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Child health and the quality of medical care

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Health investments that promote development in early life have the potential to affect physical functioning, particularly in low- and middle-income countries where infectious illnesses amenable to care contribute significantly to ill health. We evaluate whether high quality prenatal and child care promote child growth. We conclude that children who live in communities with high quality care are healthier compared with children who live in areas with poor quality care. Process measures, i.e., what health providers do, are relevant for informing current health investment and represent a more important contributor to health status compared with infrastructure and staffing.

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1. Introduction

The number of deaths among children under five years worldwide has decreased over the past 20 years from fifteen to eleven million annually –a remarkable achievement considering the increase in the absolute number of births over the same period (UNICEF, 2000). This realization is due in part to health investments in the 1970s and 1980s that expanded access to basic interventions (Rutstein, 2000). Improving the quality of care in existing health facilities has received much less emphasis, however, even though access alone is insufficient in advancing health. Currently, the vast majority of deaths among children under five in low-income settings is attributable to a handful of causes amenable to high quality care: acute respiratory infections, diarrhea, measles, malaria, malnutrition, and low birth weight (Gove, 1997). Indeed, recent evidence demonstrates that access to providers of poor quality actually *contributes* to child morbidity and mortality (Nolan *et al* 2000; Scofield and Ashworth, 1996; Sodemann *et al* 1997).

In this paper, we investigate whether children who live in communities with high quality care are healthier than those who live in areas with poor quality care. Drawing attention to the difficult task of measuring quality, we distinguish between structural quality and the care process (Donabedian, 1980). Structural quality assessments are generally based on existing data about infrastructure, staff, services, or drug availability. The technical process, or the quality of care provision, is the key measure in our analyses.

The majority of previous studies in the economic literature have employed structural quality measures to evaluate health interventions, such as the presence of medical doctors (Thomas *et al* 1996), nurses (Thomas *et al* 1996; Thomas and Strauss, 1992), hospital beds (Thomas *et al* 1996), drugs (Strauss 1990), and village midwives (Frankenberg and Thomas, 2001). In the health literature, several studies have employed process quality measures. Kogan et al (1994) reported an association between a nationally representative cross-section of pregnant women who received specific health education messages and low birth weight. Peabody et al (1998) showed that Jamaican women with access to high quality prenatal care have higher birth weights than women with access to poor quality care.

Such research illustrates two important limitations in using staffing and equipment to measure quality. First, studies evaluating structural quality have policy implications for improving access to a provider or facility – indeed, the very aim of international aid for health systems in the 1970s and 1980s (Saxenian, 1995). Yet, efforts to promote care quality currently focus on improving provider practice within existing health systems to maximize the infrastructure and human resource investments made in the 1980s. Thus, process quality is a more relevant focus for informing current health investments.

Second, the underlying assumption in employing structural measures is that the availability of such tangible assets leads to high technical quality with no variation in provider practice (de Geynt, 1995). Yet the existence of a facility or clinician is not synonomous with high quality care. Research conducted in the U.S. and internationally

has demonstrated not only enormous variation in provider practice but also that such variation can be linked to adverse health events (Nolan *et al* 2000; Schuster *et al* 1998).

In these analyses, we utilize clinical case scenarios that offer an objective method of evaluating whether provider performance accorded with established standards of care. Given that some conditions seen at the primary level are self-limiting, the case scenarios are based on specific tracer services: prenatal and child care. These services were chosen because they address conditions of high prevalence, associated poor long-term outcomes with significant functional impact, and demonstrated efficacy in the clinical intervention (Tarlov *et al* 1989).

The primary outcome measure in this paper is child growth. Poor child growth in resource-poor countries, like mortality, rarely results from a single disease but an accumulation of insults at critical periods of development during the prenatal period and the first two years of life (Martorell, 1999; Morris *et al* 1998; Gould, 1989). One-third of children younger than five years in developing countries – approximately 182 million individuals – are stunted in growth (de Onis *et al* 2000). Such failure to reach full growth potential is associated in later life with impaired immuno-competence (Barros *et al* 1992; Martorell and Habicht, 1986), and poor cognitive skills and educational attainment (Behrman, 1996; Brown and Pollitt, 1996).

Our research setting is Indonesia. The diversity of its environment and population of over 207 million people creates a dynamic milieu under which we can study how policies influence health. The country has undergone remarkable socioeconomic developments during the past thirty years: in 1970, GNP per capita was estimated at

U.S. $230 per person; prior to the economic crisis in 1996, it was U.S. $1080 (World Bank, 2000). The Government in Indonesia views health interventions as integral to overall welfare and poverty alleviation goals and invested in large-scale infrastructure and equipment for improving access to basic services.

Such health investments were curtailed, however, in response to international budget crises in the 1980s, declining oil prices, and increasing debt payments (World Bank 1991). Yet, important health needs remained: in 1985, the child mortality rate in Indonesia was estimated at 124 per 1000 live births, with diarrheal diseases and acute respiratory infections remaining primary causes of death (World Bank, 2000). Thus, the Indonesian Ministry of Health set in motion a series of organizational and financing reforms to improve the allocation of limited public resources for vulnerable populations that bear a disproportionate burden of ill health. By 1995, the child mortality rate in Indonesia had been cut in half; yet, it remains at approximately 60 deaths per 1000 live births –the majority attributable to a handful of causes amenable to high quality health care, including treatment of common childhood infections and low birth weight (World Bank 2000). While the government has expanded access to basic interventions, particularly for the poor, it has placed relatively less emphasis until recently on high quality comprehensive care, skilled providers, and responsive health systems.

We analyze the 1993 Indonesian Family Life Survey (IFLS1), distinct in its collection of a broad array of current and retrospective socio-economic and health information among individuals, households, and communities to evaluate programs and policies systematically and comprehensively. The selection of households aimed to establish a

representation of 83% of the Indonesian population, thus capturing the cultural and economic diversity among Indonesia's regional populations, in addition to the varying effects of decentralization on social policies and economic shocks. An important part of the accompanying facility survey was a series of written clinical case scenarios, enabling an assessment of the quality of provider care processes that controls for variation in illness severity for comparison across facilities.

Using data from this rich and comprehensive survey, we analyze a cross-section of children younger than 50 months to determine whether children who live in communities with high quality care are healthier than those who live in areas with poor quality care. This paper is organized in four sections. We first present our model for analysis and its assumptions. Second, we describe our data in some detail and pay special attention to the development of the process indices for measuring quality. We subsequently present the results and conclusions.

In summary, indices measuring the quality of the prenatal and child care processes are significantly associated with different aspects of child growth: height in centimeters, height for age, and weight for age. Structural quality and access variables are not associated with the distribution of conditional mean height or moderate to severe stunting. These findings suggest that investments in improving prenatal and child care process quality in existing facilities in Indonesia may be an effective way to address conditions that result in a child's inability to reach full physical potential. Associations between structural quality and being underweight suggest that access to a functioning health system may also be important for acute conditions.

2. Conceptual framework

2.1. Human growth and development

Human growth is a measure of the physiological processes associated with birth weight, environment, and genetics. Whereas maximum height is determined genetically, poor environmental factors, health care, and nutrition can prevent the attainment of full growth potential (Martorell, 1999; Pelletier, 1994; Monckeberg 1992). Health care providers that practice high quality prenatal and child care can directly influence the efficacy of the production of child health inasmuch as their practices have an empirical basis. The major assumption, therefore, is that the pathways of influence have a strong empirical foundation, i.e., that good technical quality care during both pre- and post-natal periods has the potential to address the main causal factors for child stunting.

The major factors that prevent children from attaining their genetic growth potential can be divided into three types: insults *in utero*, infection, and the synergistic effect of infection and malnutrition. The evidence that specific events *in utero* affect long-term health is well established –consider, for example, rubella, thalidomide, smoking, and alcohol and drug abuse. The long-term effects of such insults ultimately depend on a range of interrelated factors, including maternal health status and the timing of the insult itself (Hall and Peckham, 1997). Persistent untreated illness early and throughout the pregnancy can result in a reduction of placental blood flow, with proportionate reduction in skeletal and soft tissue growth during the peak in the fetal length growth curve at 20

weeks (Villar & Belizan, 1982; Kramer 1987a, 1987b). The result is proportionate reduction in brain and body size as measured by a symmetrically small or “short” infant. Proportionately growth retarded infants are less likely to catch-up in growth, and suffer impaired immuno-competence and thus high rates of infectious illnesses throughout life compared with infants of normal size at birth (Martorell and Habicht, 1986; Gould, 1989; Barros *et al* 1992). Proportionate intrauterine growth retardation in full term infants accounts for the vast majority of low birth weight infants in less developed countries, due in part to the high prevalence of infectious diseases and conditions known to promote chronic stunting *in utero* and are amenable to care, such as malaria, helminth infections, and anemia (Kramer, 2000; Villar and Belizan, 1982).

Full term infants that are *disproportionately* small at birth, however, may be the result of short-term insults in the third trimester, for example, that promote weight and muscle loss but spare brain and body length (Gould, 1989). These infants may have the ability to catch up in growth where the environment fulfills health and nutritional needs (Adair, 1999). In industrialized countries, access to intensive care technology influence an infant’s long-term prognosis (Dashe *et al* 2000), although such technology is not available to the majority of Indonesian women.

