

# Urbanisation and Coronary Heart Disease Risk Factors in South Asian Children

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## Abstract

**Background:** Coronary Heart Disease (CHD) and other Non Communicable Diseases (NCDs) are increasing globally. Comparison of various sections of the South Asian populations living at different levels of urbanization can help in understanding the role of demographic transition in the increased prevalence of these diseases in urbanized populations.

**Objective:** To compare the prevalence of certain CHD risk factors in 10-12 year old school children living at different levels of urbanization.

**Method:** Differences in height, Body Mass index (BMI), Waist Hip Ratio (WHR), Fasting Blood Glucose (FBG) and Total Blood Cholesterol (TBC) were studied.

**Subjects:** Anthropometric and biochemical measurements of six groups of 10-12 year old children, representing various urbanization categories, were studied. Three groups of children were recruited from Punjab, Pakistan: rural, middle income urban and high income urban and they were assigned urbanization rank (UR) 1, 2 and 3. Another three groups of children were recruited from Slough, UK: British Pakistani, British Indian, and British Caucasian and they were assigned urbanization rank 4, 5 and 6 respectively.

**Results:** Proportion of children having high CHD risk increased with urbanization rank. Increase in BMI and TBC with urbanization status was steadier than the increase in FBG and WHR. Stunting which have been found to have a positive association with obesity and increased risk of CHD was higher among the less urbanized groups. BMI and TBC of the urbanized South Asian groups were lower, but FBG was higher than the British Caucasian, who served as controls.

**Conclusion:** These findings support the hypothesis that high CHD death rate among South Asians in UK may have its origin in the genetic predisposition to diabetes but are not likely to be solely due to this factor. The environmental factors like under nourishment in early life, adoption of urbanized life style or a combination of both could be the major determinants of CHD morbidity and mortality (JPMA 51:22; 2001).

## Introduction

South Asians who migrated to more urbanized countries demonstrated a much higher CHD morbidity and mortality than the native inhabitants of those countries<sup>1,2</sup>. Comparison of migrants (South Asians) and natives (Caucasians) for classic risk factors like fat intake, obesity, blood lipids etc did not explain the difference in their CHD risk<sup>1,3</sup>. In 1985 Mckeigue suggested that nutritional transition, as the result of demographic shift could be responsible for high CHD risk among South Asians in UK<sup>4</sup>. Later Barker et al presented the theory of genetic programming that states that maternal and fetal under nutrition modify early fetal development and these adaptation may permanently alter adult metabolism in a way which is beneficial to survival under continued conditions of malnutrition but detrimental when

nutrition is abundant<sup>5-12</sup>. Higher prevalence of CHD in adults who were poor during childhood had been noted earlier also<sup>13,15</sup>. In a longitudinal study the highest death rates from CHD occurred in boys who were thin at birth but whose weight caught up so that they had an average or above average body mass from the age of seven years<sup>16</sup>. Thus poor nutrition in early life followed by over nutrition in later life seems to indicate a high CHD risk.

Urbanization is now increasing rapidly in South Asia and rates of maternal and fetal malnutrition as indicated by high maternal and infant mortality and low birth weights have been low for several decades<sup>17,18</sup>. Incidence of Coronary Heart Disease (CHD) is increasing worldwide and the rate of increase is expected to be higher in the urban areas of the developing world, including South Asia, in the coming decades<sup>16,19,20</sup>. Preventive measures in children and young adults are needed now, to check the spread of CUD epidemic in future.

In terms of prevention, assessment of CHD risk of children is very important. Seeds for CHD are sown in early life and differences in risk status are detectable during childhood and adolescence when behavior modifications are feasible. Risk status of children has been studied in several countries<sup>21-28</sup> and found to correspond with the risk factors found in respective adult population<sup>26,29</sup>. Risk factors track from childhood to adulthood<sup>30-33</sup> and are found to cluster<sup>19,34</sup> in some children. Positive results from early interventions have already been noticed<sup>26,29,35,36</sup>. Comparing the risk status of more and less urbanized South Asian children can provide important clues for planning proper preventive strategies.

