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“Depression from Overestimation”: Income, Perception Bias and Children’s Mental Health in China’s Rural Households

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Abstract: The mental health of rural children is closely related to their household characteristics, with household income level as one of the important influencing factors. In general, improvement in household income level is deemed to play an important role in promoting children’s mental health. However, the impact and mechanism of household income status perception bias on children’s mental health due to changes in the structure of household expenditure are under studied. On the basis of the perspective of household income status perception bias, we constructed a representative behavior household model of income status perception bias and a three-wave panel. We adopted the data from Chinese household tracking surveys in 2012, 2014, and 2016 to empirically analyze the mechanism and channel of household income status perception bias on children’s mental health. Results reveal that: (1) A significant negative correlation exists between household income level and income status perception bias, and poor households are likely to have income status perception bias. (2) A significant positive correlation exists between income status perception bias of poor households and their gift-giving expenditure, whereas a negative correlation exists between income status perception bias and expenditure for children’s education. The more the poor households overestimate their income status, the more inclined they are to increase their gift spending and reduce expenditure for children’s education, thereby changing the structure of family expenditure. (3) A significant negative correlation exists between poor household income status perception bias and the mental health status of their children, whereas a positive correlation exists between household expenditure for children’s education and children’s mental health status. That is, the more that poor households overestimate their relative income status, the greater the mental pressure on children. Finally, the reduction of expenditure on children’s education by rural households is an effective channel through which income status perception bias among poor households affects children’s mental pressure.

Keywords: rural households; income; perception bias; expenditure structure; rural children; mental health

1. Introduction

Since the Reform and the implementation of the Opening up Policy, China’s economy has experienced rapid development and has undergone structural transformation. These changes have resulted in profound changes in the social environment. Issues, such as rising childcare costs, shortage of quality education resources, and further increases in employment pressure, have become increasingly

prominent in relation to children's education and human capital creation. These phenomena have led Chinese children and their families to face an increasingly competitive environment for growth. Pressure on character shaping, interpersonal relationship building, learning ability development, and living environment adaptation has multiplied [1]. According to the latest data released by the National Health Commission in 2018, approximately 30 million children under the age of 17 in China suffer from various emotional disorders and learning and behavioral problems caused by mental pressure. (The data sources are available online at: <http://www.nhc.gov.cn/wjw/zccl/201805/93bd24e3199c4bd9bfae5ff6a258bcd8b.shtml>). Furthermore, according to the World Health Organization, global psychological barriers in children will increase by more than 50% in the next 20 years and will become one of the main causes of illness, disability, and death [2]. Therefore, studying the influencing factors of children's mental health is of great theoretical and practical significance for relieving children's mental pressure, promoting children's health, and improving the rate of return of education.

Rural areas have received the hardest hit for children's psychological problems due to structural contradictions caused by unbalanced urban and rural development. On the one hand, a large number of left-behind children (The "left-behind children" refers to children who live in the place of hukou registration and live together with one or no parents, as he or she or both have migrated [3]) are recognized in rural China. According to China's 1% National Population Sample Survey in 2015, there are more than 45.01 million of left-behind children, accounting for approximately 34.6% of the total rural children [4]. Therefore, the lack of parental care, adequate family, and parent-child education has rendered rural left-behind children vulnerable to anxiety and depression [5,6]. On the other hand, the level of general economic development in rural areas is low compared with that of cities. That is, low-income households cannot provide sufficient food, medical care, education, and entertainment facilities for children. As a result, children in poor rural households score lower than normal children in terms of health, cognitive ability, individual development, learning achievement, and happiness [7]. In addition, parents in some rural households are more prone to unstable emotions such as depression, anxiety and anger due to poverty. Family disharmony and family breakdown are relatively common in low-income households. Parents lack patience, tolerance, trust, and encouragement in raising children. Frequent punishments aggravate psychological pressure on children and seriously affect the mental health of children in rural China [8,9].

To date, the majority of existing research investigated the factors affecting the mental health of rural children on the basis of external environmental characteristics, children's individual characteristics, parental characteristics, and children's household characteristics. External environmental characteristics include economic inequality and social environment disorder in poverty-stricken areas, gender and social status discrimination, air and water pollution, medical quality differences and access methods, and regional financial credit levels [10–14]. Individual characteristics of children include gender, age, health status, academic performance, and years of schooling [15–18]. Moreover, parental characteristics include education level, health status, marital status, and effective parent-child time [19–21]. Children's household characteristics include household size and structure, income and expenditure, asset structure, and family atmosphere [15,22,23]. Among these factors, family income levels are generally considered one of the most important factors affecting children's mental health. However, existing research only focuses on objective conditions, such as actual income level of households, and ignores the subjective cognition and evaluation of household members especially the income level and economic status of heads of households and financial supervisors [24]. Therefore, we take the perspective of subjective understanding of the income status of rural households. Our systematic study of the impact of rural households' perspective of subjective understanding of the income status on children's mental health and its transmission mechanism can effectively remedy the shortcomings of the existing literature and provide a new economic explanation for the causes of rural children's mental health problems. On the basis of the abovementioned literature review and empirical facts, we select mental pressure on rural children as the research object.

Applying the perspective of household income status perception bias, a representative behavior rural household model of perceived income bias is constructed for theoretical analysis, based on which we put forward several hypotheses to be tested. The paper adopts the “China Family Panel Studies” (CFPS) data in 2012, 2014, and 2016 to construct a three-wave panel (Supplementary Material). It empirically analyzes the mechanism and channel of a household’s income status perception bias affecting mental pressure among children. Finally, it provides corresponding discussion and suggestions based on the empirical analysis results.

The remainder of this paper is organized as follows. Section 2 presents the literature review that systematically summarizes and categorizes the existing studies on perception bias and children’s mental health. Section 3 constructs a representative behavior model of income perception bias, explains empirical facts through theoretical analysis, and provides hypotheses for empirical research. Section 4 discusses the empirical strategy and measurement model. Section 5 introduces data sources, variable descriptions, and descriptive statistics. Section 6 provides empirical results and analysis. Section 7 provides a conclusion and discussion.

2. Literature Review

2.1. Effect of Household Characteristics on Children’s Mental Health

Studies on children’s mental health problems have shown that the characteristic variables associated with children and their parents and families are the main factors affecting their mental health. Children’s gender, age, health status, and academic level may be causes of their mental health problems. Among the variables, the influence of children’s gender on mental health has yet to reach a consensus because the majority of studies posit that gender does not significantly interfere with children’s mental health [16]. The effect of children’s age on their mental health level is relatively complex and are mostly realized through other factors. For example, Davis et al. (2010) [15] found that a family’s economic situation caused mental pressure on children before the age of 12. The younger a child is, the greater the mental pressure on the child is [15]. The impact of academic performance on children’s mental pressure depends on the growth environment, training mode, and policy national conditions of children in different regions. In the current context of China’s huge competitive pressure on educational resources and emphasis on exam-oriented education, families pay excess attention to children’s academic performance. This situation leads poorly performing children to face great psychological pressure [18]. However, many studies abroad have yet to find a significant correlation between academic level, academic achievement, and children’s mental health [17].

Parents’ education level, health status, marital status, and effective parent–child time influence children’s mental health. Parents’ academic qualifications and health status are often related to employment and household income. As such, parents with low education level and poor health tend to have relatively low income and a high probability of unemployment. This tendency not only leads to a decrease in the material investment of parents to children but also increases the likelihood of serious negative impact on the formation of children’s opinion on life and values, which leads to increased mental pressure [15,21]. Family relationships with loose marital status are generally characterized by quarrels, conflicts, indifference, and lack of concern for family members. An unstable and harsh marriage can lead to behavioral disorders and increased symptoms of depression among children [19,25]. In addition, long-term effective parent–child time is the main feature of parental recognition and care for children, which will effectively alleviate children’s mental pressure [19]. However, the risk of mental health problems for rural left-behind children will significantly increase due to the lack of parent–child time that results from the migration of their parents [26–28].

The household factors that affect children’s mental health can be summarized as two aspects: the demographic structure and economic conditions of the household. Demographic structure of the household will affect the distribution of household resources: Blake (1981) [29] argued that a “dilution” effect occurs in the household, that is, the more the children, the less resources each child obtains.