Post-natal infections not only occur more frequently in children stunted *in utero* but also promote stunting post-natally in young children, particularly in low- and middle-income settings where a high prevalence of infectious illnesses combines with poor sanitation to facilitate fecal-oral transmission of diarrheal and parasitic illnesses (Grantham-McGregor *et al* 1999b). Such settings promote repeated infections that may

prevent a child from completely restoring weight lost during illnesses, thereby resulting in a drop in the growth trajectory over the long term (Martorell *et al* 1975; Rowland and McCollum, 1977). Both short-term and chronic infections may result in micronutrient deficiencies via decreased food intake, impaired absorption, or direct micronutrient losses (Duggan *et al* 1980; Stephensen, 1999). Interventions addressing specific micronutrient deficits may be of limited use, particularly within environments where concurrent pathogens contribute to poor nutrition.[1] Indeed, significant associations between child mortality and nutritional deficiencies emphasize the synergism between poor nutrition and infection, which results in a magnified decrease in the frequency of child growth and/or a decrease in its velocity (Pelletier, 1994; Pelletier, Low, Johnson, Msukwa, 1994). Within the first two years in particular, growth rates are higher than in later life and the immune system is developing. Such ongoing development in early childhood implies both high nutritional requirements during a critical period of development and high susceptibility to illness (Martorell, 1999). Strengthening clinical case management of common infectious illnesses among children in low- and middle-income countries has potential, therefore, in promoting child growth during the critical first few years of life (Gove, 1997).

[1] In Indonesia during the late 1970s, a national child growth program was initiated under which some 2 million children underwent routine growth monitoring and food supplementation, under the assumption that inadequate dietary intake was the major cause of poor growth. Mosley (1984) noted that the design of the program itself might have been flawed because the primary cause of malnutrition was recurrent infection rather than inadequate diet.

2.2. Behavioral framework

We employ a behavioral framework based on an economic model of health capital developed by Grossman (1972) and Mosley and Chen's (1984) model of the proximate determinates of health. We begin by characterizing the child health production function, which is a biomedical process that converts specific investments into health. The production function characterizes health as a form of human capital, where current health status is a function of choices and shocks over the individual's lifetime. Specifically, an individual's health capital, such as height, is the result of a set of factors, including previous health status, medical care, personal behaviors, and environment – some of which are observed, i.e., altitude, whereas others are not. Some of the determinants are chosen, such as nutritional intake, medical care, and time spent in seeking care. Others, such as environmental health, are only partially determined by a household's choices of sanitation, waste disposal, and water source. Yet some inputs are fully exogenous to the household, such as the portion of the disease environment determined by public health and sanitation infrastructure. An important issue for our analysis is that the quality of medical care received is a choice variable, whereby households choose whether to obtain care and from which provider.

Formally, individual i's health status is represented at a given time:

$$h = H\left(h_o, x_h, \mathrm{K}, x_{h0}, \tilde{u}_f, \mathrm{K}, \tilde{u}_{f0}, \mathrm{K}, \tilde{u}_c, \mathrm{K}, \tilde{u}_{c0}, \tilde{z}, \mathrm{K}, \tilde{z}_0, \varepsilon, \mathrm{K}, \varepsilon_0\right) \quad [1]$$

The vector of chosen inputs consumed is represented by x_h. Choices at the individual level include those motivated by health considerations such as nutrition and the decision to utilize care or deliver in hospital. Behavioral choices may not be motivated

by health considerations but have health impacts, such as smoking or alcohol abuse. The proximate determinants in this model refer to specific health choices, i.e., obtaining prenatal and curative child care. Other behaviorally chosen proximate determinants that influence fetal growth during pregnancy are nutritional intake, physical activity, and tobacco and alcohol use.

$\tilde{u}_f$ is a vector of individual and household (family) characteristics, $\tilde{u}_c$ is a vector of community characteristics including environment, public infrastructure, and z is the quality of medical care. High technical quality can directly influence the efficacy of the health production function inasmuch as the activities conducted have an empirical basis. Structural quality may facilitate high quality technical processes as well as its cultural and financial appropriateness. ε combines unobserved individual, household and community shocks to health.

The effect that each factor has on health varies by individual biology and socioeconomics, i.e., age, gender, genetic endowments, and knowledge or education. Better-educated households, for example, may attain enhanced health improvements from medical services because they have greater ability than poorly educated ones to comply with treatment recommendations. However, it is important to distinguish between characteristics that affect the productivity of medical care, such as age and education, and those that only affect health through their influence on which and what type of medical care to obtain. Factors such as medical care prices, travel time to providers, and the household's economic resources, for example, may affect health indirectly through their influence on nutrition and medical decisions, but do not

otherwise directly affect health. These latter characteristics do not enter the production function.

Even though the child health production function captures critical information, estimation of its parameters is difficult in practice, given that it would require detailed information about the choice of each input. Such estimation would require an identifying instrument, such as a price, for each input included in the production function (Rosenzweig and Schultz, 1983). Furthermore, these choices are simultaneously determined with the outcome, are thus endogenous and likely to be correlated with the error term.

In particular, the quality of care received is a choice variable. Individuals choose whether and where to obtain care based on factors such as quality (expected efficacy of treatment), price of available providers, the type and severity of illness, and budget constraints. Individuals are not randomly assigned quality, and those that choose a high quality care provider might be more severely ill. Selection bias based on unobserved severity of illness may confound the estimated relationship between quality received and health outcomes.

Consequently, we estimate the reduced-form determinants of health that relate measures of health status to long-term constraints. The reduced-form is obtained by substituting the determinants of the chosen health behaviors into equation (1) for the x_h. To derive the determinants of the x_h, we make the standard economic assumption that households make decisions by maximizing their overall welfare as they define it; given their household resources, the available information, their beliefs, and the underlying

health and sanitation environment. However, household allocation decisions are constrained by available time and resources, by the health production function, and the price and quality of all *available* medical services. Therefore, the health behavior demands at a given period are:

$$x = H(w, \mu_f, \mu_t, z, p, h, \varepsilon) \quad [2]$$

where *w* is household resources, μ_c represents endogenous environmental factors, *z* and *p* are the quality and price of all available medical care options, respectively.

We obtain the reduced form health production function by substituting [2] into [1] and solving recursively:

$$h_t = H(h_0, w_0, \mu_f, \mu_c, z, p, \varepsilon) \quad [3]$$

where the subscript, 0 refers to the initial endowments, and μ_f is a vector of family-level and individual level constraints, and μ_c is a set of constraints at the community-level, and *z* and *p* are the quality and price of all available medical care. A key implication of this equation is that health stock is a function of past as well as current values of the constraint.

The reduced-form relates current health to current and past constraints. The reduced-form model does not distinguish the pathways through which quality of care affects health. However, the reduced form equation captures the combined direct and indirect benefits of quality care rather than solely their influences on behavioral choices. The direct effects are the consequences of actual care use; the indirect effects are the ways in which quality influences the decision where and when to seek care. Indeed, poor quality care contributes to low utilization (Akin and Hutchinson, 1999); low primary

care utilization, in turn, can result in avoidable complications. Health education that typically occurs during prenatal care, such as the knowledge of danger signs for an obstetric emergency, may also be used in subsequent pregnancies or benefit other women in the household and community. Mothers that seek prenatal care may be more likely to obtain preventive services for their infants (Shiono and Behrman, 1995). In a less developed country, in particular, prenatal care may represent an adult woman's first contact with the health system and influence future visits. Treatment of tuberculosis or malaria during and after pregnancy –a time during which women are particularly vulnerable to these illnesses (Connolly and Nunn, 1996) –not only benefits the individual but also prevents transmission to others.

2.3. Empirical specification

The empirical specification employs the following equation:

$$H_{ij} = \alpha + \beta Q_j + \sum \lambda_k X_{ik} + \varepsilon_i \qquad (4)$$

where H_{ij} is the health outcome of individual *i* in community *j.* Physiological processes are often used to represent health where those processes are empirically linked to health outcomes. In these analyses, we employ child anthropometric measures that represent unobserved nutrients and processes at the cellular level (Pelletier, 1994). Q_j is the quality of prenatal and child medical care available in community *j*. We assume that technical quality changes slowly and the values of quality and other covariates remained generally stable.

The *X's* are a set of individual, household and community control variables. Community controls encompass environmental factors known to affect intrauterine growth, such as sanitation and disease environment, proxied by province identification codes. Average food prices in the district for a selected basket of items common across different regions control for nutrition availability; prices and travel time to health care providers are also included. Household level controls represent family economic resources.

The individual level implies stable maternal and fetal characteristics. Three key maternal factors are age, parity, and height. Although typically considered endogenous, the cut-off points for age and parity also represent physiologic risk given that early and late pregnancies may carry increased biological risks of negative outcome (PHS, 1989; Kiely *et al* 1993; Fraser, 1995; DuPlessis *et al* 1997; IOM 1985; Kline, 1989). The number of previous pregnancies, particularly if closely spaced, may increase in blood volume and placental iron requirements, which could contribute to anemia concurrent with any co-existing micronutrient deficiencies in iron, folate, vitamin B12, and illness such as malaria and helminth infection.

Maternal height is determined by three factors: genetics, skeletal maturity, and the combined impact of environmental influences on maturity (Kramer, 1987). Short maternal stature could result from either genetic potential or prior stunting during the mother's development. Regardless of the cause, any deficiency in maternal stature can impose physical limitations on the growth of the uterus, placenta, and fetus (Gluckman and Harding, 1992).

