The Relationship of Family Size and Spacing To the Growth of Preschool Mayan Children in Guatemala

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Abstract: The height of preschool Mayan children is analyzed with respect to family size and the spacing of their siblings, controlling for parental heights and weights.

Data on 643 cases were abstracted from the records of two previous longitudinal studies on the health of children under age five years living in the highlands of Guatemala. Height at age three years is estimated from the linear regression equations fitted for each child to measurements of height repeated at three-month intervals from ages one to four years.

Family size is expressed in terms of birth rank, live siblings, and the number of dependent and independent family members. Family spacing is measured as birth intervals, i.e., the number of months between the birth of the index child and his previous and subsequent siblings.

Most previous studies have reported that height decreases as family size increases. This study shows that Mayan children from both small and large families are taller than those from middle-sized families. Evidence is presented to support the hypothesis that children in large families are relatively tall because their early-born siblings contribute to the family fortunes. Birth intervals are positively correlated with height. The findings are discussed in terms of their implications for family planning. (Am. J. Public Health 66:1165–1172, 1976)

Introduction

There is a characteristic pattern of growth failure[1] and excess mortality[2] from age six months to three years among low-income populations of less-technologically developed countries, which is related in large part to synergism between malnutrition and infection.[3] Information on the role that nongenetic family factors, such as family size and spacing, play in the growth failure of these preschool children is meager. Further study of these relationships seems particularly relevant in view of the high birth rates prevalent in many of the developing countries.

Among the lower socioeconomic classes of industrialized countries there is a tendency for the height of preschool children to decrease as both birth rank[4] and family size[5] increase. However, an analysis of the relationship between birth rank and the height of British school children, holding family size constant, indicates that the smaller size of children in large families is common to all ranks.[6] The same study reports that later-born siblings tend to be taller than their preceding siblings and that the preceding siblings tend to be shorter at age six years if the later-born siblings follow after an interval of less than two years than if the interval is more than two years.[6] Although numbers are too small in most cases for the height differences between siblings to be statistically significant, it is suggested that the birth of each additional child to a family acts as a check to the growth of preceding siblings, particularly when the interval between births is less than two years.

The limited data from Latin America indicate that preschool children from large families weigh less than those from small families,[7, 8] but detailed data on height according to family size and spacing are lacking. Analysis of height and weight in New Guinea according to birth rank reveals that body size is above average in first-born children and second-born girls, below average in second- and third-born boys and third- and fourth-born girls, and above average in later-born children;[9] the author suggests that the food-gathering activities of older siblings improve the growth of children born fifth and later.

The present study examines the height of preschool Mayan children in rural Guatemala as it relates to birth rank, the number of live siblings and total family members, the number of family members according to age, and the intervals between the births of siblings. It is hypothesized that intrafamilial competition between siblings for family resources is related to the height of preschool children and that competition increases with the number of dependent siblings and decreases as the interval between the births of siblings lengthens.

Method

Population

The study population consisted of 883 preschool children living in two predominantly Mayan Indian villages in the highlands of Guatemala. Data used in the present analy-

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TABLE 1—Mean Height ± S.E.* for Both Sexes at Age Three Years, by Number of Live Siblings and Birth Rank

	Birth Rank							
No. of Live Siblings	1	2	3	4	5	6	7+	Totals
1	80.6 ± .4 (71)	81.4 ± .5 (20)	79.6 ± .8 (6)	82.0 ± 1.9 (3)	82.1 ± 1.2 (2)	-	79.0 ± 3.8 (2)	80.7 ± .4 (104)
2		80.7 ± .5 (50)	80.4 ± .7 (32)	80.2 ± .8 (14)	80.6 ± 1.2 (7)	77.0 ± 2.8 (5)	81.6 ± .6 (4)	80.4 ± .3 (112)
3			79.4 ± .6 (42)	79.9 ± .8 (31	81.8 ± 1.0 (18)	80.9 ± 1.1 (14)	80.6 ± .9 (11)	80.2 ± .4 (116)
4				78.0 ± .8 (21)	79.4 ± .6 (26)	78.7 ± .9 (18)	78.7 ± .9 (27)	78.8 ± .4 (92)
5					77.0 ± 1.1 (12)	80.2 ± .8 (17)	78.2 ± .6 (38)	78.5 ± .5 (67)
6						80.2 ± 2.3 (5)	79.9 ± .6 (36)	79.9 ± .6 (41)
7+							79.7 ± .6 (44)	79.7 ± .6 (44)
Totals	80.6 ± .4 (71)	80.9 ± .3 (70)	79.8 ± .4 (80)	79.5 ± .4 (69)	79.8 ± .5 (65)	79.6 ± .5 (59)	79.3 ± .6 (162)	79.8 ± .2 (576)

