Article

The Impact of Income Disparity on Food Consumption—Microdata from Rural China

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Abstract: This paper examines the relationship between income inequality and consumption, utilizing panel data from rural China over a span of four years to validate the application of relative income theory in the domain of food consumption. Food consumption represents a significant portion of expenditures for the low-income demographic and is of vital importance to China's food security and agricultural development. To ascertain the impact of income inequality on food consumption, this paper employs a bi-directional fixed-effects model, a mediation effect model, and machine learning causal analysis methods. Utilizing four years of rural resident survey data from the China Health and Nutrition Survey database, the study empirically tests the effect of income inequality on various types of food consumption, the channels through which it operates, and the heterogeneity among different income groups and educational backgrounds. The findings indicate that (1) income inequality within rural communities positively influences food consumption, and this conclusion remains robust under endogeneity treatment and robustness checks, positively affecting the transformation of food consumption and healthy intake; (2) income inequality among rural residents promotes food consumption through two mediating channels: the "demonstration effect" and the "ratchet effect;" (3) the impact of income inequality on food consumption exhibits heterogeneity among rural residents of different income levels and educational backgrounds.

Keywords: income inequality; demonstration effect; ratchet effect; food consumption; food intake health index

1. Introduction

The ever-widening income gap is considered to be one of the significant factors contributing to the "Chinese consumption puzzle." In 2001, China entered the middle-income stage, and by 2023, China's per capita GDP reached USD 12,690.1, and per capita GNI was USD 12,596.6, approaching the threshold for high-income countries (according to World Bank standards, the per capita GNI threshold for high-income countries is approximately USD 13,845) (data source: "Statistical Bulletin of National Economic and Social Development of China 2023," published by the National Bureau of Statistics of China, https://www.stats.gov.cn/sj/zxfb/202402/t20240228_1947915.html, accessed on 20 April 2024). Throughout the entire low-income phase, food demand served as the "absolute pillar" of survival needs [1]. During this stage, China has effectively addressed the issue of poverty, leading to a significant increase in the income levels of rural residents. Consequently, there has been a notable shift in food consumption patterns from merely satisfying basic needs to having the capability to choose from a variety of food options [2], and the rapid increase in income levels among rural residents has turned them into the largest and most potential consumer group. However, the increase in income has been accompanied by a swift expansion of income inequality (see Figure 1). The average income ratio among the quintiles increased from 1:1.8:2.5:3.5:6.5 in 2000 to 1:2.3:3.3:4.6:8.5 in 2023, indicating a widening income gap. The exact impact of income inequality on consumption remains

a contentious issue. China has a rural population of 510 million. According to Engel's Law, their initial food consumption quantity and level are relatively low. With economic growth and rising income levels, food consumption and its structure are likely to undergo more complex changes. Therefore, focusing on the relationship between income inequality among rural residents and food consumption since the middle-income stage is the most direct way to study China's economic development.
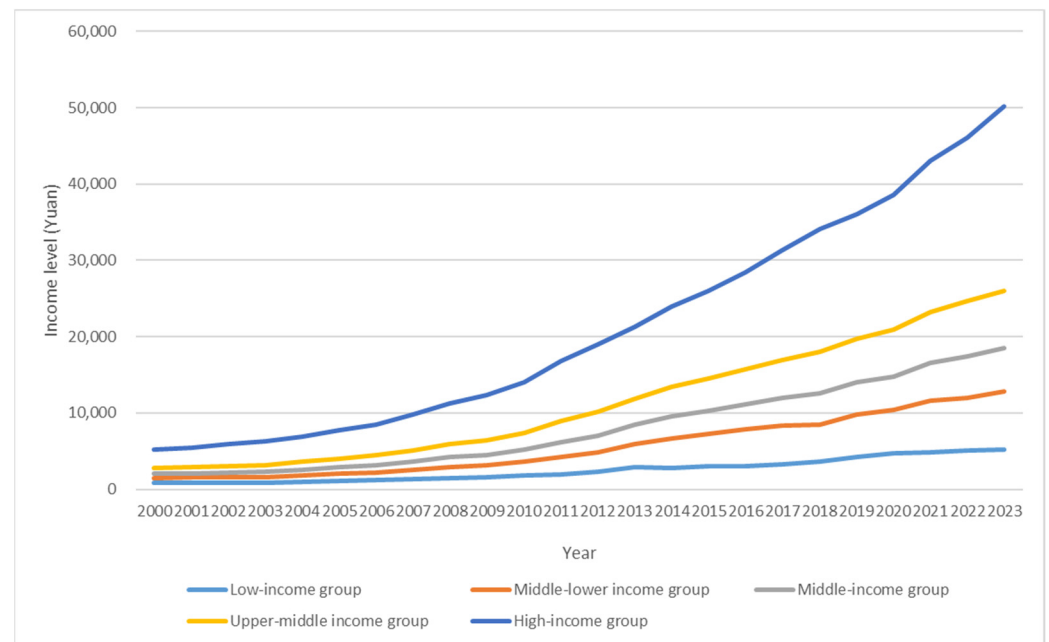
Figure 1. Changes in income level and income gap among rural residents in the fifth-grade groups from 2000 to 2023 (data source: China Statistical Yearbook).

