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KEYWORDS	ABSTRACT
Health inequality, concentration index, intergenerational health transmission, self-rated health, health behaviours	This paper examines socioeconomic, demographic and intergenerational inequalities in health capital in district Multan, Pakistan using primary survey data from adult respondents. The study analyses self-rated health, diagnosed disease, disease shared with parents, medical expenditure and health behaviours and measures income-related health inequality using the concentration curve and concentration index. Self-rated health improves steadily with income and the significantly positive concentration index confirms that good health is concentrated among higher-income respondents across the whole income distribution. Income-related health inequality is greater in urban than in rural areas. Disease clusters strongly within families: a notable share of respondents share a disease with a parent and this applies to the majority of those with a diagnosed condition. Respondents whose parents had higher incomes report better health, even though disease inheritance does not vary with parental income. Only a minority of respondents exercise regularly and women exercise less than men. OLS, ordered logit and binary logit models show that age and gender are the most robust predictors of self-rated health. Regular exercise substantially lowers the odds of reporting below-very-good health and sharply reduces the odds of diagnosed disease while sharing a disease with a parent markedly raises the odds of below-very-good health. The findings support expanding financial protection against health care costs, strengthening rural primary care, early-life and family-based interventions, gender-responsive promotion of physical activity and prevention of non-communicable diseases.
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Introduction

Health inequalities are differences in health between population groups that are systematic, avoidable, and therefore unfair (Braveman & Gruskin, 2003; Whitehead, 1992). A large body of research shows that such differences follow a social gradient: people with more income, more education, and higher occupational status live longer and report better health at every level of the social hierarchy not only at the extremes (Deaton, 2003; Marmot, 2005; Smith, 1999). The Commission on Social Determinants of Health concluded that these gradients are driven largely by the conditions in which people are born, grow, live, and work, and called for their reduction “in a generation” (Marmot et al., 2008). Economists have explained the gradient through the demand for health capital in which income and education raise both the resources and the efficiency with which individuals produce health (Grossman, 1972), and through the long reach of early-life circumstances which shape adult health long after childhood (Almond & Currie, 2011; Case et al., 2002; Currie, 2009).

Health inequality is also cross-transmissible. Parental income, education and health influences nutrition, disease exposure, access to care and health behaviours for children, and many of these impacts continue in the adult years (Barker, 1990; Currie & Moretti, 2007). There are significant genetic and environmental links between the health of parents and children in high-income countries (Halliday et al., 2020; Thompson, 2014). In the developing world, Bhalotra and Rawlings (2011, 2013) demonstrate strong links between maternal health and socioeconomic status on the one hand and child health and survival on the other and that the intergenerational transmission of health is stronger for less well-off mothers. Health disadvantage then can thus be one of the ways by which poverty is reproduced from one generation to another.

Pakistan provides an important setting for studying these processes. Current health expenditure amounted to only 3.0% of GDP in 2019-20, less than two-fifths of which was financed by government while households paid for most of the remainder out of pocket (Pakistan Bureau of Statistics, 2022). Out-of-pocket payments of this scale expose households to catastrophic health spending and can push them into poverty (van Doorslaer et al., 2006; Wagstaff et al., 2018). The burden of disease is also changing. Pakistan has one of the highest prevalences of diabetes in the world, affecting 26.7% of adults in 2021 (International Diabetes Federation, 2021), and non-communicable diseases now coexist with persistent maternal and child health problems. Under-five mortality stood at 74 deaths per 1,000 live births in 2017-18, infant mortality was higher in rural than in urban areas (68 against 50 per 1,000) and nearly 38% of children under five were stunted (National Institute of Population Studies & ICF, 2019). These outcomes are strongly determined by socioeconomic status. Child mortality in Pakistan is concentrated among poorer households, with a concentration index of -0.142 (Ibupoto & Kakepoto, 2026) and household economic status and maternal education account for most of the socioeconomic inequality in infant mortality in Punjab (Mehmood & Bashir, 2023).

Despite this evidence, research on health inequality in Pakistan has focused mainly on children and on national household surveys which rarely combine information on adult health, parental

socioeconomic status, parental disease history and health behaviours in the same instrument. As a result, little is known about how income-related inequality in adult self-rated health is distributed, how far chronic disease clusters within families and whether health behaviours such as regular exercise offset part of the socioeconomic disadvantage in health. Self-rated health is particularly useful for this purpose because it predicts future morbidity and mortality even after objective health indicators are taken into account (Idler & Benyamini, 1997) although it can also reflect differences in health expectations across social groups (Sen, 2002).

This paper addresses these gaps using an survey of 613 adults in Pakistan that records self-rated health, diagnosed disease, disease shared with parents, medical expenditure, health behaviours and the socioeconomic characteristics of respondents and their parents. We combine group comparisons with the concentration curve and concentration index developed by Wagstaff et al. (1989, 1991) and Kakwani et al. (1997) and we estimate ordinary least squares, ordered logit, and binary logit models to identify the independent correlates of health and disease. The results show a statistically significant income gradient in self-rated health, confirmed by a positive concentration index ($CI = 0.019$, $p = .003$). Disease clusters strongly within families: 14.0% of respondents report the same disease as a parent and two-thirds of those with a diagnosed condition share it with a parent. In the multivariate models, age and gender are the most robust predictors of self-rated health, regular exercise reduces the odds of below very good health by 37% and sharing a disease with a parent almost triples these odds.

The paper makes three contributions. First, it provides one of the few applications of the concentration index to adult self-rated health in Pakistan and it examines how income-related health inequality differs by gender and area of residence. Second, it offers direct evidence on the intergenerational clustering of disease and on the relationship between parental income and adult health which extends the largely child-focused evidence for Pakistan. Third, it identifies regular exercise as a modifiable behaviour associated with better health and lower disease prevalence which points to practical routes for reducing health inequality. The remainder of the paper reviews the literature, describes the data and methods, presents the results and discusses their implications for policy.

