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Livelihoods, nutrition and health in Dhaka slums

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Abstract

Objectives: To identify groups within Dhaka slums that report similar patterns of livelihood, and to explore nutritional and health status.

Design: A random sample of households participated in a longitudinal study in 1995–1997. Socio-economic and morbidity data were collected monthly by questionnaire and nutritional status was assessed. Cluster analysis was used to aggregate households into livelihood groups.

Setting: Dhaka slums, Bangladesh.

Subjects: Five-hundred and fifty-nine households.

Main outcome measures: Socio-economic and demographic variables, nutritional status, morbidity.

Results: Four livelihood groups were identified. Cluster 1 ($n = 178$) was the richest cluster with land, animals, business assets and savings. Loans as well as income were higher, which shows that this group was credit-worthy. The group was mainly self-employed and worked more days per month than the other clusters. The cluster had the second highest body mass index (BMI) score, and the highest children's nutrition status. Cluster 2 ($n = 190$) was a poor cluster and was mainly dependent self-employed. Savings and loans were lower. Cluster 3 ($n = 124$) was the most vulnerable cluster. Members of this group were mainly casual unskilled, and 40% were female-headed households. Total income and expenditure were lowest amongst the clusters. BMI and children's nutritional status were lowest in the slum. Cluster 4 ($n = 67$) was the second richest cluster. This group comprised skilled workers. BMI was the highest in this cluster and children's nutritional status was second highest.

Conclusions: Cluster analysis has identified four groups that differed in terms of socio-economic, demographic and nutritional status and morbidity. The technique could be a practically useful tool of relevance to the development, monitoring and targeting of vulnerable households by public policy in Bangladesh.

Keywords
Cluster analysis
Livelihood group
Socio-economic profile
Nutritional status
Morbidity

Undernutrition is not randomly distributed within a given population, but is a dimension of poverty. The ability of a household to command sufficient resources for food and basic needs is largely dependent upon its social, material and economic conditions. Studies conducted in urban areas of developing countries have demonstrated that undernutrition in children is associated with low income^{1–5}, low assets^{1,6}, morbidity^{2,6–9}, employment¹, total household expenditure⁵, low education of the mother^{3,6,10–13}, social networks¹¹, housing status^{9,13–15} and sanitation¹⁴. Demographic variables including household size^{10,12}, birth order^{3,13} and female gender^{2,7,10,15,16} are also associated with undernutrition.

Such studies, however, provide little information that could be of assistance in designing strategies for alleviating

poverty in vulnerable groups. The links between socio-economic status, poor nutrition and health are inadequately understood and many conventional interventions have failed to have the desired effect¹⁷. Several conceptual frameworks have been proposed for the identification of vulnerable groups, but few have been tested empirically for their ability to identify such groups within urban labour markets^{1,18,19}.

In this paper we test the hypothesis that livelihood groups differentiate economic, social and demographic variables, and predict health and nutritional outcomes in children and adults. We apply the multivariate statistical technique of cluster analysis to data collected in the Urban Livelihoods Study, a multidisciplinary research study exploring the environmental, material and social

conditions of an urban slum settlement in Dhaka City, Bangladesh.

Methods

Setting

Dhaka is the national capital and the largest city of Bangladesh. Thirty million people, over 20% of the total population of Bangladesh, live in urban areas. By the year 2005 this figure will have risen to 46 million, and by 2015 projections indicate that 68 million (more than a third of the total population of Bangladesh) will live in urban areas^{20,21}. In the absence of commensurate industrialisation and on account of little planned urban or spatial development, this rapid expansion of the urban population has serious implications for physical and socio-economic conditions of the country's cities²⁰. The number of slum settlements has grown rapidly in recent years and the urban poor are now estimated at around 11 million, or 37% of the urban population^{21,22}.

The gross national product (GNP) in 1998 was US\$ 44 billion (\$350 per capita) and the rate of growth through the 1990s was 5%. However, there is a highly uneven distribution of wealth and this is not being reduced by economic growth. The Gini Index in 1992 was 28.3, with the lowest 10% consuming 4.1% and the richest 10% consuming 23.7%. Fourteen per cent of the urban population lives below the national poverty line and the largest gap between rich and poor is in the urban areas^{20,21}.

