Indo-Fijian Children's BMI

In the Context of Urbanization, Embodied Capital, and Food Choice Trade-offs

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Abstract Health research has shown that overweight and obesity in children and adults are becoming significant public health problems in the developing world. Evidence suggests that this phenomenon is more marked in urban than rural areas and may be associated with modernization. However, the underlying reasons for this nutrition transition remain unclear. Dietary shifts, often in conjunction with income and time constraints in urban environments, may entail a greater reliance on more convenient sugar and fat-dense food. Also, the necessity of labor-intensive agricultural work to meet rural subsistence needs is supplanted in urban environments by sedentary work. This paper extends the application of human behavioral ecology theory into the realm of international development and policy by applying Kaplan's embodied capital theory to explore differences in food habits and nutritional status of Indo-Fijian children within the context of urbanization. Urban high-embodied-capital women demonstrate higher rates of wage-earning employment than urban low-embodied-capital or rural women. Findings indicate that urban high-embodied-capital households spend significantly more on food purchases, purchase a greater proportion of processed foods, and have children with higher body mass indexes (BMI) than do urban low-embodied-capital or rural households. This suggests that urban high-embodied-capital mothers, who tend to be employed, may be making trade-offs between income and food choices.

Keywords Embodied capital · Human behavioral ecology · Indo-Fijian · Maternal employment · Nutrition transition · Urbanization

Human behavioral ecology (HBE) applies evolutionary ecology models to the study of human behavior. These models assume that natural selection has resulted in evolved capacities that allow individuals to adapt their behavior to changing

environmental circumstances in fitness-enhancing ways. Furthermore, "since humans are capable of rapid adaptive shifts in phenotype, they are likely to be well-adapted to most features of contemporary environments" (Smith 2000, p. 30). Thus, HBE frameworks should be applicable to studies of human behavior in any context. Despite this broad applicability, HBE research has generally focused on foraging and hunter-gatherer societies, with some application to pastoralists and horticulturalists (Smith 2000; Winterhalder and Smith 2000). This paper extends the application of HBE theory into the realm of international development and public policy in a modern, urban context undergoing nutrition transition. Specifically, the theory of embodied capital (Kaplan 1996; Kaplan et al. 1995, 2000) is applied to investigate the relationship of urbanization and maternal employment to diet and children's body mass among Indo-Fijians.

Nutrition Transition

Nutrition transition is a broad term encompassing the patterns of dietary change throughout human history (Popkin 1994, 1999, 2001). The current nutrition transition describes the change from recurrent famine, marked by large numbers of underweight individuals, to nutrition-related noncommunicable diseases often associated with overweight and obesity. This transition, which has already occurred in developed countries like the United States, is presently underway in many less-developed countries of the world (Popkin 2004).

Nutrition transition involves broad-based changes in the food environment, including changing dietary patterns as well as associated changes in physical activity, resulting in alterations in body composition. These changes do not occur in isolation; they occur in the context of rapid economic, political, and social changes that in turn rapidly modify the environment of less-developed countries (Caballero and Popkin 2002). The links between socioeconomic development—especially urbanization fueled by internal migration—and nutrition transition are well established (Popkin 1994, 2004). They include lifestyle changes such as greater reliance on technology and a reduction in physical activity (Ramachandran et al. 2002; Tudor-Locke et al. 2003), economic changes associated with globalization (Chopra et al. 2002), and shifts toward higher-density diets (Popkin 2001; Shetty 2002). Explanations proposed thus far have yet to address the role of family dynamics, time allocation, or parental investment shifts in urban environments or how behavioral adjustments in these areas might affect dietary change.

The rate and timing of transition within societies is not uniform (Popkin 1994). For example, dietary transitions that took place over more than five decades in Japan have occurred in less than two in China (Chopra et al. 2002). Transition countries typically exhibit both under- and over-nutrition, wherein different patterns and prevalences of overweight and obesity coexist with varying levels of undernutrition in children, indicating that urban-related dietary shifts are also not uniform. The varying capacities of parents in urban environments to adjust investment strategies may be one factor influencing the lack of uniformity.

