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PATRILINEAL FAMILY VALUES, FAMILY PLANNING AND VARIATION IN STATURE AMONG TAIWANESE SIX-YEAR-OLDS

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Summary. It has been argued that patrilineal joint family systems tend to bias family planning decisions in favour of sons. A simple model suggests that in such societies, any given son will be more highly valued by his parents (1) the fewer his brothers and (2) the earlier his birth is in the brother series. A daughter's value will be greater (1) the fewer brothers she has and (2) the earlier her birth is relative to other sisters. This study first addresses the extent of son preference as inferred from family composition data for 772 Taiwanese first-graders born in the mid-1970s in two socioeconomically distinct communities in Taipei, Taiwan. It then uses linear regression to consider whether the model criteria help account for statural variation among children in each study area when controlling for differences in measurement age, parental education and housing. With respect to family composition and gender preference, available evidence was consistent with previous surveys. While better-educated parents in the more affluent study area had significantly fewer children ($p<0{\cdot}0005$) and were more willing to stop without a son, girls there, as in the less affluent area, were still significantly more likely than boys to belong to large sibships ($p \leq 0{\cdot}005$). Evidence from mean height of males and females partially accords with hypothetical predictions. In the less affluent area, the interaction effect of male birth order and the presence of younger siblings was significantly associated with mean stature ($p=0{\cdot}002$). Males without brothers were 2·0 cm taller than males with either an older or a younger brother ($116{\cdot}3 \pm 0{\cdot}5$ cm vs $114{\cdot}3 \pm 0{\cdot}4$ cm). Males who had both younger and older brothers, but often no sisters, were about as tall, however, as those without brothers. A similar, but less pronounced, pattern was found among males in the more affluent area, but only among those who had sisters. These boys were also consistently shorter than boys without sisters ($115{\cdot}6 \pm 0{\cdot}6$ cm vs $117{\cdot}7 \pm 0{\cdot}6$ cm; $p=0{\cdot}001$). Patterns of mean female stature did not clearly support the hypothesis. Girls in the more affluent area were relatively tall and did not show significant variation. Results among less affluent girls showed significant contrasts, but not necessarily in the predicted direction.

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Introduction

Skinner (1997) argues that family systems tend to bias family planning decisions in various ways that affect family composition and influence the treatment of children. In societies where patrilineal joint family systems are the ideal, sons are favoured over daughters because of their social and economic importance to their parents. He notes, though, that within such a system a daughter is still often desired. Daughters help their mothers care for family members, and when no brothers survive they may perpetuate the patriline by contributing children who assume their family's (rather than their husband's family's) name. Skinner suggests a simple model that helps predict how parents in patrilineal family systems will value a given child. A son will be more highly valued by his parents (1) the fewer brothers he has and (2) the earlier his birth is relative to other brothers. A daughter's value will be greater (1) the fewer brothers she has and (2) the earlier her birth is relative to other sisters.

Skinner supports his admittedly incomplete model using parity-stopping ratios by gender in Taiwan as well as evidence from studies of gender-related early childhood mortality risk among residents of Bangladesh (Das Gupta, 1987; Muhuri & Preston, 1992). Both Das Gupta (1987) and Muhuri & Preston (1992) imply that gender-associated differences in treatment that increase the risk of female mortality are more than the result of generalized social preferences and indicate selective neglect of individual children influenced by existing family composition.

Relationships between gender preferences, declines in family size, and discriminatory behaviour of care-givers are complex and much debated (Goodkind, 1996). With growing access to family planning, reductions in desired and actual family size are common trends in much of the developing world today. In Korea, China and Taiwan this has led in the recent past to prenatal sex determination and abortion of female fetuses, particularly among families who already have two surviving children (Park & Cho, 1995). Goodkind (1996) has suggested that perhaps such prenatal sex selection may mitigate postnatal discrimination against daughters. However, improving socio-economic circumstances would seem to be an important confounding factor in such interpretations. Similar biases may have different impacts on children's growth and well-being depending upon total familial resources. Goodkind (1996) qualifies his own argument by noting that in Taiwan excess female early childhood mortality (Fig. 1) had been eliminated on a national level by the mid-1960s, substantially prior to the rise in the male sex ratio at birth.

The present study utilizes Skinner's generalized model to examine issues of son preference and gender and birth order-related bias that may help explain height variation among Taiwanese first-graders born in 1976 and 1977 who lived in two somewhat socioeconomically and demographically distinct areas in Taipei. In these settings, where the risk of mortality was relatively low, differences in parental care interacting with familial socioeconomic circumstances might still contribute to differences in mean height. There are reasons to suspect some socially conservative views consistent with Skinner's model were present, despite dramatic changes in health care, housing, diet and availability of consumer goods in the past few decades (Fei, Ranis & Kuo, 1979; Galenson, 1979; Hermalin, Liu & Freedman, 1994). Survey data suggest that the majority of Han Chinese in Taiwan continue to place substantial

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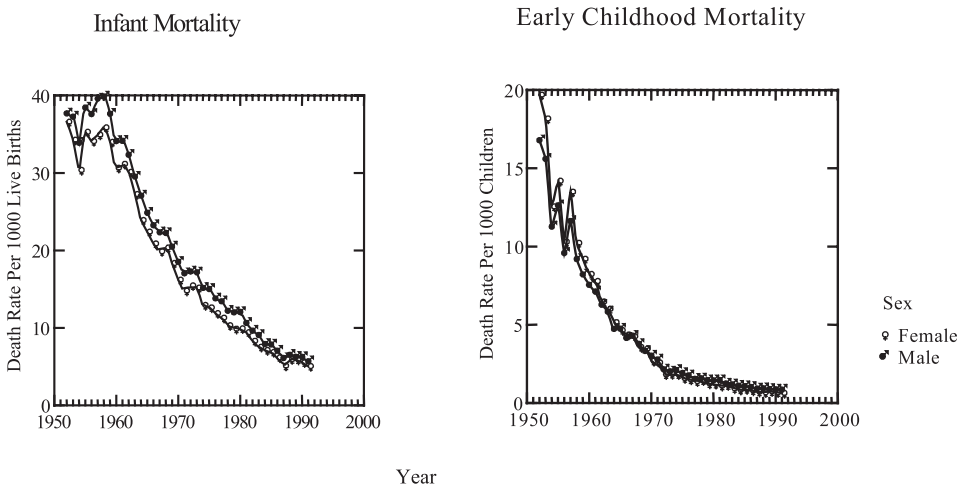

