single grandfather
Household help	9.6%(645)	6.8%(350)	2.7%(66)	7.0%(324)	4.3%(201)	2.1%(41)
Financial help	52.3%(3508)	38.0%(1947)	29.5%(725)	42.4%(1960)	27.1%(1254)	23.0%(451)

Note: The percentages are calculated for parents for whom each kind of grandparental help is potentially available (from surviving and not co-residing grandparents). For example, there are 6708 responses to whether married maternal grandparents provided financial help. In 3508 (or 52.3%) of those cases, the maternal grandparents provided financial help and 47.7% did not.

Table 2a
Random effects logistic regression analyses predicting grandparental financial help, grouped by mother to account for repeated measures.

	Maternal			Paternal		
	Married	Single grandmother	Single grandfather	Married	Single grandmother	Single grandfather
	OR (SE)	OR (SE)	OR (SE)	OR (SE)	OR (SE)	OR (SE)
Help from other GP (ref = No help from other GP)						
Other GP dead	1.141(0.114)	1.318(0.133)**	1.232(0.206)	1.42(0.259)ˆ	1.265(0.174)ˆ	1.202(0.352)
Other GP help	2.182(0.176)***	2.437(0.244)***	2.344(0.392)***	2.712(0.263)***	2.024(0.192)***	1.844(0.331)***
Live with other GP	1.531(0.287)*	0.971(0.207)	1.221(0.349)	1.233(0.27)	1.077(0.223)	1.852(0.641)ˆ
GP Education (ref = none)						
Elementary	1.405(0.121)***	1.055(0.093)	1.346(0.22)ˆ	1.605(0.177)***	1.241(0.113)*	1.422(0.285)ˆ
Jr. High	1.351(0.192)*	0.913(0.167)	0.986(0.265)	2.325(0.44)***	1.447(0.302)ˆ	1.435(0.503)
Sr. High	1.599(0.242)**	1.519(0.349)ˆ	0.867(0.256)	2.05(0.438)***	1.383(0.35)	2.273(0.855)*
University	2.124(0.573)**	2.486(1.844)	0.643(0.373)	4.337(1.536)***	2.828(1.959)	3.732(3.095)
GP Age	0.996(0.004)	0.992(0.004)ˆ	0.99(0.007)	1.003(0.005)	0.992(0.004)ˆ	0.994(0.009)
GP work − married (ref = neither work)						
One works	1.753(0.155)***			1.429(0.161)***		
Both work	2.267(0.207)***			2.107(0.247)***		
GP works − not married		2.239(0.185)***	1.638(0.228)***		1.879(0.166)***	2.054(0.362)***
Mother's education (ref = none)						
Elementary	1.511(0.24)**	1.876(0.295)***	1.394(0.347)	1.749(0.395)*	1.364(0.244)ˆ	1.507(0.553)
Jr. High	2.045(0.365)***	2.215(0.406)***	1.682(0.491)ˆ	2.074(0.51)**	1.245(0.251)	1.723(0.719)
Sr. High	2.132(0.392)***	2.088(0.405)***	2.404(0.73)**	1.824(0.461)*	1.21(0.255)	1.667(0.72)
University	2.619(0.581)***	2.201(0.538)***	1.884(0.778)	1.802(0.532)*	1.233(0.313)	1.277(0.702)
Mother's age	0.998(0.009)	1.006(0.009)	1.015(0.015)	0.989(0.011)	1.003(0.01)	0.953(0.019)*
Mother works	1.14(0.076)*	1.075(0.083)	0.91(0.112)	0.954(0.083)	0.889(0.074)	1.134(0.18)
P's wealth	0.878(0.037)**	0.961(0.046)	0.909(0.069)	0.856(0.048)**	0.95(0.049)	0.846(0.085)ˆ
Urban	0.856(0.064)*	0.99(0.085)	0.812(0.112)	0.708(0.069)***	1.084(0.098)	1.095(0.2)
Number of P's siblings	0.964(0.015)*	1.019(0.017)	1.01(0.024)	0.954(0.02)*	0.999(0.017)	0.979(0.031)
Number of living children (ref = 1)						
2	0.908(0.078)	0.915(0.105)	1.166(0.192)	1.009(0.109)	0.931(0.107)	0.719(0.153)
3−4	0.927(0.099)	0.816(0.101)ˆ	0.927(0.179)	0.567(0.08)***	0.677(0.09)**	0.882(0.226)
5+	0.826(0.138)	0.679(0.112)*	1.197(0.326)	0.738(0.172)	0.759(0.139)	1.508(0.561)
Age of youngest child (ref = under 5)						
5−10	0.958(0.075)	0.89(0.082)	0.866(0.126)	0.833(0.085)ˆ	0.915(0.091)	0.774(0.152)
Over 10	0.87(0.102)	0.862(0.101)	0.514(0.105)***	0.822(0.134)	0.65(0.087)***	1.198(0.326)
Co-resides with other GP(s)	0.86(0.137)	1.296(0.228)	0.962(0.174)	1.291(0.248)	1.324(0.234)	0.938(0.26)
Constant	0.269(0.092)***	0.161(0.057)***	0.089(0.053)***	0.128(0.061)***	0.168(0.067)***	0.148(0.126)*
n	6673(3771)	4982 (2864)	2352 (1528)	4686 (2901)	4686 (2761)	1972 (1309)
ICC	0.229(0.026)	0.214(0.032)	0.276(0.056)	0.328(0.035)	0.199(0.037)	0.43(0.064)
σ	0.988(0.072)	0.947(0.089)	1.12(0.157)	1.27(0.100)	0.903(0.104)	1.57(0.206)