From a theoretical analysis perspective, early consumption theories, such as those proposed by Blinder (1975) [3], posited that income distribution does not affect residents' consumption. However, with the development of saving motives, particularly the bequest saving motive, Khan et al. (2000) [4] revised the conclusions of classical consumption theory, asserting that income distribution does influence residents' consumption and is an important factor to consider in the study of consumer behavior. Nevertheless, there is disagreement regarding the direction of this influence. Some studies suggest that income inequality suppresses consumer spending [5,6]. Within the theory of social status pursuit, residents are motivated to ascend the social hierarchy. Social status is determined by a family's economic position, social networks, and political capital [7]. Research by Zhou et al. (2018) [8] indicates that widening income gaps indeed lower residents' self-assessment of social status, thereby increasing their motivation to pursue higher social status. To elevate their social standing, low-income groups may invest in savings and education to enter higher social strata, thus constraining their consumption, a phenomenon known as the "suppression effect" [8]. The widening income inequality among residents is one of the significant reasons for the decline in per capita consumption propensity. For every 1% increase in the proportion of disposable income held by high-income groups among urban residents, the average consumption propensity of urban residents decreases by 0.72%, indicating that the low consumption propensity of high-income families is one of the main reasons why income inequality suppresses consumption. The Theil index is used to measure provincial income disparities in China and establishes dynamic and static panel models. The results showed that, due to the decreasing marginal propensity to consume, the Theil index is significantly negatively correlated with consumption levels in the short term, and this effect is more pronounced in rural areas.

On the other hand, other studies argue that income inequality increases household consumption [9–15]. The relative income hypothesis has demonstrated the "demonstration effect" in household consumption, where higher-income families drive the consumption of other consuming households through conspicuous consumption. Thus, the consumption of low-income groups is influenced not only by their own income levels but also by the consumption of higher-income groups. Frank et al. argue that increased income inequality leads to increased household consumption and introduced the concept of "expenditure cascades" [16], where high-income families increase their consumption spending due to widening income gaps, and low-income families, influenced by high-income families, also increase their consumption spending accordingly, thus raising overall societal consumption spending. Sun et al. (2013) [14], based on the theory of social status-seeking in consumption, used a panel dataset of households in hundreds of Chinese villages from 2003 to 2006 to test that household consumption rates are negatively correlated with the relative income status of the village and positively correlated with income inequality in the village. There is disagreement in the literature regarding which types of consumption spending are increased by income inequality. Chen et al. (2023) [11] found that increased income inequality led parents to spend more on their children's education, using data from the China Family Panel Studies from 2010 to 2018 [16]. Chai et al. (2019) [17], based on household expenditure data from South Africa, found that income inequality improved household spending on tangible goods such as jewelry and clothing. Charles et al. (2013) [15], based on a study of household consumption in 18 major U.S. metropolitan statistical areas (MSAs), showed that income inequality promoted an increase in total spending, but the increase was mainly in housing and food rather than on jewelry, cars, clothing, and entertainment.

The existing literature provides a theoretical foundation for this paper's in-depth exploration of the impact of income inequality on food consumption. Despite the two opposing viewpoints presented, there is no consensus on the direction of income inequality's influence on consumption, highlighting the need for further research. Current studies exhibit several shortcomings: the literature primarily focuses on the impact of income inequality on overall consumption expenditure, which is too broad a concept as it encompasses various products and is influenced by economic development levels and inflation. Food consumption, being the most fundamental form of survival consumption, is the basis of all other consumption activities, as it is only after the issue of hunger is resolved that other forms of consumption can be pursued. This paper specifically investigates the impact of income inequality on the consumption of various food types, thereby filling a research void. Existing studies also tend to concentrate on the impact of external income disparities between urban and rural areas on consumption, overlooking the considerable differences between these areas in terms of geographical distance, customs, and habits. Furthermore, there is a lack of research exploring the mechanisms through which income inequality affects food consumption, particularly a socio-behavioral analysis of internal consumption among rural residents. In response to these gaps, this paper makes several marginal contributions: it examines the consumption of various food types as the object of study, providing a comprehensive and direct assessment of the impact of income inequality. It also converts the consumption of various food types into a cumulative health intake index for further analysis, exploring the full spectrum of income inequality's impact on food consumption. The paper focuses on the internal income inequality among rural residents, using the rural community as the smallest unit of analysis to examine the impact of income inequality within communities on food consumption. Lastly, it constructs theoretical models of the "demonstration effect" and the "ratchet effect" within the framework of relative income theory, clarifying the pathways through which income inequality affects food consumption, and employs machine learning techniques for robustness analysis, providing a reference for understanding the mechanisms by which income inequality influences food consumption.