Fig. 1. Infant and early childhood mortality in Taiwan, 1952–1991 (Ministry of the Interior, 1992).

importance on a male heir, maintain patrilineal extended families as the ideal, and anticipate being cared for by a married son in old age (Lee & Sun, 1995). Liu (1980) points out, too, that despite increases in the number of residentially defined nuclear families, particularly in urban areas like Taipei, affiliations with larger extended families continue.

The present paper describes and evaluates within each study area associations between the gender of focal individuals, the number and gender of siblings, and their family's decision whether or not to have additional children. From these data the extent of, and variability in, son preference is inferred. This is believed possible because while contraceptives were widely available and in use at the time children considered here were born, prenatal sex determination and selective abortion were not generally available (Freedman *et al*., 1994).

Skinner's model for parental valuation of children will be judged using mean height, a useful cumulative measure of environment experienced. Males who do not have brothers are anticipated to be significantly taller than males who do, and among those that do, those earlier born should have an advantage. Girls' heights are expected to be positively associated with both the absence of older sisters and fewer brothers in their families. Fewer available resources at a family's disposal are expected to increase the impact of whatever differences in care there may have been thus making the contrasts just described more likely in the less affluent study area.

Subjects and methods

Issues were addressed using data from health records of children attending schools within portions of the Da-an and Songshan districts of Taipei. Schools in each study area provided matchable records for similar numbers of children: 200 females and 164 males in the Da-an area and 209 females and 200 males in the Songshan area.

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Table 1. Distribution of children according to study area and parental education level*

Study area	Highest level of formal education completed by parent					Total
	Primary school	Middle school	High school	Technical college	University & post-graduate	
Da-an	48 (13·2%)	35 (9·6%)	56 (15·4%)	92 (25·3%)	132 (36·4%)	363 (100%)
Songshan	164 (40·1%)	100 (24·5%)	86 (21·0%)	35 (8·6%)	24 (5·9%)	409 (100%)

$\chi^2 = 199{\cdot}4$, df=4, $p \leq 0{\cdot}0005$.
*91% of the records in Da-an, and 89% in Songshan, reported father's educational level.

One male in the Da-an area, who was much shorter than any of his peers (96 cm; $-4{\cdot}6$ Z), was excluded from analyses. He was one of only ten males within that study area who had both an older and younger brother and his inclusion dramatically inflated the height standard deviation of that group (8·2 cm vs 4·8 cm).

The relative excess of females in the Da-an study area occurred as one of the schools contributing information was not initially co-educational. To permit direct between-study-area comparisons, some analyses used a random subsample of about 85% of the females from the Da-an district (169/200) that equalized the male–female ratios. All of the children in this study were reported to be of southern Chinese ancestry, the large majority with families originally from Fujian Province, so mean differences in height among children of the same sex were assumed to represent environmental differences.

The children in the two areas, born in the years 1976 or 1977, had very similar mean ages and age distributions ($6{\cdot}39 \pm 0{\cdot}02$ years vs $6{\cdot}42 \pm 0{\cdot}02$ years). Height measurements were taken within a 1- or 2-week period at the beginning of the first semester of primary school by trained nurses using standardized equipment and techniques. No direct estimates of measurement error were available, however. Indirect estimates (Floyd, 1998, 2000) using a method outlined by van't Hof & Kowalski (1979) suggest only moderate levels of error. Socioeconomic and demographic information described here were self-reported by parents on school health records. Statistical tests were carried out using SYSTAT 6·0 (Wilkinson *et al*., 1994a, b).

The two study areas provided a variety of contrasts useful in the present context. Judging from fathers' data in most instances, families in the Da-an area were considerably more affluent. Table 1 shows that parents there were generally much better educated. Completion of at least a university education represented the modal level for Da-an parents (36·4%) while primary school completion was the modal level among parents in the Songshan study area (40·1%). Da-an parents were also much more likely to be employed in professional or public service occupations and much less likely to be involved in construction or manufacturing. A comparison of parental education by occupational category across the two areas revealed that within virtually all occupational categories Da-an parents were better educated. This and the variability with which parents reported actual occupations made parental education a

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Table 2. Distribution of children according to study area and their number of siblings

Study area	Number of siblings per child					Total
	Zero	One	Two	Three	Four+	
Da-an	21 (5·8%)	168 (46·2%)	120 (33·1%)	38 (10·5%)	16 (4·4%)	363 (100%)
Songshan	10 (2·4%)	80 (19·6%)	176 (43·0%)	95 (23·2%)	48 (11·7%)	409 (100%)

$\chi^2=83{\cdot}7$, df=4, $p<0{\cdot}0005$.

better indicator of socioeconomic status. Hou (1981) reports, too, that parental education is strongly associated with income in Taiwan, even when father's age, occupation, family origins, and public vs private sector employment have been statistically controlled.

Housing was chosen as another proxy for socioeconomic status because multi-story apartments or condominiums were generally newer and more desired than the majority of single-story dwellings (Liu, 1980). Housing units within these older single-story unreinforced masonry buildings in Taipei also had modest differences in sanitary facilities that may have influenced height (Census Office of the Executive Yuan, 1982). The Da-an study area had significantly more children residing in multi-story dwellings as compared with the Songshan study area (60·9% vs 47·9%; Fisher exact, $p<0{\cdot}0005$).