Note: Model controls for region and religion (omitted from the table). GP = grandparent, P = parent, OR = odds ratio SE = standard error. For married grandparents, the grandfather's education is used for GP Education. GP Age refers to grandparent's age, defined as the average of the grandmother's and grandfather's age for married grandparents. GP work (married) variable refers to grandparental work for married grandparents and the GP work (single) variable refers to whether the grandparent worked for models of individual grandparents. n reports sample size with number of unique individuals in parentheses. σ represents the random effect and ICC represents the intra-class correlation. ˆ$p < .10$, *$p < .05$, **$p < .01$, ***$p < .001$.

grandmothers. The effect is not significant for single maternal grandmothers, but is still positively correlated. This provides evidence that kin provide more household help when the mother works. In contrast, referring to Table 2a, we find that only married maternal grandparents provide significantly more financial help when the mother works. Additionally, the direction of the effect varies across the other grandparent categories, suggesting that mother's work status is not a strong predictor of financial help.

3.2.7. Hypothesis 5: Mothers who are divorced, separated, or widowed will likely need additional support and we expect maternal grandparents to provide it

The results of the random effects logistic regression analyses predicting whether a mother's marital status is correlated with receiving financial or household help from her parents are shown in Fig. 3 and Supplementary material Table S6. We find only limited support for this hypothesis. While women who are divorced/separated or widowed have a higher likelihood of receiving both financial and household help from maternal grandparents (both married and single), the effects are only significant for single maternal grandmothers who provide more household help to divorced daughters compared to married ones. Fig. 3 shows the

predicted probability of receiving financial and household help from maternal grandparents based on marital status.

4. Discussion

Overall, we find evidence that grandparents provide a considerable amount of direct help to their adult children and grandchildren in Indonesia, though this help is more likely to be material help than household help. We also confirm previous studies which have shown that maternal grandparents provide more help than paternal grandparents (Chrastil et al., 2006; Euler and Weitzel, 1996; Pollet et al., 2006; Smith, 1991). Though the amount of help may vary from maternal and paternal grandparents, we find relatively few differences between maternal and paternal grandparents when comparing the *predictors* of grandparental help. Comparing the effects of married grandparents with single grandmothers and grandfathers, we typically find non-significant results for single grandfathers. This is likely due to smaller sample sizes of single grandfathers (grandfathers are likely to die before grandmothers), but grandfathers also appear to have lower probabilities of providing help when they are the lone surviving grandparent (see Table 1). Grandmothers, in contrast, provide slightly lower rates of

