The Effect of Tourism on Child Health Outcomes in Roatán, Honduras

Hemal Pragneshbhai Patel

Dr. Dennis Clements, Faculty Advisor

Dr. Michelle Connolly, Faculty Advisor

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Abstract

Increased tourism, especially in developing economies, brings with it more economic opportunities and avenues for development. In Roatán, the largest of Honduras' Caribbean Bay Islands, tourism has brought economic development that the island had never before experienced. However, the impact of this economic development brought by increasing cruise ship tourism on child health has yet to be investigated. The increase in economic development is expected to improve child health through improved absorbed nutrition, and this paper uses an OLS regression model to examine how differential exposure to tourism development during a child's crucial early life developmental window impacts later life health outcomes, proxied by height-for-age Z-scores.

JEL classification: **I1; I15; Z32**

Keywords: Tourism, Child Health, Economic Development, Caribbean

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I. Introduction

Tourism has the ability to transform an economy, and this is exactly what has happened in Roatán, the largest of the Bay Islands of Honduras. In recent years, Roatán has experienced a boom in its tourism industry. This can be attributed to its location as a Caribbean island that sits at the southern edge of the Mesoamerican reef, which has made it a popular cruise ship destination. Roatán has two cruise ship ports that are visited today by over 300 cruise ships each year *(Honduras Tourism Institute, 2016)*.

Prior to the cruise ship boom, the fledging tourism industry only benefitted the Honduran elite and foreigners with capital investments, who both began to build the tourism infrastructure. Because of this, increasing tourism in the Bay Islands had been viewed as a negative development for the majority of the population due to environmental externalities (Stonich, 1998). However, the modern cruise ship industry has brought more egalitarian opportunities. With over a million cruise ship passengers visiting Roatán in 2016 *(Honduras Tourism Institute, 2016)*, sustainable employment for individuals from lower socioeconomic backgrounds has become more attainable, especially as the number of restaurants, shore excursions, and souvenir shops grows.

For Roatán, where poverty is still prevalent, stunting in children has been a major public health issue. Over 20% of Honduran children are estimated to be stunted (World Bank, 2012). Poor maternal health and nutrition, insufficient infant and child feeding, and infection contribute to stunting by preventing a child from receiving nutrients that are necessary for proper development both *in utero* and during the early years of life (Weise, 2014). A tourism economy has the potential to improve child heights by bringing economic opportunities that can increase the availability of food and subsequently increase consumption. This has been observed in other parts of Central America, particularly in the Yucatán peninsula (Leatherman, Goodman, & Stillman, 2010).

This study uses cross sectional height data of Roatán school children from the age of four to 17 that was collected in the summer of 2018. Since height-for-age, the parameter used to measure stunting, is heavily influenced by nutrition in the first 1,000 days of a child's life (Cole, 2000; Victora, de Onis, Hallal, Blossner, & Shrimpton, 2010), there is a specific window during which economic factors driven by cruise tourism can impact a child's height. From 2000 to 2016, the number of cruise passengers visiting Roatán per year has increased from just over 100,000 to over 1,000,000 *(Honduras Tourism Institute, 2016)*, so school-aged children today have been exposed to drastically different levels of tourist activity during their individual development windows. Additionally, the two cruise ports in Roatán are situated in the western part of the island where all of the tourist activity takes place, while the east end of the island has been virtually unaffected by this boom. This makes the children from the east end an excellent control. This study estimates the effect cruise ship passenger arrivals has had on the height-for-age Z-scores of children based on exposure to this tourism.

Cruise ship passenger arrivals should have a positive impact on height-for-age Z-scores through increased food availability due to economic development this industry has brought. However, this increase should only be isolated to regions where tourism development is prevalent.

Section II presents existing literature on the impact of tourism on child health and background on Roatán. This is followed by a theoretical framework in Section III. Section IV continues with a summary of the data used to complete this analysis. Section V contains the empirical specifications of the OLS regression used to estimate the effect of cruise ship tourism on different regions of Roatán. The paper continues with Section VI that includes findings and implications of these results. Section VII concludes.

II. Background

Literature Survey

With economic development generally comes improved child health outcomes (Boyle et al., 2006). However, Roatán is unusual in that economic development has primarily come from the development of tourism. There are both benefits and drawbacks of economic growth due to tourism, especially in low income countries such as Honduras. Benefits include higher than average growth rates compared to other low and middle income countries, and investment in infrastructure such as roads (Holzner, 2011). These benefits could improve child health through increased food access and variety due to more economic opportunities for parents in a booming economy. Drawbacks include foreign dependency, tourist enclaves, socioeconomic and spatial inequalities, and environmental destruction (Brohman, 1996). All of these can be seen in the western half of Roatán which has enjoyed the benefits of tourism, while the east end of the island has not.

The impact of tourism on child health has been documented in the Yucatán peninsula of Mexico, where the tourist destinations Cancun and Cozumel are located. Between 1987 and 1998, the average height of boys increased by 2.6 cm while the average height of girls increased by 2.7 cm. Possible explanations include westernization of the diet and increased food availability (Leatherman et al., 2010).

Although Honduras has drastically reduced the prevalence of stunting in the past two decades (Morris, Flores, & Zúniga, 2000), 22.7% of Honduran children under the age of five were still stunted in 2012 (World Bank, 2012). Stunting in children is heavily influenced by nutrition from pregnancy to the age of two (Victora et al., 2010), but because stunting is associated with poorer cognitive development, lower school achievement, less economic productivity in adulthood, and worse maternal reproductive outcomes such as decreased survival of their children (Dewey & Begum, 2011), the implications of malnutrition evidenced by stunting can last a lifetime and make it an immediate public health concern.