2. Theoretical Framework and Research Hypotheses

2.1. Relative Income Theory

The relative income theory, proposed by economist James Duesenberry in the 1940s and 1950s, posits that individuals' consumption patterns are influenced not only by their absolute income levels but also by their income relative to others in society [18]. According to this theory, individuals tend to compare their income and consumption levels with those of their peers or reference groups rather than with some absolute standard of living. As a result, changes in relative income, such as increases or decreases in income inequality, can have significant effects on consumption behavior.

Duesenberry's relative income theory introduces two key concepts: the demonstration effect and the ratchet effect, which help explain consumption behavior in response to changes in relative income levels within society [19]. The demonstration effect refers to the tendency of individuals to adjust their consumption patterns based on the consumption behavior of others in their reference group or social circle. When individuals observe their peers or reference groups consuming certain goods or achieving a particular lifestyle, they may feel pressure to emulate or "keep up with" their peers by increasing their own consumption of similar goods or services. This effect suggests that individuals are influenced by social comparisons and aspire to match the consumption levels of those they perceive as being similar or superior to them in terms of income or social status. The ratchet effect, also known as the ratchet-down effect, describes the phenomenon where individuals are resistant to reducing their consumption levels even when faced with a decrease in their absolute income. According to Duesenberry, once individuals have achieved a certain level of consumption, they are reluctant to lower their standard of living, even if their income declines. This effect arises from the notion that individuals develop habits and expectations based on their past consumption levels and may perceive reductions in consumption as a loss of social status or well-being. As a result, consumption tends to "ratchet" upwards over time in response to increases in income but remains relatively stable or only modestly adjusted downwards during periods of income decline.

Both the demonstration effect and the ratchet effect contribute to the notion that individuals' consumption behavior is influenced not only by their absolute income levels but also by their perceptions of relative income and social comparisons. These effects highlight the importance of social context and reference groups in shaping consumption patterns and suggest that changes in relative income can have significant implications for overall consumption behavior within a society.

2.2. Income Disparity among Rural Residents

Chinese society is widely regarded as a "society of connections" and a "society of acquaintances [20]. The acquaintance society among rural residents typically exhibits specific characteristics that may differ from those found in urban settings. Firstly, there are close kinship ties. Rural areas often witness multigenerational households or close relatives residing nearby, underscoring the significance of familial relationships within rural communities. Individuals frequently maintain close contact with family members and rely on them for support and assistance [19]. Secondly, there are tight-knit neighborhood bonds. Rural inhabitants commonly foster close relationships with neighbors, whether residing in the same village or nearby villages, fostering long-term interactions and cooperative relationships. Neighbors frequently assist one another and collaborate to address life's challenges [18]. Thirdly, there is a strong sense of community cohesion. Rural residents typically inhabit relatively small communities, which fosters a strong sense of belonging and community identity. Within these communities, individuals often participate in collective activities, shared decision-making, and resource sharing, forming a mutually interdependent social network. Fourthly, there are limited information channels. Compared to urban dwellers, rural residents may have relatively restricted access to information. In such circumstances, word-of-mouth, interpersonal communication among neighbors, and community gatherings serve as vital means of information dissemination [20]. Lastly, there is a culture of

mutual aid and cooperation. As agricultural activities are typically prevalent in rural areas, residents often cultivate a culture of mutual aid and cooperation. Neighbors lend each other assistance during busy agricultural periods and participate in collective labor, strengthening internal community cohesion. These characteristics collectively shape the acquaintance society of rural residents and influence their social relationships and behavioral patterns. "Status seeking" and "social imitation" lead rural residents to learn from and emulate neighbors with higher income levels, aiming to enhance their own consumption [18]. In rural settings, the frequency and openness of social interactions among residents contribute to collective awareness and comparison of income levels and disparities. The village is a microcosm of social stratification, with its own integrated systems of production, living, beliefs, and social relationships, where internal phenomena are interrelated and causally linked. Villagers have access to information about most other villagers through observation and conversation, which enables them to understand the economic stratification within their village. By observing indicators such as income and the scale of banquets, individuals can assess their own economic status within the village hierarchy, which in turn influences their consumption decisions. The 'acquaintance society' is a key characteristic of village life, where social interactions lead to the development of face, trust, and a sense of belonging among insiders. This unique aspect of rural society differentiates rural interactions from urban–rural interactions and is also a reason why income disparities and differences in food consumption are more readily perceived within rural areas. Thus, it is hypothesized that income disparities within rural communities significantly influence food consumption patterns.

Hypothesis 1. *Food consumption in rural areas is significantly influenced by intra-community income disparities.*

