ABSTRACT

Title of Document:	WOMEN'S PAID LABOR FORCE PARTICIPATION AND CHILD IMMUNIZATION: A MULTILEVEL MODEL
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I estimated the effect of women's cash work on child immunization in 25 countries across Africa, Asia and Latin America using a multi-level fixed-effects model and found support for the hypothesis that all children benefit in areas with higher rates of women's labor force participation. The proportion of women working within a sub-national region (province) has a strong, positive impact on the likelihood of complete child immunization. While all children benefit from increasing levels of women's work, the children of those who work benefit more from living in areas where women's work is at higher rates. Thus, this analysis supports the view that a child's complete immunization is influenced by the larger social context associated with women's work.

WOMEN'S PAID LABOR FORCE PARTICIPATION
AND CHILD IMMUNIZATION:

A MULTILEVEL MODEL

By

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Dedication

To Rob, for your unconditional love and patience.

To Xiomara, for inspiring me.

Acknowledgements

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Introduction

The timely and complete immunization of children is a public health imperative. Although routine vaccination is a proven method for controlling disease, full immunization coverage for all children remains out of reach. This thesis explores an important determinant of child immunization in the developing world—women's paid labor force participation—to affirm the critical role of women in shaping immunization outcomes. My analysis estimates the impact of women's work on child immunization in 25 countries across Africa, Asia, and Latin America.

Much of the research on the determinants of child immunization uptake focuses on the impact of maternal education (for examples, see Parashar, 2005; WHO, 1990; Desai & Alva, 1998; Streatfield et al., 1990). I broaden consideration of maternal factors by focusing specifically on the effects of work because of the opportunities it provides for women's increased mobility, social networking, and access to resources and health information. Employing a multilevel model that incorporates individual- and province-level variables, the objective of this study is to determine whether a social context where women's work is normative also supports childhood immunization, regardless of individual women's work status. This research contributes to literature on child health by assessing effects of women's employment across a wide range of cultural and economic settings. Moreover, it measures the effects of women's labor force participation that might accrue even to women who do not themselves work.

Why Women's Work Matters for Child Immunization

International health agencies report remarkable improvements in vaccination rates among children over the last two decades. As of 2003, the World Health Organization (WHO) estimated that global DTP3 (three doses of the diphtheria-tetanus-pertussis combination vaccine) coverage was 78%, up from 20% in 1980 (WHO, 2005). In addition, 2004 data indicate that 133 countries reported 80% or greater national immunization coverage for measles vaccinations (UNICEF/WHO, 2005). The prevalence of vaccination programs and social marketing campaigns partly explains these widespread results. However, elective immunization is not a function of structural efforts alone. Child vaccination rates are influenced by various aspects of individual- and community-level access and demand (Nichter, 1995). In particular, the choices women make in the management of preventive health care for their children is decisive. There is abundant evidence that women are considered a key health resource for their families. They provide care at home, teach health care, and seek medical care for their families, including procuring immunizations (Pinelli, 1993). As the primary purveyors of household inputs for children's nutrition and overall health, the role of women is central. Understanding how work influences mothers' investments in the long term health of their children has important implications for future research and policy work on health and development.

"Work" is a fundamental aspect of daily living for women in the developing world. As women labor in both domestic and public spheres, the societal impact of women's work is shaped by gender norms and women's access to income-earning opportunities. Women's autonomy in pursuing livelihood strategies and controlling

resources earned outside the home has profound impact on the household economy and general welfare. Specifically, when compared to women whose work is paid in kind or not at all, the activities of cash-earning women have been shown to translate into improved living standards for household members.[1] In a study on women food vendors in the informal economy of Limbe, Cameroon, Fonchingong (2005) observes that women's supplemental income from informal labor is an essential cushion from economic shocks and is critical for household survival. Although inconclusive regarding the impact of women's income on the overall improvement in living conditions, another study suggests that working women in urban Accra, Ghana are responsible for significantly improving household food security (Levin et al. 1999).

Other strands of sociological literature emphasize the ways in which women's work for earnings shifts power within the household, enhancing gender equality and improving outcomes for women and girls. Bhachu (1988: 76) declares that "waged work in which women's input is measured in terms of money gives them a strong lever to create a powerbase both within the household and the wider kin group" (cited in Kabeer, 1997). Fonchingong's (2005) study reported that female vendors in Cameroon typically retain control over their earnings and take greater responsibility for major household decisions. Kabeer (1997) analyzed in-depth interviews of 60 female garment factory workers in Dhaka, Bangladesh and concluded that women's

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[1] However, other arguments suggest that women's access to cash-earning opportunities decreases their living conditions as, "men tend to put more of their traditional responsibilities on women without compensatory sharing of work in domestic activities or even some of the agricultural tasks. The ability to acquire some cash can thus make women worse off in terms of sharing the total household labour product" (Holmboe-Ottesen et al., 1989: Section 4.5). In addition, numerous studies have investigated the complex relationships between women's work in the informal sector and poverty (see for example, statistical tables and publications produced by the International Labor Organization of the United Nations).

wages dramatically transformed women's position in the household and, by extension, opened pathways to new social possibilities. Another study measuring four dimensions of women's autonomy in Egypt[2], showed that women who worked for cash displayed greater autonomy in all dimensions than non-working women and working women not paid in cash (Susilastuti, 2003). Additionally, with respect to women's control over income and access to resources, Kantor (2003) argues that home-based cash work may be less empowering to women than work outside the home. Informed by these discourses at the nexus of development and women's empowerment literatures, I expect that women's paid labor will contribute more to childhood immunization than unpaid or in-kind labor.

Literature Review: Maternal Work and Immunization

In contrast to the broad body of literature exploring the effects of maternal employment on child survival and child nutritional status,[3] few studies directly address the relationship between employment and immunization in the developing world. Existing research on this more specific health input has focused on unique localities and has not proven generalizable. In one study of immunization programs in urban Guinea, Cutts et al. (1990) concluded that mother's employment status, education level and experience with vaccination services determined whether a child who had begun the immunization series would complete it: the odds of children completing their vaccinations were higher for working mothers than non-working mothers. McQuestion & Jones (1995) examine immunization demand in Colombia

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[2] The four dimensions of autonomy defined by the study were: economic decision making, ability to take care of self when sick, freedom from violence and freedom of mobility.

[3] For further discussion, see Pena, 1995; Rogers, 1996; Handa, 1996; Kennedy & Peters, 1992.

over a five-year period. They modeled maternal occupational type on the probability of full immunization. Their results showed that the effects of women's work varied significantly by occupation, with mothers working in the professional, services and manufacturing sectors taking longer to complete the immunization schedule than mothers working at home. Their study attributed the time constraints of modern workers to issues of job autonomy and the opportunity costs of taking time off. Still another study based on a survey of 75 working and 75 non-working women in a village in Tamil Nadu, India, showed maternal work status to have no significant effect on the chances of a child being immunized against measles (Sivakami, 1997).[4]

These previous efforts to explore the linkages between women's work and children's health have emphasized individual- and household-level predictors. Yet, some authors suggest the need for multi-level analysis of causal factors, incorporating both individual- and community-level effects. For example, Kravdal (2004) and Desai & Alva (1998) argue that individual-level perspectives may be severely biased, often failing to capture the full effects of the many social determinants of health. Kravdal's multilevel analysis of child mortality in India suggests that community levels of women's education affect child survival "above and beyond that of the mother's own education" (Kravdal 2004: 177). As another example, Parashar (2005) found that a child's immunization status is influenced by the "spillover" effect of other women's education, independent of maternal education. Along similar lines, I analyze the effects of an individual mother's employment status, while also

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[4] Sivakami only considered measles due to the nearly universal immunization of local children for other vaccines.

considering whether the proportion of women participating in the paid labor force

within a community affects the probability of child immunization.

Women's Work and Child Health: Individual-Level Effects

As mentioned above, the literature remains inconclusive concerning the effects of labor force participation on child health in the developing world. The variation in outcomes is commonly explained in terms of the degree of compatibility between work and child care, and the quality of substitutes for maternal time (Blau et al., cited in Bisgrove, 1996; for a broad review of this literature, see Leslie & Paolisso, 1989). Numerous studies suggest that in the developing world women's incomes are particularly important because women are more likely than men to direct earnings toward meeting children's needs (Bennett, 1988; Senauer, 1990). Although employment does not always result in women controlling their own earnings, results from West Africa where women's control over their own earnings is normative reveal that women's cash employment plays a significant role in the nutritional well-being of both women and children (Bryceson, 1989; Tripp, 1981). In an example from Kenya, maternal cash earnings were also shown to help mitigate child undernutrition (Whyte & Kariuki, 1997). However, while maternal employment clearly increases cash availability and expenditure on children's needs, the time women spend in the labor force sometimes has undesirable consequences for general child care. Sempebwa (1988) observed that children whose mothers were working away from home more than six hours a day were less likely to be taken for immunization and medical treatment.

Of particular importance to the impact of employment on child care is the type of work a woman engages in (whether at home or away, part-time or full-time, formal or informal; see Popkin, 1980; Engle, 1983; DaVanzo & Lee, 1983). Studies

consistently show wage work to be especially incompatible with responsibilities related to child care, such as food preparation and doctor visits (for further discussion see Oppong, 1983). Much less often, non-wage agricultural fieldwork can also be incompatible with child care because it can be time intensive and far away from home (DaVanzo & Lee, 1983). The effects of women's work on child care depend on several additional factors, including the amount and quality of assistance available to the mother, and the age of the children. Lack of adequate substitutes for women's time can also negatively affect children's health. In a study of rural households in the Philippines, Popkin (1980) found that child care from older-sibling mother substitutes has net negative effects on child nutrition relative to mothers and adult substitute caregivers.

Analysis at the individual level measures the net effects of this income/time trade-off. However, I hypothesize that the total effect of women's labor force participation on children's health depends not only on the individual income/time trade-off, but also on the social context of women's work.