Therefore, for households with limited resources, the more the children, the greater individual mental pressure each child experiences [29]. In the social context of rural China, the oldest or youngest child in general gains more household resources, such that their mental pressure may be less [30]. Economic conditions refer to the impact of the overall income and expenditure level of a household on the access of children's resources. Low-income households are subject to lower resources endowments, and their relatively low growth investment in children (i.e., education, medical & health, and entertainment) makes it is difficult for the children to acquire basic material conditions for growth [31]. Furthermore, to improve their overall income level, most adults in low-income households opt to work longer, resulting in children who lack necessary mental support, such as companionship, communication, and family interaction, and it is easier for children to develop bad living habits in the stage of character development [32]. Therefore, children in low-income households are more likely to be lonely and depressed and have a greater negative impact on mental health in the long run [22,23]. What's more, not only general labor market and income characteristics affect adversely children's mental health but they can also affect the latter through decreased health care services consumption and unhealthy life style habits [33–35].

2.2. Perception Bias and Its Impact on Behavior

In terms of perception bias, the “D–K effect” proposed by Kruger and Dunning (1999) [36] is an internationally accepted theory. It states that individual behaviors may produce an assessment that is inconsistent with the actual situation in one aspect of themselves, and this erroneous estimation of one's tendency is called “perception bias.” The causes and manifestations of individual perception bias vary. For example, individuals with low ability are likely to overestimate themselves because they lack the correct measure of their abilities and sufficient resources to improve their cognitive level. In contrast, individuals with high ability mostly underestimate themselves because of factors, such as cognitive level, interpersonal relationships, and personality traits that cause them to mistakenly overestimate others' abilities. Perception bias has been confirmed by an increasing number of empirical studies. For example, students with poor grades tend to have optimistic expectations for their test results [37]. Students who fail driver's license exams are more likely to overestimate their driving skills than those who pass the exam [38]. Similarly, chess players will overestimate their predictive ability in the game, whereas those who are low ability will be more likely to overestimate their own level, which lead to prediction errors [39].

Perception bias has an impact on many individual behaviors. Research in economics focuses on risk behavioral decision analysis. Entrepreneurs do not show a strong risk preference when making entrepreneurial decisions, but perception bias leads to a low perception of risk and options when starting a business [40]. In venture capital research, Zacharakis and Shepherd (2001) [41] found that venture capitalists often overestimate their decision-making level compared with the average person. As such, perception bias often has a certain negative impact on the accuracy of risk investment decisions [41]. In addition, research on perception bias and its impact on behavior and decision making is widespread in areas such as consumption, credit, financial asset valuation, corporate or household financial decisions, and poverty perception [42–45].

In different decision-making situations, various types of household expenditures that result from decision-making behaviors are also affected by perception bias. Among them, perception bias of household income status largely affects the expenditure structure of households [46]. A representative household's expenditure categories mainly include food, tobacco, alcohol, clothing, housing, daily necessities, transportation, communication, education, culture, entertainment, health care, and other basic supplies. The consumption of clothing, food, housing, travel and daily necessities is relatively fixed rigid expenditure types, so it is not easy for household to adjust significantly [47]. However, other more flexible expenditure types may change due to adjustments in household income and spending decisions. For example, under the peer-effect and status concern, households are likely to choose households with equal or higher income status as a reference and then increase gift-giving expenditure

due to concerns about their social status [48]. However, under the influence of perception bias of income status, if a rural household overestimates its income status within nearby areas, then the level of gift-giving expenditure will be higher than that determined by the actual income of the household [49]. Expenditure on children's education will be further compressed in the case of poor households with low income and difficulty in reducing fixed expenditures. Therefore, children are likely to face greater pressure in terms of academic performance and getting along with peers, which will affect their mental health [50].

3. Theoretical Framework and Hypothesis

On the basis of the “D–K effect” proposed by Kruger and Dunning (1999) [36], low-income rural households tend to overestimate their income levels due to their low cognitive abilities. Furthermore, under the influence of perceptual bias, low-income rural households tend to be closer to high-income rural households in terms of household consumption due to the “demonstration effect” (The “demonstration effect” of consumption indicates that consumers compare with other consumers when they consume and intend to exceed others in the same social class at the level of consumption.) of consumer behavior; and the household gift-giving expenditure represents its “Face” in the nearby area, thus under the action of the above two effects, the gift-giving expenditure increases due to the comparison among households in the same area and this phenomenon is particularly common in rural China [51,52]. However, this phenomenon is different between normal rural household and poor rural household: (1) The income limitation of poor household makes they do not have enough resources to invest in human capital and social capital, thus the limitation of knowledge level and social skills results in relatively low perception which makes poor rural households more likely to generate income status perception biases and thus overestimate the income status, and increase gift-giving spending under the influence of income status perception biases; conversely, normal households are less likely to experience bias in income status perception, and the income status perception bias has lower influence on their gift-giving expenditure [48–52]. (2) Normal rural households have higher incomes, more adequate savings, and excellent asset allocation, so even if they increase gift-giving expenditure, they may not need to reduce other flexible expenditure; however, poor rural households, especially those below the poverty line, of which the income and savings can only meet basic living needs, once the gift-giving expenditure rises, other expenditures will inevitably be reduced, thus under the circumstance that the rigid expenditures cannot be changed, poor rural households can only reduce flexible expenditures, especially children's education expenditure which has a large share in the flexible expenditures [47,49–52]. When children's education expenditures cannot be guaranteed, children in poor rural households will face tremendous pressure in academic, social, recreational and personality building, which will negatively affect their mental health [50]. Therefore, poor rural household's perception bias of real income status will change their consumption expectation and expenditure structure, making household gift-giving expenditure increase and the human capital (education investment) of children will be reduced, which ultimately reduces the mental health level of children.

To deepen the understanding of empirical facts and provide theoretical basis for empirical research, we construct a simple but general theoretical model. The model aims to explain the likelihood that the income perception bias of rural households will have an impact on its expenditure structure and children's psychological pressure. We assume that the utility function of a representative actor (rural household) is:

$$U(x, e) \quad (1)$$

where x represents rural household expenditure, which is assumed to be the sum of children's human capital investment (H) and gift-giving expenditure (r), $x = H + r$. In addition, e represents rural household income. Therefore, Equation (1) can be rewritten as $U(H, r, e)$.

We use Equations (2) and (3) to depict rural households' willingness to maximize their utility and budget constraints under general circumstances:

$$\max_{H, r, e} U(H, r, e) \quad (2)$$

$$\text{s.t. } e - (qH + wr) = 0 \quad (3)$$

where H and r are defined similar to those in Equation (1); q represents the cost of human capital investment, w represents the cost of gift-giving expenditure, and households' income return rate is set to 1. To ensure that the above optimization problem has a unique solution, assume that the household's utility function $U(H, r, e)$ is a strictly concave function, and " H^*, r^*, e^* " are the equilibrium solution of the optimization problem.

According to the above relevant background and literature review, we refer to the perception bias model constructed by Loewenstein (2003) [53], which assumes existence probability P ($P \in [0,1]$), such that the representative actor (rural household) utility function is rewritten as:

$$\widetilde{U}(x, e | e') = (1 - P) \cdot U(H, r, e) + P \cdot U(H, r, e') \quad (4)$$

To a certain extent, the utility of rural households (\widetilde{U}) is the weighted average of real utility $U(H, r, e)$ and income perception bias utility $U(H, r, e')$ with a weight of probability (P) due to the influence of income perception bias (e'). Let $P = p(e)$ and $\partial P / \partial e \leq 0$, that is, probability P is the minus function of rural household income (e). In particular, if the rural household does not have income perception bias, when $P = 0$, then $\widetilde{U}(x, e | e') = U(H, r, e)$. Based on the cited assumptions, the income perception bias of rural households will be incorporated in their utility function. We use U_0 as the coreference of the income perception bias utility function $U(H, r, e')$ and assume that utility function has a limited range of values. Thus, the optimization problem of the representative actor (rural household) can be changed to:

$$\begin{aligned} \max_{H, r, e} [1 - p(e)] \cdot U(H, r, e) + p(e) \cdot U_0 \\ \text{s.t. } e - (qH + wr) = 0 \end{aligned} \quad (5)$$

The equilibrium solution of the optimization problem is H^{**}, r^{**}, e^{**} . In combination with the analysis results of the abovementioned theories, Proposition 1 can be obtained as follows.

Proposition 1. $e^* > e^{**}$ and $e' > e^{**}$, if $(H^{**}, r^{**}, e^{**}) \neq (H^*, r^*, e^*)$.