Three key infant characteristics are sex, gestational age, and age in months. Male infants consistently tend toward higher means in their birth weight distribution compared with females although this does not correspond to a specific pathology (Kramer 1987; Wilcox and Russell, 1983). Furthermore, we recognize that the long-term health consequences, and corresponding interventions, differ considerably among infants that small for full gestational age[2] versus preterm, the causes of which are largely unknown (Kramer 1987). Controlling for preterm births allows us to assess the contribution of prenatal care quality care for conditions amenable to intervention that are known to promote poor intrauterine growth, given the established relationships between stunting *in utero* and subsequent child height.

[2] Similar to previous studies, we assume that small for gestational age infants are small because of intrauterine growth retardation.

3. Data and Measurement

The Indonesian Family Life Survey is a unique household and community survey, distinct in its extensive array of current and retrospective socio-economic and health information to evaluate programs and policies systematically and comprehensively. The IFLS used a sampling scheme that stratified on 13 provinces[3] and randomly sampled 7730 households from 321 enumeration areas chosen from a nationally representative sample used in the 1993 SUSENAS National Socio-Demographic Survey.[4] Over-sampling in urban and small province EAs allows for comparisons between urban and rural areas, and Javanese and non-Javanese ethnicities, enabling a representation of 83% of the Indonesian population. The survey is thus designed to capture the cultural and economic diversity among Indonesia's regional populations, in addition to the varying effects of decentralized government social policies and economic shocks. In these analyses, we use data from the first wave conducted in 1993-4 (IFLS1); the household response rate was 93%.

The community and facility survey was conducted in the same 321 enumeration areas as the household survey. Inasmuch as no existing sampling frame included both public and private primary level providers, the facility survey frame was generated from locations identified by community leaders, and reported knowledge and utilization patterns of household members. Questions referred specifically to facilities *ever used*

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[3] North Sumatra, West Sumatra, South Sumatra, Lampung, DKI Jakarta, West Java, Central Java, Yogyakarta, East Java, Bali, West Nusa Tenggara, South Kalimantan and South Sulawesi

[4] The Survei Sosial Ekonomi Nasional (SUSENAS) includes more than 60,000 households. The Indonesian Demographic and Health Surveys similarly randomly select EAs from the SUSENAS sampling frame, based on the census.

to avoid potential seasonal and socioeconomic biases associated with studying only those facilities used by members that were recently ill. The sample, therefore, is representative both of public and private providers regardless of a given facility's administrative boundaries. Facilities interviewed were based on a random probability sample of public and private facilities from this frame. These analyses employ data from 2300 public and private facilities –approximately 95% of modern primary level facilities surveyed –that completed a clinical case scenario for prenatal and/or child care.

3.1. Child anthropometrics

Within the household survey, a health worker accompanied the interviewers and collected anthropometric data, the basis of our key health outcomes. In these analyses, child height is expressed both in centimeters and as standard deviation units, or z-scores scores, for gender and age; weight is also expressed by z-scores for age and gender. Z-scores are derived by subtracting each child's height from the National Center for Health Statistics median reference standard and dividing by the standard deviation of the reference distribution for a given age and gender (WHO 1993). The use of a standard growth curve establishes the potential upper mean limit, thereby illustrating the strength of environmental factors that prevent full growth potential. Height for age is thought to capture long-term insults to growth, whereas weight for age represents both short and long-term events.

Anthropometric indices were calculated using the EPI6 program from the Centers for Disease Control. All births from 1990 to 1993 listed both in the pregnancy history and in the anthropometric register were included, given plausible values for height, weight, and age. A total of 1608 children from 1359 households were included in the analyses using height and height-for age analyses; and 1785 children from 1509 households were used for the weight for age regressions.

To determine whether the excluded children had different socioeconomic characteristics than those included in this analysis, we estimated a random effects logistic regression predicting the availability of height- and weight-for age information. The dependent variables were the log of household expenditures, the number of years of maternal education, Indonesian language spoken by the mother during the interview as a proxy for ethnicity, residence in a rural area, maternal age less than or equal to 20 years and greater than 35 years, no prior pregnancies and five or more prior pregnancies, and the sex of the child. The following variables were significantly associated with the odds of height for age information being available: an increase in the number of years of maternal education (OR 1.04; 95% C.I. 1.00 - 1.08; p=.04); and an increase in the natural log of household expenditures (OR 1.17; 95% C.I. 0.97 – 1.41; p=.10); Other dependent variables were not significant at the 90% level. In predicting the odds of being having weight for age information available were higher with increasing levels of household consumption (OR 1.25; 95% C.I. 1.01 – 1.54; p=.04); and less likely for mothers under 20 years of age or less (OR .57; 95% C.I. 0.38 – 0.84; p=.005). Given the established associations between low socioeconomic status

and poor health outcomes in Indonesia (Gwatkin et al 2001), omitted observations from households with low socioeconomic status may result in conservative estimates.

Figure 4 illustrate the prevalence of stunting and being underweight in our sample of Indonesian children. Substantial heterogeneity exists among age groupings, sex, and geographic area. The standard deviation units are uniformly negative for each six-month age group, however, with the scores at zero to six months closest to the median reference values. Consistent with previous studies, the first few months after birth are characterized by relatively positive health –particularly for breastfed infants (Martorell, 1999) although the effects of insults *in utero* may manifest themselves over time. Particularly striking is the period between 0 to 6 months and 13 to 18 months characterized by a 7.5-fold decrease in height for age z-scores. The dramatic decline in z-scores after six to 18 months until two years demonstrates this period of vulnerability (Figure 5). The slight increase after 24 months should be interpreted with caution given the measurement error in the growth reference standard itself (Pelletier 1991).[5] The relative fluctuations in average z-scores are less dramatic after 36 and 42 months, albeit children remain unable to catch up in stature. By 43 months, the average height for age z-score is below negative 2, the standard cut-off point for moderate and severe stunted growth.

Turning to weight for age, infants in the 0 to 6 months age group average -.13 standard deviations from the reference median weight for age. Between six and 18

[5] The World Health Organization Expert Committee that recommended the continued use of the international growth standards also recognized its major limitation: different populations and methods of height measurement were used for children younger than 24 months and older than 24 months (de Onis and Habicht, 1996). An analysis across this disjunction at 24 months where two separate populations are combined requires some caution, particularly for height. In multivariate analyses, we control for this error by including dummy variables for by each three-month age group by sex.

months, however, a greater than 14-fold decline in weight for age z-scores occurs, suggesting a period of tremendous vulnerability. Similar to stunting, the relative fluctuations in weight for age z-scores after 24 months represent neither a worsening condition nor the ability to catch-up. By 43 months, the average weight for age z-score is –1.81. The total proportion of children considered underweight is less than the proportion stunted, indicating the relative severity of chronic rather than acute health needs.

For sex, the mean height- and weight- for age z-scores for males is less than females. This finding is consistent with a 35-country review of health status measures for children under five years (Hill and Upchurch, 1995). Those authors attributed this finding to less physical activity among female children and / or decreased exposure to disease episodes.[6] Rural children have much lower child height and weight scores compared with urban infants.

We complete our brief discussion of these anthropometric indices given that previous studies have discussed in detail nutritional status using these data (Frankenberg et al 1996). Notable, however, is the striking decline both in height for age and weight for age within the first 18 months of life that suggests periods of tremendous vulnerability with lasting effects on subsequent well-being. Whether the decline is due to prenatal insults, post-natal influences, or some combination of both, the environment is unable to compensate for the drop in the growth trajectory. Such a decline reinforces the importance of promoting health during critical periods of

development *in utero* until two years of life, in particular, when growth rates are higher than in later life and the immune system is developing (Martorell, 1999).

3.2. Quality of care

To measure the quality of care, we distinguish between the care process and structure (Donabedian, 1980). The facility survey provides comprehensive information about the structural elements of care, i.e., prices, range of services, drugs, and equipment. In addition, a key part of this survey was a series of case scenarios enabling a comparison of the quality of provider processes in prenatal and child care across individuals, locations, and time. U.S. studies validated the use of case scenarios and demonstrated their accuracy in predicting provider behavior (Luck *et al* 2000).

We developed process indices based on these case scenarios to evaluate the quality of care for 2300 public and primary level providers that completed a case scenario for prenatal care (1745 facilities), child care (2012 facilities), or both (72.5% of the facilities).[7] The selection of variables for the process indices was based on established evidence of health impact within the resource limitations of a low- to middle-income country (Villar *et al* 2001; Carroli *et al* 2001; WHO, 1998; Rooney, 1992; WHO 1994; Kiely *et al* 1993; UNICEF 1999; World Bank 1993; Gove 1997). Using this evidence-based criteria and data availability, we identified six sets of activities that have positive health impact within the process of a prenatal examination: checking for

[6] Given that medical care plays an important role in maintaining good health between the ages of one to four, sex specific variability in nutrition and health care is also a possibility, although no evidence exists of male gender discrimination in Indonesia (Hill and Upchurch, 1995).

hypertensive disorders of pregnancy, conducting a thorough physical examination, asking about preexisting medical conditions, performing key preventive activities, and establishing a system of case management (Figure 2).[8] The sets of activities were then aggregated into one 20-item index. The 12-item child care process index was based on information within the case scenario developed by Indonesian medical practitioners for the presentation of a child with diarrhea (Figure 3). The score for each prenatal and child care provider was expressed as a percentage of key criteria spontaneously mentioned, similar to previous analyses utilizing the case scenario approach (Luck *et al* 2000).