Literature Review

One of the most stable findings of the social sciences is the socioeconomic gradient in health. In the Whitehall studies of the civil service in Britain, mortality and morbidity increased with each rung of the occupational ladder including those with stable jobs and universal health coverage (Marmot, 2002, 2005). Deaton (2003, 2013) surveys evidence showing that income and health are tightly linked both within and between countries but warns that a component of this relationship is because of health on income. Smith (1999) also demonstrates that the relationship is bi-directional as is the case between poor health and lower earnings and wealth, and economic resources and later health. However, education also has a protective effect, since an increase in education is associated with a greater tendency to engage in healthy behaviors and effectively

use health information (Cutler & Lleras-Muney, 2010; Grossman, 1972). Wilkinson and Pickett (2006) suggest that more unequal societies also have poorer average health at the level of individuals.

The most commonly used measures of socioeconomic inequality in health are the concentration curve and concentration index. These tools were introduced by Wagstaff et al. (1989, 1991) for making comparisons of the distribution of health by income group and extended to international comparisons of equity in health care by van Doorslaer and Wagstaff (1992). Two corrections were developed for bounded health variables: the standard errors required for statistical inference were obtained by Kakwani et al. (1997) and Erreygers (2009) proposed a correction for bounded health variables. O'Donnell et al. (2008) offer an all-encompassing overview of these techniques with reference to household survey information. These instruments have been applied in South Asia to measure and report high pro-rich inequities in using and experiencing health care services and results (Balarajan et al., 2011; van Doorslaer et al., 2006). Recent studies indicate that there are pro-rich inequality trends in child survival (Ibupoto & Kakepoto, 2026) in Pakistan and that the factors which contribute to inequality in infant mortality are household wealth, maternal education and rural residence (Mehmood & Bashir, 2023).

The two channels of research on intergenerational transmission of health are highlighted. The first is biological. Parents pass on predispositions to conditions like hypertension, diabetes, heart disease, and asthma and the health of the mother during pregnancy influences the health of the child as he or she grows (Barker, 1990; Thompson, 2014). The second involves socioeconomic and behavioural factors such as children's nutritional circumstances, housing, health care access and the family's health behaviours (Case et al., 2002; Currie, 2009). However, low birth weight is inherited from mother to child and this inheritance is more pronounced for poorer families (Currie and Moretti 2007) and the income differential in children's health grows as children get older (Case et al. 2002). Bhalotra and Rawlings (2011, 2013) and Halliday et al. (2020) find evidence of large intergenerational persistence in health across developing countries and the United States, respectively. There is limited evidence for Pakistan especially for adults.

A further link between socioeconomic status and health is through health behaviours. More educated and affluent individuals are generally likely to engage in regular physical activity, to consume a healthy diet, to be nonsmokers and to use preventive care (Cutler & Lleras-Muney, 2010). The benefits of regular physical activity include a lower risk of cardiovascular disease, diabetes, hypertension and premature death (Warburton et al., 2006). Physical inactivity is particularly prevalent among women in South Asia as social norms, safety risks and women's domestic duties restrict their opportunities for physical activity (Guthold et al., 2018). Self-assessed health is also influenced by gender but in a more complex way. Women's health is poorer than men's even when they live longer (Case & Paxson, 2005) and son preference is associated with the distribution of household resources toward child health in early life in South Asia (Jayachandran & Pande, 2017).

Finally, urban-rural differences in health are pronounced in Pakistan. Rural households have lower access to skilled health personnel, sanitation and institutional deliveries and rural infant mortality is substantially higher than urban infant mortality (NIPS & ICF, 2019). Urban populations, however, face greater exposure to sedentary lifestyles, pollution and dietary changes associated with non-communicable diseases and they are more likely to have their conditions diagnosed (Sen, 2002). As a result, the direction of the urban-rural difference in self-reported health and diagnosed disease is not obvious in advance. Taken together, this literature suggests that health in Pakistan should vary with income, gender, age and area of residence that disease should cluster within families and that healthy behaviours should be associated with better outcomes. The present study tests these expectations using individual-level data that combine all of these dimensions.

Data and Methodology

The study uses primary data collected through a structured questionnaire administered to 613 adult respondents in district Multan, Pakistan. The questionnaire records individual, household and parental characteristics related to health, socioeconomic status, occupation and intergenerational mobility. Respondents are aged 18 to 85 years (mean 30.8 years), 74.1% live in urban areas and 65.4% are male. Because of missing values, the analytical sample varies slightly across analyses, the multivariate models use the 575 respondents with complete data on all variables.

The main outcome is self-rated health, recorded on a five-point scale: excellent (1), very good (2), good (3), fair (4) and poor (5), so that higher values indicate worse health. For the concentration index and the OLS model, the scale is reversed to measure “health capital” (5 = excellent, 1 = poor), so that higher values indicate better health. Socioeconomic variables include respondent and parental monthly income in thousands of Pakistani rupees (PKR), both entered in logarithmic form in the regressions because the income distribution is highly skewed and years of schooling. Demographic controls include age, gender, marital status and urban residence. Health variables include the presence of a diagnosed disease, whether the respondent shares the same disease as a parent (inherited disease), height and weight and personal and family medical expenditure. Behavioural variables record whether the respondent exercises regularly and whether the respondent’s parents exercised, were careful about diet and were careful about vaccination, the last two are combined in an index of parental health investment.