The Urban Livelihoods Study is based in the slum settlements of Mohammadpur subdistrict. *Agargoan* includes the biggest slum in Mohammadpur. The land is owned by the government but has been occupied informally by squatters for over 20 years. *Central Mohammadpur* includes slums in Rayer Bazaar, Jafrabad, Pisciculture, Adabar and Pulpar Bottola areas. Most of the slums in this area consist of poor housing within middle and lower-middle class residential housing settlements. Private landlords own most, though some are on disputed land. Finally, *Beri Badh* is the peripheral area of Mohammadpur. The settlements developed along the Buri Ganga river embankment of the Dhaka City Flood Protection Scheme, constructed in 1988–89. The embankment is government-owned land, with slums adjacent to the embankment situated on privately owned land.

Study design

The Urban Livelihoods Study is based on two sets of interrelated activities: quantitative data collection on a panel of around 850 households (the quantitative panel survey) and qualitative studies that explore the same study objectives within selected slum settlements in the study area. The quantitative panel survey used a cluster random sample. Twenty-five clusters of households were sampled across Mohammadpur thana. The sample size calculations

were based on planned tests of hypothesised differences between child and adult nutritional status in different livelihood groups.

Following initial registration in November 1995, households were visited every month until April 1997. A monthly questionnaire was administered to collect information on the residency status and demographic characteristics of household members, anthropometric status, morbidity, food expenditure, work participation, absence from work because of ill health, food expenditure and self-perceived financial situation. In addition, every three months, a longer questionnaire was administered to collect additional information on savings and debts, income from employment and other sources, gifts and remittances, ownership of assets including land and animals, school attendance, group membership, stocks of food and household expenditure.

Data analysis

Cluster analysis was used to identify livelihood groups amongst slum households participating in the study. More widely used techniques such as regression analysis were not suitable because of co-linearity among the variables of interest. The clustering technique used was a hierarchical agglomerative (or stepwise) method available in SPSS for Windows. A major advantage of hierarchical clustering algorithms is that results are presented in the form of a dendrogram. This aids the investigator in exercising judgements on the number of clusters that exist or are useful for the purpose at hand. Ward's method was used as suggested by Everitt²³. In Monte Carlo studies, Ward's method has been found to be the most robust clustering method using a similarity matrix based upon squared Euclidean distances^{24,25}.

A number of economic and demographic variables were entered into the cluster, including: land, animals, labour days worked per month, savings and debts, income, business assets, occupational group, days off because of illness, household type (male or female head), household size, earner/dependency ratio. Continuous variables were standardised by converting to the standard normal deviate. A stepwise fusion of cases based upon the squared Euclidean distance was computed and the clustering coefficient was used to indicate the stage on the agglomeration schedule where large changes between fusions were evident as compared with immediately preceding stages⁴.

We formally tested the stability of the cluster solution. Two methods were used: (1) analysis to test the degree of association between group membership assigned by cluster and that assigned by discriminant analysis and (2) randomly splitting the data in two, clustering separately in each subset and comparing cluster membership in the split samples.

Statistical comparisons were made across the clusters for reported socio-economic and demographic variables.

Parametric one-way analysis of variance (ANOVA)²⁶ was used to test for between-group differences in mean values, and categorical variables were tested by chi-square tests. Where the expected cell size was under five, Fisher's exact test²⁶ was used. Measures of nutritional status and morbidity were available for individuals within clusters. Means and standard errors (SEs) were calculated for body mass index (BMI), morbidity and nutritional indices of children, and comparisons across clusters were made using ANOVA.

Results

Identification of clusters

Four large clusters were identified comprising 90% of the households studied. The degree of association between group membership assigned by cluster and by discriminant analysis using the same variables was 85%. There was a good level of agreement between the cluster solutions when the procedure was run on split samples from the original data.

The clusters

Socio-economic, demographic and occupational variables are presented by cluster in Tables 1 and 2.

Cluster 1 ($n = 178$) was the richest group. The group owned more land and animals, by far the most business assets, and earned the highest incomes. Total expenditure, savings and loans were higher than in other clusters. The incomes of men and women were similar, but women had more business assets, greater savings and bigger loans than did men. The cluster had the highest mean household size and the earner/dependency ratio was second highest amongst the clusters. The majority of cluster members

were self-employed with a substantial minority in permanent work. Cluster members worked more days per month than members did in any other cluster.

Cluster 2 ($n = 190$) had the least land and animals. Business assets were very low in this cluster. Income, savings and loans were amongst the lowest. The income of men was greater but loans were less than those of the women. This cluster had the lowest household size and amongst the lowest earner/dependency ratio. The cluster comprised entirely of dependent self-employed people (where employment is contingent upon others providing goods or credit for sale or production).