Subsequently, we controlled for structural inputs for all of the facilities, selected to the extent that those elements facilitate the provision of the given technical processes. Structural quality variables include the presence of a medical doctor, an internal water source, the price of a prenatal care visit, and a structural index. The structural index aims to capture the extent to which basic structural quality exists across facilities regardless of provider specialization or public/ private sector. It is comprised of nine variables: three types of basic equipment (blood pressure cuff, gloves, and an infusion kit), observation of a clean examination room, the availability of curtains for privacy, whether the head of the facility had worked there for more than three years, and the availability of three services: delivery, family planning, and tuberculosis treatment.

[7] One public prenatal care provider was omitted from the structural quality analysis because of incomplete information on the facility survey.

[8] A seventh set of activities was also identified: risk assessment. This set of activities was omitted for two reasons. The efficacy of the risk assessment process has come into question given that it both refers women unnecessarily and misses most women who do suffer complications (WHO 1998). Second, the risk assessment process is endogenous given that we aim to control for the same socioeconomic and biological factors that predict risk. We do include, however, the identification of pre-existing maternal medical conditions.

The selection of each structural variable relates to process quality. Monitoring blood pressure in pregnant women is currently the most sensitive test for diagnosing hypertensive disorders of pregnancy when done in conjunction with urine protein (Rooney, 1992). The availability of an infusion kit to restore fluids in response to an obstetric emergency or severe dehydration allows a skilled primary level provider to provide first aid and stabilize, thereby influencing maternal and infant health outcomes at the referral hospital level (Maine and Rosenfield, 1999). Sterile gloves can protect both mother and provider from infection. A recent study about patient satisfaction in Indonesia provides some justification in the use of curtains to assess privacy and clean floors to evaluate cleanliness (Bernhart *et al*, 1999). The study found that Indonesian women undergoing prenatal care examinations mentioned the importance of privacy; it also noted that women prefer clean surroundings more than men do. Whether the head of the facility had been posted there for more than three years provides some indication of the facility's familiarity with the community and its needs. A study conducted in Indonesia noted that pregnant women were not taking the iron supplements received from health center because of poor understanding of its benefits, uncomfortable side effects, and local food and drug taboos during pregnancy (WHO 1997). This underscores the importance of trust between provider and client to ensure compliance – also a critically important factor in appropriately managing childhood illnesses at home (Gove, 1997).

The three services in the structural index are delivery, choice of family planning methods, and tuberculosis. The availability of delivery services alongside prenatal care

may promote delivery with a trained attendant. Family planning services post-delivery can influence spacing between births, which is associated with the maternal depletion syndrome (Carroli et al 2001). The key quality measure in family planning is choice (Askew, 1993); we measure choice by identifying those providers that offer any brand of three different methods: pill, injectible and IUD insertion. Lastly, tuberculosis is the single greatest infectious cause of death in women worldwide and an important cause of female morbidity, particularly for those in their reproductive years (Connolly and Nunn, 1996).

We omit drug availability for two reasons. Similar to other studies, the availability of drugs suffers from endogeneity because high quality facilities may deplete their stocks more quickly than low quality facilities (Mwabu *et al* 1993). Furthermore, key drugs such as anti-malarials reflect the distribution of supplies only to malaria endemic areas. Given that malaria during pregnancy represents a major cause of poor intrauterine and post-natal growth and is amenable to high quality care, controlling for these areas via the availability of antimalarials would remove precisely the effect we are trying to capture.

Figure 5 describes the structural and process indicators for prenatal and child care providers, expressed as a proportion of criteria mentioned. The process quality indices averaged .53 for prenatal care providers and .65 for child care providers. Therefore, a representative sample of prenatal care providers spontaneously mentioned, on average, 53% of the 20 criteria in the prenatal case scenario (Figure 2). Child care providers scored slightly higher, mentioning 65% of the 12 criteria in the scenario for a child

presenting with diarrhea (Figure 3). A larger proportion of private nurses and physicians offered curative child care compared with prenatal care, and fewer midwives did so.

The facility and household level datasets were combined by collapsing the prenatal and child care indices into mean values for each community. To ensure a representative sample, we applied the facility weights developed from a series of questions in the household survey about facilities ever visited by any family member. The indices measuring process quality in the multivariate analyses, therefore, represent the average level of care quality available in the community from a representative sample of prenatal and child care providers. A third index was also developed measuring the combined quality of child and prenatal care, whereby each of the 32 items from both scenarios was collapsed by community identification code using the facility weights and subsequently summed.

The community quality averages are listed at the bottom of Figure 7. The prenatal care quality index averaged 52%. Given evidence that such case scenarios may reflect actual practice (Luck *et al* 2000), this figure implies that households in these analyses had access to prenatal care providers in their communities who practiced, on average, 52% of efficacious procedures during a prenatal care examination. The average level of child care quality available in a community was higher, 65%, and the combined prenatal and child care process index averaged 56%.

3.3. Control variables and estimation

Because nutrition plays an important role in growth, we control for basket of food prices collected in the community survey to obtain price variation among a range of processed, unprocessed, and locally produced items aggregated by enumeration area. Socioeconomic characteristics were identified within the household survey from a roster for each household that included information about member composition, consumption, basic demographics, and household characteristics. Race and/or ethnicity are typically included in a health analysis to proxy an aspect of socioeconomic status; however, the Indonesian government's policy of "unity in diversity" precludes asking these questions. We take account of whether the interview with the mother was conducted in the Indonesian language to capture ethnicity. Additional socioeconomic controls are maternal education, any type of insurance coverage, and rural areas. Environmental risk factors that affect intrauterine growth are proxied by province identification codes, and the joint significance of the province identification variables are reported.

Maternal and infant characteristics were identified from a separate series of questions administered to all women younger than 50 years who had ever been married. From this book, we have detailed retrospective life histories about women of reproductive age who gave birth from 1990 to 1993. We include in these analyses key maternal and infant risk factors, namely, maternal age and parity at the time of birth, maternal and paternal height, sex of infant, and gestational age. For parity, women with no prior pregnancies and grandmultiparas are identified, employing a commonly used definition of five or more pregnancies. These factors not only represent biological risk

but also control for selective program placement should resources be distributed to areas of health needs.

In this paper, we first explore the associations between structural and process quality using only the facility level data. We determine the extent to which variation in the process quality indices is explained by structural quality and discuss the possible factors that influence variations in process quality (Figure 6).

Second, we examine selective program placement –an important issue in health policy analyses because health interventions are often targeted towards populations of need. Structural quality measures may be particularly sensitive to endogeneity in program placement given that they reflect tangible resource allocations. We focus first on the measures of quality from the facility survey to evaluate whether our measures of structure and process quality are associated with observable socioeconomic levels in a community (Figure 8).

Third, combining the facility and household data, we assess the influence of care quality on three outcomes that reflect different aspects of child growth: height in centimeters, the proportion of children stunted, and the proportion of children underweight. Random effects generalized least squares is first employed to systematically evaluate the relative associations of structure and process quality for prenatal and child care on the dependent variable of child height in centimeters (Figure 9). In addition to socioeconomic and individual controls, all models include a series of community prices, dummy variables for each province, and dummy variables for every three-month age group interacted with sex. The joint significance of these sets of

variables is represented by F-tests. Figures 10 and 11 describe a series of random effects logistic regression models to explore the relationship between prenatal and child care quality and the proportion of children stunted and underweight. In the model examining stunting, “one” equals less than two standard deviations below the median reference population of height for age –the cut-off point of negative two standard deviations below the reference median height for age—typically used to define moderate and severe stunting. Figure 11 also uses the established international cut-off point for being underweight, whereby “one” equals less than two standard deviations below the median reference value weight for age (WHO, 1983). In Figures 10 and 11, the joint significance of socioeconomic characteristics, individual factors, province fixed effects, age/sex fixed effects, and food prices are reported.

4. Results

4.1. Does structural quality explain process quality?

Previous studies have employed structural indicators to proxy overall health care quality. Care quality experts, however, believe that structural quality is an important facilitating factor in high quality care provision, but structure alone is insufficient for ensuring high quality technical processes (Donabedian, 1980).

We exploit the availability both of process and structural quality information in the facility dataset and explore the extent to which structural quality explains process quality (Figure 6). Three regressions are estimated, with the dependent variable as the process quality indices for providers of prenatal care, child care, and the collapsed average of prenatal and child care indices representing the average level of quality available in the community.

In the first regression, we focus on primary level facilities that provided prenatal care. All three structural quality measures –the structural index, an internal water source, and the availability of a medical doctor –are positively associated with prenatal care processes. Privately practicing nurses are associated with lower prenatal care quality compared with private clinics. In the second analysis among child care providers, the structural quality index and availability of a medical doctor are also significantly and positively associated with process quality, although an internal water source is not. Privately practicing physicians are associated with higher quality curative child care compared with private clinics. The third regression uses the combined prenatal and

child care index collapsed by community identification codes. We omitted four communities that did not have corresponding household information, for an analysis of 308 communities. The structural quality index and the presence of a medical doctor are significantly and positively associated with the combined process index, but internal water source is not.

In these regressions, three additional variables control for socioeconomic status and health needs: average household expenditure by enumeration area, average maternal age, and whether the facility was located in a rural area. Dummy variables for each province are also included. The average level of household expenditure in the community and maternal age are not significant predictors of process quality in any of the three regressions. The variable identifying rural areas, however, is significantly and positively associated with an increase in child care quality, an effect that could be attributed to strong promotion of government treatment protocols for the management of common childhood illnesses in peripheral areas. The F-test for the joint significant of the province dummy variables is also significant. The R-squared indicates that the regressions explain approximately 13% of the variation in prenatal care processes, 20% of child care processes, and 25% of the combined index within the community. Most of the variation in process quality, however, is not explained by structural factors.

