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Research Article

Intergenerational support during the rise of mobile telecommunication in Indonesia

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Abstract

BACKGROUND

In many Southeast Asian populations, urbanization and migration have increased the share of older adults supported by nonresident children. The expansion of mobile telephone infrastructure has emerged as a mechanism to bridge the spatial dispersion of families and to facilitate support for aging adults.

OBJECTIVES

We document two decades of change in the proximity of adult children of older people in Indonesia. We then ask how the arrival and expansion of mobile communication infrastructure changed key dimensions of intergenerational support: frequency of contact and material transfers.

METHODS

We combine data from a longitudinal, population-representative household survey with area-level information on mobile signal strength in Indonesia spanning the development of mobile telecommunication. We describe shifts in the family network available to older adults as well as changes in support between 1997 and 2014. We use fixed effect specifications to estimate the impact of the arrival of mobile telecommunication on intergenerational support.

RESULTS

For Indonesian older adults, the geographic dispersal of adult children increased over the two-decade period, but the proximate residence of at least one child remained stable. Weekly contact and the monetary value of material transfers to older people doubled. The arrival of mobile technology increased contact between aging parents and their adult children but had little impact on material transfers.

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CONTRIBUTION

Despite the spatial dispersion of adult children, familial support for the Indonesian older-age population has increased substantially over the past two decades. Telecommunication has supported ongoing intrafamilial exchange, but the effects differ across dimensions of support.

1. Introduction

Much of Southeast Asia relies on family to support the welfare of aging cohorts (Adlakha and Rudolph 1994; Chan 2005). Populations in this region are growing older, some rapidly, raising concerns about how proportionally smaller and more mobile younger generations can continue to support their aging parents (Lee, Mason, and Park 2011; Nugent 1990; Peterson 1999). Against this backdrop, communication technology has emerged as a possible way to reconcile the increasing demand for old-age support and the decreasing availability of physically proximate, working-age family members. In many low-income populations, the expansion of cellular technology preceded the expansion of landlines, and mobile phones were the first telephones to which many families had access (Garbacz and Thompson 2007). As a result, documenting how the expansion of mobile communication technology affects kin support is important, both for understanding patterns of intergenerational exchange and for characterizing older-age welfare in aging societies.

We study older-age support in Indonesia, which has the fourth-largest population in the world. The country is undergoing population aging alongside significant socioeconomic change (Jones 2016). Urbanization is altering the scale and ecology of economic activity toward a labor market that requires more regional integration and mobility (Firman 2004; Hugo 1982; Jones 2002). Interregional mobility has shifted younger people to urban centers, accelerating population aging in rural communities (Jones 2016). The country's weaker public old-age support system and long-held emphasis on familial reciprocity necessitate the involvement of adult children in providing old-age support. At the same time, socioeconomic growth and infrastructure development have continued at a rapid pace over the past two decades. Mobile communication availability grew from nonexistence to near complete saturation between 2000 and the present day. This shift has significantly altered how family members connect with each other. In this study, we ask how these changes have shaped support for older-age populations in particular.

We focus specifically on two forms of support that are well-established predictors of well-being among older-aged populations: contact frequency and material exchange with children. Contact between aging parents and adult children is essential in the exchange of expressive and instrumental support between generations (Peng et al. 2018). Contact with children is also particularly important for the mental health of older people (Tosi and Grundy 2019). In settings with a weak or incomplete public safety net, material transfers from adult children to aging parents are essential to older adults' economic well-being (Cameron and Cobb-Clark 2008; Silverstein, Cong, and Li 2006).

We contribute to a multi-decade line of inquiry that investigates the implications of technological change for population processes. The organization and function of family have evolved along with technological advancement (Ogburn and Nimkoff 1955; Goode 1964; Cowan 1976). The literature on the impact of technology diffusion on population processes in low-income settings pays particular attention to its interaction with existing behaviors and beliefs (Thornton and Fricke 1987; Jayakody 2019). The arrival of mobile communication technology was no less monumental in reshaping economic enterprise and individual behaviors. In many low-income populations, mobile infrastructure expansions provided many families with their first telephones.

Our research also builds on a few previous studies investigating the importance of communication technology for intergenerational relationships in populations around the globe (Gubernskaya and Treas 2016; Knodel and Saengtienchai 2007; Treas and Gubernskaya 2012). These studies demonstrate positive associations between phone ownership and intergenerational contact. We advance these ideas in two ways. First, we build on work that is largely qualitative or cross-sectional. The use of panel data from a large population sample allows us to consider (a) potential variation in the impact of new technology on family arrangements and (b) potential sources of confounding in the analysis. We are also able to compare changes in experiences across cohorts of older Indonesians as well as within cohorts that are prospectively followed as they age through this large-scale technological shift. We do this by combining two datasets, the Indonesia Family Life Survey (IFLS) and Village Potential Statistics (PODES). We use substantial spatiotemporal variation in communication infrastructure – measured using area-level changes in the strength of mobile communication signals – to help sidestep several threats to identifying the impact of mobile communication expansion. Second, we are able to investigate a more comprehensive description of older-age support over the last two decades in Indonesia. We ask how mobile telecommunication affected contact frequency as well as material exchanges to and from older adults.

This study has three goals. First, we describe trends of intergenerational support from the 1990s to the 2010s, with a focus on nonresident adult children. We pay attention to changes in the composition and interaction of networks of non-coresident children during 20 years of socioeconomic development and technological expansion. Next, we use measures of mobile phone signal coverage to explicitly relate aging parents' interaction with children to their access to mobile communication, extending the previous literature on the opportunity structure of intergenerational interaction. Finally, we assess whether mobile communication differently affects older people with distinct vulnerabilities and demands. We ask whether the impact of telecommunication expansion differs for those who are older, widowed, and not living with children and those who have a regionally dispersed network of adult children.

2. Background

2.1 Older-age family support in lower-income settings

Family members – mainly adult children – are crucial sources of old age support in most lower-income settings (Barrientos 2007; Cornman 1996). A large body of literature has investigated the motivation for this type of support, stemming from, for example, repayment for parental investment, normative obligation, and exchanges for time (Cameron and Cobb-Clark 2008; Frankenberg, Lillard, and Willis 2002; Lillard and Willis 1997; Park 2003; Raut and Tran 2005;). In turn, aging parents – particularly older adults with pension income in multigenerational families – are active contributors to adult children in various ways (Beard and Kunharibowo 2001; Schröder-Butterfill 2003).

How the family functions as an institution that provides intergenerational connection, support, and investment shifts alongside demographic and socioeconomic changes (Thornton and Fricke 1987). Declining fertility has reduced the number of physically proximate adult children on whom older-age parents can rely, causing uncertainty about sufficient support in the coming decades. Empirical evidence suggests that these effects will be the most salient for families with no children or only one child (Knodel, Chayovan, and Siriboon 1992; Zimmer and Kwong 2003). Childless older adults or those with only one child are more likely to face a decrease of intergenerational support.

Older-age parents are also more likely to be geographically separated from adult children. Coresidence of aging parents and adult children, once a common living arrangement in low- and middle-income countries, is declining (Xu, Wang, and Qi 2019; Johar and Maruyama 2011; Knodel and Debavalya 1997; Yeung, Desai, and Jones 2018). This decline reflects the changing needs of both parents and adult children (Bongaarts and Zimmer 2002; Martin 1989). Studies have demonstrated that parents' and children's characteristics, including education, housing costs, health, and child care demands, are associated with decisions about coresidence arrangements (Frankenberg, Chan, and Ofstedal 2002; Johar and Maruyama 2011).

Rising interregional migration has also played a role in dispersing older adults' family networks. Whether, and how, the migration of adult children affects old-age support depends on family size and varies by the form of support. In most Southeast Asian countries, having one child close by is sufficient for key forms of caretaking. Hak et al. (2011) found that in Cambodia, more than 90% of older-age parents had a child in the same village who regularly provided instrumental help. Siblings may also coordinate their support when some children migrate. Antman (2010) suggests that in Mexico, siblings adjust their support to older-age parents in relationship to support from other siblings. As a result, the overall contribution to older-age parents has diminished alongside child migration in Mexico – but only to a small degree. In some cases, child migration reduces the time support parents receive (Antman 2008), but physical absence may be accompanied by increased monetary support when adult children migrate. Studies demonstrate that aging parents with migrant children receive more financial transfers compared to their peers because of remittances (Cong and Silverstein 2011; Zhuo and Liang 2015).

Against this backdrop of declining fertility and larger geographic distance between older-age parents and children, telecommunication emerges as an important tool facilitating connections between family members. The section below reviews how telecommunication may affect intergenerational family support.

