*Journal of Social Policy* (2024), **53**, 950–969
doi:10.1017/S0047279422000782

CAMBRIDGE UNIVERSITY PRESS

ARTICLE

# Inequality of Opportunity in Health Among Urban, Rural, and Migrant Children: Evidence from China

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(Received 19 August 2020; revised 10 August 2022; accepted 4 September 2022; first published online 02 December 2022)

**Abstract**

Rural-urban migrants, though facing unique social and institutional constraints, remain a largely overlooked population in research on health inequality in China. This study applies the inequality of opportunity (IOp) framework to investigate health inequality among children in China. Instead of comparing only urban and rural children, we include rural-urban migrants. Drawing upon three waves of a nation-wide survey, we find that migrant children in China remain disadvantaged in terms of health when compared to urban and rural children. The decomposition of the determinants indicates that while the direct influence of *hukou*, China's household registration system, on IOp in health is low and has decreased, particularly between 2007 and 2013, one's province of residence still matters. Parental health contributes substantially to IOp in health, which likely is an indirect effect of *hukou* that creates barriers for migrant parents in regard to accessing healthcare. The policy implication of these findings is that although the direct influence of *hukou* has decreased, when coupled with the continued lack of local government support for the welfare of migrant workers, it perpetuates health inequalities.

**Keywords:** inequality of opportunity; health inequality; migration; China

## 1. Introduction

There is a growing argument that China is no longer a country of 'two peoples', (that is, urban and rural). Rather, it has developed into a country of 'three peoples', (that is, urban, rural, and rural-urban migrants; Whyte, 2010).[1] It is argued that structural factors – in particular, the institutionalized *hukou* or household registration system – have deepened the rural-urban cleavage and has created a new group of citizens (migrants) for whom clear differences exist in their quality of life and chances for upward mobility (Xie, 2016).

While attention has been given to rural-urban migrants in analyzing income inequality trends in China (Sicular *et al.*, 2007), whether or not migrants are

significantly more disadvantaged in terms of health when compared to their urban and rural counterparts remains a significant, but underexplored question. There is evidence suggesting that *hukou* poses barriers when migrants seek healthcare in destination cities (World Bank, 2010; Qiu *et al*., 2011). While policy measures such as the Urban Employee Basic Medical Insurance (UEBMI), Urban Resident Basic Medical Insurance (URBMI), and the New Cooperative Medical Scheme (NCMS) have been put in place to address this, to what extent they moderate the impact of *hukou* requires investigation.

Much of the earlier literature on health inequality in China focused on income-related health inequality (IRHI) (Chen and Meltzer, 2008; Yip, 2010; Baeten *et al*., 2013; Bakkeli, 2016; Wang and Yu, 2015). The IRHI is measured as a concentration index, similar to the Gini Index, wherein the variation of health across income groups is measured by ranking the cumulative proportion of population in each income (socioeconomic status) group against the cumulative proportion of health (Wagstaff *et al*., 1991). There are methodological advantages to using the IRHI if decomposing health inequality by income group is the primary objective (Wagstaff *et al*., 1991). However, both theoretical and methodological limitations of using such an index have been highlighted. First, concentration indices such as the IRHI make interpersonal comparisons without attaching due importance to variations in individual conditions. Indeed, Sen (2000) argues that making the simple assumption that there is something homogeneous called "income" in terms of which everyone's overall advantage can be judged and interpersonally compared is undesirable as it assumes away personal circumstances, variation in needs, and other factors that are beyond one's control. And second, a related methodological limitation of the IRHI is its use of income as the ranking variable, thus making an a priori assumption that health inequalities across income distributions are the most relevant issue. Surely, one might argue that the concentration indices can be decomposed into determining factors such as demographic characteristics and healthcare system factors (Wagstaff *et al*., 2003; McGrail *et al*., 2009). However, such a decomposition would still not address the normative question of whether these factors are legitimate or illegitimate sources of inequality.

It is these questions around the legitimacy of the sources of inequality that led to the development of a normative and empirical framework of inequality based on the responsibility principle introduced by Roemer (1993, 1998). It segregates individual advantages into two components – circumstances and effort. Circumstances are factors such as place of birth and parental characteristics, over which individuals have no influence. Effort refers to personal responsibility exercised through individual choices and actions and is measured *relative* to one's type where individuals are held responsible for their degree of effort within their type but not for the level of effort (shape of the distribution). Roemer (1993, 1998) refers to inequality resulting from circumstances as *inequality of opportunity*, and argues that such inequality should be compensated for by society as individuals are not responsible for the circumstances and the resulting differences in opportunity sets they face.

The IOp framework resulted in a shift in thinking around inequality in general and health equality in particular. It reframed the empirical and policy question from merely asking what are the determinants of health inequality to whether some of these determinants of health inequality are more ethically objectionable than others

and therefore should be compensated for. Thus, in contrast to the 'strict equality'[2] value judgement underlying utilitarian health inequality measurements, the IOp approach focuses on 'procedural fairness' to assess the legitimacy of sources of health inequality (Roemer and Trannoy, 2015; Bourguignon, 2018).

In this paper, we look beyond socioeconomic factors as drivers of health inequality in China and apply the IOp lens that incorporates individuals' background factors. We address several gaps in the literature on health inequality in China. First, we go beyond the IRHI and investigate the IOp in health. Second, instead of comparing only urban and rural residents, we also include rural-urban migrants, who, even though they face unique social and institutional constraints, remain a largely ignored population. Third, we focus on the IOp in health for children as it is a critical indicator of intergenerational mobility and the perpetuation of inequality. Fourth, we examine the IOp in health in China using data from three time periods that span a decade. This allows us to observe whether there have been changes in health inequality over time and also changes in the contribution of different factors to health inequality. Given a number of important social policy and health policy reforms in China, this study, drawing on a comparison within a decade, can not only shed light on public policies on health in China but also other contexts which may experience a similar transition in terms of rural-urban migration and access to healthcare.

