Early Childhood Care and Development (ECCD) in Two Communities in Tijuana, Mexico: maternal and household characteristics and pediatric development

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ABSTRACT:

- **Objective:** To describe the proportion of children overall and in each study arm who attain developmental milestones in two rural peri-urban communities in Tijuana, Mexico. To compare the specific proportions of milestone attainment in this region to an international standard comparison group. To describe baseline household and maternal characteristics of each study arm. To identify maternal and household factors associated with failure to meet early child development milestones.
- **Material and methods:** This was a secondary analysis of data derived from baseline cross-sectional survey data that were collected using World Vision's early childhood care and development (ECCD) questionnaire on 226 women to obtain maternal demographics and achievement of developmental milestones of children 6-23.99 months old living in the household. The developmental status of all children age 6-11.99 months was evaluated by maternal self-report of attainment of the same 5 milestones; that of all children age 12-23.99 months was evaluated by maternal self-report on attainment of the same 12 milestones. The prevalence of maternal depressive symptoms was assessed using the Center for Epidemiologic Studies-Depression (CES-D) scale. Multivariate analyses were performed to assess associations between maternal and household characteristics and failure to achieve child developmental milestones. Failure to attain developmental milestones was defined as failure to attain any milestone evaluated in the ECCD questionnaire, based on maternal self-report.
- **Results:** Overall, nearly 50% of study children 6-23.99 months old failed to achieve one or more of the developmental milestones assessed. In bivariate analyses, children of mothers at extreme ranges of age, of employed mothers, of mothers with higher educational attainment, and children who received an iron-fortified diet were least likely to fail milestones overall. In multivariate analysis, factors significantly associated with milestone failure included moderate and severe maternal depression and continuous breastfeeding, in addition to age.
- **Conclusions:** In spite of the limitations conferred by small sample size, questionnaire design, the lack of objective assessments of child developmental and nutritional standard, and the absence of a simple, internationally validated instrument for assessment of child development, this baseline study has provided useful information about the prevalence of known risk factors for poor developmental outcomes in the study communities. It identified several potentially remediable factors previously shown to affect child development, such as maternal depression and iron fortification in the child's diet. The secondary analysis also identified recommendations for improved study design to produce more robust results and to standardize the data collected to international standards.

INTRODUCTION

This paper will describe the results of a secondary data analysis of a baseline, pre-intervention study of early childhood developmental status in two peri-urban Mexican communities. Child development is the ordered emergence of sensori-motor, cognitive-language, and social-emotional functioning skills[1]. This process is greatly influenced by socio-cultural, biological and psychosocial factors. The interaction of these factors is especially influential during a child's early years when key developmental processes occur. During this time, brain development is ongoing via neurogenesis, axonal and dendritic growth, synaptogenesis and myelination, and it is affected by the environment[2]. Early stresses such as lack of adequate nutrition, iron deficiency, infectious diseases and poor social stimulation and interactions can have adverse and long-lasting effects on brain development[1,2]. It has been estimated that 200 million children under 5 years old in developing countries are unable to reach their developmental potential due to health and social factors such as poverty, poor health and nutrition, and deficient parenting care and health services [1,2,3]. Although 90% of the world's children live in low and middle-income countries, the severity of the problem of poor child development remains relatively unknown for many subpopulations due to lack of availability of national statistics [4, 2].

It is important to address maternal and household risk factors that may adversely affect a child's development and may be amenable to intervention. Principal factors that are known to influence child development at this level include poor maternal socioeconomic status, low maternal educational level, inadequate nutrition for the child, childhood anemia, diarrheal disease, perinatally acquired HIV and maternal depression; these factors are often interrelated. For example, it is known that children of less-educated women are more likely to be exposed to poor dietary intake and sanitation while also receiving less cognitive stimulation[5,6]. It has also been suggested that intervention programs to improve maternal mental health can directly help reduce the prevalence of child malnutrition[7].

Several different types of nutritional inadequacy have been causally linked to delayed child development; among the most important are iron deficiency, stunting, and wasting. One of the most common nutritional deficits in children in developing countries is iron deficiency. Animal models have shown that iron deficiency anemia in early developmental stages alters brain metabolism, neurotransmission and myelination[8]. Infants with iron deficiency anemia have been shown to have similar results, with reported decreases in mental, motor, social, emotional and neurophysiologic functioning[8].

When given the proper nutrients and raised in healthy environments, children should be able to reach their growth potential; a child who does not reach his or her genetic growth potential for height is considered stunted[9]. Wasting (low weight for height) is another common consequence of an inadequate diet during childhood. Studies have directly linked stunting and wasting to impaired educational and economic performance later in life[9].

Poor developmental outcomes associated with stunting and wasting can also be due to an infectious etiology. Infectious etiologies, including diarrheal, respiratory and vaccine-preventable diseases (i.e. pertussis) are commonly associated with stunting and wasting in children due to their direct effect on the child's ability to grow and maintain the health status necessary to be developmentally normal. However, a child infected with perinatally-acquired HIV can have poor neurodevelopment as a direct result of viral invasion of his or her central nervous system[10]. Direct effects of HIV on the developing infant brain (neuro-AIDS) can cause children to lose milestones after attaining them. In addition to biological effects of HIV, infants born to mothers infected with HIV are at a higher risk of living in a resource-limited environment that may not be able to provide adequate nutritional support for the growing child; an HIV infected mother may also be less able to provide adequate care for the child. HIV-infected infants are therefore known to perform more poorly on developmental tests[10].

Maternal depression has been well documented in high-income countries to have high economic and human costs that extend across generations by affecting the health, development and behavior of children[4]. The prevalence of maternal depression is estimated to be between 35-50% in Latin America[11]. However, its impact on child development in developing countries, where the majority of the world's children live, is less well studied[12,4]. The prevalence of depression among the general population in Mexico is estimated to be 9.2%, with women being at twice the risk of men of having a depressive episode[13].

Depressive disorders are a common disability among women, with symptoms ranging from sadness, negative affect, loss of interest in daily activities, fatigue and withdrawal that can directly interfere with interactions between mothers and young children[4]. Infants of depressed mothers are less likely to be securely attached leading to delayed cognitive development and behavioral problems[14, 4]. Depressed mothers are also more likely to terminate breastfeeding earlier and be less sensitive in their interactions with their children, leading to malnutrition and developmental delay[4].

Early interventions are key to promoting normal developmental outcomes in children. The Institute of Nutrition of Central America and Panama (INCAP) showed that nutritional supplementation in children before age 3 years old, but not after, improved economic productivity in these individuals as adults[15]. This suggests that key interventions to positively affect child development must occur in infants and toddlers. There have been other trials in which modification of a social, economic or nutritional risk factor has suggested an improvement in child developmental outcomes. For example, a study in Colombia looked at 433 families and assigned the children to a nutritional supplement program, a stimulation (home visit) program, or both in the prenatal to 3 years of age ranges[3]. A mental developmental scale at specific age cut-offs was used, in addition to scoring locomotor, personal-social, speech and language skills, to assess developmental outcomes. The effect of these interventions showed that food and stimulation each affected different areas of performance; food supplementation affected motor development and stimulation affected language, but the two together did not have additive effects on development. The causes of developmental failure are multifactorial, and this study is a prime example that multiple concurrent interventions may be required in children who have multiple risk factors for delay. Knowing that certain social and biological risk factors have an effect on the development of a child's gross motor, social and language development, it is necessary to invest more time and energy to better understand the magnitude of their impact and how to intervene. Addressing these underlying social determinants of health may be an effective approach to reducing developmental delay, especially where programs incorporate interventions that have previously been tested and found to be successful at improving child development outcomes (e.g. certain intervention programs for maternal depression[4]).