Table 2b
Random effects logistic regression analyses predicting grandparental household help, grouped by mother to account for repeated measures.

|	Maternal		Paternal	
	Married	Single grandmother	Married	Single grandmother
	OR (SE)	OR (SE)	OR (SE)	OR (SE)
Help from other GP (ref = No help from other GP)				
Other GP dead	1.129(0.179)	1.444(0.268)^	1.464(0.445)	1.674(0.498)^
Other GP help	1.67(0.178)***	1.609(0.263)**	2.104(0.313)***	1.697(0.335)**
Live with other GP	1.341(0.362)	1.394(0.506)	1.788(0.635)	1.094(0.546)
GP education (ref = none)				
Elementary	1.082(0.139)	0.928(0.129)	1.343(0.207)^	1.014(0.198)
Jr. High	1.012(0.211)	0.747(0.22)	1.502(0.405)	1.62(0.631)
Sr. High	1.071(0.224)	0.923(0.32)	1.793(0.507)*	1.125(0.583)
University	1.217(0.401)	0.533(0.586)	2.696(1.135)*	5.799(5.381)^
GP Age	1.003(0.007)	0.992(0.007)	1.013(0.008)^	1.001(0.009)
GP work − married (ref = neither work)				
One works	1.832(0.267)***		1.21(0.225)	
Both work	1.919(0.284)***		1.854(0.333)***	
GP works − not married		1.324(0.17)*		1.187(0.216)
Mother's education (ref = none)				
Elementary	1.197(0.31)	3.805(1.535)***	1.312(0.465)	1.800(0.718)
Jr. High	1.62(0.449)^	4.454(1.908)***	1.393(0.523)	1.456(0.661)
Sr. High	1.854(0.53)*	4.766(2.088)***	1.553(0.596)	1.827(0.83)
University	1.906(0.63)^	5.129(2.542)***	1.11(0.492)	2.666(1.385)^
Mother's age	0.974(0.013)*	0.99(0.015)	0.959(0.016)*	1.000(0.021)
Mother works	1.422(0.135)***	1.205(0.151)	1.383(0.171)**	1.446(0.262)*
P's wealth	0.961(0.055)	0.989(0.075)	1.003(0.077)	0.813(0.084)*
Urban	0.89(0.091)	0.897(0.121)	0.722(0.097)*	0.975(0.185)
Number of P's siblings	0.931(0.021)**	1.000(0.026)	0.958(0.027)	0.987(0.037)
Number of living children (ref = 1)				
2	0.897(0.107)	1.071(0.187)	1.069(0.167)	0.724(0.173)
3−4	0.96(0.148)	0.999(0.196)	0.931(0.187)	0.921(0.251)
5+	0.81(0.212)	0.706(0.202)	1.547(0.516)	0.394(0.169)*
Age of youngest child (ref = under 5)				
5−10	0.675(0.083)***	0.643(0.100)**	0.958(0.146)	0.658(0.141)*
Over 10	0.417(0.094)***	0.348(0.080)***	0.402(0.133)**	0.191(0.07)***
Co-resides with other GP(s)	0.839(0.19)	0.961(0.285)	0.752(0.233)	0.685(0.29)
Constant	0.073(0.038)***	0.032(0.021)***	0.025(0.018)***	0.01(0.009)***
n	6635 (3750)	4957 (2850)	4686 (2901)	4664 (2747)
ICC	0.107(0.056)	0.072(0.077)	0.001(0.04)	0.339(0.089)
σ	0.627(0.186)	0.505(0.292)	0.050(1.317)	1.299(0.257)

Note: See note from Table 2a.

help compared to married grandparents, but the results of our regression models suggest that when they do help, their helping behavior has a similar pattern to that of married grandparents.