2.3. Demonstration Effect

Lee et al. (2019) [21] cited the concept of the demonstration effect and conducted further research, which refers to the influence that the consumption patterns, levels, and income changes of certain consumers or households have on the expenditure of other consumers and families. This effect implies that consumers engage in spatial comparisons during consumption, striving to surpass or at least not fall below the consumption level of others within the same social stratum. Xu et al. (2021) [22] found that income comparison significantly affects material desires, especially in rural areas where the intensity of social interactions is higher, and being respected and maintaining dignity are important external constraints and incentives. For example, within a social circle, if the majority begin to pursue organic foods, imported goods, or upscale dining experiences, individuals may be influenced by this demonstration effect to elevate their own food consumption levels to match or exceed the average level of the group, even if their economic conditions have not changed significantly. Linssen et al. (2011) [23], using data from India, confirmed that visiting neighbors is a unique custom in rural societies, where villagers believe in maintaining relationships and exchanging favors. Visiting for meals and hosting banquets are typical social activities for rural residents, which are not only affordable but also serve as a means of display. The lavish food and exquisite dining presented by relatives, friends, or neighbors during festivals and celebrations may trigger imitation and competitive behavior, leading to increased investment in food consumption. As food consumption is the most observable and demonstrable basic expenditure, it becomes an important pathway for the rural "demonstration-chase" dynamic. Hopkin et al. (2004) [24] found that the intergroup disparities formed during the growth of disposable income among different income groups enable high-income families to be the first to afford higher-quality, more expensive food and a greater variety of food types. The influx of new food types and higher-quality food changes the lifestyle of high-income families, forming a reference point for the consumption choices of low-income households. For low-income families, despite having lower incomes, concerns about their relative social status, dignity, and position within the community

or village may compel them to "keep up appearances" by raising their consumption levels, mirroring the food consumption patterns and levels of higher-income groups. This psychological effect can cause the consumption function to shift upward as the societal average income increases [25]. From this, it can be deduced that internal income disparities in rural areas promote food consumption through the demonstration effect.

Hypothesis 2. *Income inequality promotes food consumption through the "demonstration effect."*

2.4. Ratchet Effect

The "ratchet effect" refers to the phenomenon where a consumer's current level of consumption expenditure is influenced by their current income, past consumption levels, and the highest income level they have previously achieved. Xu (2017) [26] found that consumption habits formed during periods of peak income are difficult to change, meaning that when current income decreases, people do not immediately reduce their consumption. Instead, they prefer to reduce savings or incur debt to maintain their existing level of consumption, adhering to the adage, "It is easy to go from frugality to luxury, but difficult to go from luxury to frugality." Consumption is rigid in the short term and exhibits irreversibility [27]. Wang et al. (2024) [28] also confirmed this consumption habit in the context of food consumption, finding that even when current income decreases, the influence of past consumption habits and the highest consumption levels causes the reduction in consumption expenditure to be proportionally less than the reduction in income, thus imparting a stabilizing characteristic to consumption expenditure [29]. The "ratchet effect" has a spatial clustering effect; in addition to temporal factors, geographical proximity also influences the consumption habits of rural residents [30]. Therefore, internal income disparities in rural areas promote food consumption through the "ratchet effect".

Hypothesis 3. *Income inequality promotes food consumption through the "ratchet effect".*

3. Research Methods, Variable Descriptions, and Data Sources

3.1. Data Sources

This paper utilizes data from the China Health and Nutrition Survey (CHNS) database. Given the focus on the middle-income stage, the data years selected are 2004, 2006, 2009, and 2011 (the database was updated with data for 2015 and 2019, but due to adjustments in the questionnaire content in these two years, the food data are not consistent with earlier years). To maintain the coherence and comparability of the research, data from the four years with consistent information were chosen. Following the categorization used in the literature by Han et al. (2019) [31] and Yu et al. (2016) [32], food is divided into ten categories: grains (gr), tubers (sl), beans (bn), meat (mt), eggs (eg), aquatic products (fs), poultry (ql), fruits and nuts (fr), vegetables and edible fungi (vg), and dairy products (mk) [32,33]. The food codes in the questionnaire were classified and processed according to the "Chinese Food Composition Table" 2002 edition (source of materials: https://www.samr.gov.cn/, accessed on 20 April 2024) and the food nutrition composition labeling guidelines of the Ministry of Health of China (source of materials: http://www.nhc.gov.cn/wjw/gfxwj/200801/17fe8 16424ab4dafbecd720ab6209045.shtml, accessed on 20 April 2024). To eliminate the impact of inflation on actual purchasing power, the year 2004 was chosen as the base year, and per capita disposable income was deflated accordingly. The descriptive statistics for the variables are presented in Table 1.

Table 1. Descriptive statistics of the dependent and independent variables.

Variable	Abbreviation	Units	Sample Size	Mean Value	Standard Deviation	Minimum Value	Maximum Value
Grains	gr	g/day	32,004	1517.743	600.5739	0	2716.748
Vegetables and edible fungi	vg	g/day	32,004	918.3966	475.4367	0	1915
Tubers	sl	g/day	32,004	109.8674	158.5111	0	500
Beans	bn	g/day	32,004	134.4055	168.1833	0	580
Eggs	eg	g/day	32,004	74.30256	84.45381	0	280
Meat	mt	g/day	32,004	182.8873	178.3328	0	620
Aquatic products	fs	g/day	32,004	67.70194	117.0522	0	400
Poultry	ql	g/day	32,004	31.41392	73.34061	0	275
Fruits and nuts	fr	g/day	32,004	121.2411	234.6905	0	860
Dairy products	mk	g/day	32,004	22.57268	101.1456	0	600
Logarithmic income	inc	-	32,004	8.634919	1.075818	0	12.88736
Rural Thiel index	TPi	-	32,004	0.35978774	1.179068	0.09256049	1
Educational level	edu	0 = below primary school; 1 = primary school; 2 = junior high school; 3 = high school; 4 = secondary vocational school; 5 = College or university; 6 = Master's degree or above	32,004	1.425728	1.286729	0	6
Marital status	mar	0 = Living alone (unmarried, divorced, widowed, etc.); 1 = married	32,004	0.7001312	0.4582074	0	1
Age	age	year	32,001	42.88155	20.34006	0.7	99.4
Gender	gen	0 = female; 1 = male	32,004	0.4891264	0.4998896	0	1
Household size	hhs	person	32,004	3.970992	1.662422	1	13
Whether they have health insurance	med	0 = No; 1 = Yes	32,004	0.6506999	0.4767564	0	1
Have you been sick in the last week	sik	0 = No; 1 = Yes	32,004	0.1360455	0.3428422	0	1