Women's Work and Child Health: Province-Level Effects

A rich body of literature produced in the last ten years provides much evidence of an association between community characteristics and health outcomes. Mosley and Chen's (1984) well-known framework of the proximate causes of child mortality links outcomes to socioeconomic determinants at individual, household and community levels. Indeed, empirical contributions exist across a range of public health outcomes (e.g. infant and child health, women's health, and chronic diseases) to show the impact of neighborhood characteristics, independent of individual factors (Subramanian, 2004; Diez Roux, 2001; Pande, 2003; Pickett & Pearl, 2001; Rauh et al., 2001). Based on a survey of studies relating community socioeconomic context to health outcomes, Diez Roux (2001: 1784) has concluded that "for the most part, contextual and multilevel studies have been consistent in documenting an 'independent' effect of neighborhood socioeconomic environment on individual level outcomes after controlling for individual socioeconomic position indicators".

Kravdal (2004) demonstrates the sharp contextual effect of other women's education on preventive child care and child's disease risk in India. Sastry (1996) shows evidence of community effects on child survival in Brazil and includes a thoughtful discussion of how community characteristics shape individual survival probabilities. He argues that by complementing or substituting for certain household attributes, community characteristics have an additive effect on survival chances and also help to explain regional differentials in survival outcomes. Study findings suggest that the effects on child survival of individual maternal characteristics vary by community variables such as the quantity and quality of health and sanitation

infrastructures. Overall, he found several of the community variables to have significant effects beyond what would be expected from the individual-level effects of the corresponding individual-level variables.

Women's participation in the labor force might work in a similar fashion, with even women who are not engaged in cash-based employment having higher rates of immunized children if the community context is one where it is normative for women to access those health resources. Factors such as access to immunizations are likely to be shared in common by women in a given community, which may in turn enhance their use of such health inputs. This existing literature provides reason to believe that community-level influences may indeed be relevant to working women's access and choices regarding child health and immunization. More specifically, in areas where women's work is more common, children might benefit from women's empowerment—perhaps especially mobility—and from information exchanged in work-based social networks.

Work Fosters Women's Mobility

Greater numbers of women in the workforce have been associated with increases in the status of all women (Blumberg, 1981; Bennett, 1988). Women's status includes mobility, defined as "the propensity of women to move about freely and autonomously in public" (Balk, 1994: 24). Available data on women's labor in a wide range of developing countries suggest that working women are usually highly mobile, engaging in a range of informal economic enterprises and contract employment outside the home (Chen, 2001). Indeed, the informal employment sector is the primary source of paid labor for women in most developing countries. A

careful analysis of United Nations and World Bank labor statistics published in 2000 has determined that:

> The composition of the female informal workforce varies somewhat across regions. In many African countries, almost all women in the informal sector are either self-employed or unpaid workers in family enterprises. In many countries in Latin America and Asia, although the majority of workers are self-employed or contributing family members, at least 20 percent of women in the informal sector are casual wage workers. Some additional percentage works as industrial outworkers or homeworkers and is not fully captured in official statistics (Chen, 2001: 74).

By all efforts, measuring the social effects of women's mobility is a complex undertaking. However, some studies evidence important associations between women's work, mobility, and empowerment (Balk, 1994; Greenhalgh, 1991; Kishor, 1995; Durrant & Sathar, 2000; Roushdy, 2004). Women's mobility in the public domain can increase women's social interaction and agency, buttressing women's access to and interest in an array of positive interventions for child health. Admittedly, causal explanations of the relationship between women's mobility and children's health remain understudied. However, common knowledge of the negative consequences of restricted mobility on women's health, status, education and livelihood security (among other measures of well-being) motivates further exploration of the potential positive effects of women's work, especially work outside the home. Areas where women commonly work are less likely to be restrictive of women's mobility regardless of individual work status.

Work-Based Social Networks

A limited number of studies have investigated the effects of social networks on health outcomes in developing countries. Adams et al. (2002) investigated the

implications of women's social networks for child survival in Mali, examining four types of network support: material (assistance with money, food or clothing); practical (household work and child care); cognitive (advice and information); and emotional (characterized by caring and intimacy). Among one ethnic group in their study, they found the three non-monetary forms of network assistance to function as a catalyst in the recognition and treatment of child illness.[5] Boulay and Valente (1999) researched links between women's social networks and health knowledge in Kenya. They found that membership in social clubs strengthened knowledge of modern contraceptives. They also observed that club members were more likely than non-members to discuss family planning with extended networks of women beyond their club network.

Anthropologists Guyer (1981) and Rogers (1978) have found evidence of the instrumentality of women's social ties and networks in resource mobilization. Similarly, Halvorson's (2003) findings suggest that women in Pakistan rely upon a combination of strategies to acquire health assets and knowledge for their children. Specifically, the study found that the combined effect of household income and women's engagement in social networks decreases child diarrheal disease risk. Other studies link women's participation in networks to increased control over resources. Mwaniki (1986) documents, for example, that women's "self-help" labor collectives have a thriving history in Kenya. In the Mbeere region, women's groups have engaged in a range of income-generating projects (e.g., raising pigs and building retail shops) and general development activities (e.g.: homestead improvement and

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[5] The study was a comparative investigation of the effects of social networks in mitigating adverse circumstances for child survival between two Malian ethnic groups: the Fulbe and the Bamana.

water extension projects). And despite considerable variability in women's income

autonomy in an analysis of several Grameen bank funded microenterprises, overall

women maintained significant control over their income and enterprises when

compared to women not participating in the credit programs (Hashami et al., 1996).

Women's command of work-based social and material resources are likely to

positively influence women's decision-making, service use and expenditure on health

through the dispersion of contextual effects. 'Contextual effects' are premised on two

prevailing notions: on the one hand, that shared membership of a family or larger

community modifies individual attitudes and behavior; on the other hand, that the

behaviors of some individuals in a community can influence society and the behavior

of other community residents (Parashar, 2005). Pharmaceutical anthropology

literature utilizes the concept of "local vaccination cultures" to refer to the prevailing

beliefs among members of a community about disease etiology, preventive health,

and the efficacy of modern medicine (Streefland et al., 1999). Shared notions emerge

within a collective that can influence conformity to medical practices. In the context

of women's work environments, practical information may be shared about the

location of vaccination sessions, the purpose of vaccination, and the diseases that

vaccinations are designed to prevent.

In one example of the contextual effects of both employment and linguistic

affiliation, Cutts et al. (1990) observe in Conakry, Guinea that maternal employment

proved important concerning the likelihood of children receiving the final dose of

DPT/OPV[6] only for women who spoke the dominant language. Hence, their

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[6] DPT/OPV, diphtheria-pertussis-tetanus/oral poliomyelitis vaccine

conclusions suggest that work based social networks may be important because workers who do not speak the dominant language would not have the same kind of access. Thus, it can be argued that the diffusion of information and the availability of support through work-based networks create influential channels for the externalities of women's work to have an impact on child immunization itself. Indeed, it is also conceivable that work-based social networks can have a negative effect, such as Adams et al. (2002: 175) mention may occur, "when dangerous health advice is dispensed, and/or preventive action is discouraged by influential others". Further, if women's work interferes with immunization at the individual level because of the time costs involved, norms regarding immunization could be harder to establish in areas with higher rates of women's labor force participation.

Hypotheses

In the preceding literature review, I have outlined the discursive and empirical framework upon which my central research question is based. In the absence of multilevel studies focusing on the effect of work on immunization, this analysis addresses the question: *Do labor force participation rates in a mother's area affect her child's probability of being fully immunized net of her own work status?* I have formulated three central hypotheses about the relationship of child immunization and women's labor force participation.

1) Individual women's labor force participation does not have a significant influence on immunization outcomes because the net effect of the income/time trade off could be highly variable and net out to zero in the aggregate. However, it is possible that women's work has some positive effect at the individual level because work confers status and mobility to individual women.

2) Child immunization is more prevalent in areas where women's labor force participation is at higher levels, independent of an individual woman's employment status. Increases in women's mobility and status in sub-national regions associated with labor force participation can have spill over effects for all women across diverse employment situations, effectively expanding the reach of health information and services.

3) The benefits associated with high rates of women's labor force participation will be lower where more women work at home. Where women's work does

not promote women's mobility or social networking, the positive effects of

work may not be very pronounced.

Study Design

To test the hypotheses, I model the probability of immunization as a function of women's work status and proportion of women in the labor force in the community. This study is designed to explore the effect of work in two stages: first, by conducting a descriptive examination of women's employment and full immunization at the national level; second, by employing a multilevel fixed effects model to estimate the impact of women's work when controlling for other explanatory variables of interest not captured in univariate and bivariate descriptive analysis. I utilize a multilevel modeling method for the purposes of adding predictive power and precision to an understanding of causal community effects. A range of demographic studies employs multilevel models to explore maternal-, household- and community-level factors affecting health (Pebley, 1996; Sastry, 1996; Entwisle et al., 1996). Sastry (1996), for example, added community-level explanatory variables to child-level and household-level variables to model child mortality in Northeast Brazil. Subramanian argues that "multilevel models are a means to empirically testing the different circumstances under which neighborhood differences remain or get explained away" (Subramanian, 2004: 1963). Multilevel modeling is also appropriate for this analysis because it allows sub-national regional differences across the sample to be viewed randomly, as a 'population' of communities "modeled as a function…of individual as well as neighborhood exposures" (Subramanian et al., 2003).

However, identifying community effects can be difficult for a variety of reasons (Diez Roux, 2004; Kravdal, 2004). Pearl et al. (2001) caution that

community level associations may reflect unmeasured factors at the individual level. Similarly, Diez Roux (2001) points out the need to distinguish between the effects of context (properties of a given area), and compositional effects (the aggregated characteristics of individuals living in a particular area). Rauh et al. (2001) raise concerns about the radius of influence of area conditions. They argue that large 'communities' defined for research purposes "may not conform to the boundaries that define an individual woman's sense of space" (2001: 1822).

