

BMJ Open Disparity of the Chinese elderly's health-related quality of life between urban and rural areas: a mediation analysis

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ABSTRACT

Objectives This study aimed to examine the urban–rural disparity in health-related quality of life (HRQoL) of the Chinese elderly and to explore the mediating roles of socioeconomic status (SES) and frequency of contact with children in the relationship between urban/rural areas and HRQoL.

Methods This cross-sectional study used data from China Health and Retirement Longitudinal Study for 2015–2016, involving 12 369 Chinese aged 45 years and over. HRQoL of respondents was measured by three-level EuroQol five dimensions (EQ-5D-3L). SES, based on principal components analysis, was combined by the individual possessions of durable consumer goods and houses. Frequency of contact with children was derived from the responses to whether they live with children and how often they contact with them. Mediation analyses were performed to examine the mediating effects of SES and frequency of contact in the relationship between urban/rural areas and HRQoL.

Results Urban respondents had higher scores of HRQoL than rural respondents ($p < 0.05$). As SES and frequency of contact with children increased, the scores of HRQoL of the elderly went up as well. Mediation analyses proved the possible mediating effects of SES and frequency of contact in the relationship between urban/rural areas and HRQoL (0.0713 and 0.0064). The indirect effects induced by SES and frequency of contact were 65.45% and 5.90%, respectively.

Conclusions There was a significant difference in HRQoL between urban and rural middle-aged and elderly participants, which was partially mediated by urban–rural disparities in SES and frequency of contact with children. Higher SES and frequency of contact with children contributed to higher health status in the Chinese elderly.

INTRODUCTION

With the rapid development of Chinese economy, life expectancy increased from 67.9 years in 1981 to 76.5 years in 2016,¹ people aged 65 years and over accounted for 8.87% of the total.² However, the evaluation of the health of population should focus on the length of life and the health-related quality

Strengths and limitations of this study

- This study aimed to explore the causes of urban–rural disparity in health-related quality of life (HRQoL) among the middle-aged and elderly from two angles—SES and frequency of contact with children through multiple mediation analysis.
- This study employed principle component analysis, a more comprehensive method, to generate the mediator of 'SES' as a replacement of income or wealth.
- SES and frequency of contact with children only explained partial indirect effect, and the current study could not explain the whole mediating effects between urban–rural disparity and HRQoL.

of life (HRQoL) and its differences. A large number of studies have found that a huge disparity in HRQoL exist among urban and rural middle-aged and elderly adults,^{3–5} and the overall HRQoL of urban residents is better than that of rural residents.⁶ It may be due to the large gap of development between urban and rural areas in China. Some relevant factors may contribute to the difference of HRQoL between urban and rural residents, such as demographic factors, marital status, level of education, socioeconomic status (SES)^{7 8} and social support, especially frequency of contact with children, which acts as the core of social relationship.^{9 10} Some researchers found that SES had a positive impact on HRQoL in China, Korea and many other countries.^{11 12}

It has been well demonstrated that weak social ties could result in physical and mental health problems among the elderly.^{13 14} The scope of the social network usually shrinks as the elderly grow older¹⁵ and elderly parents' relationship with children becomes a greater proportion of their social relationships. Especially in China, blood relations were emphasised by the traditional culture; relationships

between children and elderly parents have usually been considered a core element of the family structure.^{16 17} Elderly people who got support from their family members had an enhanced quality of life (QoL).¹⁸ Some studies have proposed that older adults who are less connected to their children exhibit the higher risk of developing depression.¹⁹ However, urbanisation in recent years has led to an increase in the number of empty nesters in rural areas and weakening of family function in rural areas.²⁰

Although it has been demonstrated that urban–rural areas, SES and frequency of contact with children have association with HRQoL of the middle aged and elderly,²¹ few studies has explored the mediating effects of SES and frequency of contact with children as mediators between urban–rural area and HRQoL of older adults in China. Therefore, we hope to study the possible mediating effect of SES and frequency of contact with children on the overall health status of older adults. Based on previous research, we hypothesise that: (1) Urban participants have higher level of HRQoL than rural participants, (2) Older adults with higher SES have higher HRQoL, (3) The participants who have more contacts with children may have higher HRQoL and (4) SES and frequency of contact with children may possibly mediate the difference of HRQoL between urban and rural elderly population.

