RESEARCH REPORT

Household crowding index: a correlate of socioeconomic status and inter-pregnancy spacing in an urban setting

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Objectives: This paper examines the effect of household crowding on inter-pregnancy spacing and its association with socioeconomic indicators, among parous mothers delivered in an urban environment.
Design: Cross sectional survey.
Methods: Sociodemographic data were obtained on 2466 parous women delivering at eight hospitals in Greater Beirut over a one year period. Statistical methodology comprised Pearson χ^2 test and logistic regression analysis.
Main results: A significant inverse relation was observed between household crowding and socioeconomic status, defined as education and occupation of women and their spouses. Inter-pregnancy spacing increased with higher levels of crowding. Further analysis suggested that this positive association was confounded by maternal demographic characteristics.
Conclusions: These data have shown that household crowding, a correlate of low parental socioeconomic status, is associated with longer birth intervals. This association, however, seems to be largely explained by maternal age and parity.

Household density has long been viewed as both an indicator of low socioeconomic status and as a stressful situation associated with high morbidity and mortality risks. Several decades of research have correlated a high household crowding index, denoted by the number of co-residents per room, with socioeconomically deprived urban communities and a wide range of pathological health outcomes.[1–11] Previous studies have shown a cumulative effect of household crowding through an increased incidence of chronic conditions[12 13] as well as higher perinatal[14] and old age[15] mortality rates. Domestic crowding was shown to impact on psychological wellbeing,[3 16] violent behaviour,[1 17] and injuries.[18] Patterson suggested a protective effect of crowding on the incidence of insulin dependent diabetes mellitus.[19] Others found no effect of household density on morbid behaviour[1] or adverse birth outcome.[20]

Studies relating household crowding and reproduction[21–24] are comparatively scarce. Ethological research using experimental animals suggested that crowded environments promote aberrant forms of sexual behaviour ranging from complete abstinence to hypersexuality accompanied by a decline in successful reproduction.[1 2 25] Correlational studies in various sociocultural settings, including North America and the Far East, have associated household crowding with psychological stress among co-residents.[25] The latter was associated with a decreased sense of privacy thereby affecting most aspects of daily life, including sexual activity, reproduction, and the use of contraceptive methods.[25] Nevertheless, the impact of household crowding on fertility in human populations is still controversial. Johnson and Booth reported no influence of neighbourhood or household crowding on the probability of pregnancy and infant survival.[22] Edwards found only modest and selective effects of objective and subjective crowding on sexual and reproductive behaviour among Bangkok city dwellers.[24] A community based study by Fikree and Berendes reported a higher risk for intrauterine growth retardation in the context of poor housing conditions in Pakistan,[26] while another by Kieffer found no association between objective crowding and the prevalence of low birth weight in Hawaii.[20]

Another measure of reproductive health and behaviour with many policy implications is inter-pregnancy spacing. Previous studies found that short as well as long inter-pregnancy spacing increase the risk of adverse pregnancy outcomes, affecting child survival and wellbeing.[27–30] Thus, it is important to look at background characteristics that might increase inter-pregnancy spacing to an optimal range (usually 18–23 months), thus reducing the incidence of these adverse outcomes.[28] In addition, short inter-pregnancy spacing is associated with high fertility. According to the economic theory of fertility, fertility is inversely correlated with ''child quality'',[31] thus diminishing the resources provided to the individual child as well as their siblings and parents. A number of demographic and socioeconomic characteristics have been shown to affect inter-pregnancy spacing, the most frequently reported being maternal age,[28–30] socioeconomic status (educational and occupational characteristics),[28–30] and reproductive history (parity).[31]

This study was conducted among parous women delivering at medical care centres in Beirut. The main objectives of this study are to correlate household crowding with maternal and paternal socioeconomic characteristics and to assess the impact of household crowding on inter-pregnancy spacing, before and after controlling for demographic and socioeconomic factors. To our knowledge, this is the first study of its kind to be conducted in the Lebanon region that looks at household crowding as a potential predictor of inter-pregnancy spacing. Based on previous findings in the literature, we expect household crowding to have a negative impact on fertility leading to longer birth intervals.

