Original Article

Is college education an equalizer for social disparities in health literacy? A case study in Shanghai, China

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Abstract:
Objectives: The aim of the study was to illustrate the immediate effect of the college education process (across college grades) on the strength of association between parental education and college attendees' health literacy.
Methods: Cross-sectional analysis was conducted based on data from a random sample of students in one university in Shanghai, China ($N = 574$). Exploratory factor analysis was used to generate factors of different dimensions of health literacy. Ordinary least square regression models were estimated to investigate how college education process alters the family-based disparity in health literacy.
Results: The link between parental education and health-related skills did not vary significantly across grades of participants, but participants in their third ($p < 0.05$) and fourth year ($p < 0.001$) revealed a significantly weaker association between health-promoting proactivity and parental education, relative to the first-year counterparts. Also, the impact of parental education on health-related attitudes significantly declined among the fourth-year seniors, compared with first-year students ($p < 0.05$).
Conclusions: Higher education experience is an important mechanism to alleviate the socioeconomic gap in health literacy. Such an equalizer effect, nevertheless, is contingent on the particular dimensions of health literacy.

Keywords: health literacy, college attendees, socioeconomic gradient, China

Introduction

Health literacy

Defined as the capacity to acquire, understand, and use information in ways which promote and maintain good health (1,2), health literacy has been noted to be associated with a wide range of positive health indicators (3). Modern health care settings and professional medical knowledge are not easily accessible to the lay audience, and such a barrier negatively affects the efficiency of health care. In a systematic review, scholars found low health literacy to be a consistent risk factor for the poor use of health services (4). As a consequence, costs associated with delayed health care, inappropriate prevention skills, and incorrect self-diagnosis remain enormous as long as widespread health illiteracy remains an unsolved issue (4,5). In the United States (US), between 20% and 46% of the population were considered as having inadequate health literacy (6). In the Chinese context, the first nationwide survey

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on health literacy conducted in 2009 reported that, for different dimensions of health literacy, the percentage of those with adequate health literacy ranged between 4.66% and 29.97%, with an overall percentage of 6.48% (7). However, a later study conducted in Jiangsu Province suggested that 52.5% of the 12,450 surveyed cases had comprehensive health literacy (8). Evaluation of the 2012 Chinese Resident Health Literacy Scale in Hunan Province showed that the proportion of correct responses to a series of items varied from 10.8% to 96.7% (9).

The level of health literacy is strongly related to the socioeconomic status, which accounts for the disparities in various health outcomes (10). Higher socioeconomic standing translates not only into better affordability of health care, but also into timely acquisition of adequate health information and effective communication with health professionals, both of which are essential elements of health literacy. Studies find that having a low income, less education, and being a minority are all associated with poor health literacy (4,11). Therefore, the gradient of health literacy corresponding to the level of one's socioeconomic background constitutes a crucial component of general inequalities in health.

The equalizing effect of education on health literacy

As noted by Link and Phelan, socioeconomic status has an enduring association with one's health conditions, and is the fundamental cause for health disparities across different social strata (11,12). Health-promoting mechanisms that help weaken the link between socioeconomic resources and health-related outcomes can thus improve societal health equality. In this regard, social science research has acknowledged the equalizing effect of formal education, especially that of tertiary education, for reducing the gap between socioeconomic attributes that are inherited from one's family background in industrialized societies (13,14). Employing the theoretical framework of the fundamental cause theory, a series of articles appeared in 2015 to investigate the relationship between educational attainment and health disparities, and they suggested with overwhelming evidence that education provides greater health benefits for the disadvantaged population and that schooling suppresses preventable deaths among the vulnerable population by improving their health literacy and skills (15).

In this study, we refer to the 'equalizing effect' as the process of tertiary education in alleviating the health-related inequalities caused by socioeconomic background. This is in line with the resource substitution theory proposed by Ross and Mirowsky, which argues that socioeconomically disadvantaged people have fewer alternative resources and are more dependent on education for health promotion (16,17,18). As a result, the educational process benefits the disadvantaged students more, and narrows the gap in health-related variables between students of different backgrounds.

Following the resource substitution theory, we hypothesize that the inequality in health literacy by family background would be reduced by the tertiary educational process. This is an understudied question, particularly for China. On the one hand, post-reform China has seen a tremendous increase in socioeconomic inequalities, which further deteriorates the quality of health information and services received by the society's poor strata (19). On the other hand, health illiteracy has become a momentum fueling the rampant physician–patient conflicts and mistrust of professional medicine in contemporary China (20,21,22). Against this backdrop, university campuses have become a central platform of health education, since an increasing number of colleges have now incorporated health promotion classes and comprehensive health education for their students (23,24). Also, the facilitative function of tertiary education on health literacy may be socially profound because China's college enrollment rate has increased from 34% to 75% from 1998 to 2015. Altogether, the social changes in Chinese society motivate us to ask whether formal education alleviates the disparity in health literacy associated with differential socioeconomic statuses.