Proposition 1 shows that if optimization problems (Equations (2) and (5)) have different solutions under the same constraints (Equation (3)), then households with relatively low income are likely to have income perception bias and tend to overestimate their income level due to the influence of perception bias. Combining Proposition 1 with the solutions of optimization problems (Equations (2) and (5)), the following Lemmas can be obtained.

Lemma 1. $H^* > H^{**}$ and $r^* \leq r^{**}$.

Lemma 1 indicates that rural households with low income are likely to increase gift-giving expenditure and reduce human capital investment in children under the influence of income perception bias. If children's psychological pressure function in this situation is assumed to be " $F = f(H)$ " and has the first order condition " $\partial F / \partial H < 0$ ", then Lemma 2 can be obtained as follows.

Lemma 2. $F^* = f(H^*) < f(H^{**}) = F^{**}$.

Lemma 2 indicates that children's psychological pressure will increase as rural households with low income reduce their investment in human capital under the influence of income perception bias.

In summary (The proofs of Proposition 1, Lemma 1, and Lemma 2 are shown in Appendix A), on the basis of the theoretical model provided in this section and combined with the existing literature, we propose the following hypotheses:

Hypothesis 1 (H1). *Poor rural households are likely to have income status perception bias and tend to overestimate their income level. That is, the lower their income is, the easier for rural households to overestimate their income levels.*

Hypothesis 2a (H2a). *Poor rural households' income status perception bias will affect the structure of household expenditures. Poor rural households who overestimate their income status will increase their gift-giving expenditure.*

Hypothesis 2b (H2b). *Poor rural households' income status perception bias will affect the structure of household expenditure. Poor rural households who overestimate their income status will reduce their expenditure for children's education.*

Hypothesis 3 (H3). *Poor rural households' income status perception bias will increase psychological pressure on their children by reducing human capital investment in children, which will lead to a reduction in their mental health level.*

4. Empirical Strategies and Econometric Models

According to the research hypothesis, our empirical strategy design aims to test whether low-income rural households with income status perception bias will overestimate their income level, then change the structure of household expenditure, which ultimately affects the mental health of children. Therefore, we will test each hypothesis and conduct an empirical analysis, based on which we build econometric models. Considering endogenous problems caused by the unobservable effect existed in different individuals and years in the micro panel of rural households and children, which may lead to biased estimation results, we establish a two-way fixed effect model to test the abovementioned hypotheses in Section 3 based on the research of Rockoff (2004), Zhou and Yu (2011), and Lu (2012) [27,54,55] (In the empirical study in this paper, there is basically no reverse causality between dependent and independent variables, the endogenous problem mainly comes from the omission of variables. The missing variables include external environmental factors such as regional social ethos and economic development level, factors such as individual personality traits in rural households, time effects such as political systems and policies in certain years, and rural households' social capital and peer effect such as peer pressure. The two-way fixed effects model provided in this article can strip the influence of the first three unobservable effects; however, peer effect is related to social networks and individual spillover effects, which are difficult to handle through technical means. However, in the context of this article, the endogenous problem caused by missing peer effect will not systematically overestimate the results of the sample, especially the sample of the poor rural households, and because we have fully controlled covariates at different levels and several robustness tests have been performed, the possibility that the final estimation result is disturbed by endogenous problems that lead to inconsistent estimation is relatively low).

To test Hypothesis 1, we construct the following two-way fixed effect regression equation:

$$Bias_{fkt} = \alpha + \beta_1 Income_{fkt} + \delta' X_{fkt} + \varphi_{fm} + \lambda_{kt} + \epsilon_{fkt} \quad (6)$$

where the dependent variable $Bias_{fkt}$ indicates the perception bias of rural household f living in county k in year t . The core independent variable $Income_{fkt}$ indicates the income of household f in county k in year t . β_1 measures the effect of household income level on household income status perception bias.

The vector matrix X_{fkt} represents a set of control variables that may have an impact on the perception bias of income status, including a series of rural household characteristic variables. We adopt those variables to eliminate the interference of other factors on the estimation of core independent variables. φ_{fm} denotes individual fixed effects by controlling for the endogenous problem on the estimated results caused by unobservable factors that vary only with the individual characteristic but not with time (It mainly controls for the fixed effects of long-term individual and household characteristics, and its meaning is similar across equations). λ_{kt} indicates the county-year fixed effect by controlling for the endogenous problem on the estimated results caused by unobservable factors that vary only with county and time but not with household and individual characteristics [56] (It mainly controls for the fixed effects of external environment characteristics that vary with county and time, and its meaning is similar across equations). ϵ_{fkt} represents the random error term of the regression equation. According to Hypothesis 1, the lower the household income level is, the higher the income status perception bias is. Therefore, we expect a negative correlation between the two variables. The estimated coefficient β_1 of the core independent variables $Income_{fkt}$ should be significantly negative.

Further, we conduct the following regression equation to test Hypothesis 2a:

$$Gift_{fkt} = \alpha + \beta_2 Bias_{fkt} + \delta' X_{fkt} + \varphi_{fm} + \lambda_{kt} + \epsilon_{fkt} \quad (7)$$

where the dependent variable $Gift_{fkt}$ indicates the gift-giving expenditure of household f living in county k in year t . The core independent variable $Bias_{fkt}$ represents the income status perception bias of household f living in county k in year t . Furthermore, β_2 measures the effect of perception bias on household gift spending. The meanings of other variables in Equation (7) are the same as those in Equation (6). According to Hypothesis 2a, the higher the income status perception bias of poor rural households, the more their gift-giving expenditures. Therefore, we expect a positive correlation between them. The estimated coefficient β_1 of the core independent variables $Bias_{fkt}$ should be significantly positive.

Hypothesis 2b is tested using the following regression Equation (8):

$$Edu_cost_{ifkt} = \alpha + \beta_3 Bias_{fkt} + \delta' X_{fkt} + \theta' X_{ikt} + \varphi_{fm} + \lambda_{kt} + \epsilon_{ifkt} \quad (8)$$

where the dependent variable Edu_cost_{ifkt} indicates the expenditure for education for child i in household f living in county k for year t . The core independent variable $Bias_{fkt}$ represents income status perception bias, and β_3 measures its effect on expenditure for children's education. The vector matrices X_{fkt} and X_{ikt} represent a set of control variables that may have an impact on household's expenditure for children's education, the former includes a series of household characteristic variables, the latter includes a series of individual characteristic variables of children. We adopted these variables to eliminate the interference of other factors on the estimation of the core independent variables. The meanings of other variables in Equation (8) are the same as those in Equations (6) and (7). According to Hypothesis 2b, the higher the income status perception bias of poor rural households, the lower their expenditure for children's education. Therefore, we expect a negative correlation between them. The estimated coefficient β_3 of the core independent variables $Bias_{fkt}$ should be significantly negative.

Hypothesis 3 is tested using the following regression Equation (9):

$$MH_{ifkt} = \alpha + \beta_4 Bias_{fkt} + \beta_5 Edu_cost_{ifkt} + \delta' X_{fkt} + \theta' X_{ikt} + \mu' X_{ifkt} + \varphi_{fm} + \lambda_{kt} + \epsilon_{ifkt} \quad (9)$$

where dependent variable MH_{ifkt} indicates the mental health of child i for household f living in county k and year t . The core independent variable $Bias_{fkt}$ represents income status perception bias, and β_4 measures its effect on children's mental health. Independent variable Edu_cost_{ifkt} represents expenditure for children's education, and β_5 measures its effect on children's mental health. The vector matrices X_{fkt} , X_{ikt} and X_{ifkt} represent a set of control variables that may have an impact on children's mental health, including a series of rural household characteristic variables, individual characteristic

variables of children and individual characteristic variables of children's parents, respectively. We adopt these variables to eliminate the interference of other factors on the estimation of the core independent variables. The meanings of other variables in Equation (9) are the same as those in Equations (7) and (8). According to Hypothesis 3, when there is only one independent variable $Bias_{fkt}$ in the regression, the higher the income status perception bias of poor rural households, the lower their children's mental health, if we use mental pressure to represent the children's mental health level, then there will be a positive correlation between income status perception bias and children's mental health and a significantly positive coefficient of β_4 ; however, the more the poor rural households spend on their children's education, the higher their children's mental health level, and we expect a negative correlation between expenditure for children's education and children's mental health and the estimated coefficient β_5 of Edu_cost_{ifkt} should be significantly negative. However, the estimated coefficient β_4 of the independent variables $Bias_{fkt}$ may be non-significant after Edu_cost_{ifkt} is added into the regression.