4.2. Are the process quality indices associated with socioeconomic levels in a community?

One problem with an ordinary least squares analysis of cross-sectional data evaluating health services is selective government policies and program placement because resources are not randomly distributed (Gertler and Molyneaux, 2001; Pitt *et al* 1993; Rosenzweig 1988; Rosenzweig and Wolpin, 1986). Public health resources are normally targeted to areas based on specific socioeconomic factors, particularly in low- and middle-income countries where the government remains the primary financier and / or provider of health services, especially for the poor. Indeed, previous studies using structural quality to evaluate health interventions have had conflicting results. Cross-sectional analyses using data from the Ivory Coast showed positive associations between the presence of medical doctors and child height (Thomas *et al* 1996); this study and others, however, found negative associations between child height and structural measures, such as the availability of nurses (Thomas *et al* 1996; Thomas and Strauss, 1992), hospital beds (Thomas *et al* 1996) and drugs (Strauss 1990). Frankenberg and Thomas (2001) use a quasi-experimental design and longitudinal data across Indonesian communities to control for program placement; they demonstrate positive associations between the presence of a trained health worker and the outcomes of maternal body mass index and birth weights.

The analyses in Figure 7 demonstrate that average household consumption levels do not predict process quality using facility level data. Using the average process quality measures merged with the household dataset, we cross-tabulate the average structural and process quality available by household expenditures levels, whereby “one” equals the lowest monthly quintile of real per capita household expenditure and

"five" equals the highest quintile (Figure 8). The first three rows show the average availability of structural inputs, specifically an internal water source, presence of a medical doctor, and the structural quality index measuring a range of services and client perceptions. The next three rows evaluate the three process quality indices, and the last two rows, travel time to the public health center, and price for a prenatal care visit. Significant differences are noted between the first and fifth quintile mean values for all three structural measures, travel time, and price.

Tests measuring differences in subpopulation means, however, demonstrate no significant differences between the first and fifth expenditure quintiles for the three indices measuring process quality. This suggests that process assessments may more accurately capture the influence of care quality in cross-sectional analyses, although future research using data from consecutive panels is required to control fully for selective program placement. To further control for placement of resources based on observable socioeconomic factors, we include in the multivariate analyses variables identifying rural areas, household consumption levels, maternal education, insurance coverage, language spoken during the interview, in addition to province identification codes and community prices.

4.3. Does process quality predict child height?

The models described in Figure 9 employ a random effects estimator to predict the influence of community quality on the conditional mean of child height in centimeters, while controlling for other community factors, socioeconomic status, and maternal,

paternal, and infant factors associated with biological risk. Model 1 first includes only structural quality and access variables, and none is significantly associated with height. In Model 2, we add the process quality index for prenatal care, representing the average quality of prenatal care available in the community. A 10 % increase in the prenatal care process index is associated with a significant increase in height by .31 centimeter. This association is independent of the range of services and basic equipment available as represented by the structural index, in addition to the presence of an internal water source. The variables measuring price and distance to the health center are also not significant. In Model 3, we replace prenatal care with the child care process index derived from a different vignette assessing care quality for children with diarrhea (see Figure 3), while also including a variable measuring maternally reported small size at birth. This enables us to distinguish to some extent between the potential influences of prenatal and postnatal child care quality. The child care process index, however, is not a significant predictor of mean height; nor are the other community variables representing structural quality and access.

In Model 4, we replace the prenatal care index with one representing combined prenatal and child care provider processes to capture the effect of a high quality care continuum. This index is the sum of the weighted average of each item in the prenatal and child care indices by community. Model 4 demonstrates that a 10 % increase in the combined prenatal and child care index is significantly associated with .42 centimeter increase in mean height. Models 5, 6, and 7 include the process quality measures and omit the structural variables, given that structure explains some of the variation in

process (Figure 6). The magnitude of the process quality coefficients increases slightly, with a 10% prenatal care process quality being associated with approximately .32 centimeter increase in conditional mean height. Similarly, a 10% increase in the combined quality index in Model 7 is associated with a .43 centimeter increase in height.

Evaluating the socioeconomic and individual correlates of child growth, the significant covariates are in the expected directions and consistent with previous studies. Significant positive predictors of height include monthly household expenditures (Models 3 and 6), maternal education, maternal height, missing maternal height values, and paternal height. Given that we included a variable for small size at birth in Models 3 and 6 to distinguish between the influence of pre- and post-natal care, the significance of monthly household expenditures implies that household resources may be relatively more important during the postnatal period. Short maternal stature could result either from genetic potential or prior stunting during the mother's development, either of which could physically constrain fetal growth. Values were coded missing if the mother's height was not measured during the household visit; the significance of this dummy variable suggests that missing maternal height values proxy a working mother.

Significant negative predictors across all models were residence in a rural area, maternal age less than 20 years at the time of giving birth, preterm birth, and being small at birth. As discussed previously, young maternal age is a predictor of biological risk, particularly for adolescent mothers who are not physiologically mature (DuPlessis

et al 1997; IOM 1985; Kline, 1989). Young maternal age has a slightly stronger association with health outcomes in Models 3 and 6 compared with the other five models; this suggests that young maternal age may be an important factor in poor post-natal growth. The control variables for preterm birth and small in relative size (Models 3 and 6) are negative as expected. Although associated with child height, we control for preterm birth because its causes are largely unknown (Kramer 1987). The three sets of F-tests evaluate the joint significance of community food prices, province location, and a series of three-month age dummy variables by sex. Fixed effects for food prices and province location are not significant in these analyses, with the exception of Model 3.

Figure 10 describes seven identical models that estimate the influence of care quality on the proportion of children stunted using the same quality constructs while controlling for socioeconomic status, maternal and community factors. In these models, the odds ratios are reported for the factors associated with the probability of stunting, whereas "one" equals less than two standard deviations below the median reference population of height for age. Model 1 includes only the structural quality measures, none of which are significantly associated with the odds of stunting. In Model 2, we include the variable measuring prenatal care process quality, which is significantly and negatively associated with the odds of stunting. Similar to the previous explorations, Model 3 replaces the prenatal care variable with one measuring the quality of child care, while also including a variable to control for small size at birth. While child care process quality was not significant in predicting the distribution of height (Figure 9), an increase in child care quality is significantly associated with a decrease in the proportion of

children in the tail end of the distribution (Figure 10). In Model 4, the combined prenatal and child care index is significantly and negatively associated with the probability of stunting. Similar to the previous sets of models, Models 5, 6, and 7 include the process quality measures and omit the structural variables. All three process indices remain significant.

We report a series of F-tests to evaluate the joint significance of other factors in the models. Maternal, paternal, and infant characteristics are jointly significant in all seven models, as are socioeconomic controls and age/sex fixed effects. Neither food prices nor province location are jointly significant in any of the models.

The third aspect of child health, weight for age, captures both long- and short-term insults to child growth. In Figure 11, we employ a random effects logistic regression to evaluate the association between process quality and the established cut-off point for underweight children, less than two standard deviations below the reference median weight for age. Similar to the previous set of models, we first evaluate structure and access. In Model 1, the structural quality index –representing a range of services, basic equipment, and perceptions –is a significant negative predictor of the odds of being underweight. Adding prenatal care process quality in Model 2, the coefficient for the structural index declines slightly but it remains significant, as is prenatal care quality. Surprisingly, child care process quality is not associated with low weight for age (Model 3), although the combined index for prenatal and child care quality is significant in Model 4. The consistent significant association between structural quality and being underweight may represent the importance of a functioning health system and range of

facilities that can respond to the more acute condition of low weight-for-age. Models 5, 6, and 7 do not include the structural quality variables; the process quality indices for prenatal and the combined prenatal and child care remain highly significant. In Model 6, the price of a prenatal visit becomes significant, suggesting that financial access may also be a factor in explaining being underweight. The F-tests indicate that individual characteristics and age/sex fixed effects are jointly significant. The province fixed effects, jointly significant in Models 5 and 7, suggest provincial variation in structural resource allocation. Socioeconomic controls are not jointly significant in these models.

Overall, significant associations exist between access to high quality provider practice and healthy children. Furthermore, these analyses imply different relationships between the type of care quality and the three aspects of growth. An increase in quality child care is associated with a decreased likelihood of being stunted. This finding suggests that the availability of high quality child care in a community may influence the probability of stunting, presumably via curative care that addresses common childhood illness. High quality prenatal care, however, is significant for all three health outcome measures: the distribution of height, the proportion of stunted children, and the proportion of underweight children.

The association between prenatal care quality on mean height is consistent with literature a propos the relationship between child anthropometrics and mortality. A review of 28 community-based studies concluded that the majority of deaths associated with malnutrition is attributable to mild and moderate (rather than severe) malnutrition given the larger proportion of children affected (Pelletier *et al* 1994). Those authors

argue that health strategies focusing only on the sickest children will not make a substantive impact on child mortality at a population level. These findings similarly imply that investments in improving the quality activities associated with positive prenatal development may result in a shift in the distribution of height. This is logical given that poor prenatal development is an underlying cause of the incidence of childhood illnesses (Gove 1997). Such a shift in the distribution represents improved overall child health, which implies health benefits that extend throughout the life cycle (Behrman, 1996). Furthermore, the index measuring the combined impact of prenatal and child care quality was stronger and more highly significant than the indices measuring the quality of prenatal or child care alone. Such a relationship suggests that promoting integrated services and their utilization –particularly in vulnerable communities –could have important health effects.