Urbanization and Maternal Employment

The proportion of the world population living in urban areas is on the rise and is expected to reach 60% by 2030. This urban increase is fueled mainly by rural-to-urban internal migration in developing regions, where the urban population is expected to rise between 2 and 4 billion compared with between 0.9 and 1 billion in developed areas (United Nations 2001). Internal migration in developing countries occurs because cities contribute disproportionately to national economies and seem to offer better options for employment, education, health care, and culture (Moore et al. 2003). With rapid urbanization and migration the shifts in mode of subsistence and the value of wage-labor jobs can be dramatic. Changes in dietary patterns, education options, and work patterns often accompany these shifts. The changes in labor patterns that accompany migration can be particularly acute for mothers. Because women now make up at least one third of the world's labor force in all regions except northern Africa and western Asia, more women than ever before are employed throughout their reproductive years (United Nations 2000) and are consequently juggling the dual demands of jobs and childcare (Short et al. 2002).

Maternal employment is not a new phenomenon, but in urbanizing environments it may take on new forms that are more incompatible with childcare than ever before —for example, full-time employment in office or manufacturing jobs (Engle 1991). Assessments of the effects of mothers' work on child welfare vary across societies (Short et al. 2002). Studies in the developing world provide evidence of the incompatibility between maternal employment and time spent in childcare (Short et al. 2002; Sivakami 1997). However, some studies suggest that time spent with children has remained stable despite increasing maternal wage employment (Bianchi 2000; Desai and Jain 1994). The effect of maternal employment on child nutrition also varies. A review of studies from developing countries failed to find a conclusive link between maternal employment and poorer nutritional status in children (Leslie 1988).

An HBE approach appreciates the ecologically specific nature of parental investments and predicts "diverse and flexible behavior, contingent on localized and often changing conditions" (Winterhalder and Smith 1992, p. 9). The lack of consensus in research examining the effect of maternal employment on childcare and child nutrition highlights the effect of ecologically specific variation in types of maternal employment, time spent working, availability of alternative caregivers, and impact of maternal wages on child heath. This paper applies HBE theory to explore the effects of urbanization on investment in child growth among Indo-Fijians.

The Theory of Embodied Capital

This paper applies the theory of embodied capital to examine the effects of urbanization and parental embodied capital on household dietary patterns and children's BMI. It is suggested that the urban ecology fundamentally alters payoffs to parental investment through increased importance of education and wage-labor

and that the changes in investment impact food choice and dietary investment. The theory of embodied capital posits the existence of an evolved psychological mechanism that is "sensitive to environmental variations in learning opportunities and payoffs" (Kaplan et al. 2002, p. 234). This mechanism allows parents to make behavioral adjustments in investments in their own and their offspring's learning in accordance with ecologically contingent demands for skills-based resource acquisition. As such, parents should be capable of altering investment strategies as they transition to living in urban environments. Urban environments increase the importance of wage income for the purchase of goods. Since wage labor is inherently tied to learned skill sets, this in turn creates an incentive for increased investments in learning for skills-based resource acquisition. Thus, urban environments create changing payoffs to investment in human capital that are manifest in the increased importance of education in determination of wages.

Greater investment in education leads to changes in fertility and parental investment. As the average level of investment increases, the production of each additional offspring is more costly, leading to lower-quantity but higher-quality offspring (Kaplan 1996). In urban environments where increasing payoffs to investments in education exist, some parents are likely to choose a high-quality strategy with long-term payoffs to investments in skill acquisition. Increased parental investment in education is expected to result in a trade-off between these long-term returns on educational investment and short-term returns from work activities of offspring (Bock 2002). Thus the fitness-related currency being maximized is skill.