3.2. Research Methods

3.2.1. Two-Way Fixed Effects Model

Since the CHNS public database lacks price data and various food categories are aggregated from multiple detailed food items, it is difficult to calculate their prices. Therefore, following the approach of Liu et al. (2022) [34], Li et al. (2019) [35], and Bai et al. (2014) [36], it is assumed that residents in the same province face the same food market prices during the survey period (3 days). Additionally, the inclusion of regional dummy variables and year dummy variables in the model can, to some extent, control for the influence of provincial and annual price differences on residents' food consumption. Consequently, this study adopts a two-way fixed effects model.

$$FC_{it} = \alpha_0 + \alpha_1 TPI_{it} + \sum \delta Control_{it} + \sigma_i + \mu_t + \epsilon_{it} \tag{1}$$

In Equation (1), i and t, respectively, denote the region and the year. FC_{it} represents the number of various types of food consumption by the i-th rural resident in year t; TPI_{it} indicates the internal income inequality within the community of the i-th rural resident in year t; $Control_{it}$ includes a series of control variables that may influence the quantity of food consumption. α is the intercept term, α_1 is the coefficient for the core explanatory variable, δ is the coefficient for the control variables. σ_i, μ_t, and ϵ_{it} represent the regional fixed effects, time fixed effects, and random disturbance term, respectively.

3.2.2. Mediation Effect Model

Given that income inequality may influence rural residents' food consumption through the demonstration effect and the ratchet effect, this paper constructs the following mediation effect model to test the channels of influence, referencing the research of Dicken et al. (2012) [37] and Salazar et al. (2021) [38].

$$Med_{it} = \beta_0 + \beta_1 TPI_{it} + \sum \delta Control_{it} + \sigma_i + \mu_t + \epsilon_{it} \tag{2}$$

$$FC_{it} = \gamma_0 + \gamma_1 TPI_{it} + \gamma_2 Med_{it} + \sum \delta Control_{it} + \sigma_i + \mu_t + \epsilon_{it} \tag{3}$$

In Equations (2) and (3), Med_{it} represents the mediating variables, namely the demonstration effect and the ratchet effect; the meanings of other variables are consistent with those in Equation (1). If both β_1 and γ_2 are significant, it indicates that the mediating effect is established. If γ_1 is significant, it suggests that the mediating variable has a partial mediating effect. If γ_1 is not significant, it implies that the mediating variable has a full mediating effect.

3.3. Variable Descriptions

3.3.1. Dependent Variable

Following the research of Han et al. (2019) [31] and Yu et al. (2016) [32], the quantity of food consumption is selected as the dependent variable, which includes ten categories of food: grains (gr), tubers (sl), beans (bn), meat (mt), eggs (eg), aquatic products (fs), poultry (ql), fruits and nuts (fr), vegetables and edible fungi (vg), and dairy products (mk). The variables above are all based on individual-level data.

3.3.2. Core Explanatory Variable

Income inequality (TPi): this paper adopts the Thiel index as the measure of income inequality within rural communities, drawing on the research of Yu et al. (2016) [32] and Rashidi et al. (2021) [33]. A higher Thiel coefficient indicates greater income inequality among rural residents within the community. The formula for calculating the Thiel index is:

$$T = T_b + T_w = \sum_{k=1}^{K} y_k log \frac{y_k}{n_k/n} + \sum_{k=1}^{K} y_k \left(\sum_{i \in g_k} \frac{y_i}{y_k} log \frac{y_i/y_k}{1/n_k} \right) \tag{4}$$

Assuming a sample consisting of n individuals is divided into *K* groups, each group denoted as g*k* (k = 1, 2...k), with the number of individuals in group *K* being n_k, y_i and y_k represent the income share of an individual *i* and the total income share of a group *K*, respectively. T_b and T_w represent the between-group disparity and within-group disparity, respectively. In this paper, communities within the same province in the same year are taken as the smallest unit for group division to calculate the Thiel index. The within-group disparity is considered the internal income inequality within rural communities. Inter-group income inequality refers to the income inequality between resident communities within the same province and the income inequality between urban and rural resident communities within the same province.