Here I am not seeking to measure the effects of communities that individual women interact within, but rather how areas differ according to the economic opportunities that they afford women. Therefore, I chose large sub-national regions (called provinces in many countries) that reflect general labor market opportunities. For instance, maternal employment may involve migration to localities beyond a woman's residential community. Thus, measuring the effect of work at the province level may capture important unobserved cross-community interactions. Also, social and cultural variables that can shape female labor force participation and immunization preferences tend to extend beyond the village level. Provinces sometimes reflect historically strong regional patterns and socio-cultural norms that confer complex and multifaceted social influences. Because women's work is associated with women's mobility, status, and access to work-based social networks, it is theoretically plausible that meaningful province-level effects exist.

Numerous unobserved province-level factors may actually determine both the proportion of women working and the level of immunization. I include control variables that reflect the socioeconomic development of the province in which a

woman is located. However, the set of these controls is incomplete and does not cover other possible omitted variables. Therefore, I also include province-level fixed effects to account for at least the unobserved time-invariant factors.[7]

Data and Methods

The data used in this research are from the Demographic and Health Surveys (DHS), spanning 14 years from 1990 to 2004 (Rounds II-IV). I use data from 25 countries that had more than one Demographic and Health Survey after 1990. For each country, I include two survey years spaced four to ten years apart. Table 2 (see Appendix) lists, by survey year, the countries and sub-national regions included in the aggregate analysis. I omit countries for which the provinces identified were not compatible across the surveys. In all, 190 such provinces define the focal units of analysis. Additional countries with too much missing data in key variables were dropped.[8]

The child immunization data are linked to individual records of reproductive age (15-49) women. The sample is restricted to children 12 to 35 months of age because the WHO recommends that infants should receive all immunizations in the first year of life. The selected age range thus optimizes the number of children with

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[7] While not all DHS countries included in the study sample define their sub-national regions as provinces, I have chosen to use the term "province" for convenience. For example, some countries use the terms "state" and "governorate". Despite terminological differences, it should be noted that the level of aggregation used is comparable across all countries.

[8] For example, Turkey was dropped because only one of the two survey years that were available had all relevant variables for women's work. The 1993 survey only asked whether women were "currently working" and to describe their "occupation"; there were no data on women's work for earnings status or work location. Thus, such countries had to be discarded because they could not be analyzed through time.

exposure to the full range of vaccinations. Summarily, I include 189,416 children in my analysis, with one child per woman.[9]

Key Variables: Defining 'Work' and 'Immunization' Levels

The key independent variable is maternal work, measured by the respondent's work-for-earnings status at time of interview [WORK]. Country and province levels of cash work are measured by the proportion of women who are working in the entire country [CWORK] and province [PWORK], respectively. Across the sample, 39% of women work for cash.[10] In the fixed effects model, work location (i.e.: at home or away) was added after the overall effect of work was estimated. This serves to indicate how much of the effect of work depends upon maternal work location. Work location is only defined for cash earning women.

Child's immunization status is the dependent variable. The reference category is no immunization or incomplete immunization, and "1" represents full immunization (3 DPT, 3 Polio, 1 Measles, 1 BCG). The immunization variable was structured in this manner following the precedents of previous multilevel studies in the developing world (for examples, see Kiros & White, 2004; McQuestion & Jones, 1995; Steele et al., 1996). Further, because vaccine-preventable diseases infect unimmunized or *under*immunized children, focusing on the children who have

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[9] A study by Streefland et al. (1999) based on vaccination patterns in Bangladesh, Ethiopia, India, Malawi, the Netherlands and the Philippines found that parents' acceptance of vaccination may change "between one child and the next, in the course of one child's vaccination career, or in the case of a specific vaccination". However, I am not convinced that women's vaccination behavior is as random as Streefland et al. suggest. For this analysis, I have randomly selected one child per woman to avoid bias caused by individual woman fixed effects and overrepresentation of women with short birth intervals in the sample.

[10] Women are regarded as working if they responded "yes" to DHS survey questions v714: 'Are you currently working?', and v720: 'Do you earn cash for your work?'.

followed the full immunization schedule emphasizes the best practices that greatly reduce childhood disease and mortality. Descriptive statistics reveal that 51.6 % of children in the sample are fully immunized, and 17.2 % have received only some vaccinations. Preliminary analysis also revealed that women's work rates contributed to full immunization, but not to partial immunization.

In DHS surveys, child's vaccination history is determined by an immunization record on a child's health card presented by the mother at interview. Data quality from health card information is high, although mothers do not always have their cards and must produce immunization information for their children based on recall. The data based on recall may be of lower quality. This analysis nevertheless uses both health card information and mothers' verbal reports. Some authors have provided convincing arguments for the accuracy of mothers' reports, and insist that "dropping such cases can cause severe sample attrition" (Langsten & Hill, 1998; Desai & Alva, 1998; as cited in Parashar, 2005). I do not include the immunization data on children who have died, as there is much variation across surveys in the extent to which vaccination histories of dead children were obtained. Further, I created a series of dummy variables representing provinces for a hierarchical model where children are nested within provinces.

Socioeconomic Characteristics

Other studies focusing on the determinants of immunization highlight maternal education (Pillai & Conaway, 1992; Lanata & Novara, 1991). Cleland (1989: 17) presents strong evidence that education probably "enhances knowledge about effective ways to prevent, recognize and treat childhood illnesses" (cited in

Streatfield et al., 1990). For this analysis, the effect of women's education is examined in three categories based on a woman's highest level of educational attainment. Individual education is represented by a set of dummy variables with no education as the reference category and primary education distinguished from secondary and higher. Province-level education [PYEARSEDUC] is the average number of years of schooling among women of reproductive age in the province.

As is common in developing country analyses, wealth is proxied by assets (e.g.: Montgomery et al., 2000). I have created an index for wealth based on housing quality and consumer durables in the household. This wealth index also provides a hidden measure of the father's contribution to the household. A study that surveyed 8000 mothers in the Philippines on their use of immunization and other child care services found household assets to be important determinants of access to services (Becker et al., 1993). The study found, for example, that children in urban households with piped (or pumped) water had three times the odds of having some immunizations and seven times the odds of full immunization (versus none) relative to children in households that used an open-water source. Similarly, children in households with any toilet had approximately twice the odds of having partial or full immunizations relative to those who had no toilet in both urban and rural areas.

For this analysis, measures of wealth include availability of: (1) piped water, (2) flush toilet, (3) electricity, (4) radio, and (5) floor material other than dirt in the house. The sum total (0-5) of these assets comprises the wealth variable [WEALTH]. This is also averaged within provinces to create PWEALTH. Averaged among five asset variables, the mean wealth score for the entire sample is 2.11.

Place of residence is also included at the individual level [URBAN] and the province level [PURBAN]. Area of residence has been shown to affect immunization in previous work (e.g., Lanata & Novara, 1991). Moreover, women who live in rural areas of predominantly urban communities may experience more advantages associated with proximity to urban centers than those who live in predominantly rural communities. PURBAN is the proportion of the region's population that lives in urban areas.

Other Independent Variables

Following Matthews and Diamond (1997), I also included birth order, child's age, sex of child, and mother's age. Several authors provide additional support for the validity of these control variables. Pande (2003) observes patterns of selective neglect in immunization across siblings in India based on birth order. Parents are more likely to immunize ("wanted") first male and female children, and tend to neglect ("unwanted") higher birth order females. Maternal age has been included in the model because older cohorts may not have been consistently socialized to seek out vaccinations. Child's age is relevant to the schedule of planned immunization as well as to the perceived benefits. In rural India, Pande (2003) showed that the odds of child immunization decrease with age, suggesting perhaps that children who are not immunized close to the recommended age may miss critical opportunities for vaccination, particularly where vaccination campaigns have specifically targeted younger children.

Additionally, a dummy variable for whether there is another reproductive-age woman in the house [OTHERWOMAN] is meant to proxy the availability of

substitute caretakers of a woman's children; research on maternal time allocation and child health has frequently identified this as a mediating variable. In households where large amounts of women's time are spent away from the home, the availability of adequate caretakers can have ramifications for the timely receipt of vaccinations and general health care. For women with multiple children and no additional caretakers, "having several children in tow can serve as a major deterrent to seeking clinic-based care" (Coreil, 1991: 230).

I have also created a set of dummy variables for survey year. Clearly, the association between work and immunization may be affected by temporal changes in the accessibility of vaccination or perceptions of disease risk.

Descriptive Analysis

Descriptive statistics for the sample, at both the individual and province levels are included in the Appendix. In the entire sample, over one-third of women are urban (36%), and nearly two-thirds (64%) are literate, with two-thirds (67%) having completed at least a primary education. Thirty-nine percent work for cash, with 26.7% working away from home and 12.3% working at home. Over half of the children in the sample (51.6%) are fully immunized.

National trends in the bivariate relationship between maternal paid labor and immunization suggest the need for further investigation of the contextual pathways in which community levels of work matter. Figure 1 represents current levels of women's paid labor force participation and full immunization across the 25 countries included in the study. Seemingly, the percentage of fully immunized children in a country decreases as the proportion of working women increases. However, in the absence of knowledge about in-country disparities in wealth, access, and normative health behaviors, it is unclear whether the negative relationship between work and immunization is spurious.