*Mean height in centimeters

sis were gathered in the course of two longitudinal studies on the health of preschool children carried out by members of the Institute of Nutrition for Central America and Panama. The first included all children under age five years in two rural villages* which had been matched with respect to ethnic background and general life styles and revealed no significant differences in mean growth rates of children.[10-12] The second was initiated in one of the same villages** at the time that the earlier study was completed and studied children from birth to age five years.[13]

Family Size and Spacing

Measures of family size and spacing used in the present study (see Appendix A) were derived from detailed census data available from the two longitudinal studies. These data were verified and supplemented by field notes made on changes in household composition which occurred before and after each census and by checking local birth and death registers from 1950 to 1964. In addition to the usual measures of birth rank and live siblings, family members were categorized as dependent or independent according to age at which they would be expected to contribute to the family resources.‡

Growth Index

Inasmuch as family size and spacing might be expected to exert their influence on growth rates over the whole of the child's growth period, age-specific height was chosen as an index which summarizes the extent of both prenatal and postnatal growth. Heights of parents and children during the initial period, 1959–1964, were measured using a steel tape. After 1964, the steel tape was used for parents while a wooden "infantometer" with the child in a prone position was used for children.

*Santa María Cauqué and Santa Cruz Balanyá, 1959–1964.
**Santa María Cauqué, 1964–1971.
‡See Appendix for definitions.

The heights of children were measured at three-month intervals; however, the children were not all measured at the same age. Advantage was taken of the repeated measurements to fit a linear regression equation, based on at least four measurements between the ages of one and four years, for each child. Height at age three years was then established from the individual growth curves.‡‡ Height was estimated by interpolation for over 71 per cent of the children; in the remaining cases, extrapolation was limited to six months or less. This method of estimating height maximized the number of children who could be included in the study and made possible detailed studies of the relationship of family size and spacing to growth. Before combining sex-specific data from the three village-study subgroups, adjustment factors based on systematic village, study, and sex differences in height were added to the heights of individual children in the appropriate village-study-sex group.

Children born between January and June were taller on the average at age three years, 80.47 S.E. 0.25 cm. (N = 251), than children born between July and December, who were an average of 79.35 S.E. 0.20 cm. tall (N = 325; $P < .001$; see Appendix A, Figure A1). However, month of birth was not significantly related to the measures of family size and spacing presently under study; therefore, no adjustments in children's height were made for season of birth.

Results

The height of preschool Mayan children is more closely related to the number of live siblings in the family than to birth rank. For a given birth rank, mean height tends to decrease with increasing numbers of live siblings; however, the converse relationship is not seen (Table 1). The predominant

‡‡Growth rates decelerate during the first year of life, but they are nearly linear between the ages of one and four years,[12] and the linear regression equations accounted for over 95 per cent of the

influence of live siblings is confirmed by alternating the order in which the two factors enter a regression on height. When birth rank enters the regression first, it accounts for 1.9 per cent of the variability in height (slope = .05 S.D. .15 cm.; P < .001) with live siblings accounting for an additional 1.4 per cent (slope = .47 S.D. .18 cm.; P < .001), whereas when live siblings enter the equation first, they account for all 3.3 per cent of the variability in height.