## Methods

In order to study the association between urbanization and CHD risk, relative CF-ID risk status of six groups of 10-12-year-old school children, representing various urbanization categories was compared. Fasting blood glucose, total blood cholesterol, waist-hip ratio, body mass index and body height were used as risk indicators in this study. Anthropometric measurements were taken from a total of 588 children and 457 children participated in blood tests. Group wise distribution of subjects is presented in Table 1.

**Table 1. Sample size for anthropometric measurements and blood tests.**

Measurement	Group						Total
	UR1 (RrP)	UR2 (MIP)	UR3 (HUP)	UR4 (BrP)	UR5 (BrI)	UR6 (BrC)	
<b>Anthropometry</b>							
Girls	55	64	76	65	41	19	320
Boys	64	67	39	51	33	14	268
Total	119	131	115	116	74	33	588
<b>Blood Test</b>							
Girls	46	49	45	54	35	17	246
Boys	53	48	32	42	23	13	211
Total	99	97	77	96	58	30	457

## **Subjects**

Three groups of children were recruited from Punjab, Pakistan: rural (RrP), middle-income urban (MUP) and high-income urban Pakistani (HUP); and they were assigned urbanization rank (UR 1, 2 and 3). Another three groups were recruited from Slough, UK: British Pakistani (BrP), British Indian (Bri) and British Caucasian (BrC) and these were assigned urbanization rank 4, 5 and 6 respectively. Assessment of dietary habits and exposure to Western culture confirmed that ranking of Indian and Pakistanis in Britain was correct<sup>37</sup>.

The recruitment of schools was purposive. The basic selection criterion was representation of particular demographic status. In UK, Slough (a city adjacent to London) was selected for the study because of the high concentration of South Asians. Out of the total of seven middle schools in Slough, the three schools that were willing to participate concurrently were recruited. In Pakistan the subjects were recruited from the province of Punjab because the majority (more than 90%) of the Pakistani immigrants in Slough come from that area. Six urban schools (from Lahore) and one rural school (from Kala-Shah-Kaku) were recruited to represent middle-income and high-income urban and rural groups. Initially the principals of several schools fulfilling the criterion of selection were contacted and the ones willing to participate at the same time were recruited. Information about rural or urban status of the area and general financial status of the students of particular schools was obtained from the association of private schools (Punjab). All the ten to twelve year old students studying in year 6 and 7 within each school were invited to take part in the study. Seventy-six to ninety-four percent of the eligible children from various schools participated in the study.

### **Anthropometric measurements**

Height was measured with a portable stadiometer following standard procedure<sup>38</sup>. SOEHNLE digital personal weighing scale was used for weighing. All the subjects were weighed without shoes, in single layer of indoor clothing. For waist and hip measurements, subjects were asked to stand straight with feet together and head up. Waist circumference was measured by holding the non-stretchable measuring tape snugly around the waist at the midpoint between the bottom rib and tip of hipbone. Hip circumference was measured at the fullest part of the hips.

### **Blood test**

Prior to testing blood, the fasting status confirmation sheet, signed by parents was received and subjects were also asked whether they had eaten or drunk anything that morning. If they indicated eating or drinking anything except water they were excluded from the test. The Autoclix tool by Boehringer Mannheim was used for the finger skin prick. Children were asked to warm up their hands by exercising them so that blood flow was normal. The first finger of the left hand was selected for pricking, unless the child wanted the other hand or another finger. Accutrend GC meter was used for analyzing blood for fasting glucose and total cholesterol. This small portable instrument analyses the blood for glucose and cholesterol by using disposable strips and is found to be accurate and precise<sup>39,40</sup>.

## **Results**

Mean values for TBC and BMI increased with urbanization rank irrespective of genetic origin (Figure 1 and 2).