Abbreviations: NCPNN, National Collaborative Perinatal Neonatal Network; HCI, household crowding index

METHODS

Study design

This study is based on a cross sectional survey conducted by the National Collaborative Perinatal Neonatal Network (NCPNN). Data on all newborn admissions and their mothers were collected prospectively at eight NCPNN hospitals between 1 April 2000 and 31 March 2001. These hospitals were randomly selected from a pool of 30 major healthcare institutions in Beirut, Lebanon. Households served by NCPNN hospitals come from a wide range of socioeconomic backgrounds and are mainly concentrated in the urban and suburban areas of Beirut. The units of observation were comprised of consecutive singleton live births registered to parous mothers at these eight NCPNN centres. Miscarriages and late fetal deaths were not considered in the study design. All women who were approached for an interview agreed to participate. Analysis was restricted to 2466 infants after the exclusion of cases delivered to nulliparous mothers (n = 2912) and those identified as multiple pregnancies (n = 376). The NCPNN database project was reviewed and approved by the ethics committee of an institutional review board at the American University of Beirut.

Study instrument

Research assistants, nurses, and midwives collected data prospectively using a standardised questionnaire. Data sources included direct interviews with admitted mothers as well as obstetric and nursery charts. The questionnaire inquired about sociodemographic, lifestyle, and fertility characteristics of maternal subjects.

Variable definitions

The last inter-pregnancy spacing was defined, among parous mothers, as the number of months between last and current delivery. In addition, short spacing was defined as less than 24 months between consecutive births.[27–30] The household crowding index (HCI) was defined as the total number of co-residents per household, excluding the newborn infant, divided by the total number of rooms, excluding the kitchen and bathrooms. The continuous variable was re-grouped into three distinct categories: (1) <1, (2) 1–2, and (3) >2 residents per room. In addition to HCI, hypothesised determinants of inter-pregnancy spacing were the following[28–30]: mother's age at delivery, parity, education and work status as well as father's education and occupation.

Age at delivery, in years, was classified into five categories with the lower category being <20 and the upper category being 35+ years. Based on the number of previous live births, women were labelled as either para I or para II+. Mother's and father's educational categories were regrouped into the following categories: (1) illiterate to primary, (2) intermediate to secondary, and (3) technical or higher. With regard to work status, women were identified as: (1) never worked, (2) worked previously, and (3) currently working. Social class was defined according to father's occupation grouped into seven different categories, with the highest including ''legislators, senior officials, and managers'' whereas the lowest category included ''unskilled workers''. Unemployed fathers were considered as a separate group.

Maternal age and parity were treated as control variables. On the other hand, socioeconomic characteristics may either be conceptualised as confounding (partially or wholly

Key points

- Household crowding is negatively associated with parental socioeconomic characteristics in an urban setting.
- A positive association exists between household crowding and inter-pregnancy spacing, which is partially explained by maternal age and parity.

Table 1 Socioeconomic correlates of household crowding index* among parous mothers