METHODS

Data

Data were derived from the China Health and Retirement Longitudinal Study (CHARLS), which is a nationally representative longitudinal survey conducted by Institute of Social Science Survey, Peking University. Follow-up data were collected through face-to-face computer-assisted personal interview every 2 years since 2011 to obtain a representative sample of Chinese aged 45 years and over in 28 provinces. A wide range of topics were involved in the questionnaire, including assessments of social, economic and health status of residents. This study used the third wave of CHARLS data for 2015–2016. In the first step, we selected 13 920 respondents whose answers to questions related with HRQoL, SES and contact with their children were not missing. Then, after excluding missing values of other variables (age, gender, marital status and education attainment), a total of 12 369 respondents with complete data on all variables were included in this analysis. Most baseline characteristics are comparable between enrolled and excluded respondents.

Our study followed the tenets of the Declaration of Helsinki. Written informed consent was obtained from all responders after the nature of the study was explained to them.

Variables

Dependent variable (Y)

HRQoL was measured by EQ-5D-3L²² that consists of a five-item descriptive system used to measure five dimensions of health status (mobility, self-care, usual activities,

pain and depression) with three levels per domain (no problem, some problems and extreme problems). Two hundred and forty-three potential health states can generate in the form of a five-digit number, such as 23221, by combining every level of each dimension. In addition, the Chinese EQ-5D-3L value set based on time trade-off²³ was used in order to elicit values of health states. Hence, the five-digit numbers of health status were all converted into numbers from –0.149 to 1.

Independent variable (X)

The variable area of residency was geographically divided into urban or rural area on the basis of the National Bureau of Statistics of China. Value ‘1’ represents the urban area and ‘0’ represents the rural area.

Mediators (M)

The variable SES as a mediator represents the SES that can reflect the individual living standards. It is defined as a combination of economic, social and work status, which is commonly measured by income or wealth, education and occupation. Owing to the challenges in collecting income data, particularly in rural or low-income settings, the online supplementary information on income, such as household asset, can be used to form a composite asset index as a replacement of income or wealth.²⁴ Principal components analysis (PCA) is a general method to create the index.²⁵ In this study, the synthetic asset index, based on PCA, was combined by the individual options about durable consumer goods (including automobile, electric bicycle, motorcycle, refrigerator, washing machine, TV, computer, stereo system, video camera, camera, air conditioner, mobile phone, furniture, music instrument, valuable decorations, ornaments, treasures and precious metal and artistic work) and housing characteristics (including the type of structure of residence, one story or multilevel building, toilet, electricity, running water, bath facility, coal gas or natural gas, heating, source of cooking fuel, telephone and internet connection). Based on quintiles that are often used to be cut-off points for a given population, we classified the continuous index of SES into the following levels: 0=low, 1=middle low, 2=middle, 3=middle high and 4=high.

With regard to frequency of contact with children, whether the middle age and elderly had living children and cohabitated with their children were taken into consideration. Respondents without living children were considered the worst case, while those cohabitating with at least one child were divided into the group that had the most frequent contact with their children. Meanwhile, contact with children of those who had non-cohabitating children consists of two aspects that are ‘face-to-face’ contact and ‘phone’ contact. The conditions of contact with non-cohabitating children was described by the following questions in CHARLS: ‘How often do you see your non-cohabitating children?’ and ‘How often do you have contact with children either by phone, text message, mail, or email when you didn’t live with them?’ The available options all ranged

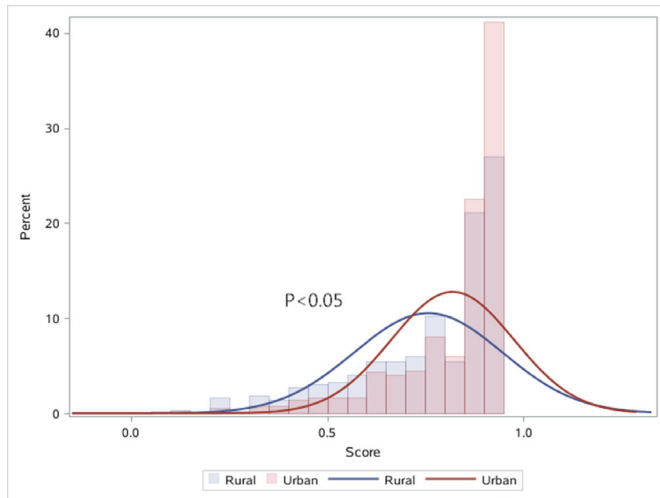


Figure 1 Urban/rural graphic distribution of the EQ-5D scale.