2.2 Telecommunication and family support

Advances in communication technology have the capacity to shape many aspects of old-age support. Telecommunication can effectively shrink the *social* distance between older adults and nonresident children when they are geographically farther apart. The most direct impact of telecommunication on old-age support is the frequency of contact. Telecommunication technology typically facilitates prioritized interaction with the people users already know well (Ling 2008). The expansion of technology appears to be best at maintaining bonds between family members and close friends who are already rooted in face-to-face interactions (Kraut et al. 2002; Wei and Lo 2006). Studies demonstrate that this extends to relationships between older adults and their adult children (Gubernskaya and Treas 2016; Knodel and Chayovan 2008; Treas and Gubernskaya 2012). This may be particularly true in settings where younger cohorts move for work and partnership. Studies on transnational and transregional families demonstrate the capacity of telecommunication technology to sustain family ties across great distance (Knodel and Saengtienchai 2007; Parreñas 2005; Vertovec 2004; Wilding 2006). In this study, we hypothesize that the expansion of mobile communication will increase contact frequency between older-age populations and nonresident children.

Some argue that telecommunication, as a result of its impact on contact, may also augment material transfers. The frequency of intergenerational contact is closely associated with functional support (Bengtson and Roberts 1991). More contact supports the maintenance of emotional ties and the sharing of information. These ties may sustain or even increase resource transfers. The efficient flow of information among adult siblings may also facilitate the coordination of support for parents. When family members are farther apart following migration, communication may empower the left-behind older adults to become proactive agents who co-construct the kin network instead of being only passive recipients of remittances (Adugna 2018).

Importantly, most research argues that advances in telecommunication technology are not likely to revolutionize relationships between family members. Studies about the social impact of telecommunication technology emphasize its nonintrusive nature, highlighting the limits of its impact in strengthening behaviors that are easily affected by connectivity (Fischer 1994). Telecommunication technology, as powerful as it is in transforming the way people connect with each other, cannot be the sole force determining interpersonal relationships. Intergenerational transfers, especially adult children's financial transfers to parents, are rooted in social institutions, cultural attitudes, and traditional behaviors (Kreager and Schröder-Butterfill 2008). In light of these arguments, we expect material transfers to be less sensitive than contact frequency to the interaction supported by telecommunication infrastructure.

The availability of new technology will likely affect different families in different ways. An essential, growing literature on the digital divide highlights a new form of inequality in accessing and using information and communication technology (Korupp and Szydlik 2005; Attewell 2001; Katz and Rice 2002). As a result, the impact of new technologies differs across groups. A central question in the digital divide literature is whether the introduction of new technologies can benefit the segments of the population most in need (Ebo 1998; Ekdahl and Trojer 2002). Among older individuals, those who are in more isolated and vulnerable situations – for example, those who live alone or farther away from children, those with fewer resources, and the oldest of the old – have greater need for support that can be facilitated by telecommunication technology (Peng et al. 2018; Schröder-Butterfill 2004). In our analysis, we explore the implication of digital divides on intergenerational support by assessing how the expansion of mobile telecommunication affects distinct groups of older people differently. To do this, we stratify our sample across older adults' union status, age, proximity of nonresident children, and consumption levels.

In addition to the factors characterizing older-age vulnerability and demand for support, other elements of families shape intergenerational transfers. These include the socioeconomic status of older adults and children. In the present analysis, we incorporate factors that are well-established predictors of older-age support more generally, including parents' education, household resources, and the number, age, and educational level of nonresident children (Frankenberg, Chan, and Ofstedal 2002; Johar and Maruyama 2011).

2.3 The Indonesian context

The study of technological expansion must be understood within the context of Indonesia's changing demographic landscape. At present, Indonesia has the fifth-largest older-age population in the world. By the year 2050, the population above age 60 is projected to be about 20% of the total population (UN 2019). As in other Southeast Asian countries, growing urban labor markets have increased interregional mobility and the rurality of population aging. More young individuals are on the move, creating a population of older adults who are more likely to live apart from their adult children (Hugo 1982; Van Lottum and Marks 2012). Amid these changes, some traditional cultural and behavioral patterns have persisted. Adult children describe obligations to honor and respect their parents (Mulder 2005; Schröder-Butterfill 2004). Reciprocity within kinship networks remains an important feature of family life (Geertz 1961; Jay 1969; Kreager and Schröder-Butterfill 2007). Intergenerational coresidence has long been common. In the 1990s, more than 70% of older parents coresided with adult children. Approximately 60% of adults with surviving parents provided monetary transfer to parents (Frankenberg, Chan, and Ofstedal 2002; Frankenberg, Lillard, and Willis 2002).

The remarkable rise of the telecommunication industry since the early 2000s complicates how these trends interact. Within less than two decades, the mobile communication market grew from nonexistent to near saturation (Figure 1). Following deregulation of the cellphone market in 1999, investment in construction and leasing of base transceiver stations (BTS) spread through the country. In 2000, approximately 1.7 per 100 Indonesian residents were mobile phone subscribers. By 2007, the number had reached 40 per 100. By 2011, the Indonesian population had, on average, one mobile phone subscription *per person* residing in the country (International Telecommunication Union 2017). In Indonesia, market penetration of mobile phones substantially exceeds the reach of fixed phone lines in homes. As in other populations experiencing rapid socioeconomic development, some families and communities never had fixed lines; people's first phones were mobile phones (ITU 2017; Knodel and Saengtienchai 2007; Williams, Anderson, and Dourish 2008).

The expansion of base transceiver stations happened in some communities before others. The initially uneven expansion was in part due to the landscape of the country – an archipelago comprising 14,000 islands – and in part due to regional differences in economic and infrastructure development. In the present study, we use the geographic and temporal variation of mobile signal coverage to examine how intergenerational support shifted alongside the expansion of mobile phone service into regions without access. In doing so, we consider the ways expansion may have been correlated with other, ongoing forms of socioeconomic development.

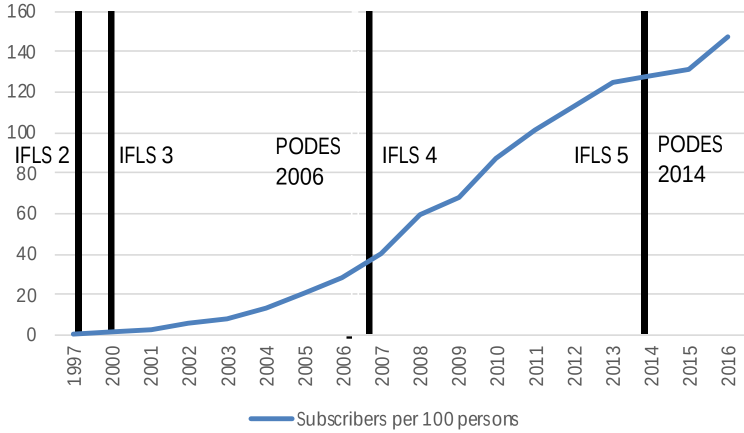
We begin the study by describing the changes of older-kin support from the 1990s to the 2010s. We then assess whether the mobile communication expansion has affected intergenerational support. Finally, we consider how these relationships vary across subpopulations.

3. Data

This study combines two data sources from Indonesia: (1) the 1997, 2000, 2007, and 2014 rounds of the Indonesia Family Life Survey (IFLS), a longitudinal panel study of more than 7,224 households; and (2) the Village Potential Statistics survey (PODES), which collected information on village cellphone signals in 2006 and again in 2014. We complement these with national data about the timing of BTS construction and the number of cellular phone subscriptions, shown in Figure 1. In combination, this information demonstrates that cellular infrastructure was unavailable to nearly all IFLS respondents in 1997 and 2000. For 2006 and 2014, we use PODES data to measure regional variation in area-level cellular signal strength. This is discussed in Section 4.2.

The IFLS collects rich information about older adults' demographic, socioeconomic, and kin networks. The IFLS was initially conducted in 1993, in 13 provinces that together contained approximately 83% of Indonesia's total population. In each successive round in 1997, 2000, 2007, and 2014, the sample was augmented via births, new marital partners, and new household residents, including new members of split-off households. The IFLS is designed either to be used as a longitudinal panel or to provide cross-sectional information on the population. (See Farré and Fasani 2013 and Witoelar et al. 2009 for examples of cross-sectional period population estimates using the IFLS.) In each round, cross-sectional weights (Thomas, Frankenberg, and Smith 2001) that can be used to generate population-representative estimates are constructed. This is particularly valuable because the IFLS contains far more comprehensive, detailed data on intrafamilial exchange and support for older adults than other cross-sectional health and labor surveys in Indonesia.