Figure 1.
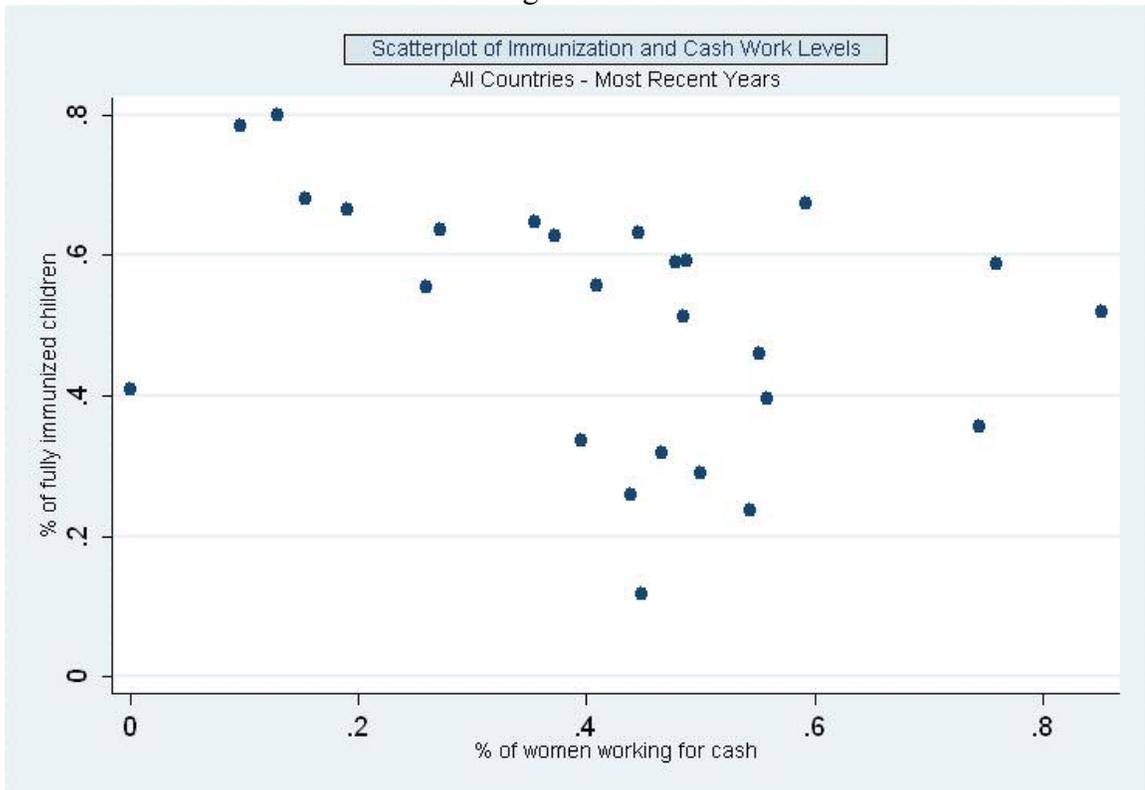
Table 1 (below) presents changing levels of both work and immunization through chronological time. The table exhibits widely varying results: women's labor force participation improved in 18 countries between the early year and recent year data, and full child immunization increased in 15 countries during the same periods of time. If there were a negative relationship between work and immunization, as Figure 1 suggests, those areas that saw the most growth in labor force participation would also see the least improvement in immunization, all else being equal. However, Table 1 illustrates that positive change was observed in both variables in 11 countries and negative change in both variables in an additional 3 countries. The other 11 countries exhibited an inverse relationship between the variables of interest.

Table 1.
Changes in country levels of women's paid labor force participation
and full child immunization (1990-2004)

Region/Country	% Change in women's paid employment	% Change in full immunization levels
South Asia		
Bangladesh (1994-2004)	+3.6	+17.3
Philippines (1998-2003)	-7	-1.9
South America		
Bolivia (1994-2003)	+6.4	+23.5
Brazil (1991-1996)	+2.3	+8.2
Colombia (1990-2000)	+12.4	-35
Guatemala (1995-1999)	+3.7	+12.4
Peru (1992-2000)	+0.5	+0.9
The Caribbean		
Dominican Republic (1991-2002)	+7	-1.6
Haiti (1995-2000)	+17.6	-2.2
North Africa		
Egypt (1992-2000)	-1.8	+18.9
Morocco (1992-2003)	-2.7	+8.6
Sub-Saharan Africa		
Benin (1996-2001)	+1.4	+9.7
Cameroon (1991-1998)	+32	-1
Ghana (1993-2003)	+10.3	+20
Kenya (1993-2003)	+4.5	-14.4
Madagascar (1992-1997)	-24.3	-10.4
Malawi (1992-2000)	-0.1	+2.2
Mali (1996-2001)	+5.5	+2.4
Niger (1992-1998)	+5.3	+3.1
Nigeria (1999-2003)	+7.4	+2.1
Rwanda (1992-2000)	-40.9	-2
Tanzania (1992-1999)	+19.6	+9.3
Uganda (1995-2001)	+17.3	-0.6
Zambia (1992-2002)	-12.4	+11
Zimbabwe (1994-1999)	+4.5	-3.2

Positive associations are visible in South Asia and across most Latin

American nations, while sub-Saharan Africa encapsulates a broader range of

relationships. Despite the inverse relationship shown in North Africa, decreases in

levels of women's work attendant with increases in immunization may indicate the

pervasiveness of conservative gender norms constraining women's employment

opportunities alongside targeted government investments in child health. In the

Caribbean nations of Haiti and the Dominican Republic, perhaps the reverse principle

is in effect. Increasing women's work force participation and decreasing

immunization may point to the effects of spreading immiseration in these conjoined

island nations.

Amidst these fluctuations, a more detailed picture of the work-immunization

association manifests when taking regional variation at the province level into

account. As an example, the sub-Saharan African nation of Ghana is comprised of

ten provinces that vary in terms of socioeconomic, demographic and cultural

character. In 1993, a positive, linear relationship between work and immunization

can be seen (Figure 2).

Figure 2.
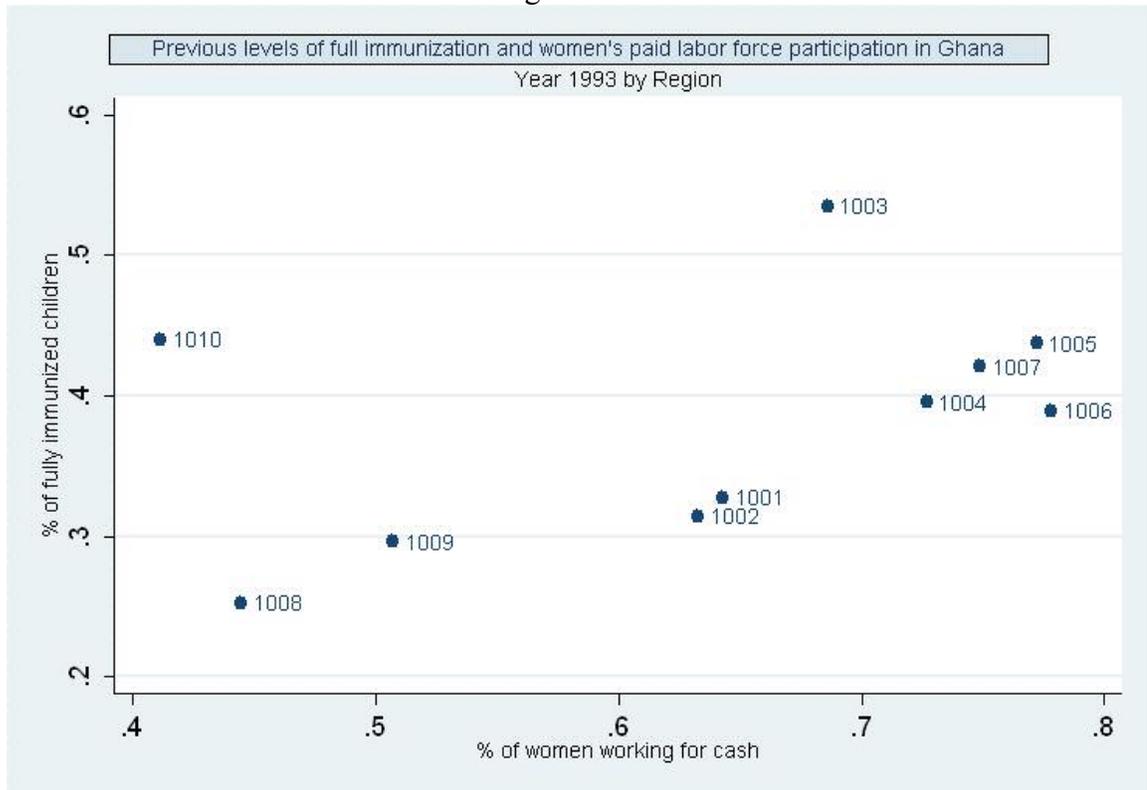
Full immunization is highest in Greater Accra (scattergram point 1003).

Preventive health services are most concentrated in this province, which includes the

country's capital city and largest metropolitan hub. Similarly, Ghana's central

provinces of Volta and Brong-Ahafo (1004 and 1007), characterized by middle range

socioeconomic success, reflect average immunization levels. Unsurprisingly, the

impoverished and poorly educated provinces of northern Ghana (1008 and 1009)

have relatively low levels of vaccination when compared to the more affluent coastal

regions (1005, 1006). The Upper East province (1010), a poor region in the north, is

a notable outlier. Regarding immunization coverage, the Upper East's parity with

region's where women's work is higher reflects remarkable national government

health investments in maternal and child health, undertaken in 1992 and expanded

under the auspices of the Navrongo Health Research Centre pilot project (Nyonator et al., 2005).

By the year 2003 (Figure 3), the best performing provinces for female labor force participation are also the most improved for full immunization. The northern region (1008) still reflects low immunization rates. However, due to the successful scaling up of the Navrongo Project and the government launch of the Community-based Health Planning and Services Initiative in 2000 (Phillips et al., 2005), the Upper East and the Upper West (1009, 1010) show higher immunization levels than their socioeconomic standing would predict. Overall, the positive relationship between work and immunization previously observed in 1993 has diminished. The homogenization of paid employment and immunization may in fact signify that no relationship exists.

Figure 3.