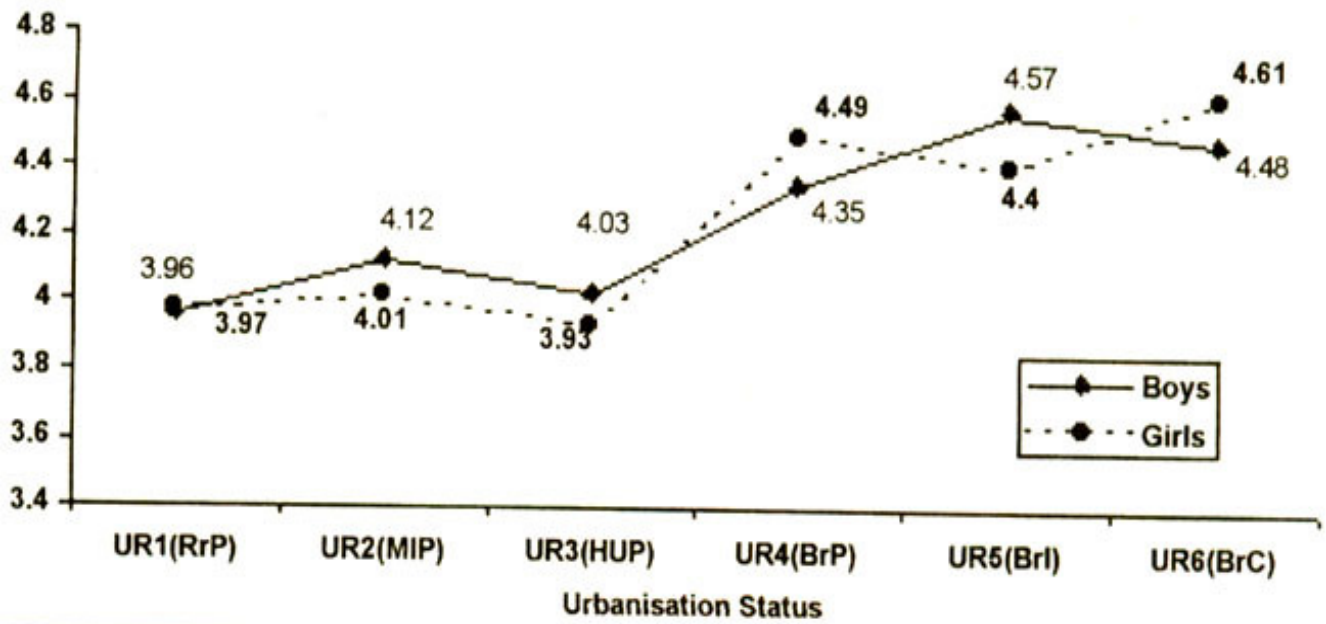


Figure 1. Mean Total Blood Cholesterol (TBC) of the six groups of children having different urbanization status