Because few studies exist in Mexico looking at the prevalence of these social, psychosocial and biological factors known to affect child development, World Vision (WV) elected to conduct a baseline study to assess local prevalence and correlates of developmental delay in children in two rural communities of Tijuana, Mexico, in the context of a quasi-experimental prospective evaluation of an intervention designed to address potentially modifiable factors associated with failure to attain normal child development.. WV is a non-profit faith-based development organization that promotes the advancement of children around the world. WV conducted its cross-sectional baseline survey in 2010, and subsequently implemented a new, multi-faceted approach to address the social, educational and health factors that influence early child development in this region of Latin America intervention. A follow-up cross-sectional study was conducted in 2012, and its results will be used to assess the impact of the intervention. In the future, the WV evaluation has the potential to inform scaled ECD interventions in Mexico and other international sites.

This paper will describe the results of a secondary analysis of WV's baseline data. Because data from the post-intervention phase of the parent study were unavailable, the secondary data analysis performed for this thesis only uses baseline data from WV's initial cross-sectional survey. The principal aims of the secondary analysis are the following: First, to describe the proportion of children in each study arm (intervention vs. control) who attain all developmental milestones assessed in the baseline survey. Second, to describe the ages at which specific proportions of children overall and in each study arm are reported to have achieved specific gross motor milestones, and compare them to the age ranges (with their corresponding confidence intervals) at which WHO has observed achievement of comparable milestones in international populations[16]. Third, to describe and compare the baseline maternal and household characteristics of each study arm. Finally, to describe associations between potentially modifiable and other maternal and household characteristics with indicators of early childhood development. An additional aim, added after the initiation of data analysis, was to identify potential modifications in the WV questionnaire that might enhance the quality data obtained in future, similar studies.

MATERIAL AND METHODS

Parent Study

Study population

The WV baseline survey took place in two communities (Zapata and Reforma) in the municipality of Tijuana, Mexico. At the time of the baseline survey, the estimated population of Zapata was 2,169 inhabitants and the population of Reforma was 1,523 inhabitants, with the number of children under 5 years old being 251 and 189, respectively. For the baseline assessment of maternal and household characteristics and early child development, a cross-sectional baseline household survey was conducted in the two study communities (one identified as intervention and the other as control) from June to August 2010. Participants were selected via simple random sampling (SRS) of households following a census activity to identify eligible households with pregnant women or children under three years of age in each community. A total of 413 women between the ages of 18-49 who were either currently pregnant or had a child under the age of three years old were interviewed. An early childhood care and development (ECCD) program questionnaire developed by World Vision was used to record maternal and household characteristics and child developmental status. The primary health-related domains addressed by the questionnaire were: maternal demographics, household composition, child nutrition and feeding practices, and household sanitation. In households with more than 1 child under 5 years old, the youngest child was identified as the subject of the interview. Medical students from the Universidad Autónoma de Baja California were recruited and trained to administer face-to-face interviews to mothers using a field tested and pre-coded questionnaire. Interviews were conducted in Spanish. Each participant was required to give oral consent, which was obtained and certified. The study was approved by the human subjects review committee at the Universidad Autónoma de Baja California, and approval to perform a secondary data analysis for this thesis was granted through the University of Washington's Human Subjects Division.

Developmental milestone assessment

Gross motor, social and language development was assessed by mother's report using a series of age-appropriate questions in the ECCD questionnaire. Direct observation of the index child was not employed. The basic questionnaire was modified by inclusion of specific questions relevant to five age groups, pertaining to the age of the index child: 0-2 months old, 3-4 months old, 4-6 months old, 6-12 months old, 1-2 years old. In total, questions corresponding to up to 12 different milestones were asked, as appropriate for the age of child and ordered from least advanced (i.e. holds head up) to most advanced (i.e. walks confidently). Fewer developmental questions were asked for the youngest children, and progressively more questions were included for older children (**Table 1**). Mothers were asked to respond “yes” or “no” for each age-appropriate milestone achieved by her child.

Assessment of maternal depression status

The Center for Epidemiologic Studies-Depression (CES-D) scale was administered to all participants in Spanish[17]. The scale was self-administered by each participant in private without the use of an interviewer in order to ensure honest responses. This scale was designed to measure the prevalence of current depressive symptoms at the community level using a 20-question scale without providing an individual clinical diagnosis of depression[17]. The CES-D scale addressed the following symptoms of depression: depressed mood, guilt, worthlessness, loss of appetite, sleep disturbance and psychomotor retardation. Participants rated the frequency of symptoms from 0 ‘rarely or never’ to 3 ‘most or all the time.’ Possible scores were 0 to 60 with higher scores indicating a higher prevalence of depressive symptoms. A score of 16 or greater was identified as separating depressed from non-depressed individuals in the original field trials[17]. Subsequent studies identified a cut-off of 24 or greater to represent clinical depression and to distinguish moderate from severe depression[18]. This scale has been tested for intercultural reliability in Spanish, particularly among Mexican-American, Puerto Rican-American and Cuban-American youths compared to Anglo youth in the United States, showing that CES-D scores did not vary as a function of language or ethnic status[19]. The scale has not been validated in Mexican women of child-bearing age.

Secondary Analysis

Subjects excluded from the secondary analysis

15 households' data (or data from 15 mother-child dyads) were excluded from analysis for the following reasons: 1) Mismatch between selected questionnaire and recorded age of child, e.g. use of the 6-12 month questionnaire for a child whose recorded age was 4 months; 2) Incomplete developmental milestone data recorded. Children who did not have answers to all milestone questions that should have been asked in their age category were omitted from the analysis; 3) Developmental data not interpretable due to unknown age of child.

We restricted analyses to children age 6 to 23.99 months, thus excluding 172 additional households, for the following reasons: 1) only a small number of milestones was addressed in the youngest children, and there were fewer children in the 0 – 6 month age category, leaving a total sample size too small to conduct milestone-specific analyses; 2) poor discriminatory power of questionnaires to detect delay in children over 2 years of age, owing to absence of questions about milestones ordinarily achieved after the age of 1 year.

Statistical Analyses

Descriptive statistics summarized maternal, child, and household demographic information collected via the ECCD questionnaire, restricted to households with index child age of 6 months through 1 year, 11 months and 29 days. We described the characteristics of intervention and control community subjects separately and overall.

For the primary analysis of child development status, we calculated the proportion of children reported to have attained each milestone, stratified by age category (6-11.99 or 12-23.99 months), both overall and by study arm. Where appropriate, the ages at which children were reported to have achieved specific milestones were compared to the age ranges at which an international sample of children was observed to have attained similar gross motor milestones as assessed by WHO[15]. In order to describe the overall proportion of children attaining all milestones for age, a dichotomous variable (0=fail, 1=pass) was created for each developmental milestone assessed by the study instrument. A total milestone score sum was calculated for each child by adding the sum of each age-appropriate milestone achieved. A new dichotomous variable was then created (0=PASSALL if child met all milestones evaluated, 1=FAIL if child failed one or more of the milestones evaluated) to identify children who did not meet all milestones in his or her age category. Nutrition variables were created to conform with World Vision nutrition indicators[19]. These included variables for children breastfed within 1 hour of birth, children continuously breastfed (see **Table 2** for definitions), children receiving a minimum meal frequency, children receiving a diet adequately fortified with iron, and children meeting a minimum dietary diversity.

Maternal depression was described using CES-D scores as both a continuous and categorical variable, with the categorical variable separating non-depressed (score of 0 – 15.9), moderately depressed (score of 16-23.9) and severely depressed (score of 24 – 60) based on cut points defined in the published literature[18]. Scores were determined only for women answering at least 16 out of 20 questions. For those answering 16-19 questions, scores were normalized against scores for those answering all 20 questions.