Numbers of siblings per child were also significantly greater in the Songshan area than in the Da-an study area (Table 2), though Songshan sibships were smaller than those common in rural townships (Freedman *et al.*, 1994). The modal number of sibs per child declined from two in the Songshan area (43·0% of children) to one in the Da-an area (47·2% of children). Although a variety of such useful contrasts were present between study areas, within each study area chi-squared tests revealed no significant confounding differences between boys and girls with regard to the distribution of parental education levels or occupational categories, residence in single or multi-story dwellings, or the gender of the parent being reported as contact person on the primary school health record.

Family planning preferences

The relative importance of sons was first evaluated in each study area through the pattern of increase in the ratio of females to males as children were ranked from those with no siblings to those with four or more. This assumed that when a child was born, their parents weighed the importance of achieving a desired gender configuration with the potentially conflicting goal of limiting completed family size. To the extent that families in an area favoured a son or sons, girls were anticipated to have more siblings than would be expected by chance alone. Following the same reasoning, an even greater gender imbalance was expected among children with no older brothers as their parents would have been more likely to continue having children than parents who already had at least one son. These patterns were examined within each area using

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Cochran's test of linear trend. As relatively few children of either gender had four or more siblings, they were grouped together to maintain adequate cell size. In each instance, Cochran's test evaluated the null hypothesis that across the ordered range of sibling numbers (from 0 to 4 or more) the slope of increase in the proportion of females was zero.

Family planning preferences were also evaluated using parity-stopping ratios according to gender composition of the first three children in applicable families. Relative satisfaction with various sibling sets may be judged by the percentage of parents who stopped having children at that point (Skinner, 1997). Because only the number and gender of older and younger siblings of focal children (those whose records were being used) were available, precise definition of siblings sets was possible in most, but not all cases. Among the Da-an families, 6·4% of the combinations could not be precisely identified. Because of larger sibships, this percentage rose to 15·4% for Songshan families. These uncertain sets were assigned randomly to the limited subset of possible combinations. Although the adjustments lowered stopping percentages modestly, they had almost no impact on overall patterns. Percentages by gender configuration were also reported for the families who had only one or two children.

Linear regression analyses of stature variation

A preliminary regression analysis was performed to identify or confirm significant aspects of children's growth-related environments, acting independently or interacting together. Height acted as the criterion variable with measurement age used as a covariate. Predictors considered included the main effects of study area, sex, parental education level, type of housing and birth order. Main effects and two-way interactions with study area were examined using an iterative forward stepping process that permitted the best model to be identified as judged by the amount of variance explained (multiple R^2) when using only statistically significant effects ($p \leq 0{\cdot}05$) that were not highly intercorrelated (tolerance>0·10). Because nine effects were initially included for consideration, the alpha levels for acceptance into the model were adjusted to maintain the 0·05 level using a sequentially rejective Bonferroni test (Holm, 1979). The independent influence of each effect was also examined after the covariate measurement age and the most significant effect, study area, had been introduced into the model. Residuals from the final model were normally distributed around zero with no outliers. While the specific effects identified require further validation using additional data, the relationships have been provisionally interpreted as reflecting growth influencing features in the children's environments that interacted with their genetic make-up.

Following the preliminary step just described, linear regression analyses were used to assess implications of Skinner's model. For each study area, male height was provisionally regressed on measurement age, parental education, housing, male birth order (a first or later born son), the presence of younger brothers, the presence of sisters, and a male birth order by younger brothers interaction effect. Results with the interaction effect and all predictors with $p \leq 0{\cdot}10$ were reported. Evaluation of expectations regarding female height in each area used a regression analysis that provisionally included measurement age, parental education and/or housing, female

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Table 3. The distribution of children with from zero to four or more siblings by area and gender

Study area	Sex of child	Number of siblings per child				
		Zero	One	Two	Three	Four+
Da-an*	Female	29·4%	46·8%	55·0%	58·8%	71·4%
	Male	70·6%	53·2%	45·0%	41·2%	28·6%
		$n=17$	$n=156$	$n=111$	$n=34$	$n=14$
Songshan†	Female	30·0%	38·8%	48·3%	60·0%	68·8%
	Male	70·0%	61·2%	51·7%	40·0%	31·2%
		$n=10$	$n=80$	$n=176$	$n=95$	$n=48$

Test statistics: *Cochran's linear trend=7·8, $p=0·005$; †Cochran's linear trend=16·1, $p<0·0005$. Da-an totals: 163 males, 169 females; Songshan totals: 200 males, 209 females.

birth order (first or later born), the number of brothers (0, 1 or 2 or more), the presence of younger sisters, and an interaction between female birth order and numbers of brothers. Categories such as presence of younger brothers or male birth order were collapsed to maintain cell size. It was generally appropriate because among those with older or younger siblings of a given sex, the large majority of individuals had only one sibling in a given category.

Results

Evidence of son bias in family planning preferences

Table 3 shows the results of Cochran's test among all children in each study area. In both areas, the probability of a child being female rose significantly as the number of siblings per child increased ($p \leq 0·005$). Differences between study areas mostly reflect the smaller sibships in the Da-an area. The slopes of increase in the percentage of females across sibling categories were similar: 9·63% and 9·88% for the Da-an and Songshan areas, respectively. The tendency for males to predominate among children with no more than the modal number of siblings was virtually the same: 54·9% (95/173) in the Da-an area and 55·3% (147/266) in the Songshan area.

Table 4 shows the even greater shifts in gender ratio expected as siblings per child rose among children without an older brother. Differences between the study areas were also accentuated. The upward shift in percentage of females from the modal sibling category to the next larger was particularly great in the Da-an area: 44·8% to 66·1%. The pattern of increase in the Songshan study area was more curvilinear with smaller increases among small siblings sets increasing progressively from sib category two to three and then four or more. This more curvilinear pattern among those without older brothers in the Songshan area was due in part to the increase in males relative to females in this subset of children, a change not seen in the Da-an area.