Background of Roatán

Roatán is about 45 miles long and 5 miles wide at its widest point, but there is only a single paved road on the island. This road, included in Figure 1, has two lanes, one for traffic in each direction and is poorly maintained with a number of potholes. This makes the journey from West Bay in the west to Oakridge in the east approximately two and a half hours by vehicle.

Figure 1. Map of Roatán. Satellite imagery from Google Maps (2018).

Only about 20% of individuals living in Roatán have a vehicle (Table 1), so public transportation is the primary means of transportation on the island. There are three bus routes on Roatán that originate in Coxen Hole, the capital of Roatán. The first route runs southwest from Coxen Hole to Flowers Bay, the second runs north from Coxen Hole then west to West End, and the third runs east from Coxen Hole to Oakridge.

Roatán's two cruise ship ports and only airport are situated in the western part of the island (Figure 1). Because of the general lack of public infrastructure, the development that tourism brings is isolated to the western half of the island.

There are two municipalities in Roatán: the municipality of Roatán in the west and the municipality of Jose Santos Guardiola in the east, and the Honduran census reports information about these municipalities separately.[1] Table 1 includes important population statistics about each of the two municipalities from the 2013 Honduran census data, although they are very similar. Noteworthy, however, is the difference in ethnicity, as the east is far smaller and has a higher proportion of Black English speakers, while the west has more Mestizos. The demographic similarities between the west and the east set up a natural experiment in which the east can serve as a control for the west.

Table 1.

Population Statistics of Roatán

Variable	***West***	***East***
Population (2018)	49,079	11,953
% Mestizo	68	59
% Black English Speakers	14	22
% Has a Car	22	21
% Electricity	76	77
% lived more than 5 years outside their municipality	11	6

Note. Data from Honduran Census Data (2013).

[1] The border between Roatán and Jose Santos Guardiola is slightly to the east of Parrot Tree in Figure 1.

III. Theoretical Framework

This study aims to measure the impact on health of the economic impacts of tourism during the developmental period from conception to the age of two on the health of school-aged children living in Roatán today. The World Health Organization recommends five parameters to measures child health. They include height-for-age, weight-for-age, weight-for-length, weight-for-height, and body mass index-for-age (World Health Organization, 2006). This study will utilize height-for-age as the parameter to proxy for child health outcomes because stunting, which is associated with poorer cognitive development, lower school achievement, and less economic productivity in adulthood (Dewey & Begum, 2011) and is defined as having a height-for-age Z-score <2 SD below the median WHO Growth Standard (World Health Organization, 2010). The literature suggests that two factors that explain virtually all of the variance in child height: genetics and absorbed nutrition (Fedorov & Sahn, 2005; Silventoinen, 2003; Weise, 2014) and thus can be modelled for an individual by the following equation:

$$H_{i,t} = f(N_{i,t}, N_{i,t-1}, \dots, N_{i,1}, N_{i,0} | G_i) \quad (1)$$

Where $H_{i,t}$ is the height of child *i* in time period *t* and $N_{i,t}$ is the absorbed nutrition of child *i* in time period *t* given a genetic endowment *G*.[2] Although absorbed nutrition in all periods of a child's life has the ability to affect his or her current height, poor nutrition during prenatal conditions and the first two years of life will lead to permanent impairment in height that cannot be fully recovered by improved nutrition in subsequent periods (Cole, 2000; Victora et al., 2010). Previous studies have explored the magnitude of this catch-up effect, and have all found it to be negative and statistically significant from 0, indicating that potential height lost due to poor nutrition in early life cannot ever be completely regained (Hoddinott & Kinsey, 2001; Ruel, Rivera, Habicht, & Martorell, 1995; Adair, 1999; Fedorov & Sahn,

[2] Time period *t* is the age of child *i*, while time period *t=0* refers to prenatal conditions. Each period corresponds to one year.

2005). Because of this, ignoring nutrition from time periods *t=3* to *t* will effectively create developmental windows for children of different ages. However, the estimated effect of nutrition during this developmental window from time periods *t=0* to *t=2* will be biased towards 0 because older children, who were exposed to less tourism, exhibit more catch-up and higher height-for-age Z-scores than they would at age two. Equation (1) is therefore simplified to the following:

$$H_{i,t} = f(N_{i,2}, N_{i,1}, N_{i,0} | G_i) \quad (2)$$

Where the parameters are the same as in Equation (1).

Absorbed nutrition is determined by a host of factors. Food availability is a significant component of nutrition and is influenced heavily by economic conditions. Roatán is a unique case in that the economic development it has experienced has come primarily from tourism. In 2002, already 52% of the island's GDP came from a tourism related sector, and this tourism revenue has continued to grow 8% annually (Taylor, 2010). This is also evidenced by the increase in the number of cruise passenger arrivals in Figure 2. Additionally, businesses such as Eldon's supermarket and fast food restaurants have been built for tourists visiting the island but have also increased the availability of both affordable and calorie dense foods for the residents of Roatán. Economic development has the ability to increase food consumption (Schneider et al., 2011; Sinha, 1995), and therefore, improve nutrition during the developmental window of child *i*. Absorbed nutrition can be modelling by the following equation:

$$N_{i,t} = f(D_{i,t}, \mu_{i,t}) \quad (3)$$

Where $D_{i,t}$ is the economic development experienced by child in time period *t,* and $\mu_{i,t}$ are other factors that affect absorbed nutrition such as maternal feeding practices and early life illness (Weise, 2014).

Equation (3) can be substituted into Equation (2) and the following equation can be derived:

$$H_{i,t} = f(D_{i,2}, D_{i,1}, D_{i,0}, \mu_{i,t} | G_i) \quad (4)$$

Where the parameters are the same as defined for Equation (2) and Equation (3).