To achieve this, we apply the Human Opportunity Index (HOI) developed by de Barros *et al.* (2008, 2009), which draws upon the IOp framework proposed by Roemer (1993, 1998). HOI combines both the coverage or access to basic opportunities and the extent to which the distribution of opportunities is conditional upon circumstances. Following their methodology, we develop the HOI for children of urban residents, rural residents, and rural-urban migrants using data from the Chinese Household Income Project in 2002, 2007, and 2013 and investigate the distribution of their health statuses. We supplement the HOI analysis with stochastic dominance tests to check the robustness of our results.

Our key finding is that migrant children in China remain disadvantaged in terms of health when compared to urban and rural children. The inequality stems mainly from parental health, which is likely an indirect effect of *hukou* that creates barriers for migrant parents in regard to accessing adequate healthcare.

The paper is organized as follows. Section 2 presents a review of the literature and the theoretical framework for IOp. Section 3 discusses the data, methodology, and empirical strategy. Section 4 presents the descriptives and results. Section 5 discusses the factors underlying IOp in health for children and concludes.

## 2. Literature review and theoretical framework

### *2.1 Rural-urban-migrant inequality in China*

Inequality in China has been primarily attributed to two factors – regional (that is, an extensive focus on coast-oriented and urban-biased development), and institutional (that is, the *hukou* system). The two factors are interlinked as the *hukou* system constrains those from rural areas from migrating to urban areas to take advantage of the growth and opportunities.

The unique *hukou* system, introduced in China in 1958, lies at the crux of the rural-urban-migrant inequality debate. The original intention of the *hukou* system

was to ensure minimum agricultural output and job security in cities. However, over the decades, it was used to prevent the free movement of labor from rural to urban areas as well as to determine eligibility for benefits across various social programs, including education. Post-1978, economic reforms eased restrictions set by the *hukou* system on rural-urban migration and enabled migrants to gain temporary and conditional residence in urban areas. However, migrants continue to face challenges when accessing social protection programs and entitlements such as employment in urban government jobs, healthcare, housing, and public education (Knight and Song, 1995, 1999; World Bank, 2010; Qiu *et al.*, 2011). Specific to access to healthcare, under the updated health policy, migrants are covered under two main health insurance schemes for urban residents – Urban Employee Basic Medical Insurance (UEBMI) targeted at urban employed population, and Urban Resident Basic Medical Insurance (URBMI) targeted at unemployed urban residents, especially the elderly, students, and children. However, owing mainly to the lower wages of migrants and the inability to pay high premiums, the coverage received by migrants tends to be significantly lower (World Bank, 2010). Further, even though migrants may have coverage under the New Cooperative Medical Scheme (NCMS), a subsidized voluntary health insurance scheme for rural residents, the benefits of NCMS are not portable to UEBMI or URBMI (World Bank, 2010). Thus, even with these policies in place, health inequalities might endure.

A huge gap remains, however, in investigating inequality specifically among rural-urban migrants in China when compared to rural and urban residents. Sicular *et al.* (2007) argue that it is imperative for income inequality measurements in China to account for migrants as migration is an important coping strategy to bridge the rural-urban income gap, and that excluding migrants can cause an overstatement of the rural-urban income gap. Using the 1995 and 2002 Household Income Surveys and including migrants, they found that in 2002 the rural-urban gap contributed about 25 percent of overall inequality, as compared to previous estimates of 50 percent or more. Further, they found that the contribution of location in determining overall inequality declined between 1995 and 2002, indicating the positive effects of spatial mobility. There is no such empirical evidence available on rural-urban-migrant health inequality in China.

### 2.2 Inequality of opportunity

According to the 2006 World Development Report, IOp is of significance to policymakers mainly because it is intrinsically unfair and can lead to social instability and conflict (World Bank, 2006). Further, shifting the debate away from income redistribution towards opportunity redistribution is likely to gain more political consensus and provides a better direction for formulating policy and interventions (de Barros *et al.*, 2009). The idea underlying equality of opportunity is to provide each individual an equal chance such that, in principle, they each have the potential to achieve and maximize their desired outcomes.

Normative frameworks proposed by egalitarian philosophers such as Rawls (1971), Dworkin (1981a, 1981b), and Sen (1985) posit that distributive justice does not necessitate that all individuals have equal outcomes, but rather it requires that all individuals have equal opportunities that lead to the outcomes of interest.

Borrowing from these theories, Roemer (1993, 1998) proposed that society should compensate people for poor outcomes resulting from causes that are beyond their control (circumstance), but not against outcomes resulting from causes that are within their control (effort, preference, choice, personal will, or ambition).

The Roemer model thus entails that some sources of inequality for which individuals can be held responsible are legitimate while others are arguably illegitimate because they are beyond one's control (Rosa Dias, 2009; Trannoy *et al.*, 2010). A challenge that remains is to empirically assess the equality of opportunity, and identify and operationalize variables that count as circumstance and effort, especially when factors such as effort are unobservable. Much of the empirical work on equality of opportunity focuses on family background as the circumstances, and income or earnings as the outcome (Bourguignon *et al.*, 2007; Ferreira and Gignoux, 2008; Cogneau and Mesplé-Somps, 2008).

Studies on the IOp in health conducted in the context of developed countries identify parents' socioeconomic status and parents' health as the circumstances determining IOp in health during adulthood (Rosa Dias, 2009; Trannoy *et al.*, 2010; Jusot *et al.*, 2013). There is a growing body of literature on IOp in health in China, but it mostly focuses on rural-urban inequalities and does not separately examine the migrant population. Ma *et al.* (2021) examined IOp in rural-urban healthcare utilization with a focus on health insurance and found that while the restrictions imposed by the *hukou* on health insurance characterize IOp in healthcare utilization, health policy reforms which changed the insurance reimbursement ratio for rural residents have resulted in lower IOp. Using longitudinal data, Zhang and Coyte (2020) found a decline in IOp in health expenditures from 2011-2015. However, a decomposition suggested that disparities still exist owing to unequal regional distribution of medical resources and less than sufficient subsidies under the NCMS.