The analysis proceeds in three steps. First, we compare mean health scores across gender, area, marital status, income quartiles and education groups using two-sample *t* tests and one-way analysis of variance (ANOVA) and we describe disease prevalence, intergenerational disease transmission, medical expenditure and health behaviours. Second, we measure income-related inequality in health using the concentration curve which plots the cumulative share of health against the cumulative share of respondents ranked from poorest to richest and the concentration index (Wagstaff et al., 1991):

$$CI = (2/\mu) \text{Cov}(h_i, r_i) \quad (1)$$

where h_i is the health of individual i , μ is mean health and r_i is the individual's fractional rank in the income distribution. The index ranges from -1 to +1, a positive value indicates that good health is concentrated among the better-off. Because self-rated health is bounded between $a = 1$ and $b = 5$, we also report the Erreygers (2009) corrected index:

$$E = [4\mu / (b - a)] \times CI \quad (2)$$

Standard errors for the concentration index are computed using the asymptotic formula of Kakwani et al. (1997). Third, we estimate four regression models. Model 1 is an OLS regression of health capital with heteroskedasticity-robust (HCl) standard errors (White, 1980). Model 2 is an ordered logit model of the five-category health score which respects the ordinal nature of the outcome:

$$P(\text{Health}_i \leq j) = \Lambda(\kappa_j - X_i'\beta), \quad j = 1, \dots, 4 \quad (3)$$

where $\Lambda(\cdot)$ is the logistic distribution function, κ_j are threshold parameters and X contains age, gender, urban residence, marital status, log income, education, log parental income, regular exercise, inherited disease and diagnosed disease. Because 92.1% of respondents report good or better health, we also estimate Model 3, a binary logit model of the probability of reporting good, fair or poor health rather than excellent or very good health which divides the sample more evenly (about 40% against 60%). Model 4 is a binary logit model of the probability of having any diagnosed disease (McFadden, 1974). The regressions use a parsimonious set of covariates, father's and mother's education are excluded because they are highly correlated with respondent education and parental income (variance inflation factors of about 2.1 to 2.6).

Results

Sample Characteristics and Self-Rated Health

Table 1 summarises the characteristics of the sample. The respondents are relatively young predominantly urban and male and well educated by Pakistani standards.

As presented in Table 1, the mean age was 30.8 years, the mean years of schooling was 13.1 years and 74.1% of the respondents lived in urban areas. The sample is then more likely to represent the younger, more urban, more educated, working age population than the national population. The mean household size of 5.5 signifies the large household size that is common in Pakistan while mean body mass index (BMI) of 23.0 is within normal range set by the World Health Organization (WHO). Table 2 shows the distribution of self-rated health.

Table 2 reveals that most respondents rate their health favourably: 60.4% say their health is excellent or very good, 92.1% say it is good or better. 7.9% report fair or poor health and the mean score is 2.21 (very good to good).

Table 1: *Sample Characteristics*

Variable	Statistic	Value
Age (years)	Mean (SD)	30.8 (8.9)
	Range	18–85
Gender	Male (%)	65.4
	Female (%)	34.6
Area of residence	Urban (%)	74.1
	Rural (%)	25.9
Marital status	Married (%)	54.9
	Unmarried (%)	44.9
Education (years)	Mean	13.1
Family size	Mean (SD)	5.5 (2.3)
Body mass index (kg/m ²)	Mean (SD)	23.0 (4.5)

Note. N = 613. SD = standard deviation. Marital status percentages do not sum to 100 because of missing values.

Table 2: *Distribution of Self-Rated Health*

Self-rated health	N	Share (%)
Excellent (1)	171	27.9
Very good (2)	199	32.5
Good (3)	195	31.8
Fair (4)	42	6.9
Poor (5)	6	1.0
Total	613	100.0
Mean score (SD)	—	2.21 (0.96)

Note. Scores range from 1 (excellent) to 5 (poor).

This is a compressed distribution, a characteristic of young adult samples being one of the reasons for the small absolute differences between groups (O'Donnell et al., 2008).

Socioeconomic and Demographic Differences in Health

We next compare mean health scores across groups. Table 3 reports the results for gender, area of residence, marital status and income.

Table 3: Mean Self-Rated Health Score by Group

Group	Mean score	Test statistic	p
Male	2.165	t = -1.457	.146
Female	2.283		
Urban	2.220	t = 0.624	.533
Rural	2.165		
Married	2.306	t = 2.821	.005
Unmarried	2.087		
Income quartile 1 (lowest)	2.359	F = 4.111	.007
Income quartile 2	2.267		
Income quartile 3	2.109		
Income quartile 4 (highest)	2.008		

Note. Scores range from 1 (excellent) to 5 (poor); lower values indicate better health. Two-sample t tests are used for gender, area, and marital status; one-way ANOVA is used for income quartiles (N = 184, 165, 137, and 127 from the lowest to the highest quartile).

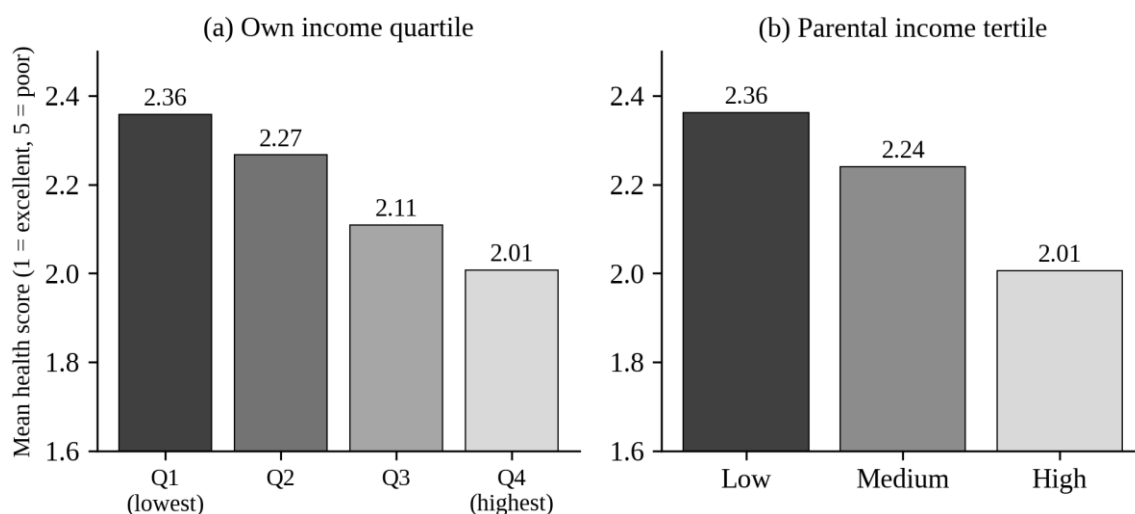
Table 3 shows that there is a clear income gradient in health. The mean health scores are consistently better in the highest income quartile (2.008) than in the lowest quartile (2.359) and the difference between quartiles is statistically significant (F = 4.111, p = .007). The disparity between the health score in the poorest and richest 25 percent is approximately a third of a standard deviation of the health score. This is a similar gradient to the evidence internationally that income can buy better nutrition, conditions and health care (Deaton 2003; Marmot 2002; Smith 1999).