Figure 1: Number of mobile phone service subscribers per 100 persons in Indonesia, 1997–2016



Source: 2000–2016 International Telecommunication Union (ITU) mobile phone subscriber statistics.
Notes: Numbers of subscribers per 100 persons in 2000–2016 are from the ITU. The number of subscribers per 100 persons in 1997 is set to 0. The indicator includes the number of postpaid subscriptions and the number of active prepaid accounts (those used during the previous three months).

In this study we leverage both the cross-sectional and the longitudinal nature of the IFLS to assess the impact of telecommunication expansion on old-age support from both period and cohort perspectives. When using the 1997, 2000, 2007, and 2014 surveys as population-representative cross sections, we assess how the introduction of telecommunication technology is associated with changes in old-age support across the two decades. We include 878, 1,181, 1,265, and 1,501 respondents ages 60–85 who have nonresident children over 15 years old in 1997, 2000, 2007, and 2014.

The longitudinal nature of the IFLS also allows us to investigate changes in the experiences of older adults as they age. We focus on a set of cohorts – older adults aged 60–85 in 2007 – and trace changes in family support through 2014. Following these cohorts for a seven-year period minimizes sample attrition and the impact of selection on mortality. Focusing on the period from 2007 to 2014 allows us to observe familial support for older adults alongside the accelerated popularization of mobile communication (Figure 1). This longitudinal sample includes 931 respondents aged 60–85 with nonresident children in 2007 who were reinterviewed in 2014. We ask whether the acquisition of area-level cellular infrastructure during this seven-year period changed patterns of exchange within the same families observed before and after this area-level shift.

4. Measures

4.1 Measures of support for older adults

To document changes in older-age family support, we focus in particular on the availability and proximity of adult children, as well as older parents' interaction with them. We measure the number of adult children and their proximity: whether an older adult has children in the same home or in the same village/urban community, as well as whether an older adult has children outside the district (*kabupatan*) or outside the province (*provinsi*).

The main dependent variables in the analysis of telecommunication's impact on old-age support include older adults' contact frequency with nonresident children and transfers between aging parents and nonresident children. In the 2007 and 2014 IFLS, respondents answered questions about their frequency of contact with nonresident children. A small share of older adults (11.8% in 2007 and 10.5% in 2014) see all their nonresident children every day; these respondents were not asked about the frequency of phone contact given their daily in-person interactions with their children. Those who did not see all their nonresident children every day were asked whether they had phone contact, including phone calls and text messages, with each nonresident child: every day, at least once a week, at least once a month, at least once a year, or never. We generate a dichotomous indicator of whether a respondent has contact with at least one nonresident child at least once a week by measuring the contact frequency across children. We construct the dependent variable in this way because it effectively reflects the *availability* of intergenerational support through contact from the perspective of older individuals/couples, regardless of which child provides the support. Indeed, prior evidence has shown that when a family network becomes smaller and more dispersed, having one child providing support is essential (Knodel, Chayovan, and Siriboon 1992). In the primary specifications, parents who see all nonresident children in person every day are grouped with at-least-weekly phone recipients to indicate the couple's access to frequent contact with at least one adult child. We also test the sensitivity of the estimates to the use of specifications that separately examine respondents with daily in-person interaction.

To capture material support, we use the reported amount of money and goods transfers between elderly parents and nonresident children. Goods transfers are reported in values estimated by the respondent; we sum values for monetary and nonmonetary transfers to capture total material support. We code the amount of transfer as 0 for respondents who did not receive any material transfers from nonresident children. To minimize the effects of measurement error, we trim the top 1% of the values from this measure. Because of the right skew, we take the log of the total amount. This measure is constructed in all four survey waves used in this study.

In the IFLS, information about nonresident children is reported for all households. All unpartnered adults report on their nonresident children. Among couples, information is typically reported by a single member of the couple. In most couples, women report on kin support given or received by the couple. Within couples, men with previous marriages also provide information about children from those marriages. Because the goal of this study is to assess change in family support over time, we combine sources of support for couples, including all their children, regardless of whether or not they are from the current marriage. The unit of analysis is a couple if an older adult is in a union and is an individual if an older adult is not.

4.2 Measures of mobile telecommunication expansion

A primary issue of interpretation in research on technological expansion is that individual device ownership – here, ownership of a cellphone – is likely correlated with unmeasured features of individuals and families that influence outcomes, such as contact frequency and intrafamilial exchange. Older individuals' cellphone ownership, especially the acquirement of a device at the early stage of mobile telecommunication development, could be correlated with support from children. This situation could introduce significant upward bias into estimates of the effects of technological expansion. In light of this, a common approach is to measure differences in the regional availability or proximity of new infrastructure (Farré and Fasani 2013; Olken 2009). We take that approach here. We also test estimates that use information on individual-level cellphone ownership, first collected in the IFLS in 2014. In Table A-1, we show the adjusted association between cellphone ownership and measures of intergenerational support.

We take the approach of measuring differences in the regional availability of new infrastructure. We use PODES data to measure the expansion of mobile phone infrastructure across subdistricts in Indonesia. Subdistricts vary in size but on average comprise about 12 villages or urban neighborhoods. Beginning in the 2006 PODES, a respondent knowledgeable about each village – most often the village head or a senior village official – was asked to report whether the village had a mobile phone signal. If a signal existed, the official characterized the signal as strong or weak. We define a subdistrict as having strong, near complete mobile signal coverage when on average 99% of villages/urban neighborhoods within the subdistrict have a strong cell phone signal. Figure 2 shows the change in the regional distribution of subdistricts with strong mobile signal coverage from 2006 to 2014.

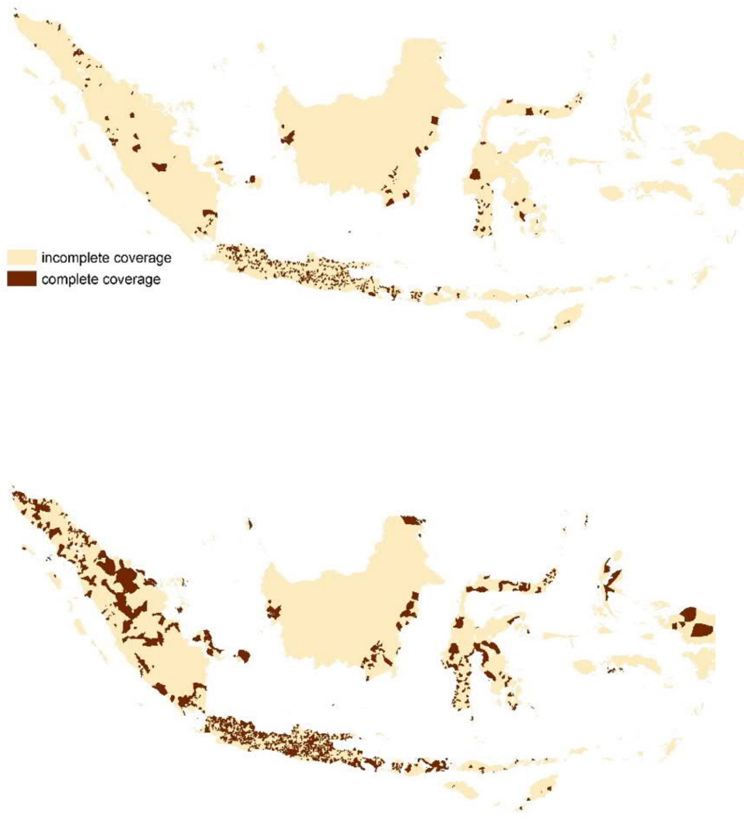
To provide evidence that this regional variation translates into meaningful differences in cellphone ownership and use at the household level, we test the association between regional signal coverage and two measures of household cellphone use in the IFLS: whether the older adult's household had telecommunication expenses in 2007 and 2014, and whether the older adult owned a mobile phone, first measured in the IFLS in 2014. Table 1 displays the estimates acquired by regressing these measures on the subdistrict measure of signal strength. We observe that complete signal coverage in the subdistrict is associated with a 4 and 5 percentage point increase (a 7% and 29% increase, respectively) in the probability of having telecommunication expenditures and owning a cellphone, respectively, after adjusting for older adults' education, age, marital status, coresidence status, distance from the farthest nonresident children, and household consumption, as well as children's education and age, other community infrastructure characteristics, and provincial fixed effects.