Although the shift to employment in a wage-economy increases relative payoffs to some women, it also increases the costs of child rearing because wage employment may be incompatible with household work. As parental investment in education increases and quantity of offspring decreases, there are fewer offspring to help with household work and act as alternative caregivers, and because of the increased importance of investment in education, parents may be less inclined to shift household work to those offspring who are available. Thus, the ecologically contingent investment trade-offs working women in urban environments face may be high. This study explores how high-embodied-capital women adjust parental investments in environments that place new emphases on job skills and formal education. Do highly skilled women, who are likely to be employed, have different dietary patterns? And, are their food choices consistent with the nutrition transition? These questions are addressed through three hypotheses:

H1: Urban high-embodied-capital households spend more on food purchases than urban low-embodied-capital or rural households.

H2: Urban high-embodied-capital households rely more on heavily processed foods (relative to fresh foods) than urban low-embodied-capital or rural households.

H3: Children of urban high-embodied-capital parents are heavier than those of low-embodied-capital or rural parents.

Methods

Study Population

The 1996 Fiji census found 775,077 persons living in Fiji, 44% of whom are Indo-Fijians. Indo-Fijians first came to Fiji as indentured labors beginning in 1879, and by 1916 when this immigration ended, 60,000 had arrived. Following their period of indenture, most Indian laborers chose to stay in Fiji. Indenture ended in 1920, and by 1922 nearly 80% of the Indians in Fiji were freely working in agriculture. By law, indigenous Fijian kin groups own 83% of the land in Fiji, inalienably. The remaining 17% of land is owned by either the Fiji government or foreign entities. Nonetheless, Indo-Fijians have been traditionally tied to the land and currently grow most of the crops in Fiji on land leased through the Native Land Trust Board, which generally allows for leases of 30 years. These leases, which were first granted in the late 1960s, will all have expired by the beginning of the twenty-first century (Kelly 1991; Lal 2001). It has been suggested that the "most important threat facing (the Indo-Fijian population) concerns the possible non-renewal of land leases" (Lal 2001, p. 38). Land tenure issues have likely influenced the high rate of rural-to-urban internal migration among Indo-Fijians. Presently, half of all urban residents are Indians, and the percentage of urban residents in Fiji is steadily increasing (Fiji Islands Bureau of Statistics 2002).

Among adults in Fiji, 26% of Indians are overweight or obese. Rates of overweight increase with age and are significantly higher for women and in urban areas [37 vs 22% and 25 vs 14% in Indian urban and rural women and men, respectively; NFNC (1995)]. Consistent with nutrition transition findings, national survey data show that underweight among Indo-Fijians persists as well. Among children under 10 years, 2–3% are stunted and 7–8% are wasted. The prevalence of both underweight and overweight increases with age, with rural children having higher rates of underweight than urban children (NFNC 1995). Though not broken down by ethnic group, a recent report by the Ministry of Health (2003) shows that in 2000, noncommunicable diseases accounted for 82% of deaths in Fiji, a substantial increase from 1980, when deaths caused by noncommunicable diseases accounted for about 50% of all deaths. Since 1993 obesity in children up to four years of age has more than doubled from 4.5 to 12.9%, and obesity rates in children aged 5 to 9 years has increased 159% (Fiji Times 2006; NFNC 2005).

In Fiji, as in most areas of the world, women are generally responsible for childcare and domestic activities. Relative to men, women are underrepresented and underpaid in the labor force. Statistics show one quarter of women are engaged in wage-earning work, and in urban areas more than 40% of woman are employed (NFNC 1995). Indian women are employed as industrial machine operators (33%), clerks (21%), professionals (17%), and in sales and service (9%). When compared with indigenous Fijian women, Indo-Fijian women show higher employment in industrial machine operation (33 vs 12%) and lower employment in services (9 vs 17%; Fiji Islands Bureau of Statistics 2005). Since many service industries cater to

tourism in Fiji, the greater job availability for Fijians in the services area is not surprising. The high rate of Indian women employed as industrial machine operators, such as in garment work, may reflect a lack of alternatives for relatively unskilled women.