5. Conclusions

These data demonstrate associations between high quality prenatal and child care available in a community and height, height for age, and weight for age among Indonesian children. Prenatal process quality indices were associated with the conditional mean distribution of height; this suggests that high quality prenatal care activities in a community may be relatively more important than child care, which was associated with the proportion of children stunted. Yet, access to high quality prenatal and child care activities combined demonstrate the strongest associations with all three health outcomes. On an operational level, access to a health service continuum for women during and after pregnancy may have the strongest overall influence on child growth. Particularly for vulnerable groups, integrated quality of care initiatives focusing on high quality process care during the prenatal and early childhood may lessen the probability that a child will suffer from poor growth and its concomitant long-term sequelae on physical functioning and productivity.

We identified wide variation in provider practice across communities in Indonesia, and some possible sources for this variation. The significance of structural quality in predicting high quality provider process suggests that infrastructure plays a role in supporting evidence-based prenatal and child care practices (Figure 6). Indeed, the structural quality index alone was significant and negative in predicting low weight for age in these analyses, implying that a functioning health system and range of facilities may be important for such acute conditions. Similarly, an internal water source was

associated with high prenatal care processes, and a medical doctor was associated with high prenatal and child care processes (Figure 6). In these analyses, the joint significance of the province variables may reflect the “uneven” quality of initial and continuing medical education (World Bank, 1994), such as sub-optimal residency or post-theoretical training, non-standardized in-service and continuing education programs across regions, and provincial differentials in technical support and dissemination systems. Yet, structural quality, the level of socioeconomic development, or even provincial differentials explained only a fraction of the total variation in process quality. Also striking is the low average overall for the process indexes, particularly for prenatal care.

Infrastructure deficiencies and medical education programs are clearly important in promoting high quality care processes. Efforts to improve provider practice in other countries, however, suggest a more complex problem that encompasses not only infrastructure and clinical training but also incentives that promote best practices (Shortell *et al* 1998) and household behavior (Langsten and Hill, 1995).

While performance incentives –within the Indonesian civil service in particular-- are not absent, they are the exception (World Bank 1994). Before the recent decentralization laws, the public health system was highly centralized, characterized by few rewards for innovation; technical programs, for the most part, remain managed and funded vertically. Indeed, the decentralization policies currently underway present new opportunities for revitalizing the health sector, although the challenges and complexities should not be underestimated. Decentralization may also offer an opportunity to

address low wages –particularly among peripheral level staff – that effectively prevent the formation of a full-time cadre of public health professionals (Leiberman 1996). Although used as a pragmatic way to financially support public health staff in peripheral areas, the policy of allowing public staff to practice privately –often within the public facility –may present the clinician with competing incentives.

Such incentives may align themselves with individual demand. One study in Egypt found that children from poor households were more likely than those from wealthier households to be given the appropriate care for diarrheal episodes, i.e., oral rehydration salts, whereas children taken to private clinics were more likely to receive antidiarrheals –not only contraindicated in children but also of no curative value (Langsten and Hill, 1995). The authors of this study, however, attributed their findings less to the financial incentives from drug sales and more to maternal demand for an immediate cure. This factor is particularly important for the management of childhood illnesses given that a key component is appropriate care at home (Gove 1997).

The important responsibility of promoting informed consumers of high quality process care presents an entirely new way of thinking and working for the Indonesian Ministry of Health. This research proposes, however, a method to systematically measure activities that are empirically linked to health outcomes, compare process quality across regions, and inform consumers about the importance of technical quality. Furthermore, given that user fees from health services will remain an important source of revenue for the district governments –one that may be further exploited under the

decentralization laws –quality of care improvements concurrent witih user fee increases will remain an important research area to inform health policy.

More and better data about care quality will support the Ministry of Health's efforts in careful monitoring and feedback into policy development as it proceeds with modifications on the current fiscal decentralization laws. One of the more pressing issues is the continued financing of high quality care for the poor and public health activities because no specific provisions ensure recurrent funding of these basic government responsibilities under the current decentralization laws. Technical programs supporting high quality child care, in particular, have been critical of the decentralization process, suggesting that it may effectively reduce technical support essential in maintaining high quality technical processes (Claeson and Waldman, 2000). The importance of rapid and accurate information about the possible negative influences of decentralization on the provision of social services is crucial. Monitoring changes in care process quality can provide essential information about activities that can influence health status.

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Figure 1. Definition of variables

Variables	Definition
Per capita real household expenditures	Sum of monthly household expenditure divided by the total number of household members. Includes purchased and self-produced food. Divided by deflator for each province and urban/ rural areas using Consumer Price Index.
Maternal education	The number of years of maternal education from 0 to 15 years, squared.
Insurance coverage	Any health insurance benefits through a householder's family or workplace or from a designated company clinic for hospital or outpatient coverage.
Mother non-Indonesian speaking	The woman did not speak Indonesian (official language) during the survey interview.
Food prices in district	Average of community -reported prices for fish, wheat, oil, and canned milk by each district; missing values replaced by average for each province.
Maternal and paternal height	Measured by individuals trained in collecting anthropometrics; height in centimeters. Missing values set to mean and variables generated to identify missing maternal and paternal height values.
Maternal age	Reported maternal age birth divided into </=20 yrs; 21 - 34 yrs; >34 yrs.
Parity	Total number of previous pregnancies, including living children those who died, stillbirths, and miscarriages: 0, 1-4, >/= 5.
Preterm birth	Maternal recall of the number of weeks gestation as less than 37 weeks.
Small at birth	Maternal response to "*In your opinion, compared with other infants, was … bigger, smaller, or similar in size*?" as much bigger, bigger, the same, smaller, or much smaller compared with other infants. "Small at birth" combines smaller and much smaller.
Prenatal care process index	Variables selected from the prenatal care case scenario (listed in Figure 1) summed and averaged for each prenatal care provider; average provider scores collapsed into a weighted mean for each community.
Child care process index	Variables selected from the child care case scenario (listed in Figure 2) summed and averaged for each child care provider; average provider scores collapsed into a weighted mean for each community.
Prenatal and child care process index	Each of the 32 variables from the prenatal and child care case scenarios and providers either of prenatal, child care, or both collapsed into a weighted mean for each community.
Structural quality index	Proportion of criteria met for providers of prenatal, child care, or both collapsed into a weighted mean for each community: infusion set, gloves, sphygmomanometer, observed "clean" by interviewer, curtains on examination room, the head of the facility posted there for more than 3 years, delivery service available, a choice of three family planning methods, and tuberculosis services.
Internal H20	Health facilities that provide prenatal, child care or both have piped water. Average availability generated by collapsing weighted facility observations for each community.
Medical doctor available	Medical doctor works at facility that provides prenatal, child care, or both. Average availability generated by collapsing weighted facility observations for each community.
ln real price for prenatal care	Natural log of price per PNC visit as reported by the facilities providing prenatal care. Public facilities include registration fee. Deflated using consumer price index.

Figure 2. Case scenario for the examination of a pregnant woman

I would like to understand the process by which you provide a pregnancy examination… from the arrival of the patient, waiting upon the patient until she goes home. I shall describe a pregnant mother, then I shall ask you to explain anything you regularly perform. Please state things in consecutive order. Mrs. Ani, a married woman, says she has not had her periods for 3 months. She has come to you for a pregnancy examination. This is her first visit. She appears to be in good health. Please recount everything you would do during Mrs. Ani's first visit… Mrs. Ani is at an advanced stage of pregnancy estimated to give birth in another 2 weeks. Mrs. Ani's condition so far has been good, and she is expected to give birth without complications. Now I would like to know the exact services Mrs. Ani has received up to this moment. [*]

Hypertensive disorders of pregnancy: Did the provider:

- Check blood pressure
- Check urine protein
- Ask about a history of high blood pressure
- Ask about smoking

Physical examination: Does the provider measure:

- Body height
- Body weight
- Abdominal examination
- IDs high risk pregnancy

Case management: Does the provider:

- Date the pregnancy
- Schedule the next visit
- Plan the delivery
- (Refer to a hospital) [‡]

Preexisting maternal medical conditions: Does the provider ask about:

- Diabetes
- Heart disease
- Hereditary disease

Preventive care: Does the provider:

- Check for tetanus toxoid coverage
- Check for STDs
- Give nutritional advice
- Supply iron folate
- Check hemoglobin levels

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[*] The original survey was divided into two separate parts evaluating the initial and final prenatal visit; these parts were combined into one.

[‡] This variable was obtained from a question in the facility survey to the head of the facility, and was included for completeness in terms of establishing a case management system given the importance of a referral system for emergency obstetric care.

Figure 3. Case scenario for the examination of a child with vomiting and diarrhea

On this occasion, I would like to understand the process by which you examine a child suffering from diarrhea. I would like to know the steps you take from the moment the patient arrives, is waited upon, until he/ she leaves for home. After that, I request that you explain just what you usually do. Please make consecutive statements. Mrs. Nani came to the clinic together with her daughter Eli, an eight month old baby. She came with complaints about diarrhea for two days, with vomiting. Please tell me just what you did during the first examination.