Table 3 provides a summary of the results found for the five hypotheses, broadly demonstrating that grandparents are likely to adjust the help they provide based on the need of parents and grandchildren. Grandparents provide more help, particularly household help, when grandchildren are younger and when mothers are engaged in the labor force, and they provide more financial help when parents are less well-off economically. We do not consistently find that maternal grandparents significantly increase rates of help to divorced, separated and widowed mothers,
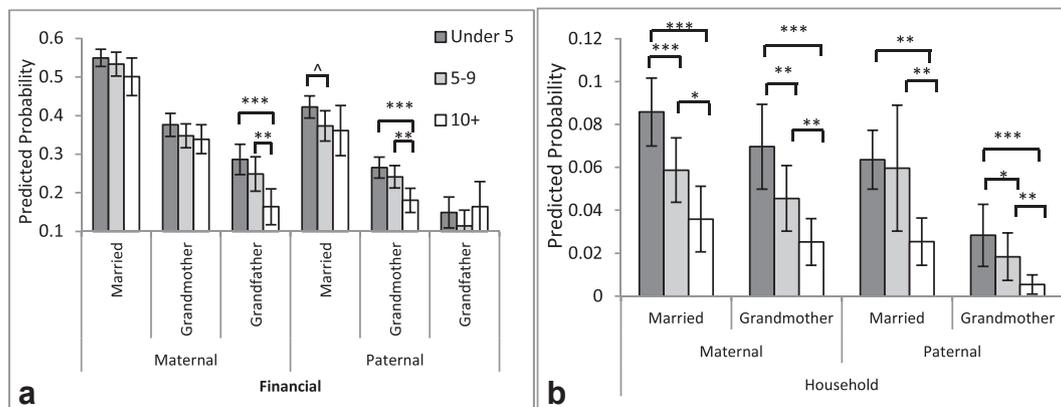
Fig. 1. Predicted probability of grandparental (a) financial help and (b) household help by age of youngest grandchild. Error bars represent 95% confidence intervals. ^p < .10, *p < 0.05, **p < 0.01, ***p < 0.001.
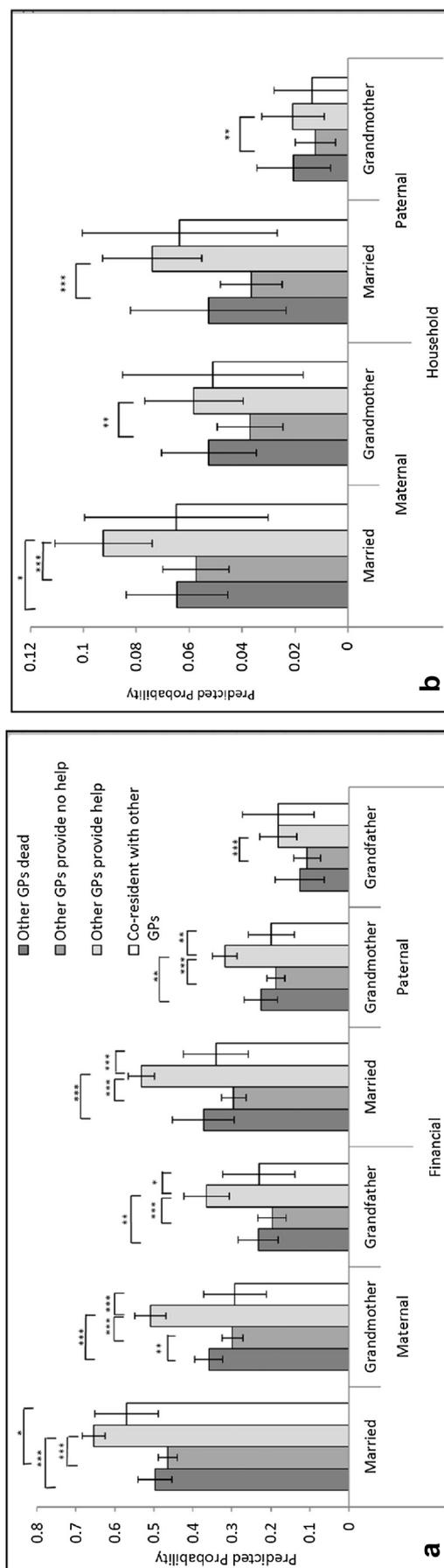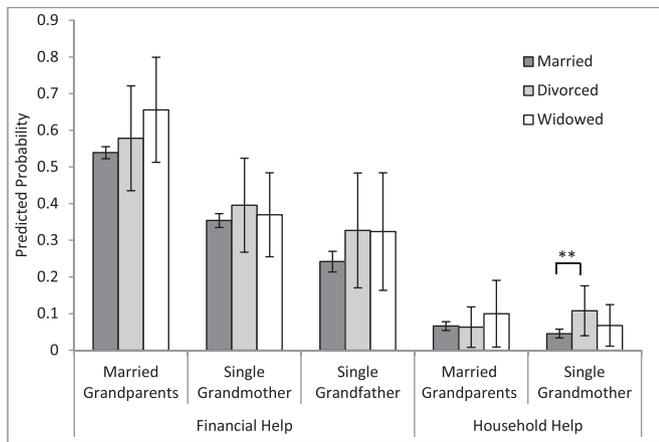
Fig. 2. Predicted probability of receiving (a) financial and (b) household help from grandparents based on the helping status of the other grandparents. GP = grandparent. Error bars represent 95% confidence intervals. *p < 0.05, **p < 0.01, ***p < 0.001.