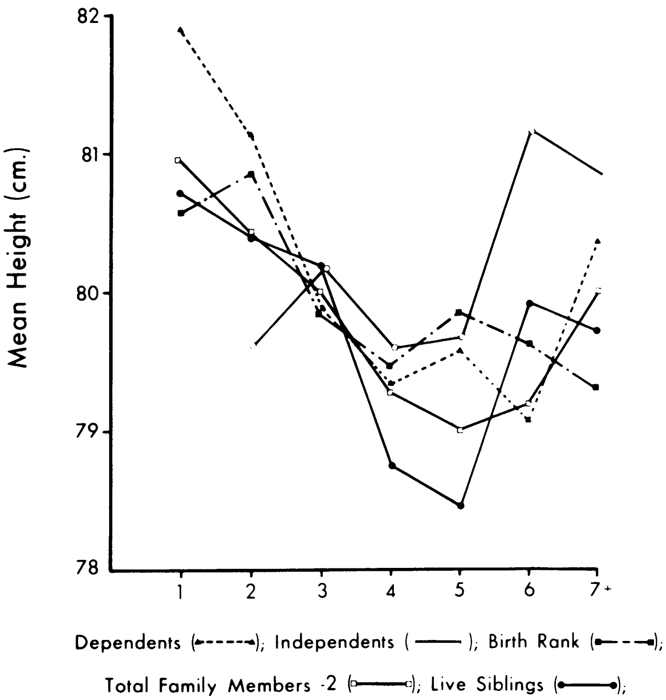

FIGURE 1—Mean Height for Both Sexes at Age Three Years, by Dependents, Independents, Birth Rank, Total Family Members Minus Two, and Number of Live Siblings*

Mean height is plotted according to five measures of family size in Figure 1. Children are tallest on the average when there is only one dependent in the family. There is a significant decrease in height with increases in the number of dependents from one to six, of live siblings from one to five, and of total family members from three to seven. However, after an initial drop in mean height as these measures of family size increase, there is a tendency for height to increase with further increments in family size. Thus, children with six live siblings are almost as tall on the average as those with only three, whereas children with four or five live siblings are over a centimeter shorter than groups with either fewer or more live siblings. The only measure of family size that is positively correlated with height is independents, with height averaging 79.7 cm. in children from families with fewer than six independent members and 81.0 in those from families with over five (P < .05).

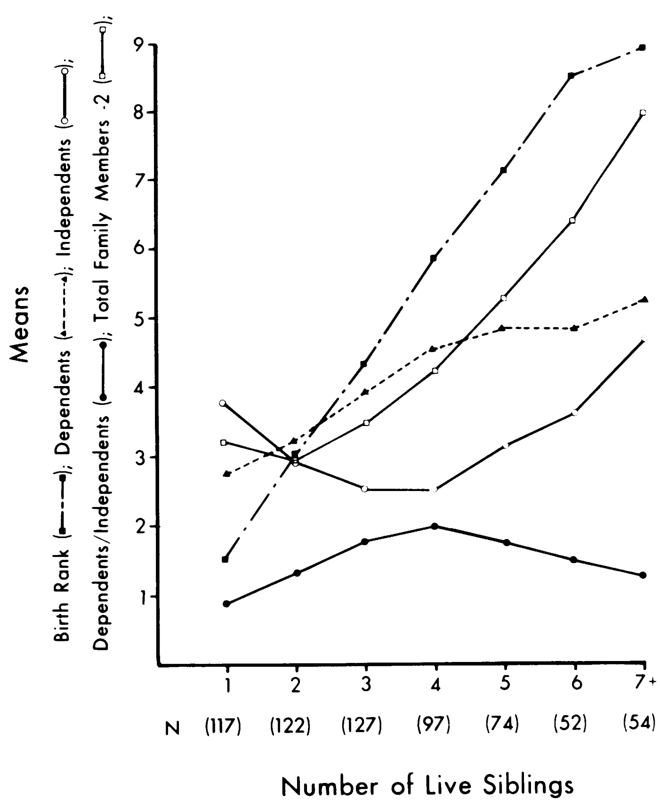

FIGURE 2—Mean Values for Selected Variables for Both Sexes at Age Three Years, by Number of Live Siblings*

The interrelationships among the measures of family size are of interest in themselves (see Figure 2). The number of dependents in the family tends to increase as live siblings increase. The average number of independents is relatively high at the birth of the first child and decreases as the next two live siblings are added to the family but then increases with the addition of more than five live siblings. Thus, the average ratio of dependents to independents is low when there is one, two, or over five live siblings in the family. Due to the high infant and child mortality rates, the number of live siblings fails to keep up with birth rank. The discrepancy is especially marked in birth rank beyond the eighth child. In families of more than eight offspring, the average increase of live siblings per unit increase in birth rank is only 0.12 S.E. 0.13 (N.S.) compared to families with fewer than nine in which the average increase is 0.62 S.E. 0.02 live siblings per unit (P < .001).