from ‘1=Almost every day’ to ‘7=almost never’. According to previous researches,¹⁹ we classified the frequency of contact with non-cohabitating children into four groups through the answers to these questions. Respondents in group 1 had infrequent contact neither in face to face (less than once a month) nor phone way (less than once a week). Given that group 1 represented the least frequent contact, respondents without living children were in this group as well. Respondents in group 2 had frequent phone contact (once a week phone and more) but infrequent face-to-face contact (less than once a month). Respondents in group 3 had frequent face-to-face contact (once a month and more) but infrequent phone contact (less than once a week). Respondents in group 4 had both frequent face-to-face contact (once a month and more) and frequent phone contact (once a week and more). Since group 4 had the most frequency of contact, respondents cohabitating with their children were regarded as a part of this group as well.

Other variables

As the most relevant confounding factors, age, gender, marital status and education attainment were adjusted for in this study. Age was grouped into three classifications: 60 years and younger, 61–75 years and older than 75 years. Marital status was classified into six degrees including married and living with spouse, married but not living together temporarily, separated, divorced, widowed and never married. Education was classified into five degrees including illiterate/semiliterate, elementary school, junior high school, senior high school and college/university or higher.

Statistical analysis

Descriptive statistics were used to show the population distribution in demographic characteristics (age, gender, marital status and level of education), SES and frequency of contact between rural and urban respondents. The Kolmogorov-Smirnov test and the rank sum test were used to test the distribution and disparity of HRQoL

between rural and urban areas.²⁶ Stratified analysis was conducted for the variables (age, gender, marital status, education, SES and frequency of contact) to examine whether the disparity of HRQoL between rural and urban areas existed across strata.

Mediation analysis started with a simple mediation model (online supplementary figure 1.I) for SES and frequency of contact, respectively, which was used to verify the possible mediating effects of SES or frequency of contact on the relationship between area and HRQoL with a series of linear regression analysis.²⁷ Besides, multiple mediation analysis was conducted in a single-step multiple mediator model (online supplementary figure 1.II).²⁸ This model simultaneously incorporated two mediators, which allowed to test an overall direct effect of area on HRQoL and to test specific indirect effect of one mediator while the other was controlled. In order to compare the magnitude of indirect effects of SES and contact, all variables were standardised according to suggestions from Mackinnon.²⁹

In addition, magnitude of total, direct and indirect effect as well as 95% CIs of indirect effect in aforementioned models were estimated based on a bootstrap method, which has been recommended as the most powerful and reasonable method to obtain estimation of indirect effects under most conditions that were not restricted to a normal sampling distribution.³⁰ In this study, mediation analyses were computed from 5000 bootstrap samples. Mediating effects were also confirmed by the Sobel test, a statistical method that estimated the indirect effect and its SE.³¹ All analyses were performed using both SPSS software (V.20.0) with a process designed for mediation analysis³² and SAS software (V.9.4). The significance was set at $\alpha=0.05$. In aforementioned models, age, gender, marital status and education were controlled for all the time.

Patient and public involvement statement

CHARLS, as a household survey, involved no patients in the design or development of the research question and outcome measures. No patients were involved in developing the hypothesis and plans for design of this study either. The results would not be disseminated to study participants or any other individuals or communities.

RESULTS

SES and frequency of contact with their children

There were 12369 respondents in all. Compared with urban interviewees, rural interviewees were more likely to be male, older, lack of spouse companionship and under-educated. Besides these demographic differences, the elderly were generally poorer in rural areas. More than half (52.43%) of the rural respondents were in middle-lower and lower SES, while urban respondents in this status only accounted for 20.38% (online supplementary table 1).

Moreover, urban older adults contacted with their children more frequently (online supplementary table 2).