3.3.3. Mediating Variables

Ratchet effect (Y_{it-1}), which represents the quantity of various types of food consumed by the *i*-th rural resident in the previous period.

Demonstration effect (Y_{i+1t}), which is operationalized by dividing the sample within the same community into quintiles based on disposable income, resulting in low-income, lower-middle-income, middle-income, upper-middle-income, and high-income groups. The demonstration effect for the i-th rural resident within the same community is measured by the average consumption quantity of various types of food by the income group one level higher than their own (*i* + 1). For the high-income group, the demonstration effect is represented by the maximum consumption quantity of various types of food within the community.

3.3.4. Control Variables

Food consumption is influenced by a multitude of factors. Drawing from the existing literature, this study selects several key factors as control variables. Specifically, per capita disposable income (inc) [39]: the rise in per capita disposable income directly enhances residents' purchasing power and consumption levels, thereby promoting food consumption. Gender (gen) [39]: men and women may have different energy intake and

food consumption needs due to differences in the nature of work and preferences. Age (age) and Age Squared (ag2) [40]: as age varies, an individual's total food consumption will change, with different growth stages having varying demands for different foods and nutrients. Marital status (mar) [39]: marital status can determine lifestyle habits to some extent, affecting where meals are eaten and the variety of foods consumed. Generally, unmarried individuals or those living alone have simpler food consumption, while married individuals have more diverse diets. Education level (edu) [40]: different levels of education determine the knowledge of dietary nutrition, which in turn affects food consumption decisions. Household size (hhs) [39]: different household sizes [40] have variations in the types, quantities, and nutritional combinations of food consumed. Especially in larger households, which typically include elderly members or children, family members at different stages of growth can influence overall food consumption. Medical insurance (med) [41]: residents with medical insurance may worry less about the costs associated with illness and thus pay less attention to a balanced diet, influencing food consumption. Recent illness (sik) [41]: recent illness can lead to changes in food consumption, such as eating lighter meals or consuming nutritionally rich foods to recover health more quickly.

4. Empirical Results

4.1. Basic Regression

The internal income inequality within rural resident communities has a suppressive effect on the consumption of grains, vegetables, edible fungi, beans, and eggs, while it promotes the consumption of tubers, meat, poultry, and dairy products (see Table 2). With the passage of time and economic development, changes may occur in the intra-group income disparity among rural residents. For every 0.1 increase in intra-group income disparity measured by the Theil index, the corresponding food consumption is expected to undergo the following changes: For every 0.1 increase in income inequality, the consumption of tubers increases by 1.48 g/day, meat by 2.53 g/day, poultry by 0.85 g/day, and dairy products by 1.15 g/day; conversely, for every 0.1 increase in income inequality, the consumption of grains decreases by 15.0 g/day, vegetables and edible fungi by 15.8 g/day, and beans by 1.69 g/day. There is no significant impact on the consumption of eggs, fruits, and aquatic products, as these three types of food have stronger individual preferences.

Income inequality has facilitated the transformation and upgrading of food consumption among rural residents. Firstly, grains, vegetables, edible fungi, and beans are the most basic foodstuffs for rural residents and represent subsistence-level food consumption, with a high proportion of self-cultivation and breeding among rural residents. By growing rice, vegetables, and beans, rural residents can largely meet their family needs, and even when purchasing, these products are the cheapest food categories. Since there is an upper limit to the daily intake of food, an increase in the consumption of other foods inevitably leads to a decrease in the intake of lower-level foods. Income inequality has promoted the consumption of tubers, meat, poultry, and dairy products. Tubers are complementary to staple foods (grains and beans), increasing the diversity of staple food intake, while meat and poultry increase the intake of fats, proteins, and energy. Dairy products are rich in calcium and protein. These foods are generally obtained through purchase, are higher in price, contain a diverse range of nutrients, and are situated at the upper levels of the dietary nutrition pyramid. Therefore, income inequality promotes substitution and transformation between food consumptions, leading to an increase in the consumption of higher-level, more expensive, and more nutritious foods, thereby facilitating the transformation and upgrading of food consumption among rural residents.

From the empirical results of controlling variables, income is one of the significant factors influencing food consumption, exerting a notable impact on the consumption levels of various food categories. The increase in income has a negative impact on grains and tubers, while it has a positive impact on other food items. Rural residents, due to their initially low income levels, have a high initial consumption of staple foods (grains and

tubers), primarily to satisfy their hunger needs without considering nutritional balance. With increasing income, rural residents' purchasing power improves, leading to a gradual diversification of their diets, considering both the diversity and nutritional balance of food consumption. Consequently, the consumption of other food items increases. However, due to physiological constraints, the increased intake of other foods inevitably leads to a decrease in the initial consumption of staple foods. Among the increased food items, the growth in meat consumption is the most significant, with a 1% increase in income associated with a 22.61 g/day increase in meat consumption, as meat serves as a primary source of fat and protein, providing more energy. Following meat, the consumption of fruits, nuts, and aquatic products increases, as these foods are rich in vitamins and trace elements and are relatively expensive. For every 1% increase in income, consumption increases by 16.06 g/day and 9.35 g/day, respectively. Consumption of poultry, eggs, vegetables, edible fungi, dairy products, and beans also experiences growth.