Mean height by birth interval is presented in Figure 3. The average, subsequent birth interval in this population is 31.5 S.D. 10.1 (541) months, and the average of all prior birth intervals is 30.0 S.D. 12.0 (554) months. However, the prior birth interval, i.e., the period between the index child's birth and that of his previously-born sibling, is shorter if the pre-

variability in the height measurements of 80 per cent of the children. Three per cent of the children were excluded because the linear regression failed to account for a minimum of 80 per cent of the variability in their height measurements.

*Numbers upon which this figure is based are given in Appendix A, Table A1.

*Numbers upon which this figure is based are given in Appendix A, Table A2.

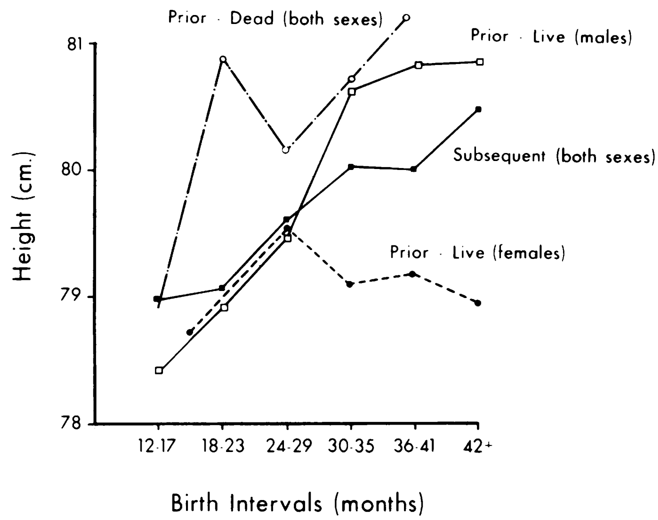

FIGURE 3—Mean Height at Age Three Years, by Subsequent and Prior Birth Intervals*

viously-born sibling died, 20.5 ± 12.2 months (N = 50), compared to 32.5 S.D. 11.6 months (N = 453) in cases in which the previously-born sibling survived. As can be seen in Figure 3, the average height associated with a short prior birth interval is influenced by the survival of a previously-born sibling.

In general, the data support the hypothesis that children tend to be taller as birth intervals lengthen; however, there is a marked sex difference in the relationship between prior birth intervals and height. In males there is a highly significant increase in average height as the prior birth intervals lengthen from 12–17 months to 30–35 months, whereas in females there is an initial increase in height similar to that seen in males up to intervals from 24–29 months after which mean height actually decreases slightly as prior birth intervals lengthen further. The sex difference in mean height associated with prior birth intervals of two and one-half years or more amounts to 1.6 cm. (P < .001).

*Numbers upon which this figure is based are given in Appendix A, Table A3.

Further analyses were conducted in order to determine which of the nongenetic family factors identified in the present study is most closely related to height and whether the factors are additive in their associations with height. The strengths of linear relationships between height and the nongenetic family factors are estimated by correlation coefficients given in Table 2.* The results of combining the nongenetic family factors in several multiple regression equations which predict the height of preschool Mayan children are summarized in Table 3. Previous work has demonstrated a significant relationship between height at age three and parental body size;[15] therefore, parental and maternal heights and weights were entered into the regression equation before the relationships between height and the nongenetic family factors were examined. For the most part, contributions of the nongenetic family factors to the regression in height are very similar whether or not parental body size is taken into consideration.**

Regression equations were calculated for the sexes separately and with dependents and independents entering the equation individually and expressed as a ratio. The total per cent variability in height accounted for by nongenetic family factors approaches in magnitude the variability attributable to parental body size. In general, once one of the four factors negatively associated with height (live siblings, birth rank, total family members, or dependents) enters the regression, none of the other three adds significantly more to the variability accounted for by the equation. The regression on female

TABLE 2—The Relationship of Nongenetic Family Factors to Height at Age Three Years as Expressed by Pearsonian Correlation Coefficients