Age-adjusted binary logistic regression models were used to determine the bivariate association of maternal demographic characteristics, maternal depression scores and child nutrition variables with the failure to attain developmental milestones at various age cut-offs. In addition to analyses involving all eligible subjects, two age subcategories (6 – 11.99 months and 12 – 23.99 months) were evaluated separately for each bivariate model, because the 6 – 11.99 month questionnaire did not evaluate all of the developmental milestones addressed by the questionnaire for the older children. The dichotomous dependent outcome for these analyses was reported failure to achieve one or more age-appropriate milestones. Independent variables included maternal depression CES-D scores, maternal demographic factors (employment status of mother, occupation, maternal age, marital status, financial support from child's father, highest education level attained, years of residence in community), number of prenatal visits attended, location of birth of child, insurance status, and child nutrition factors (breastfed at one hour of life, continuously breast fed, meets minimum meal frequency, receives iron-fortified diet, meets minimum dietary diversity).

Age-adjusted multivariate models were then constructed in parallel fashion, including all variables that were found to be significantly associated with developmental outcomes at the level of $P \leq 0.20$ in the bivariate analyses. The core multivariate model included maternal age (modeled as a categorical variable in three age bins: teen mothers [13 – 19 years at time of delivery], middle age range [20 – 34 years at time of delivery] and advanced maternal age [≥35 years at time of delivery]); maternal employment status, maternal marital status, maternal education level (modeled as a categorical variable: incomplete primary education, complete primary education, incomplete secondary education, complete secondary education, beyond secondary education), gender of child, age of child, iron fortification of the diet, a diet including adequate diversity of food groups for the child, and continuous breast-feeding. These variables were chosen as the core model given their previously documented influence on child development. The additional covariates initially chosen for analyses included maternal depression, maternal financial assistance from the child's father, maternal years of residence in the community, insurance status, residence in the intervention versus comparison community, and a diet including adequate diversity of food groups for the child. Of these covariates, those with a $P < 0.20$ were selected to build the final multivariate model. Each covariate was added to the core model individually, and its effect was assessed using likelihood ratio tests. Covariates with a p-value < 0.20 for the likelihood ratio tests between the core model and the core model with the added covariate were included in the final multivariate model. Once these final covariates were chosen, they were added step-wise to the core model, with likelihood ratio tests checked between the core model and the core model plus covariates. Each time a new covariate was added, that model became the new "core" model to which the new model was tested.

Given the potential for collinearity between various demographic and nutrition factors, interaction terms were created to assess associations between maternal marital status and receiving financial support from the child's father, iron-fortification and dietary diversity, iron-fortification and continuous breast feeding, dietary diversity and continuous breast feeding, and infant age and nutrition-related variables. Non-significant findings were used to exclude variables from the final model. Subjects with missing variables were excluded from the analysis.

RESULTS

Maternal and household characteristics

After exclusion of 15 individual participants and all households with children lying outside the age ranges of interest (children age 6 – 23.99 months), the total study sample consisted of 226 women; each woman reported on the developmental status of 1 child; their characteristics are described in **Table 3.** Most participating women had resided in the community for more than a decade. Nearly all women were married or in civil union relationships. Nearly half of the women had completed some secondary education and the majority were unemployed. There was no significant variability in demographic and risk factor profiles between intervention and comparison communities, confirmed by chi2 testing.

Milestone failure

One hundred fourteen (50.4%) children demonstrated age-appropriate milestone achievement (attainment of all developmental milestones assessed by the relevant study questionnaire) as ascertained by maternal self-report, and 112 (49.6%) children were found not to have achieved at least one milestone in their age group **(Figure 1)**. However, several milestones were achieved by nearly 100% of subjects **(Figure 2);** failure to pass "all milestones" was generally due to failure to pass only a small subset of milestones, often those that only children at the upper ranges of the 2 main age groups (6-11.99 months, 12-23.99 months) might have been expected to pass – e.g. "crawling" for the younger infants and "walking confidently" for the older ones . Fifty-two (48.15%)

children in the intervention community attained all milestones for age compared to 62 (52.54%) children in the comparison community who attained all milestones for age.

Only four motor milestones (ability to walk, sit up, crawl, stand up) were compared to WHO international standards, because there were no comparable WHO standards for the other milestones evaluated in the WV baseline survey. The youngest age category by which 50% of study children could reportedly sit up was 7-7.99 months, compared to the 50^{th} percentile of 5.9 months in the WHO comparison group (**Table 4**). Overall, at least 50% of study children could crawl by 8-8.99 months of age, compared to the 50^{th} percentile of 8.3 months in the WHO comparison group. At least 50% of children overall in this study could stand up by 9-9.99 months of age, compared to the 50^{th} percentile of 10.8 months in the WHO comparison group. Finally, at least 50% of children in this study met the WHO 50^{th} percentile standard for walking by 12 months of age. Nearly all participants 12 – 23.99 months could walk by 17 months of age.

Association of social factors with failure of milestones

Milestone failure was reported less commonly in children of teen mothers (OR for association of teen motherhood and milestone failure 0.58) and children of mothers of advanced maternal age (0R 0.59) than in children of women in the middle age range (**TABLE 5**). Approximately one-third of mothers greater than 35 years old at the time of delivery had a child who failed milestones. Milestone failure was approximately the same frequency in children of single mothers compared to married mothers. Approximately half of children whose fathers lived in the household and half whose fathers contributed financially also failed milestones. Children who had insurance coverage more commonly failed milestones (OR = 1.24).

Association of nutritional factors with failure of milestones

Forty-three percent of eligible children were reported to have been breastfed within their first hour of life with 58.8% receiving continuous breastfeeding (i.e., still breast-feeding at the time of the maternal interview). Approximately 48% of children received diets adequately fortified with iron per WV nutrition indicators (**Table 2**). Twenty-six percent of children not breastfed received the minimally accepted frequency of solid-food meals per day (≥ 4 times day as outlined by WV nutrition indicators); this question was not asked of women who were still breast-feeding. Thirty percent of children were fed diets rich in at least 4 different food groups per day. Bivariate analysis was significant for a negative association of failure to achieve all milestones and reported provision of an iron-fortified diet for children 6 – 23.99 months of age (OR = 0.56, P = 0.050). Only about 40% of children who received a diet adequately fortified with iron failed milestones.

Association of maternal depression with failure of milestones

223 of the eligible women answered ≥16 questions, meeting criteria for valid CES-D scores. The mean normalized CES-D score was 14.15 (±9.21), with a minimum score of 0 and a maximum score of 48.4. Approximately one-third of women had scores of 16 or greater. 15.9% of eligible women met the threshold for severe depression (score ≥24). Age-adjusted bivariate analysis showed a significant association (using our

threshold of P<0.20) between severe depression scores and failure of developmental milestones (OR = 1.87, P = 0.128). Approximately 55% of children with mothers who had CES-D scores in the severe depression ranged failed milestones. In the bivariate analysis, each category was compared to women in all other categories.

Multivariate analysis

The final core multivariate model (**Table 6**) included selected socioeconomic variables plus depression scores, continuous breast-feeding and iron-fortification. This model was comprised of 208 participants and had a chi2 probability < 0.0001. Moderate and severe depression scores retained their statistically significant positive association with failure of milestones. Continuous breast-feeding also retained its statistically significant positive association with failure of milestones (OR 1.79, P = 0.081). In the multivariate model, iron-fortification and adequate dietary diversity were still negatively associated with failure of milestones but neither association was statistically significant.

In the final multivariate model, observed associations between covariates of interest and milestone failure were generally similar to those observed in bivariate analyses except for teen pregnancy, maternal employment, iron supplementation and continuous breastfeeding (**Table 6**). Teen pregnancy, maternal employment and continuous breastfeeding all became more statistically significant in the final multivariate model, but iron supplementation became less statistically significantly associated with child developmental failure. In this final model, extreme maternal ages were negatively associated with milestone failure. Maternal employment was also associated with less failure of milestones. Maternal marital status had a non-significant association with milestone failure but was retained in the core model due to its importance as a demographic indicator. Maternal education did not show a significant association with attainment of milestones. Increasing age of the child was significantly associated with failure of milestones. Iron-fortification and adequate dietary diversity were negatively associated with milestone failure in the multivariate model, but the strength of these associations was decreased (in comparison to bivariate analyses).   For this reason, we conducted unplanned analyses of the associations between these important nutritional factors and between these factors and age. We found significant positive associations between iron fortification and dietary diversity ($P < 0.001$ by χ^2 test), and significant negative associations between iron fortification and age ($p<0.001$ by logistic regression) and between continuous breast-feeding and age ($p=.007$ by logistic regression). We did not find a significant association between continuous breast-feeding and dietary diversity. Moderate and severe depression and continuous breast-feeding showed increased association with failure of milestones.