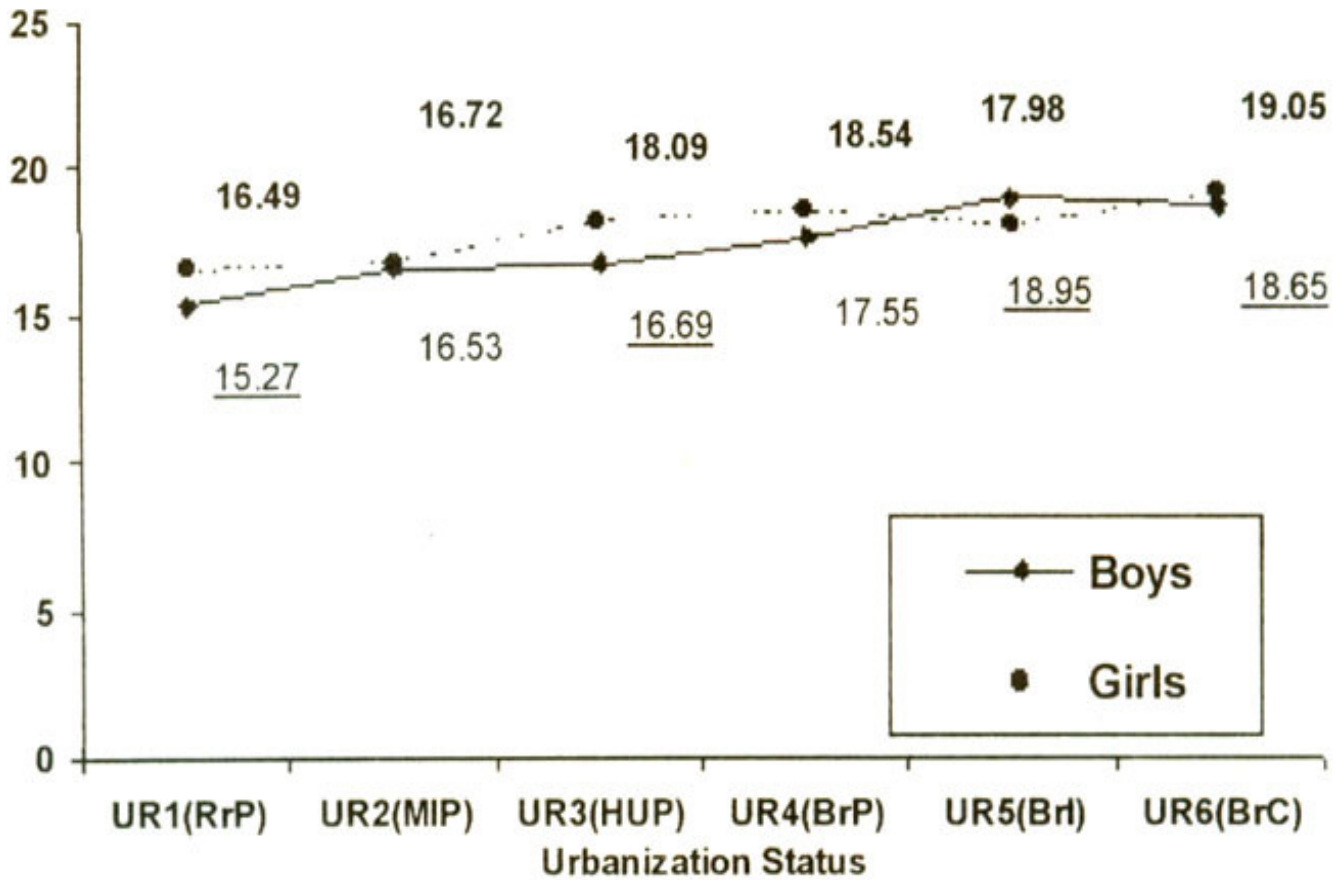


Figure 2. Mean Body Mass Index (BMI) of the six groups of children having different urbanization status

increment in FBG with urbanization rank occurred only within the South Asian group (Figure 3).