Nongenetic Family Factors	Both Sexes		Males		Females	
	r	N	r	N	r	N
Live Siblings (1-5)	-.18¶	504	-.17*	234	-.21¶	270
Birth Rank (1-7)	-.14¶	469	-.13*	226	-.19¶	243
Total Family Members (1-7)	-.17¶	442	-.19¶	206	-.18¶	236
Dependents (1-6)	-.16¶	558	-.14*	254	-.19¶	304
Independents	.07	576	.06	266	.08	310
Dependents/Independents	-.15†	576	-.15*	266	-.16¶	310
Subsequent Birth Intervals	.10*	486	.09	230	.09	256
Prior Birth Intervals—All	.06	496	.15*	230	.01	266
Prior Birth Intervals—Live	.07	408	.18*	199	.02	209

*P ≤ .05 ¶P ≤ .01 †P ≤ .001

*For family size factors such as live siblings in which the association with height has a nonlinear component, the calculation of the correlation coefficient is based on the predominantly linear portion of the distribution. The percentages of the variability in average height accounted for by fitting linear and nonlinear curves[14] over the complete distribution of the measures of family size are compared in Table A4 of Appendix A.

**A negative correlation between fathers' height and live siblings (r = −.16; P < .01) had the effect of reducing the partial correlation between children's height and live siblings. There is a significant negative correlation between fathers' height and birth rank among males but not among females, indicating that shorter fathers tend to have larger families, which is apparently related to more births among fathers of male children and to greater survival among fathers of female children. The latter is consistent with the hypothesis that slower growth rates and smaller body size may have survival value under conditions of stress and malnutrition[16].

TABLE 3—Multiple Regression Analyses of the Nongenetic Family Factors on Height at Age Three Years, Controlling for Parental Body Size

Sex	N	Family Factors*	P To Enter	Contributions To R^2	$\beta \pm$ S.D. (cm.)
Both Sexes	406	Parental Body Size	<.001	.077	
		Live Siblings	<.001	.028	-.404 ± .113
		Subsequent Birth Intervals	<.01	.010	.036 ± .018
		Independents	<.01	.009	.237 ± .113
		Prior Birth Intervals**	~.05	.004	.022 ± .015
Males	193	Parental Body Size	<.001	.101	
		Total Family Members	<.001	.022	-.561 ± .203
		Prior Birth Intervals**	<.001	.020	.054 ± .023
		Independents	<.001	.019	.330 ± .160
Females	213	Parental Body Size	<.001	.086	
		Birth Rank	<.001	.043	-.308 ± .151
		Dependents	<.001	.014	-.411 ± .206
		Independents	~.05	.008	.226 ± .160
Both Sexes	406	Parental Body Size	<.001	.077	
		Live Siblings	<.001	.028	-.315 ± .120
		Dependents/Independents	<.001	.012	-.578 ± .275
		Subsequent Birth Intervals	<.001	.008	.034 ± .018
Males	193	Parental Body Size	<.001	.101	
		Dependents/Independents	<.001	.026	-.584 ± .364
		Prior Birth Intervals**	<.001	.014	.044 ± .023
		Total Family Members	<.001	.014	-.361 ± .204
Females	213	Parental Body Size	<.001	.086	
		Birth Rank	<.001	.043	-.392 ± .146
		Dependents/Independents	<.001	.014	-.617 ± .385
		Subsequent Birth Intervals	~.05	.008	.034 ± .027

*In the first three equations dependents and independents are analyzed separately and in the last three as a ratio.
**All prior intervals were considered to maximize the number of cases with complete data sets.

height is an exception, with the number of dependents entering the equation after birth rank. The number of independents makes a significant contribution to predicting height in all the analyses, whether entering on its own or expressed as a ratio.

Birth intervals account for more of the variability in the height of males than of females. There is a tendency for either subsequent or prior birth intervals to account for most of the variability in height attributable to family spacing, rather than for both to contribute, though both subsequent and prior intervals enter the regression equation when the data for the sexes are combined.

Discussion

In families with a given number of live siblings, there is a tendency for average height to increase with increasing birth rank up to a point, i.e., birth rank five in families with one, three, or four live siblings and birth rank six in families with five live siblings (Table 1). After these points there is a less marked trend toward decreasing height with further increases in birth rank. The initial increase in height suggests that growth is faster if previously-born children have died. Possible explanations for this may be that the family compensates for the death of one child by giving the next more care, the death of the immediately preceding child may reduce intrasibling competition, or faster growth with its correspondingly greater demand for nutrients may carry with it a greater risk of dying when stressed.[16] Decreases in height with further increases in birth rank may be related to poor living conditions that account for the excessive mortality and are also conducive to slower growth.