Table 1: Association between regional signal coverage and older adults' telecommunication expenditures and cellphone ownership

	(1) Household has nonzero telecom expenditures b (95% CI)	(2) Household has a cellphone b (95% CI)
Signal coverage	0.037	0.048
	(0.000–0.072)	(0.008–0.086)
Constant	0.117	0.69
	(–0.104–0.336)	(0.483–0.947)
Observations	2,764	1,501
R-squared	0.331	0.240

Notes: Estimates and standard errors from two linear probability models predicting expenditures on telecommunication and cellphone ownership among Indonesians aged 60 to 85; telecommunication expenditures measured in 2007 and 2014; cellphone ownership measured only in 2014; covariates not shown; 95% confidence intervals in parentheses. Individual characteristics include older adults' educational attainment, age, marital status, coresidence status, consumption levels, and distance from the farthest nonresident children, as well as nonresident children's education (the highest) and age (the youngest). Community characteristics include a transportation index, number of schools, whether most households have piped water, whether the community disposes of garbage in designated facilities, the number of health posts in the community, and whether the main income source in the community is industry, farming, or service. In the regression predicting whether a household has nonzero telecom expenditures (column 1), provincial and year fixed effects are also included..

Figure 2: Indonesian subdistricts with complete mobile signal coverage in 2006 (top) and 2014 (bottom)



Source: 2006 and 2014 Village Potential Statistics (PODES).
Notes: Indonesia is divided into 34 provinces (*provinsi*), 514 districts (*kabupaten or kota*), 6,543 subdistricts (*kecamatan*), and 75,244 villages (*desa or keluraha*). The maps show subdistricts with full mobile signal coverage aggregated from village-level signal strength data. Several large swaths of unshaded areas in 2014 are largely unpopulated.

5. Methods

5.1 Impact of mobile telecommunication expansion in a period perspective

To assess the impact of mobile telecommunication on intergenerational family support in a period perspective, we use a two-way fixed effect specification:

$$y_{ikt} = \delta\, Coverage_{ikt} + \gamma_t + \lambda_k + \beta X_{ikt} + \varepsilon_{ikt}\,. \quad (1)$$

y_{ikt} includes three measures of support, including (1) weekly contact and the amount of (2) upward and (3) downward material transfers.

However, the two-way fixed effect models cannot account for the time-varying subdistrict characteristics that may be associated with both cellular signal expansion and family support to aging parents. The expansion of mobile signal coverage may be coincident with changes in population composition in the subdistrict, the development of infrastructure, or economic development. These, in turn, may also affect older adults' family support. To account for this, we also include a battery of controls for individual and subdistrict characteristics. The individual controls include older adults' age, education, marital status, coresidence status, distance from the farthest nonresident children, and consumption, as well as children's education and the age of the youngest nonresident children.

Because the primary measure of interest is a community-level shift in mobile telecommunication infrastructure, it is essential that we control for other time-varying features of community-level change that may be correlated with telecommunication expansion and with intrafamilial processes. The community-level controls include an index of transportation infrastructure that sums over indicators of bus stops, markets, telephone offices, post offices, and whether the village is a district, subdistrict, or provincial capital center. We measure the number of schools in the subdistrict. We measure community water and sanitation facilities by indicating whether the community pipes water directly to homes for drinking and cooking and whether residents in the community dispose of garbage in cans carried away by sanitation workers. We account for the change in community health facilities by measuring the number of health facilities, including health posts, in the community. To measure the general economic development of the community, we include three binary variables indicating whether industry (mining, manufacturing, construction), farming, and service (trade, restaurants, hotels) constitute primary income sources in the community.

To demonstrate that this set of community characteristics captures variation in other forms of infrastructure development happening simultaneously with mobile telecommunication expansion, we estimate subdistrict-level regressions to test the association between mobile phone signals and two additional measures characterizing infrastructure and connectivity that are not used in the analysis: the share of households with electricity and whether the community has improved roads, which are paved with asphalt or cement. The results show that the inclusion of controls used in the analysis substantially reduces the association between infrastructure development and signal coverage (Table A-2). So indeed, concurrent development is an important potential source of confounding. The controls included here appear to address much of this confounding variation.

We then test for variation in the association between mobile expansion and old-age support. To assess whether the impact of mobile communication expansion on support differs by social and demographic characteristics that may capture older adults' particular needs for connection to adult children, we estimate Equation (1) on samples stratified by coresidence, union status, age group, household per capita expenditures (a measure of household resources), and the geographic dispersion of adult children. We test for coefficient equality across groups by modeling the subgroup outcomes simultaneously using seemingly unrelated regressions.

To adjust for multiple hypothesis testing across these different subsamples, we conduct both the Bonferroni correction (VanderWeele and Mathur 2001) and the correction for false discovery using the method outlined in Benjamini and Hochberg (1995).

5.2 Impact of mobile telecommunication expansion in a cohort perspective

We then test the impact of telecommunication expansion on support for the cohorts of older adults aged 60 to 85 in 2007 as they age forward to 2014, a period during which 12% of Indonesian subdistricts reached complete signal coverage. We use a two-way fixed effect specification tracing the couple/individual-level change of support:

$$y_{ikt} = \delta\, Coverage_{ikt} + \gamma_t + \lambda_i + \beta X_{ikt} + \varepsilon_{ikt}\,. \qquad (2)$$

Equation (2) differs from Equation (1) in that now λ_i is an older-age couple/individual fixed effect. In this way, we difference out the time-invariant characteristics of the older-age respondents that may be correlated with both cellphone signal access and family support. This effectively compares contact and exchange within the *same* family before and after its subdistrict acquires cellular infrastructure between 2007 and 2014, net of period changes observed across the country and net of other forms of infrastructure change (in terms of transportation, health care, and water) in the community. Descriptive statistics for the sample used in longitudinal analysis are located in Table A-3.

We include the same set of individual- and community-level control variables as in the period analysis. We also conduct stratified sample analysis to test for variation in the association between mobile expansion and older-age support.

One concern in any longitudinal analysis is sample attrition if the attrition is nonrandom. In other words, if older adults with specific characteristics are more likely than their counterparts to die or be lost to follow-up, this will introduce estimate bias. To evaluate the influence of sample attrition in this study, we use linear probability models to explore the sample attrition pattern (Table A-4). We observe that education, age, coresidence status, and children's characteristics are associated with the probability of death. Age and coresidence status are associated with the probability of being lost to follow-up. When controlling for individual and community characteristics, signal coverage is not associated with sample attrition.

6. Results

6.1 Patterns of older-age kin support in Indonesia

Table 2 shows changes in kin availability, proximity, and support from 1997 to 2014. On average, the number of nonresident children remained close to four through the period studied. We observe three key patterns in the proximity of those nonresident children. First, coresidence with adult children declined. More than two-thirds of older adults lived with adult children in the late 1990s; only half of the older-age population did so in 2014. Second, there was a general trend of the dispersion of kin networks. Older adults with the farthest nonresident child living in a different district increased from 60% to 66%. Third, despite this dispersion, we find that nearly two-thirds of the older-age population had at least one nonresident child living in the same village or neighborhood; this remained stable across the two-decade period.

We observe that communication with older-age parents and material support given to older-age parents from adult children increased over this period. Despite a small decline in older adults who saw all their nonresident children every day, phone contact with nonresident children increased. In 2007, 20% of older adults talked or texted on the phone with their children every week. This share increased to about 40% in 2014. Material support between older adults and adult children also increased over this period, including both upward and downward transfers; 79% of older adults received transfers from nonresident children in 1997 whereas 90% of older adults received transfers in 2014. Among those who received transfers, the median amount of the transfer nearly doubled. (All estimates have been adjusted for inflation.) In 2014 the median amount received was 1,500,000 rupiahs (approximately $120 in 2014 U.S. dollars) over 12 months, increasing from 770,000 rupiahs (approximately US$62) in 2007. The share of older adults transferring resources to children increased as well, from 28% in 2007 to 49% in 2014. The value of transfer from older adults to adult children was smaller compared to the value of transfer from adult children to older adults prior to 2014, but became similar in 2014. In 1997 the median value of transfers to children was 513,000 rupiahs (about US$42). This increased to 1,500,000 rupiahs (about US$120) in 2014.

Table 2: Changes of adult children availability, proximity, and intergenerational support for adults ages 60–85 with nonresident children over 15-year old from 1997 to 2014. Cross-sectional weights applied

Year	1997	2000	2007	2014
Kin support availability				
Coresidence with child (%)	64.7	68.1	52.9[d]	52.6
Number of nonresident children	3.8	3.6	3.9[d]	3.7
Closest child/children in				
Same village/neighborhood (%)	67.0	68.4	69.8	68.8
Farthest child/children in				
Different district and farther (%)	60.0	59.5	65.0[d]	65.8
Different province (%)	46.1	41.2	47.0[d]	47.4
Intergenerational support				
See all nonresident children every day (%)	15.5	12.4	11.8	10.5
See nonresident children weekly (%)	76.5	75.3	77.8	80.2
Phone contact weekly (%)[b]			19.9	39.2[d]
Receipt of transfers (%)	79.0	81.9	90.7	90.0
Median amount (1,000)[c]	770	672	1,125	1,500
Gift of transfers (%)	27.8	39.8[d]	40.8	49.2[d]
Median amount (1,000)[c]	513	560	900	1,500
Unweighted N	878	1,181	1,265	1,501

Source: Indonesia Family Life Survey.
Note: Descriptive statistics on family and transfer arrangements for persons aged 60–85 in survey year.
a. The unit is an older-age couple in a union or an older-age individual who is not in a union (single, divorced, or widowed).
b. Among those did not see all nonresident children every day.
c. Median values shown; rupiah values inflated to 2014 values; does not include those who did not receive/give transfers.
d. Values different from those in the previous round based on 95% confidence intervals.