With reference to IOp in health among children, Eriksson *et al.* (2014) found evidence supporting intergenerational health inequality between urban and rural children, with rural children being relatively worse off owing to parental socioeconomic factors such as education, income, and employment, and also parental environmental and healthcare factors such as standard of living and access to healthcare. Hu *et al.* (2020) used data on nine cities in Guangzhou and found that while IOp in growth of children has decreased with urbanization, new health inequities have emerged among rural children such as the incidence of obesity.

Few studies on China include migrant status as determinants of differences in children's health outcomes. The evidence is mixed with some studies finding no difference in self-reported health status or mental well-being between urban and migrant children (Lau and Li, 2011; Xu and Xie, 2015) and others finding migrant children worse off in terms of vaccination compared to urban children (Liang *et al.*, 2008). Two gaps to note in these studies are, first, their framework does not explicitly focus on IOp in health. And second, they only examine cross-sectional data and not changes over time.

Recognizing the challenge of empirical assessment of IOp, de Barros *et al.* (2009) developed the Human Opportunity Index (HOI), which measures inequality in the access to basic opportunities for children such as access to education, healthcare, sanitation, and other basic services with the idea that a just society should attempt to equitably supply these basic opportunities to as many children as possible.

de Barros *et al.* (2009) argue that the HOI has advantages over other measures in that by focusing on children it invalidates the issue of endogeneity that concerns measurements of IOp. For instance, in the case of an adult, access to water might depend on the choice of location, which is likely to be within her control, and therefore, we cannot attribute it entirely to circumstance. However, for a child below the age of consent, access to water is entirely dependent on the choices made by her parents and therefore is exogenous to her. Another argument in favor of the HOI is that early life opportunities for children are quintessential for development later in life and can provide a better ex-ante outlook of intergenerational upward mobility.

Evidence on the application of the HOI to examine IOp in health is limited. Singh (2011) used the HOI to determine the IOp in regard to immunization and nutrition among children in India and found significant disparities based on two circumstances – parental education and region (rural/urban and state) of residence. Jemmali (2018) applied the HOI to examine IOp in the access to basic services pertaining to health such as water and sanitation among Tunisian children and found that the number of siblings, parents' education, wealth and location of residence are the key circumstances determining IOp. Parental characteristics and location are therefore important circumstances underlying IOp that warrant further examination.

## 3. Data and methodology

### *3.1 Data description*

We use data from the 2002, 2007, and 2013 Chinese Household Income Project (CHIP) surveys. The survey defines rural-urban migrants as individuals who held rural *hukou* but resided in an urban area at the time of the interview. For analytical purposes, we only used sub-groups of children aged 0 to 16 years across urban, rural, and migrant households who live with one or both parent(s), which resulted in 28,827 observations – 3,044, 1,790 and 2,406 urban children; 8,706, 4,869, and 6,239 rural children; and 856, 716, and 201 migrant children from the 2002, 2007, and 2013 surveys respectively. The samples have been appropriately weighted to ensure representativeness (see Appendix 1).

### *3.2 Methodology*

To examine the degree of IOp in access to basic opportunities among migrant and non-migrant (urban and rural) children, we borrowed the methodology for computing the HOI from de Barros *et al.* (2008, 2009) and Singh (2011). The HOI is a composite index that combines (i) for how many children the basic opportunities are available (that is, the coverage rate), and (ii) how equitably the basic opportunities are distributed conditional on exogenous circumstances. To measure equity, a dissimilarity index or the D-Index was used. A basic opportunity is an indicator that (i) influences current and future outcomes such as income and wages, (ii) is critical for the development of individuals, (iii) is exogenous to individuals but endogenous to society (that is, it can be modified through policy intervention), and (iv) is likely to be negatively influenced by circumstances.

The key component of the HOI used to estimate IOp is the D-Index. It measures the dissimilarity in access for a given basic opportunity for groups defined by the

circumstances (such as *hukou*, parental education, parental income, gender, and so on) compared with the average access rate for the given basic opportunity for the population as a whole. The D-index is the weighted average of all such access probability gaps – that is, the weighted average of absolute differences between group-specific access rates $p_i$ and the overall average access rate $\bar{p}$. It ranges from 0 to 1 (0 to 100 in percentage terms). In a situation of perfect equality of opportunity, D will be zero.

The HOI, represented by $O$, is conceived as $O = \bar{p}(1 - D)$, where the coverage rate $\bar{p}$ is discounted if $D$ is high – that is, the basic opportunities are inequitably distributed. Intuitively, an increase in coverage $\bar{p}$ will improve the HOI. Details on the computation of the D-index and HOI are described in Appendix 2.

### 3.3 Variables

Drawing upon previous studies, we focus on two circumstances in this study – parental health status and *hukou*. Importantly, parental health status may in itself be closely linked with *hukou* as parents can access healthcare in their place of residence based on their *hukou*-specific health insurance scheme. In addition, parental health status also reflects access to health insurance. For instance, migrant parents working in the informal sector in urban areas may lack access to formal health insurance, consequently reporting low health status. For *hukou*, only households whose status is local urban, local rural, or migrant are used in the analyses.[3] Parents were asked to evaluate their own health status compared to people of the same age on a 5-point scale with higher values representing better health. Parents who reported their health status as 4 or 5 were classified as having "high health" status and those with lower values were classified as having "low health" status. We used the highest health status reported by either parent.

We controlled for other relevant circumstances in our estimation that may determine children's health status. These included a child's gender, province of residence, minority status, number of children in the household, household consumption expenditure, highest parental education (either father's or mother's), and whether both parents are present.[4,5]

The variable used to operationalize basic opportunity is children's health status. The CHIP surveys do not contain consistently available objective measures of child health, such as physical health or immunization. We therefore used children's health status as reported by their parents on a 5-point scale with higher values representing better health. Children whose health status was reported as 4 or 5 were classified as having "good" health. Studies on the validity of using self-reported health (SRH) have found there to be a strong association between SRH and mortality risk (Idler and Benyamini, 1997; Franks *et al.*, 2003; Benjamins *et al.*, 2004). This assuages the concern around unobserved biases such as reporting errors, psychological factors, and norms when using SRH.