The current study

This study examines changes in the socioeconomic gradient in health literacy across different grades of college education, based on a pilot random sample collected from a comprehensive university in Shanghai, China. As noted earlier, higher education in Chinese society has been expanding rapidly since the late 1990s. Against this background, tertiary

education has become an essential stage of formal education for a large number of Chinese citizens. Meanwhile, previous studies conducted in China have shown that the educational stages prior to college (i.e. the compulsory education and secondary education) cannot effectively close the gap in health literacy between students from advantaged and disadvantaged families (25,26,27). In light of this, the equalizer role of higher education for health literacy disparities deserves more attention.

Empirical research conducted in China has produced some specially designed surveys focusing on college students, but these studies mainly discussed the demographic differentials related to health literacy (e.g. sex), and fell short of the information pertaining to the family background gradient (28,29,30). The empirical results of this study explicate how the *process* of college education alters the strength of association between parental education and the level of students' health literacy. Because of the focus on college attendees instead of postgraduate respondents, this study sheds light on an *instant effect* of higher education on health literacy disparity.

By focusing on college attendees, another advantage of the current study is its ability to avoid the selection bias seen in some previous studies on the health-related benefits of college education. Such selection bias lies in the very problem that people do not attend college in a random fashion. Therefore they cannot conclude if any outcome found among college students is a result of tertiary education per se, but not driven by the particular way of college recruitment. For example, college attendees may disproportionately come from wealthier families, and have better prior health knowledge. Instead, by attending to the instant effect of tertiary education – the changes in health literacy among those who are being exposed to the educational process, this study circumvents this selection problem because the background issue of how an individual entered college is eliminated.

Methods

Data source and study population

Respondents were recruited from a comprehensive university in Shanghai, China. A cross-sectional random sample was taken from the undergraduate student population between 16 and 25 years of age (mean age = 19.76). The investigator dispatched 70 interviewers into four groups and each group conducted the survey in one of the four living blocks on campus. For each dormitory building in each living block, one undergraduate student was randomly selected from each room. The selected students were then given a paper-based questionnaire after oral consent was obtained. Taken from the revised Chinese version of the Health Literacy Management Scale, this questionnaire was designed to cover multiple items related to health literacy, which are consistent with the theoretical content of health literacy as noted in the previous literature (1,2). In addition, the validity of the survey items was affirmed in a separate study based on Shanghai citizens (31). Throughout the survey process, no assistance was requested from the respondents. The research duration was from September 2015 to February 2016. The resulting sample is self-weighted due to the randomized design. The first author's academic institution approved the study. The original total sample size is 640, from which $N = 574$ respondents had valid information.

Defining outcomes and covariates

Outcome variable

Health literacy was measured in this study by a battery of 13 questions. These questions were selected from the revised Chinese version of the Health Literacy Management Scale (HeLMS) (32). It was translated collectively by the experts from the School of Public Health at Fudan University in Shanghai, who made necessary revisions on items that were not appropriate in the Chinese social context and deleted redundant items (31). Although back translation was not used, the overall rate of agreement between the English and Chinese versions, according to (31), is satisfactory. In this study, we use the revised HeLMS as opposed to using the Chinese Resident Health Literacy Scale because the latter focuses on general health knowledge, health behavior, health belief, and health skills (9), while the former emphasizes the cognitive aspect of health literacy (32). This feature of the HeLMS is more relevant to college students whose health literacy is still in the formative stage. Detailed descriptions of these items are presented in Table 1.

Table 1. Exploratory factor analysis with orthogonal varimax rotation: health literacy among a sample of college attendees in China.