History: Did the provider ask about:

- Duration of diarrhea
- Frequency of diarrhea
- Appearance of stools
- Blood in stools
- Presence of fever

Physical: Did the provider:

- Check alertness
- Take temperature
- Examine crown of head
- Check pulse
- Checked skin elasticity

Care: Did the provider

- Administer oral rehydration solution
- Instruct when to return if condition worsens

Figure 4. Standardized measurements of stunting and being underweight by age, gender, and location*

	Average number of standard deviations (z-) scores below the reference median	
	Height for age	**Weight for Age**
Age (months)		
0 –6	-0.24 (.13)	-0.13 (.10)
7- 12	-1.10 (.16)	-1.14 (.09)
13-18	-1.80 (.12)	-1.87 (.10)
19-24	-2.02 (.14)	-1.74 (.07)
25-30	-1.67 (.15)	-1.88 (.12)
31-36	-1.79 (.15)	-1.74 (.10)
37-42	-1.68 (.13)	-1.69 (.08)
43-50	-2.07 (.12)	-1.81 (.08)
Sex		
Male	-1.63 (.07)	-1.56 (.06)
Female	-1.47 (.08)	-1.45 (.06)
Location		
Urban	-1.18 (.08)	-1.31 (.07)
Rural	-1.72 (.08)	-1.60 (.05)
Average	-1.55 (.06)	-1.51 (.05)
# observations	1609	1785

* Tabulations and means done in STATA's survey (svy) program to account for strata, primary sampling unit, and respondent weights. Standard error in parentheses.

Figure 5. Descriptive statistics for health facilities*

	Prenatal care providers		Child care providers	
	Mean	SD	Mean	SD
Quality indicators				
Process quality index	.53	.16	.65	.20
Structural index	.65	.15	.62	.18
Internal water source (=1)	.71		.69	
MD available (=1)	.45		.49	
Socioeconomics: community averages				
Ln household expenditure	11.0	.56	11.0	.55
Maternal age	28.0	3.1	27.9	3.1
Rural community (=1)	.38		.40	
Type of staff				
Public health center	27.0		23.4	
Public auxiliary health center	19.5		18.9	
Privately practiving nurse	5.8		18.6	
Privately practicing midwife	30.4		14.1	
Privately practicing physician	14.3		21.9	
Private clinic	3.0		3.1	
# Observations	1745		2012	

* STATA survey regression identifies province strata, primary sampling unit, and facility weights.

Figure 6. Coefficients Explaining Facility Process Quality*

Explanatory variables	Prenatal care process quality index	Child care process quality index	Combined prenatal and child care process quality index
Structural quality at the facility			
Structural index	.12 (4.000)****	.09 (3.099)***	.16 (2.783)***
Internal water source (=1)	.03 (2.882)***	.00 (0.084)	.02 (0.813)
MD available (=1)	.04 (2.811)***	.09 (4.540)****	.08 (3.145)***
Type of staff (=1)			
Public health center	.01 (0.496)	.01 (0.337)	--
Public auxiliary health center	-.02 (-0.679)	-.01 (-0.374)	--
Privately practiving nurse	-.06 (-1.655)*	-.05 (-1.616)	--
Privately practicing midwife	-.01 (-0.278)	-.01 (-0.374)	--
Privately practicing physician	-.01 (-0.298)	.06 (2.164)**	--
Private clinic	(omitted)	(omitted)	--
Socioeconomics: community averages			
Ln household expenditure	.00 (0.289)	-.00 (0.424)	.00 (0.335)
Maternal age	.00 (0.542)	.00 (1.434)	.00 (0.479)
Rural community (=1)	.01 (0.805)	.02 (1.855)*	.01 (0.834)
Constant	.37 (3.151)***	.48 (3.479)****	.39 (3.876)****
F-test: Province fixed effects	>.001	>.001	>.001
# Observations	1745	2012	308
R-squared	.13	.20	.25

* Coefficients reported with t-values in parentheses. Level of significance * p<.10; ** p<.05; ***p<.01; ****p<.001 for two-tailed tests. STATA survey regression identifies province strata and primary sampling unit; facility weights applied in models 1 and 2..

Figure 7: Descriptive statistics*

		Height (n =1608)		Weight (n = 1785)	
		Mean	SE	Mean	SE
Average z-score for age and gender		-1.55	.06	-1.51	.05
% Below cut-off reference median for gender and age	< -2 standard deviations (=1)	.40		.38	
Socio-economic					
Ln (real mo. hshd expend per capita –rupiah)		10.69	.03	10.69	.03
Number of years maternal education		5.44	.19	5.44	.18
Any type of insurance coverage (=1)		.12		.11	
Mother non-Indonesian speaking (=1)		.41		.41	
Rural (=1)		.69		.68	
Food prices in the district (rupiah):	Fish, kg	3178.31	88.59	3168.77	83.82
	Wheat, kg	834.10	6.37	835.68	6.17
	Oil, kg	1281.45	13.11	1284.51	12.53
	Canned milk	1623.55	9.37	1624.53	9.14
Maternal, paternal and infant					
Maternal height (cm)		149.86	.20	149.88	.20
Paternal height (cm)		161.15	.20	161.17	.18
Maternal age	<21 years (=1)	.13		.13	
	21-34 years (=1)	.73		.74	
	>34 years (=1)	.14		.13	
Parity	0 (=1)	.23		.23	
	1-4 (=1)	.61		.61	
	5 or more (=1)	.16		.16	
Female infant (=1)		.48		.48	
Preterm birth (=1)		.07		.07	
Small in relative size at birth (=1)		.15		.15	
Community averages					
Prenatal care process quality index		.52	.01	.52	.01
Structural quality index		.62	.01	.62	.01
Child care quality process index		.65	.01	.65	.01
Combined prenatal and child care process index		.57	.00	.57	.00
Internal water source		.66	.02	.65	.02
Medical doctor available		.42	.01	.41	.01
Real price per prenatal care visit (rupiah)		2514.63	70.92	2509.90	68.23
Travel time to public health center (minutes)		22.74	1.50	22.43	1.44

* Tabulations and means done in STATA's survey (svy) program to account for strata, primary sampling unit, and respondent weights where applicable.

Figure 8. Cross tabulation of average quality of care available in communities by household expenditure quintiles*

Average quality of care available in the community's health facilities	Range	Average quality available by household expenditure quintile from lowest (1) to highest (5)				
		1	2	3	4	5
Internal water*	0-1	.63 (.58-.69)	.65 (.60-.69)	.65 (.59-.70)	.70 (.66-.74)	.69 (.64-.74)
Medical doctor*	0-1	.37 (.33-.41)	.39 (.36-.42)	.40 (.38-.43)	.43 (.40-.46)	.44 (.40-.47)
Structural quality index*	.37 - .85	.62 (.61-.64)	.63 (.61-.64)	.62 (.60-.64)	.63 (.62-.65)	.64 (.63-.65)
Prenatal process index	.29 - .85	.52 (.50-.55)	.53 (.51-.54)	.52 (.51-.54)	.53 (.52-.55)	.54 (.52-.56)
Child care process index	.39 - .92	.65 (.63-.68)	.65 (.63-.67)	.64 (.62-.66)	.65 (.64-.67)	.66 (.64-.69)
Combined prenatal and child care process index	.38 - .80	.57 (.55-.59)	.57 (.56-.59)	.57 (.55-.58)	.58 (.57-.59)	.59 (.57-.60)
Travel time to public health center (minutes)*	1- 240	30.2 (25.3-35.1)	24.0 (19.9–28.1)	23.1 (19.1-27.1)	17.5 (14.3-20.7)	15.6 (13.5-17-8)
Price for a PNC visit (rupiah)*	600 – 7162	2332 (2170-2494)	2490 (2294-2687)	2665 (2395-2894)	2629 (2425-2834)	2533 (2337-2729)

* STATA survey estimations identify province strata, control for clustering at community, and apply the household weights. 1509 households with weight and age information available for one or more children in the pregnancy register born from 1990 to 1993. Significant differences noted betweem quintile 1 and 5 subpopulation means (*p<.10); 95% confidence intervals in parentheses.

Figure 9. Coefficients from Random-Effects Generalized Least Squares Models Explaining Child Height in centimeters*

Explanatory variables	1	2	3	4	5	6	7
Community							
Combined prenatal and child care process index	--	--	--	4.165 (2.237)**	--	--	4.257 (2.394)**
Child care process index	--	--	1.885 (1.264)	--	--	2.092 (1.465)	--
Prenatal care process index	--	3.087 (1.960)**	--	--	3.192 (2.084)**	--	--
Structural index	1.609 (0.949)	1.194 (0.707)	1.471 (0.884)	0.982 (0.583)	--	--	--
Internal water source	-0.353 (0.559)	-0.445 (0.712)	-0.413 (0.678)	-0.428 (0.693)	--	--	--
MD available	0.342 (0.411)	0.169 (0.205)	-0.018 (0.021)	-0.006 (0.008)	--	--	--
Ln travel time to health center	-0.179 (1.226)	-0.184 (1.268)	-0.148 (1.024)	-0.190 (1.314)	-0.167 (1.165)	-0.129 (0.899)	-0.177 (1.236)
Ln real price per PNC visit	-0.269 (0.740)	-0.308 (0.860)	-0.371 (1.052)	-0.312 (0.879)	-0.371 (1.062)	-0.425 (1.232)	-0.364 (1.055)
Socio-Economics							
Ln real hshd mo. expend per capita	0.314 (1.575)	0.296 (1.487)	0.357 (1.779)*	0.306 (1.541)	0.305 (1.534)	0.364 (1.820)*	0.314 (1.581)
Maternal education (yrs squared)	0.006 (2.093)**	0.006 (2.167)**	0.005 (1.730)*	0.006 (2.170)**	0.006 (2.134)**	0.005 (1.704)*	0.006 (2.138)**
Any insurance coverage	0.466 (1.216)	0.484 (1.265)	0.566 (1.475)	0.487 (1.276)	0.484 (1.270)	0.568 (1.481)	0.492 (1.294)
Mother non-Indonesian speaking	-0.134 (0.429)	-0.146 (0.468)	-0.152 (0.489)	-0.142 (0.456)	-0.135 (0.435)	-0.139 (0.448)	-0.128 (0.416)
Rural	-0.833 (2.534)***	-0.805 (2.474)***	-0.825 (2.582)***	-0.811 (2.516)***	-0.779 (2.550)***	-0.792 (2.632)***	-0.768 (2.539)***

[*] Level of significance * p<.10; ** p<.05; ***p<.01; ****p<.001 for two-tailed tests. STATA random effects generalized least squares model grouped on community identification codes. In addition to the variables reported in the table, all regressions include a series of dummy variables for each of 13 provinces, a series of dummy variables for sex interacted with each 3-month age group to control for non-parametric distributions of z-scores, and for dummy variables identifying missing values for weeks gestation, maternal height, and paternal height; missing values set to mean. Standard errors in parentheses.