The results of other control variables also demonstrate certain economic phenomena. Higher levels of education are associated with a deeper understanding of nutrition and health knowledge, emphasizing balance and diversity in food consumption. Therefore, education level is positively correlated with foods high in nutrients, such as meat, eggs, dairy products, aquatic products, and fruits. If residents have recently fallen ill, they are more inclined to consume vegetables, fruits, and dairy products, which aligns with reality as these foods are rich in vitamins and beneficial for recovery. Meats, aquatic products, and similar foods are not suitable for consumption by patients. Rural residents with medical insurance may be less concerned about the costs associated with illness, which could lead to reduced attention to the diversity of food consumption and increased consumption of grains, vegetables, beans, and meats. Another possibility is that this pattern could be related to the fact that these goods are self-produced and, therefore, more consumed. Typically, rural men are more engaged in physical labor, so they consume more grains, vegetables, and meats to supplement energy, which have higher consumption coefficients. Women, on the other hand, prefer dairy products and fruits with sweeter tastes. Married households usually prioritize family health, paying more attention to protein supplementation from eggs, aquatic products, and dairy products. As individuals age, most food consumption initially increases and then decreases, which aligns with common sense. However, the consumption of eggs and dairy products increases among the elderly, as they are prone to osteoporosis and are advised to consume more eggs and milk. Conversely, fruit consumption decreases because of its high sugar content, which needs to be reduced in cases of major elderly diseases. In general, larger family sizes lead to increased demand for food, causing households to prefer lower-priced grains and poultry.

4.2. Endogeneity Discussion: Instrumental Variable

To address the endogeneity problem between current income inequality and food consumption quantity, this paper follows the approach of Zakari et al. (2022) [42] by replacing current income inequality with lagged income inequality for regression. The 2SLS model, which stands for two-stage least squares, shows robust standard error regression results, and the instrumental variable passes the overidentification test and weak instrument variable test. The impact coefficients of lagged income inequality on food consumption quantity in the 2SLS model are somewhat reduced but maintain the same level of significance as the OLS model; thus, the model passes the endogeneity test (see Table 3).

4.3. Robustness Checks

4.3.1. Sample Processing

Following the practices of Zhu et al. (2023) [43], this paper refines the sample by excluding non-continuous samples and retaining those with four consecutive annual observations. The significance of the regression results for the consumption of various types of food remains consistent with the original model, passing the robustness check (see Table 4).

Table 2. Basic regression results of the impact of intra-rural income inequality on various food consumption.

Variable	(1) Grains	(2) Vegetables and Edible Fungi	(3) Beans	(4) Tubers	(5) Eggs	(6) Meat	(7) Aquatic Products	(8) Poultry	(9) Dairy Products	(10) Fruits and Nuts
Rural Thiel index	−149.9 ***	−158.0 ***	−16.86 ***	14.76 ***	−1.436	25.28 ***	3.027	8.474 ***	11.54 ***	−6.635
	(14.43)	(12.01)	(4.436)	(3.786)	(2.252)	(4.327)	(2.986)	(1.915)	(2.744)	(6.120)
Logarithmic income	−17.70 ***	8.331 ***	4.664 ***	−4.885 ***	5.043 ***	22.61 ***	9.346 ***	5.739 ***	5.421 ***	16.06 ***
	(3.073)	(2.558)	(0.945)	(0.807)	(0.480)	(0.922)	(0.636)	(0.408)	(0.585)	(1.304)
Educational level	−37.57 ***	−11.29 ***	11.07 ***	−4.680 ***	4.424 ***	17.00 ***	6.348 ***	3.502 ***	6.374 ***	12.52 ***
	(2.674)	(2.225)	(0.822)	(0.702)	(0.417)	(0.802)	(0.553)	(0.355)	(0.508)	(1.134)
Have you been sick in the last week	−59.77 ***	12.55*	−5.644 **	−0.0321	−3.237 **	−10.04 ***	−7.652 ***	0.0352	3.040 *	16.61 ***
	(8.700)	(7.242)	(2.675)	(2.283)	(1.358)	(2.609)	(1.800)	(1.155)	(1.655)	(3.691)
Whether they have health insurance	25.90 ***	28.88 ***	4.530 *	1.195	0.811	22.89 ***	−3.681 **	1.778	−0.828	6.945 *
	(8.472)	(7.052)	(2.605)	(2.223)	(1.322)	(2.541)	(1.753)	(1.124)	(1.611)	(3.594)
Gender	242.9 ***	73.60 ***	9.743 ***	10.91 ***	2.892 ***	24.12 ***	6.724 ***	3.574 ***	−4.040 ***	−19.08 ***
	(5.915)	(4.924)	(1.819)	(1.552)	(0.923)	(1.774)	(1.224)	(0.785)	(1.125)	(2.509)
Marital status	−32.09 ***	0.732	−6.595 **	2.314	3.119 **	3.815	7.739 ***	0.139	6.502 ***	4.776
	(9.540)	(7.941)	(2.934)	(2.504)	(1.489)	(2.861)	(1.974)	(1.266)	(1.814)	(4.047)
Age	48.47 ***	26.74 ***	2.178 ***	2.513 ***	−0.585 ***	2.401 ***	0.593 ***	0.370 ***	−3.928 ***	−2.011 ***
	(0.798)	(0.664)	(0.245)	(0.209)	(0.125)	(0.239)	(0.165)	(0.106)	(0.152)	(0.339)
Quadratic term for age	−0.534 ***	−0.278 ***	−0.0199 ***	−0.0303 ***	0.00662 ***	−0.0291 ***	−0.00689 ***	−0.00590 ***	0.0417 ***	0.0128 ***
	(0.00890)	(0.00741)	(0.00274)	(0.00234)	(0.00139)	(0.00267)	(0.00184)	(0.00118)	(0.00169)	(0.00378)
Household size	6.631 ***	0.474	0.562	0.476	−1.698 ***	−2.280 ***	−3.226 ***	0.661 **	−3.125 ***	−3.253 ***
	(1.986)	(1.653)	(0.611)	(0.521)	(0.310)	(0.596)	(0.411)	(0.264)	(0.378)	(0.843)
Control	393.7 ***	122.6 ***	5.509	74.25 ***	45.53 ***	−180.0 ***	−75.56 ***	−50.45 ***	98.49 ***	−39.70 **
	(39.38)	(32.78)	(12.11)	(10.33)	(6.148)	(11.81)	(8.150)	(5.227)	(7.490)	(16.71)
Obs.	31352	31352	31352	31352	31352	31352	31352	31352	31352	31352
R2	0.671	0.591	0.518	0.677	0.499	0.650	0.575	0.543	0.475	0.544