We classified children into two sub-groups. The first was based on their *hukou* – (i) urban, (ii) rural, and (iii) migrant. The second was based on parental health – (i) high parental health and (ii) low parental health. Further, we classified children into six *types* based on a combination of parental health and *hukou* circumstances – (i) high-health-urban, (ii) high-health-rural, (iii) high-health-migrant, (iv) low-health-urban, (v) low-health-rural, and (vi) low-health-migrant. The sample size for each of the six types is summarized in Table 1.

**Table 1.** Number of children by sub-groups and type

| | 2002 | 2007 | 2013 | Total |
|---|---|---|---|---|
| ***Sub-groups*** | | | | |
| urban | 3,044 | 1,790 | 2,406 | 7,240 |
| rural | 8,706 | 4,869 | 6,239 | 19,814 |
| migrant | 856 | 716 | 201 | 1,773 |
| high parental health | 11,245 | 6,527 | 7,934 | 25,706 |
| low parental health | 1,361 | 848 | 912 | 3,121 |
| ***Types*** | | | | |
| high-health-urban | 2,371 | 1,490 | 2,153 | 6,014 |
| high-health-rural | 8,057 | 4,396 | 5,597 | 18,050 |
| high-health-migrant | 817 | 641 | 184 | 1,642 |
| low-health-urban | 673 | 300 | 253 | 1226 |
| low-health-rural | 649 | 473 | 642 | 1,764 |
| low-health-migrant | 39 | 75 | 17 | 131 |
| Total | 12,606 | 7,375 | 8,846 | 28,827 |

We computed the D-index, HOI, and coverage for relevant combinations of the six types. For example, "high-health-urban and low-health-urban" combined two types of children with urban *hukou*: ones whose parental health status was high and ones whose parental health status was low. Similarly, we recorded IOp in health for the two types "high-health-urban and high-health-migrant" after combining these sub-samples. This allowed us to examine IOp in health within sub-groups with the same *hukou* (urban, rural, and migrant children) as well as between types.

### 3.4 Stochastic dominance test

We conducted a stochastic dominance test of IOp in health for the six types. First, we plotted the cumulative distribution functions (CDFs) of children's health status evaluated on the 5-point scale for each type, then tested the statistical significance of these distributions using the Wilcoxon rank-sum test (Wilcoxon, 1945). The null hypothesis of the Wilcoxon rank-sum test is that the two independent samples are from populations with the same distribution. We tested the distribution for relevant combinations of the six types – for example, "high-health-urban versus low-health-urban", and so on, by combining these sub-samples of children.

## 4. Results

### 4.1 Descriptive statistics

Tables 2a, 2b, and 2c summarize the child and household characteristics in 2002, 2007, and 2013 respectively for the three sub-groups of children – urban, rural,

**Table 2a.** Descriptive statistics for children by sub-group (2002)

| | Urban | | | | Rural | | | | Migrant | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variable | Mean | S.D. | Min | Max | Mean | S.D. | Min | Max | Mean | S.D. | Min | Max |
| Child is male | 0.51 | 0.50 | 0 | 1 | 0.55 | 0.50 | 0 | 1 | 0.56 | 0.50 | 0 | 1 |
| Age of child | 10.31 | 4.21 | 1 | 16 | 10.67 | 4.34 | 0 | 16 | 8.10 | 4.37 | 1 | 16 |
| Minority | 0.06 | 0.23 | 0 | 1 | 0.16 | 0.37 | 0 | 1 | 0.87 | 0.34 | 0 | 1 |
| Father's education in years | 11.66 | 3.07 | 0 | 23 | 7.68 | 2.29 | 0 | 16 | 8.29 | 2.63 | 0 | 18 |
| Mother's education in years | 11.00 | 3.04 | 0 | 23 | 6.44 | 2.62 | 0 | 16 | 7.05 | 2.83 | 0 | 15 |
| Father's health status | 3.95 | 0.84 | 1 | 5 | 4.11 | 0.70 | 1 | 5 | 4.22 | 0.65 | 1 | 5 |
| Mother's health status | 3.87 | 0.86 | 1 | 5 | 4.00 | 0.73 | 1 | 5 | 4.16 | 0.66 | 1 | 5 |
| Two-parent household | 0.95 | 0.21 | 0 | 1 | 0.98 | 0.15 | 0 | 1 | 0.97 | 0.16 | 0 | 1 |
| Number of children in household | 1.09 | 0.29 | 1 | 3 | 1.84 | 0.79 | 1 | 5 | 1.45 | 0.61 | 1 | 4 |
| Log of household consumption | 9.64 | 0.57 | 7.08 | 12.26 | 8.76 | 0.58 | 6.77 | 12.31 | 9.34 | 0.55 | 7.31 | 11.25 |
| **Number of observations** | **3,044** | | | | **8,706** | | | | **856** | | | |

and migrant. Across all years, migrant children were younger when compared to their urban and rural counterparts on average. This may be because migrant parents, on average, tend to be younger than their urban and rural counterparts. This is also plausibly why the mean health status of migrant fathers and mothers is higher than urban and rural parents.[6]

Parental education differed across the three sub-groups. While urban parents had the highest education levels among the three sub-groups, migrant parents were more educated than rural parents. This may be due to the fact that finding a job in urban areas requires relatively higher levels of education and skills. With the accelerated urbanization in China, many educated rural people are actually remaining in urban areas. Minority children are concentrated among migrant households while the number of children is lowest among migrant households. The mean consumption expenditure of urban households is highest followed by migrant and rural households. It is observed from Tables 2b and 2c that differences across the sub-groups along some of the circumstances such as parental education and household consumption expenditure widened in 2007 before narrowing in 2013. Again, this may be due to the changing profile of rural-urban migrants between these periods with more educated rural residents moving to urban areas in recent years.