Table 5 reports that 47·9% (159/332) of the Da-an parents had three or more children as compared with 78·0% (319/409) of the Songshan parents. This is consistent

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Table 4. Among those without older brothers, the distribution of children with zero to four or more siblings

Study area	Sex of child	Number of siblings per child				
		Zero	One	Two	Three	Four+
Da-an*	Female	29·4%	44·8%	66·1%	56·3%	77·8%
	Male	70·6%	55·2%	33·9%	43·7%	22·2%
		$n=17$	$n=116$	$n=62$	$n=16$	$n=9$
Songshan†	Female	30·0%	36·5%	41·0%	56·0%	82·1%
	Male	70·0%	63·5%	59·0%	44·0%	17·9%
		$n=10$	$n=63$	$n=100$	$n=50$	$n=28$

Test statistics: *Cochran's linear trend=10·2, $p=0·001$; †Cochran's linear trend=17·8, $p<0·0005$. Da-an totals: 106 males, 114 females; Songshan totals: 133 males, 118 females.

Table 5. Stopping ratios by gender configuration at parity three for each study area

Study area	Percentage of total	Gender configuration		Percent stopping at three*
		Male	Female	
Da-an	47·9%	3	0	82·4% (14/17)
	(159/332)	2	1	82·0% (41/50)
		1	2	65·5% (38/58)
		0	3	52·9% (18/34)
Songshan	78·0%	3	0	66·7% (24/36)
	(319/409)	2	1	61·8% (76/123)
		1	2	53·7% (66/123)
		0	3	27·0% (10/37)

*Percentages calculated as the number of families with the specified offspring configuration who stopped at that point compared with all families with that configuration after three births.

with the noticeably higher percentages of Da-an parents who stopped at parity three across all gender configurations. Aside from differences in absolute value, patterns were similar. There is a clear bias for sons over daughters in both areas. While 82·0% (41/50) of the Da-an parents stopped if two sons and one daughter were present, only 65·5% (38/58) stopped if they had only one son. Among their Songshan counterparts comparable values were 61·8% (76/123) and 53·7% (66/123). In both study areas there was no significant difference in stopping percentage among those parents with three sons and those with two sons and a daughter, the former actually being a little higher in both areas. However, the probability that parents stopped after three children was significantly lower if they had three daughters as compared with two daughters and a son, particularly in the Songshan area (Fisher exact, $p=0·005$). The same bias towards sons existed among parents in the two areas who had no more than two

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Table 6. Results of stepwise regression analysis on height of Da-an and Songshan children

Source	Analysis of variance					
	Sum of squares	df	Mean square	*F* ratio	*p*	Tolerance*
Meaurement age	1395·9	1	1395·9	69·9	0·000	0·983
Study area	322·8	1	322·8	16·2	0·000	0·801
Parental education	248·6	1	248·6	12·4	0·000	0·781
Housing	153·7	1	153·7	7·7	0·006	0·937
Sex	138·0	1	138·0	6·9	0·009	0·996
Error	15,305·6	766	20·0			

Criterion variable, height; $N=772$; multiple $R=0{\cdot}387$; squared multiple $R=0{\cdot}149$.
*Tolerance is defined as one minus each predictor's multiple correlation with other predictor variables included in the model.

children. In the Da-an area 36·4% (63/173) had no daughters, but only 18·5% (32/173) had no sons. In the Songshan area the respective percentages were 35·6% (32/90) and 14·4% (13/90).

Evidence of growth-influencing factors

Results of the preliminary regression analysis (Table 6) showed that study area, parental education, type of housing and a child's sex were all significantly associated with height variation among these first-graders. Each effect that was eventually included in the full model was itself statistically significant when included in a reduced model with the predictor study area and covariate measurement age. This is consistent with the moderate to very high tolerance values (0·78 to 0·99) of effects used in the model. The stepwise process did reveal that differences in mean stature accounted for by study area diminished modestly when other predictors were included in the model, but it continued to be the single best predictor of stature, explaining about 4% of the total stature variance. Da-an children were, on average, about 1·4 cm taller than Songshan children ($116{\cdot}2 \pm 0{\cdot}3$ cm vs $114{\cdot}8 \pm 0{\cdot}2$ cm; $p<0{\cdot}0005$) with differences in sex, housing and parental education controlled.

With other variables held constant, the 418 children living in multi-story dwellings were 1·0 cm taller than the 354 living in single-story structures ($116{\cdot}0 \pm 0{\cdot}2$ cm vs $115{\cdot}0 \pm 0{\cdot}2$ cm; $p<0{\cdot}0005$). Higher parental educational level was also positively associated with stature ($p<0{\cdot}0005$). The increase was not monotonic across levels, however. There was a plateau effect so that only about 0·2–0·3 cm differences existed between the heights of children of primary- versus middle-school-educated parents or between those whose parents had high school or technical school degrees versus those with university undergraduate or graduate degrees. A 1·2 cm difference was found between the mean heights of children of 'less' well educated and 'better' educated parents ($114{\cdot}9 \pm 0{\cdot}3$ cm vs $116{\cdot}1 \pm 0{\cdot}2$ cm). There was also a statistically