Men report slightly better health than women (2.165 vs 2.283) but this is not significant (p = .146). Men are more likely to report excellent health (30.4%) while women are more likely to report good health (35.4%) reflecting the fact that women tend to rate their health less favourably than men (Case & Paxson, 2005). In comparison, more rural respondents rate their health as excellent (34.2% vs. 25.7%) and they report slightly better health (2.165 vs. 2.220; p = .533). This is likely a result of a difference in reporting as rural people are less likely to be diagnosed and may have lower expectations for health (Sen, 2002). The respondents who were married are significantly less healthy than single respondents (2.306 vs 2.087; p = .005). This difference will be due to the average age of the respondents, as married people tend to be older; this difference is not significant in the regressions when age is controlled. The same is true of education where there is a

similar though less significant gradient from the poorest health (2.344) for those with five years or fewer of schooling to the best health (2.149) for those with 15 years or more ($F = 1.072$, $p = .360$) perhaps because education is closely related to income (Cutler & Lleras-Muney, 2010). The income gradient is presented alongside the income gradient by parental income in Figure 1.

Figure 1

Mean Self-Rated Health Score by Own Income Quartile and Parental Income Tertile



Note. Lower scores indicate better health (1 = excellent, 5 = poor). Values are taken from Tables 3 and 5.

Figure 1 shows that health improves with both the respondent's own income and the income of the respondent's parents. The parental income gradient (from 2.363 to 2.006) is of the same size as the gradient by own income (from 2.359 to 2.008) which suggests that part of the socioeconomic advantage in health is inherited from the family of origin as predicted by the literature on early-life determinants of adult health (Case et al., 2002; Currie, 2009).

Disease Burden, Intergenerational Transmission, and Health Behaviours

Of the 613 respondents, 128 (20.9%) report at least one diagnosed disease. Table 4 shows the prevalence of the most common conditions.

Table 4: *Prevalence of Diagnosed Diseases*

Condition	N	Prevalence (%)
High blood pressure	32	5.2
Diabetes	19	3.1
Asthma	9	1.5
Heart disease	7	1.1
Chronic fever	7	1.1
Stomach disorders	6	1.0
Hepatitis C	5	0.8
Vision problems	4	0.7
Allergy	4	0.7
No disease reported	485	79.1

Note. N = 613. Conditions reported by fewer than four respondents are not shown.

Table 4 shows that the disease burden is dominated by non-communicable conditions, particularly high blood pressure (5.2%) and diabetes (3.1%) followed by asthma and heart disease. This trend is consistent with the continuous epidemiological transition in Pakistan and the high prevalence of diabetes in the country (IDF, 2021). Women also have a slightly higher prevalence rate (21.7%) compared with men (20.4%) and urban residents (22.0%) compared with rural residents (17.7%) which is in line with the higher diagnosis of chronic conditions in urban compared with rural areas (Sen, 2002).

There is a high familial clustering of diseases. Overall, 14.0% of respondents say they have the same disease as both of their parents and of the 128 respondents who have a diagnosed disease, 66.4% have the same disease as one or both parents. This concentration is based on the intergenerational health literature (Thompson, 2014; Halliday et al., 2020) that highlights genetic predispositions and common diets, behaviours and environments. Table 5 looks at the relationships between disease inheritance and parental income and adult health.

There is a contrast in the data from Table 5. The inheritance rates of disease are similar among the various income groups of parents (13.2% to 15.0%) indicating that the inheritance of disease is not dependent on family income. The pattern is markedly different with respect to adult health however a respondent with high income parents is much more likely to report excellent health (2.006) than is a respondent with low income parents (2.363).

Table 5: Adult Health and Disease Inheritance by Parental Income Tertile

Parental income tertile	Mean health score	Disease inheritance (%)
Low	2.363	15.0
Medium	2.241	13.2
High	2.006	14.0

Note. Health scores range from 1 (excellent) to 5 (poor). Disease inheritance is the percentage of respondents reporting the same disease as a parent.

The relationship between parental income and adult health is therefore not only through the transmission of disease but also through the nutritional quality of children's diet, access to health care, upbringing and health behaviors (Almond & Currie, 2011; Currie, 2009; Bhalotra & Rawlings, 2013).

There is a high level of skewness in medical expenditure. The mean monthly family medical expenditure is PKR 2,118 while the median is PKR 1,000. For the expenditure of the respondents, the mean is PKR 531 and the median is zero. The difference in urban and rural household expenditures on health is not significant ($t = 1.536$ and $p = .125$) and urban households spend more on health than rural households (PKR 2,263 compared to PKR 1,693). The high urban premium is consistent with the higher rate of private health services utilization in cities while low spending in rural areas could be due to limited access to health services rather than limited need (van Doorslaer et al., 2006; PBS, 2022). Table 6 gives a summary of health behaviours.

Table 6: Health Behaviours by Area and Gender (%)

Indicator	Overall	Urban	Rural	Male	Female
Respondent exercises regularly	26.9	27.4	25.5	29.4	22.2
Parents exercised regularly	31.9	—	—	—	—
Parents careful about diet	54.2	53.6	55.7	—	—
Parents careful about vaccination	65.3	—	—	—	—
Respondent knows vaccination status	92.2	—	—	—	—

Note. — = not available by subgroup.