DISCUSSION

In this analysis, we described the baseline characteristics of households, women and children across two study arms and looked at their associations with developmental delay on the youngest child under 2 years of age in the household. There was a high overall “fail” rate among all children that indicated almost half of children in these communities are not meeting their developmental potential. This likely overestimates the prevalence of developmental failure among young children in this setting because the age ranges evaluated using the same questionnaire were inappropriately broad. As seen in

Figure 1, there is a dramatic drop in failure rate for the highest age category administered in the 6-11 month questionnaire and an increase in prevalence of failure in the lowest age category administered in the next questionnaire. In addition, the approach to the analysis was modeled on the US standard of declaring a child to have failed if he/she fails any question in an *age-appropriate* questionnaire that covers all 4 of the important domains (gross motor, fine motor, social and language). This method could not be adapted precisely to this study because not enough milestones were evaluated in each domain to permit us to identify a specific group of *age-appropriate* indicators that included all 4 domains for each one-month age cut.

In study objective one, the baseline comparison of all characteristics assessed showed no significant difference across the study arms in the intervention and comparison communities. Overall, the eligible population for this secondary analysis consisted of primarily middle-aged mothers (between 20 and 34.9 years) who were mostly unemployed. The majority were married or engaged in a civil union and received financial support from the child's father. Educational attainment in these communities was overall low, with less than one-third of women completing secondary education. Of these demographics, low education levels and high unemployment rates are high risk factors for negatively impacting a child's growth and development, as found in previous literature[1,3,5,6]. This suggests that our study population may be at high risk of milestone failure owing to low maternal education and employment rates.

In objective two, this study attempted to apply validated WHO criteria to determine whether observed attainment of developmental milestones overall and in each study arm at baseline was "normal" per international standards in objective two. In a multi-country assessment of milestone attainment, WHO found that 50% of children achieved the milestone "to sit-up" by age 5.9 months. In our study subjects, 50% of study subjects in age categories 6 and 7 months had attained this milestone, which is consistent with the interpretation that our study subjects' developmental status is normal with regard to this milestone. However, small numbers within each 1-month age category limit our ability to interpret these findings; although the parent study did include children under 6 months, only 9 children in the 5-5.99 month age group were assessed. Despite this, the gross motor milestones "crawl" and "stand-up," were attained by 50% of children in this analysis at a somewhat earlier age than in the WHO comparison group. Children in our analysis (at the 50th percentile) attained the ability to walk at the same age as those in the WHO comparison group. These findings actually refute the high failure estimate yielded by the study questionnaire.

However, the observed similarities and differences in reported attainment of milestones between the WHO multi-country study and this study, particularly for the milestone "stand-up", are challenging to interpret owing to several factors. This dataset does not lend itself to be able to properly describe the ages at which specific proportions of children overall have achieved specific gross motor milestones in comparison to WHO international standards for those milestones. In the WV study, not all relevant milestones were evaluated across all age categories, and the wording of the descriptions of gross motor milestones evaluated did not match the exact description of the gross motor milestones used in the WHO comparisons (**Table 4**). The milestone specified as "ability to stand up" in the WV questionnaire most closely matches the WHO motor milestone labeled "ability to stand up alone." This difference in definitions and level of detail of description for the milestones is important. While it appears that our study population was able to attain the ability to stand up somewhat sooner than the WHO international standard group, it may be artifact of questionnaire wording causing misclassification of those who stand with assistance as being able to “stand alone.” Therefore, the WV definition of “stand up” is not the same as the WHO definition and it is difficult to compare our dataset to an international standard without standardization of the questionnaire’s milestone definitions.

In the third objective, the achievement of each milestone was assessed overall and by study arm. Overall, approximately half of children of eligible participants failed one or more their developmental milestones overall. These results were also consistently seen by study arm, with no significant differences between the two communities. The highest proportions of overall milestone failure were seen in the younger children, ages 6 – 12 months. By milestone, nearly all children attained the ability to hold up his or her head, sit up, roll over, smile, recognize own name, make and follow sound, and follow instructions by age-appropriate ages. There was more variability in the major motor milestone such as the ability to sit-up, crawl, stand-up and walk. While most children could attain these milestones by 12 – 17 months, there was great variability in the reported progression of attainment of milestones with increasing age.

Objective 4 is the association of specific characteristics with milestone failure. In spite of the limitations conferred by the small sample size and the questionnaire design, this analysis confirmed that maternal depression and certain nutritional factors are potentially modifiable risk factors for developmental failure in the study population, and these findings support WV’s plan to attempt a multidisciplinary intervention to prevent developmental failure, and to assess the results quantitatively. However, it was challenging to assess associations of age-varying covariates (such as the iron content in the diet, dietary diversity) with an outcome measure (developmental milestone failure) that is also strongly age-associated. Our final covariate model probably underestimates the positive associations between an iron-replete diet and developmental achievement, and the positive associations between breast-feeding and child development, because of the difficulty of adjusting for collinearity involving infant age and these covariates.

This analysis described cross-sectional associations between baseline characteristics of mothers/households and developmental status of index children in the baseline survey. The interactions between the social, biological and psychosocial factors influencing early child development are known to be complex. One of the primary goals of this secondary data analysis was to evaluate the local prevalence of select maternal demographics and psychosocial factors that are known to influence the biological and cognitive ability of children between the ages of 0 and 2 years old to achieve their developmental milestones in a population previously not studied.

The results of this analysis are consistent with what is known about the effect of maternal socioeconomic status, child nutrition and maternal depression on the development of young children. Positive associations, shown in the published literature to be causally associated with normal developmental status, were found between overall milestone attainment and low CES-D scores (0 – 15.9), an employed mother, child's father living at home, higher education level of the mother (beyond secondary), the mother attending greater than 5 prenatal visits during the pregnancy with the index child, normal birth weight of the child, child nutritional factors such as an iron-fortified diet, eating food from more than 4 food groups per day and eating greater than 3 meals per day. But, of these factors, only low depression scores, teen pregnancy, advanced maternal age, and maternal employment were statistically significant in both the bivariate and multivariate models.

Negative associations, described in the previous literature as being harmful to the attainment of milestones (i.e. more likely to fail milestones overall), were found with moderate and severe depression scores, low educational attainment of the mother (only completion of incomplete primary schooling) and single moms. Moderate and severe depression, continuous breastfeeding and maternal marital status were statistically significant variables in the bivariate and multivariate models.

The multivariate model produced further information about the association of these factors with developmental outcomes in a model that adjusted for maternal and child demographics and certain nutritional factors. Somewhat surprisingly, the observed associations between reported milestone failure and extremes of maternal age were negative. This may be due to the presence of a second care figure, such as a grandmother, who is assisting younger mothers with the care of her child. Older mothers, however, may have more experience raising children, leading to a protective environment for development. However, the observed associations may be artifact of small sample size. Increased socioeconomic status of the mothers was also protective, with child of employed mothers being less likely to fail milestones overall. Maternal education, while a known important protective factor for child development, showed varying results in our study. Although the lowest levels of maternal education were negatively associated with successful development, there was not a consistent decrease in negative developmental seen with increased educational attainment as we expected to see. This, however, is most likely due to insufficient cell sizes to allow us to draw a distinction between attainment of milestones and strata of educational levels.