Sample

Data were collected from July 2004 to February 2005 in two areas of Fiji. Although Fiji is a multiethnic country, these data come only from the Indian ethnic minority. Data collection was designed to yield three sample groups: high-income urban, low-income urban, and rural. The urban study population was defined as Suva City, the capital of Fiji and by far the most urban area in the country. The rural population was defined as the rural component of the predominantly Indo-Fijian area of Rakiraki, a mainly sugarcane farming community located on the north part of the main island of Viti Levu. Randomly chosen cluster sampling was employed, with high-income urban areas over-sampled to ensure adequate numbers of high-income households in the final sample. Urban clusters were defined as enumeration areas, official national census data units. Since geographic delineation of enumeration areas is not available for rural areas of Fiji, clusters of settlements were created by the research team and then randomly chosen for sampling. A large segment of the urban data (85 households) came from large squatter settlements (Raiwaqa and Nanuku) in Suva.

Within each cluster, 100% of Indo-Fijian households with children between 5 and 16 years were targeted. Data collection took 1 to 2 h per household and consisted of a quantitative survey, qualitative interview, and standard anthropometric measuring of mothers and children. Data were collected from 232 urban households, a response rate of 89%, and 116 rural households, a response rate of 98%. Data from 12 urban and 2 rural households have been deemed unusable, as they do not contain biological mother-child pairs that fall within the age range of this study. This leaves 334 households in the analysis: 221 urban households yielding a sample of 363 children aged 5–16 years (85 high-income households, $N=141$ children, and 135 low-income households, $N=227$ children) and 114 rural households yielding a sample of 215 children aged 5–16 years.

Food Ecology in Fiji

Food availability and cost do not differ greatly between the urban and rural areas in Fiji. In Suva, a large open-air market is located in central downtown adjacent to the bus station and shopping district. A few other small markets are located elsewhere in the urban area. Grocery stores are common. Three are within a few blocks of the market. In contrast, Rakiraki is a typical small, rural town. The town center consists of a one-square-block area housing the bus station, market, and post office, bordered by retail shops, grocery stores, and cafes. In Rakiraki, no fewer than four grocery stores operate within the town center.

The markets in Suva and Rakiraki are similar in price and product offering, though the Suva market is larger. Vendors are Indian and Fijian individuals who sell between a few and several types of seasonal produce, most of which is grown in Fiji. Produce is generally sold "by the heap" for about F$1, with large items, such as taro

and pumpkin, costing more. Chili peppers and curry leaf are generally purchased at the market. Other staples of Indian cooking, such as onion, garlic, and various spices, are usually bought at the grocery store. Grocery stores in Fiji are well-stocked, modern facilities selling all types of foods, as well as cleaning supplies, dishes, liquor, and personal care products. With few exceptions, everything available in Suva is also available in Rakiraki. The price, however, is a few cents on the dollar higher in rural areas.

Though many rural Indo-Fijians engage in farming, they primarily farm sugarcane. Many urban and rural households rely on some level of home production. In this sample, 75% of rural and 47% of urban households grow some garden products for home consumption. Those rural individuals not growing a garden cite the dry climate as the main reason, while urban residents cite lack of space, time, or interest. Only 5% of urban households keep any animals for food, compared with 86% of rural households. Rice and flour are never grown and must be purchased. Though beans (e.g., purple hull peas) are sometimes grown, dried peas, chickpeas, and lentils are generally purchased from the grocery store. Vegetables are often purchased weekly from a market, and staples are purchased every 1 to 3 weeks from the grocery store. Meat may be purchased from the grocery store or live from a number of sources (e.g., butchers, other individuals). Fish can be purchased frozen from the grocery or fresh from market vendors. Processed foods are widely consumed in urban and rural areas. Though children often eat at least one cooked meal daily, many also consume cookies and crackers one or more times daily with tea. Instant noodles, white bread with butter, and soda or other high-sugar fruit drinks are popular for breakfast, lunch, or as snacks throughout the day.