The analysis in this paper is limited by a cross sectional dataset, thus the catch-up effect is ignored so that children of different ages have different developmental windows which will negatively estimate the effect of economic development on later life height. This model will estimate the impact of economic development due to tourism during a child's developmental window from $D_{i,0}$ to $D_{i,2}$ on height.[3]

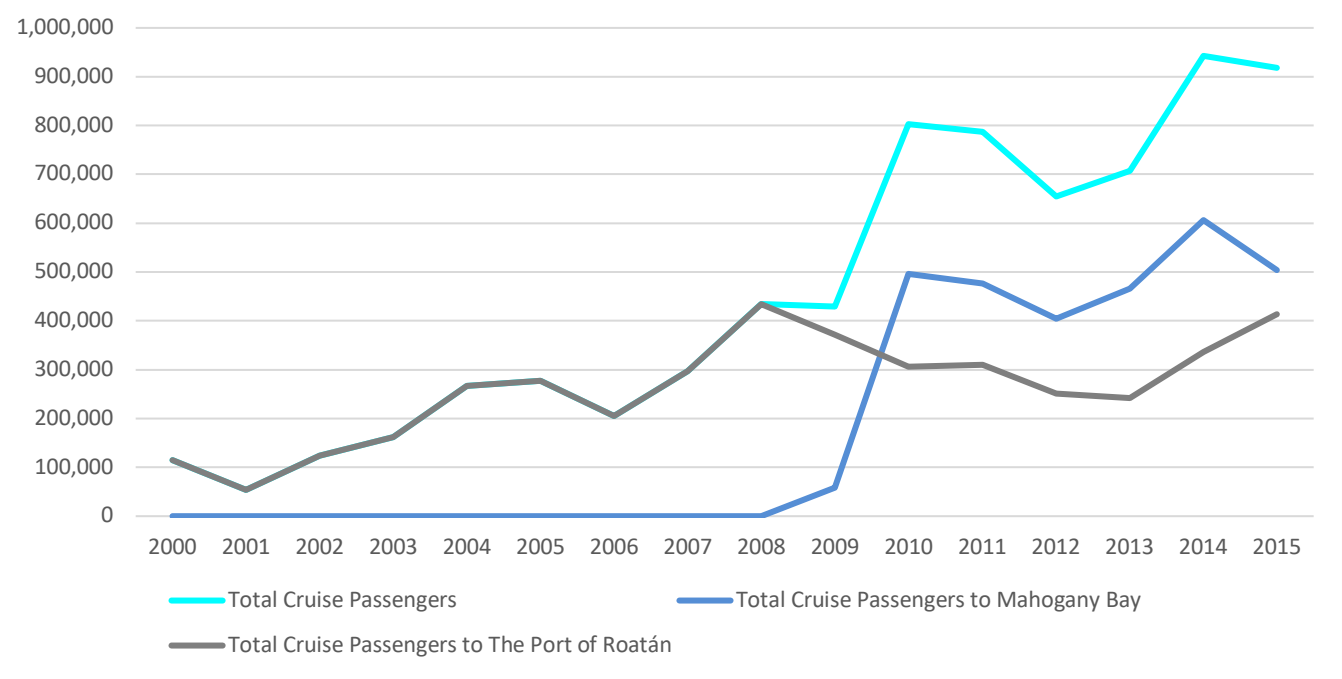
[3] This equation is visualized in Appendix C.

IV. Data

Tourism Data

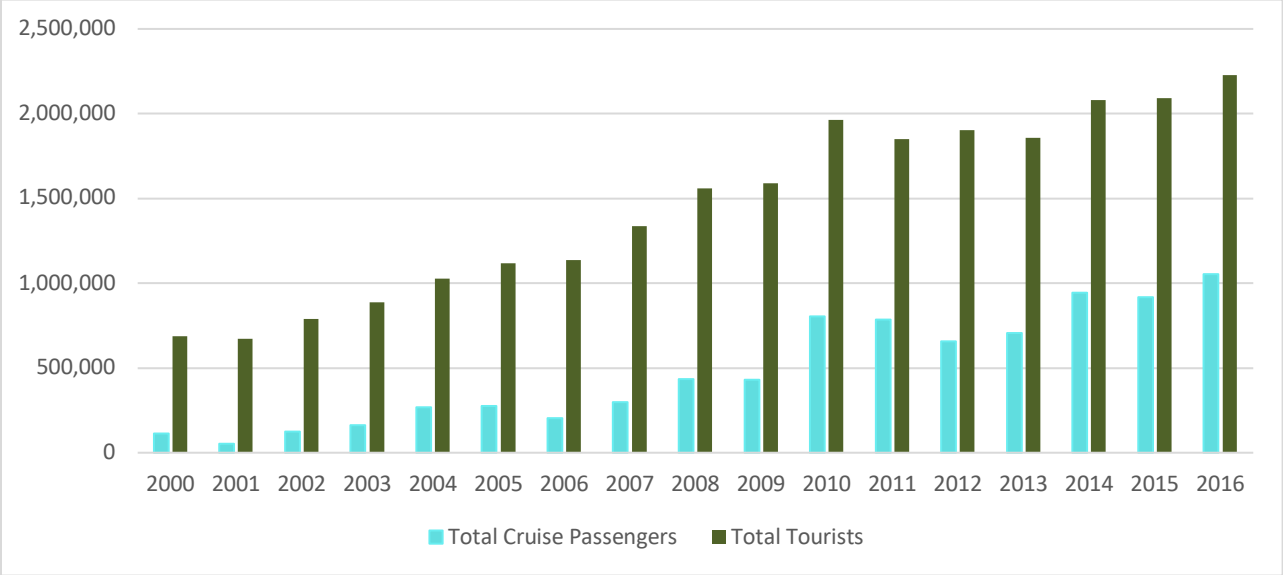
The two cruise terminals in Honduras are located in Roatán. Since Honduras does not readily provide tourism data by region, cruise passengers can proxy for the increase in tourism that Roatán has experienced. From 2000 to 2016, cruise passenger arrivals to Roatán has increased from 114,101 to 1,052,738 (Figure 2). Additionally, the number of visitors to Honduras overall has increased in the same time period, but as shown in Figure 3, cruise ships are accounting for a greater percentage of these visitors. In 2000, about 15% of tourists to Honduras came via cruise ship. In 2016, this number was over 45%. This suggests that cruise ships will have an important stake in the future of tourism to Honduras, and these tourists that are coming by cruise ship will be arriving in one of the two cruise ports in Roatán.