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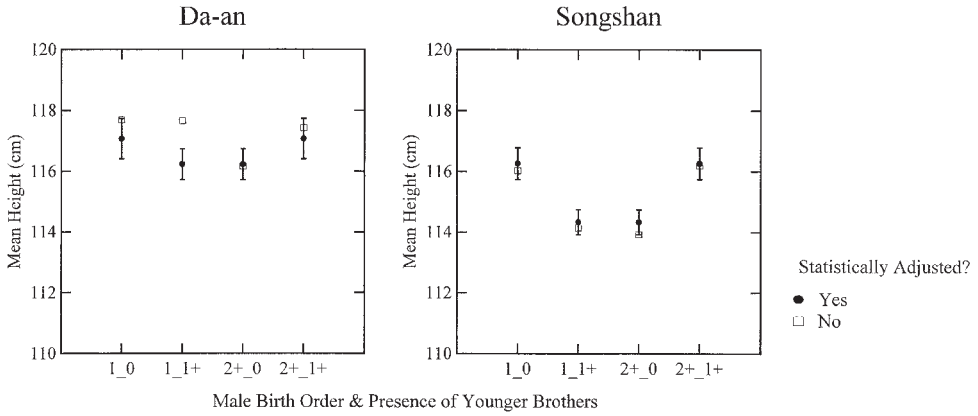

Fig. 2. Distribution of statistically adjusted (mean ± standard error) and unadjusted 6-year-old male heights by study area according to male birth order and presence of younger brothers. Cell sizes from left to right are: Da-an, 58, 49, 47, 9; Songshan, 61,72, 50, 17.

significant ($p=0{\cdot}009$) but smaller mean difference of 0·8 cm between males ($n=363$; $115{\cdot}9 \pm 0{\cdot}2$ cm) and females ($n=409$; $115{\cdot}1 \pm 0{\cdot}2$ cm) with other variables controlled.

Anthropometric evidence for and against Skinner's model

Regression analyses on male heights within each study area controlled for variation in measurement age ($p \leq 0{\cdot}001$), parental education (Da-an, $p=0{\cdot}003$; Songshan, $p=0{\cdot}021$), and housing (in the Songshan area, $p=0{\cdot}075$). Neither male birth order nor the presence of younger brothers was significant as main effects in either area. The presence of sisters, while having relatively little impact on male heights in the Songshan area, was significantly negatively associated with mean heights in the Da-an area ($p=0{\cdot}007$). The 86 boys with sisters were 2·1 cm shorter than the 77 without ($115{\cdot}6 \pm 0{\cdot}6$ cm vs $117{\cdot}7 \pm 0{\cdot}6$ cm). Further analysis shows that having older as opposed to younger sisters made relatively little difference; the 46 boys with only older sisters ($115{\cdot}4 \pm 0{\cdot}8$ cm) were only a little shorter, on average, than the 36 with only younger sisters ($115{\cdot}9 \pm 0{\cdot}9$ cm). The mean height of the four Da-an boys who had both older and younger sisters was $115{\cdot}1 \pm 2{\cdot}4$ cm.

Figure 2 reveals a curvilinear pattern to mean male heights in both study areas as the outcome of the male birth order by younger brothers interaction effect. Males without brothers, or with both younger and older brothers, were taller on average. In the Da-an area the 0·9 cm 'dip' produced by the interaction effect was not statistically significant ($p=0{\cdot}28$), and only appeared when the presence of sisters was included as a predictor variable. Figure 3 further shows the impact of sisters on the interaction effect in this area. The 77 boys with no sisters are tall on average, with less than 0·1 cm difference in mean height when grouped by male birth order and presence of younger brothers (117·8 cm vs 117·7 cm). The 'dip' noted earlier was restricted to Da-an boys with sisters. Among them, the 46 males with no brothers had a mean

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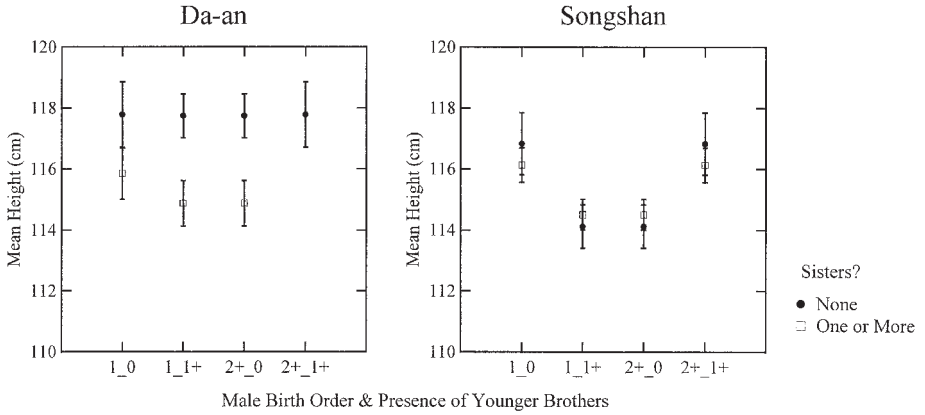

Fig. 3. Distribution of statistically adjusted male heights (mean ± standard error) by study area according to 6-year-old male birth order, presence of younger brothers and presence of sisters. Cell sizes from left to right are: Da-an, with and (without) sisters, 46 (12), 17 (32), 23 (24), 0 (9); Songshan, 54 (7), 46 (26), 35 (15), 5 (12).

height of 115·9 cm. Those 40 males with both brothers and sisters were about 1·0 cm shorter.

In the Songshan area the interaction effect shown in Fig. 2 was significant ($p=0{\cdot}002$) and quite similar with or without statistical control of other variables. The 61 first-born males with no younger brothers were significantly taller ($116{\cdot}3 \pm 0{\cdot}5$ cm) than the 72 first-born males with younger brothers ($114{\cdot}3 \pm 0{\cdot}4$ cm) and the 50 last-born sons with older brothers ($114{\cdot}3 \pm 0{\cdot}4$ cm). Curiously, the seventeen boys who had at least one older brother and a younger brother were as tall, on average, as those without brothers.