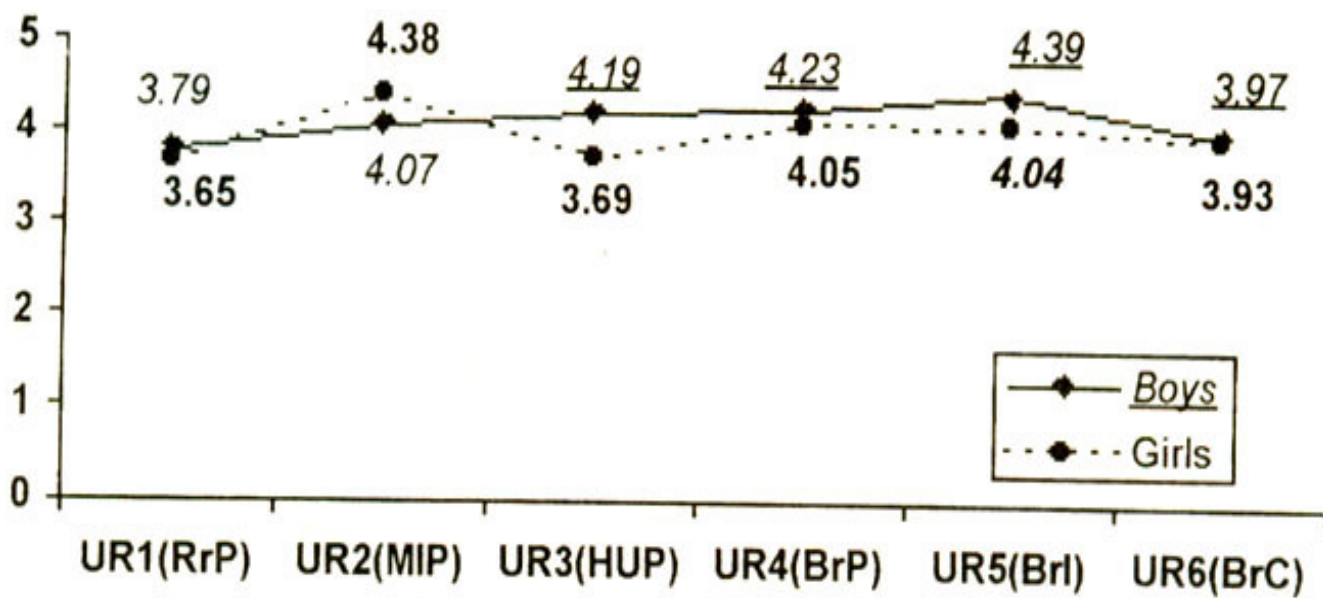


Figure 3. Mean Fasting Blood Glucose (FBG) of the six groups of children having different urbanization status

Increase in WHR occurred only through UR 3-5 for boys and tJR 2-4 for girls (Figure 4).

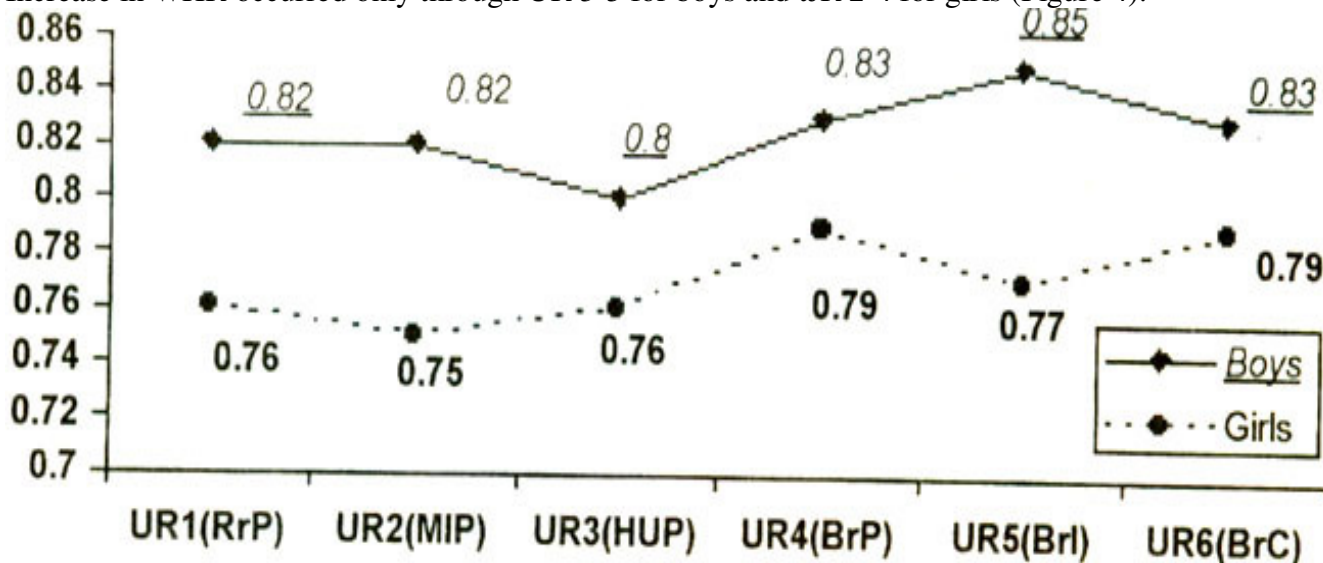


Figure 4. Mean Waist Hip Ratio (WHR) of the six groups of children having different urbanization status