5. Data Sources and Descriptive Statistics

Combined with the abovementioned summarized research hypotheses, empirical strategies, and econometric models, the sample data adopted in the empirical research in this paper should comprehensively cover the income, relative income status, and subjective perception of rural households in all regions of China, structure of household expenditure, and relevant individual and household characteristic variables. The CFPS database was established by the China Social Survey Center of Peking University, and it aims to collect and analyze the individual and household data of more than 16,000 households in more than 600 counties in 25 provinces of China. The database is intended to comprehensively examine China's social and economic changes and support academic research and policy decisions. The CFPS database covers the samples and variables required for this study (A detailed introduction to CFPS data and data acquisition methods can be found at: <http://opendata.pku.edu.cn/dataverse/CFPS>). Up to now, the CFPS database has been updated with individual tracking data in 2010, 2012, 2014 and 2016. We use the three-wave panel composed of the survey data in 2012, 2014, and 2016 for empirical research because of the large systematic difference in the design of the questionnaire of household expenditure between the 2010 survey and the latter three periods surveys. Finally, 3688 effective sample observations are obtained with data cleaning (The three-wave panel data contain 25,701 observations, and valid observations are retained after excluding samples missing from the rural samples and psychological stress-related data).

This study mainly investigates the influence of income status perception bias of rural households on the mental pressure experienced by children. Three core variables should be tested, namely, household income and subjective perception, mental health status of children, and household expenditure structure. The main research objects are children under the age of 15 in rural households. As the core dependent variable, the mental health of children in rural households was measured by the Kessler Mental Distress Scale (K6 Scale) [57]. The K6 scale is a widely used mental pressure test scale worldwide. In the CFPS questionnaire, the K6 scale contains six questions answered by children as follows. (If the child is unable to answer independently due to young age or other special reasons, then the investigator will assist and guide his or her guardian). In the past month, "how frequently do you feel that you can't do anything?" "How often do you feel nervous," "How frequently do you feel uncomfortable and unable to keep calm?" "How frequently do you feel hopeless for the future?" "How often do you feel unable to do anything," and "how often do you think you're failing?" Each of these items has a score range of 0–4. The larger the score is, the greater the mental pressure and the lower the mental health level. A total score of more than 13 for the six items indicates that the child may be in a substantial state of psychological depression. In addition, two important variables of rural household social spending and expenditure for children's education can also be directly obtained from the CFPS database.

The questions in the CFPS questionnaire about household financial income and expenditure are answerable by the person who is “most familiar with family finances.” Thus, this article assumes that “the person who is most familiar with family finances” refers to household financial supervisors, and we use their income status perception to represent the entire household. The measurement of a household’s subjective income status perception is derived from the question “what level of income does your income belong to locally” in the questionnaire, which divides households’ subjective income into five levels arranged from low to high. Correspondingly, we divide the actual income of rural households within the same county/district into five levels arranged from low to high. Finally, the overestimation of the household’s income status is measured by the abovementioned individual household income perception minus its corresponding actual income. We use it as the proxy variable for the income status perception bias.

According to the literature review, the factors affecting children’s mental health include children’s individual, household, and parental characteristics and external environment. Therefore, we also control for the relevant variables in combination with empirical strategies and measurement models. Among them, the control variables of children’s individual characteristics mainly include age, current education, physical health status, and academic performance. The control variables for household characteristics mainly include economic status, age of other household members, health status, number of children, and whether the child is the first child. The parental characteristics control variables mainly include parents’ education, marital status, and effective parent–child time. Other external environmental factors are controlled for by county–year fixed effects in the panel two-way fixed effect model. Table 1 reports the definitions and descriptions of the variables required for empirical research.

In addition, this study aims to investigate the differences between poor and non-poor households and further test whether the impact of rural household income perception bias on children’s mental health is heterogeneous. Thus, the total sample is divided into the poor and non-poor samples according to the income level of rural households. On the basis of the results, we use the sample of the non-poor rural households as a control group for empirical demonstration. The poor group sample is divided according to household per capita net income standard published in the “China Rural Poverty Monitoring Report.” Rural households with per capita net income of less than 2300 CHY (2012), 2800 CHY (2014), and 3000 CHY (2016) in the three waves of the samples are categorized into the poor sample group. Table 2 reports the descriptive statistics of all relevant variables for both sample groups. From the descriptive statistical results of the sample, mental pressure on children in poor households, income status perception bias, and total number of children in the family are significantly higher than those in non-poor households under the condition of uncontrolled two-way fixed effect. Variables, such as expenditure on children’s education, children’s academic performance, household disposable income, household per capita expenditure, and parental marital status, are significantly lower than those of non-poor households. After controlling for the two-way fixed effect, the gap between poor and non-poor households has narrowed. However, the level of psychological pressure and income status perception bias, which are the core variables of poor households, remain significantly higher than those of non-poor households. However, expenditure for children’s education and per capita disposable income of poor households are significantly lower than those of non-poor rural households. In addition, the gift-giving expenditure of poor households also becomes significantly higher than that of non-poor households. Thus, no significant difference in other variables was observed between the two groups. (Table A1 in Appendix A provides a Pearson correlation coefficient matrix of the correlation among the variables in this research, which can be used as a priori judgments of the empirical study).

Table 1. Description of variables.

Definition of Variables	Variable Names	Variable Descriptions
Core independent and dependent variables	Children's mental health	Children's mental pressure measured using the K6 scale
	Expenditure for children's education	Household's per capita educational expenditure for children (unit: CHY)
	Household gift-giving expenditure	Household's per capita gift-giving expenditure (unit: CHY)
	Perception bias of household income status	Household financial supervisor's household income perception–actual income perception
	Household income	Household's per capita disposable income (unit: CHY)
Children's individual characteristics control variables	Children's age	Children's age during the survey year
	Children's education	Children's current grade: Nursery = 1; Kindergarten = 2; Primary school = 3; Junior high school = 4; High school/Technical school/Vocational school = 5; Junior college = 6
	Children's physical health status	Children's frequency of hospital visits for illness in the past year
	Children's academic performance	Current grade ranking of children's academic performance: Top 10% = 1; 11–25% = 2; 26–50% = 3; 51–75% = 4; Bottom 24% = 5
	Whether the child is the first child	Yes = 0; No = 1
Household characteristics control variables	Household expenditure	Household's per capita expenditure (unit: CHY)
	Household members' age	The age of household members except children in the survey year
	Household members' physical health	Household members' self-rated health scores
	Number of children in the household	The number of children in the household during the survey year
Parents' characteristics control variables	Parents' educational attainment	Highest educational attainment of children's parents: Illiterate/Semi-illiterate = 1; Primary school = 2; Junior high school = 3; High school/Technical school/Vocational school = 4; junior college = 5; Bachelor's = 6; Master's = 7; Doctor = 8
	Parents' marital status	Divorced = 0; Married = 1
	Effective parent-child time	Total length of time the father or mother spent with the child within one year: less than 6 months = 0; 6 months or more = 1

Table 2. Descriptive statistics.

Variable Name	Non-Poor			Poor			Non-Poor–Poor			
	Obs	Means	S.D.	Obs	Means	S.D.	Diff. (S.E.)		Cond. Diff. (S.E.)	
Children’s mental health	2796	7.698	3.571	892	8.081	3.719	−0.382 ***	(0.142)	−0.224 ***	(0.078)
Expenditure for children’s education	2762	1860	2854	880	1337	2442	523.2 ***	(98.59)	160.8 ***	(58.43)
Household gift-giving expenditure	1189	3320	4632	369	2975	6250	344.4	(351.8)	−257.8 *	(151.2)
Perception bias of household income status	2796	−0.0293	1.959	892	0.666	1.675	−0.695 ***	(0.0672)	−0.497 ***	(0.149)
Household income	2577	8993	11315	844	1886	13206	7107 **	(506.2)	1274	(792.4)
Children’s age	2796	12.57	1.723	892	12.54	1.684	0.0301	(0.0651)	0.000157	(0.0058)
Children’s education	2603	3.453	0.712	802	3.429	0.718	0.0240	(0.0289)	0.0266	(0.0750)
Children’s physical health status	2726	1.088	2.250	867	1.002	2.526	0.0857	(0.0960)	−0.235	(0.210)
Children’s academic performance	2413	3.627	1.933	757	3.489	1.916	0.138 *	(0.0800)	−0.178	(0.180)
Whether the child is the first child	2747	9222	7233	880	1132	762.2	8090 ***	(140.4)	6246 ***	(447.6)
Household expenditure	2796	46.10	11.26	892	45.67	11.88	0.426	(0.451)	0.562	(0.667)
Household members’ age	2796	3.138	1.226	892	3.157	1.291	−0.0185	(0.0490)	0.0899	(0.0982)
Household members’ physical health	2796	1.786	0.903	892	2.012	1.060	−0.226 ***	(0.0394)	0.0214	(0.0360)
Number of children in the household	2796	0.866	0.340	892	0.834	0.372	0.0322 **	(0.0140)	0.0413	(0.0418)
Parents’ educational attainment	2724	2.910	1.402	853	3.022	2.042	−0.112	(0.0749)	−0.103	(0.176)
Parents’ marital status	2796	0.922	0.268	892	0.900	0.300	0.0218 *	(0.0112)	0.0131	(0.0121)
Effective parent-child time	2796	0.0866	0.281	892	0.105	0.307	−0.0188	(0.0116)	0.0340	(0.0207)