Expectations that girls' heights were positively associated with the absence of older sisters and fewer brothers in their families were not generally fulfilled. While significantly influenced by measurement age ($p \leq 0{\cdot}0005$) and parental education ($p=0{\cdot}008$), Da-an girls' heights were not significantly affected by being first or later born in the sister series, the presence of younger sisters, or the interaction between female birth order and the number of brothers (Fig. 4). In the Songshan study area, while girls' heights were not significantly associated with parental education, or the presence of younger sisters, girls mean heights were significantly associated with measurement age ($p \leq 0{\cdot}0005$) and housing ($p=0{\cdot}030$) and there was a significant interaction effect between female birth order and the number of brothers ($p=0{\cdot}038$).

The statistically significant effect just noted was not, however, consistently in the predicted direction (Fig. 4). The sixteen girls first in the female birth order with no brothers were relatively short on average ($113{\cdot}6 \pm 0{\cdot}6$ cm). Those 56 girls first in the female birth order with one brother were, on average, taller than the 52 with two or more brothers ($115{\cdot}3 \pm 0{\cdot}5$ cm vs $114{\cdot}0 \pm 0{\cdot}5$ cm). A somewhat similar pattern is found repeated among girls who are second or higher in the female birth order; the fifteen with no brothers ($115{\cdot}0 \pm 0{\cdot}5$ cm) are taller than the 43 with one brother ($113{\cdot}3 \pm 0{\cdot}5$ cm). However, the 27 girls second or higher in the female birth order who had two or more brothers ($114{\cdot}5 \pm 0{\cdot}5$ cm) were not as short as those with only one.

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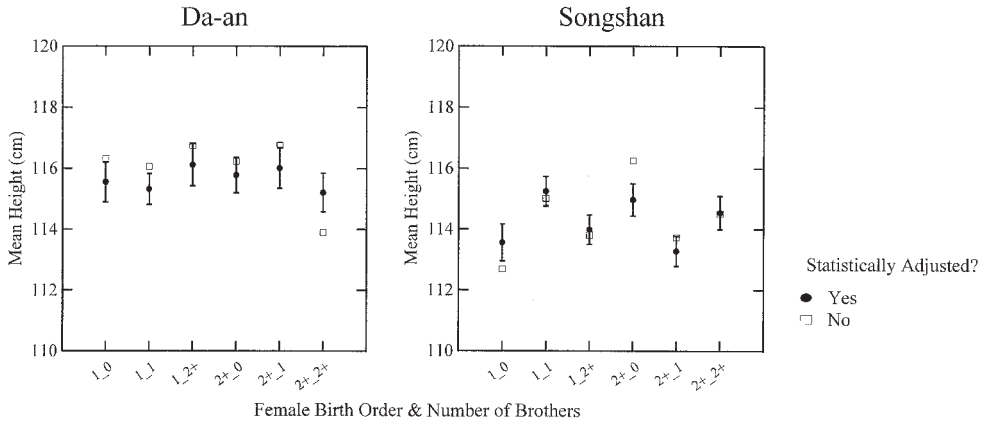

Fig. 4. Distribution of statistically adjusted (mean ± standard error) and unadjusted 6-year-old female heights by study area according to female birth order and number of brothers. Cell sizes from left to right are: Da-an, 34, 75, 22, 36, 23, 10; Songshan, 16, 56, 52, 15, 43, 27.

Discussion

Coombs & Sun (1978) conclude that family size and gender preferences in family planning may be distinguished as influences altering the demography of Taiwanese society. Using a survey strategy that they claim disentangles preferences towards family size from those towards gender configuration, they argue that while parental background (education, income, occupation, urbanization and ethnic differences related to arrival times in Taiwan) significantly shaped family size preferences, it has had much less impact on bias favouring sons. Evidence from the two study areas in Taipei reported on here agrees closely with this conclusion. A significant negative association between parental education and number of children is found within both the Da-an ($p \leq 0{\cdot}0005$) and Songshan areas ($p = 0{\cdot}011$). A noticeably higher percentage of parents with two or fewer children and uniformly higher parity-stopping frequencies at parity three across all gender configurations (Table 5) reflect preference for fewer children among Da-an parents as compared with parents in the Songshan area. But the results also reveal that preference for sons clearly influenced gender composition among many of the families in both study areas, even among parents who had two or fewer offspring. Among this subset, about twice as many accepted having no daughters as having no sons. Tables 3 and 4 show, too, that across the range of siblings per child, females made up a progressively higher percentage in both study areas whether all children were considered or just those without older brothers.

Relatively greater desire to limit family size among the better-educated parents in the Da-an area may have moderated son bias somewhat. Assuming that one-half of the families with a configuration of two daughters and one son at parity three (Table 5) were without a son at parity two, it may be estimated that about 30% (27/90) of the parity two Da-an parents stopped without having a son. This estimate was only about 9% (10/109) among Songshan parents. At parity three, over half (52·9%) of the

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Da-an parents with no sons stopped having children, while only 27% of Songshan parents with no sons stopped (Table 5).

Preference for sons in Taiwan appears socially conservative, being modified but not substantially reduced by dramatic socioeconomic and demographic change beginning in the late 1950s. This is consistent with the continued strength of the patrilineal kinship system among Taiwanese (Weinstein *et al*., 1990). However, along with nearly unprecedented economic growth and expanding educational opportunities have come major changes in health care, housing and diet (Fei *et al*., 1979; Galenson, 1979; Hermalin *et al*., 1994). Infant and early childhood mortality rates plummeted as public health improved (Fig. 1). Improvements in prenatal and perinatal care are associated with substantial declines in infant mortality beginning in about 1960. Particularly noticeably at this time are the relatively greater declines in male deaths. This may reflect their greater inherent vulnerability and the relatively greater advantage to them of improvements in health care.