6.2 How intergenerational kin support changed alongside mobile communication expansion

Tables 3a and 3b includes estimates from fixed effect models predicting each of the measures of older-age kin support in the period and cohort analysis, respectively. Linear probability fixed effect models are estimated for weekly contact. Linear fixed effect models are estimated for the amount of transfers. Given the staggered rollout of cellular signals, we test for bias driven by heterogeneous effects across time and place (Chaisemartin and d'Haultfoeuille 2020) and find that the estimates are not significantly biased by this variation.

In the period analysis, across the three measures of older-age kin support, we observe that weekly contact with adult children is the only outcome correlated with the expansion of signal coverage. Living in an area with signal coverage is associated with a 5.3 (95% CI: 0.001–0.106) percentage point higher probability of having weekly contact with children. This amounts to a 13.5% increase. The large secular increase in material transfers appears in these estimates in the year terms, but we do not observe that the increase in transfers is spatially correlated with the regional expansion of mobile network infrastructure.

We detect several expected associations between the control covariates and these dimensions of intergenerational exchange. Exchange is highly patterned by socioeconomic status. Weekly contact with adult children is more common among younger and highly educated older adults. All three outcomes are more common among older adults with higher levels of per capita expenditures. The amount of transfers is positively associated with the educational level of nonresident children. Material transfers from nonresident children to aging parents also increase with parent's age.

We now turn to the results of cohort analysis in Table 3b. We observe patterns for the impact of signal coverage that are similar to those in the period analysis. Among the three outcomes, weekly contact is the only one associated with signal coverage. For older cohorts, having signal coverage is associated with a 10 percentage point (95% CI: 0.031–0.178) increase in the probability of having weekly contact with nonresident children. This represents a 28% increase.

Table 3a: Area-level mobile signal coverage and exchange between older adults and their children. IFLS 1997, 2000, 2007, and 2014 as repeated cross sections

	(1) Weekly contact[a] b (95% CI)	(2) Amount of transfer given (in)[b] b (95% CI)	(3) Amount of transfer received (in)[b] b (95% CI)
Signal coverage	0.053	0.079	0.022
	(0.001–0.106)	(–0.560–0.718)	(–0.453–0.498)
Year (ref. 1997)			
Year 2000		1.125	–0.327
		(0.424–1.826)	(–0.928–0.274)
Year 2007		1.594	1.046
	(ref. 2007)	(0.811–2.377)	(0.397–1.695)
Year 2014	0.168	2.845	0.982
	(0.122–0.213)	(1.990–3.699)	(0.303–1.661)
Old age couple/individual characteristics[c]			
> = jr. high school	0.167	0.696	0.410
	(0.105–0.230)	(0.013–1.378)	(–0.151–0.972)
Age	–0.008	–0.042	0.082
	(–0.012– –0.004)	(–0.075– –0.008)	(0.053–0.110)
Married	0.051	1.419	0.030
	(0.011–0.091)	(1.002–1.837)	(–0.253–0.313)
Coresidence	–0.001	–0.013	–0.823
	(–0.040–0.039)	(–0.397–0.370)	(–1.108– –0.538)
Farthest child in different district	–0.137	0.022	0.613
	(–0.188– –0.086)	(–0.429–0.472)	(0.242–0.984)
2nd tertile of household consumption	0.026	0.478	0.499
	(–0.023–0.075)	(–0.010–0.966)	(0.119–0.878)
3rd tertile of household consumption	0.114	0.820	0.945
	(0.058–0.169)	(0.262–1.378)	(0.506–1.383)
Nonresident children characteristics[d]			
> = jr. high school	0.103	1.444	1.455
	(0.060–0.145)	(0.967–1.921)	(1.073–1.837)
Age (youngest)	–0.000	–0.104	–0.074
	(–0.003–0.003)	(–0.131– –0.076)	(–0.097– –0.051)

Table 3a: (Continued)

	(1) Weekly contact[a] b (95% CI)	(2) Amount of transfer given (in)[b] b (95% CI)	(3) Amount of transfer received (in)[b] b (95% CI)
Community characteristics			
Transportation index	0.004	0.055	0.027
	(–0.025–0.032)	(–0.186–0.297)	(–0.175–0.228)
Number of schools	–0.003	–0.083	0.028
	(–0.010–0.005)	(–0.158– –0.008)	(–0.037–0.094)
Dispose garbage in designated barrels	–0.039	0.073	0.484
	(–0.152–0.075)	(–0.641–0.786)	(–0.133–1.100)
Pipe water as main source of water	0.035	0.018	–0.059
	(–0.034–0.103)	(–0.577–0.612)	(–0.571–0.453)
Number of health posts	0.002	–0.027	0.027
	(–0.008–0.012)	(–0.078–0.024)	(–0.015–0.069)
Industry as main income	–0.014	–0.027	0.112
	(–0.078–0.050)	(–0.607–0.553)	(–0.304–0.529)
Farming as main income	–0.011	–0.059	0.268
	(–0.150–0.127)	(–1.142–1.023)	(–0.708–1.243)
Service as main income	–0.007	0.602	0.170
	(–0.067–0.053)	(0.061–1.143)	(–0.275–0.616)
Subdistrict fixed effect	yes	yes	yes
Constant	0.817	8.141	6.119
	(0.497–1.138)	(5.740–10.543)	(3.941–8.296)
R-squared			
Within	0.104	0.087	0.079
Between	0.231	0.078	0.055
Overall	0.127	0.079	0.062
Observations	2,756	4,810	4,810
Number of subdistricts	294	449	449

Notes: Estimates and confidence intervals are from linear probability models predicting weekly contact, and from linear regressions predicting the amount of transfers (logged). Confidence intervals are adjusted for the clustering structure of respondents at the subdistrict level. Robust 95% confidence intervals in parentheses.
a. Weekly contact is measured in 2007 and 2014, including those who see all their nonresident children every day and those who have phone contact with nonresident children at least once a week.
b. Rupiah values inflated to 2014 values; includes total monetary value of money transferred and goods transferred; 0 values included and coded as 1. Values are then logged.
c. Female respondents' characteristics are for older-age couples or widowed females; male respondents' characteristics are for widowed males.
d. Education is the degree attained by nonresident children with the highest educational attainment; age is that of the youngest nonresident children.

Table 3b: Area-level mobile signal coverage and exchange between older adults and their children, cohorts aged 60–85 in 2007, followed until 2014

	(1) Weekly contact[a] b (95% CI)	(2) Amount of transfer given (in)[b] b (95% CI)	(3) Amount of transfer received (in)[b] b (95% CI)
Signal coverage	0.102	–0.058	0.123
	(0.031–0.178)	(–1.121–1.004)	(–0.557–0.804)
Year 2014 (ref. 2007)	0.166	3.984	0.497
	(–0.106–0.439)	(0.372–7.596)	(–2.336–3.329)
Older-age couple/individual characteristics[c]			
Age	–0.008	–0.534	–0.052
	(–0.049–0.034)	(–1.090–0.023)	(–0.479–0.376)
Married	0.113	–0.646	–0.635
	(–0.008–0.234)	(–2.404–1.112)	(–1.663–0.392)
Coresidence	0.032	–1.275	–1.281
	(–0.073–0.137)	(–2.764–0.214)	(–2.292– –0.270)
Farthest child in different district	–0.118	0.558	1.492
	(–0.234–-0.002)	(–1.017–2.134)	(0.442–2.542)
2nd tertile of household consumption	0.269	–2.701	0.908
	(–0.139–0.676)	(–6.872–1.471)	(–2.208–4.024)
3rd tertile of household consumption	0.504	–2.402	–1.537
	(0.090–0.919)	(–7.847–3.043)	(–4.879–1.806)
Nonresident children characteristics[d]			
> = jr. high school	0.085	–0.376	1.239
	(–0.064–0.235)	(–2.474–1.723)	(–0.265–2.743)
Age (youngest)	–0.004	–0.118	–0.048
	(–0.012–0.004)	(–0.242–0.006)	(–0.138–0.042)
Community characteristics			
Transportation index	–0.020	0.095	0.226
	(–0.061–0.021)	(–0.488–0.679)	(–0.208–0.659)
Number of schools	–0.002	0.012	–0.020
	(–0.013–0.009)	(–0.129–0.153)	(–0.131–0.091)
Dispose garbage in designated barrels	–0.032	–1.208	0.932
	(–0.161–0.096)	(–2.893–0.476)	(–0.258–2.123)
Piped-in water as main source of water	–0.027	1.392	–0.456
	(–0.118–0.064)	(0.099–2.686)	(–1.291–0.380)
Number of health posts	–0.010	–0.005	0.034
	(–0.022–0.003)	(–0.295–0.285)	(–0.099–0.167)
Industry as main income	0.016	–0.176	0.142
	(–0.071–0.104)	(–1.350–0.998)	(–0.721–1.005)
Farming as main income	–0.112	–2.49	–0.039
	(–0.324–0.100)	(–4.653– –0.328)	(–2.063–1.985)
Service as main income	0.015	1.227	0.500
	(–0.077–0.107)	(0.035–2.419)	(–0.413–1.414)