Note: Standard errors in brackets; * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

6. Empirical Analysis

6.1. Effect of Household Income Level on Household Income Status Perception Bias

First, we use the panel two-way fixed effect model in regression (Equation (6)) to test Hypothesis 1. The dependent variable is household income status perception bias, which is established by its self-estimated income minus actual income. The independent variable is household income, which is described by the absolute logarithm value of household income and household relative income ranking in its county. Table 3 provides the empirical results of the effect of household income level on household income status perception bias. All regression models in the table control for household–individual and county–year fixed effects. To avoid heteroscedasticity problem in random error terms, we employ the White heteroscedasticity robust standard error to improve the estimation coefficients. Columns (3) and (4) are baseline regression, which represents the results of the effect of the log income and relative income ranking on income status perception bias, respectively. Columns (1) and (2) portray the contrast of baseline regression, of which the econometric models did not control for household characteristic variables. Comparing the baseline and contrast regressions, the estimated results of the regression model remain robust.

Table 3. Effect of household income level on household income status perception bias.

Variables	Perception Bias			
	(1)	(2)	(3)	(4)
Income	−0.198 *** (0.066)		−0.174 *** (0.065)	
Income ranking		−0.099 *** (0.029)		−0.091 *** (0.031)
Household controls	No	No	Yes	Yes
Household-individual FE	Yes	Yes	Yes	Yes
County-year FE	Yes	Yes	Yes	Yes
Observations	3621	3627	3512	3517
R ²	0.255	0.257	0.304	0.307

Note: White heteroscedasticity robust standard errors in brackets; * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Household control variables include household members' age, self-rated health, household expenditure, and number of children in the household. Due to space limitations, please refer to Table A2 in Appendix A for full version including estimated coefficients of control variables.

Table 3 shows a significant negative correlation between household income level and income status perception bias ($p < 0.01$) regardless of whether the independent variable is log income or income ranking. Furthermore, this result is unaffected by whether or not the household characteristic variables are controlled for. The estimation coefficient of the log income variable in Column (3) depicts that, after controlling for the related household characteristic variable and two-way fixed effect, every 10% increases in household income will lead to a degree of 0.02 decreases of household income status perception bias. The estimation coefficient of the income ranking variable in Column (4) shows every 1 level increase in household income ranking after controlling for the related household characteristic variable and two-way fixed effect. That is, the degree of household income status perception bias will be reduced by approximately 0.1. The empirical results imply that the higher the income level is, the lower the degree of income status perception bias. Conversely, the lower the income level is, the poorer the household is, and the more likely it is to overestimate the relative status of their income. This tendency leads to income status perception bias. This result not only provides supporting evidence for Kruger and Dunning's research but also verifies the relationship between household income level and perceived bias of household income status as proposed in Hypothesis 1 [36].

6.2. Effect of Household Income Status Perception Bias on Household Expenditure Structure

On the basis of testing Hypothesis 1, we further test Hypothesis 2a by conducting a regression (Equation (7)), which is the effect of household income status perception bias on household gift-giving expenditure. Table 4 presents the regression results. According to the relevant documents of Section 5, to explore the impact of household income status perception bias on household gift-giving expenditure we divide the sample into two groups, namely, non-poor (normal) and poor households, we use the regression results of the poor households sample as baseline and that of the non-poor households sample as contrast. Regression controls for the household–individual and county–year fixed effects. White’s heteroscedasticity robust standard error is used to improve the estimation efficiency. Columns (3) and (4) in Table 4 are listed as the baseline results of controlling for the household characteristic variables, and Columns (1) and (2) are the contrast result without controlling for the household characteristic variables. Columns (1) and (3) are listed as the regression results of the non-poor group samples, whereas Columns (2) and (4) are listed for the opposite group samples.

Table 4. Effect of household income status perception bias on household gift-giving expenditure.

Variables	Gift-Giving Expenditure			
	Non-Poor	Poor	Non-Poor	Poor
	(1)	(2)	(3)	(4)
Perception bias	−89.802 (374.600)	300.543 *** (0.000)	84.830 (482.452)	179.718 *** (0.000)
Household controls	No	No	Yes	Yes
Household–individual FE	Yes	Yes	Yes	Yes
County–year FE	Yes	Yes	Yes	Yes
Observations	2762	880	1366	441
R ²	0.255	0.257	0.304	0.307

Note: White heteroscedasticity robust standard errors in brackets; * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Household control variables include household members’ age, self-rated health, household expenditure, and number of children in the household. Due to space limitations, please refer to Table A3 in Appendix A for full version including estimated coefficients of control variables.

The regression results in Column (4) in Table 4 indicate a significant positive correlation between income status perception bias of poor households and gift-giving expenditure ($p < 0.01$). This result is unaffected by whether or not the household control variables are controlled for. The estimated coefficient of the income status perception bias shows that, after controlling for the related household characteristic variables and two-way fixed effects, the income status perception bias of poor households will increase by an average of 180 CHY per year, which is equivalent to 10% of the per capita expenditure of poor households per year (According to Table 2, the per capita expenditure of the sample households in the poverty group is 1886 CHY). As a control group, the regression coefficients of Column (2) also showed similar results. The abovementioned regression results imply that the more households overestimate their income status, the more inclined they are to increase their family gift-giving expenditure. Combined with theory of peer effect and status anxiety [48], the hypothesis that income status perception bias of poor households affects their expenditure structure by increasing their gift-giving expenditure is verified [48].

Correspondingly, the estimated coefficient of “perception bias” in Columns (1) and (3) in Table 4 is non-significant, and the coefficient symbols are inverted when the control variables are added. This finding shows that the perception bias of household income status has no significant impact on households’ gift-giving expenditure for the non-poor sample. On the one hand, normal households have high income levels, and their income status perception bias is weak, which is inadequate so as to affect households’ gift-giving expenditure. On the other hand, even if the perception bias of income

status is generated, most normal households lack incentives to adjust their gift-giving expenditure because of stable social relations and economic conditions.

Table 5 reports the empirical results for testing Hypothesis 2b. For this part, we also divide the sample into two groups, namely, non-poor (normal) and poor households. Regression Equation (8) is used to estimate the impact of household income status perception bias on household expenditure for children's education. Columns (3) and (4) in Table 5 are listed as the baseline result of controlling for the household characteristic variables. Columns (1) and (2) denote the contrast result without controlling for household characteristic variables, and Columns (1) and (3) are listed as the regression results of the non-poor group samples. Columns (2) and (4) are listed as regression results of the poor group samples. All regressions control for the household-individual and county-year fixed effects and use the White heteroscedasticity robust standard error to improve the estimation efficiency.

Table 5. Effect of household income status perception bias on household expenditure for education.

Variables	Expenditure for Children's Education			
	Non-Poor	Poor	Non-Poor	Poor
	(1)	(2)	(3)	(4)
Perception bias	70.127 (102.100)	−188.032 *** (53.521)	144.879 (111.035)	−444.461 *** (0.000)
Household controls	No	No	Yes	Yes
Children's characteristics controls	No	No	Yes	Yes
Household-individual FE	Yes	Yes	Yes	Yes
County-year FE	Yes	Yes	Yes	Yes
Observations	2762	880	1366	441
R ²	0.512	0.825	0.631	0.903

Note: White heteroscedasticity robust standard errors in brackets; * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Household control variables include household members' age, self-rated health, household expenditure, and number of children in the household. Children's characteristics include children's age, education, physical health status, academic performance, and whether the child is the first child in the household. Due to space limitations, please refer to Table A4 in Appendix A for full version including estimated coefficients of control variables.