Cluster 3 ($n = 124$) households owned some land and animals but less than cluster 1. Men and women owned business assets and these exceeded business assets owned by members of cluster 2 or cluster 4. Incomes and expenditures were low in this cluster. Men had the highest levels of savings amongst the clusters, but women had the lowest level of savings. The earner/dependency ratio was low and a sizeable subgroup of the households in this cluster were female-headed. Women in this cluster worked fewer days per month than did women in any other cluster. The mode of occupation in this cluster was almost entirely casual unskilled work.

Cluster 4 ($n = 67$) had some land and animals, but less than cluster 1. Business assets were lowest after cluster 2, but incomes and expenditures were high. Men had the highest level of loans and the lowest level of savings amongst the clusters. Women had the lowest level of loans and the highest level of savings after women in cluster 1. The earner/dependency ratio in cluster 4 households was high, households were male-headed and earners were mainly casual skilled workers.

Table 1 Socio-economic variables by cluster

Variable	Cluster 1 ($n = 178$)	Cluster 2 ($n = 190$)	Cluster 3 ($n = 124$)	Cluster 4 ($n = 67$)	P^*
	Self-employed	Dependent self-employed	Casual unskilled, female head	Casual skilled	
Land in bigha†, mean (SE)	0.27 (0.01)	0.15 (0.04)	0.20 (0.05)	0.24 (0.03)	<0.036
Animals, mean (SE)	0.31 (0.03)	0.02 (0.01)	0.12 (0.03)	0.12 (0.02)	<0.0001
Men's business assets in taka‡, mean (SE)	3090 (426)	79 (49)	355 (154)	179 (123)	<0.0001
Women's business assets in taka, mean (SE)	6181 (1515)	98 (45)	334 (138)	174 (145)	<0.0001
Men's savings in taka, mean (SE)	571 (163)	369 (122)	610 (268)	351 (125)	<0.0001
Women's savings in taka, mean (SE)	820 (318)	340 (107)	134 (42)	473 (135)	<0.102
Men's loans in taka, mean (SE)	266 (38)	226 (38)	283 (68)	522 (125)	<0.026
Women's loans in taka, mean (SE)	485 (139)	272 (68)	215 (56)	157 (48)	0.030
Men's income/per consumption unit in taka, mean (SE)	892 (75)	740 (123)	660 (54)	881 (105)	<0.0001
Women's income/per consumption unit in taka, mean (SE)	858 (60)	657 (56)	564 (52)	838 (104)	<0.0001
Total expenditure/per consumption unit in taka, mean (SE)	578 (37)	573 (14)	510 (21)	568 (23)	<0.0001
Food expenditure/per consumption unit in taka, mean (SE)	466 (12)	499 (13)	436 (17)	536 (33)	<0.0001
Male work days/month, mean (SE)	25.5 (0.6)	21.1 (0.8)	20.3 (1.2)	21.1 (1.6)	<0.0001
Female work days/month, mean (SE)	25.0 (0.7)	21.5 (0.7)	18.3 (1.8)	20.7 (1.1)	<0.0001

* Probability that differences between groups arose by chance.

† One bigha is approximately one-third of an acre.

‡ 100 taka is worth approximately \$2.

Table 2 Demographic and occupational characteristics by cluster

Variable	Cluster 1 (n = 178)	Cluster 2 (n = 190)	Cluster 3 (n = 124)	Cluster 4 (n = 67)	P*
	Self-employed	Dependent self-employed	Casual unskilled, female head	Casual skilled	
Household size, mean (SE)	5.26 (0.15)	4.34 (0.12)	4.63 (0.18)	4.47 (0.17)	<0.0001
Household type					
Female-headed	2	0	49	0	<0.0001
Male-headed	176	190	75	67	
Earners/dependency ratio, mean (SE)	2.20 (0.13)	1.99 (0.10)	1.58 (0.13)	2.23 (0.15)	<0.004
Men's occupational category					
Permanent work	10	0	0	0	<0.0001
Casual skilled	1	0	0	35	
Casual unskilled	1	0	48	0	
Self-employed	63	0	5	0	
Dependent self-employed	5	96	5	0	
Family worker	0	0	0	2	
Women's occupational category					
Permanent work	22	0	0	0	<0.0001
Casual skilled	1	0	0	27	
Casual unskilled	0	0	55	0	
Self-employed	63	1	2	0	
Dependent self-employed	12	93	9	0	
Family worker	0	0	0	3	

* Probability that differences between groups arose by chance.

Nutritional status and morbidity

Table 3 presents adult BMI, children's nutritional status and morbidity by cluster.