Variables	*Factor loadings*		
	Skills	*Proactivity*	*Attitude*
1. Having no difficulty in understanding written medical information	**0.70**	0.12	0.17
2. Being able to understand health-related information in daily life	**0.66**	0.27	0.25
3. Being able to visit the doctor independently	**0.72**	0.14	0.19
4. Being able to retrieve useful information from the communication with a doctor	**0.77**	0.18	0.28
5. Filling out medical forms independently	**0.72**	0.18	0.26
6. Extracting useful information from mass information	**0.67**	0.25	0.30
7. Making preparations for each doctor visit	0.18	**0.80**	0.19
8. Discussing health-related topics with individuals other than doctors	0.21	**0.77**	0.23
9. Taking advantage of and practicing health information in daily life	0.18	**0.71**	0.38
10. Being willing to spend time on health-related issues	0.22	0.21	**0.82**
11. Being willing to pay attention to health needs	0.24	0.21	**0.85**
12. Being willing to take efforts to improve health	0.19	0.16	**0.88**
13. Being willing to change lifestyle to promote health	0.18	0.20	**0.82**
Cronbach's alpha coefficient	0.86	0.77	0.91
Eigenvalue	1.51	1.08	6.28
Explained variance (%)	11.61%	8.28%	48.29%
Cumulative explained variance (%)	68.18%		

In our survey, respondents were asked if they could accomplish a list of tasks. The response options are '1 = totally cannot accomplish; 2 = almost cannot accomplish; 3 = can basically accomplish; and 4 = can always accomplish'. In order to reveal the latent dimensions of health literacy, exploratory factor analysis was adopted and three factors were generated according to the factor structure (See Table 1). Potential underlying factors were determined based on the factor loadings greater than 0.5. We have ruled out the issue of multicollinearity because the determinant of the correlation matrix is 0.001 (>0.00001). The construct validity was supported by the estimated values of the Kaiser–Meyer–Olkin Measure of sampling adequacy (=0.916) and Bartlett's Test of Sphericity ($p < 0.0001$). The content validity was supported by the strong correlations between the generated factors and their corresponding constructive items (all >0.5). In total, the three factors account for 68.18% of the variance in the original items. The Cronbach's alpha for each factor was reported. According to their values, both factor 1 (alpha = 0.86) and factor 3 (alpha = 0.91) show a property of excellent internal consistency. Due to the limited number of observed items ($N = 3$), the Cronbach's alpha for factor 2 was relatively small but still indicated good internal consistency (0.77).

In general, the items for factor 1 were substantively related to the respondent's medical skills and cognitive capacities, so we named factor 1 to be 'Skills'. In contrast, the items for factor 2 concerned their attitudes towards health-related issues, which directed us to name factor 2 to be 'Attitude'. Lastly, the items for factor 3 concerned taking initiative when interacting with doctors and acquiring daily life health information. In light of this, factor 3 was named 'Proactivity'.

Predictor variables

The primary predictor for health literacy is the process of college education. This variable was operationalized using the grade of respondents, with options '1 = the first grade (freshman/women students); 2 = the second grade (sophomores); 3 = the third grade (juniors); and 4 = the fourth grade (seniors).' Another predictor variable is the

highest level of parental education. This variable was generated by comparing mother's and father's educational attainment for each respondent and preserving the higher one. Parental education was measured with the question "*What is the highest education of your father (mother)?*" Options to this question are '1 = no formal education; 2 = preliminary school; 3 = junior high school or equivalent; 4 = senior high school or equivalent; 5 = junior college; 6 = regular college; and 7 = graduate school'. According to research in the social sciences, parental education is a major indicator of the socioeconomic status for the college-age population (33), and its association with health literacy can be validly used to measure the socioeconomic disparity by family background.

Control variables

A series of control variables were taken into account, including sex (1 = female; 0 = male), college major (1 = reference = liberal arts; 2 = science; 3 = engineering; 4 = business; 5 = social sciences and legal studies; 6 = medicine and pharmacy), political identity (1 = Chinese Communist Party Member; 0 = otherwise), ethnicity (1 = Han; 0 = otherwise), household registration status before matriculation (1 = rural; 0 = urban), and household annual income (Unit of Ten Thousand Yuan).

Descriptive information of variables is presented in an online appendix (Table A1). For variables with binary options, proportions of individuals with a positive answer were reported.

Statistical analysis

The statistical analysis regressed each newly generated factor on the predictors as well as the control variables in an OLS (ordinary least squares) model. An interaction term between college grade and parental education was added to each of the three OLS models to test whether the strength of association between parental education and health literacy varied from the first-year students to the fourth-year students. Both the predictor of parental education and the interaction term were mean centered.

Both exploratory factor analysis and the OLS regression model were estimated in STATA 13.0 (the commands *factor* and *regress*).