Figure 2. Cruise Passenger Arrivals in Roatán by Year and Port.



Source: Honduran Tourism Institute (2016) and Mahogany Bay Port Schedule (2019).

Figure 3. Number of Visitors to Honduras by Year.



Source: Honduran Tourism Institute (2016).

The cruise data can be further divided between the two ports. Mahogany Bay opened for business in December 2009. Since the Honduras Tourism Institute only provides data for all cruise passengers, data for cruise passenger arrivals to Mahogany Bay is provided by the official port schedule provided on their website ("Port Schedule," 2019). The annual cruise passenger data by port is also provided in Figure 2.

The amount of development each passenger brings is also important and might be proxied by how much money each passenger spends in Roatán during the time of analysis. Table 2 presents how much each cruise passenger spent in real 2018 Lempira. The amount of real Lempira each passenger spends per year has remained relatively stable with a slight overall increasing trend.

Table 2

Real 2018 Lempira spent per passenger

YEARS	REAL 2018 LEMPIRA SPENT PER PASSENGER
2008-2009	L1,995
2011-2012	L1,529
2014-2015	L2,021
2017-2018	L2,395

Source: Florida-Caribbean Cruise Association (2018).

Child Data

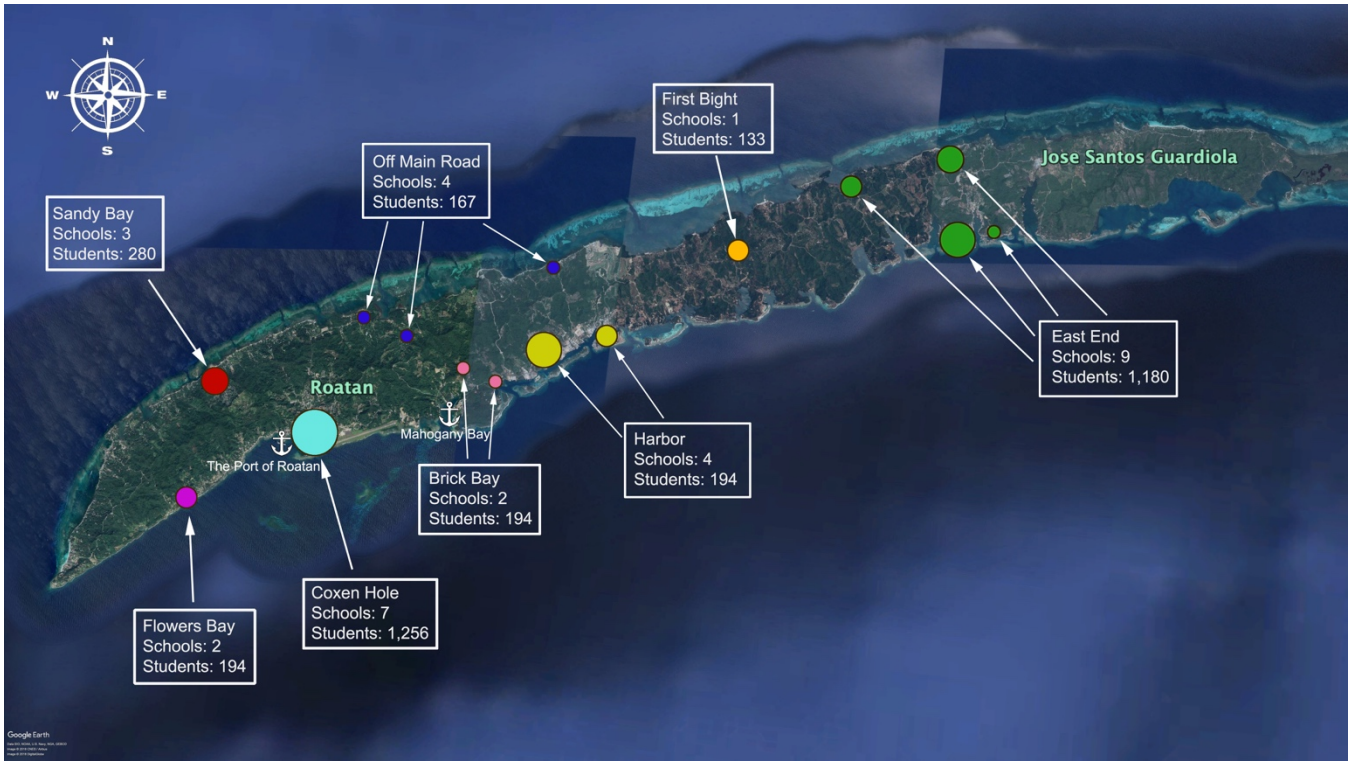
Child health data for Roatán were collected by the Duke Global Health Student Research Training team, *iCare*. The primary objective of our team was to assess and improve visual acuity in schools across the island, but we also collected height and weight data for each child using a scale and a tape measure. For these children, self-reported age, gender, and school were also recorded. Region of residence was determined by which school a child attended. There are data for 4,179 children. The total number of schools is unknown on the island due to poor government records. However, these 4,179 students make up nearly 20% of school aged children in Roatán from age 5 to 19 according to official 2018 Honduras census data (Instituto Nacional de Estadisticas, 2018). Summary statistics by school can be found in Appendix A.