Table 6 shows that only 26.9% of respondents exercise regularly with a clear gender gap: 29.4% of men exercise compared with 22.2% of women. This gap is consistent with global evidence that women in South Asia are among the least physically active populations largely because of social norms, safety concerns and domestic responsibilities (Guthold et al., 2018). Awareness of vaccination status is almost universal (92.2%) and about two-thirds of parents were described as careful about vaccination but only 54.2% were described as careful about diet which suggests

scope for improving the transmission of healthy habits within families (Cutler & Lleras-Muney, 2010). Mean body mass index is higher among men (23.7) than women (21.6) and similar in urban (23.1) and rural areas (22.7).

Income-Related Inequality in Health: Concentration Curve and Index

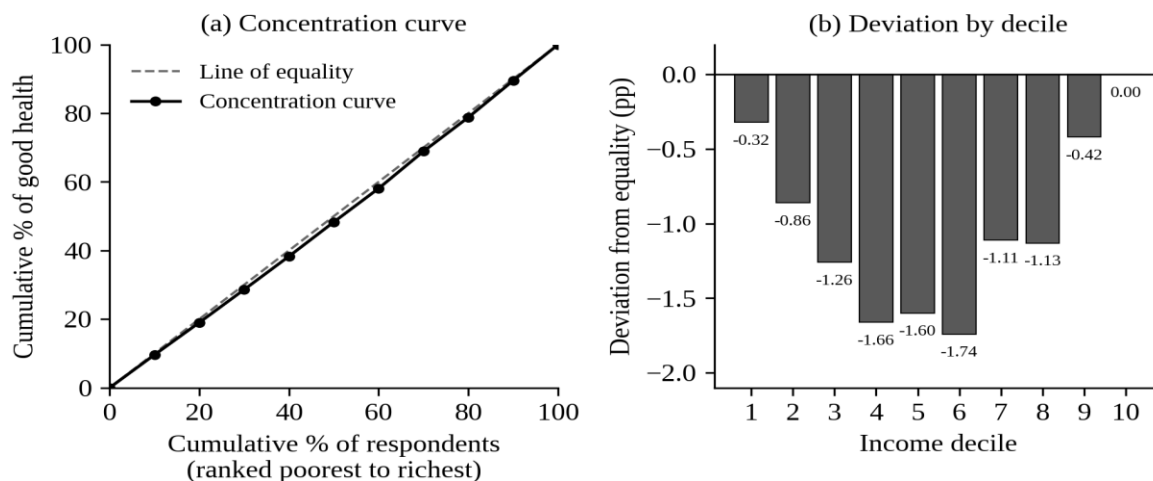
The group comparisons show that health improves with income but they do not summarise inequality across the whole income distribution. We therefore construct the concentration curve for self-rated health using the reversed scale on which higher values indicate better health. Table 7 reports its coordinates by income decile.

Table 7: Concentration Curve Coordinates for Self-Rated Health by Income Decile

Income decile	Cumulative population (%)	Cumulative health share (%)	Deviation from equality (pp)
1 (poorest)	10.0	9.6	-0.32
2	20.0	19.0	-0.86
3	30.0	28.6	-1.26
4	40.0	38.3	-1.66
5	50.0	48.3	-1.60
6	60.0	58.1	-1.74
7	70.0	68.9	-1.11
8	80.0	78.8	-1.13
9	90.0	89.5	-0.42
10 (richest)	100.0	100.0	0.00

Note. Health is measured on the reversed scale (5 = excellent, 1 = poor). Deviation = cumulative health share – cumulative population share, computed before rounding. pp = percentage points.

Table 7 shows that the cumulative share of good health falls below the population share at every decile before the last. The bottom half of the income distribution holds 48.3% of total good health, 1.7 percentage points less than its population share and the largest shortfall occurs at the sixth decile (-1.74 percentage points). Good health is therefore concentrated among the better-off throughout the income distribution not only at the extremes. Figure 2 displays the concentration curve and the deviation at each decile.

Figure 2: Concentration Curve for Self-Rated Health

Note. Panel (a) plots the cumulative share of good health against the cumulative share of respondents ranked by income. Panel (b) shows the deviation of the concentration curve from the line of equality at each decile. Values are taken from Table 7.

Figure 2 shows that the concentration curve lies below the line of equality along its entire length. The gap is small in absolute terms as expected for a bounded health measure with a compressed distribution but it is systematic. Table 8 reports the concentration index and associated statistics.

Table 8: Concentration Index for Self-Rated Health

Statistic	Value
N	613
Mean health (reversed scale, 1–5)	3.795
Concentration index (CI)	0.0191
Standard error	0.0063
95% confidence interval	[0.007, 0.032]
z statistic	3.022
p value	.003
Erreygers corrected index (E)	0.072

Note. Standard errors follow Kakwani et al. (1997). $E = [4\mu / (b - a)] \times CI$, with $a = 1$ and $b = 5$ (Erreygers, 2009).

Table 8 shows that the concentration index is positive and statistically significant ($CI = 0.019$, $p = .003$) and its 95% confidence interval excludes zero. Good health is therefore significantly concentrated among higher-income respondents which confirms the ANOVA result in Table 3 using a measure that draws on the full income distribution (Wagstaff et al., 1991). The Erreygers corrected index which adjusts for the bounded nature of the health scale is 0.072. The magnitude of the index is modest compared with values reported for health care use and child mortality in South Asia (Ibupoto & Kakepoto, 2026; van Doorslaer et al., 2006) which is expected for a young and relatively educated adult sample with a compressed health distribution (O'Donnell et al., 2008). To examine whether this inequality differs across groups, Table 9 reports concentration indices computed separately within each subgroup.