	Crowding index			
	Total	<1	1–2	>2
	Nimber (%)	Number (%)	Number (%)	Number (%)
Total	2466 (100)	1158 (47.0)	1097 (44.5)	211 (8.6)
Maternal				
Education				
Illiterate to primary	324 (13.3)	35 (3.1)	172 (15.9)	117 (56.0)
Intermediate to secondary	1049 (43.1)	367 (32.1)	601 (55.6)	81 (38.8)
Technical or higher	1060 (43.6)	742 (64.9)	307 (28.4)	11 (5.3)
			p<0.001†	
Work status				
Never worked	1366 (55.4)	422 (38.2)	735 (67.0)	189 (89.6)
Worked previously	589 (23.9)	359 (31.0)	217 (19.8)	13 (6.2)
Currently working	511 (20.7)	357 (30.8)	145 (13.2)	9 (4.3)
			p<0.001†	
Paternal				
Education				
Illiterate to primary	294 (12.2)	22 (1.9)	177 (16.4)	95 (46.1)
Intermediate to secondary	879 (36.4)	293 (25.8)	502 (46.6)	84 (40.8)
Technical or higher	1245 (51.5)	819 (72.2)	399 (37.0)	27 (13.1)
			p<0.001†	
Occupation				
Legislators, senior officials, and managers	296 (12.6)	188 (17.1)	102 (9.8)	6 (2.9)
Professionals	352 (15.0)	271 (24.7)	77 (7.4)	4 (2.0)
Technicians and associate professionals	880 (37.6)	415 (37.8)	396 (38.1)	69 (33.7)
Clerical and sales workers	367 (15.7)	125 (11.4)	197 (19.0)	45 (22.0)
Skilled workers	183 (7.8)	51 (4.6)	105 (10.1)	27 (13.2)
Unskilled workers	243 (10.4)	43 (3.9)	150 (14.4)	50 (24.4)
Unemployed	20 (0.9)	4 (0.4)	12 (1.2)	4 (2.0)
			p<0.001†	

*Number of co-residents (excluding newborn) divided by number of rooms (excluding kitchen and bathrooms). †χ^2 Test.

accounting for the observed effect of HCI on inter-pregnancy spacing) or mediating (in the causal pathway between HCI and inter-pregnancy spacing) factors.

Statistical analysis

All statistical analyses were conducted using the Satistical Package for Social Sciences version 11.0.[32] Bivariate associations were assessed using Pearson χ^2 test at a 5% level of significance. All p values were two tailed. The net effect of HCI on inter-pregnancy spacing, after controlling for potential confounding factors, was assessed through multiple logistic regression analysis.

RESULTS

Sociodemographic characteristics

A total of 2466 parous mothers delivered at eight centres were considered for this study. The mean (SD) age at delivery was 30.7 (5.2), ranging between 16 and 52 years. Most mothers (72.9%) were between 20 and 34 years of age, whereas teenage (<20 years) and elderly mothers (35+ years) represented 0.8% and 26.3% of the population, respectively. Parity or the number of previous live births was distributed as follows: para I (48.9%), II+ (51.1%). Around 44% of mothers and 52% of fathers had technical or university levels of education. More than half of the interviewed mothers (55.4%) had never worked, while 23.9% worked previously and 20.7% reported working during pregnancy. The distribution of mothers by their spouse's occupation indicated a comparatively high proportion within the categories of ''technicians and associate professionals'' (37.6%) and ''clerical and sales workers'' (15.7%).

Household crowding index: a correlate of parental socioeconomic status

Table 1 presents HCI by socioeconomic characteristics among parous women. The mean (SD) crowding index was 1.1 (0.8), whereby 53.1% had HCI ⩾1, and 8.6% had HCI >2. HCI decreased as we moved from low to high socioeconomic status. This graded inverse relation was evident for all four socioeconomic indicators. For instance, the proportion having HCI >2 was highest in the illiterate to primary group of mothers (56.0%) and fathers (46.1%). Mothers who worked

Table 2 Socioeconomic and demographic predictors of birth spacing* among parous mothers