Because the Honduras Tourism Institute only provides cruise data back to the year 2000, tourism data for the developmental window of children over the age of 17 is unavailable, and therefore these children are excluded from the analysis. There are 59 such children, leaving 4,120 for analysis. The number of children by region is mapped in Figure 4.

As mentioned before, location is an important factor in exposure to tourism as children closest to the ports have the greatest exposure. Ideally, the exact distance each child lives from the port could be interacted with passenger arrival during their developmental window, but because the location of children

is determined by the school they attend, regions were created. This allow for children living in regions with similar exposure to cruise tourism to be clustered and compared. Eight regions were identified as mapped in Figure 4. The regions were clustered by proximity with the exception of the Off Main Road region as the communities in this region share the trait of only being accessible by dirt roads, making exposure to tourism similarly low.

Figure 4. Map of Roatán with child data by region



Source: Satellite Imagery from Google Earth (2018). Child data from *iCare* SRT dataset.

Exact birth dates for children were not recorded, so every child of declared age *n*, was assumed to be exactly *n*+.5 years old. Since the data were collected in the summer of 2018, the birth date of each child was assumed to be January 1st. Exposure to tourism for each child was calculated based on the total number of cruise passenger arrivals during the period of -9 months to 24 months of age. This makes the assumption that all children of age *n* within a given region have been exposed to the same amount of tourism and introduces noise into this analysis.

Height-for-age Z-scores were calculated using WHO growth standards in the package *zanthro* in Stata. *Zanthro* controls for gender and creates missing values if a child's height-for-age Z-score is outside (-5,5). Seven such children were not included in the analysis since their Z-scores could introduce outlier bias. The mean height-for-age Z-score for the 4,113 children is .1380 with a standard deviation of 1.2587. The distribution is approximately normal as shown in Appendix B.

V. Empirical Specifications

The outcome variable of interest is $Z_{i,a,g}$, which is the height-for-age Z-score of child i with age a and gender g. $Z_{i,a,g}$ is estimated by the following quadratic ordinary least squares multivariate regression:

$$Z_{i,a,g} = \beta_0 + \beta_1 * P_i + \beta_2 * {P_i}^2 + \beta_3 * M_i + \beta_4 * {M_i}^2 + \beta_5 * (region_i * P_i) + \beta_6 * (region_i * M_i) + \beta_7 * region_i + \delta_j + \varepsilon_{i,j} \quad (6)$$

A quadratic model is logical because the impact of cruise ship tourism on child health should have diminishing returns because there is an upper bound to how much cruise ship tourism can improve heights. Eventually, as a greater proportion of children on the island reach the height of their genetic potential, the height-for-age Z-scores of fewer children can be improved.

Although parental heights would be ideal to control for genetic variances height, the best alternative in this data set is an ethnicity control. All schools in the data had either majority (>90%) children of black or mestizo children, and there is negligible intermixing between these two ethnicities in Roatán. Ethnicity varies between schools but not strongly within schools, so a dummy for school ethnicity δ_j, can capture their effects on height-for-age Z-scores.

The independent variables of interest in this model are (1) the region child i lives in and (2) the quantity of exposure to tourism during his or her developmental window. Because there are two cruise ports in Roatán: Mahogany Bay and The Port of Roatán, exposure to tourism brought by the two ports can be captured by the sum of the cruise ship passenger arrivals by month in the time period from -9 months of age to 24 months of age using the birth date estimated for child i in the data section.

Each child is potentially exposed to the effects of tourism from two ports:

$$P_i = \sum_{m=-9}^{m=23} PRpassengers_m \quad (7)$$

$$M_i = \sum_{m=-9}^{m=23} MBpassengers_m \quad (8)$$

Specifically, P_i and M_i are the sum of cruise passengers that visited the Port of Roatán and Mahogany Bay respectively during the developmental window of child i from m= -9 to m= 23 months of age.

Distance from these ports is also an important determinant in how tourism development can affect height, but because how distance affects exposure is unknown, it is inappropriate to impose an arbitrary relationship. Therefore, the interaction between each region and the level of tourism in each port determined in Equations (7) and (8) are included as independent variables.

Because the east end has virtually no tourism development but is otherwise socioeconomically and demographically very similar to the rest of the island (Table 1), the East End Region dummy is not included in this regression so that the effects on each of the other regions are compared to this counterfactual trajectory. This allows for the effects of other factors that affect absorbed nutrition to be fixed between the experimental groups and the control group so that the effect of cruise ship tourism development on child heights can be isolated.

VI. Results

Results of the impact of cruise tourism height-for-age Z-scores are presented in Table 3. The effect is presented by every 10,000 passengers for a clearer interpretation. The results indicate that only passenger arrivals to the Port of Roatán have a positive and significant effect on height-for-age Z-scores, but this effect is primarily mediated by the two regions closest to the port when compared to the east end of the island.

Table 3.