The gender of the child was non-conclusive in its association with the attainment of milestones. This variable, however, was kept in the final multivariate model given its importance as a child demographic indicator. The age of the child, however, appeared to be highly associated with developmental milestone attainment, as expected. This is consistent with the normal clinical progression of increased developmental abilities with age, as the child grows and develops along a normal scale of development. However, in this study, the strength of the observed association between age of child and failure of milestones in the final multivariate model is complicated by the choice of questionnaire design for age of child. This is because all 6-12 month olds were evaluated for the same milestones (whether or not they were developmentally appropriate for the age of the specific child) and all of the 1 – 2 year olds were evaluated for a different, but overlapping, group of milestones. Thus, children in the younger age categories for each questionnaire-defined subgroup (6-11.99 months, 12-23.99 months) were at a disadvantage compared to older children in the same subgroup; and 7-month-olds were at a disadvantage compared to 6-month-olds because of the change in content of the questionnaires. Therefore, the ability to assess pediatric development at one month age cut-offs, as is done clinically, was lost. For example: per the WHO multi-country assessment, only 50% of children in an international sample are able to stand by the age of 10.8 months. In this study, the ability to stand was assessed in all children age >=6 months, and it was therefore likely that >50% of children in the 6-11.99-month range would fail (as we observed).

Child nutritional factors showed some expected and some surprising results. A diet consisting of iron-rich foods should likely be a strong indicator of attaining development milestones. It was highly significant in the bivariate analysis but lacked significance in the multivariate model, probably caused by collinearity with age. The significant bivariate association is consistent with known literature that lack of iron can negatively affect the cognitive development of children.

The nutritional indicator that produced unexpected results was continuous breastfeeding. Breastfeeding is encouraged worldwide by pediatricians given the immense nutritional and immunologic benefits for child development and maternal-child bonding. Better nutrition, increased stimulation from the mother, and increased levels of antibodies against common infectious diseases are all protective factors for child development. Our study, however, showed that continuous breastfeeding was positively associated with failing milestones overall in children. We did not study exclusively breastfed children because we were only interested in children 6 months of age or older, and this age group should not be only receiving breast milk as the single source of nutrition. There are several reasons why we might be seeing these results. One is that children 6 – 12 months of age might not be receiving other micronutrients (iron, vitamin A, vitamin D) crucial for the development of a child if they are only breastfeeding. This is the age group where children transition to semi-solid and solid foods as well, and it is possible that children who continue to be breastfed in this group are not receiving adequate additional meal supplementation (i.e. low dietary diversity) to meet their developmental needs. Continuous breastfeeding and dietary diversity were not found to be significantly collinear, but dietary diversity and iron-fortification were collinear. Therefore, continuously breastfed children might be from poorer families who cannot afford to supplement breastfeeding with vitamins and additional nutritious meals. These children might also be more likely to have a mother who is unemployed (and therefore home to breastfeed the child) and therefore has decreased socioeconomic abilities to purchase other sources of nutrition. However, chi2 testing showed that continuous breastfeeding is no associated with maternal employment status or with receiving financial help from the child's father. Also, as noted above, younger children were both more likely to fail milestones and more likely to be continuously breast-fed, and so collinearity involving breast-feeding and child age may have resulted in confounding.

Lastly, this could be an artifact of small cell size and wording of the questionnaire. The question asked "did your child breastfeed in the last 24 hours?" which might not be capturing all children who are breastfeeding.

Maternal depression was shown to be positively associated with milestone failure and was greatly prevalent in these data. These results are consistent with previous studies that suggest there is a higher prevalence of maternal depression in developing countries and that this has an indirect but important effect on the development of children. The prevalence of self-reported depressive symptoms among mothers in these communities is much higher than the reported national average in Mexico, suggesting that social stressors in these may communities, such as lack of maternal employment and low levels of higher education levels achieved, may play a role in the etiology of depressive symptoms seen here at a community level. Addressing the risk factors noted in this study population has been shown to be an effective way to improve developmental outcomes in children – i.e. that mitigation of risk factors causes improvement in child development indicators.

Study Strengths

There are several strengths to this study. First, it provides information about maternal demographics, maternal depression and child nutritional factors that were previously unknown in this setting. Maternal depression, in particular, is not widely studied or addressed in Latin America, and this study has detected an association with the already known problem of child developmental delay in the developing world. Secondly, this study used a questionnaire that was administered in the primary language of the participants, administered by native speakers of that language. This ensured greater reliability of communication between the interviewer and interviewee. Third, WV used a systematic process to collect baseline data to do a community assessment of key demographic features before designing an intervention and follow-up study. There are few studies currently in progress designed with the overall objective of enhancing overall child function and development, as many focus on child mortality. WV has therefore focused on an important aspect of pediatric health. Lastly, WV was able to use this study model flexibly, being open to changes and better future similar studies in other regions of the world.

Study Limitations

There are several limitations to this study. First, the data used in this analysis are derived from a cross-sectional study design. While this is unavoidable in the assessment of baseline demographic data, one major limitation of the study for risk factor association is the inability of a cross-sectional design to assess temporal causal relationships, and indispensible element of causality.

Secondly, lack of direct measurement of developmental outcomes (e.g. by direct observation of child behavior) provides subjective, rather than objective, data regarding milestone achievement for each child. Although more practical to gather, all data regarding achievement of developmental milestones are based on maternal report, leading to the possibility for the definition of each milestone to be interpreted differently among mothers. For example, when asked if her child can crawl, a mother may have answered "no" if her child has progressed to walking and no longer crawls. However, by responding "no," the data indicate that the child was never able to attain this milestone. This may also reflect poor explanations by interviewers or poor definition of milestones in study questionnaires. The interviewers were highly trained and educated individuals, therefore suggesting that the problem lies in the wording of the questionnaire. The lack of specificity in the wording of question used to assess the ability to stand for this dataset may have misclassified some children as passing this milestone even if they required assistance to stand, leading to differential misclassification and causing and over-estimate in children attaining milestones. For variables such as "hold head up" and "follow sound," the pass rate was near 100%, suggesting that these questions had essentially no discriminatory value thus not contributing information to the evaluation of milestone failure. There is no direct observation by a trained specialist in child development nor is there use of a standardized developmental milestone scale such as the Bayley Scales.

In addition, developmental milestones included in the study instrument have been limited to those that can be readily explained to mothers by trained interviewers; the gross motor domain is consequently overrepresented in the milestones included in the study instrument, and other domains are underrepresented. Thus many children may be misclassified as developmentally delayed when they are not and vice versa, resulting in differential misclassification and grossly under or overestimating the total prevalence of developmental delay. There is also concern for recall bias in this study. For example, mothers are asked to recall if their child was breastfed within one hour of birth. This may have led to misclassified data for this particular nutrition variable.

A fourth major limitation of this study is small cell sizes within age groups. This created a barrier to seeing a step-wise increase in attainment of milestones with increasing age, as one would expect. There were many fluctuations in milestone achievement in older children for unknown reasons. It is likely that lack of specificity of questionnaire wording or lack of understanding or misinterpretation of the question being asked on the part of the interviewee contributed to misclassification in these cases. Data entry error may have also contributed to the failure to see a step-wise increase in milestone achievement with increasing age.

A fifth limitation of this study is the inability to accurately quantify overall prevalence of failure of milestones due to questionnaire design. The implausibly high failure rate of overall milestone attainment seen in this analysis is likely a result of the questionnaire design. Too few developmental questions were asked in a very broad age category for 6-11.99 month old and 12 – 23.99 month old children. These age ranges mark periods of development that are critical to many developmental changes that occur in children on a monthly basis. At least 4 questions (1 per domain) and up to 8 questions (2 per domain) specifically tailored to each 1-month age cut would have provided a more detailed and accurate assessment of developmental potential. By asking the same set of developmental questions to a mother of a 6 month old as to a mother of an 11 month old, the 6 month old will therefore be held accountable for attaining the same set of milestones as the 11 month old. Naturally, this is not feasible and the mother of the 6 month old will likely answer "no" to several of the developmental questions for her child since he or she has not developed to that stage yet, for his or her age. The consequence of this scoring system is that the 6 month old will automatically "fail" all milestones based on having answered "no" for one or more milestones. Therefore, the failure rate of almost half of the children in this study most likely does not accurately reflect the developmental status of the pediatric community eligible for analysis. It is likely a reflection of improper use of developmental questions for age of child.