Table 9: Concentration Index for Self-Rated Health by Subgroup

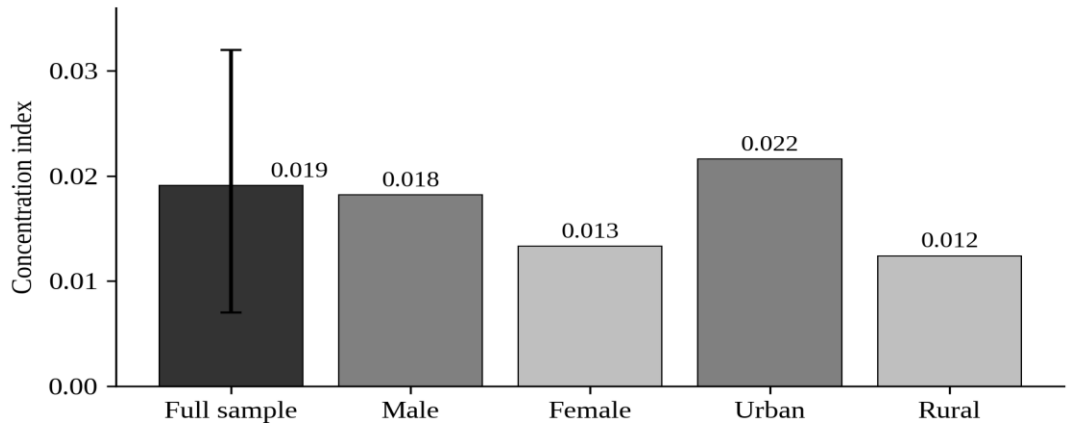
Subgroup	N	Mean health (reversed scale)	CI
Male	390	3.828	0.0182
Female	186	3.704	0.0133
Urban	421	3.770	0.0216
Rural	155	3.839	0.0124

Note. Respondents are ranked by income within each subgroup. Health is measured on the reversed scale (5 = excellent, 1 = poor).

Table 9 shows that the concentration index is positive in every subgroup so the pro-rich distribution of good health is not an artefact of the composition of the sample. Income-related inequality in health is greater in urban areas (0.022) than in rural areas (0.012) which is consistent with the wider dispersion of incomes and the greater variation in the quality of health care in cities where private providers serve those able to pay (Balarajan et al., 2011). The index is also slightly higher among men (0.018) than women (0.013) although women's narrower income range and smaller sample limit the precision of this comparison. Figure 3 compares these indices with the full-sample estimate.

Figure 3 shows that all subgroup indices lie within the confidence interval of the full-sample estimate with the urban index highest and the rural index lowest. A concentration index calculated for diagnosed disease is also positive ($CI = 0.065$, $SE = 0.045$) but not statistically significant ($p = .14$) which suggests that diagnosed disease is if anything slightly more common among higher-income respondents. This pattern is more likely to reflect better access to diagnosis among the better-off than a higher true prevalence of disease (Sen, 2002).

Figure 3: Concentration Index for Self-Rated Health by Subgroup



Note. The error bar shows the 95% confidence interval for the full-sample index. Values are taken from Tables 8 and 9.

Multivariate Analysis

The descriptive results may be confounded by correlations among age, gender, income and health behaviours. Table 10 therefore reports the four regression models described in the methodology.

Table 10: Regression Estimates of Self-Rated Health and Diagnosed Disease

Variable	Model 1 OLS: Health Capital	Model 2 Ordered Logit: Health Score	Model 3 Logit: Good or Worse	Model 4 Logit: Any Disease
Age (years)	−0.016*** (0.005)	0.032*** (0.011)	0.033** (0.013)	0.019 (0.023)
Male	0.207** (0.090)	−0.402** (0.181)	−0.357* (0.212)	−0.111 (0.376)
Urban	−0.185* (0.098)	0.335* (0.195)	0.200 (0.227)	1.092** (0.506)
Married	−0.113 (0.093)	0.211 (0.190)	0.112 (0.223)	−0.262 (0.420)
ln(income)	0.085 (0.061)	−0.199* (0.116)	−0.193 (0.131)	0.042 (0.236)
Education (years)	0.015 (0.011)	−0.027 (0.022)	−0.026 (0.025)	−0.053 (0.045)
ln(parental income)	0.059	−0.124	−0.096	0.133

	(0.041)	(0.080)	(0.093)	(0.159)
Exercises regularly	0.162*	-0.325*	-0.458**	-1.298***
Parental health investment index	(0.086) 0.033	(0.174) —	(0.208) —	(0.499) —
Inherited disease	(0.040) -0.289*	0.575* (0.344)	0.992** (0.402)	7.333*** (1.075)
Has diagnosed disease	(0.169) -0.156	0.324	0.073	—
Constant	(0.141) 3.682***	(0.289) —	(0.343) -0.237	-3.275***
	(0.242)		(0.535)	(1.001)
N	575	575	575	575
R ² /Pseudo R ²	0.096	—	0.059	0.531
AIC	1555.6	1492.0	749.6	297.4

Note. Standard errors in parentheses; Model 1 uses heteroskedasticity-robust (HC1) standard errors. In Model 1 higher values indicate better health (5 = excellent, 1 = poor). In Models 2 and 3 positive coefficients indicate worse health; Model 3 models the probability of reporting good, fair, or poor health. Model 4 models the probability of any diagnosed disease. Threshold parameters of Model 2 are not reported. Adjusted R² for Model 1 = 0.078.

*** p < .01. ** p < .05. * p < .10.

Table 10 shows that the results are consistent across the three models of self-rated health. Age is significant at the 1% level in Models 1 and 2 and at the 5% level in Model 3; gender is significant in all three; and regular exercise and inherited disease are significant in all three, at the 5% level in Model 3 and the 10% level in Models 1 and 2. Because Model 1 measures better health and Models 2 and 3 measure worse health, the coefficients have opposite signs but the same substantive interpretation. Table 11 converts the logit estimates into odds ratios.