The regression results under Column (5) in Table 5 show a significant negative correlation between income status perception bias and expenditure for children's education among poor households ($p < 0.01$). This result is robust regardless of whether or not the control variables are added. Every unit increase in perceived income status bias of poor households will reduce the annual expenditure for children's education by more than 400 CHY on average. This value is equivalent to 20% of the annual per capita expenditure of poor rural households (According to Table 2, the per capita expenditure of the sample households in the poverty group is 1886 CHY) after controlling for related household and children characteristic variables and two-way fixed effects. As the control group, the regression coefficients of Column (2) also showed similar results. The cited regression results imply that the more that households overestimate their income status, the more inclined they are to reduce their expenditure for children's education. The estimated coefficient in Columns (1) and (3) in Table 5 is non-significant, which indicates that household income status perception bias does not significantly affect expenditure for children's education for the non-poor group. On the one hand, the reason is that normal households have high income levels, and the income status perception bias is weak. On the other hand, even if income status perception bias occurs under the circumstances that high-income households attach great importance to education and human capital investment, the majority of normal households will also be inclined to increase expenditure for children's education.

6.3. Effect of Household Perception Bias of Income Status on Children's Mental Health

Finally, the regression in Equation (9) is used to investigate the effect of household income status perception bias on children's mental health. The regression adopts the White variance robust standard error and controls for household–individual and county–year fixed effects. Table 6 reports the estimated results. Columns (5)–(8) depict the baseline regression results, where Columns (5)–(8) represent the non-poor and poor group samples, respectively. Among them, Columns (5) and (7) are listed as the result of reduced form estimation to measure the total effect of household income status perception bias on children's mental health. Columns (6) and (8) add “expenditure for children's education” as a covariant to examine whether such expenditure is an ideal indirect channel through which household income status perception bias affects children's mental health. Columns (1)–(4) are in contrast to the baseline regression, of which econometric models without control variables are established. The comparison of the two results shows that the regression model estimation results remain robust.

The regression results of Column (7) in Table 6 show a significant negative correlation between household income status perception bias and children's mental health ($p < 0.01$). After controlling for the related variables of household, children, and their parents as well as two-way fixed effects, every unit income status perception bias will lead to an average of 6.4-point-increase in children's mental stress (The total score of K6 is 24. The higher the score is, the greater the mental pressure is. See Section 4 for details). After adding expenditure for children's education as a covariate in Column (8), the coefficient of income status perception bias remains significant but is reduced to 5.9. The regression coefficient of expenditure for children's education was significantly negative, which indicates a significant positive correlation between expenditure for children's education and children's mental health ($p < 0.01$). Every unit income status perception bias will lead to an average of 5.9 points increase in children's mental stress. If households spend 1000 CHY more on children's education every year, the average mental stress of children will be reduced by 4.7 points. This result means that nearly 30% of children from poor households will become mentally stressed if their families overestimate their income status. However, more than 37% of depressed children may recover if expenditure for children's education increases by 1000 CHY. As the control group, Columns (2) and (4) also showed similar results, and the regression results of non-poor household samples were non-significant, which are also less affected by other control variables. When expenditure for children's education is added as a covariant, the regression coefficient of perception bias decreases, which indicates that expenditure for children's education will weaken the negative impact of certain income perception bias on children's mental health. Therefore, the reduction of expenditure for children's education is an effective channel through which poor household income perception bias increases mental pressure on children. Based on cited analysis, Hypothesis 3 can be basically verified.

Table 6. Effect of household perception bias of income status on children’s mental health.

Variables	Children’s Mental Health							
	Non-Poor		Poor		Non-Poor		Poor	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Perception bias	0.0475 (0.0726)	0.0299 (0.0730)	3.509 *** (0.476)	2.765 *** (0.526)	0.0686 (0.0902)	0.0623 (0.0900)	6.433 *** (0.475)	5.910 *** (0.000)
Education expenditure		−0.00783 (0.0588)		−0.00304 ** (0.00127)		0.0478 (0.121)		−0.00466 *** (0.000)
Household controls	No	No	No	No	Yes	Yes	Yes	Yes
Children’s characteristics controls	No	No	No	No	Yes	Yes	Yes	Yes
Parents’ characteristics controls	No	No	No	No	Yes	Yes	Yes	Yes
Household–individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County–year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2113	2085	654	647	1432	1416	455	451
R ²	0.697	0.705	0.935	0.945	0.755	0.756	0.993	0.998

Note: White heteroscedasticity robust standard errors in brackets; * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Household control variables include household members’ age, self-rated health, household expenditure, and number of children in the household. Children’s characteristics include children’s age, education, physical health status, academic performance, and whether the child is the first child in the household. Parents’ characteristics include parents’ educational attainment, marital status, and effective parent–child time. Due to space limitations, please refer to Table A5 in Appendix A for full version including estimated coefficients of control variables.

6.4. Robustness Checks

(1) Using different poverty recognition standards to divide the poor and non-poor group samples. In contrast to the national standards provided in the “China Rural Poverty Monitoring Report,” Columns (1)–(3) in Table 7 report the results of the panel two-way fixed effect regression for (relatively) poor households identified by the standard of lower-than-median income per capita disposable income of rural households in each county/district. The correlation regression coefficients are the same as those of the baseline regression results in Tables 4–6, which also support the relevant hypothesis and indicate that the original model and results remain robust.

(2) Proportion of gift-giving expenditure and expenditure for children’s education in the total expenditure per capita of the household is adopted to enter the regression. Household gift-giving expenditure and expenditure for children’s education in Tables 4 and 5 are replaced by their respective share of total expenditure, and the panel two-way fixed effect regression is conducted. Columns (4)–(5) in Table 7 report the results. The regression results and analysis are consistent with the baseline regression in Tables 4 and 5, which indicate that the original model and results are robust.

In addition, we also carry out robustness checks as followings: (1) we use different clustering levels of Newey-West robust standard errors instead of the White heteroscedasticity robust standard errors in baseline estimation, the results are consistent with that in our main text, indicating that the original model and results remain robust (see Table A6 in Appendix A); (2) in addition to the two-way fixed effect model in the main text, we also use methods such as pooled OLS regression and multiple choice Probit models for alternative estimates, the final results are consistent with that in the main text, indicating that the original model and results remain robust (see Table A7 in Appendix A); (3) we conducted an exclusive test on the structure of rural household expenditure by running the regression where rigid expenditures such as expenditure of food, clothing, transportation, communication, housing and daily necessities are dependent variables as well as income status perception bias is independent variable, the obtained regression coefficients were not significant, indicating the rationality of theoretical analysis, hypothesis formulation and empirical logic in this paper (see Table A8 in Appendix A).

Table 7. Robustness checks.

Variables	Relative Poverty Sample			Proportion of Total Expenditure	
	Gift-Giving Expenditure	Education Expenditure	Children's Mental Health	Gift-Giving Expenditure	Education Expenditure
	(1)	(2)	(3)	(4)	(5)
Perception bias	47.943 *** (0.000)	−214.926 *** (0.000)	3.676 *** (0.549)	0.00843 *** (0.000)	−0.0300 *** (0.000)
Education expenditure			−0.00398 *** (0.000)		
Household controls	Yes	Yes	Yes	Yes	Yes
Children's characteristics controls	No	Yes	Yes	No	Yes
Parents' characteristics controls	No	No	Yes	No	No
Household–individual FE	Yes	Yes	Yes	Yes	Yes
County–year FE	Yes	Yes	Yes	Yes	Yes
Observations	486	513	529	486	437
R ²	0.724	0.698	0.899	0.976	0.953

Note: White heteroscedasticity robust standard errors in brackets; * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Household control variables include household members' age, self-rated health, household expenditure and number of children in the household. Children's characteristics include children's age, education, physical health status, academic performance, and whether the child is the first child in the household. Parents' characteristics include parents' educational attainment, marital status, and effective parent–child time.

7. Conclusions and Discussion

The mental health of rural children is closely related to their household characteristics, with household income level as one of the important influencing factors. In general, improvement in household income level is deemed to play an important role in promoting children's mental health. However, the impact and mechanism of household income status perception bias on children's mental health due to changes in the structure of household expenditure are under studied. We construct a theoretical model of the representative household model based on perception bias theory using the difference between households' self-rated income ranking and actual income ranking to measure their income status perception bias level. Furthermore, we adopt the CFPS 2012, 2014, and 2016 household survey data to construct a three-wave panel for empirical research. The effect of household income status perception bias on children's mental health and its mechanism channel are also explored.