Decline in early childhood mortality reflects a somewhat different pattern. As Fig. 1 reveals, mortality rates of 1- to 4-year-old girls were consistently higher than for boys until the early 1960s. Similar findings from other societies with strong male preference, as in Mainland China, India and Bangladesh (Chen, Huq & D'Souza, 1981; Das Gupta, 1987; Muhuri & Preston, 1991; Goodkind, 1996), have been interpreted as evidence of female discrimination. In Taiwan, however, since the beginning of the 1970s, female early childhood mortality has consistently been slightly below that for males (Ministry of the Interior, 1992). Also according to government statistics, female enrolment in middle and high school rose more rapidly than male enrolment during the 1960s and 1970s so that by the early 1980s equivalent enrolment levels had been achieved (Statistical Yearbooks of the Republic of China, 1977–1992). These suggest that the preference for a son and gender-biased behaviour in other spheres may not be closely associated under the changing circumstances in Taiwan. If gender-related biases towards children continued to exist at all, they did not produce differences in nutrition and health care large enough to influence mortality risk.

Results of regression analyses on male heights in the two study areas suggest stature variation may be associated with sibship gender configuration, but in some ways not initially anticipated based upon the author's initial interpretation of Skinner's hypothesis. As seen in Fig. 2, brother-less males are taller, on average, than those who have at least one younger or one older brother and the difference is more pronounced in the less affluent Songshan area ($\Delta = 2{\cdot}0$ cm, $p = 0{\cdot}002$). This is consistent with the initial hypothesis. However, in both areas, the few boys with both older and younger brothers are relatively tall for their respective areas. In the Da-an area, the nine boys who have both an older and younger brother have an unadjusted average height of $117{\cdot}4 \pm 1{\cdot}6$ cm. Their seventeen Songshan counterparts have an unadjusted mean of $116{\cdot}2 \pm 0{\cdot}8$ cm. These values are not consistent with initial expectations, but may be speculated to relate to common familial circumstances. None of the nine Da-an boys, and only five of the seventeen Songshan boys, have sisters. These ratios are unusual as compared with those for other males in each area (Fisher exact, $p \leq 0{\cdot}001$).

The absence of sisters may be associated with greater mean height, at least within the Da-an area. Only the 86 Da-an males with sisters appeared to be influenced by male birth order and the presence of younger brothers; the 77 without sisters were

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consistently rather tall (Fig. 3). The impact of sisters on male height in the Da-an area is not a statistical artifact. Unadjusted values indicate that those with sisters are consistently shorter than those without in each category. The extent of difference is also similar to that shown in Fig. 3, with the smallest unadjusted difference of 1·0 cm being found among those first-born males with no younger brothers. The greater unadjusted differences of 3·0 cm and 2·1 cm occurred among males with younger brothers or older brothers, respectively. No clear association between mean stature and the presence of sisters was found in the Songshan area. This may be, in part, because of small numbers of sister-less Songshan boys, but the influence of sisters on male height does appear to be somewhat different in the two areas.

As already noted, stature data from girls does not generally support Skinner's hypothesis as initially interpreted. As indicated in Fig. 4, mean height of girls in the Da-an area varied relatively little, from $116{\cdot}1 \pm 0{\cdot}7$ cm among the 22 who were first in the female birth series with two brothers to $115{\cdot}2 \pm 0{\cdot}6$ cm among the ten who were later in the female series but with a similar number of male sibs. Unadjusted values follow a similar, though slightly more exaggerated pattern. In the Songshan area a significant interaction effect between female birth order and number of brothers was identified ($p = 0{\cdot}038$), but contrary to Skinner's hypothesis, the sixteen girls born first who had no brothers were relatively short ($113{\cdot}6 \pm 0{\cdot}6$ cm). One may speculate that these girls were from less well-off families. Absence of a brother when the girl was first born may indicate less than average socioeconomic circumstances in the Songshan, but not the Da-an area, given differences in parental attitude about family size and the relative importance of sons. Most other aspects of mean female height variation in the Songshan area are consistent with the view that for a given position in the female birth order, girls with fewer brothers were better off. As shown in Fig. 4, this is true of both adjusted and unadjusted data. A final exception, however, is that among the 27 girls with both older sisters and two or more brothers, mean stature of $114{\cdot}5 \pm 0{\cdot}5$ cm is greater than would be expected.

Though largely speculative, a model that considers inter-relationships among variation in attitudes about a child's gender, sibship gender configuration and sex-based differences in inherent vulnerability to specific circumstances may help account for the patterns identified here. For example, more egalitarian attitudes about gender may have led parents (or other care-givers) in the Da-an area to treat daughters, frequently first born in the female series, in ways that enhanced stature. The pattern of mean heights in the Da-an area hint that females were buffered from the presence of brothers, unlike their Songshan counterparts. Relatively greater percentage of resources directed towards daughters in the Da-an area may also help account for the patterning of mean male heights. Songshan males do not appear to be directly influenced by the presence of sisters, but those with brothers clearly faired less well judging from mean stature than those without ($p = 0{\cdot}002$). In the Da-an area, only males with sisters appeared to be influenced by the presence of older or younger brothers. Alternatively, sister-less Da-an males may well have come from families that succeeded in both limiting family size and meeting their ideal gender configuration. The greater variation in mean male height relative to female height hints at greater inherent male vulnerability to factors affecting statural growth. Unfortunately, given limited information, this study is unable to effectively distinguish inherent differences

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in sensitivity to environmental stressors from culturally mediated differences in environment. As Stinson (1985) has pointed out, a greater understanding of the actual environments being experienced is key.