Table 3b: (Continued)

	(1) Weekly contact[a]	(2) Amount of transfer given (in)[b]	(3) Amount of transfer received (in)[b]
	b	b	b
	(95% CI)	(95% CI)	(95% CI)
Couple/individual fixed effect	yes	yes	yes
Constant	0.864	48.834	16.034
	(–1.992–3.719)	(10.507–87.161)	(–12.853–44.920)
R-squared			
Within	0.059	0.046	0.042
Between	0.041	0.021	0.02
Overall	0.041	0.017	0,019
Observations	1,598	1,598	1,598
Number of individuals	931	931	931

Notes: Robust 95% confidence intervals in parentheses. Estimates and confidence intervals are from linear probability models predicting weekly contact, and from linear regressions predicting the amount of transfers (logged). Confidence intervals are adjusted for the clustering structure of respondents at the subdistrict level.
a. Weekly contact is measured in 2007 and 2014, including those who see all their nonresident children every day and those who have phone contact with nonresident children at least once a week.
b. Rupiah values are inflated to 2014 values; includes total monetary value of money transferred and goods transferred; 0 values included and coded as 1. Values are then logged.
c. Female respondents' characteristics are for older-age couples or widowed females; male respondents' characteristics are for widowed males.
d. Education is the degree attained by the nonresident children with the highest educational attainment; age is that of the youngest nonresident children.

In comparison with the period analysis, the association between signal coverage and contact frequency is larger in both absolute and relative terms in the within individual change analysis. We discuss two potential sources of difference. First, the period and cohort analyses draw on different sets of comparisons. In the period analysis, intergenerational contact for adults aged 60 to 85 in 2007 is compared to contact for adults aged 60 to 85 in 2014. In the cohort analysis, the comparison is made for the same group of individuals between different ages — namely, individuals aged 60 to 85 in 2007 and the same group at ages 67 to 92 in 2014. It is possible that the impact of mobile telecommunication expansion was particularly felt by adults aged 60 to 85 in 2007 because they entered old age when mobile communication developed most rapidly. However, this effect heterogeneity is not driven by selection of survivorship, one important form of potential bias in a longitudinal study concerning older-age populations. In Table A-2 we show that survivorship is not correlated with signal coverage in these specifications.

A second possibility is that by design, the period and cohort analyses differ in an unobserved variation that can potentially affect estimates. The period analysis differences out unobserved time-invariant differences across subdistricts; the associations are identified off within-subdistrict variation in signal coverage. In the cohort analysis, any constant characteristics of an older-age couple/individual are differenced out, including any variations within subdistricts. The fact that the estimate is larger in the panel data analysis suggests that the unobserved across-couple and within-subdistrict variation may suppress the impact of signal coverage on weekly contact.

We then examine the impact of mobile expansion on sociodemographic subgroups of the population for the period analysis. We estimate Equation (1) using samples stratified by coresidence, marital status, age, expenditures, and the dispersion of adult children. The coefficients on signal coverage from the period and cohort analyses are presented in Tables 4a and 4b, respectively. In the specifications shown in Table 4b, the stratifying characteristic is measured in 2007. When interpreting the results of multiple specifications in Table 4, one important concern is the possibility of multiple testing. In Table A-5 we show the results adjusted for multiple testing for specifications predicting weekly contact. Most of the stratified sample analysis models are imprecisely estimated due to the smaller sample sizes. For example, the smallest subgroup is older adults in the lowest tertile of household consumption in the contact frequency analysis (877 observations; 348 and 529 with higher and lower signal coverage, respectively). In this sample, respondents with signal coverage have a 9 percentage point higher probability of having weekly contact compared to those in areas with incomplete signal coverage.

In the stratified analysis, two substantive differences in the estimate sizes are worth noting, despite their imprecision. In particular, we observe a 12 (95% CI: 0.013–0.233) and 16 (95% CI: 0.019–0.297) percentage point (26% and 39%) increase in the probability of having weekly contact with nonresident children associated with signal coverage among married older adults in the period and cohort analyses, respectively. By contrast, the association is close to 0 for single, divorced, and widowed older adults. In the cohort analysis, the arrival of improved signal coverage in respondents' subdistricts between 2007 and 2014 has a larger association with weekly contact among older adults who were married in 2007 relative to older adults who were single, divorced, or widowed in 2007.

We also observe a substantively larger association between signal coverage and weekly contact for older adults with the fewest resources – here measured in the amount of per capita household monthly expenditures. We observe this in both Table 4a and Table 4b. These households would have been the least likely to have access to landlines prior to the arrival of cellular devices. The reach of cellular technology may have been most important for communication access among these households. We note these differences, despite the imprecision in the results given multiple testing concerns, as they are substantively large and signal patterns of potential interest for future studies.

Table 4a: Variability in the association of strong signal coverage with intergenerational support. Coefficients estimated on signal coverage for 11 population subgroups; IFLS 1997, 2000, 2007, and 2014 as repeated cross sections

Stratifying measures	Weekly contact[a] b (95% CI)	Amount of transfer given (in)[b] b (95% CI)	Amount of transfer received (in)[b] b (95% CI)
Coresidence with children			
Not coresident	0.057	–0.503	–0.157
	(–0.032–0.145)	(–1.535–0.529)	(–0.847–0.532)
Coresident	0.068	0.337	–0.089
	(–0.005–0.141)	(–0.444–1.118)	(–0.754–0.576)
Married[c]			
Not married	0.018	0.624	0.086
	(–0.065–0.104)	(–0.127–1.375)	(–0.567–0.740)
Married	0.122	–0.729	0.150
	(0.013–0.233)	(–1.799–0.340)	(–0.637–0.938)
Age of older member of couple			
60–70	0.072	–0.462	–0.064
	(–0.014–0.159)	(–1.315–0.390)	(–0.723–0.595)
70–85	0.042	0.518	0.318
	(–0.039–0.128)	(–0.613–1.649)	(–0.406–1.042)
Residence of most geographically distant child			
In district	0.046	–0.422	0.647
	(–0.052–0.148)	(–1.321–0.478)	(–0.261–1.555)
Outside district	0.066	0.481	–0.290
	(–0.003–0.132)	(–0.403–1.364)	(–0.914–0.334)
Household expenditures (log)			
1st tertile	0.089	–0.276	–0.872
	(–0.005–0.186)	(–1.204–0.651)	(–1.643– –0.101)
2nd tertile	–0.040	0.412	0.728
	(–0.060–0.142)	(–0.659–1.482)	(–0.131–1.587)
3rd tertile	0.057	–0.184	–0.117
	(–0.176–0.092)	(–1.536–1.168)	(–1.030–0.795)

Table 4b: Variability in the association of strong signal coverage with intergenerational support for cohorts aged 60–85 years in 2007, followed until 2014

Stratifying measures	Weekly contact[a] b (95% CI)	Amount of transfer given (in)[b] b (95% CI)	Amount of transfer received (in)[b] b (95% CI)
Coresidence with children			
Not coresident	0.067	–0.388	0.078
	(–0.055–0.190)	(–2.428–1.651)	(–1.175–1.331)
Coresident	0.118	1.004	0.390
	(0.006–0.230)	(–0.507–2.515)	(–0.663–1.443)
Married[c]			
Not married	0.026[d]	0.396	0.578
	(–0.072–0.124)	(–1.053–1.844)	(–0.312–1.469)
Married	0.158[d]	–0.004	–0.147
	(0.019–0.297)	(–1.810–1.803)	(–1.387–1.092)
Age of older member of couple			
60–70	0.088	–1.168	0.453
	(–0.066–0.242)	(–3.425–1.089)	(–0.793–1.698)
70–85	0.021	0.813	0.050
	(–0.110–0.152)	(–1.257–2.884)	(–1.190–1.291)
Residence of most geographically distant child			
In district	0.078	0.035	1.044
	(–0.075–0.231)	(–2.076–2.147)	(–0.206–2.293)
Outside district	0.097	0.125	–0.301
	(0.002–0.191)	(–1.282–1.532)	(–1.234–0.632)
Household expenditures (log)			
1st tertile	0.166	–0.159	–0.958
	(0.016–0.316)	(–1.653–1.334)	(–2.279–0.362)
2nd tertile	0.097	–0.147	0.753
	(–0.020–0.214)	(–1.990–1.695)	(–0.243–1.749)
3rd tertile	–0.013	–0.188	0.192
	(–0.181–0.155)	(–2.287–1.910)	(–0.895–1.279)

Notes: Robust 95% confidence intervals in parentheses. Results from 66 regression specifications shown. Each estimate shows the association between the presence of signal coverage in the subdistrict and the outcome shown at the top of columns 1–3. Each regression includes the covariates shown in Table 3a and 3b. Confidence intervals are adjusted for the clustering structure of respondents at the subdistrict level.