30
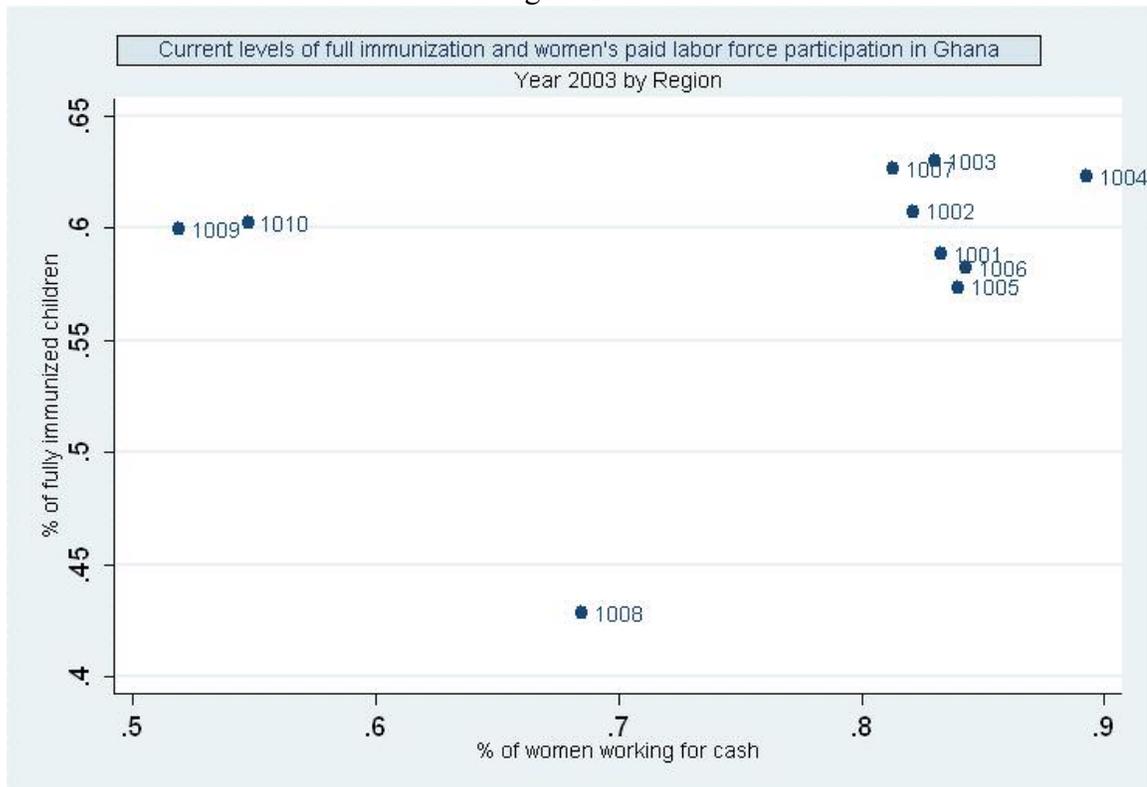
In the case of Haiti, which exhibits a marginal decline in immunization and double-digit gains in women's paid employment over time, negative and positive associations can be observed in the earlier and latter years, respectively (Figures 4 and 5 on the following page). In sum, country-level descriptive analysis demonstrates a combination of positive, negative and no relationship scenarios. As a result, the general effect of women's work remains indiscernible. Moreover, the bivariate illustration does not convey whether existing associations are compositional or contextual; that is, whether immunization levels reflect the compositional effects of individual women's work and background characteristics alone, or whether immunization is affected by the group effects of the overall proportion of women working. To address these limitations, I pooled regional data across countries to incorporate into a multilevel fixed effects model.

Figure 4.

Previous levels of full immunization and women's paid labor force participation in Haiti
Year 1995 by Region

Figure 5.

Current levels of full immunization and women's paid labor force participation in Haiti
Year 2000 by Region
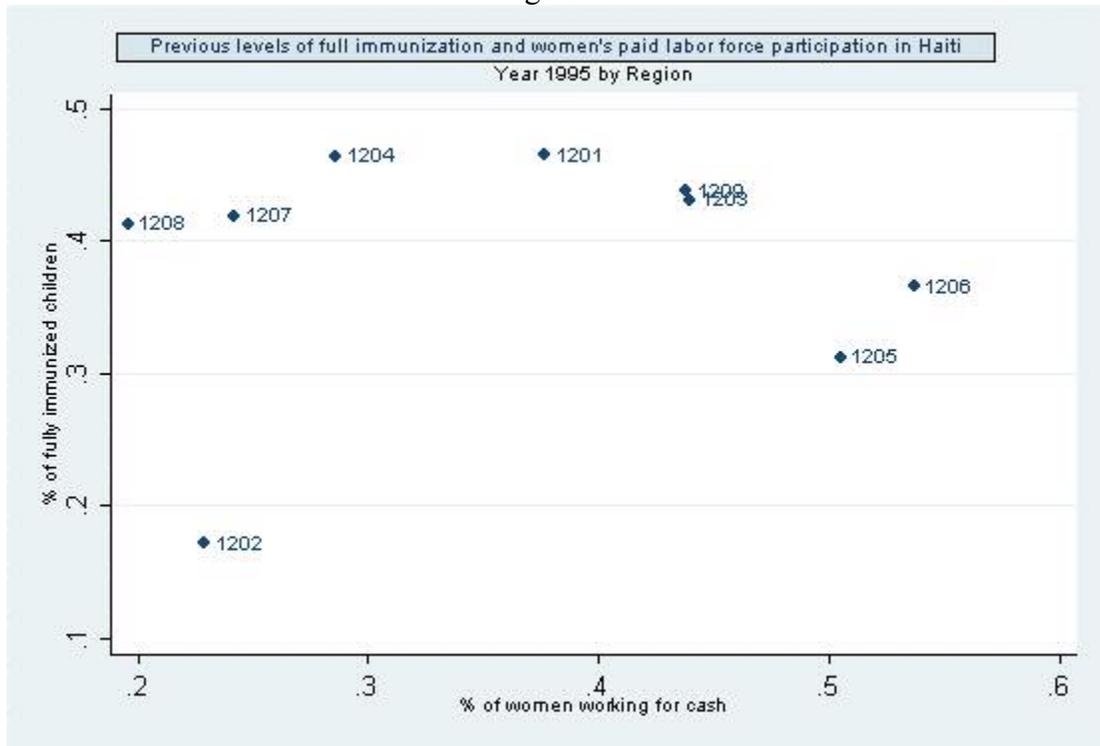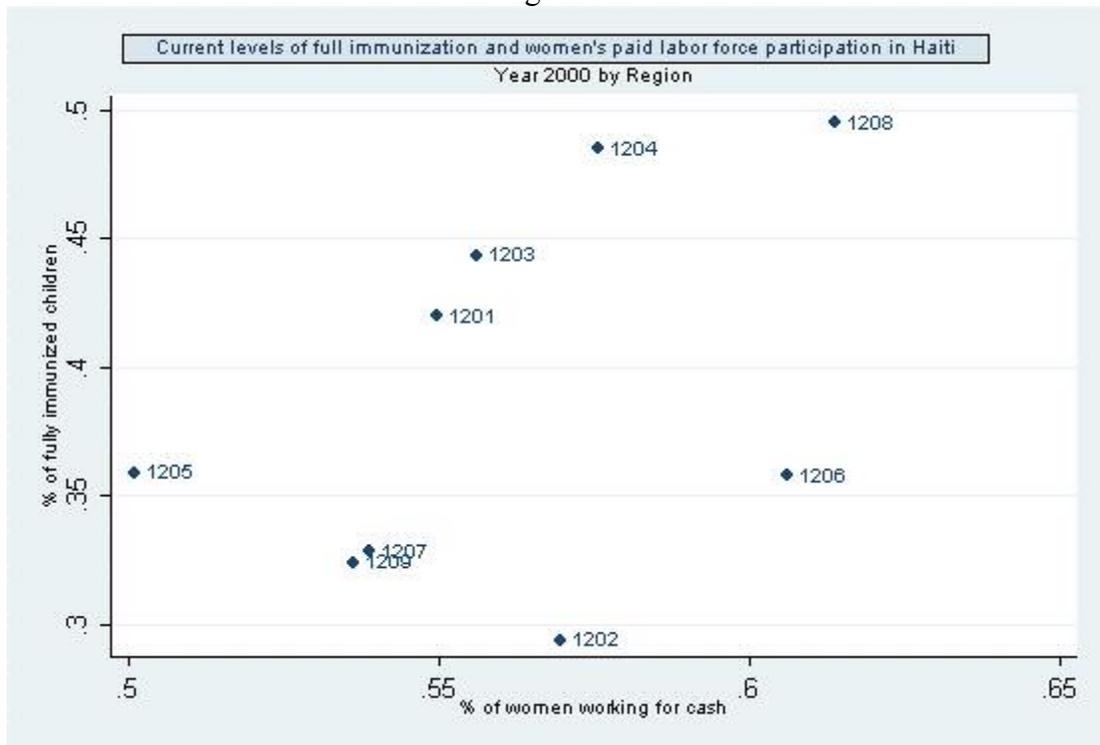
Multilevel Results and Discussion

I use multilevel regression models to examine whether province-level women's labor force participation rates affect a child's probability of being fully immunized. In Model 1a, I estimate the effect of province-level female workforce participation on a child's immunization status, controlling only for the region in which the woman lives and the year of the survey. Model 1b estimates the individual-level effect. Model 1c includes the contribution of both levels of work, and Model 1d adds a cross-level interaction to test whether work context affects the immunization probabilities of workers and non-workers differently.

In Models 2a and 2b, I introduce provincial and individual controls, respectively, to explore whether the relationships observed in Model 1 remain consistent. Model 2c again adds a cross-level interaction term. In effect, these models estimate the effect of women's work in the province on immunization when controlling for (a) other relevant province-level factors, and (b) individual and household factors. Together, they assess the extent to which individual, household, and province factors explain the observed relationship between women's work levels in a province and child immunization. These models allow separation of the effects of context and of composition. Because provinces can be thought of as contexts with individuals nested within them, Model 2a examines the effects of individual-level attributes that women living in certain provinces may share (composition). Model 2b shows the residual contextual effect after controlling for those characteristics of individuals within provinces. Further, Model 2c tests whether the effects of work context depend on individual work status when accounting for all controls. Finally,

Model 3 includes work type characteristics to examine differential effects by work location. Tables 4 and 5 report the stepwise results of this analysis.