Results show (1) a significant negative correlation between household income level and income status perception bias, and poor households are likely to have income status perception bias. That is, the higher the income level is, the less likely it is to overestimate income status. On the contrary, the lower the income level is, the poorer the household is. Thus, they poor households more likely to overestimate their relative status of income, which results in income status perception bias. (2) A significant positive correlation exists between income status perception bias of poor households and their gift-giving expenditure. The more that poor households overestimate their relative income status, the more inclined they are to increase their gift-giving expenditure, thereby changing the structure of household expenditure. Specifically, non-poor households do not appear to experience a similar phenomenon. (3) A significant negative correlation exists between poor households' income status perception bias and expenditure for children's education. The more that poor households overestimate their relative income status, the more inclined they are to reduce their expenditure for children's education. However, non-poor rural households do not appear to experience a similar phenomenon. (4) Income status perception bias among poor households is negatively correlated with children's mental health level, whereas expenditure for children's education is positively correlated with children's mental health level. The more that poor households overestimate their relative income status, the greater the children's mental health level in their households. The reduction of household expenditure on children's education is a channel through which poor rural households' income perception bias increases children's mental pressure.

On the basis of these conclusions, the government and relevant departments are encouraged to further promote the development of rural regional economy, raise the income level of rural households, ensure that rural households have unlimited necessary expenditures for living, and fundamentally reduce the negative impact of perception bias. Increasing efforts on precise poverty alleviation and focusing on supporting poor households to steadily eliminate poverty and increase income are important. Moreover, narrowing the income gap among rural households and timely and effective publicity and education about reasonable expenditure on household consumption at the village and community levels are measures that can be taken. Furthermore, enhancing the ability for rational arrangement and utilization sourcing of poor households, improving the awareness of expenditure structure, and enhancing the cognitive ability of poor households can reduce the level of perception bias. Especially, raising awareness among poor households about the importance of children's education can effectively guarantee expenditure on children's education, improve the level of education in rural areas, and increase the necessary mental education and counseling services. Providing further policy support and financial subsidies to poor households can help guarantee a conducive environment for the good mental health of children and improve the level of mental health of children in poor rural areas.

This study provides a new story in the unique economic and cultural context of China, the world's largest developing country, for children's mental health-related research. This study focuses on the special group of rural households, especially poor rural households, and provides explanations from new perspectives such as perception bias and household expenditure structure, enriching the conclusions of existing research and complementing the latest literature on the causes and influence

mechanisms of children's mental health [34,35,58]. In addition, the policy implications derived from this study is of great significance to improve the mental health of children from poor rural households in developing countries and regions, and helps to promote the sustainability of families and child welfare.

Admittedly, this study still has the following limitations: (1) the short panel and relatively small number of valid samples makes the data not comprehensive enough, resulting in the lack of research on long-term effects and sample heterogeneity in this study; (2) this study only analysis one channel for D-K effect and demonstration effect to influence the mental health of children from poor rural household, lacking the research on other influence channels and mechanisms; (3) although the data and empirical strategies we adopted maximize the control of variables and unobservable effects that may interfere with the estimation results, the endogenous problems caused by missing variables and selective biases still constitute a potential threat to the results of this study. In the future, on the basis of improved data, we will further investigate whether income perception bias affects children's mental health through other channels, and incorporate heterogeneity analysis such as different cultural frameworks and regional differences; in addition, we will focus on the solutions for endogeneity problem such as finding suitable instrumental variables or conducting research through random controlled trials or quasi-natural experiments.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Proof of Proposition 1. Optimality implies:

$$U(H^{**}, r^{**}, e^{**}) \leq U(H^*, r^*, e^*)$$

$$(1 - p(e^*)) U(H^*, L^*, e^*) + p(e^*) U_0 \leq (1 - p(e^{**})) U(H^{**}, r^{**}, e^{**}) + p(e^{**}) U_0$$

Then we have

$$(1 - p(e^*)) U(H^{**}, r^{**}, e^{**}) + p(e^*) U_0 \leq (1 - p(e^{**})) U(H^{**}, r^{**}, e^{**}) + p(e^{**}) U_0$$

$$p(e^*) [U_0 - U(H^{**}, r^{**}, e^{**})] \leq p(e^{**}) [U_0 - U(H^{**}, r^{**}, e^{**})]$$

$$[p(e^*) - p(e^{**})] [U_0 - U(H^{**}, r^{**}, e^{**})] \leq 0$$

Since $U_0 - U(H^{**}, r^{**}, e^{**}) > 0$, therefore $U(H^{**}, r^{**}, e') > U(H^{**}, r^{**}, e^{**})$, and then must be $p(e^*) \leq p(e^{**})$ and $e' < e^{**}$. So, if the solution set $(H^{**}, r^{**}, e^{**}) \neq (H^*, r^*, e^*)$, by the fact that there is a unique maximum, all of the inequalities above become strict. Finally, we have $e^{**} < e^*$ and $e' < e^{**}$. \square

Proof of Lemma 1. Follows directly from the objective functions and budget constraints in Equations (2), (3) and (5). \square

Proof of Lemma 2. Follows directly from the assumption of psychological pressure function F. \square

Table A1. Pearson correlation coefficient matrix.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	1																
2	−0.135 ***	1															
3	0.028	0.179 ***	1														
4	−0.016	−0.002	0.034	1													
5	−0.060 ***	0.189 ***	0.016	0.003	1												
6	−0.045 ***	0.191 ***	0.019	−0.022	0.413 ***	1											
7	−0.028 *	−0.005	−0.058 **	−0.008	−0.053 ***	−0.013	1										
8	0.059 ***	0.002	−0.033	−0.034 *	−0.023	−0.034 *	0	1									
9	−0.081 ***	0.171 ***	0.033	−0.004	0.306 ***	0.152 ***	−0.015	−0.032 *	1								
10	−0.079 ***	0.171 ***	0.134 ***	−0.128 ***	0.027	0.021	0.016	0.021	0.075 ***	1							
11	−0.014	0.177 ***	0.208 ***	0.006	0.036**	0.020	0.024	0.0080	0.034 **	0.213 ***	1						
12	−0.089 ***	0.022	−0.052 **	0.013	0.002	0.032 *	0.042 **	0.035 *	0.005	−0.011	−0.102 ***	1					
13	0.065 ***	−0.019	−0.046 *	−0.032 *	0.007	−0.019	0.095 ***	0.059 ***	−0.012	−0.048 ***	−0.060 ***	0.219 ***	1				
14	0.046 ***	−0.305 ***	−0.036	0.020	−0.116 ***	−0.066 ***	0.019	−0.021	−0.362 ***	−0.152 ***	−0.110 ***	0.019	0.003	1			
15	−0.047 ***	0.039 **	0.050 *	0.068 ***	−0.011	−0.012	−0.037 **	−0.029	−0.020	0.044 ***	0.062 ***	−0.016	−0.042 **	0.044 ***	1		
16	0.006	0.040 **	0.028	0.005	0.005	−0.007	−0.022	0.016	−0.013	0.014	0.046 ***	−0.177 ***	−0.057 ***	0.011	0.019	1	
17	0.012	−0.066 ***	0.030	−0.023	−0.016	0.041 **	0.031 *	−0.028	0.020	−0.017	−0.035 **	0.120 ***	0.041 **	0.040 **	−0.054 ***	−0.167 ***	1

Note: 1—Children’s mental health; 2—Education expenditure for children; 3—Household gift-giving expenditure; 4—Perception bias of household income status; 5—Children’s age; 6—Children’s education; 7—Children’s physical health status; 8—Children’s academic performance; 9—Whether the child is the first child; 10—Household income; 11—Household expenditure; 12—Household members’ age; 13—Household members’ physical health status; 14—Number of children in household; 15—Parents’ education; 16—Parents’ marital status; 17—Effective parent-child time. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table A2. Effect of household income level on household income status perception bias (full version).