A more complete evaluation of possible relationships between parental attitudes, socioeconomic background, number and sex of siblings and children's growth requires more detailed knowledge of individual families and their members. Clearer assessment of socioeconomic backgrounds could be accomplished retrospectively using additional information about occupations, housing and lifestyle. Knowledge of mothers' occupations and household activities, how these changed during the first several years of each child's life, and who else helped care for each child might be particularly useful. Waldmann *et al*. (1977) notes that in Hong Kong among families where the primary care-giver was an older female relative, rather than the mother, the skeletal age of preschool males was significantly more advanced than that of females. This was not the case when the mother was the primary care-giver. Because women are more likely to be living with their husband's parents early in their marriage, this may have greater influence on the first one or two children born. Clearer contrasts in the present data might be found if such information were collected. Birth spacing and relative ages of older and younger siblings are important considerations as well. Sons with one or more younger brothers in the Songshan study area may have been shorter because of relatively shorter birth intervals and greater indirect competition with younger siblings. Finally, knowledge of parents' and siblings' heights could help statistically reduce unaccounted for variability, and increase the chance of meaningful differences being detected.

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References

Census Office of the Executive Yuan (1982) *The 1980 Census of Population and Housing, Taiwan-Fukien Area, R.O.C.*, Vol. 3. Population and Housing, Taipei Municipality, June.

Chen, L. C., Huq, E. & D'Souza, S. (1981) Sex bias in the family allocation of food and health care in rural Bangladesh. *Popul. Dev. Rev*. **7**, 55–70.

Coombs, L. C. & Sun, T. H. (1978) Family composition preferences in a developing culture: the case of Taiwan, 1973. *Popul. Stud.* **32**, 43–64.

Das Gupta, M. (1987) Selective discrimination against female children in rural Punjab, India. *Popul. Dev. Rev.* **13**, 77–100.

Fei, J. C. H., Ranis, G. & Kuo, S. W. Y. (1979) *Growth with Equity: The Taiwan Case.* Oxford University Press, Oxford.

Floyd, B. (1998) The contribution of adolescent growth to shorter adult statures among girls of Chinese ancestry. *Am. J. hum. Biol.* **10**, 735–746.

https://doi.org/10.1017/S0021932003003699 Published online by Cambridge University Press

Floyd, B. (2000) Can socioeconomic factors account for 'atypical' correlations between the timing, peak velocity, and intensity of adolescent growth in Taiwan? *Am. J. hum. Biol.* **12**, 102–117.

Freedman, R., Chang, M. C., Sun, T. H. & Weinstein, M. (1994) The fertility transition in Taiwan. In: *Social Change and the Family in Taiwan,* pp. 264–304. Edited by A. Thornton & H-S. Lin. University of Chicago Press, Chicago and London.

Galenson, W. (1979) *Economic Growth and Structural Change in Taiwan: The Postwar Experience of the Republic of China.* Cornell University Press, Ithaca and London.

Goodkind, D. (1996) On substituting sex preference strategies in East Asia: does prenatal sex selection reduce postnatal discrimination? *Popul. Dev. Rev.* **22**, 111–125.

Hermalin, A., Liu, P. K. C. & Freedman, D. (1994) The social and economic transformation of Taiwan. In: *Social Change and the Family in Taiwan,* pp. 49–87. Edited by A. Thornton & H-S. Lin. University of Chicago Press, Chicago and London.

Hof, van't M. A. & Kowalski, C. J. (1979) Analysis of mixed-longitudinal data sets. In: *A Mixed-Longitudinal Interdisciplinary Study of Growth and Development*, pp. 161–172. Edited by B. Prahl-Anderson, C. J. Kowalski & P. Heydendael. Academic Press, New York.

Holm, S. (1979) Simple sequentially rejective multiple test procedure. *Scand. J. Stats.* **6**, 65–70.

Hou, C. M. (1981) Education, manpower and growth with equity: the case of Taiwan. *Econ. Rev.* **207**, 14–26.

Lee, M. L. & Sun, T. H. (1995) The family and demography in contemporary Taiwan. *J. comp. Fam. Stud.* **26**, 101–115.

Liu, J. K. C. (1980) *Housing Transformations: A Study of Family Life and Built Form in Taiwan.* Doctoral Dissertation, University of California, Berkeley.

Ministry of the Interior (1992) *1991 Taiwan–Fukien Demographic Fact Book, Republic of China*. Taiwan, China.

Muhuri, P. K. & Preston, S. H. (1991) Effects of family composition on mortality differentials by sex among children in Matlab, Bangladesh. *Popul. Dev. Rev.* **17**, 415–434.

Park, C. B. & Cho, N. H. (1995) Consequences of son preference in a low-fertility society: imbalance of the sex ratio at birth in Korea. *Popul. Dev. Rev*. **21**, 59–84.

Skinner, G. W. (1997) Family systems and demographic processes. In: *Anthropological Demography: Toward a New Synthesis*, pp. 53–95. Edited by D. Kertzer & T. Fricke. University of Chicago Press, Chicago and London.

Statistical Yearbooks of the Republic of China (1977–1992) *Taipei: Directorate-General of Budget, Accounting and Statistics*. Executive Yuan, Republic of China.

Stinson, S. (1985) Sex differences in environmental sensitivity during growth and development. *Yrbk Phys. Anthropol.* **28,** 123–147.

Waldmann, E., Baber, F. M., Field, C. E., Billewicz, W. Z. & Thomson, A. M. (1977) Skeletal maturation of Hong Kong Chinese children in the first five years of life. *Ann. hum. Biol.* **4**, 343–352.

Weinstein, M., Sun, T. H., Chang, M. C. & Freedman, R. (1990) Household composition, extended kinship, and reproduction in Taiwan: 1965–1985. *Popul. Stud.* **44**, 217–239.

Wilkinson, L., Hill, M. A., Howe, P., Birkenbeuel, G., Beck, J. & Liu, J. (1994a) *SYSTAT for DOS: Using SYSTAT, Version 6 Edition*, p. 871. SYSTAT Inc., Evanston, IL.

Wilkinson, L., Hill, M. A., Howe, P., Birkenbeuel, G., Beck, J. & Liu, J. (1994b) *SYSTAT for DOS: Advanced Applications, Version 6 Edition*, p. 902. SYSTAT Inc., Evanston, IL.

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