The developmental milestones evaluated in the parent study were heavily weighted toward gross motor development. No fine-motor milestones were evaluated, and few social or language milestones were included. This limits the sensitivity of the survey for detection of true milestone delay, and for detection of risk factors that may be less strongly associated with gross motor development than with other milestone domains.

Lastly, this study lacks anthropometric data of each child such as accurate weight-for-age, height-for-age, and weight-for-height Z-scores and hemoglobin values to better assess the biological association of maternal factors and nutrition with child growth. Anthropometric indices and hemoglobins would provide an objective indicator of the child's current nutritional status, in the same way that direct observation of milestone attainment would have provided objective evidence of development, and if available would permit internal validation of maternal self-reports re feeding practices.

Conclusion

As the global community aspires to achieve the Millennium Development Goals, it is vital that governments of developing countries address the important impact that maternal and household factors such as maternal depression, socioeconomic status, child nutrition and maternal education level have on the ability of children to develop normally and progress through early childhood and school successfully. Areas of future studies to consider include creating globally accepted indicators of child development to better measure the status of development of children in Mexico in both rural and urban environments. Future steps include the implementation of early childhood development programs with targeted interventions to ensure that children are able to meet their development potential, even among stressful social situations. In spite of the limitations conferred by small sample size, questionnaire design, the lack of objective assessments of child developmental and nutritional standard, and the absence of a simple, internationally validated instrument for assessment of child development, this baseline study has provided useful information about the prevalence of known risk factors for poor developmental outcomes in the study communities. Findings derived from study of this relatively stable peri-urban population are not necessarily generalizable to other populations even within Mexico, e.g. rural indigenous populations. However, the baseline results may help the sponsoring agency to target its multidisciplinary interventions toward the more prevalent risk factors, and to refine its survey methods in order to obtain more robust results in future surveys.

Appendix A:

Table 1: Developmental milestones assessed grouped by age and developmental category[1]

Age group	**Gross Motor development Indicators**	**Social Development Indicator**	**Language development Indicator**
6-11.99 months	-Hold his/her head up -Roll over by him/herself -Sit by him/herself -Crawl -Stand up	-Smile to his/her siblings or father	-Follow sounds or music -Respond to his/her name -Make or reproduce sounds
Total milestones assessed	5	1	3
12-23.99 months	-Hold his/her head up -Roll by him/herself -Sit by him/herself -Crawl -Stand up -walk	-Smile to his/her siblings or father	-Follow sounds or music -Respond to his/her name -Make or reproduce sounds -Follow easy instructions -recognize and name sounds
Total milestones assessed	7	1	5

Table footnotes:

1. **Fine motor milestones were not assessed in this study**

Table 2: World Vision Definitions of nutrition indicators[20]

Nutrition indicator	Definition
Breastfed within 1 hour of life	Proportion of children under 2 years receiving early initiation of breastfeeding, within 1 hour of birth
Continuously breastfed	Proportion of children aged 6-23 months receiving breast milk in the 24 hours previous to of administration of the survey
Minimum meal frequency	Percent of breastfed and non-breastfed children aged 6-23 months who received solid, semi-solid, of soft foods (including milk feeds for non-breastfed children) ≥ 4 times during previous day
Iron fortified diet	Percent of parents of caregivers who report that children aged 6-59 months received any of the following during the previous day: iron-rich food or condiments; food that is especially designed for infants and young children and was fortified with iron; food that is fortified in the home with a product that included iron (meat/fish or legumes).
Minimum dietary diversity	Percent of children aged 6-23 months who received food from at least 4 food groups (eggs, meats, fruits, vegetables, grains, dairy, legumes) during the previous day

Table 3. Characteristics of Participating Mothers, Infants and Households

Characteristics	Subgroups defined by age of index child			Subgroups defined by community of residence	
	6 - 11.99 months (N=81) N (%) or median (IQR)	**12-23.99 months (N=145)** N (%) or median (IQR)	**6 - 23.99 months (N=226)** N (%) or median(IQR)	**Intervention (N=108)** N (%) or median(IQR)	**Comparison (N=118)** N (%) or median(IQR)
Demographics					
Maternal age (in years) (1[0.4%] missing): Median, (IQR)	24 (16, 40)	25 (15, 41)	25 (15, 41)	25 (16, 41)	25 (15, 40)
Extremes of maternal age at time of delivery (0, 0% missing):					
Teen pregnancy (delivery before age 20 years)	22 (27.2)	38 (26.2)	60 (26.5)	29 (26.9)	31 (26.3)
Delivery between 20 and 34.9 years	53 (65.4)	95 (65.5)	148 (65.9)	71 (65.7)	77 (65.3)
Advanced maternal age (≥35 years at time of delivery)	6 (7.4)	12 (8.3)	18 (8.0)	8 (7.4)	10 (8.5)
Maternal depression scores[1] *modeled as categories* (3, 1.3% missing):					
CES-D Scores 0-15.9 (low score)	51 (63.0)	88 (60.7)	139 (61.5)	62 (57.4)	77 (65.3)
CES-D Scores 16-23.9 (medium score)	16 (19.8)	32 (22.1)	48 (21.2)	28 (25.9)	20 (17.0)
CES-D Scores ≥24 (high score)	12 (14.8)	24 (16.6)	36 (15.9)	17 (15.7)	19 (16.1)
Length of maternal stay in community (in years) (1, 0.4% missing): median (IQR)	10 (0, 39)	14 (0, 35)	12 (0, 39)	16.5 (0, 39)	10 (0, 35)
Single Mother (2, 0.8% missing)	10 (12.5)	22 (15.2)	32 (14.2)	16 (14.8)	16 (13.6)
Employed mother (0, 0% missing)	21 (25.9)	47 (32.4)	68 (30.0)	33 (30.6)	35 (29.7)
Maternal occupation as maquiladora (0, 0% missing)	11 (13.6)	21 (14.5)	32 (14.2)	15 (13.9)	17 (14.4)
Father of child lives in the household (0, 0% missing)	68 (84.0)	116 (80.0)	184 (81.4)	88 (81.5)	96 (81.4)
Father of child contributes financially (0, 0% missing)	75 (92.6)	120 (82.8)	195 (86.3)	92 (85.2)	103 (87.3)
Maternal education, by highest level achieved modeled in categories (3, {1.3%} missing):					
Incomplete Primary *(<6 years of primary instruction completed*	9 (11.1)	18 (12.4)	27 (11.9)	14 (13.0)	13 (11.0)
Complete Primary *(6 years of primary instruction only completed)*	22 (27.2)	42 (29.0)	64 (28.3)	27 (25.0)	37 (31.4)
Incomplete Secondary *(<3 years of secondary instruction completed)*	11 (13.6)	17 (11.7)	28 (12.4)	9 (8.3)	19 (16.1)
Complete Secondary (*3 years of secondary instruction + 6 years of primary instruction completed*	27 (33.3)	38 (26.2)	65 (28.8)	39 (36.1)	26 (22.0)
Beyond Secondary (*Completion of ≥1 semesters of prep or university studies)*	11 (13.6)	28 (19.3)	39 (17.3)	19 (17.6)	20 (17.0)
Mother and/or child has insurance coverage (0, 0% missing)	52 (64.2)	98 (67.6)	150 (66.4)	74 (68.5)	76 (64.4)
Pregnancy of index child was planned (16, 7.1% missing)	25 (30.9)	66 (45.5)	91 (40.3)	41 (38.0)	50 (42.4)
Prenatal visits (≥5 visits) (16, 7.1% missing)	67 (82.7)	115 (79.3)	182 (80.5)	87 (80.6)	95 (80.5)
Child was born in a clinic (16, 7.1% missing)	20 (24.7)	33 (22.8)	53 (23.6)	30 (27.8)	23 (19.5)
Child was born in a hospital (16, 7.1% missing)	55 (67.9)	100 (69.0)	155 (68.6)	71 (65.7)	84 (71.2)
Child was breastfed within one hour of birth (7, 3.1% missing)	37 (45.7)	60 (41.4)	97 (42.9)	46 (42.6)	51 (43.2)
Child is continuously breastfed (breastfed within last 24 hours of time of interview) (0, 0% missing)	37 (45.7)	96 (66.2)	133 (58.8)	62 (57.4)	71 (60.2)
Child receives an adequately iron fortified diet (4, 1.8% missing)	30 (37.0)	79 (54.5)	109 (48.2)	49 (45.4)	60 (50.8)
Non-Breastfed children meeting a minimum meal frequency of solid foods standard (135, 59.7% missing)	5 (6.2)	21 (14.5)	26 (11.5)	15 (13.9)	11 (9.3)
Dietary diversity of child modeled in categories: (n, {%} missing):					
Child is fed diet with ≥4 food groups/day (0, 0% missing)	14 (17.3)	52 (35.8)	66 (29.2)	32 (29.6)	34 (28.8)
Dietary diversity of child modeled as a linear variable, 0 vs 7 food groups/day: (0, {0%} missing: median, IQR)	2 (0, 5)	3 (0, 7)	3 (0, 7)	3 (0, 6)	3 (0, 7)
Birth weight of child ≥2500 gms (29, 12.8% missing)	69 (85.2)	115 (79.3)	184 (81.4)	89 (82.4)	95 (80.5)