Results

The results of the OLS models are listed in Table 2. No multicollinearity was detected since the variance inflation factor was as small as 1.57. Model 1 suggested that respondents' health-related skills were not significantly associated with parental education, nor was there a significant interaction effect between grade and parental education. In contrast, Model 2 showed a significant link between parental education and proactivity in health promotion ($\beta = 0.19$, $p < 0.01$). People from a better educated family were more proactive in learning about their health status and acquiring health information. Further examination of the interaction effect revealed that the strength of the association between parental education and health literacy gradually declined as one progressed across school grades. Initially in the second grade, the interaction effect was negative but not significant ($\beta = -0.12$). However, the interaction effect with the third grade was significantly negative and had an increased magnitude ($\beta = -0.18$, $p < 0.05$). When it came to the fourth grade, the magnitude of the interaction term had further increased and remained statistically significant ($\beta = -0.39$, $p < 0.0001$). Lastly, Model 3 affirmed the positive link between parental education and health-related attitude ($\beta = 0.22$, $p < 0.001$), and the strength of this association declined among the fourth-year students relative to their first-year counterparts ($\beta = -0.23$, $p < 0.05$). In other words, by the time students had spent four years in college, the extent to which their family origin influenced their health attitude had significantly declined.

Results of Model 2 and Model 3 suggest that the extent of parents' influences on children's health literacy is weakened during the higher education process. This finding lends support to the role of educational process in *alleviating* the family-background disparities in health literacy – that is, the equalizer effect as discussed in the introduction section.

For demographic covariates, being a female ($\beta = 0.27$, $p < .01$) and majoring in sciences ($\beta = 0.24$, $p < .05$) were associated with better attitude towards health. Medical students ($\beta = 0.40$, $p < .05$) and Communist Party members ($\beta = 0.27$, $p < .05$) had better health skills but their scores on the other two dimensions of health literacy

Table 2. College education process and health literacy disparities among a sample of college attendees in China.

	(1)	*(2)*	*(3)*
	Skills	*Proactivity*	*Attitude*
Parental education (mean centered)	**−0.07**	**0.19****	**0.22*****
	(0.06)	(0.06)	(0.06)
Sex (female)	0.06	0.06	0.27**
	(0.09)	(0.09)	(0.09)
College major (reference = liberal arts)			
Science	0.01	−0.12	0.24*
	(0.12)	(0.12)	(0.12)
Engineering	−0.05	−0.13	−0.00
	(0.15)	(0.15)	(0.15)
Business	−0.45**	0.10	0.07
	(0.14)	(0.14)	(0.14)
Social sciences and legal studies	0.04	−0.20	−0.15
	(0.16)	(0.16)	(0.16)
Medicine and pharmacy	0.40*	0.11	0.08
	(0.17)	(0.16)	(0.17)
Political identity (Chinese Communist Party member)	0.27*	0.02	0.15
	(0.13)	(0.13)	(0.13)
Ethnicity (Han)	−0.03	−0.13	0.06
	(0.14)	(0.13)	(0.14)
Household registration status before matriculation (rural)	0.25	0.02	−0.09
	(0.16)	(0.15)	(0.15)
Household income/10	−0.02	0.02	−0.02
	(0.02)	(0.02)	(0.02)
Grade (reference = first year)			
Second year	−0.02	0.70	0.42
	(0.47)	(0.46)	(0.46)
Third year	0.54	1.11*	0.41
	(0.48)	(0.46)	(0.47)
Fourth year	1.09	2.20***	1.22*
	(0.60)	(0.59)	(0.59)
Parental education × second year (mean centered)	**0.05**	**−0.12**	**−0.09**
	(0.09)	(0.09)	(0.09)
Parental education × third year (mean centered)	**−0.04**	**−0.18***	**−0.08**
	(0.09)	(0.08)	(0.09)
Parental education × fourth year (mean centered)	**−0.09**	**−0.39*****	**−0.23***
	(0.11)	(0.11)	(0.11)
Intercept	−0.50*	−0.02	−0.15
	(0.23)	(0.23)	(0.23)
N	574	574	574
Adjusted R^2	0.05	0.02	0.04

Standard errors in parentheses.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

were not significantly higher. The coefficients of ethnicity, household registration (hukou), and family income were not statistically significant at the 0.05 significance level.

Discussion

Principal findings

The current exploratory research was conducted to examine whether the experience of college education had an *instant* effect on alleviating the disparity of health literacy inherited from one's family background. Results based on a random sample collected in a comprehensive university in China supported the equalizing effect of higher education on the socioeconomic gradient of health literacy. The association between health-promoting proactivity and family background significantly declined as people progressed to their third and fourth years in college as compared with their first-year counterparts. In addition, the impact of parental education on participants' health attitude was shown to be significantly weaker among the fourth-year seniors compared with freshman/woman students. The results also suggested that such an effect was contingent on the *dimensions* of health literacy. For example, the link between parental education and health-related skills was not significantly weakened as it did not reveal significant variations across grades of college education. Overall, this study established that formal education served as an equalizing factor that significantly reduced the socioeconomic disparity in health literacy as caused by differentials in parental education.