Maternal, paternal, infant							
Maternal height (cm)	0.122 (5.181)****	0.122 (5.193)****	0.129 (5.413)****	0.121 (5.157)****	0.122 (5.229)****	0.129 (5.425)****	0.121 (5.180)****
(Missing maternal height values=1)	1.708 (1.825)*	1.754 (1.876)*	1.911 (2.047)**	1.807 (1.932)**	1.768 (1.895)*	1.907 (2.048)**	1.812 (1.943)**
Paternal height (cm)	0.115 (4.990)****	0.115 (4.994)****	0.119 (5.076)****	0.115 (4.968)****	0.117 (5.070)****	0.120 (5.147)****	0.116 (5.027)****
Maternal age (yrs) </= 20 yr	-0.952 (2.220)**	-0.974 (2.272)**	-1.049 (2.420)**	-0.981 (2.290)**	-0.980 (2.290)**	-1.054 (2.435)**	-0.987 (2.305)**
Maternal age >35 yrs	-0.107 (0.272)	-0.144 (0.365)	-0.093 (0.234)	-0.157 (0.400)	-0.158 (0.402)	-0.111 (0.279)	-0.172 (0.436)
Parity 0	0.345 (0.993)	0.347 (1.001)	0.341 (0.971)	0.345 (0.995)	0.357 (1.031)	0.345 (0.984)	0.351 (1.012)
Parity 5+	-0.198 (0.519)	-0.216 (0.566)	-0.317 (0.819)	-0.219 (0.574)	-0.209 (0.549)	-0.302 (0.782)	-0.214 (0.562)
Female sex	-1.271 (1.077)	-1.350 (1.143)	-1.111 (0.935)	-1.357 (1.149)	-1.406 (1.192)	-1.151 (0.970)	-1.411 (1.196)
Preterm	-1.098 (2.532)***	-1.063 (2.451)***	-1.091 (2.261)**	-1.068 (2.464)***	-1.074 (2.483)***	-1.105 (2.292)**	-1.082 (2.503)***
Small in relative size at birth	--	--	-0.900 (2.589)***	--	--	-0.926 (2.672)***	--
F-test joint food prices fixed effects	0.57	0.56	0.55	0.62	0.59	0.53	0.62
F-test joint province fixed effects	0.15	0.11	0.07	0.09	0.13	0.09	0.10
F-test joint age/sex fixed effects	<.001	<.001	<.001	<.001	<.001	<.001	<.001
Constant	34.082 (2.463)***	31.594 (2.296)**	28.261 (2.006)**	28.905 (2.095)**	31.315 (2.307)**	28.25 (2.030)**	28.593 (2.102)**
# Observations	1608	1608	1563[‡]	1608	1608	1563	1608
Prob > chi2	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
R-squared Within	.83	.83	.83	.83	.83	.83	.83
Between	.84	.84	.84	.84	.84	.84	.84
Overall	.82	.82	.83	.82	.82	.83	.82

[‡] Missing relative size values included to estimate the post-natal influence of care account for fewer observations.

Figure 10. Odds Ratios from Random Effects Logistic Regression Models Explaining Stunting[*]
Dependent Variable 1 = <2 Standard Deviations Below the Reference Median Height for Age[†]

Explanatory variables	1	2	3	4	5	6	7
Community							
Combined prenatal and child care process index	--	--	--	.07 (-2.583)***	--	--	.07 (-2.705)***
Child care process index	--	--	.14 (-2.293)**	--	--	.15 (-2.330)**	--
Prenatal care process index	--	.20 (-1.829)*	--	--	.19 (-1.933)**	--	--
Structural index	.65 (-0.463)	.78 (-0.262)	1.09 (0.092)	.96 (-0.049)	--	--	--
Internal water source	1.02 (0.057)	1.07 (0.191)	.95 (-0.147)	1.06 (0.167)	--	--	--
MD available	.74 (-0.647)	.82 (-0.447)	1.12 (0.232)	.93 (-0.162)	--	--	--
Ln travel time to health center	1.04 (0.561)	1.05 (0.573)	1.03 (0.404)	1.05 (0.610)	1.04 (0.525)	1.03 (0.430)	1.05 (0.595)
Ln real price per PNC visit	.97 (-0.176)	.99 (-0.053)	1.02 (0.107)	1.00 (0.006)	1.00 (0.025)	1.01 (0.062)	1.01 (0.045)
F-tests							
Maternal, paternal, infant factors	>.001	>.001	>.001	>.001	>.001	>.001	>.001
SES factors	>.001	>.001	>.001	>.001	>.001	>.001	>.001
Food prices	.64	.62	.75	.74	.68	.74	.75
Province fixed effects	.43	.30	.32	.21	.25	.22	.17
Age/sex fixed effects	>.001	>.001	>.001	>.001	>.001	>.001	>.001
# Observations	1608	1608	1563[±]	1608	1608	1563	1608
Wald Chi2	>.001	>.001	>.001	>.001	>.001	>.001	>.001

[*] Odds ratios reported with z-values in parentheses. Level of significance * p<.10; ** p<.05; ***p<.01; ****p<.001 for two-tailed tests. STATA random effects logistic regressions grouped on community identification codes. In addition to the variables reported in the table, all regressions include a series of dummy variables for each of 13 provinces, a series of dummy variables for sex interacted with each 3-month age group to control for non-parametric distributions of z-scores, and for dummy variables identifying missing values for weeks gestation, maternal height and paternal height ; missing values set to mean.

† The number of standard deviations below the National Center for Health Statistics Reference Median.

[±] To assess child care quality, we include a variable measuring relative size at birth; missing relative size values account for fewer observations.

Figure 11. Odds Ratios from Random Effects Logistic Regression Models Explaining Being Underweight[*]
Dependent Variable 1 = <2 Standard Deviations below the Reference Median Weight for Age[†]

Explanatory variables	1	2	3	4	5	6	7
Community							
Combined prenatal and child care process index	--	--	--	.11 (-2.648)***	--	--	.07 (-3.218)****
Child care process index	--	--	.50 (-1.009)	--	--	.35 (-1.609)	--
Prenatal care process index	--	15 (-2.684)***	--	--	.12 (-3.099)***	--	--
Structural index	.22 (-1.985)**	.27 (-1.773)*	.29 (-1.638)*	.30 (-1.634)*	--	--	--
Internal water source	.78 (-0.862)	.83 (-0.664)	.79 (-0.867)	.82 (-0.720)	--	--	--
MD available	.64 (-1.185)	.69 (-1.000)	.71 (-0.882)	.75 (-0.772)	--	--	--
Ln travel time to health center	1.06 (0.823)	1.07 (0.992)	1.06 (0.920)	1.07 (1.027)	1.05 (0.788)	1.05 (0.762)	1.07 (0.864)
Ln real price PNC visit	1.23 (1.259)	1.27 (1.475)	1.29 (1.553)	1.27 (1.499)	1.28 (1.597)	1.30 (1.625)*	1.28 (1.600)
F-tests							
Maternal, paternal, infant factors	>.001	>.001	>.001	>.001	>.001	>.001	>.001
SES factors	.24	.24	.40	.23	.13	.18	.13
Food prices	.87	.85	.75	.83	.83	.70	.80
Province fixed effects	.27	.11	.20	.09	.07	.12	.04
Age/sex fixed effects	>.001	>.001	>.001	>.001	>.001	>.001	>.001
# observations	1785	1785	1737[‡]	1785	1785	1737	1785
Wald Chi2	>.001	>.001	>.001	>.001	>.001	>.001	>.001

[*] Odds ratios reported with z-values in paretheses. Level of significance * p<.10; ** p<.05; ***p<.01; ****p<.001 for two-tailed tests. STATA random effects logistic regressions grouped on community identification codes. In addition to the variables reported in the table, all regressions include a series of dummy variables for each of 13 provinces, a series of dummy variables for sex interacted with each 3-month age group to control for non-parametric distributions of z-scores, and for dummy variables identifying missing values for weeks gestation, maternal height, and paternal height ; missing values set to mean.

† The number of standard deviations below the National Center for Health Statistics Reference Median.

‡ Missing relative size values account for fewer observations.