Measurement

Parental Embodied Capital: Parental embodied capital is a measure of parental skills and knowledge-based abilities in urban environments (Kaplan 1996). To capture the influence of both parents on investment in children in the urban environment, summed father's and mother's years of education was chosen as a proxy for parental embodied capital (Shenk 2004). In order to take single parents into account this summed value was then divided by two to create an average value. Twenty-four households have single mothers who are divorced or widowed (10 Urban non-migrant, 6 Migrant, 8 Rural non-migrant). Urban high- and low-embodied-capital groups were formed based on the median value of summed years of parents' education (median=10, SD=3.0; mean=10.1).

Food Frequency and Budget Data: To assess food purchases, food frequency questionnaire (FFQ) data were used to generate a typology of unprocessed and processed foods. Given the similarities in food ecology between urban and rural areas, the same instrument was used throughout data collection. Unprocessed foods generally require a moderate to high level of processing before consumption. These include dhal, beans, fish, seafood, chicken, lamb, roti (Indian flat bread), and fresh vegetables. Processed foods include tinned fish, milk, cheese, bread, biscuits/cookies/crackers, instant noodles, rice, and yogurt. Several foods from the FFQ were excluded from the typology because they were rarely eaten (mung bean curry, goat,

pork, beef, canned fruits, and canned vegetables), and eggs and fresh fruit were excluded because they can be either labor intensive or not, depending on the type of fruit and preparation. Frequency of consumption of unprocessed and processed foods was calculated. The ratio for each was then created by dividing by the total.

As part of the quantitative questionnaire, self-reported income and food expenditure data were collected. Parents provided data on all sources of income and monetary earnings. These data were converted to weekly and annual household income values. Parents were asked to estimate their weekly food expenditures (in Fiji dollars). Most households purchased food from the grocery store and open-air market. Probing questions were asked to ensure the weekly food expenditures included all money spent in food purchases.

BMI Z Scores: Because this study includes children from 5 to 16 years, anthropometric comparisons must take into account height, weight, sex, and age. Age-specific BMI is a useful proxy for measuring adiposity, a necessary consideration when studying nutrition transition (Cole et al. 2005). The BMI Z-score is the number of standard deviation units that a person's BMI is from a sex- and age-specific reference value. BMI Z-scores were chosen as appropriate for group comparisons because Z-scores allow for standard comparisons across a group of individuals and are appropriate for use in summary statistics (mean values; WHO 1995). Age- and sex-specific BMI Z-scores were calculated using public domain Epi Info 3.3 software and based on Centers for Disease Control and Prevention growth charts (Kuczmarski et al. 2000).

Background Characteristics

Within the sample, the age-adjusted average number of children per mother differs significantly between the rural and urban areas ($F=18.98$, $p < 0.01$), with rural mothers having on average 3.0 children and urban mothers having 2.5. This is consistent with the national fertility rate of Indo-Fijians (Fiji Islands Bureau of Statistics 1996), indicating the representative nature of this sample. The number of children also differs significantly by level of embodied capital, with urban high-embodied-capital households averaging 2.2 children and urban low-embodied-capital households averaging 2.8 children ($F=14.67$, $p < 0.01$; Table 1).

The average number of years of education for mothers differs significantly between rural and urban areas, with rural women averaging 9.0 years and urban women averaging 10.8 years ($t=-5.40$, $p < 0.01$). Urban employed women have significantly more years of education than all other groups ($F=22.38$, $p < 0.01$). Urban unemployed and rural women's education levels do not differ significantly. Sixty-four percent of the employed mothers in the sample are from urban high-embodied-capital households. Urban high-embodied-capital women are significantly more likely to be employed than urban low-embodied-capital or rural women ($\chi^2=41.51$, $p < 0.01$). Fifty-three percent of urban high-embodied-capital mothers work, compared with 23% of urban low-embodied-capital and 17% of rural mothers (Table 2).