Within the South Asian group (UR1 -5), FBG ( $r = 0.18, p = 0.000$ ), TBC ( $r = 0.28, P = 0.000$ ). WHR ( $r = 0.10, P=0.014$ ) and BMI ( $r=0.27, P=0.000$ ) had significant positive correlation (Pearson's  $r$ ) with the urbanization rank. It could be noted that the associations between UR and TBC and UR and BMI, were stronger than the associations between UR and FBG, and UR and WHR. Inclusion of Caucasians (UR6) in the analysis made 0.17,  $P0.005$ ) and BMI ( $r = 0.32, P = 0.000$ ), but made it weaker for FBG ( $r = 0.17, P = 0.000$ ). These results while support the view that genetic susceptibility to diabetes and central obesity could be the underlying risk factors for CHD among South Asians. also indicate that the differences in diet and activity could be responsible for higher BMI and TBC.

Heights of children were compared with NCHS reference values with the help of a WHO sponsored software "ANTHRO'41. Height for age Z scores increased steadily with urbanization rank (Figure 5).

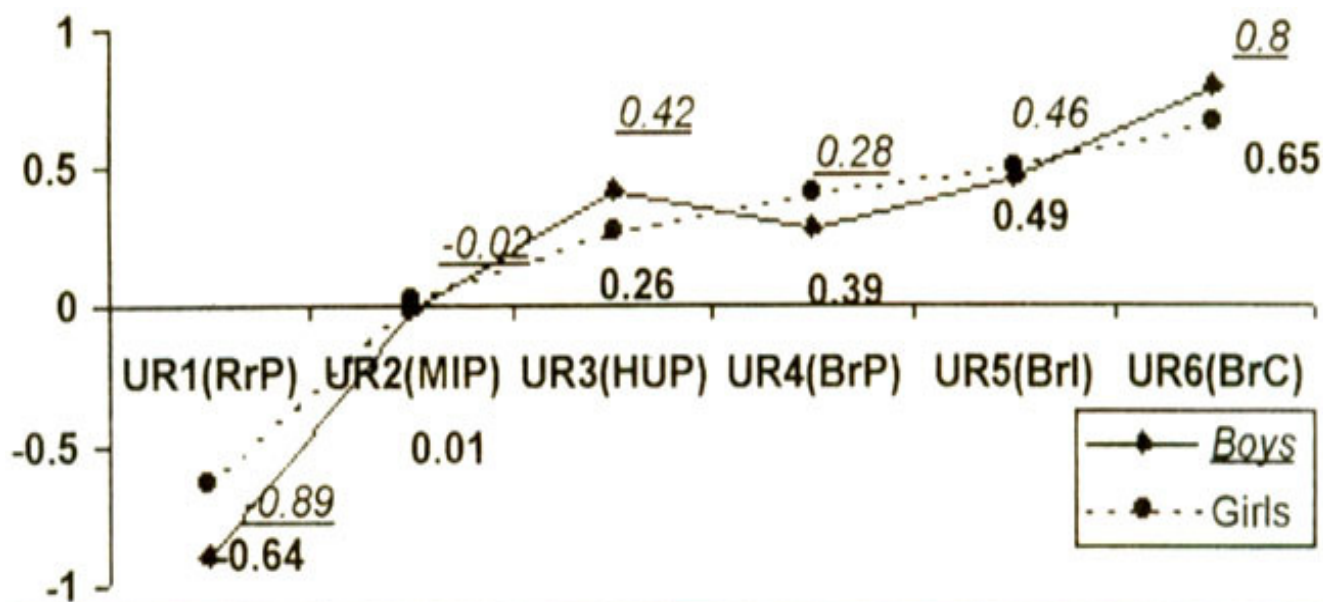


Figure 5 Mean height for Age Z scores (HAZ) of the six groups of children having different urbanization status