After combination of two types of contact, the proportion of urban respondents in group 4 was significantly higher than that of rural respondents (63.41% vs 44.59%). According to separate statistical data for frequency of two types of contact, urban respondents contacted with their children more frequently whatever the type was. Compared with urban respondents, rural older adults were more likely to have only one type of contact with children, either frequent face-to-face contact (group 3) or frequent phone contact (group 2).

Health-related quality of life

The graphic distribution of the EuroQol five dimensions (EQ-5D) scale shows a significant difference in HRQoL

between urban and rural participants ($p < 0.05$). Generally, the score of HRQoL of participants in urban areas was greater to that of rural areas (figure 1). Disparities between urban and rural areas in the score of HRQoL existed in all strata of gender, age and frequency of contact (all $p < 0.05$). The result is given in the form of mean \pm SE. However, the statistical differences between urban and rural in the score of HRQoL disappeared when it comes to the elderly with senior high school or higher degree. Comparing the score of HRQoL in different marital status, the difference between urban and rural participants disappeared except for the level of 'married with spouse/living with partner', 'married but

Table 1 Stratified analysis of the score of HRQoL between urban and rural areas

Variables	Urban (mean \pm SE)	Rural (mean \pm SE)	P value
Gender			
Male	0.8487 \pm 0.0034	0.8092 \pm 0.0027	<0.001
Female	0.7980 \pm 0.0035	0.7240 \pm 0.0028	<0.001
Age			
≤ 60	0.8434 \pm 0.0034	0.7980 \pm 0.0027	<0.001
61–75	0.8071 \pm 0.0039	0.7434 \pm 0.0031	<0.001
>75	0.7719 \pm 0.0093	0.6943 \pm 0.0078	<0.001
Marital status			
Married with spouse/living with partner	0.8301 \pm 0.0027	0.7773 \pm 0.0022	<0.001
Married but not living with spouse temporarily	0.8206 \pm 0.0127	0.7902 \pm 0.0078	0.0406
Separated	0.7901 \pm 0.0480	0.7279 \pm 0.0447	0.3432
Divorced	0.7920 \pm 0.0204	0.7419 \pm 0.0274	0.1426
Widowed	0.7769 \pm 0.0082	0.7011 \pm 0.0061	<0.001
Never married	0.7873 \pm 0.0462	0.6965 \pm 0.0196	0.0706
Education			
Illiterate/semiliterate	0.7678 \pm 0.0046	0.7295 \pm 0.0028	<0.001
Elementary school	0.8191 \pm 0.0054	0.7780 \pm 0.0039	<0.001
Junior high school	0.8438 \pm 0.0046	0.8217 \pm 0.0044	<0.001
Senior high school	0.8648 \pm 0.0059	0.8502 \pm 0.0074	0.1232
College/university or higher	0.8874 \pm 0.0098	0.8831 \pm 0.0279	0.8820
Socioeconomic status (SES)			
Lower	0.7285 \pm 0.0084	0.7096 \pm 0.0038	0.0401
Middle lower	0.7717 \pm 0.0071	0.7531 \pm 0.0038	0.0203
Middle	0.8013 \pm 0.0061	0.7903 \pm 0.0040	0.1310
Middle upper	0.8299 \pm 0.0048	0.8250 \pm 0.0048	0.4587
Upper	0.8672 \pm 0.0040	0.8454 \pm 0.0072	0.0079
Frequency of contact			
Neither	0.7881 \pm 0.0062	0.7493 \pm 0.0035	<0.001
Phone	0.8382 \pm 0.0072	0.7869 \pm 0.0054	<0.001
Face to face	0.7791 \pm 0.0088	0.7557 \pm 0.0063	0.0305
Both	0.8361 \pm 0.0031	0.7804 \pm 0.0030	<0.001

HRQoL, health-related quality of life.