**Table 2b.** Descriptive statistics for children by sub-group (2007)

| | Urban | | | | Rural | | | | Migrant | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variable | Mean | S.D. | Min | Max | Mean | S.D. | Min | Max | Mean | S.D. | Min | Max |
| Child is male | 0.53 | 0 | 0 | 1 | 0.55 | 0 | 0 | 1 | 0.55 | 0.50 | 0 | 1 |
| Age of child | 8.88 | 5 | 0 | 16 | 9.71 | 5 | 0 | 16 | 7.68 | 4.90 | 1 | 16 |
| Minority | 0.02 | 0 | 0 | 1 | 0.01 | 0 | 0 | 1 | 0.02 | 0.13 | 0 | 1 |
| Father's education in years | 12.59 | 4 | 1 | 35 | 8.32 | 2 | 0 | 19 | 8.65 | 2.33 | 1 | 16 |
| Mother's education in years | 12.05 | 3 | 2 | 35 | 7.53 | 2 | 1 | 19 | 7.97 | 2.43 | 1 | 16 |
| Father's health status | 3.94 | 1 | 1 | 5 | 4.18 | 1 | 1 | 5 | 4.27 | 0.73 | 1 | 5 |
| Mother's health status | 3.91 | 1 | 1 | 5 | 4.09 | 1 | 1 | 5 | 4.22 | 0.74 | 2 | 5 |
| Two-parent household | 0.93 | 0 | 0 | 1 | 0.62 | 0 | 0 | 1 | 0.97 | 0.18 | 0 | 1 |
| Number of children in household | 1.10 | 0 | 1 | 3 | 1.64 | 1 | 1 | 10 | 1.40 | 0.56 | 1 | 3 |
| Log of household consumption | 10.36 | 0.64 | 8.32 | 12.86 | 9.40 | 0.61 | 7.54 | 12.28 | 10.02 | 0.54 | 7.98 | 11.49 |
| **Number of observations** | **1,790** | | | | **4,869** | | | | **716** | | | |

### *4.2 Estimates of the D-index and HOI*

Table 3 shows the D-index, HOI, and coverage for combinations of the six types. The D-index, HOI, and coverage presented in rows (a), (b), (c), and (d), suggest that the IOp in health between urban and migrant children has decreased over time and nearly halved between 2002 and 2013 while that between rural and migrant children increased during the same period. In comparison, inequality between children with high versus low parental health increased in 2007 but decreased to about the same level as 2002 in 2013.

Estimates in rows (e), (f), and (g), which compare types within sub-groups with the same *hukou*, suggest that, in 2002, IOp in health was highest for urban children owing to differences in parental health status. Parental health status matters much less for disparities within rural and migrant children. In 2007, IOp in health increased for rural and migrant children while decreasing for urban children. In 2013, the influence of parental health status on the IOp in health of urban children decreased further. Similarly, in 2013, disparities in regard to rural children and migrant children also narrowed. As these are within sub-group comparisons, they do not fully reflect the influence of the underlying structural factors.

A more telling picture emerges from the between-type comparisons. The D-index, HOI, and coverage presented in rows (h), (i), and (j) show that the influence of *hukou* on IOp in health for children with high parental health status is less

**Table 2c.** Descriptive statistics for children by sub-group (2013)

| | Urban | | | | Rural | | | | Migrant | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variable | Mean | S.D. | Min | Max | Mean | S.D. | Min | Max | Mean | S.D. | Min | Max |
| Child is male | 0.53 | 0.50 | 0 | 1 | 0.55 | 0.50 | 0 | 1 | 0.56 | 0.50 | 0 | 1 |
| Age of child | 8.96 | 4.64 | 0 | 16 | 8.48 | 4.69 | 0 | 16 | 7.89 | 4.37 | 0 | 16 |
| Minority | 0.07 | 0.25 | 0 | 1 | 0.09 | 0.29 | 0 | 1 | 0.05 | 0.23 | 0 | 1 |
| Father's education in years | 12.16 | 3.18 | 0 | 21 | 8.42 | 2.38 | 0 | 18 | 9.40 | 2.45 | 2 | 16 |
| Mother's education in years | 11.76 | 3.20 | 0 | 22 | 7.97 | 2.60 | 0 | 18 | 8.82 | 2.38 | 0 | 16 |
| Father's health status | 4.22 | 0.74 | 1 | 5 | 4.17 | 0.76 | 1 | 5 | 4.36 | 0.64 | 3 | 5 |
| Mother's health status | 4.18 | 0.74 | 1 | 5 | 4.12 | 0.77 | 1 | 5 | 4.29 | 0.65 | 2 | 5 |
| Two-parent household | 0.94 | 0.23 | 0 | 1 | 0.94 | 0.23 | 0 | 1 | 0.98 | 0.14 | 0 | 1 |
| Number of children in household | 1.23 | 0.47 | 1 | 4 | 1.62 | 0.70 | 1 | 7 | 1.67 | 0.63 | 1 | 3 |
| Log of household consumption | 10.88 | 0.61 | 7.31 | 13.54 | 10.18 | 0.55 | 8.51 | 13.17 | 10.51 | 0.80 | 7.63 | 12.15 |
| **Number of observations** | **2,406** | | | | **6,239** | | | | **201** | | | |

pronounced across all time periods. However, we observe a striking dispersion in rows (k), (l), and (m), which compare types with low parental health status. This suggests that *hukou* has a stronger association with IOp in health among children with low parental health status. Looking at the trends, disparities between urban and rural children with low parental health status saw an increase between 2002 and 2007 but decreased substantially between 2007 and 2013. Similarly, disparities between rural and migrant children with low parental health status increased between 2002 and 2007 but underwent a drastic reduction between 2007 and 2013. In contrast, disparities between urban and migrant children with low parental health status witnessed an increasing trend between 2002 and 2007 and again between 2007 and 2013. This implies a shift in the nature of IOp in health over time.

To investigate the magnitude of the contribution of the two circumstances – parental health status and *hukou* – we conducted Shapley decomposition analysis. As shown in Table 4, we found that within the three sub-groups, parental health status contributes the most to IOp in health across all years and its contribution increased over the years. The contribution of *hukou* to IOp in health was found to be much smaller in magnitude compared to parental health. However, it increased between 2002 and 2007 before decreasing between 2007 and 2013. While *hukou* seems to matter less to health inequality, province of residence appears to be more significant. This could be an indication of the differences in the implementation of health policies across provinces.