Cluster differentials for BMI were highly significant, with cluster 4 having the by far the highest BMI and cluster 3 having the lowest ($P < 0.0001$). Child nutritional measures weight-for-age ($P < 0.0001$), height-for-age ($P < 0.0001$) and weight-for-height ($P < 0.0001$) were all low for children in cluster 3 compared with children in other clusters. Children in cluster 1 and cluster 4 tended to be the better nourished, with those in cluster 2 occupying an intermediate position.

The pattern of illness did not reflect the distribution of poor nutritional status between clusters, although statistically significant differentials were present. For fever, cluster 1 suffered the least sickness days in any two-week period, while the burden of illness was similar in the other clusters

($P < 0.015$). For diarrhoea, the greatest number of days with diarrhoea in any two-week period was in cluster 3, with similar levels in cluster 4 and less in clusters 1 and 2 ($P < 0.010$).

Discussion

Clustering methods are multivariate statistical procedures that start with a dataset containing information about a sample of units and attempt to reorganise these into relatively homogeneous groups. The approach is particularly useful when data exhibit co-linearity and regression techniques prove unhelpful. A number of economic and demographic variables were entered into the model, including: land, animals, labour days worked per month, savings and debts, income, business assets, occupational group, days off because of illness, household type,

Table 3 Body mass index (BMI), children's nutritional status and morbidity

Variable	Cluster 1 (n = 178)	Cluster 2 (n = 190)	Cluster 3 (n = 124)	Cluster 4 (n = 67)	P*
	Self-employed	Dependent self-employed	Casual unskilled, female head	Casual skilled	
BMI, mean (SE)	19.1 (2.5)	18.8 (2.0)	16.3 (0.5)	26.1 (3.3)	<0.0001
WAZ, mean (SE)	-3.25 (3.8)	-3.58 (4.1)	-5.21 (5.2)	-3.20 (3.7)	<0.0001
HAZ, mean (SE)	-2.30 (1.4)	-2.10 (2.3)	-3.18 (3.2)	-2.25 (1.6)	<0.0001
WHZ, mean (SE)	-2.19 (4.5)	-2.30 (5.5)	-3.25 (4.9)	-2.20 (3.4)	<0.0001
Days off ill					
With fever, mean (SE)	1.50 (0.51)	1.82 (0.07)	1.88 (0.08)	1.90 (0.02)	<0.015
With diarrhoea, mean (SE)	3.50 (1.02)	3.17 (0.48)	7.00 (3.61)	6.50 (1.50)	<0.010

*Probability that differences between groups arose by chance.

WAZ – weight-for-age Z-score; HAZ – height-for-age Z-score; WHZ – weight-for-height Z-score. Reference: National Center for Health Statistics (NCHS).

household size and earner/dependency ratio. Four livelihood groups were identified and stability of clusters was demonstrated by an associated discriminant analysis and by comparing cluster solutions in split samples.

Many analyses assume that slum populations are homogeneous^{27–29}. In contrast, this analysis demonstrates that there are relatively well-defined livelihood groups within urban slum populations, each with particular economic, demographic and social characteristics. Furthermore, these livelihood groups were also differentiated with respect to nutritional status and illness experience, with the worse nutritional status in the poorest group^{19,30–35}. The value of this form of appraisal is that it does not prejudice the outcome – the most vulnerable categories emerge. *A fortiori*, it becomes clear that the use of continuous variables related to ‘wealth’ provide a poor fit with the ways households are differentiated by nutritional and health outcomes. However, other characteristics were identified that associated with vulnerability, notably dependence on casual unskilled employment and being a female-headed household.

The patterns of income, expenditure, occupation and dependency in the various livelihood groups offer an insight into the dynamic and interrelated nature of livelihood strategies that is lost in traditional multivariate analysis. From the perspective of public policy a more integrated analysis is important. Interventions can then be designed more effectively, so as to strengthen and complement people’s own efforts to manage adversity. This is important if resources are severely constrained and essential if people are to participate in the process of change, rather than receiving aid as passive recipients. Cluster analysis can help policy makers better understand the complexity of people’s lives and to can guide them in the design of poverty alleviation strategies which take this complexity into account. This kind of exercise, conducted at the beginning of a study or policy intervention, could also be useful in providing the basis for long-term monitoring of panels of households and interventions.

In conclusion, cluster analysis has shown that slum populations are not homogeneous. Rather, there are more or less well-defined livelihood groups within slum populations, each with particular economic, demographic and social characteristics. The groups were also differentiated with respect to nutritional status and experience of illness. Cluster analysis could be a useful tool of practical relevance to the identification, monitoring and targeting of vulnerable households for public policy interventions in Bangladesh.

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Urban Livelihoods Study

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