Table 2 The mediating effects of SES and contact on the relationship between area and HRQoL in simple mediation model

	Coefficient	SE	P value	Sobel test: Z(P)	Ratio of indirect effect to total effect
Area→SES→HRQoL				19.3815 (<0.0001)	67.61%
Total effect (c path)	0.1090	0.0089	<0.0001		
Direct effect (c')	0.0353	0.0094	0.0002		
Area→SES (a)	0.3488	0.0081	<0.0001		
SES→HRQoL (b)	0.2113	0.0097	<0.0001		
Area→contact→HRQoL				7.0208 (<0.0001)	10.59%
Total effect (c path)	0.1090	0.0089	<0.0001		
Direct effect (c')	0.0975	0.0090	<0.0001		
Area→contact (a)	0.1772	0.0093	<0.0001		
Contact →HRQoL (b)	0.0651	0.0086	<0.0001		

HRQoL, health-related quality of life; SES, socioeconomic status.

not living together temporarily' and 'widowed'. Similarly, the difference in the score of HRQoL between urban and rural middle-aged and elderly participants disappeared among the strata of SES for the level of middle and middle-upper SES. Moreover, as the educational level, SES and frequency of contact with children rose, scores of HRQoL of the elderly in both urban and rural areas went up (table 1).

Mediation analyses

The simple mediation analysis (table 2) indicated that area was positively associated with SES and HRQoL ($a=0.3488$ and $c=0.1090$, both $p<0.0001$). As a mediator, SES was positively associated with HRQoL ($b=0.2113$, $p<0.0001$), leading to a reduction in effect of area on HRQoL ($c=0.1090$ vs $c'=0.0353$). The percentage of indirect effect to total effect of area was 67.61% ($Z=19.3815$, $p<0.0001$). Moreover, frequency of contact with children had similar results as the mediating variable. Area was statistically significant related with frequency of contact and HRQoL ($a=0.1772$ and $c=0.1090$, both $p<0.0001$) and the frequency of contact was positively associated

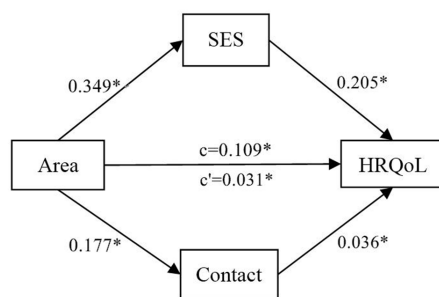
with HRQoL ($b=0.0651$, $p<0.0001$), explaining 10.59% of the variance in HRQoL induced by area ($Z=7.0208$, $p<0.0001$).

Multiple mediation analysis showed that area, SES and frequency of contact with children were all related with HRQoL, and area had association with SES and frequency of contact as well (figure 2). Table 3 showed that the total effect of area on HRQoL was statistically significant and after adjusting for two mediators at the same time, the direct effect was still significant ($c=0.1090$ vs $c'=0.0312$, both $p<0.05$). The mediating effects of SES and frequency of contact with children proved to be true with bootstrap CIs that did not contain zero (95% CI 0.0637 to 0.0792% and 95% CI 0.0034 to 0.0097). Besides, there was contrast between SES and frequency of contact with children that SES had a greater indirect effect in the association of area with HRQoL than frequency of contact (65.45% vs 5.90%).

DISCUSSION

HRQoL, a comprehensive index, is selected as the independent variable to evaluate and compare the health status of the middle aged and elderly in both urban and rural areas. Our results explicitly reveal a huge gap, even after controlling known confounders, in the HRQoL among urban and rural individuals who are aged over 45 years and indicate that living in urban areas leads to better health status of older adults than rural areas. Moreover, the current study provides vital information about the relationship of urban–rural disparity in HRQoL with SES and frequency of contact with children among the middle aged and elderly in China. SES and frequency of contact with children play positive mediating roles in the difference of HRQoL between urban and rural older residents.

The mediation analysis indicates that the difference of HRQoL between urban and rural areas is partly mediated



* $P<0.05$

Figure 2 Multiple mediation analysis. HRQoL, health-related quality of life; SES, socioeconomic status.

Table 3 The mediating effects of SES and contact on the relationship between area and HRQoL in single-step multiple mediator model

	Parameter estimate	SE	Lower 95% BC CI	Upper 95% BC CI	Ratio of indirect effect to total effect (%)
Total effect (c)	0.1090*	0.0089	0.0916	0.1265	
Direct effect (c')	0.0312*	0.0094	0.0128	0.0497	
Indirect effect 1 (SES)	0.0713*	0.0039	0.0637	0.0792	65.45
Indirect effect 2 (contact)	0.0064*	0.0016	0.0034	0.0097	5.90

*P<0.05.