Variables	Perception Bias			
	(1)	(2)	(3)	(4)
Income	−0.198 *** (0.066)		−0.174 *** (0.0651)	
Income ranking		−0.099 *** (0.029)		−0.0908 *** (0.0307)
Household members' age			0.0115 (0.0116)	0.0103 (0.0117)
Household members' health			−0.00145 (0.0668)	−0.00261 (0.0666)
Household expenditure			−0.00167 ** (0.000819)	−0.000880 ** (0.000391)
No. of children			0.845 (0.906)	0.840 (0.933)
Household-individual FE	Yes	Yes	Yes	Yes
County-year FE	Yes	Yes	Yes	Yes
Observations	3621	3627	3512	3517
R ²	0.255	0.257	0.304	0.307

Note: White heteroscedasticity robust standard errors in brackets; * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table A3. Effect of perception bias of household income status on its gift-giving expenditure (full version)

Variables	Gift-Giving Expenditure			
	Non-Poor	Poor	Non-Poor	Poor
	(1)	(2)	(3)	(4)
Perception bias	−89.802 (374.600)	300.543 *** (0.000)	84.830 (482.452)	179.718 *** (0.000)
Household members' age			−279.2 * (166.1)	265.6 *** (0.0192)
Household members' health			1501 * (899.0)	274.3 *** (0.0471)
Household expenditure			0.451 ** (0.211)	−0.105 *** (0.0175)
No. of children			−1533 (1915)	5581 *** (468.2)
Household-individual FE	Yes	Yes	Yes	Yes
County-year FE	Yes	Yes	Yes	Yes
Observations	2762	880	1366	441
R ²	0.255	0.257	0.304	0.307

Note: White heteroscedasticity robust standard errors in brackets; * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table A4. Effect of perception bias of household income status on education expenditure (full version)

Variables	Education Expenditure for Children			
	Poor	Non-Poor	Poor	Non-Poor
	(1)	(2)	(3)	(4)
Perception bias	70.127 (102.100)	−188.032 *** (53.521)	144.879 (111.035)	−444.461 *** (0.000)
Household members' age			18.26 (34.55)	−83.65 ** (40.302)
Household members' health			105.7 (105.7)	80.49 ** (38.990)
Household expenditure			0.0384 (0.0364)	0.00382 * (0.00211)
No. of children			−2293 *** (709.7)	−3035 *** (602.3)
Children's age			596.6 ** (268.2)	532.2 *** (295.4)
Children's education			193.7 (442.0)	258.1 *** (0.001)
Children's physical health			−14.56 (59.70)	−143.0 *** (0.003)
Children's academic performance			237.0 ** (120.6)	238.1 *** (0.000)
Whether the child is the first child			−1451 ** (617.2)	0.000 (.)
Household-individual FE	Yes	Yes	Yes	Yes
County-year FE	Yes	Yes	Yes	Yes
Observations	2762	880	1366	441
R ²	0.512	0.825	0.631	0.903

Note: White heteroscedasticity robust standard errors in brackets; * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table A5. Effect of perception bias of household income status on education expenditure (full version)

Variables	Children's Mental Health							
	Non-Poor		Poor		Non-Poor		Poor	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Perception bias	0.0475 (0.0726)	0.0299 (0.0730)	3.509 *** (0.476)	2.765 *** (0.526)	0.0686 (0.0902)	0.0623 (0.0900)	6.433 *** (0.475)	5.910 *** (0.000)
Expenditure for children's education		−0.00783 (0.0588)		−0.00304** (0.00127)		0.0478 (0.121)		−0.00466 *** (0.000)
Household members' age					0.0140 (0.0271)	0.0122 (0.0263)	−0.912 (0.899)	−0.221 (0.364)
Household members' health					0.146 (0.152)	0.137 (0.153)	−2.845 (2.539)	−3.027 (2.924)
Household expenditure					0.000750 ** (0.000)	0.000734 ** (0.000)	−0.0006.98 *** (0.000)	−0.000347 *** (0.000)
No. of children					0.268 (0.972)	0.421 (0.978)	0.127 (0.363)	0.096 (0.139)
Children's age					−2.021 *** (0.463)	−0.838 (0.753)	2.674 (2.276)	1.585 * (0.478)
Children's education					0.309 (0.455)	0.305 (0.462)	−5.250 (4.007)	−3.748 * (1.978)
Children's physical health					0.185 ** (0.0765)	0.185 ** (0.0771)	−2.891 ** (2.653)	−2.574 ** (1.245)
Children's academic performance					0.436 * (0.223)	0.413* (0.226)	−1.950 *** (0.0008)	−1.436 *** (0.0009)
Whether the child is the first child					−0.749 (1.113)	−0.667 (1.115)	0.000 (.)	0.000 (.)
Parents' educational					−0.0761 (0.173)	−0.0746 (0.172)	−2.716 *** (0.000)	−2.744 *** (0.000)
Parents' marital status					−0.369 (0.872)	−0.612 (0.933)	−1.352 *** (0.007)	−1.245 *** (0.002)
Effective parent–child time					0.352 (0.827)	0.357 (0.833)	−10.97 *** (0.00978)	−8.446 *** (0.0149)
Household-individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2113	2085	654	647	1432	1416	455	451
R ²	0.697	0.705	0.935	0.945	0.755	0.756	0.993	0.998

Note: White heteroscedasticity robust standard errors in brackets; * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table A6. Robustness checks of diverse clustering levels.

Variables	Total Sample		Poverty Sample			
	Perception bias		Gift-Giving Expenditure	Education Expenditure	Children's Mental Health	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel I: Clustering at county level						
Income	−0.174 ** (0.0742)					
Income ranking		−0.0908 *** (0.0339)				
Perception bias			179.718 *** (0.000)	−444.5 *** (0.000)	6.433 *** (0.449)	5.910 *** (0.000)
Education expenditure						−0.00466 *** (0.000)
Observations	3512	3517	441	437	455	451
R ²	0.304	0.307	0.310	0.896	0.993	0.998
Panel II: Clustering at household level						
Income	−0.174 *** (0.0666)					
Income ranking		−0.0908 *** (0.0313)				
Perception bias			179.718 *** (0.000)	−444.5 *** (0.000)	6.433 *** (0.485)	5.910 *** (0.000)
Education expenditure						−0.00466 *** (0.000)
Observations	3512	3517	441	441	455	451
R ²	0.304	0.307	0.317	0.936	0.993	0.998
Household controls	Yes	Yes	Yes	Yes	Yes	Yes
Children's characteristics controls	No	No	No	Yes	Yes	Yes
Parents' characteristics controls	No	No	No	No	Yes	Yes
Household-individual FE	Yes	Yes	Yes	Yes	Yes	Yes
County-year FE	Yes	Yes	Yes	Yes	Yes	Yes

Note: Newey-West robust standard errors in brackets; * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Household control variables include household members' age, self-rated health, household expenditure, and household's children number. Children characteristics include children's age, education, physical health status, academic performance, and whether the child is the first child in the household.

Table A7. Robustness checks of diverse specifications.

Variables	Total Sample		Poverty Sample			
	Perception Bias		Gift-Giving Expenditure	Education Expenditure	Children's Mental Health	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel I: OLS estimation						
Income	−0.268 *** (0.0232)					
Income ranking		−0.106 *** (0.0118)				
Perception bias			268.0 *** (30.180)	−7.458 (71.39)	0.697 *** (0.0991)	0.721 *** (0.0992)
Education expenditure						0.00357 (0.0425)
Observations	3512	3517	353	441	455	451
R ²	0.167	0.167	0.163	0.207	0.148	0.147
Panel II: Probit model estimation						
Income	0.0973 *** (0.0190)					
Income ranking		0.0590 *** (0.00965)				
Perception bias			— —	— —	0.313 *** (0.0418)	0.225 * (0.125)
Education expenditure						−0.0215 ** (0.012)
Observations	3512	3517	—	—	455	451
Pseudo R ²	0.145	0.131	—	—	0.190	0.183
Household controls	Yes	Yes	Yes	Yes	Yes	Yes
Children's characteristics controls	No	No	No	Yes	Yes	Yes
Parents' characteristics controls	No	No	No	No	Yes	Yes

Note: White heteroscedasticity robust standard errors in brackets; * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Household control variables include household members' age, self-rated health, household expenditure, and household's children number. Children characteristics include children's age, education, physical health status, academic performance, and whether the child is the first child in the household.

Table A8. Effect of perception bias on rigid expenditure of poor household

Variables	Food	Clothing	Housing/Daily Necessities	Transportation
	(1)	(2)	(3)	(4)
Perception bias	50.15 (213.8)	−7.506 (14.85)	−145.7 (124.9)	−29.62 (42.05)
Household controls	Yes	Yes	Yes	Yes
Household-individual FE	Yes	Yes	Yes	Yes
County-year FE	Yes	Yes	Yes	Yes
Observations	822	819	824	820
R ²	0.891	0.955	0.998	0.947

Note: White heteroscedasticity robust standard errors in brackets; * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. Household control variables include household members' age, self-rated health, household expenditure, and household's children number.

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