	Inter-pregnancy spacing		
	Total	<24 months	⩾24 months
	Number (%)	Number (%)	Number (%)
Total	2466 (100)	638 (25.9)	1828 (74.1)
Household			
Crowding index†			
<1	1158 (46.9)	325 (50.9)	833 (45.6)
1–2	1097 (44.4)	266 (41.7)	831 (45.5)
>2	211 (8.6)	47 (7.4)	164 (9.0)
		p=0.054‡	
Maternal			
Age at delivery			
<25	297 (12.3)	143 (23.0)	154 (8.6)
25–29	702 (29.3)	228 (36.6)	474 (26.7)
30–34	819 (34.1)	158 (25.4)	661 (37.2)
35+	582 (24.3)	94 (15.1)	488 (27.5)
		p<0.001‡	
Education			
Illiterate to primary	324 (13.3)	82 (13.0)	242 (13.4)
Intermediate to secondary	1049 (43.1)	271 (43.1)	778 (43.1)
Technical or higher	1060 (43.6)	276 (43.9)	784 (43.5)
		p=0.97‡	
Work status			
Never worked	1366 (55.4)	376 (58.9)	990 (54.2)
Worked previously	589 (23.9)	138 (21.6)	451 (24.7)
Currently working	511 (20.7)	124 (19.4)	387 (21.2)
		p=0.11‡	
Parity			
I	1207 (48.9)	399 (62.5)	808 (44.2)
II+	1259 (51.1)	239 (37.5)	1020 (55.8)
		p<0.001‡	
Paternal			
Education			
Illiterate to primary	294 (12.2)	76 (12.2)	218 (12.2)
Intermediate to secondary	879 (36.3)	228 (36.5)	651 (36.3)
Technical or higher	1245 (51.5)	321 (51.4)	924 (51.5)
		0.99‡	
Occupation			
Legislators, senior officials, and managers	296 (12.6)	80 (13.1)	216 (12.5)
Professionals	352 (15.0)	80 (13.1)	272 (15.7)
Technicians and associate professionals	880 (37.6)	224 (36.7)	656 (37.9)
Clerical and sales workers	367 (15.7)	103 (16.9)	264 (15.3)
Skilled workers	183 (7.8)	58 (9.5)	125 (7.2)
Unskilled workers	243 (10.4)	62 (10.1)	181 (10.5)
Unemployed	20 (0.9)	4 (0.7)	16 (0.9)
		0.37‡	

*Number of months between last and current pregnancy. †Number of co-residents (excluding newborn) divided by number of rooms (excluding kitchen and bathrooms). ‡χ^2 Test.

Table 3 Multiple logistic regression models for household crowding index as a predictor of birth spacing above 24 months

	Crude		Adjusted	
	OR	95% CI	OR	95% CI
Crowding index				
<1	1.00		1.00	
1–2	1.22	1.01 to 1.47	1.06	0.85 to 1.32
>2	1.36	0.96 to 1.93	0.94	0.63 to 1.41
Maternal age at delivery				
<25	1.00			
25–29	1.94	1.49 to 2.52	1.86	1.42 to 2.45
30–34	3.62	2.79 to 4.71	3.27	2.46 to 4.35
35+	4.49	3.35 to 6.03	3.70	2.68 to 5.11
Maternal parity				
I	1.00		1.00	
II+	2.11	1.75 to 2.53	1.64	1.29 to 2.06
Maternal work status				
Never worked	1.00		1.00	
Worked previously	1.24	0.99 to 1.55	1.08	0.84 to 1.39
Currently working	1.18	0.94 to 1.49	0.97	0.74 to 1.27

during pregnancy were less likely to report a high crowding index (HCI >2: 4.3%) as compared with either those who worked previously (6.2%) or those who never worked (89.6%). Similarly, social class determined by paternal occupation correlated negatively with HCI.

Household crowding index and other sociodemographic predictors of birth spacing

Table 2 presents the socioeconomic and demographic characteristics of parous mothers by inter-pregnancy spacing. Overall, 74.1% of mothers spaced at least 24 months between the last and current pregnancy with a mean (SD) birth interval of 40.9 (28.5) months and a range of nine months to 22 years between consecutive pregnancies. Short inter-pregnancy spacing correlated significantly ($p < 0.001$) with low parity and young age at delivery. Whereas a borderline positive relation between HCI and birth spacing was reported, associations between the birth spacing and SES indicators did not reach statistical significance.