although there is weak evidence to support this hypothesis. Single women tend to receive more financial and household help from all categories of maternal grandparent(s), but this effect is only significant for divorced/separated women receiving household help from single maternal grandmothers.

While we hypothesized that grandparents invest in descendants with the greatest need to maximize their descendants' marginal benefits, it is also possible that grandparents favor descendants with greater reproductive value as they are more likely to survive to reproductive age (Jeon, 2007). If this were the case, we would expect grandparents to invest in older grandchildren over younger ones (controlling for other characteristics of descendants that may make them more competitive on the mating market). Evidence from hypothesis one does not bear this out, as families with younger grandchildren tend to receive greater investments than families with older grandchildren, suggesting that grandparents may not be particularly sensitive to changes in reproductive value in this context – possibly because low rates of child mortality result in small changes in reproductive value through childhood.

One surprising result is that grandparents fail to provide more help when the other set of grandparents are not helping. Instead, they provide more help when the other grandparents are also providing help. This may mean that needy couples are likely to receive help from both sets of grandparents or that the marginal return on investment increases as adult children or grandchildren receive investments from other individuals; potentially increasing their quality overall. This is hypothesized to be the case in contexts of fertility transition, where parents are expected to invest more in children when institutions (or other individuals) are also investing in their children – for instance, by improved educational opportunities or healthcare (Kaplan, 1996).

Given that Indonesia is a large, ethnically diverse country, it is possible that our results may be influenced by kinship system, and that patterns of grandparental help may differ between patrilocal and matrilocal groups. To explore this possibility, we re-ran our main analyses running separate models for each post-marital residence category (lived with wife's parents, husband's parents, or neither). Output from these analyses is shown in Supplementary material Table S7, and suggests that our results are quite consistent across post-marital residence categories. For example, both maternal and paternal grandparents, regardless of post-martial residence, provide more financial help when they work, provide more financial help when adult children have less wealth, and provide more household help when mother's work. Another potentially confounding factor is the possibility that these results are driven by grandparent's proximity to adult children and grandchildren. While residence decisions may be endogenous to this process of intergenerational transfers – those with more need may choose to live near kin – we can explore whether our effects are influenced by grandparental proximity by including grandparental location in our models as a control variable (results available on request from authors). Results from these models demonstrate that grandparental proximity is a significant predictor of grandparental help (more help is provided if grandparents live closer to adult children), but other predictors of grandparental help, such as grandparental work status, parental wealth, and age of youngest child remain significant, suggesting that these effects are not purely driven by proximity to kin. Finally, we interpret our results as evidence that grandparents are strategically directing help towards descendants who need it, but an alternative interpretation is that grandparents are investing in adult children and grandchildren as a means of 'insurance', hoping to have help returned to them by their descendants when they are in need of it (Frankenberg et al., 2002; Geurts et al., 2012, but see Schröder-Butterfill, 2004). This is not necessarily a mutually exclusive hypothesis to the one that we test

Fig. 3. Predicted probability of receiving financial and household help by maternal grandparents by marital status of the mother. Error bars represent 95% confidence intervals. **p < 0.01.