[a] Weekly contact is measured in 2007 and 2014, including those who see all nonresident children every day and those who have phone contact with nonresident children at least once a week.

[b] Rupiah values inflated to 2014 values; includes total monetary value of money transferred and goods transferred; 0 values included and coded as 1. Values are then logged.

[c] “Not married” includes older adults who are widowed, divorced, or separated.

[d] Coefficients in the stratified samples differ from each other at $p < .05$.

6.3 Robustness checks

Because the two-way fixed effect specification presented in this study relies on the parallel trend assumption to identify the impact of signal coverage on intergenerational support, we test whether the trends of material support to and from older adults are similar in the years *before* mobile telecommunication expansion: 1997 and 2000. We find that respondents living in subdistricts that subsequently would and would not receive complete signal coverage by 2014 do not have different patterns of intergenerational exchange from 1997 to 2000. The results are shown in Table A-6. Unfortunately, we cannot provide evidence on the parallel trend assumption for contact frequency because the measure of intergenerational contact was introduced into the study in 2007 and measured again in 2014.

Two additional tests provide evidence about the robustness of the results. First, in a test of randomization inference – similar to the logic of a placebo test – we randomly reassign cell coverage to subdistricts 1,000 times (that is, with 1,000 random permutations) to generate an empirical distribution of test estimates. The resulting p-values, shown in Table A-7, confirm that random assignment of cell coverage does not result in meaningful associations between cell coverage and contact frequency (see Heß 2017 on randomization inference).

Second, we conduct a placebo test using height as a placebo outcome in the period analysis. Mobile signal coverage cannot possibly have an impact on older adults' heights because heights of respondents were determined long before mobile telecommunication expansion. At the same time, height captures much about regional variation in socioeconomic development, via nutrition and infection exposure, and thus provides a potentially useful placebo test. If we observed an association between signal expansion and height, we would assume confounding associated with how people are sorted across space. The results are displayed in Table A-8. The association between the availability of signal coverage and height among respondents is negligible in the presence of controls used in the primary specifications.

7. Conclusion

Intrafamilial exchange is an essential part of caregiving in societies with few public transfers to older-age populations. As rising interregional migration has reshaped living arrangements in many parts of the world, the expansion of mobile phone technology presents a new mechanism for providing old-age care and sustaining intergenerational ties to older adults. We study these relationships in Indonesia, a country with one of the largest populations in the world and one with a rising share of older adults. In Indonesia, the mobile telecommunication industry exploded in the early 2000s, revolutionizing communication across the diverse archipelago. We use two decades of data spanning this remarkable expansion to study how familial support for older adults changed. In doing so, we build on a long history of demographic research that assesses the impact of technology on family dynamics (Billari, Rotondi, and Trinitapoli 2020; Jayakody 2019; Axinn and Yabiku 2001; Cowan 1976; Fischer 1994; Thornton and Fricke 1987) and contribute to a growing body of work that integrates measurement of the built environment to study family and social behavior (Farré and Fasani 2013; Olken 2009).

We find evidence of increased communication between adult children and their parents as well as growing monetary and monetary-equivalent transfers between 1997 and 2014. Transfers to aging parents are common in Indonesia (Frankenberg, Lillard, and Willis 2002); the estimates here suggest a strengthening of support from the late 1990s to the mid-2010s. We also observe a marked reduction in the share of older adults who coreside with adult children and an increased dispersal of adult children out of their natal communities. Despite this rise in regional migration, most older adults continue to live near at least one adult child. This is consistent with some descriptions of changing family residence patterns in other Southeast Asian countries (Knodel and Saengtienchai 2007). In light of these patterns, the net impact of interregional migration on the welfare of older adults may be modest as long as there is more than one adult child in the family. An analysis concerning *which* adult child stays in the natal village is beyond the scope of this research but likely would shed light on important features of family arrangements in Indonesia.

The results here support previous analyses of mobile communication and intergenerational contact (Gubernskaya and Treas 2016; Treas and Gubernskay 2012). We find that their association persists in a longitudinal, population-representative sample with a design that sidesteps some forms of confounding bias about which individuals seek and use new forms of technology. However, the analysis of population subgroups suggests that mobile expansion did not increase contact for people who may be more vulnerable to gaps in support. People who were older, who did not coreside with children, and who were not in a marital union did not differentially benefit from the larger increase in communication with adult children alongside the rollout of mobile technology as a means of connection with and support from adult children.

The absence of an impact of mobile communication on material support to older adults differs from previous evidence about how communication and financial exchange are tightly linked in studies of migrant family members (Adugna 2018; Lindley 2009). For upward transfers from children to aging parents, it is possible that sending money is primarily responsive to long-standing filial norms and to necessity in the absence of a public safety net. It may be that both are far more influential than the convenience brought by mobile communication expansion. The causes behind the secular increases in downward transfers, however, remain to be explored in Indonesia and warrant further research. A final alternative explanation is that the impact of mobile signal coverage on transfers is positive but small and difficult to detect with the specifications here. By design, the study sidesteps threats to interpretation by using distal, upstream factors that are less precise indicators of household-level behavior.

One way modern telecommunication may facilitate family support to older adults is by allowing communication and exchange for aging parents when those in the younger generation increasingly migrate away from natal communities. We find no evidence that the impact of mobile communication expansion on aging parents' weekly contact with nonresident children is larger for those with dispersed adult children. In this sense, we did not find evidence that telecommunication access significantly 'redefined geographic distance' between family members.

This study has several limitations worth noting. First, to study exchange that would plausibly involve telecommunication, we include only older adults with nonresident children in the analysis (86% of all older adults). Despite the increasing importance of nonresident children in supporting aging parents, this approach misses a description of older adults who coreside with all their adult children. Complete coresidence represents mutual support between aging parents and adult children and may be driven by both parents' and children's needs (Beard and Kunharibowo 2001), making it hard to speculate how the inclusion of complete coresidence would alter our account of older-age family support. The study is also silent on older adults who are childless. Though childlessness among the 1912–1954 birth cohorts was rare – as was the premature death of all children – these older adults are potentially most in need of support (Knodel, Chayovan, and Siriboon 1992). Future studies would benefit from attention to the needs and support of childless older adults and how they are affected by the development of modern communication.

Second, the estimates here may mask additional relevant heterogeneity among older populations, especially the ethnic and regional differences characterizing family dynamics in Indonesia (Kreager and Schroder-Butterfill 2008). Understanding how motivations for, attitudes toward, and necessities of intergenerational transfers vary across cultural and ethnic groups may help us better assess the role of mobile communication in shaping intergenerational exchange.

Third, the analysis includes a two-way fixed effect specification that relies on a parallel trend assumption to identify the unbiased impact of mobile telecommunication expansion on intergenerational support. Providing evidence on the parallel trend assumption requires at least one time point of variable measurement before the introduction of signal coverage. The IFLS began collecting information about contact frequency with nonresident children in the last two waves, in 2007 and 2014. We provide evidence that trends of intergenerational material exchange prior to mobile telecommunication expansion are not different in subdistricts that subsequently do and do not receive complete signal coverage.

Finally, in this study we have stressed the value of integrating measures of the built environment to learn how older-age support has evolved since the mid-1990s. The data here are based on reports provided by knowledgeable village leaders. To the extent that ongoing research is able to leverage administrative information on the timing and placement of specific elements of mobile infrastructure, such as base transceiver towers, and to integrate information about topology (which in Indonesia is particularly diverse across regions), it may be possible to *predict* spatiotemporal variation in mobile coverage and further advance the study of technological change and family dynamics.