Regression Results of Equation (6) by 10,000 passengers

VARIABLES	(1) Zheight	(2) Zheight
PRpassengers	0.0158***	0.00267
	(0.00604)	(0.00762)
PRpassengers^2	-4.13e-05	7.12e-06
	(4.57e-05)	(5.06e-05)
MBpassengers	0.000317	0.00279
	(0.00228)	(0.00239)
MBpassengers^2	1.90e-05	1.33e-05
	(1.92e-05)	(1.91e-05)
PR *coxenhole		0.0130***
		(0.00314)
PR *flowersbay		-0.00753
		(0.00677)
PR *sandybay		0.0118**
		(0.00584)
PR *offroad		0.00341
		(0.00871)
PR *brickbay		0.00490
		(0.00889)
PR *harbor		0.00402
		(0.00344)
PR *firstbight		0.00675
		(0.00756)
MB *coxenhole		-0.00387***
		(0.00108)
MB *flowersbay		-0.00361*
		(0.00189)
MB *sandybay		-0.00215
		(0.00153)
MB *offroad		-0.00145
		(0.00194)
MB *brickbay		-0.00445**
		(0.00214)
MB *harbor		-0.000853
		(0.00102)
MB *firstbight		-0.00355
		(0.00230)
coxenhole		-0.804***
		(0.239)
sandybay		-0.954*
		(0.487)
flowersbay		0.727
		(0.531)
offroad		-0.494
		(0.762)
brickbay		-0.396
		(0.753)
harbor		-0.208
		(0.275)
firstbight		-0.880
		(0.604)
Honduran	-0.244***	-0.288***
	(0.0404)	(0.0630)
Constant	-0.838***	-0.171
	(0.187)	(0.313)
Observations	4,113	4,113
Adj. R-squared	0.0435	0.0583

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Column (1) presents the results of the effect of cruise passenger arrivals to the Port of Roatán and Mahogany bay and the squares of these values with no region effects. The results for this regression suggest that there are no diminishing effects due to a lack of significance on both square terms, but it also finds that the Port of Roatán has had a significant ($p<.01$) and positive impact on height-for-age Z-score in general on the island, while there is no significant effect for Mahogany Bay.

Column (2) presents the second regression, which introduces the regional effects and the marginal effect of each port on children of each region. This regression finds that the significance of the effect of the Port of Roatán on the entire island is lost, but the effect of the Port of Roatán in Sandy Bay ($p<.05$) and Coxen Hole ($p<.01$) are significant when compared to the East End of the island. This loss of the Port of Roatán's baseline effect of tourism on the entire island is because this trend in column (1) is an average of all children on the island, but children of each of the eight regions have not necessarily benefitted from increasing tourism. The more specific model presented in column (2) is able to specify which regions benefited the most from cruise tourism and can determine if this effect exists for the whole island or if it is specific regions that are primarily contributing to the effect seen in column (1). The overall trend in column (2) would only be significant if all children in Roatán benefitted from increasing tourism. However, because it is not significant, it suggests that benefits to child height brought by tourism do not come to all regions but are rather highly localized to the two regions closest to the Port of Roatán: Sandy Bay and Coxen Hole.

The results for Coxen Hole are expected as the Port of Roatán is situated within the city, but the results indicate that children in Sandy Bay have experienced similar improvements in height compared to children in Coxen Hole. This large improvement in Sandy Bay can likely be attributed to two reasons. Child health data collected in Sandy Bay came from children living in La Colonia, a community in which immigrants from the mainland have settled to work in Roatán's booming tourism industry. A greater

percentage of these children's parents are expected to work in the cruise ship industry, and thus a greater proportion of these children would reflect improvements in height when compared to children in other regions. Additionally, Sandy Bay is where Clinica Esperanza, the island's most advanced clinic, is located. This clinic in funded entirely by donations, especially those of tourists, and although tourism helps to maintain it, its location provides the most impactful benefit to the residents of Sandy Bay.

The results for Mahogany Bay suggest there is a negative effect for Coxen Hole, Flowers Bay, and Brick Bay. This could be due to two reason. First, because all three communities are relatively close to the Port of Roatán, this decrease could be due to the fact that Mahogany Bay was actually taking passengers away from the Port of Roatán, and thus was bringing about a detrimental effect. This is supported in Figure 2 which shows that the number of annual cruise passengers to the Port of Roatán actually decreased after Mahogany Bay was build. Second, these effects for Mahogany Bay are less clear because there is very little data for Mahogany Bay. It was built in 2009, so only children aged four to nine may have benefitted from it, but because children's developmental windows are nearly three years, there is significant overlap in developmental windows of children being compared, producing unreliable results.

The coefficients on the square terms of both the Port of Roatán and Mahogany Bay are not statistically significant. Although there is an expected diminished effect of tourism development on height in the long run, this analysis only considers about the initial 15 years of increasing tourism, and the expected diminished effect has likely not yet been realized in Roatán.

Limitations

One noteworthy limitation is the adjusted R-squared of .0583, which indicates this approach does not explain most of the variance in height-for-age Z-scores. However, this low adjusted R-squared could be due to the inability of this analysis to control for the catch-up effect due to data limitations, which as mentioned before, has negatively biased the results. Additionally, another limitation of this approach that may have affected this adjusted R-squared is the sparsity of the data. For some older ages, there are very

few observations in the data set within a region, and these small samples are likely not representative of all of the children who live in this region, which would introduce significant random error.[4]

Using 2006 WHO growth standards is also potentially limiting because it does not control for changing height-for-age Z-score standards throughout time. This would mean that the results could be partially explained by a world trend of increasing heights. However, a study by the NCD Risk Factor Collaboration finds that for the birth years of children included in this analysis, the average height of an 18-year-old man in most OECD countries has stabilized (NCD Risk Factor Collaboration, 2016). This indicates that there has been no general world time trend in heights in the past 25 years, and any improvements in heights in Roatán are predominantly due to nutritional improvements. For Roatán, this improvement in nutrition has most likely come from the additional economic development due to cruise ship tourism that Sandy Bay and Coxen Hole have experienced.