Overall Effect of Work

Model 1a shows the positive and significant relationship between the proportion of women working for cash in a province and a child's full immunization status (0.455). An individual woman's work is also positively associated with full immunization in the absence of any control variables (0.131; Model 1b). When province and individual levels of work are included in the same model (1c), the effect of individual work remains about the same, while the province-level coefficient shows a moderate decrease. These results confirm that the proportion of women working has a positive effect on child immunization over and above the positive effect of the individual woman's work. When controlling for region, year, and individual employment, a one standard deviation increase (0.196) in the proportion of women working for cash in a province increases the log odds of a child's being completely immunized (relative to being partially and not being immunized) by a factor of 0.065 (0.332*0.196=0.065).

Upon examining the cross-level interaction of individual employment and proportion employed in Model 1d, results confirmed that individual working women benefit more from their work status in provinces where women's work is normative than where it is less common. Because the cross-level interaction is significant and positive, women's work at both levels is mutually reinforcing. Thus, all women regardless of their work status benefit from the contextual effect of women's work for cash, but working women benefit even more.

Model 2a includes the province-level variables that may lie causally before work status—proportion urban as well as average levels of wealth and education. Results indicate that the proportion of women working in the province still augments immunization even when controlling for these factors. The log odds of complete immunization increases by a factor of 0.083 when the proportion of women working in the province increases by one standard deviation (0.428*0.196=0.083).

Other individual and household variables are added to Model 2b, including maternal work, education, age, area of residence, substitute caretaker and wealth. Child's sex and birth order are also controlled for because of known relationships with immunization that can affect differential outcomes among children in a household. When controlling for individual characteristics to test the robustness of the work effects, the analysis shows that the individual woman's work status no longer matters for her child's full immunization status, but the proportion of women working for cash in her province does still matter. In fact, individual cash work turns out to have a negative impact on immunization (-0.055) when controlling for other individual-level factors.

Interactions between maternal work and province-levels of women's work provide information on how an individual woman's employment status can complement or substitute for the broader context of women's labor force participation (Sastry, 1996). Despite the negative coefficient for individual employment in Model 2c (-0.196), positive and significant cross-level interaction results (0.330) provide further evidence that maternal work and the proportion of women working in a province complement one another, such that an increase in the proportion working

will benefit the children of working mothers more greatly. The total effect of employment for mothers who work in a province one standard deviation (0.196) above the sample mean is -0.07 (-0.07 = -0.196 + [0.196*(0.275 + 0.330)]). In effect, one standard deviation increase in the proportion of women working in a province reduces the negative effect of maternal work by 64%.

Importance of Education and Other Socioeconomic Variables

In a test of the effect of average education without any controls (not shown), education shows a significant and positive influence on full immunization (0.049). This beneficial effect of community education on child health outcomes is supported in the literature (for examples, see Parashar, 2005; Kravdal, 2004). Province-level education retains its positive effect (0.051) when individual controls are present (excluding individual work). However, this positive effect is reversed when controlling for women's paid employment at any level of analysis. Indeed, the province-level average education shows a significant negative association with immunization (-0.167) in Model 2a, which incorporates the province-level variables of women's work, education, proportion urban, and wealth. When the full set of individual controls are added in Model 2b, the negative effect of average education decreases by approximately half (-0.079). On the other hand, individual women's education had a consistently significant positive effect, obtaining coefficients as high as 0.244 for women with primary education and 0.420 for women with secondary schooling and higher. These findings indicate that maternal education promotes child immunization, but that the positive effect of education at the province level may derive from the ways in which education promotes work.

As anticipated, a positive relationship exists between province wealth and health. However, children are less likely to be vaccinated as provinces become more urbanized. Urban expansion in developing countries is sometimes accompanied by the proliferation of slums and associated socioeconomic deprivation that bears consequences for overall health. Some studies suggest that low income urban populations suffer a double burden of epidemiological disadvantage, showing troubling levels of both communicable childhood diseases as well as non-communicable lifestyle diseases characteristic of urban settings (UNCHS, 2001). Urban population densities can overwhelm local health resources, diminishing individual women's prospects for quality care. In addition, for urban working women whose livelihood resources are derived solely from cash income, the opportunity costs of leaving work to procure immunizations may seem too great. A study on maternal health care in 23 Sub-Saharan African countries found that physical proximity to health facilities does not necessarily guarantee access by the urban poor, who may be constrained by unwillingness to take time off from income-earning activities and economic deprivation (Magadi et al., 2003). The relatively low average wealth score (2.11 on a scale of 0 to 5) in this analysis may reflect a significant but unmeasured number of urban poor in addition to the high proportion of rural dwellers (0.63) in the overall sample. Further, efforts to expand the reach of immunization services into more remote areas may explain why increases in urbanization do not predict increases in immunization even though immunization is still more likely in urban areas.

The presence of substitute caretakers in the household showed a significant negative effect (-0.064). This negative finding may be affected by the ages or other relevant characteristics of the caretakers not provided in the dataset. Children left in the care of adolescent relatives, for example, may be less likely to be vaccinated due to the limited health knowledge or mobility of their caretakers.

Importance of Bio-Demographic Factors

In all models, higher birth order infants are less likely to be fully immunized. This finding is unsurprising given that higher order infants are born into families with other young children who may compete for mother's time and resources (Munshi & Lee, 2000). While the persistence of gender differentials in immunization in some countries is well known, gender appears to have no significant effect on the likelihood of complete immunization in my sample as a whole. Gender-based preferences may not be pervasive in all countries, thus canceling out effects of cultural- or community-specific discrimination.

In all models, both maternal age and child's age showed positive and significant effects for full immunization. As expected, older children in the sample are more likely to have completed the immunization schedule than younger children. The positive effect of mother's age (0.020) runs contrary to evidence from the literature that older mothers may not have been socialized to seek out vaccinations. The inclusion of relatively recent data in this analysis probably counteracts this assumption.

Effects of Work Location and Other Characteristics of Work

WORK and PWORK variables were dropped from Model 3 because all cash earning women are represented either in the "working at home" or "working away" variables. In Model 3a, which is inclusive of the remaining province-level controls, the proportion of women working away from home has a strong positive impact on immunization (0.508), while proportion working at home is equally significantly negative (-0.505). Model 3b explores the true contextual effect of women's work outside the home by adding individual-level controls to remove compositional effects. In this model, the proportion of women working away from home has an even stronger influence on immunization (0.616), indicating that children residing in provinces with higher proportions of women working outside the home are more likely to be fully immunized regardless of whether their mothers work outside the home or not. One standard deviation (0.159) increase in the proportion of women working away from home increases the log odds of full immunization by a factor of 0.097 (0.616*0.159=0.097).

Individual work "away" is negative (-0.093), again recalling the compromises a woman must make given the income/time trade-off.   Individual women who work away from home are less likely to get their children vaccinated; the distance to work may put greater pressures on their time than home-based workers experience. However, adding a cross-level interaction term for work away in Model 3c, revealed that increases in the proportion of women working away benefits individual women working outside the home even more than their non-working or home-based counterparts. The children of all women are more likely to be immunized where more

women work away from home, but the additional advantage to living in a province with high work rates accruing to women who work outside the home offsets some of the negative effect of their own work status. Compared to the coefficient for an individual woman working away from home (-0.170), the total effect for the child of a mother working away from home in a province one standard deviation (0.159) above the mean is (-0.046)—a 73% reduction in the overall negative effect (-0.046= -0.170 + [0.159 * (0.535+0.237)]). In all, province-level coefficients of women's work away from home support the argument that women's mobility positively affects child health.

Conclusion

Contrary to hypothesis 1, individual women's paid employment is significantly negative for full child immunization, when controlling for individual- and/or province-level predictors. These results are supported by an extensive literature on the maternal income/time trade-off, which suggests (somewhat inconclusively) that a woman's work may interfere with health and child care practices. Additional findings from the multilevel analysis support my hypotheses about province-level effects of work. With respect to hypothesis 2, the multilevel logistic regression models show that the proportion of women working in a sub-national province has a strong independent effect on the odds of complete child immunization. Indeed, the proportion of women working has an impact beyond a woman's individual employment status.

As a complement to previous studies showing a positive association between education and the use of modern preventive services, individual maternal education was also shown to be an important determinant of child immunization. However, an independent positive effect of average education in a province did not remain when controlling for work. Increases in province-levels of education may in fact benefit child health outcomes by promoting women's work. A particularly important finding is that the proportion of women working retains an independent effect on complete immunization even when controlling for individual and province levels of education and wealth.

While the specific influence of women's work-based social networks on child health cannot be confirmed within the scope of this study, proportion of women

working away from home supports the hypothesis of an important contextual effect of women's mobility. The high degree of mobility experienced by women working outside the home has positive ramifications for the immunization of all children in a province, even those whose mothers do not work or work at home.

Limitations of the current study need to be acknowledged. Primarily, due to data limitations, I have been unable to address the contribution of some other factors that affect child immunization. Although I have attempted to capture unobserved variables with province fixed effects, this analysis lacks discrete controls for important health provision variables, such as quality of area health services and frequency of immunization campaigns. Also, because of wide variability in the types of paid employment women are engaged in across countries, I am unable to clearly ascertain the specific routes through which women's work characteristics contribute to immunization.

In conclusion, the study results reveal that maternal work for earnings at the province level has a strong, positive impact on child immunization. The otherwise positive effect of the mother's own employment diminishes when accounting for province effects. Further, even when controlling for relevant compositional variables, all women benefit from increasing levels of women's work, and those who work benefit more. Thus, this analysis supports the view that a child's complete immunization is influenced by the larger social context associated with women's work. In addition, I have drawn upon the literature to argue that the broad context of women's work matters for child immunization in large part due to the ways in which work contributes to women's mobility and information exchange through work-based

social networks. While work networks are not the only mechanisms through which employment affects vaccination behavior, the results of this analysis show support for the notion that key social learning about health occurs when women work and engage each other outside the home. And, evidently, such social learning operates for the benefit of all women in a province. Though more analysis is needed to further illuminate the relative benefits of women's cash earnings, autonomy, and work-based networking as they relate to the positive contextual effect of employment, this thesis indicates a promising way forward for future research on the unequivocal importance of women's paid labor force participation on child immunization outcomes.