Implications

Health literacy and the lack thereof have lately become an emerging public health concern in many societies. Even in developed countries, the US for instance, a review study conducted in 2004 suggests that more than 20% of the population were considered to have low health literary, as illustrated by their limited health promotion knowledge, health communication skills, and health numeracy (6). With the increasing professionalization and digitalization of modern medicine, people from lower socioeconomic status and in a marginal group have particular difficulties. The disadvantaged populace begrudge not only increasing medical bills, but also the bleak reality that they no longer understand how a healthcare setting works for them. Moreover, individuals with inadequate health literacy cannot properly interpret medical documents, acquire appropriate medical advice and information, and ultimately lose their trust in medical professionals (34). Since health illiteracy is correlated with a wide range of health behaviors and outcomes, understanding what mechanism could improve health literacy for the disadvantaged group is needed in current health scholarship. This is particularly the case for China. Since entering the 21st century, this country has seen severe doctor–patient conflicts due to distrust of medical professionals and opacity in health care settings. Hence, improving health literacy is an urgent task for this rapidly developing society.

Our study provides evidence for the *instant* effect of higher education on improving health literacy, supplementing prior studies that primarily focused on the *ex post* effect of educational attainment on health-related outcomes. In our population, socioeconomic disparities in two major dimensions of health literacy – health proactivity and health promotion attitude – had been significantly reduced by the process of college education. Our findings are particularly relevant for health educators and health policymakers by illustrating the more nuanced equalizer role of college education on the inequality of health literacy. With the steady expansion of higher education opportunities in Chinese society, more adolescents and young adults would benefit from educational institutions for the improvement of their health literacy.

Our analytical results direct us to another policy-related question: is college the appropriate time to intervene with issues like disparities in health literacy? Or would it be more efficient to invest public resources in earlier phases, such as primary and secondary education, or the home learning environment? While some previous studies have highlighted the effect of literacy practices at home, such as the report of the Canadian Council on Learning that recommended strengthening health-related reading at home (35), we suspect that investment in the tertiary instead of the earlier stages of education yields more health-literacy returns in the context of contemporary China, for three reasons. First, with the rapid development of medical technologies, the lack of health literacy is a life-long issue. It is among the adults instead of adolescents that the negative impact of health illiteracy is most pronounced (6). Second, the educational system prior to the tertiary level in China is well known for

its uniform school system, a standardized curriculum, and an extreme focus on test preparation. Constrained by the curriculum design, health education assumes a very marginal position relative to the fields related to various examinations (e.g. the national college entrance exam) (36). In contrast, the curriculum for tertiary education is much more flexible and less test-oriented, which serves as a good platform for projects aimed to promote students' health literacy. Third, college attendees are at the life-course stage of transitioning from adolescence to adulthood, so they have greater demand for health knowledge and skills, particularly those that are concerned about reproductive health, health insurance, and preventive screening (37). Also, college students have better cognitive and learning capabilities in relation to their counterparts in previous educational stages, which enhance the effectiveness of health literacy promoting programs. Altogether, higher education institutions should play a more salient role in narrowing the disparities in health literacy as compared with pre-tertiary education. We suggest that policy makers consider the adoption of a flexible but comprehensive health promotion program in as many college settings as permissible. Successful experiences in the implementation of health promotion programs in China's universities can be consulted (38).

Lastly, our results also call attention to the distinction between the multiple dimensions of health literacy, as they are involved in the equalizer effect of college education in different ways. This nuanced distinction deserves further investigation.

Strengths and limitations

The cross-sectional design of this study determines that we cannot strictly infer causation. In addition, the exploratory nature of this pilot survey limits the generalizability of our conclusions to other higher education institutions and introduces selection bias. For instance, the university in our study is selective in China, which might partly account for the insignificant effect of the education process on health-related skills, since attendees of this university may already have learnt these skills before they entered college. In this regard, research in the other types of institutions might report different results. Lastly, although this study has identified a dissipating socioeconomic gradient in health literacy during tertiary education, future study may expand this territory by designing questions on parental relationship and examining how bonds with parents moderate the socioeconomic gradient of health literacy.

These limitations notwithstanding, the strengths of this study include a detailed survey of health literacy among college attendees within a Chinese university, thus providing the micro evidence for the immediate health-equalizing effect of college education process. Also, this study highlights how the equalizing effects of college education are contingent on the particular dimensions of health literacy.

Conflict of interest

The corresponding author Anning Hu declares that he has no conflict of interest.

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Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent

Informed consent was obtained from all individual participants included in the study.

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