### Clustering of Risk Factors

Cluster analysis procedure identifies relatively homogenous groups of cases based on selected characteristics, using an algorithm that can handle large number of cases. Cluster analysis (K means cluster) was performed on the whole sample (all groups combined) to see that whether groups of children were identifiable on the basis of selected CHD risk factors. The three clusters thus created by this technique had markedly different CHD risk status. There was significant difference in the central means of three clusters in relation to all the four variables entered. The cluster that had the least values was termed “low risk” and the one with the highest values was named “high risk” and so on (Table 2).

**Table 2. Differences in Central Means of the Three Coronary Heart Disease Risk Clusters created by Cluster Analysis**

Clusters	Central Mean of CHD Risk Factors			
	FBG	TBC	BMI	WHR
1 (low risk)	3.9	4.0	15.0	0.78
2 (moderate risk)	4.1	4.3	18.6	0.79
3 (high risk)	4.2	4.4	23.7	0.83
P value (chi sq.)	0.001	0.000	0.000	0.003

Proportion of children falling into high, middle or low risk category from each urbanization group was compared. Proportion of children having high CHD risk increased steadily with urbanization status.

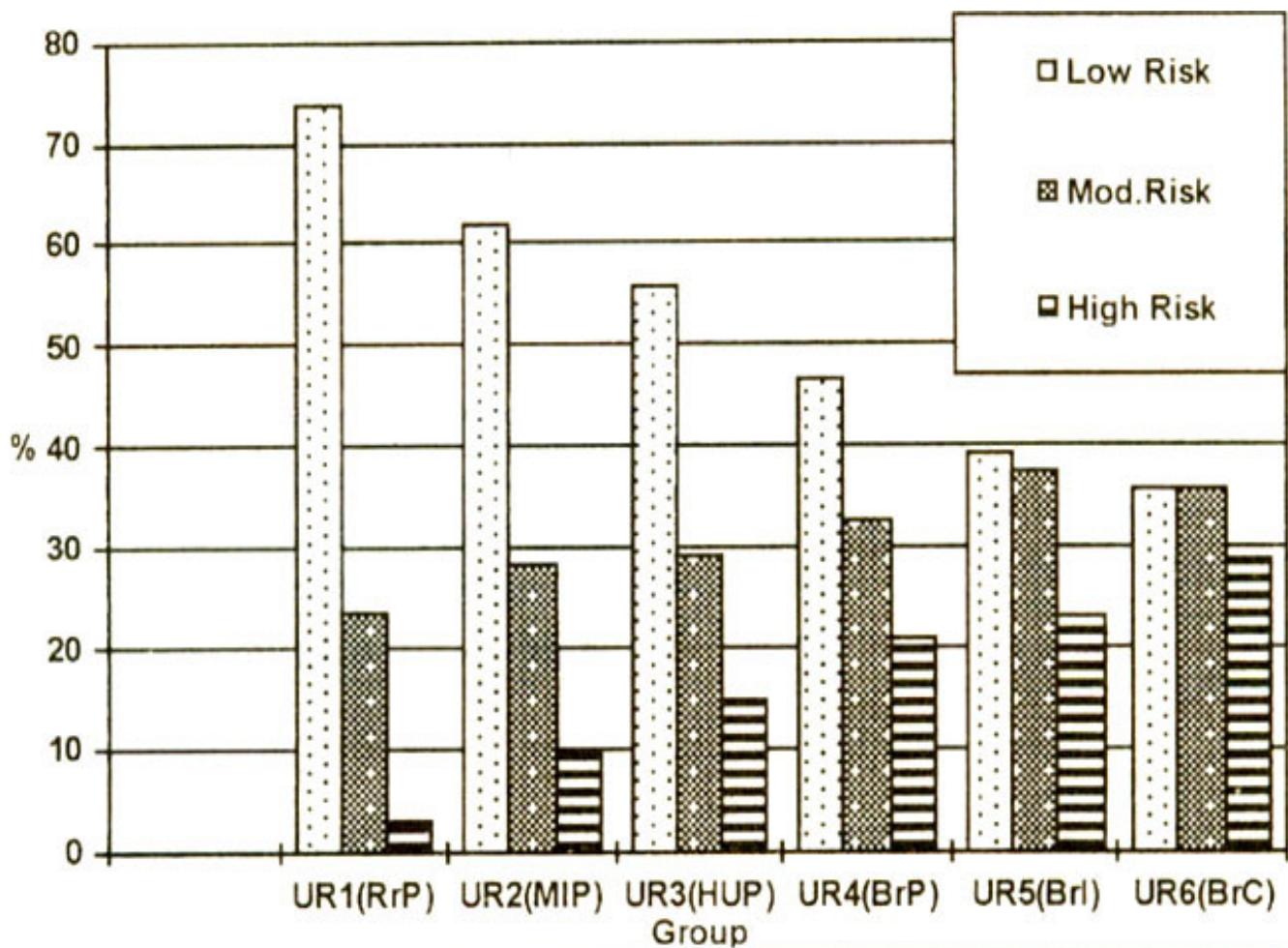


Figure 6 Proportion of children from each demographic group falling into Three CHD Risk Clusters

Figure 6 shows the percentage of children from each group falling into each risk cluster.

These findings indicate that even within the Pakistani population impact of urbanization was evident and thus support the hypothesis that the high CHD death rates among South Asians in UK are not solely due to genetic predisposition but environmental factors would also be playing their role.

However the observation that the mean FBG level of British Caucasian children was lower than that of British Pakistani children points out the fact that there is some basis for genetic and/or innate susceptibility of Pakistanis to Type 2 Diabetes Mellitus.

## Discussion

Differences observed in the relative CHD risk of the five groups of children in this study indicate the presence of an association between urbanization and CHD risk. The manifestation of this trend within the offspring of Pakistanis shows that the problem of higher rates of CHD in South Asians is not likely to be solely of genetic origin. Differences in CHD risk of more and less urbanized groups have been found in India also<sup>24,42,43</sup> Studies done at