Appendices

Table 2. Countries, Survey Years and Provinces

Region/Country	Survey years	Number of Provinces
South Asia		
Bangladesh	1994, 2004	5
Philippines	1998, 2003	13
South America & the Caribbean		
Bolivia	1994, 2003	9
Brazil	1991, 1996	9
Colombia	1990, 2000	5
Dominican Republic	1991, 2002	8
Guatemala	1995, 1999	7
Haiti	1995, 2000	9
Peru	1992, 2000	13
North Africa		
Egypt	1992, 2000	3
Morocco	1992, 2003	6
Sub-Saharan Africa		
Benin	1996, 2001	6
Cameroon	1991, 1998	5
Ghana	1993, 2003	10
Kenya	1993, 2003	7
Madagascar	1992, 1997	6
Malawi	1992, 2000	3
Mali	1996, 2001	9
Niger	1992, 1998	6
Nigeria	1999, 2003	5
Rwanda	1992, 2000	5
Tanzania	1992, 1999	21
Uganda	1995, 2001	4
Zambia	1992, 2002	9
Zimbabwe	1994, 1999	7

Table 3a. Descriptive Statistics, Individual-Level Variables

Variable	Number of Observations	Mean	S.D.
Work	189268	.397093	.4892969
Athome	186079	.1188259	.3235844
Away	186079	.2675208	.4426674
Urban	189416	.3662098	.481769
Literate	159848	.6441119	.478783
Noeduc	189416	.3248353	.4683145
Primary	189416	.4101924	.4918698
Secplus	189416	.2649354	.4413
Otherwoman	189416	.3206012	.4667089
Momage*	189416	28.67809	7.209247
Kidage**	189416	27.11644	16.61475
Boychild	189416	.507143	.4999503
Wealth***	188544	2.106118	1.652634

*Range: 12-49 years of age   **In Months   ***Index score ranges between 0 and 5

Table 3b. Descriptive Statistics, Province-Level Variables

Variable	Number of Observations	Mean	Standard Deviation	Min	Max
Proportion fully vaccinated	189416	.5161127	.168704	.0938851	.798684
Proportion working	189416	.3969055	.1969909	.0265487	.9565217
Proportion of urban residents	189416	.3662098	.2483136	.025	1
Proportion working at home	189416	.1179512	.0807265	0	.4299065
Proportion working away	189416	.2652257	.159569	0	.7777778
Average education among women (years)	189416	4.657335	2.482126	.3566177	10.51198
Consumer items index for community	189416	2.104741	1.114716	.3865546	4.875494

Table 4.
Logistic Regressions - Effects (with standard errors) of work and other variables
on the likelihood of full vaccination among children[11]

	Model 1a	Model 1b	Model 1c	Model 1d
Province-level coefficients				
Proportion working	0.455*** (0.074)		0.332*** (0.075)	0.264*** (0.080)
Average education among women (years)				
Consumer items index for community				
Proportion urban				
Proportion working away				
Proportion working at home				
Cross-level coefficient				
Work (Individual) x PWork (Province)				0.149* (0.064)
Individual-level coefficients				
Mother's employment status				
Not working (ref category)				
Working		0.131*** (0.011)	0.123*** (0.011)	0.059* (0.029)
Mother's education				
No education (ref category)				
Primary				
Secondary and above				
Mother's age				
Child's age				
Birth order				
Sex of child (boy)				
Substitute caretaker				
Urban				
Consumer items index				
Work characteristics				
Working away				
Working at home				

Significance levels: * $p<0.05$ **$p<0.01$ ***$p<0.001$

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[11] Included in every model were fixed effects for region and year, consisting of a set of 190 regional dummies and dummy variables for year.

Table 4. (continued)
Logistic Regressions - Effects (with standard errors) of work and other variables
on the likelihood of full vaccination among children

	Model 2a	Model 2b	Model 2c
Province-level coefficients			
Proportion working	0.519***	0.428***	0.275**
	(0.075)	(0.082)	(0.096)
Average education among	-0.167***	-0.079**	-0.074**
women (years)	(0.025)	(0.026)	(0.026)
Consumer items index for	0.681***	0.464***	0.458***
community	(0.051)	(0.055)	(0.055)
Proportion urban	-0.341*	-0.482**	-0.473**
	(0.144)	(0.153)	(0.153)
Cross-level coefficient			
Work (Individual) x			0.330***
PWork (Province)			(0.068)
Individual-level coefficients			
Mother's employment status			
Not working (ref category)			
Working		-0.055***	-0.196***
		(0.042)	(0.031)
Mother's education			
No education (ref category)			
Primary		0.244***	0.245***
		(0.014)	(0.014)
Secondary and above		0.420***	0.423***
		(0.019)	(0.019)
Mother's age		0.020***	0.020***
		(0.001)	(0.001)
Child's age		0.046***	0.046***
		(0.000)	(0.000)
Birth order		-0.059***	-0.059***
		(0.003)	(0.003)
Sex of child (boy)		0.011	0.011
		(0.011)	(0.011)
Substitute caretaker		-0.064***	-0.064***
		(0.011)	(0.011)
Urban		-0.011	-0.008
		(0.015)	(0.015)
Consumer items index		0.104***	0.104***
		(0.005)	(0.005)

Significance levels: * p<0.05 **p<0.01 ***p<0.001

Table 5.
Effects (with standard errors) of work location and other variables
on the likelihood of full vaccination among children

	Model 3a	Model 3b	Model 3c
Province-level coefficients			
Proportion working away	0.508***	0.616***	0.535***
	(0.093)	(0.102)	(0.106)
Proportion working at home	-0.505**	-0.365*	-0.339
	(0.180)	(0.201)	(0.201)
Average education among	-0.160***	-0.089***	-0.089***
women (years)	(0.025)	(0.027)	(0.027)
Consumer items index for	0.668***	0.469***	0.469***
community	(0.052)	(0.056)	(0.056)
Proportion urban	-0.234	-0.372*	-0.373*
	(0.151)	(0.164)	(0.164)
Cross-level coefficient			
Away (Individual) x			0.237**
PAway (Community)			(0.087)
Individual-level coefficients			
Mother's education			
Primary		0.238***	0.239***
		(0.014)	(0.015)
Secondary and above		0.417***	0.420***
		(0.019)	(0.019)
Mother's age		0.021***	0.021***
		(0.001)	(0.001)
Child's age		0.047***	0.047***
		(0.000)	(0.000)
Birth order		-0.059***	-0.059***
		(0.003)	(0.003)
Sex of child (boy)		0.010	0.010
		(0.010)	(0.010)
Substitute caretaker		-0.063***	-0.063***
		(0.012)	(0.012)
Urban		-0.005	-0.005
		(0.015)	(0.015)
Consumer items index		0.103***	0.103***
		(0.005)	(0.005)
Work characteristics			
Working away		-0.093***	-0.170***
		(0.014)	(0.031)
Working at home		0.015	0.021
		(0.017)	(0.017)

Significance levels: * p<0.05 **p<0.01 ***p<0.001

Bibliography

Adams, A.M., S. Madhavan, and D. Simon (2002) Women's social networks and child survival in Mali. *Social Science & Medicine* **54**, 175-178.

Balk, D. (1994) Individual and community aspects of women's status and fertility in rural Bangladesh. *Population Studies* **48**, 21-45.

Becker, S., D.H. Peters, R.H. Gray, C. Gultiano, and R.E. Black (1993) The determinants of use of maternal and child health services in Metro Cebu, the Philippines. *Health Transition Review* **3**, 77-89.

Bennett, L. (1988) The role of women in income production and intra-household allocation of resources as a determinant of child nutrition and health. *Food and Nutrition Bulletin* **10(3)**, 16.

Bisgrove, E. and B. Popkin (1996) Does women's work improve their nutrition: Evidence from the urban Philippines. *Social Science & Medicine* **43**, 1475-1488.

Blumberg, R.L. (1981) Rural women in development. In *Women and World Changes: Equity Issues in Development.* London: Sage.

Boulay, M. and T. Valente (1999) The relationship of social affiliation and interpersonal discussion to family planning knowledge, attitudes and practice. *International Family Planning Perspectives* **25**, 112-118.

Bryceson, D. (1989) Nutrition and the commoditization of food in sub-Saharan Africa. *Social Science and Medicine* **28**, 425-440.

Chen, M.A. (2001) Women and informality: A global picture, the global movement. *SAIS Review* **21**, 71-82

Coreil, J. (1991) Maternal time allocation in relation to kind and domain of primary health care. *Medical Anthropology Quarterly* **5**, 221-235.

Cutts, F.T., D.C. Glik, A. Gordon, K. Parker, S. Diallo, F. Haba, and R. Stone (1990) Application of multiple methods to study the immunization programme in an urban area of Guinea. *Bulletin of the World Health Organization* **58**, 769-776.

DaVanzo, J. and D.L. Lee (1983) The compatibility of child care with market and nonmarket activities: Preliminary evidence from Malaysia. In *Women and Poverty in the Third World* (Edited by Buvinic, M. et al.) Baltimore, MD: Johns Hopkins University Press.

Desai, S. and S. Alva (1998) Maternal education and child health: Is there a strong causal relationship? *Demography* **35**, 71-81.

Diez Roux, A.V. (2001) Investigating neighborhood and area effects on health. *American Journal of Public Health* **91**, 1783-1789.

Diez Roux, A.V. (2004) Commentary: Estimating neighborhood health effects. The challenges of causal inference in a complex world. *Social Science & Medicine* **58**, 1953-1960.

Durrant, V.L. and Z.A. Sathar (2000) Greater investments in children through women's empowerment: A key to demographic change in Pakistan?" Policy Research Division No. 137. New York: Population Council.

Engle, P.L. (1983) The effect of maternal employment on children's welfare in rural Guatemala. In *Child Development and International Development: Research-Policy Interfaces* (Edited by Wagner, D.A.). San Francisco: Jossey-Bass.