Table 1 Background characteristics of sample

	Urban								Rural				Total			
	High embodied capital, N=131				Low embodied capital, N=89				N=114				N=334			
	Mean	SD	Minimum	Maximum	Mean	SD	Minimum	Maximum	Mean	SD	Minimum	Maximum	Mean	SD	Minimum	Maximum
Number of children	2 2	0 9	1	5	2 8	1 2	1	6	3 0	1 2	1	7	2 7	1 2	1	7
Mother's education (years)	12 7	2 0	9	18	7 8	2 8	0	12	9 0	2 7	0	16	10 2	3 4	0	18
Father's education (years)	11 9	4 1	6	20	7 4	3 2	0	12	8 3	3 5	0	15	9 5	4 1	0	20
Household income (annual, F$)	32,827	35,115	4,420	186,000	11,569	14,120	1,820	114,000	8,276	7,013	600	52,000	18,783	26,078	600	186,000
BMI (mother)	25 1	4 7	15 5	40 1	26 2	4 9	15 7	39 1	26 6	6 0	13	45 5	25 9	5 2	13	45 5
BMI Z-score (child)	-0 5	1 5	-0 63	2 7	-1 2	1 6	-6 9	2 6	-1 1	1 5	-5 0	2 2	-0 9	1 5	-6 9	2 6

Table 2 Background characteristics of employed mothers

	Urban								Rural				Total			
	High embodied capital				Low embodied capital											
	Mean	SD	Minimum	Maximum	Mean	SD	Minimum	Maximum	Mean	SD	Minimum	Maximum	Mean	SD	Minimum	Maximum
Employed	64% (N=69)				19% (N=20)				17% (N=19)				32% (N=108)			
Hours/week worked	39 0	8 6	15	60	40 6	9 5	20	70	39 3	5 1	20	45	39 2	8 3	5	70
Annual contribution to household income (F$)	11,408	9,289	2,000	50,000	3,436	2,401	1,040	13,000	3,870	5,444	780	26,000	8,606	8,654	780	50,000

Analysis

To investigate the relationships among urbanization, embodied capital, and diet patterns, three hypotheses are tested. H1 and H2 examine the effect of embodied capital on household food consumption, and H3 examines embodied capital and children's BMI. Using SPSS version 13.0, tests of H1 and H2 employ group comparisons of urban high-embodied-capital, urban low-embodied-capital, and rural households. H1 uses a generalized linear model (GLM) to compare food expenditures between groups, while controlling for income and number of household residents. H2 uses ANOVA to compare the ratio of processed to unprocessed foods between groups.

H3 is analyzed in STATA/SE version 9.0, which allows for the specification of a robust standard error since BMI measures from children in the same household may not be independent. This method substitutes a robust variance matrix calculation compensating for the lack of independence within a specified group, in this case the household. A group mean comparison of BMI Z-scores is performed. Finally, a regression model is estimated to assess the effects of maternal employment, urbanization, income, and parental embodied capital on child's BMI.

Results

H1

To test whether urban high-embodied-capital households spend more on food, a GLM was created to assess the differences in weekly food expenditures between groups, adjusting for theoretically relevant covariates of interest. The estimated model compares urban high-embodied-capital, urban low-embodied-capital, and rural household groups. The dependent variable is weekly food expenditure (self-reported Fiji dollars). Initially, the model was adjusted for the number living in the house, number of adult female helpers, weekly income, and whether or not the family had migrated to the urban area. Number of adult female helpers and migration to the urban area were found to be not significant and were subsequently removed from the model. Weekly income and the number living in the house are significant covariates ($p < 0.01$) and remained in the final analysis (Adjusted $R^2 = 0.31$).