— that grandparents are directing help adaptively towards their descendants in hopes of fitness benefits.

The patterns of grandparental help in Indonesia appear quite similar to results found from the United States and Europe, at least in terms of the predictors of help. Maternal grandparents tend to provide more help than paternal, and grandparents in a better position to provide help (healthier and employed) provide more help than those with fewer resources. One difference is that we found more financial help from single grandmothers than single grandfathers, which is opposite of a recent result based on US data (Ho, 2013). The similarities between high-income contexts and Indonesia suggests that retirement benefits are not necessary for intergenerational transfers of financial or household help from grandparents to adult children and suggests that grandparental helping trends may be similar across a variety of different contexts. One perhaps unexpected difference is that Indonesian grandparents apparently provide relatively little household help, but given that they provide substantial financial help, overall levels of help may not be that different between contexts. We are unable to provide much of a comparison between our middle-income context and low-income contexts, given the paucity of data on the details of grandparental help in such settings, but our results show that grandparental lineage does not make much difference to the help provided, which contrasts Gibson and Mace's (2005) study in Ethiopia where maternal and paternal grandmothers provided different kinds of help.

Our results illustrate the importance of studying grandparental help itself, and not just the effects of that help, in order to fully understand how intergenerational transfers may affect the health of grandchildren. Given that grandparents provide help to those adult children and grandchildren who are more in need of help, we suggest that analysis of cross-sectional data on the impact of grandparental help on child health might produce a misleading picture: a negative or null relationship between grandparental help and grandchild outcomes may be seen if grandparents direct useful help to grandchildren who are already suffering negative outcomes. A few studies from the United States support this, as children who live with grandparents have worse academic outcomes compared to two parent households, but these effects are likely due to the non-random assortment of children solely cared for by grandparents (Pittman and Boswell, 2007; Sear and Coall, 2011; Solomon and Marx, 1995). Further, as mortality declines and child health improves, it becomes more important to study the inputs of grandparental help (i.e. which individuals are most likely to give and receive help) since it may become harder to detect the outputs of such help, at least in terms of child health and survivorship (Coall and Hertwig, 2010).

In conclusion, we provide evidence that grandparental help is often mediated by need of receiver, particularly when grandparents provide household help to working mothers and financial help to poorer couples, although there are circumstances in which grandparental ability to help seems to be more important than recipient need — for example, single grandfathers are least likely to provide help and are least likely to provide help based on need of the receiver. Married grandparents and single grandmothers are more similar in their helping patterns, with married grandparents providing the most help. Given that grandparents, particularly married grandparents and single grandmothers, provide help to those adult children and grandchildren who have greater need, we might expect grandparents to be particularly important in buffering the negative effects of that greater need.

Acknowledgments

Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.socscimed.2015.01.012.

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Table 3
Summary of results.

Hypothesis	Result	Hypothesis supported?
1. Parents with young children receive more help	Grandparents provide more household help when grandchildren are young.	Yes
2. There is an inverse relationship between help from maternal and paternal grandparents	Grandparents help *less* when the other set of grandparents do not help, and more when the other grandparents provide help	No
3. Poorer parents will receive more financial help	Poorer parents are more likely to receive financial help	Yes
4. Mothers who work will receive more childcare help from grandparents	More household help is received by working mothers from married grandparents and single paternal grandmothers	Yes
5. Divorced, separated, or widowed mothers will receive more help from maternal grandparents	The effect is only significant for single maternal grandmothers providing household help	Somewhat

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