Table footnotes:

1. **CES-D scores normalized to adjust for missing responses**

Table 4. Ages at which specific proportions (those possible to calculate) of children overall and in each study arm achieved specific milestones as compared to WHO standards of achievement in international populations[13]

Milestone	Percentile of children attaining milestone	Youngest age at which percentile of children attained milestone:	Youngest age at which percentile of children attained milestone:		Youngest age at which percentile of children attained milestone:
		All Study Subjects	Intervention Study Subjects	Comparison Study Subject	WHO comparison group
Sit up[1]	25th	6 months	6 months	6 months	5.2 months
	50th	7 months	6 months	7 months	5.9 months
Crawl[2]	10th	6 months	7 months	6 months	6.6 months
	50th	8 months	11 months	8 months	8.3 months
Stand up[3]	50th	9 months	9 months	10 months	10.8 months
	75th	11 months	11 months	11 months	12 months
	90th	13 months	12 months	17 months	13.4 months
Walks confidently[4]	50th	12 months	17 months	12 months	12 months

Table footnotes:

1. **Listed as "sitting without support" in WHO milestones**
2. **Specified as "hands and knees crawling" in WHO milestones**
3. **WHO comparison milestone used was specified as "stands alone"**
4. **WHO comparison milestone used was "walking alone."**

Table 5. Developmental Outcomes and Characteristics of Study Participants and Households

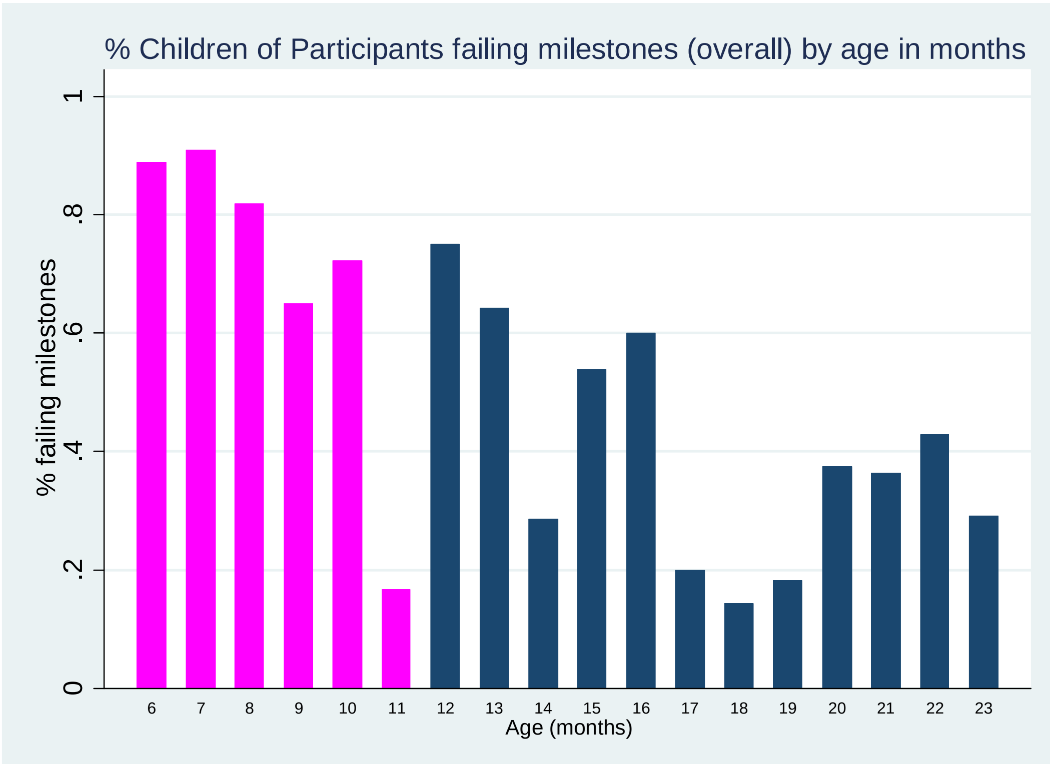
Characteristic (N, %)	**N(%) Failing developmental screen, by age of index child**		
	6-11.99 months (N=81)	**12-23.99 months (N=145)**	**6-23.99 months (N=226)**
All children	55 (67.9)	57 (39.3)	112 (49.6)
Extremes of maternal age at time of delivery:			
Teen pregnancy **(delivery before age 20 years): (60, 26.5%)**	14 (63.6)	13 (34.2)	27 (45.0)
Delivery between 20 and 34.9 years**: (148, 65.9%)**	37 (69.8)	41 (43.2)	78 (52.7)
Advanced maternal age **(≥35 years at time of delivery): (18, 8.0%)**	4 (66.7)	3 (25.0)	7 (38.9)
Maternal depression scores[1] *modeled as categories*:			
CES-D Scores 0-15.9 **(139, 61.5% low score)**	31 (60.8)	31 (35.2)	62 (44.6)
CES-D Scores 16-23.9 **(48, 21.1% medium score)**	12 (75.0)	15 (46.9)	27 (56.3)
CES-D Scores ≥24 **(36, 15.9% high score)**	10 (83.3)	10 (41.7)	20 (55.6)
Single Mother **(32, 14.2%)**	6 (60.0)	11 (50)	17 (53.1)
Employed mother **(68, 30.0%)**	12 (57.1)	14 (29.8)	26 (38.2)
Maternal occupation as maquiladora **(32, 14.2%)**	6 (54.5)	7 (33.3)	13 (40.6)
Father of child lives in the household **(184, 81.4%)**	46 (67.6)	45 (38.8)	91 (49.5)
Father of child contributes financially **(195, 86.3%)**	53 (70.7)	46 (38.3)	99 (50.8)
Maternal education, by highest level achieved **modeled in categories:**			
Incomplete Primary ***(<6 years of primary instruction completed)* (29, 11.9%)**	6 (66.7)	10 (55.6)	16 (59.3)
Complete Primary ***(6 years of primary instruction only completed)* (64, 28.3%)**	13 (59.1)	16 (38.1)	29 (45.3)
Incomplete Secondary ***(<3 years of secondary instruction completed)* (28, 12.4%)**	10 (90.9)	7 (41.2)	17 (60.7)
Complete Secondary **(*3 years of secondary instruction + 6 years of primary instruction completed*) (65, 28.8%)**	18 (66.7)	13 (46.4)	31 (47.7)
Beyond Secondary **(*Completion of ≥1 semesters of prep or university studies*) (39, 17.3%)**	7 (63.6)	10 (35.7)	17 (43.6)
Mother and/or child has insurance coverage **(150, 66.4%)**	39 (75.0)	36 (36.7)	75 (50.0)
Pregnancy of child was planned **(91, 40.3%)**	18 (72.0)	27 (40.9)	45 (49.5)
Prenatal visits (≥5 visits) **(182, 80.5%)**	47 (70.1)	44 (38.3)	91 (50.0)
Child was born in a clinic **(53, 23.6%)**	12 (60.0)	10 (30.3)	22 (41.5)
Child was born in a hospital **(155, 68.6%)**	42 (76.4)	44 (44.0)	86 (55.5)
Child was breastfed within one hour of birth **(97, 42.9%)**	27 (73.0)	26 (43.3)	53 (54.6)
Child is continuously breastfed **(breastfed within last 24 hours of time of interview) (133, 58.8%)**	30 (81.1)	40 (41.7)	70 (52.6)
Child receives an adequately iron fortified diet **(109, 48.2%)**	17 (56.7)	25 (37.9)	42 (43.8)
Non-Breastfed children meeting a minimum meal frequency of solid foods standard **(26, 11.5%)**	2 (40.0)	7 (33.3)	9 (34.6)
Dietary diversity of child modeled in categories:			
Child is fed diet with ≥4 food groups/day **(66, 29.2%)**	5 (35.7)	17 (32.7)	22 (33.3)
Birth weight of child ≥2500 **gms (184, 81.4%)**	49 (71.0)	43 (37.4)	92 (50.0)