The relationships among family size, spacing, and height are best understood in the context of the Mayan culture. The Mayans are subsistence farmers, growing corn and beans as staples together with a few vegetables. They are largely dependent on hand labor and, by the age of ten years, most children have left the village school and are actively contributing to the family welfare. Gordon *et al.*[2] have identified weaning as a critical period in the lives of preschool children in developing countries during which they must make the transition from breast milk to an adult diet. The adult diet tends to be very bulky with a high fiber content, and it is difficult for a young child with a small stomach capacity to consume and digest large enough amounts of the diet to meet his caloric and protein needs for growth. The problem is compounded by the fact that adult foods are given at first in dilute form, further decreasing their food value. Under these circumstances the time spent feeding the child and coaxing him to eat and the frequency of feedings may be very influential in determining the adequacy of his diet. Given the labor intensive quality of the Mayan's way of life, time to feed children who still need help eating may be more plentiful in families with a favorable dependent to independent ratio. Also, lactation may be prolonged or more abundant among women whose work load is distributed over a larger number of independent family members.

It is customary among the Mayans for a young couple to continue living with the parents of one of them until after the birth of their first two children. This extended family structure accounts for relatively large numbers of independents in families with one or two live siblings compared to those with three or four (Figure 2). These children are cared for by their grandparents, aunts and uncles, as well as by their parents, and they grow well despite the youth of their parents. Given an average birth interval of approximately two and one-half years between children, a couple typically establishes a separate household with two children under five and adds an average of two more children within the next five years for a ratio of two dependent children for each independent adult. This unfavorable dependent/independent ratio is associated with a slower growth rate than is seen among children with one to three live siblings, and the addition of a fifth sibling is associated with still slower growth.

In families with over five live siblings, the maturation of early-born children adds to the independents while the number of dependents stays more or less the same. The increase in average height over that seen in children with four or five live siblings suggests that this is a relatively favorable family environment for preschool children, which is consistent with the hypothesis that growth is favored by a low dependent/independent ratio. The difference in height is not attributable to the fact that some of these children are last in their families and do not have to compete with a younger sibling for attention; average height was 79.684 cm. for children with a subsequent sibling and 79.689 cm. for children with no subsequent sibling.

Thus, the original hypothesis that height would decrease as the number of live siblings increased should be restated as follows: the height of preschool children tends to decrease as the number of dependents *relative to the number of independents* in the family increases. The restated hypothesis is also consistent with the linear relationship between live siblings and height seen in industrialized countries and among poorly paid day laborers in less technologically developed countries. In these situations children tend to stay dependent for longer periods and to leave the parental household once they become independent, which minimizes their contribution to the welfare of younger preschool siblings.

Although longer birth intervals are positively correlated with growth, the relatively good growth of children in families with more than five live siblings cannot be attributed to longer intervals between births. Failure to see longer birth intervals associated with increasing birth rank or live siblings may be partly related to the fact that the study population is limited to families with preschool children. However, in other highland Guatemalan villages, the average increase in birth intervals with increasing maternal age is reported to be negligible in mothers between the ages of 20 and 37,[17] suggesting that the birth intervals in the present study may be rather typical for these villages. It may be that birth intervals would have accounted for more of the variability in height if abortions had been taken into account. The probable effect of an abortion is to lengthen the intervals between full-term births. Since it is hypothesized that a longer interval between births will reduce competition between siblings, and since an abortion represents an unmeasured source of competition, the effect of omitting these data is to make the test of the hypothesis more conservative.

It has been suggested that the growth of boys tends to be more affected by environmental pressures than the growth of girls.[18] Thus, the greater significance of prior birth intervals in males might indicate a greater growth response in males to longer birth intervals. However, none of the other nongenetic family factors were more strongly correlated with height in males than in females. In fact, in the multiple regression equation, nongenetic family factors accounted for more of the variability in the height of females than in the height of males.

It seems clear to most observers that family size must be quickly reduced in many areas of the world to aid efforts to minimize future food shortages. Individuals are likely to choose to have fewer children only if effective means of family planning are readily available, if child mortality rates are low, and if economic and/or social benefits would result from such a choice. The increasing numbers of independent family members associated with more than five live siblings may well be perceived as economically desirable. However, before reaching this stage, families go through a period of hardship when the parents alone care for four or five young children. This unfavorable ratio of dependents/independents could be avoided if the average birth intervals between live siblings were lengthened to 48 months.