Multivariate analysis

Table 3 presents logistic regression analysis for the effect of HCI on inter-pregnancy spacing before and after adjusting for potential confounders. Covariates in the logistic regression model were limited to those variables that showed at least borderline significance in their association with birth spacing. A positive association was observed between HCI and inter-pregnancy spacing, before adjustment for maternal age, parity, and work status. In particular, women who reported living in households with one to two people per room were significantly more likely to delay pregnancy beyond two years (OR = 1.2, 95% CI: 1.0 to 1.5), when compared with those reporting an HCI <1. The effect of HCI >2 on birth spacing did not reach statistical significance. However, after adjustment for confounders in the multiple logistic regression, the only significant predictors of long inter-pregnancy spacing (above 24 months) were older maternal age and higher parity.

DISCUSSION

The aim of this study was to link HCI with socioeconomic and fertility characteristics of mothers delivering at eight tertiary care centres serving an urban population. HCI was correlated with maternal indicators of low socioeconomic status and longer birth spacing.

The finding that crowding index was highest among women reporting low social class, low educational attainment, and no previous work experience is consistent with the literature, highlighting the intricate association of crowding with conditions of low socioeconomic status in an urban setting.[4 7 10 33] Lotstein reported household crowding as mediating the effect of the Hollingshead two factor index—a composite score for level of education and occupational prestige—on adverse mental and physical health outcomes.[34] Thus, household crowding can be considered as one aspect of socioeconomic deprivation, which correlates with a wide range of health outcomes and behavioural characteristics.

Furthermore, the crude effect of household crowding on birth spacing was significant for moderately crowded environments, whereas birth spacing did not differ considerably between HCI extremes. Multivariate analysis showed a predominant effect of maternal age and parity that tend to diminish the impact of household crowding on inter-pregnancy spacing. In particular, maternal age at delivery seems to play an important part as a determinant of longer birth intervals. One explanation may be that women residing in a crowded environment are more likely to be older, less educated, and unemployed mothers who may have already achieved their desired family size and are more likely to postpone future pregnancies. Further analysis showed a significant positive relation between maternal age and crowding index, suggesting a potentially confounding effect of maternal age on the association between HCI and inter-pregnancy spacing.

Interpretation of study results requires some knowledge of the important limitations involved. Firstly, because of the cross sectional nature of the study, no clear cut causal association between HCI and inter-pregnancy spacing can be deduced. Secondly, the hospital setting may have restricted sample generalisability although previous reports have suggested that over 90% of deliveries in the Lebanese population are currently taking place in hospitals rather than at home or in another clinical setting.[35] Thirdly, indicators of socioeconomic status were limited to parental education and occupation and did not include more explicit measures such as household income. Fourthly, qualitative research is needed to explain the crude effect of household density on birth spacing. Perceived or subjective crowding is likely to mediate the effect of objective crowding or household density on health and behavioural outcomes. Therefore, one drawback is the absence of data on the subjective experience of crowding. Similarly, the choice of last birth interval, as a measure of fertility characteristics needs to be complemented with reports on fertility related to stage of family making as well

Policy implications

Future research should be based on nationally representative sample of Lebanese urban dwellers, with more emphasis placed on the subjective aspect of household crowding.

as the actual use of contraceptives and subjective variables such as desired family size. Another issue is the need for a detailed description of family structure for the purpose of classifying households into nuclear, poly-nuclear, or extended family types.[25] Extended families are commonly observed in developing societies, including Lebanon. Married couples who live with their parents, parents in law, or siblings are more likely to perceive household density as a long term stress, with consequent effects on their psychological wellbeing and behaviour.[16] Finally, it is accepted that this area is very complex with many inter-related variables. It may therefore be difficult to distinguish accurately between the effects of potentially closely related variables such as parity and age, and HCI and parity.

Our data have demonstrated that household crowding, a correlate of low parental socioeconomic status, is associated with longer birth intervals. The last association seems to be largely explained by maternal age and parity. Future research should be based on a nationally representative sample of Lebanese urban dwellers, with more emphasis placed on the subjective aspect of household crowding.

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