Migration is also a potential issue. Given that our data do not indicate where children lived during their developmental windows, this could result in overestimating exposure to tourism during their developmental windows if they moved closer to the cruise ports when their height was measured. This would bias results to zero because these children were in reality exposed to lower levels of tourism than assumed in this analysis, and thus, would exhibit lower heights than expected.

The data set only contains about 20% of school-aged children on the island, so there is a selection bias towards children who are likely to attend school. The children who do not attend school are likely unhealthier than children who do attend school, but it is unknown how tourism development in Roatán has affected school participation rates. If fewer children are attending school, it might be due to the fact that there is an opportunity cost associated with increased tourism opportunities outside of school, and children from the lowest socioeconomic classes would be the ones dropping out. However, the more likely

[4] Histograms of age by region are provided in Appendix D.

result is that more children are in school because their parents have greater economic opportunities and do not need their children to supplement household income. This would mean that more children from lower socioeconomic classes would be in school. The true effect is unknown and further study is needed to determine how this tourism development impacts whether a child will stay in school.

Robustness Check

Improved early life nutrition also brings earlier onset of late adolescent growth spurts (Karaolis-Danckert, Buyken, Sonntag, & Kroke, 2009). A check of this effect on children who are too young or too old to be undergoing pubescent growth spurts can control for this effect. In this check, children between the ages of 10 and 14 are excluded, and results are presented in Table 4. As expected, the adjusted R-squared increases to .077, but the results overall are nearly identical to the original results.

Table 4.

VARIABLES	(1) Zheight
PRpassengers	-0.00955
	(0.0131)
PRpassengers^2	4.76e-05
	(9.92e-05)
MBpassengers	0.0106*
	(0.00578)
MBpassengers^2	-3.86e-05
	(4.03e-05)
PR *coxenhole	0.0151***
	(0.00437)
PR *flowersbay	-0.00563
	(0.00946)
PR *sandybay	0.0187**
	(0.00772)
PR *offroad	0.00304
	(0.0112)
PR *brickbay	0.0174
	(0.0161)
PR *harbor	0.00652
	(0.00473)
PR *firstbight	0.00482
	(0.0129)
MB *coxenhole	-0.00322*
	(0.00179)
MB *flowersbay	-0.00349
	(0.00353)
MB *sandybay	0.000311
	(0.00303)
MB *offroad	0.00200
	(0.00360)
MB *brickbay	0.00193
	(0.00576)
MB *harbor	-0.00169
	(0.00195)
MB *firstbight	-0.00380
	(0.00407)
coxenhole	-1.063***
	(0.290)
sandybay	-1.838***
	(0.644)
flowersbay	0.559
	(0.761)
offroad	-0.848
	(1.015)
brickbay	-2.159
	(1.734)
harbor	-0.389
	(0.352)
firstbight	-0.686
	(1.077)
Honduran	-0.215**
	(0.0865)
Constant	0.338
	(0.437)
Observations	2,388
Adj. R-squared	0.077

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VII. Conclusions

This paper finds that economic development brought via increased cruise tourism improves child health, as measured by height-for-age Z-scores. The effects are significant for the closest communities to the cruise port, but farther communities do not experience significant increases in height-for-age Z-scores when compared to the farthest communities.

The isolation of the effect to regions closest to the cruise port is likely explained by the general lack of public infrastructure in Roatán, and future studies should examine if similar Caribbean islands with better public infrastructure have a greater area for which cruise tourism can improve child health. A more widespread effect in similar islands would make a strong case for improving public infrastructure in Roatán so that more individuals can benefit from cruise ship tourism.

Future studies that examine the impact of tourism on child health would ideally use longitudinal data to account for the catch-up effect and differential growth trends from WHO standards. Future research, particularly research that focuses on other long-term indicators of well-being such as educational attainment and later life income due to cruise tourism, has the ability to inform international policy both from an economic development perspective as well as a global health one. Additionally, negative impacts should also be investigated, especially the impact of this rapid development on the prevalence of obesity and other chronic diseases on the island.

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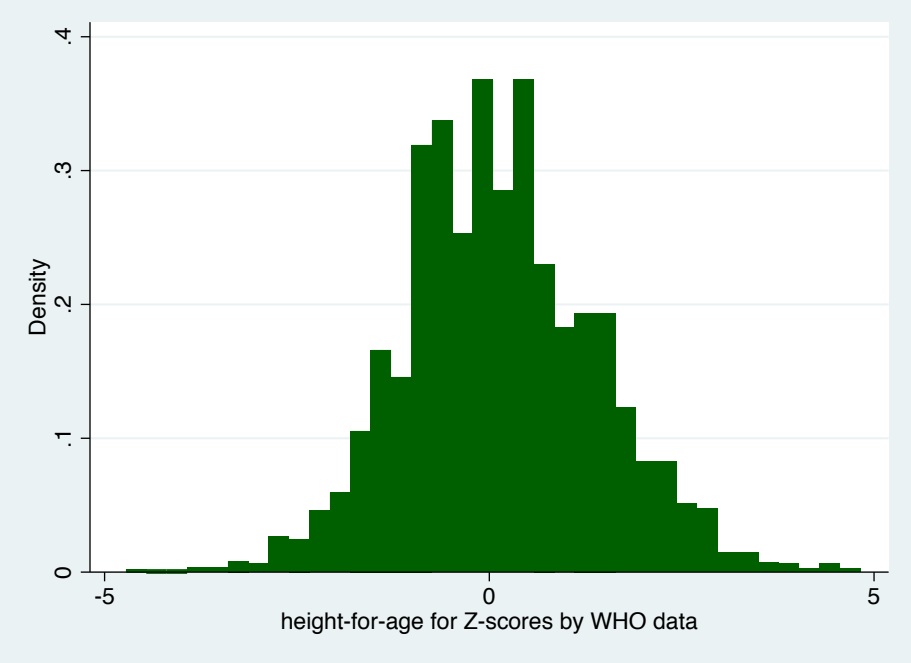
Appendix