**Table 3.** D-index, HOI, and coverage for children's health status

| | | 2002 | | | 2007 | | | 2013 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | D-index | HOI | Coverage | D-index | HOI | Coverage | D-index | HOI | Coverage |
| | ***Between sub-groups*** | | | | | | | | | |
| (a) | urban & rural | 3.66 | 89.10 | 92.48 | 5.64 | 84.21 | 89.24 | 3.73 | 90.21 | 93.70 |
| (b) | urban & migrant | 7.66 | 78.76 | 85.30 | 6.61 | 83.07 | 88.95 | 3.85 | 90.55 | 94.13 |
| (c) | rural & migrant | 1.93 | 93.55 | 95.38 | 4.97 | 85.67 | 90.14 | 3.33 | 90.77 | 93.84 |
| (d) | high parental health & low parental health | 3.63 | 89.13 | 92.49 | 5.46 | 84.69 | 89.58 | 3.53 | 90.55 | 93.86 |
| | ***Within sub-groups*** | | | | | | | | | |
| (e) | high health urban & low health urban | 8.13 | 77.51 | 84.37 | 6.93 | 82.23 | 88.35 | 4.13 | 89.98 | 93.86 |
| (f) | high health rural & low health rural | 1.91 | 93.60 | 95.42 | 5.05 | 85.31 | 89.85 | 3.55 | 90.25 | 93.57 |
| (g) | high health migrant & low health migrant | 2.93 | 91.72 | 94.49 | 4.13 | 89.40 | 93.25 | 2.91 | 93.58 | 96.38 |
| | ***Between types*** | | | | | | | | | |
| (h) | high health urban & high health rural | 1.05 | 95.37 | 96.37 | 1.39 | 94.05 | 95.38 | 0.89 | 96.90 | 97.77 |
| (i) | high health urban & high health migrant | 1.85 | 92.38 | 94.12 | 1.48 | 94.58 | 96.00 | 0.90 | 97.12 | 98.00 |
| (j) | high health rural & high health migrant | 0.83 | 96.37 | 97.17 | 1.38 | 94.01 | 95.33 | 0.77 | 96.97 | 97.73 |
| (k) | low health urban & low health rural | 10.60 | 56.01 | 62.65 | 12.28 | 42.32 | 48.24 | 6.39 | 54.17 | 57.87 |
| (l) | low health urban & low health migrant | 8.73 | 47.69 | 52.25 | 9.31 | 44.88 | 49.49 | 12.72 | 50.68 | 58.06 |
| (m) | low health rural & low health migrant | 9.66 | 66.09 | 73.16 | 17.29 | 39.04 | 47.20 | 8.85 | 54.36 | 59.64 |

**Table 4.** Decomposition of HOI by circumstances

| | All | | | High parental health | | | Low parental health | | | Urban | | | Rural | | | Migrant | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2002 | 2007 | 2013 | 2002 | 2007 | 2013 | 2002 | 2007 | 2013 | 2002 | 2007 | 2013 | 2002 | 2007 | 2013 | 2002 | 2007 | 2013 |
| Highest parental health | 89.525 | 97.112 | 98.838 | | | | | | | 90.505 | 95.910 | 98.027 | 86.468 | 96.288 | 98.478 | 91.569 | 96.283 | 91.611 |
| *Hukou* | −0.010 | 0.387 | 0.152 | 16.085 | 52.939 | 3.308 | 18.791 | 2.223 | 3.757 | | | | | | | | | |
| Province | 10.610 | 2.395 | 1.285 | 83.394 | 42.824 | 66.295 | 68.681 | 86.986 | 68.301 | 8.696 | 4.408 | 1.645 | 13.382 | 3.089 | 1.063 | 4.837 | 2.473 | 3.903 |
| Highest parental education | −0.152 | 0.125 | −0.173 | −0.806 | −2.905 | 6.984 | 6.316 | 5.152 | 0.888 | −0.089 | −0.200 | −0.074 | −0.279 | −0.067 | −0.169 | 0.001 | 0.111 | 0.132 |
| Child gender (male=1) | 0.211 | 0.115 | 0.008 | 1.837 | 2.381 | 0.442 | 0.122 | −0.021 | 0.041 | 0.015 | 0.063 | 0.040 | 0.405 | 0.113 | −0.003 | −0.019 | 0.661 | −0.100 |
| Number of children | −0.005 | −0.055 | 0.062 | −0.441 | 0.084 | −0.243 | 1.681 | 0.216 | 6.165 | 0.519 | −0.028 | −0.040 | −0.140 | 0.055 | 0.087 | 2.170 | 0.051 | 2.124 |
| Two-parent household | −0.003 | −0.002 | −0.120 | 0.503 | 4.442 | 24.154 | 5.340 | 3.662 | 0.000 | −0.001 | −0.120 | 0.211 | −0.024 | −0.037 | −0.067 | 0.702 | −0.215 | 1.111 |
| Minority | −0.065 | 0.026 | −0.068 | −1.330 | 2.359 | −0.560 | 4.751 | 0.973 | 9.157 | 0.018 | −0.003 | −0.003 | 0.005 | 0.195 | −0.061 | 0.316 | 0.757 | −1.591 |
| Log consumption expenditure | −0.111 | −0.103 | 0.017 | 0.758 | −2.125 | −0.381 | −5.682 | 0.809 | 11.691 | 0.337 | −0.029 | 0.194 | 0.114 | 0.365 | 0.012 | 0.424 | −0.121 | 2.810 |