In support of H1, tests of adjusted mean values (Table 3) indicate that the urban high-embodied-capital group (F$93) have significantly higher weekly food expenditures than the urban low-embodied-capital (F$81, $p < 0.02$) or rural (F$66, $p < 0.01$) groups. Rural households spend significantly less than either urban group ($p < 0.01$).

H2

To test whether urban high-embodied-capital households rely more heavily on processed foods, the ratio of processed to unprocessed foods in the diet was calculated and compared (Table 3). In support of H2, results show that the ratio of processed to unprocessed foods is greatest for urban high-embodied-capital

Table 3 Adjusted weekly food expenditure and ratio of processed to unprocessed foods by group

	Urban high embodied capital (N 131)	Urban low embodied capital (N 89)	Rural (N 114)
Weekly food expenditure	F$93 (SE 3.0)	F$81 (SE 3.4)	F$66 (SE 3.2)
Ratio of processed to unprocessed foods	1.08 (SE 0.01)	1.02 (SE 0.01)	0.98 (SE 0.01)

Urban high-embodied-capital households have significantly higher weekly food expenditure (mean F$, adjusted for weekly income and number living in household) and consume a higher ratio of processed to unprocessed foods than urban low-embodied-capital or rural households.

households (proportion=1.08) with significantly lower amounts for urban low-embodied-capital (proportion=1.02) and rural groups (proportion=0.98; F=20.46, $p < 0.01$). Rural households consume a significantly lower ratio of processed to unprocessed foods than the urban low-embodied-capital group ($p < 0.03$).

H3

H3 examines the effect of parental embodied capital on child's BMI. In support of H3, mean group comparisons show that children of urban high-embodied-capital parents (BMI Z-score=–0.5, SE=0.12) are heavier than those of urban low-embodied-capital (BMI Z-score=–1.2, SE=0.14) or rural parents (BMI Z-score=–1.1, SE=0.11; F=13.40, $p < 0.01$). Although not significantly different than the urban low-embodied-capital group, the rural group is shown to be intermediate.

To examine the relative effects of urbanization, maternal employment, parental embodied capital, and income on child's BMI, a linear regression analysis was performed with robust standard error estimator (Table 4). Neither income (p=0.25) nor urban living (p=0.42) is a significant predictor of child's BMI Z-score. However, mother works is a marginally significant, positive predictor for child's BMI Z-score

Table 4 Parental embodied capital and maternal employment are significant, positive predictors of child's BMI Z-score, unlike urban area or income

	Coefficient	Robust SE	t	p	95% CI
Parental Embodied Capital (average of education years)	0.094	0.023	4.10	0.000	[0.049, 0.140]
Mother's BMI	0.119	0.012	9.94	0.000	[0.096, 0.143]
Income (standardized, annual F$)	0.094	0.081	1.15	0.249	[0.066, 0.253]
Area (rural 0, urban 1)	0.110	0.139	0.79	0.430	[0.163, 0.383]
Mother Works	0.235	0.141	1.67	0.097	[0.042, 0.512]
Constant	5.10*	0.418	12.21	0.000	[5.932, 4.287]

Linear Regression results (robust estimation of SE) show that neither urban area nor income is a significant predictor of child's BMI Z-score, whereas parental embodied capital and maternal employment are both significant, positive predictors.

($p=0.04$), indicating that mother working has a stronger effect on children being heavier than does income or living in an urban environment. Parental embodied capital ($p < 0.01$) and mother's BMI ($p < 0.01$) are also significant, positive predictors for child's BMI Z-score.