Appendix A: Summary Statistics by School

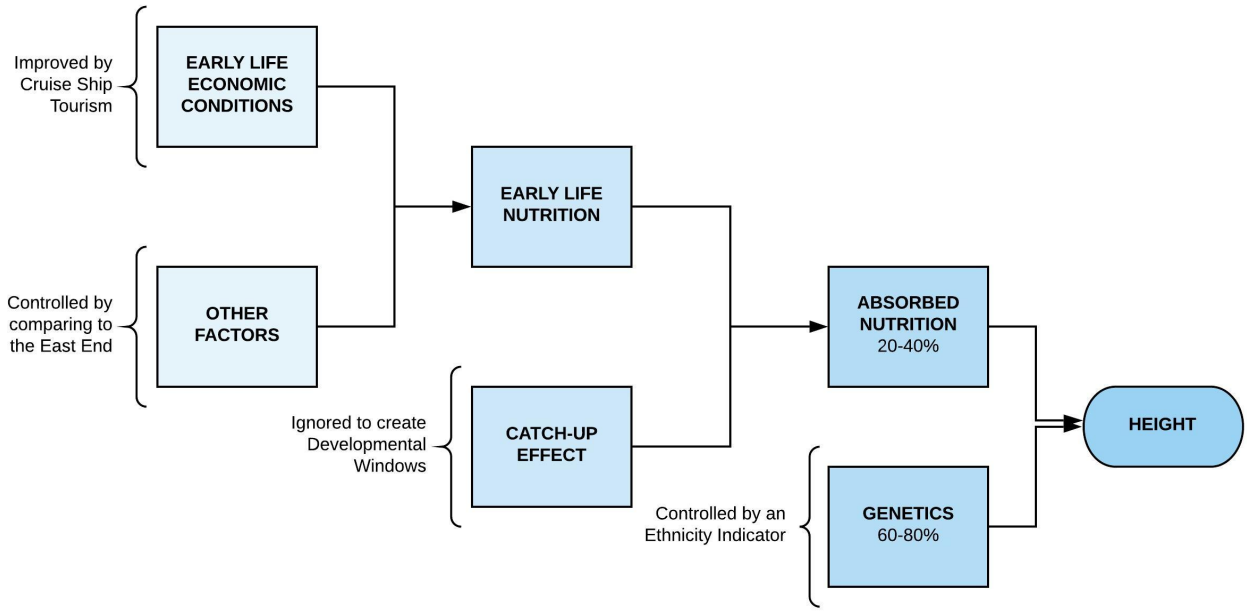
School	*Number of students*	*Mean Height-for-age Z-score*	*Mean age*	*Mestizo school*	*Region*
Alfa	124	-.0279403	12.523809	0	*Coxen Hole*
Arobia Alexander	505	.0308752	9.3762379	1	*Harbor*
Clinton Everett	111	.7103562	10.027027	0	*Coxen Hole*
Dionisio de Herrera	441	-.3046586	9.7959185	0	*East End*
Escuela Guaymuras	165	.1429536	9.1636362	0	*Coxen Hole*
Fausto	72	-.3412272	7.9305553	1	*Brick Bay*
Froylan Turcios	133	-.2227652	10.195489	0	*First Bight*
Garvey Nelson	41	.251815	10.341463	0	*Off Road*
Graciela O. Ramos	84	-.1092373	9.8095236	1	*Brick Bay*
Guardiola	264	-.5684542	15.208955	0	*Coxen Hole*
IPB	88	1.169816	9.9887638	0	*East End*
Iglesia de Dios	178	.1579068	11.275281	1	*Coxen Hole*
Isidrio	57	-.0268376	8.0350876	0	*Off Road*
Ivan Jones	22	-.0830645	4.869565	0	*East End*
Jose Santos Guardiola (Punta Gorda)	263	.9562209	9.4037733	0	*East End*
Juan Brooks	109	.046434	9.9357796	1	*Coxen Hole*
Leonard Ashley	59	-.2458519	15.084745	0	*Harbor*
Liceo Hondureno Insular	116	.4213232	10.847458	1	*Harbor*
Lunsford Johnson	147	.4124914	10.088435	0	*Flowers Bay*
Marco Aurelio	176	.152975	10.977273	0	*East End*
Mario	22	1.27687	4.7272725	0	*East End*

Metodista	295	.3679715	11.816053	0	*Coxen Hole*
Modelo	153	-.4897619	10.679739	1	*Sandy Bay*
Pedro Nufio	110	.6306989	9.409091	0	*East End*
Policarpo Bonilla	22	.751827	8.545455	0	*Off Road*
Rosabella McKenzie	36	.5694061	7.0833335	0	*East End*
Ruben Barahona	131	.366038	9.5725193	0	*Harbor*
Samuel Raymond	54	.8629472	9.3148146	0	*Sandy Bay*
Sandy Bay Adventista	73	.1998122	8.6849318	1	*Sandy Bay*
Teresa Sevilla	18	.8452484	4.5555553	0	*East End*
Tomas McField	47	-.2583907	9.0851068	0	*Flowers Bay*
Toribio Bustillo	47	-.2462479	8.8085108	0	*Off Road*

Appendix B: Distribution of Height-for-age Z-scores



Appendix C: Theoretical Framework



Appendix D: Histograms of Age by Region