Table 11: Odds Ratios from the Ordered and Binary Logit Models

Variable	Model 2: worse health category	Model 3: good or worse health	Model 4: any disease
Age (years)	1.032***	1.033**	1.020
Male	0.669**	0.700*	0.895
Urban	1.398*	1.221	2.980**
Married	1.235	1.118	0.769
ln(income)	0.820*	0.825	1.042
Education (years)	0.974	0.974	0.948

ln(parental income)	0.883	0.909	1.142
Exercises regularly	0.722*	0.632**	0.273***
Inherited disease	1.778*	2.697**	—
Has diagnosed disease	1.383	1.076	

Note. Odds ratios above 1 indicate higher odds of worse health (Models 2 and 3) or of having a diagnosed disease (Model 4). The inherited-disease odds ratio in Model 4 is not reported because respondents who share a disease with a parent have a diagnosed disease by definition.

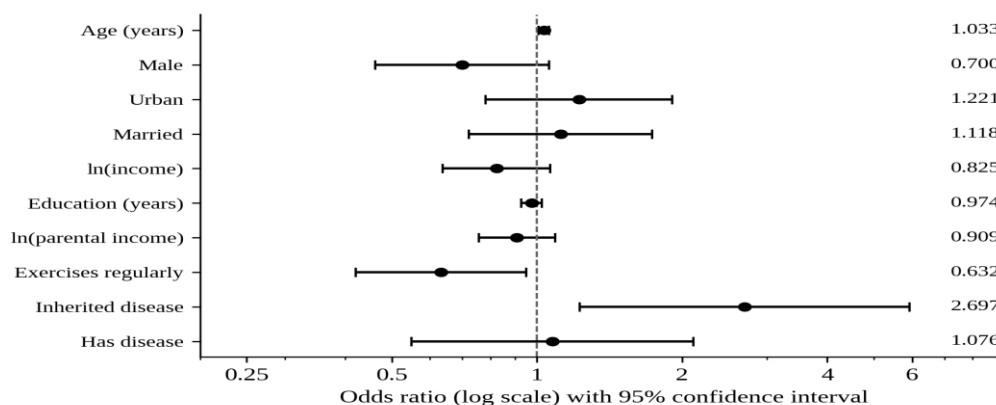
*** $p < .01$. ** $p < .05$. * $p < .10$.

Table 11 shows the size of each association. Figure 4 plots the odds ratios from Model 3, the binary model of below-very-good health with their 95% confidence intervals. The sign of each relationship is discussed below.

Figure 4 shows that only the confidence intervals for age, regular exercise and inherited disease lie entirely on one side of one while the interval for male gender only just includes one. The remaining intervals are centred close to one.

Age (worse health). Each additional year of age reduces health capital by 0.016 points ($p = .003$) and raises the odds of a worse health category by 3.2% ($OR = 1.032$, $p = .004$). This sign is expected. In Grossman's (1972) model, the stock of health capital depreciates with age and the prevalence of chronic conditions rises over the life course (Case & Deaton, 2005). The age effect also explains the poorer health of married respondents in Table 3 since the marital status coefficient becomes insignificant once age is controlled.

Figure 4: Odds Ratios for Reporting Good, Fair, or Poor Health (Model 3)



Note. Points show odds ratios from Model 3 in Table 10; horizontal lines show 95% confidence intervals computed from the reported standard errors. The dashed line marks an odds ratio of 1. The horizontal axis uses a log scale.

Gender (men report better health). Men report 0.207 points higher health capital than women ($p = .021$) and have 33% lower odds of being in a worse health category ($OR = 0.669$, $p = .026$). Women's poorer self-rated health is consistent with the international "gender paradox," in which women report more morbidity than men despite living longer (Case & Paxson, 2005). In Pakistan, it also reflects women's lower access to health care, lower physical activity and the unequal allocation of household resources that begins in childhood (Guthold et al., 2018; Jayachandran & Pande, 2017).

Urban residence (worse reported health, more diagnosed disease). Urban residence is associated with lower health capital (-0.185 , $p = .058$) and with higher odds of a worse health category ($OR = 1.398$, $p = .086$) and it almost triples the odds of having a diagnosed disease ($OR = 2.980$, $p = .031$). The positive association with disease is best explained by better access to diagnosis in cities: people cannot report conditions that have never been diagnosed (Sen, 2002). Urban lifestyles, including sedentary work, dietary change and pollution, may also raise the risk of chronic disease (NIPS & ICF, 2019).

Marital status (not significant). Married respondents report slightly worse health but the coefficient is not significant in any model once age is controlled. The literature suggests that marriage can protect health through social support and pooled resources but in a young sample this effect may be offset by the health demands of childbearing and household responsibilities (Robards et al., 2012).

Income (better health, marginally significant). Higher income is associated with better health in all three self-rated health models and the association is significant at the 10% level in the ordered logit model ($OR = 0.820$, $p = .086$). The positive sign reflects the ability of richer households to afford better nutrition, living conditions and private care (Deaton, 2003; Smith, 1999). The effect is weaker than the bivariate gradient in Table 3 because part of the income–health relationship operates through age, exercise and family background which the models control for. Reverse causality in which poor health reduces earnings is also possible in cross-sectional data (Smith, 1999).

Education (better health, not significant). Education has the expected protective sign in every model but is not significant. More educated people use health information more effectively and adopt healthier behaviours (Cutler & Lleras-Muney, 2010; Grossman, 1972) but in this sample education is high on average and strongly correlated with income which reduces its independent effect.

Parental income (better health, not significant). Parental income has a positive association with health capital (0.059 , $p = .151$) and a negative association with the odds of worse health ($OR = 0.883$, $p = .119$). The sign is consistent with the lasting effect of childhood circumstances on adult health (Case et al., 2002; Currie, 2009) which is visible in the parental income gradient in Table 5. The effect falls short of significance once the respondent's own income and education which themselves partly reflect parental resources are controlled.