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Appendix

Table A-1: Cellphone ownership and intergenerational support, 2014

	(1) Weekly contact	(2) Amount of transfer received (in)[b]	(3) Amount of transfer given (in)[b]
	b	b	b
	(% 95 CI)	(% 95 CI)	(% 95 CI)
Cellphone ownership	0.355	0.662	1.193
	(0.281–0.428)	(–0.174–1.498)	(0.123–2.264)
Individual and community characteristics	Yes		
Constant	1.082	3.945	16.907
	(0.516–1.648)	(–3.542–11.432)	(6.474–27.341)
Observations	1,494	1,507	1,507
R-squared	0.148	0.072	0.101
Number of subdistricts	266	266	266

Notes: Robust 95% confidence intervals in parentheses. Estimates and confidence intervals are from linear probability models predicting contact frequency and linear regressions predicting the amount of material exchange received and given (logged). Confidence intervals are adjusted for the clustering structure of respondents at the subdistrict level.

Table A-2: Community characteristics and signal coverage

Variables	(1) Signal coverage	(2) Signal coverage	(3) Signal coverage	(4) Signal coverage
% of households in the community with electricity	0.007	0.000		
	(0.005–0.009)	(–0.002–0.002)		
Predominant type of road in the community is asphalt or cement			0.273	0.071
			(0.162–0.383)	(–0.017–0.160)
Transportation index		–0.007		–0.010
		(–0.029 – 0.014)		(–0.031–0.011)
Number of schools in the community		0.016		0.015
		(0.005–0.028)		(0.003–0.026)
Has garbage service		0.058		0.058
		(–0.032–0.148)		(–0.031–0.148)
Water piped directly to homes		0.034		0.017
		(–0.041–0.108)		(–0.058–0.092)
Number of health posts		0.005		0.005
		(0.000–0.011)		(0.000–0.010)
Main income source is industry		–0.007		–0.007
		(–0.078–0.063)		(–0.076–0.063)
Main income source is farming		–0.126		–0.127
		(–0.214– –0.037)		(–0.215– –0.039)
Main income source is service		0.011		0.014
		(–0.066–0.087)		(–0.062–0.089)
Year 2000 (ref. 1997)		0.003		–0.001
		(–0.079–0.085)		(–0.082–0.081)
Year 2007 (ref. 1997)		0.501		0.486
		(0.415–0.587)		(0.402–0.570)
Year 2014 (ref. 1997)		0.608		0.594
		(0.518–0.698)		(0.508–0.681)
Constant	–0.373	–0.049	0.042	–0.071
	(–0.564– –0.182)	(–0.252–0.154)	(–0.059–0.144)	(–0.225–0.082)
Observations	440	440	449	449
R-squared	0.096	0.519	0.050	0.520

Notes: 95% confidence intervals in parentheses. Estimates and confidence intervals are from subdistrict-level linear probability models predicting signal coverage in subdistricts.

Table A-3: Changes in adult children availability, nonresident children proximity, and intergenerational support for adults ages 60–85 with nonresident children over age 15 from 1997 to 2014

Year	2007
Kin support availability	
Coresidence with child (%)	54.4
Number of nonresident children	3.9
Closest children in	
Same village/neighborhood (%)	69.8
Farthest children in (%)	
Different district/farther	67.8
Different province	48.9
Intergenerational support	
See all nonresident children every day (%)	11.6
See nonresident children weekly (%)	78.2
Phone contact weekly (%)[b]	24.1
Receipt of transfer (%)	90.0
Median amount (1,000)[c]	1,125
Gift of transfer (%)	45.8
Median amount (1,000)[c]	900
N	931

Source: Indonesia Family Life Survey.
Notes: Descriptive statistics on family and transfer arrangements for persons ages 60–85 in survey year, by survey year.
[a] The unit is an old-age couple if they are in a union and an older individual who is not in a union (single, divorced, or widowed).
[b] Among those who did not see all nonresident children every day.
[c] Median values shown; rupiah values inflated to 2014 values; 0 values included and coded as 1. Values are then logged.

Table A-4: Baseline (2007) characteristics and dead/lost to follow-up in 2014

	(1) Dead vs. followed	(2) Lost vs. followed
Signal coverage in baseline (2007)	–0.028	0.047
	(–0.087–0.031)	(–0.011–0.105)
> = jr. high school	–0.061	0.023
	(–0.135–0.012)	(–0.052–0.098)
Age	0.019	0.023
	(0.013–0.024)	(0.018–0.029)
Married	–0.011	–0.073
	(–0.066–0.044)	(–0.126– –0.019)
Coresidence	0.062	–0.116
	(0.010–0.114)	(–0.167– –0.065)
Farthest child in different district	0.033	–0.012
	(–0.026–0.091)	(–0.068–0.043)
2nd tertile of household consumption	–0.056	0.009
	(–0.122–0.009)	(–0.052–0.070)
3rd tertile of household consumption	–0.060	0.050
	(–0.132–0.013)	(–0.020–0.120)
Education of nonresident child > = jr. high school	0.009	–0.002
	(–0.054–0.072)	(–0.060–0.057)
	0.002	–0.001
Age of youngest nonresident child	(–0.002–0.006)	(–0.005–0.002)
Community characteristics and province fixed effect: yes		
Constant	–1.099	–1.404
	(–1.550– –0.649)	(–1.858– –0.951)
Observations	1,042	992
R-squared	0.133	0.189

Notes: Robust 95% confidence intervals in parentheses. Linear probability estimates and confidence intervals of the association between baseline characteristics and dead/lost to follow-up in 2014.

Table A-5: Subgroup analysis using Beferroni and FDR thresholds for weekly contact models

Panel A. IFLS 1997, 2000, 2007, and 2014 as repeated cross sections				
Subgroup	Observed p-values	Rank	Bonferroni thresholds	FDR thresholds[a]
Married	0.030	1	0.005	0.005
Outside district	0.055	2	0.005	0.009
Coresident	0.065	3	0.005	0.014
1st tertile	0.069	4	0.005	0.018
60–70	0.097	5	0.005	0.023
Not coresident	0.206	6	0.005	0.009
70–85	0.328	7	0.005	0.027
In district	0.369	8	0.005	0.032
2nd tertile	0.425	9	0.005	0.036
3rd tertile	0.564	10	0.005	0.041
Not married	0.665	11	0.005	0.045

Panel B. Cohorts aged 60–85 in 2007, followed until 2014				
Subgroup	Observed p-values	Rank	Bonferroni thresholds	FDR thresholds[a]
Married	0.035	1	0.005	0.005
Coresident	0.043	2	0.005	0.009
Outside district	0.044	3	0.005	0.014
1st tertile	0.045	4	0.005	0.018
2nd tertile	0.103	5	0.005	0.023
60–70	0.237	6	0.005	0.009
Not coresident	0.312	7	0.005	0.027
In district	0.315	8	0.005	0.032
Not married	0.652	9	0.005	0.036
3rd tertile	0.736	10	0.005	0.041
70–85	0.768	11	0.005	0.045

[a] FDR thresholds are calculated using methods in Benjamini and Hochberg 1995.

Table A-6: Signal coverage and intergenerational support, 1997–2000

Variables	(1) Amount of transfer received (in)	(2) Amount of transfer given (in)
Year 2000 (ref. year 1997)	0.110	0.677
	(–0.590–0.810)	(0.083–1.271)
Will receive signal coverage	0.936	0.942
	(0.079–1.793)	(0.216–1.668)
Year 2000 X will receive signal coverage	0.399	0.438
	(–0.570–1.368)	(–0.390–1.265)
Individual and community characteristics: yes		
Constant	5.877	2.077
	(3.667–8.087)	(0.347–3.808)
Observations	3,191	3,191
R-squared	0.008	0.016
Number of subdistricts	397	397

Notes: Robust 95% confidence intervals in parentheses. Estimates and confidence intervals are from linear regressions predicting the amount of transfers received and given (logged).

Table A-7: Randomized inference coefficients on signal coverage

	P = c/n	SE(p)	[95% CI of P]
Weekly contact	0.011	0.003	[0.006, 0.020]
Amount of transfer given (in)	0.748	0.014	[0.720, 0.775]
Amount of transfer received (in)	0.76	0.014	[0.732, 0.786]

Table A-8: Signal coverage and height

Variables	(1) Height (cm)
Signal coverage	0.050
	(–0.934–1.035)
Year 2000 (ref. 1997)	0.248
	(–0.326–0.822)
Year 2007 (ref. 1997)	–0.500
	(–1.513–0.513)
Year 2014 (ref. 1997)	–0.072
	(–0.997–0.854)
Individual and community characteristics: yes	
Constant	154.474
	(150.598–158.351)
Observations	4,626
Number of subdistricts	449
R-squared	0.033

Notes: Robust 95% confidence intervals in parentheses. Estimates and confidence intervals are from linear probability models predicting height. Confidence intervals are adjusted for the clustering structure of respondents at the subdistrict level.