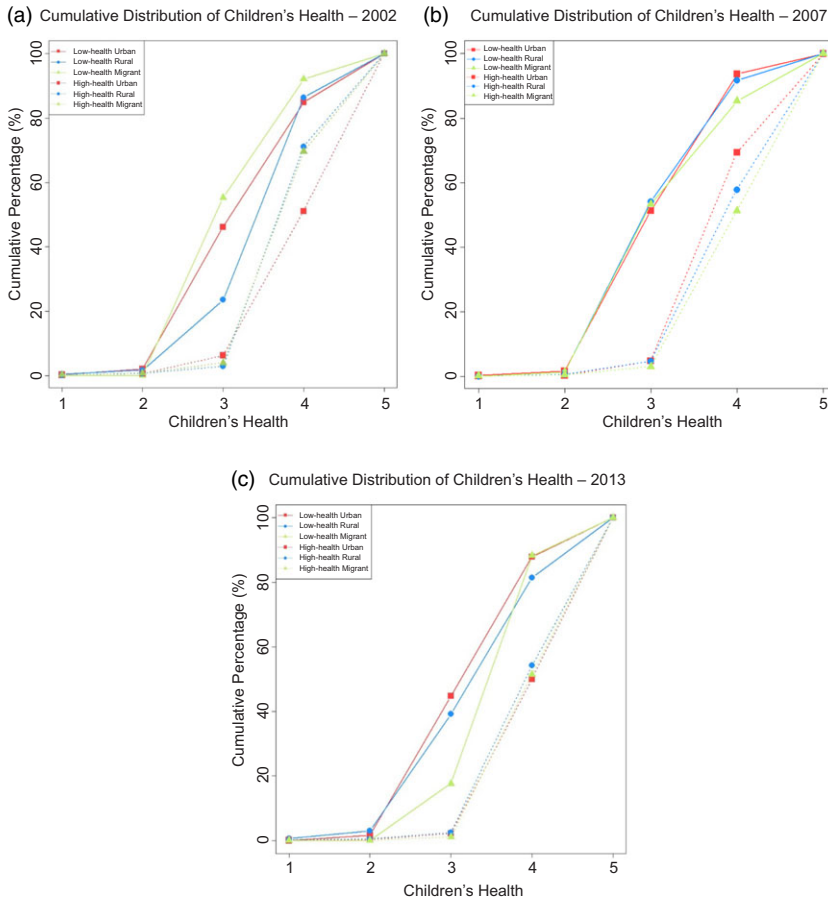


**Figure 1.** (a) Cumulative distribution of children's health status in 2002. (b) Cumulative distribution of children's health status in 2007. (c) Cumulative distribution of children's health status in 2013.

Next, we examined IOp in health using stochastic dominance tests. We visually examined the stochastic dominance by plotting the CDFs of children's health status for the six types. Figures 1(a), (b), and 1(c) plot the CDFs for 2002, 2007, and 2013, respectively. As the CDFs intersect, it is difficult to establish first-order stochastic dominance. We therefore conducted Wilcoxon rank-sum tests to establish which distribution is more dominant. We compared combinations of the six types. Table 5 summarizes the results of the Wilcoxon rank-sum tests. P{health(Type 1) > health(Type 2)} is the probability that the health status of a child from Type 1 is higher than that of a child from Type 2. The results indicate that in all three waves – 2002, 2007, and 2013 – parental health status determined IOp in health within the urban, rural, and migrant sub-groups. When comparing between types, it was observed that disparities between urban and rural children remain regardless of parental health status. While in 2002 and 2007, migrant

**Table 5.** Wilcoxon rank-sum tests

| | Comparisons | | 2002 | | 2007 | | 2013 | |
|---|---|---|---|---|---|---|---|---|
| | Type 1 | Type 2 | P{health(Type 1) > health(Type 2)} | p-value | P{health(Type 1) > health(Type 2)} | p-value | P{health(Type 1) > health(Type 2)} | p-value |
| | ***Between sub-groups*** | | | | | | | |
| (a) | urban | rural | 0.473 | 0.000 | 0.565 | 0.000 | 0.487 | 0.043 |
| (b) | urban | migrant | 0.475 | 0.013 | 0.597 | 0.000 | 0.509 | 0.634 |
| (c) | rural | migrant | 0.502 | 0.852 | 0.532 | 0.002 | 0.522 | 0.230 |
| (d) | high parental health | low parental health | 0.300 | 0.000 | 0.203 | 0.000 | 0.249 | 0.000 |
| | ***Within sub-groups*** | | | | | | | |
| (e) | high-health-urban | low-health-urban | 0.76 | 0.000 | 0.777 | 0.000 | 0.791 | 0.000 |
| (f) | high-health-rural | low-health-rural | 0.647 | 0.000 | 0.803 | 0.000 | 0.732 | 0.000 |
| (g) | high-health-migrant | low-health-migrant | 0.785 | 0.000 | 0.793 | 0.000 | 0.725 | 0.000 |
| | ***Between types*** | | | | | | | |
| (h) | high-health-urban | high-health-rural | 0.586 | 0.000 | 0.445 | 0.000 | 0.521 | 0.001 |
| (i) | high-health-urban | high-health-migrant | 0.581 | 0.000 | 0.408 | 0.000 | 0.504 | 0.855 |
| (j) | high-health-rural | high-health-migrant | 0.496 | 0.632 | 0.464 | 0.001 | 0.483 | 0.365 |
| (k) | low-health-urban | low-health-rural | 0.409 | 0.000 | 0.507 | 0.708 | 0.461 | 0.053 |
| (l) | low-health-urban | low-health-migrant | 0.552 | 0.241 | 0.488 | 0.722 | 0.380 | 0.071 |
| (m) | low-health-rural | low-health-migrant | 0.654 | 0.000 | 0.482 | 0.573 | 0.430 | 0.292 |

children with high parental health status were more disadvantaged than urban children with high parental health status, the same is not true for 2013. While there were no disparities between urban and migrant children with low parental health status in 2002 and 2007, the gap between these two types widened, marginally, in 2013. In contrast, while there was greater IOp in health between rural and migrant children with low parental health status in 2002, there were no significant differences between them in 2007 and 2013. This could be because of worsening IOp in health for these two types over time.

To summarize, while the influence of *hukou* on IOp in health has decreased over time, particularly between the period of 2007 to 2013, the influence of parental health status has become prominent. Relative to *hukou*, one's province of residence contributes more to IOp in health. Both the D-index and stochastic dominance tests suggest that migrant children with low parental health status have become more disadvantaged compared to urban children with low parental health over time. Overall, there has been a shift in the nature of IOp in health from urban-rural to urban-migrant.