Table footnotes:

1. CES-D scores normalized to adjust for missing responses

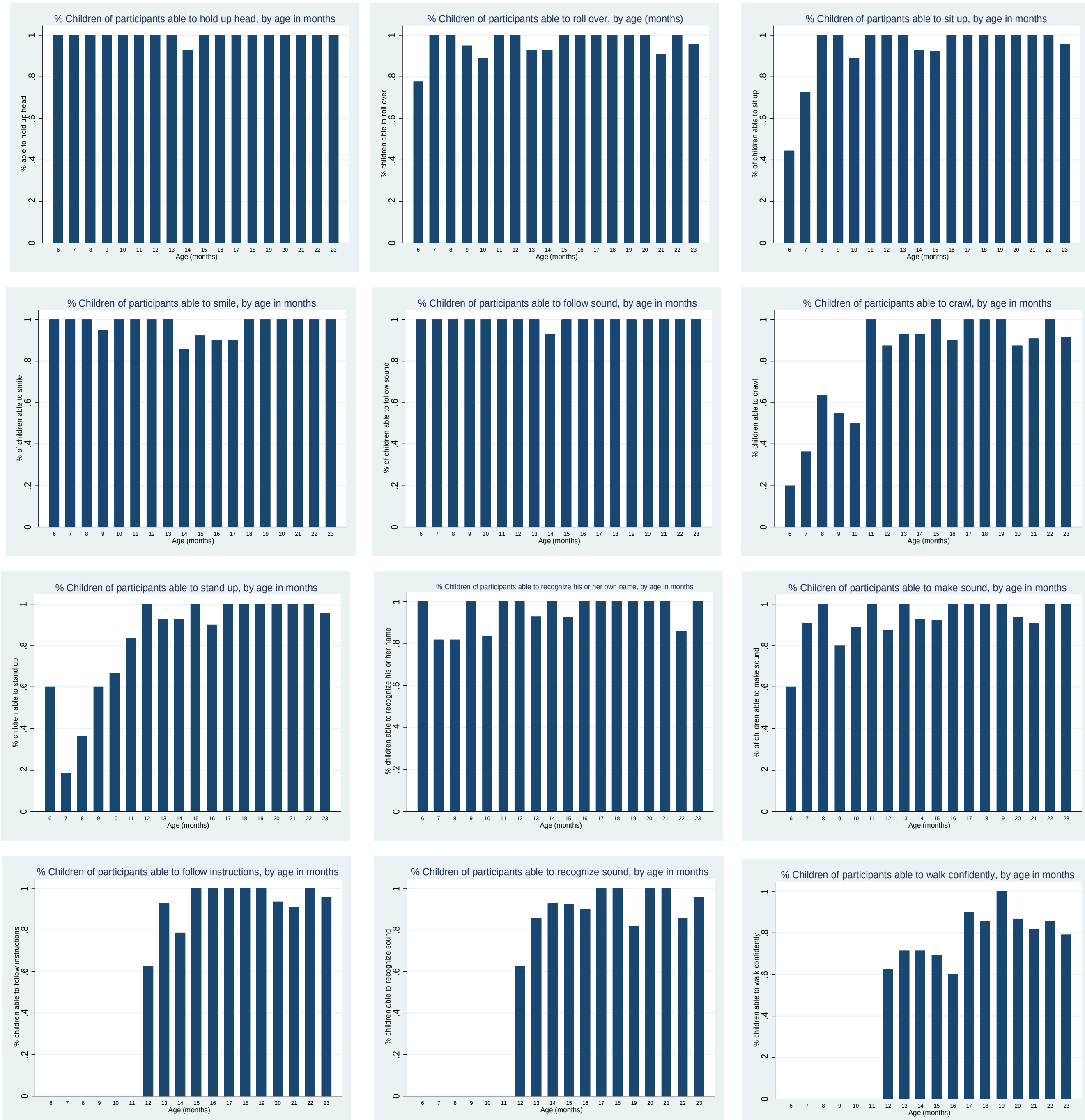
Table 6. Bivariate and multivariate logistic regression of covariates and dependent outcome "fails all milestones"				
	Bivariate analysis		**Multivariate analysis**	
Covariate	**6-23 months old**		**6-23 months old**	
	OR	*p*-value	OR	*p*-value
Maternal depression				
CES-D scores, 16-23.9	2.00	0.060	2.23	0.034
CES-D scores, 24 - 48.42	1.87	0.128	1.94	0.093
Maternal age at time of delivery				
Teen pregnancy (13-19 years)	0.58	0.108	0.45	0.040
Age 20-34 years (reference category)	-	-	-	-
Advanced maternal age, ≥35 yrs	0.59	0.369	0.38	0.161
Single mother	1.30	0.526	1.70	0.306
Employed mother	0.63	0.148	0.53	0.085
Maternal education, by highest level achieved				
Incomplete primary	1.87	0.160	-	-
Complete primary	0.49	0.143	0.45	0.150
Incomplete secondary	0.96	0.945	1.54	0.523
Complete secondary	0.52	0.193	0.67	0.480
Beyond secondary	0.43	0.122	0.58	0.374
Child continuously breastfed	1.42	0.260	1.79	0.081
Iron in child's diet	0.56	0.050	0.69	0.183
Children with diet from ≥4 food groups/day	0.57	0.085	0.69	0.279
Dietary diversity of children, 0 vs 7 food groups/day (continuous)	0.73	0.008	-	-
Normal vs low birth weight of child	0.32	0.088	-	-
Gender (child)	-	-	0.72	0.317
Age of child (months)	0.87	0.000	0.87	0.000

Figure 1. % of Children Failing milestones overall, by age in months*



*Pink bars represent children in 6-11 month old age group who used the same questionnaire as one another. Blue lines represent 12-23 month olds who used the same questionnaire as one another.

Figure 2. % Children attaining each milestone by age in months



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