The above suggestion is not made in the naive assumption that no one has ever thought of lengthening birth intervals or that it would be easy to accomplish. Rather, it is based on a detailed study of the effect of family size and spacing *on the family itself*. This approach is prompted by a conviction that the acceptance of family planning at the village level depends less on whether it makes sense in terms of national population policy than it does on whether it makes sense in terms of the family's immediate well-being. If the advantages associated with a large family outweigh the disadvantages in the minds of Guatemalan farmers, it is unlikely that family planning would interest them. However, if it were demonstrated that spacing births further apart would ease the burden of work significantly, this might represent an attractive alternative to the present reproductive pattern.

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APPENDIX A

Measures of Family Size and Spacing:

Birth Rank—The number of live and stillbirths, including the one under study.

Live Siblings—The birth rank of the index child minus the number of previously-born siblings who died before the index child was six months old.

Family Members—Individuals living in the same house as the index child for at least six months of the child's first five years of life. All live siblings were considered family members; additional members were added to the number of live siblings to calculate the total number of family members.

Dependents—Family members, including the index child, who were under age 10½ years at the birth of the index child.

Independents—Family members who were over age 10½ years at the birth of the index child.

Dependents/Independents—The ratio of dependent to independent family members.

Prior Birth Interval—Months between the birth of the index child and his previously-born sibling. This interval does not apply to the case of first-born children; it includes all live births and stillbirths. Data on abortions were not collected in the first longitudinal study and though reproductive histories were taken in the second study, Mayan women are reluctant to give information regarding abortions. Among older women it may have been difficult to remember details of their early reproductive history. For these reasons the data on abortions are not included in the present analysis.

Prior Birth Intervals (Live)—Months between the birth of the index child and his previously-born sibling in cases in which the previously-born sibling survives to age six months or older.

Prior Birth Intervals (Dead)—Months between the birth of the index child and his previously-born sibling in cases in which the previously-born sibling died before the age of six months.

Subsequent Birth Intervals—Months between the birth of the index child and his subsequently-born sibling. This interval is not included in cases where the child is the last born or where the observation period ended before the birth of a subsequent sibling.

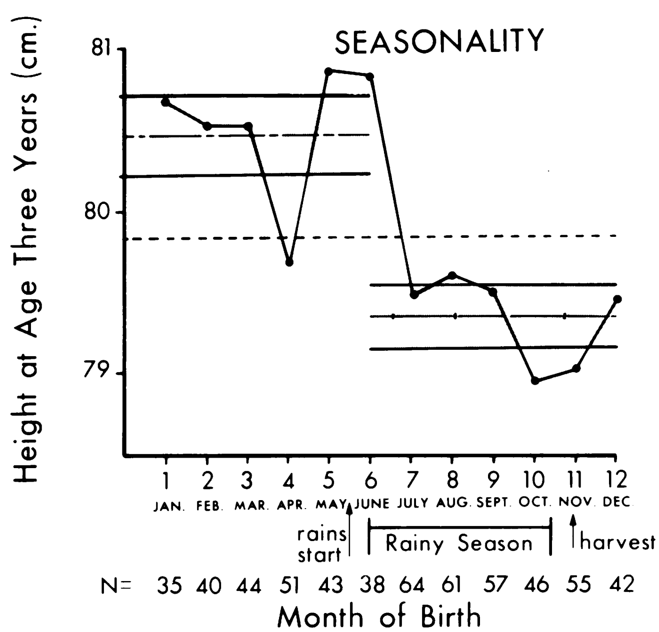

FIGURE 1—Mean Height for Both Sexes at Age Three Years, by Month of Birth*

***Shaded areas denote mean heights with 95% confidence intervals for the six-month periods January through June and July through December.**

TABLE A-1—Mean Height ± S.E.* for Both Sexes at Age Three Years, by Dependents, Independents, Birth Rank, Total Family Members Minus Two, and Number of Live Siblings