 $\chi^2 = 361.89$ (p<0.0001) RMSEA: 0.171, GFI: 0.858 and NFI: 0.917.

BC CI, bias-corrected confidence intervals.

by SES. According to our analysis, families or individuals living in rural areas have lower level of SES, which will correspondingly contribute to the significantly worse self-perceived HRQoL of the middle-aged and elderly than those in cities. As shown in previous studies, the disparity mediated by SES may credit to the correlation between the level of health self-management and consciousness of the middle aged and elderly.³³ Many studies have shown that high SES is indeed an advantage in promoting healthy behaviours and health service utilisation that further promote health status.^{34–36} Therefore, it is necessary for improving well-being of Chinese older adults to accelerate the process of balanced economic development and to enhance the equity of health service utilisation between urban and rural areas.

Another discovery of this study is that the frequency of contact with children plays an intermediary role in the relationship between urban/rural areas and HRQoL. We found that urban middle-aged and elderly residents have more contact with children than rural ones. The more frequent contact with children elderly residents have, the higher the index score of HRQoL they received. Considering the stage of China country's social development and demographic transition related with population policy, it may be ascribed to the migration to cities of many rural young workers for a better life.³⁷ Rural-to-urban migration is an important reason that decreases the frequency of contact between children and parents. The previous researches put forward that the elderly's social network affects their physical and psychological well-being by buffering stress and promoting health relevant behaviours.^{38–40} Meanwhile, other researches also stand the point that family and social support can affect the mental health of the elderly, children could play a key role in positively affecting the social network of their elderly parents¹⁵ and among elderly population, the risk of suffering from depression was negatively correlated with frequency of contact with adult children.¹⁹ Compared with the group of frequent face-to-face and phone contact with adult children, the risk of suffering from depression was higher in the other three groups, which lack of either face-to-face contact or phone contact or both. From the above, young people should give more care and support to the elderly. Meanwhile, the government should also

encourage more young people to return to work in the countryside and support the development of rural economy in our country.

However, SES and frequency of contact with children merely explained partial disparity in HRQoL of urban and rural elderly participants in multiple mediation analysis. This may remind us that there are still many other mediation factors to be explored. Concerning the two mediators we studied, SES has greater mediating effect on the relationship between urban–rural disparity in HRQoL of middle-aged and elderly participants compared with frequency of contact. It is possible that SES as a synthetic index covers more extensively. In some ways, it is suggested that reducing the unfairness of economic development between urban and rural areas is the most important task for the country to improve the national health.

The current study has three major limitations. First, we employed the cross-sectional data that cannot distinguish cause and effect between mediators and HRQoL. The longitudinal mediation analysis will be a good choice in the future study. Second, the two mediators we chose only explained about 70% indirect effect, and the current study is not to further explore the relationship between the mediators and HRQoL. Some other researchers found the positive effects of SES on HRQoL of older adults might credit to some additional factors such as social functioning. Maybe a more complex mediation model or more mediation variables could be applied to explore the relevant relationship. Third, urban and rural respondents may have different performance in different dimensions of HRQoL.⁴¹ Further investigation could be conducted in each dimension separately to study the mediating effects of SES and frequency on urban–rural disparity among middle-aged and elderly people.

Our findings prove the fundamental influence of SES on health status of the middle aged and elderly. Therefore, this study is of great significance for the government to carry out future healthcare policies and promote the health equality for middle-aged and elderly residents in urban and rural areas.⁴² Moreover, it also provides the adequate foundation that young people need to provide financial support for our parents and to establish close relationships with them to maintain their QoL when they get older.

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Contributors HS and QM designed the experiments; XY and YZ collected the samples; YZ and JZ managed statistical analysis and interpretation of the results; XY wrote the manuscript; CW, YM and YX offered advice for study and helped language editing; all authors reviewed the manuscript.

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Competing interests None declared.

Patient consent for publication Obtained.

Ethics approval Our study was approved by the ethics committee of the Medical College of Soochow University in Suzhou, Jiangsu, China.

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement The data sets used and analysed in this study are available from the China Health and Retirement Longitudinal Study (<http://charls.pku.edu.cn/zh-CN>), a nationally representative longitudinal survey conducted by Institute of Social Science Survey, Peking University.

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