Discussion

This paper applies an HBE approach to understanding nutrition transition among Indo-Fijians in an urbanizing environment. In doing so, parental embodied capital is considered as parental learned skill, which is important for wage-earning and resource acquisition in the urban environment. A high level of parental embodied capital is suggested to be predictive of a quality-based parental investment strategy, and the fitness-related currency being maximized is offspring skill. Although the children in the present study have not completed their educational attainment and thus we have no concrete data on their level of formal skill acquisition, these data show that urban high-embodied-capital parents have significantly lower offspring numbers than urban low-embodied-capital or rural parents, providing some support for a quality-based strategy. Evolutionary theory suggests that "natural selection should favor organisms that maximize the net fitness result of their possible behavioral options (e.g., food gains as a function of time and energy spent foraging)" (Kaplan and Hill 1992, p. 168). In terms of diet, this means that parents should favor acquiring more food when more food would lead to increased fertility or survivorship. Alternatively, when less time spent in food-related activities allows for more time spent in non-foraging activities that lead to increased fertility or survivorship, this behavioral adaptation should be favored.

Though some women are reaping the benefits of increased participation in the urban labor force, they are also coping with the increased cost of child rearing. Results show that urban women from high-embodied-capital households spend more on food purchases (controlling for income and number living in household), rely more heavily on processed foods, and are more likely to be employed than women from urban low-embodied-capital or rural households. Consistent with predictions based on an HBE approach to nutrition transition, these results suggest that in modern wage-based environments, women may be making investment trade-offs that maximize skill acquisition in offspring by limiting time spent in food-related activities. Maternal employment may intensify the need for trade-offs, but increases in income and the availability of processed foods may enable this strategy. Since parental investment patterns in urban and urbanizing areas emphasize the importance of education, high-embodied-capital women are not likely to shift household work or childcare to their offspring.

Results show that parental embodied capital has a significant, positive effect on child BMI and that maternal employment is a stronger positive predictor than income or urban living on child's BMI. This indicates that urban high-embodied-capital women are making successful investment trade-offs that do not undermine child nutrition. In Fiji, where nutrition transition is taking place, national survey data indicate the existence of both under- and over-nutrition (NFNC 1995, 2005). The

data presented here suggest that the effect of differential levels of embodied capital may affect child BMI. The varying capacities of parents to adjust investment strategies may be one factor influencing the lack of uniformity in diet transition.

Urban high-embodied-capital households have improved the nutritional status of their children by making food choices that move them away from more negative BMI Z-scores. As competition for wage jobs in urban environments increases and wage devaluation occurs, however, some women may be faced with more extreme trade-offs. As urbanization continues, more women of lower embodied capital may enter the workplace in less-skilled positions in order to maintain or attempt to increase their household income. Some women may be ineffective at balancing the trade-off between income and food choice. Thus, as urbanization intensifies and women seek even greater quantities of processed foods, the deleterious effects of trade-offs involved in nutrition transition for working women may become more visible.

From a policy standpoint, these findings indicate the applicability of research on household dynamics to child health outcomes. Although these findings may not be broadly generalizable because of their specific ecocultural context, and because nutrition transition is not uniform in its progression, they do demonstrate the utility of HBE models—specifically, embodied capital theory—to address issues of international development and public health in urban environments. Food policy in Fiji recognizes the escalating threat from noncommunicable diseases associated with diet. Fiji is one of 159 nations committed to developing a national nutrition plan with attainable goals and measurable targets consistent with WHO and FAO guidelines. National dietary guidelines were established in 1991 and revised in 1999, and a national nutrition plan was completed in 1997. As of 2004, however, the plan had not been implemented and was generally unknown outside the Ministry of Health (WHO 2004). The Employment Act of Fiji sets safety standards, prohibits some forms of child labor, and guarantees workers' rights to form and join unions. However, there is no national minimum wage, no upper limit on weekly work hours, and lax enforcement of safety and child labor policies (US State Department 2005). Future policy approaches should seek to improve employee protections as well as nutrition education. Food policy planners may seek to provide more readily available food markets and increase food offerings that are both easy to process and healthy. Although obesity in developed countries reached epidemic proportions over a comparatively long timeframe, developing countries are now facing a rapidly escalating obesity epidemic. Policy approaches that rely on an understanding of family dynamics, time allocation, and parental investment shifts, such as the one presented here, are well positioned to respond to the challenges of urbanization through examining the underlying factors that drive behavioral change.

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