Regular exercise (better health, less disease). Regular exercise is associated with 0.162 points higher health capital ($p = .061$) reduces the odds of below very good health by 37% ($OR = 0.632$, $p = .028$) and reduces the odds of a diagnosed disease by 73% ($OR = 0.273$, $p = .009$). These protective effects are consistent with clinical evidence that physical activity lowers the risk of hypertension, diabetes, cardiovascular disease and premature death (Warburton et al., 2006). Because the data are cross-sectional, part of the association may reflect reverse causality as people in poor health are less able to exercise.

Inherited disease (worse health). Respondents who share a disease with a parent have 0.289 points lower health capital ($p = .088$), 78% higher odds of a worse health category ($OR = 1.778$, $p = .094$) and 2.7 times higher odds of below very good health ($OR = 2.697$, $p = .014$). The negative effect on health reflects both genetic susceptibility and shared family environments and behaviours (Halliday et al., 2020; Thompson, 2014). In the disease model, the inherited-disease coefficient is very large (7.333) because all respondents who share a disease with a parent have by definition a diagnosed disease; this coefficient therefore reflects the construction of the variable rather than a behavioural effect.

Diagnosed disease and parental health investment (not significant). Having a diagnosed disease is associated with worse self-rated health in all models as expected (Idler & Benyamini, 1997) but the effect is not significant once inherited disease is included because most diagnosed conditions are shared with parents. The index of parental health investment has a positive but insignificant association with health capital (0.033, $p = .421$) consistent with the idea that parental care for diet and vaccination supports children's health (Currie & Almond, 2011), although the index is measured imprecisely.

Taken together, the multivariate results suggest that the income gradient in health observed in the group comparisons operates partly through behavioural and intergenerational channels, particularly exercise and family disease history rather than only through a direct effect of income. This interpretation is consistent with evidence that health behaviours account for part of the socioeconomic gradient in health (Cutler & Lleras-Muney, 2010) although cross-sectional data cannot establish mediation formally.

Discussion and Policy Implications

The most robust finding of this study is a significant income gradient in self-rated health, confirmed by both group comparisons and a positive concentration index. The gradient is present even in a young and relatively educated sample which suggests that health inequality emerges early in adult life as the literature on the origins of the health gradient predicts (Case et al., 2002; Deaton, 2013). The gradient is also continuous across the income distribution rather than confined to the poorest group which implies that policies targeted only at the very poor will not remove it (Marmot, 2005).

The strong clustering of disease within families, with two-thirds of those with a diagnosed condition sharing it with a parent is one of the most striking results. Genetic predisposition explains part of this clustering but shared diets, behaviours and environments are also likely to contribute (Thompson, 2014). The finding that adult health improves with parental income, even though disease inheritance does not vary with parental income, suggests that socioeconomic advantage is transmitted through channels such as childhood nutrition and care, consistent with the fetal origins hypothesis and the wider evidence on early-life determinants of health (Almond & Currie, 2011; Barker, 1990).

The urban-rural results require careful interpretation. Rural respondents do not report worse health than urban respondents, and urban residents are more likely to have a diagnosed disease. Given the well-documented disadvantages of rural Pakistan in health services and child survival (NIPS & ICF, 2019) these patterns are more plausibly explained by differences in diagnosis and health expectations than by better rural health (Sen, 2002). The higher medical spending of urban households together with the greater income-related health inequality in cities, points to the role of costly private care in urban health systems (PBS, 2022). The gender gap in physical activity reflects constraints on women's mobility and time and contributes to women's poorer self-rated health (Guthold et al., 2018).

These findings suggest several directions for policy. First, the dominance of out-of-pocket spending means that expanding financial protection including broader outpatient coverage under the Sehat Sahulat Programme would reduce the barriers that lower-income households face in seeking care (van Doorslaer et al., 2006; Wagstaff et al., 2018). Second, investment in rural primary care including Basic Health Units, Lady Health Workers, community midwives, and telemedicine is needed to ensure that low rural spending does not reflect unmet need. Third, the strong intergenerational clustering of disease calls for early-life interventions such as antenatal care, maternal nutrition support and school health programmes, together with family-based screening for hypertension and diabetes among the children of affected parents (Almond & Currie, 2011). Fourth, the gender gap in physical activity calls for community programmes that create safe spaces for women to exercise and that integrate health education into women's social networks. Finally, the predominance of hypertension and diabetes points to the need for systematic screening and management of non-communicable diseases in primary care (IDF, 2021).

The study has several limitations. The cross-sectional design does not permit causal inference, and reverse causality from health to income and exercise cannot be ruled out. The sample over-represents young, urban, male and educated respondents and is not nationally representative. Self-rated health, diagnosed disease, income and expenditure are self-reported and may be affected by reporting and recall bias and the analysis does not control for occupation. Future research should use longitudinal and nationally representative data, objective health measures such as biomarkers and clinical records and more detailed information on occupation and living environments.

Conclusion

This paper has examined health inequality and the intergenerational transmission of health capital using a survey of 613 adults in district Multan, Pakistan. Four main findings emerge. First, there is a statistically significant income gradient in self-rated health: respondents in the highest income quartile report substantially better health than those in the lowest ($F = 4.11$, $p = .007$), and the positive concentration index ($CI = 0.019$, $p = .003$) shows that this inequality extends across the entire income distribution. Second, disease is strongly concentrated within families: 14.0% of respondents share a disease with a parent and 66.4% of those with a diagnosed condition do so while the children of higher-income parents report better health. Third, health behaviours differ by gender with women exercising less than men (22.2% against 29.4%). Fourth, the multivariate models identify age, gender, regular exercise and inherited disease as the main correlates of self-rated health: regular exercise is associated with 37% lower odds of below-very-good health and sharing a disease with a parent with 2.7 times higher odds.

These results imply that Pakistan's health equity agenda should combine financial protection against health care costs, stronger rural primary care, early-life and family-based interventions to interrupt the intergenerational transmission of disease, gender-responsive promotion of physical activity and systematic prevention of non-communicable diseases. Such policies can help ensure that people's health depends less on the circumstances of their birth and more on equal access to good-quality care.

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