	Dependents, Independents, Birth Rank, Total Family Members Minus Two, No. of Live Siblings (Number of cases in parentheses)						
	1	2	3	4	5	6	7
Dependents	81.9 ± .7 (18)	81.1 ± .4 (85)	79.8 ± .3 (134)	79.3 ± .3 (140)	79.6 ± .3 (128)	79.1 ± .6 (53)	80.4 ± .8 (18)
Independents	83.5 ± 2.1 (2)	79.6 ± .2 (295)	80.0 ± .3 (133)	79.6 ± .5 (64)	79.7 ± .6 (41)	81.2 ± .6 (16)	80.9 ± .8 (25)
Birth Rank	80.6 ± .5 (71)	80.9 ± .4 (70)	79.8 ± .4 (80)	79.5 ± .5 (69)	79.8 ± .5 (65)	79.6 ± .5 (59)	79.3 ± .3 (162)
Total Family Members Minus Two	81.0 ± .5 (55)	80.4 ± .4 (93)	80.0 ± .4 (114)	79.3 ± .4 (101)	79.0 ± .5 (79)	79.2 ± .5 (50)	80.0 ± .4 (84)
No. of Live Siblings	80.7 ± .4 (104)	80.4 ± .3 (112)	80.2 ± .4 (116)	78.8 ± .4 (92)	78.5 ± .5 (67)	79.9 ± .5 (41)	79.7 ± .6 (44)

*Mean height in centimeters.

TABLE A-2—Means Values ± S.E. for Selected Variables for Both Sexes at Age Three Years, by Number of Live Siblings

Selected Variables	Number of Live Siblings						
	1	2	3	4	5	6	7+
Birth Rank	1.6 ± .1	3.1 ± .1	4.3 ± .1	5.8 ± .2	7.1 ± .2	8.5 ± .3	8.9 ± .2
Dependents	2.7 ± .1	3.2 ± .1	3.9 ± .1	4.5 ± .1	4.8 ± .1	4.8 ± .2	5.2 ± .1
Independents	3.7 ± .2	2.9 ± .2	2.5 ± .1	2.5 ± .1	3.1 ± .1	3.6 ± .1	4.6 ± .2
Ratio of Dependents to Independents	0.89 ± .05	1.30 ± .05	1.77 ± .06	1.97 ± .07	1.73 ± .09	1.48 ± 1.0	1.24 ± .03
Total Family Members Minus Two	3.2 ± .3	2.9 ± .2	3.5 ± .1	4.2 ± .1	5.3 ± .1	6.4 ± .2	7.9 ± .2

TABLE A-3—Mean Height ± S.E.* at Age Three Years, by Subsequent and Prior Birth Intervals (Number of Cases in Parentheses)

	Birth Intervals (in months)					
	12-17	18-23	24-29	30-35	36-41	42+
Subsequent Birth Intervals (both sexes)	79.0 ± 1.0 (10)	79.1 ± 0.5 (66)	79.6 ± 0.3 (174)	80.0 ± 0.4 (116)	80.0 ± 0.4 (54)	80.5 ± 0.4 (66)
Prior Intervals, Live (males)	78.4 ± 2.2 (5)	78.9 ± 0.9 (31)	80.0 ± 0.5 (63)	80.6 ± 0.4 (51)	80.8 ± 0.6 (26)	80.9 ± 0.7 (23)
Prior Intervals, Live (females)	78.7 ± 0.6** (39)		79.5 ± 0.5 (68)	79.1 ± 0.5 (40)	79.2 ± 0.8 (23)	78.9 ± 0.7 (39)
Prior Intervals, Dead (both sexes)	78.9 ± 0.8 (25)	80.9 ± 0.8 (24)	80.2 ± 0.7 (18)		81.2 ± 0.9*** (18)	

*Mean height in centimeters. **Birth intervals 12-23 months. ***Birth intervals 30+ months.

TABLE A-4—Percentage of the Variability in Mean Height at Age Three Years Attributable to Linear and Quadratic Trends in Nongenetic Family Factors for Both Sexes

Nongenetic Family Factors (N = 576)	% Variability in Mean Height Attributable to Linear Trends	% Variability in Mean Height Attributable to Quadratic Trends
Live Siblings	0.94 (P = .018)	1.52 (P = .003)
Total Family Members	N.S.	1.62 (P = .003)
Brith Rank	N.S.	N.S.
Dependents	1.07 (P = .013)	0.98 (P = .017)
Independents	0.67 (P = .050)	N.S.
Dependents/ Independents	2.04 (P < .001)	N.S.