### 4.3 Limitations

It is important to highlight the data and analytical limitations of our study. First, we used a self-reported measure of health status for children in the absence of consistent anthropometric and objective measures such as BMI across the publicly available CHIP datasets. And second, the migrant sample in the CHIP datasets was small and the typologies we defined further reduced the sample size. We attempted to partially overcome the bias introduced by the small sample size by using appropriate sampling weights.

## 5. Discussion and conclusion

Our analysis reveals two important aspects of IOp in health in China. First, while the direct influence of *hukou* on IOp in health has decreased, one's province of residence still matters. The decreased influence of *hukou* might be attributed to health reforms in recent years. The period between 2002 and 2013 saw several important reforms in healthcare provision and health insurance driven in part by the SARS 2003 outbreak. Coverage expansion has been the key target of reforms such as UEBMI, URBMI and NCMS. Particularly, NCMS covers rural people and migrant workers who hold rural *hukou* and live in urban areas (Gao *et al.*, 2015; Yu, 2015). The central government also encourages migrant workers who are on contracts with employers to join UEBMI.

However, at an institutional level, in China, subnational governments instead of the central government are responsible for government spending on healthcare, owing to which provincial differences in access to health, quality of healthcare, and health outcomes may arise (Wang and Zeng, 2015). Although there have been some reforms to mitigate regional inequalities in public healthcare spending, the variations have remained. Second, as demographic characteristics such as median age are different across provinces, policy interventions concerning healthcare are distinct at the local level. Third, and more importantly, health insurance schemes

are not the same across the board, although the central government has recently attempted to introduce a universal health insurance system. Thus, depending on the fiscal capacity and demographic characteristics in a given province, subnational governments have a substantial say in healthcare policy, which may impact parental health status.

The second important finding highlighted by our analysis is the growing disadvantage faced by migrant children with low parental health status. Even with the health reforms, coverage of migrant workers remains an essential concern. The State Council of the People's Republic of China (PRC) stated that migrant workers' social welfare should be taken care of at the local level (State Council Bulletin, 2006). Particularly, the inpatient spending of migrant workers should be addressed. The State Council also encourages migrant workers to join rural healthcare schemes in the localities where their *hukou* is based. However, a caveat is in order. Although the central government has emphasized the inclusion of migrant workers in health insurance, local governments may not promote it wholeheartedly. Local governments worry about their fiscal burden if migrant workers are included in health coverage and are concerned that the improvement of health coverage for migrant workers will lead to an excessive inflow of migrant workers in their region and dilute the financial and health resources for local residents.

Related to the disadvantages faced by migrant children, our analysis also underscores a shifting trend in IOp in health – that is, while in 2002 the largest disparity of IOp in health was between urban and rural children with low parental health status, in 2013 the largest disparity was between urban and migrant children with low parental health statuses. The inequalities in 2002 reflect the dynamics of urbanization in favor of urban residents in the early years of market reform in China. The reform did not result in equitable benefits for rural-urban migrants. In the early 2000s, migrant workers' healthcare was largely ignored. Migrant workers had to fully bear the cost of any inpatient health services resulting in low utilization of health services, and consequently, low health status of migrant parents. However, in 2013, many migrant workers were de facto urbanized after almost two decades of living in urban areas, although the majority of them still held rural *hukou*. Further, as urbanization gained momentum, there was a fresh wave of rural-urban migration. Thus, the sources of IOp plausibly shifted towards newly urbanized migrants and new in-migrants. From a policy perspective, the integration of health insurance for migrant parents into mainstream health insurance is of paramount significance to improving their children's health status. Currently, the benefits for urban employees and migrant workers remain substantially different (Lam and Johnston, 2012).

To conclude, given the unprecedented scale of rural-urban migration in China, the inclusion of migrants when analyzing IOp is vital. The ineffective inclusion of migrant workers in universal health insurance schemes remains an obstacle to improving the health status of migrant workers, which has profound implications for their families. The significance of *hukou* in itself as a barrier may be moderate over time, but when coupled with continued lack of local government support for the welfare of migrant workers, it perpetuates health inequalities. Constraints imposed on migrant workers include not only inadequate health insurance but also widespread discriminatory practices, which obstruct migrant workers' integration into urban life and the enjoyment of public goods provision in urban areas, which

engenders social injustice and may potentially lead to social instability in China. Policymakers thus need to focus on removing the structural barriers and reducing IOp in health and also ensure that disadvantages are not transmitted intergenerationally.

**Supplementary material.** To view supplementary material for this article, please visit https://doi.org/10.1017/S0047279422000782

**Acknowledgements.** We thank Ms. Luu Diu Khue for her excellent research assistance. We are especially thankful to seminar participants at East Asia Institute, National University of Singapore, for their valuable comments. We are grateful for the financial support provided by the Lee Kuan Yew School of Public Policy, National University of Singapore. The findings, interpretations, conclusions, and any errors are entirely those of the authors.

**Competing interests.** The authors declare none.

## Notes

**1** 'Rural-urban migrants' are hereafter referred to as 'migrants'.
**2** Strict equality in the utilitarian sense whereby the objective is simply to minimize the gap between the winners and losers without due consideration to the process that led to the differences in outcomes.
**3** Those whose *hukou* are non-local urban or non-local rural are excluded from the analyses.
**4** Consumption expenditure is used instead of household income because it is easily identifiable and comparable across households unlike income, which has multiple sources, especially for rural households.
**5** While we would have preferred to also include a variable indicating whether parents have access to health insurance, the CHIP datasets capture this information differently for urban, rural, and migrant respondents. Further, the question also varies over the 2002 and 2013 waves of CHIP surveys. As explained in Section 3.3, parental health status indirectly captures access to social insurance.
**6** Mean age of fathers in the sample is 39 years, 38 years, and 35 years for urban, rural, and migrant residents respectively. Mean age of mothers in the sample is 37 years, 36 years, and 33 years for urban, rural, and migrant residents respectively.

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**Cite this article:** Chindarkar N, Nakajima M, and Wu AM (2024). Inequality of Opportunity in Health Among Urban, Rural, and Migrant Children: Evidence from China. *Journal of Social Policy* **53**, 950–969 . https://doi.org/10.1017/S0047279422000782