two different times in middle income<sup>44</sup> and more affluent<sup>45</sup> school children in Karachi showed that middle income children had lower blood cholesterol levels. Lower prevalence of CHD risk factors among low-income groups have been reported for Pakistani adults also<sup>46</sup>. The results of this study show that although the over nutrition related risk (TBC and BMI) increase with urbanization the undernutrition related risk (stunting) decrease with urbanization. Stunting is positively associated with obesity and other CHD risk factors<sup>47-57</sup>. High rates of stunting in

less urbanized groups need to be considered a potential indicator of obesity and CHD in later life. According to current state of knowledge, the extent of demographic transition and incorporation of heart healthy food and activity habits in the modified life style would determine the ultimate outcome. This notion is supported by the findings in Bangladesh and Puerto Rico. In Bangladesh adjusting for age, sex and social class the prevalence of Type 2 Diabetes Mellitus among urban subjects did not differ significantly from that among rural subjects<sup>58</sup>. In Puerto Rico urban men who had always lived in the same area had an incidence rate as low as that for rural men whereas recent rural migrants to urban areas had the highest rates of all<sup>59</sup>. Thus changes in health related behavior, being brought by demographic transition needs to be checked and channeled in positive direction to prevent the hazardous outcome of urbanization. The price any nation pays for urbanization would be inversely proportional to alertness and promptness it shows in taking these measures. Attempts to support urbanization, without making and implementing plans for providing health education and opportunities for physical activities could do more harms than good. While currently the most urbanized group indicates the highest CHD risk, the actual future risk would be determined by extent of over nutrition by various groups of children. In this regard undernourished children if they become more urbanized need to adopt a very prudent life style. Educational interventions are thus needed both for more and less urbanized groups of parents and children. Furthermore, with continued trends of migration, urbanization and prevalence of stunting, in future, the relative burden of CL-ID is likely to be higher among the urban poor as found in the developed countries.

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