Entwisle, B., R.R. Rindfuss, D. Guilkey, A. Chamratrithirong, and S.R. Curran, and Y. Sawngdee (1996) Community and contraceptive choice in rural Thailand: A case study on Nang Rong. *Demography* **33**, 1-11.

Fonchingong, C. (2005) Negotiating livelihoods beyond Beijing: The burden of women food vendors in the informal economy of Limbe, Cameroon. *International Social Science Journal* **57**, 243-253.

Greenhalgh, S. (1991) Women in the informal enterprise: Empowerment or exploitation? *Population Council Research Division Working Papers,* No. 33. New York: Population Council.

Guyer, J. (1981) Household and community in African studies. *African Studies Review* **24**, 87-137.

Halvorson, S. (2003) A geography of children's vulnerability: Gender, household resources, and water-related disease hazard in Northern Pakistan. *The Professional Geographer* **55**, 120-133.

Handa, S.(1996) Expenditure behavior and children's welfare: An analysis of female-headed households in Jamaica. *Journal of Development Economics* **50**, 165-187.

Hashemi, S.M., S.R. Schuler, and A. Riley (1996) Rural credit programs and women's empowerment in Bangladesh. *World Development* **24**, 635-653.

Holmboe-Ottesen, G., O. Mascarenhas, and M. Wandel (1989) Women's role in food chain activities and the implications for nutrition. Nutrition Policy Discussion Paper No. 4. New York: United Nations.

Kabeer, N. (1997) Women, wages and intra-household power relations in urban Bangladesh. *Development and Change* **28**, 261-302.

Kantor, P. (2003) Women's empowerment through home-based work: Evidence from India. *Development and change* **34**, 425-445.

Kennedy, E. and P. Peters (1992) Household food security and child nutrition: The interaction of gender and income of household head. *World Development* **20**, 1077-1085.

Kiros, G. and M.J. White (2004) Migration, community context, and child immunization in Ethiopia. *Social Science & Medicine* **59**, 2603-2616.

Kishor, S. (1995) Autonomy and Egyptian women: Findings from the 1988 Egypt Demographic and Health Survey. *DHS Occasional Papers* No. 2. Calverton, MD: Macro International.

Kravdal, Ø. (2002) Education and fertility in sub-Saharan Africa: Individual and community effects. *Demography* **39**, 233-250.

Kravdal, Ø. (2004) Child mortality in India: The community-level effect of education. *Population Studies*. **58**, 177-192.

Lanata, C. F. and J. Novara (1991) Child immunization trends and determinants in Peru. In: Proceedings of the Demographic and Health Surveys World Conference, 1. Washington, DC: 717–726.

Leslie, J. and M. Paolisso, eds. (1989) *Women, Work and Child Welfare in the Third World*. Boulder: Westview Press.

Levin, C., D. Maxwell, M. Armar-Klemesu, M. Ruel, S. Morris, and C. Ahiadeke (1999) Working women in an urban setting: Traders, vendors and food security in Accra. *Food Consumption and Nutrition Division Discussion Paper* No. 66. Washington, DC: International Food Policy Research Institute.

Magadi, M.A., E.M. Zulu, and M. Brockerhoff (2003) The inequality of maternal health care in urban sub-Saharan Africa in the 1990s. *Population Studies* **57**, 347-66.

Matthews, Z. and I. Diamond (1997) Child immunization in Ghana: The effects of family, location and social disparity. *Journal of Biosocial Science* **29**, 327-343.

McQuestion, M. and R.E. Jones (1995) A Dynamic, multi-level analysis of recent immunization trends in Colombia. *CDE Working Paper* No. 95-13. Center for Demography and Ecology, University of Wisconsin-Madison.

Montgomery, M., M. Gragnolati, K.A. Burke, and E. Paredes (2000) Measuring living standards with proxy variables. *Demography* **37**, 155-174.

Mosley, W.H. and L.C. Chen. (1984) An analytical framework for the study of child survival in developing countries. *Population and Development Review* **10** **(**Supplement**)**, 25-45.

Munshi, R. and S.H. Lee (2000) Child immunization in Madhya Pradesh. *National Family Health Survey Subject Reports* **15**.

Mwaniki, N. (1986) Against many odds: The dilemmas of women's self-help groups in Mbeere, Kenya. *Africa: Journal of the International African Institute* **56**, 210-228.

Nichter, M. (1995) Vaccinations in the third world: A consideration of community demand. *Social Science & Medicine* **41**, 617-632.

Nyonator, F.K., J.K. Awoonor-Williams, J.F. Phillips, T.C. Jones, and R.A. Miller (2005) The Ghana Community-based Health Planning and Services initiative: Fostering evidence-based organizational change and development in a resource-constrained setting. *Health Policy and Planning* **20**, 25–34.

Oppong, C. (1983) Women's roles, opportunity costs, and fertility. In *Determinants of Fertility in Developing Countries*. Edited by Bulatao, R. & R. Lee. New York: Academic Press.

Pande, R. (2003). Selective gender differences in childhood nutrition and immunization in rural India: The role of siblings. *Demography* **40**, 395-418.

Parashar, S. (2005) Moving beyond the mother-child dyad: Women's education, child immunization, and the importance of context in rural India. *Social Science & Medicine* **61**, 989-1000.

Pearl, M., P. Braveman, and B. Abrams (2001) The relationship of neighborhood socioeconomic characteristics in birthweight among five ethnic groups in California. *American Journal of Public Health* **91**, 1808-1824.

Pebley, A. R., N. Goldman, and G. Rodrígues. (1996) Prenatal and Delivery Care and Childhood Immunization in Guatemala: Do Family and Community Matter? *Demography* **33**, 231-247.

Pena, C. (1995) Women: The key to food security. *Food Policy Report.* Washington, DC: International Food Policy Research Institute.

Phillips, J.F., A.A. Bawah, and F.N. Binka (2005) Accelerating reproductive and child health program development: The Navrongo initiative in Ghana. *Policy Research Division Working Paper* No. 208. New York: Population Council.

Pickett, K.E. and M. Pearl. (2001) Multilevel analyses of neighborhood socioeconomic context and health outcomes: A critical review. *Journal of Epidemiology and Community Health* **55**, 111-122.

Pillai, V. K. and M. Conaway (1992) Immunization coverage in Lusaka, Zambia: Implications of the social setting. *Journal of Biosocial Science* **24**, 201–209.

Pinnelli, A. (1993) The Condition of women and the health and mortality of infants and children. In *Women's Position and Demographic Change*. Edited by N. Federici, K. O. Mason and S. Sogner. Oxford, Clarendon Press.

Popkin, B.M. (1980) Time allocation of the mother and child nutrition. *Ecology of Food and Nutrition* **9**, 1-14.

Rogers, B. (1996) The implications of female household headship for food consumption and nutritional status in the Dominican Republic. *World Development* **24**, 113-128.

Rogers, S.C. (1978) Woman's place: A critical review of anthropological theory. *Comparative Studies in Society and History* **20**, 123-162.

Roushdy, R. (2004) Intrahousehold resource allocation in Egypt: Does women's empowerment lead to greater investments in children? Paper presented at the Economic Research Forum Eleventh Annual Conference, Beirut, Lebanon, 14 – 16, December.

Ruah, V.A., H.F. Andrews, and R. Garfinkel (2001) The contribution of maternal age to racial disparities in birthweight: A multilevel perspective. *American Journal of Public Health* **91**, 1815-1824.

Sastry, N. (1996) Community Characteristics, Individual and Household Attributes, and Child Survival in Brazil. *Demography* **33**, 211-229.

Sempebwa, E. (1988) The relationship between mother's availability and infant and child health. Paper presented at workshop on Research and Intervention Issues Concerning Infant and Child Mortality and Health, International Research Development Centre, Ottawa, August.

Senauer, B. (1990) The impact of the value of women's time on food and nutrition. In *Persistent Inequalities: Women and World Development.* Edited by Tinker, I. New York, NY: Oxford University Press.

Sivakami, M. (1997) Female work participation and child health: An investigation in rural Tamil Nadu, India. *Health Transition Review* **7**, 21-32.

Steele, F., I. Diamond and S. Amin (1996) Immunization uptake in rural Bangladesh: A Multilevel analysis. *Journal of the Royal Statistical Society. Series A (Statistics in Society)* **159**, 289-299.

Streatfield, K., M. Singarimbun, and I. Diamond (1990) Maternal education and child immunization. *Demography* **27**, 447-455.

Streefland, P., A.M.R. Chowdhury, and P. Ramos-Jimenez (1999) Patterns of vaccination acceptance. *Social Science & Medicine* **49**, 1705-1716.

Subramanian, S.V. (2004) The relevance of multilevel statistical methods for identifying causal neighborhood effects. *Social Science and Medicine* **58**, 1961-1967.

Subramanian, S.V., K. Jones, and C. Duncan. (2003) Multilevel methods for public health research. In *Neighborhoods and Health*. Edited by I. Kawachi and L.F. Berkman. New York: Oxford University Press.

Susilastuti, D.H. (2003) Women's education, work and autonomy: An Egyptian case. Doctoral Dissertation, Florida State University.

Tripp, R. (1981) Farmers and traders: Some economic determinants of nutritional status in Northern Ghana. *Journal of Tropical Pediatrics* **27**, 15-22.

UNCHS (2001) *The State of the World's Cities Report 2001*. Nairobi: United Nations.

UNICEF/WHO (2005) *Immunization Summary 2005*. New York: United Nations Children's Fund.

Whyte, S. R. and P.W. Kariuki (1997) Malnutrition and Gender Relations in Western Kenya. In *African Families and the Crisis of Social Change*. Edited by T. S. Weisner, C. Bradley and P. L. Kilbride. Westport, CT, Bergin and Garvey.

World Health Organization (WHO) (1990) Expanded programme on Immunization: Missed opportunities for immunization. *Weekly Epidemiological Record* **65**, 165-172.

WHO (2005) Immunization against diseases of public health importance. Fact Sheet No. 288, March. Geneva: WHO.