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 3. Endogeneity discussion: Empirical results using lagged income inequality as an instrumental variable.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Grains	Vegetables and Edible Fungi	Beans	Tubers	Eggs	Meat	Aquatic Products	Poultry	Dairy Products	Fruits and Nuts
Rural Thiel index	−411.953 ***	−62.573	52.163 **	0.104	55.620 ***	202.636 ***	33.758 **	39.731 ***	42.322 ***	3.920
	(80.814)	(63.648)	(23.966)	(19.493)	(13.345)	(24.680)	(16.183)	(11.344)	(13.309)	(34.489)
Control	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Obs.	23514	23514	23514	23514	23514	23514	23514	23514	23514	23514
Kleibergen-Paap rk LM statistic					606.166 ***					
Kleibergen-Paap rk Wald F statistic					529.158					
Stock-Yogo bias critical value					16.38 (10%)					

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

Table 4. Robustness check: Empirical regression results using trimmed sample and additional variables.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Variable	Grains	Vegetables and Edible Fungi	Beans	Tubers	Eggs	Meat	Aquatic Products	Poultry	Dairy Products	Fruits and Nuts
Sample processing	Income inequality within groups	−135.7 ***	−172.9 ***	−21.85 ***	23.90 ***	−8.774 **	21.23 ***	−4.710	10.05 ***	15.38 ***	1.310
		(21.81)	(18.71)	(6.976)	(5.928)	(3.469)	(6.543)	(4.680)	(2.833)	(3.374)	(9.395)
Join the rural income gap between communities in the same province	Income inequality within groups	−166.8 ***	−141.4 ***	−16.50 ***	16.51 ***	1.610	24.49 ***	3.307	9.813 ***	11.16 ***	−3.644
		(14.73)	(12.26)	(4.531)	(3.867)	(2.299)	(4.419)	(3.049)	(1.955)	(2.802)	(6.250)
	Income gap between groups	22.95 ***	−22.53 ***	−0.487	−2.385 **	−4.147 ***	1.074	−0.382	−1.824 ***	0.523	−4.073 **
		(4.080)	(3.395)	(1.255)	(1.071)	(0.637)	(1.224)	(0.845)	(0.542)	(0.776)	(1.731)
Join the urban–rural income gap between communities in the same province	Income inequality within groups	−167.8 ***	−146.6 ***	−18.19 ***	16.66 ***	0.942	24.28 ***	3.090	8.685 ***	11.59 ***	−2.511
		(14.65)	(12.20)	(4.508)	(3.847)	(2.287)	(4.396)	(3.034)	(1.946)	(2.788)	(6.217)
	Income gap between groups	47.02 ***	−29.82 ***	3.497 *	−4.992 ***	−6.241 ***	2.611	−0.166	−0.555	−0.123	−10.83 ***
		(6.824)	(5.682)	(2.100)	(1.792)	(1.065)	(2.048)	(1.413)	(0.906)	(1.299)	(2.896)
	Control variable	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Obs	31352	31352	31352	31352	31352	31352	31352	31352	31352	31352

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4.3.2. Addition of Variables

Referring to the practice of Jun et al. (2023) [44] and Pan et al. (2021) [45], this paper adds the control variable of the income gap between rural communities in the same province on the basis of the benchmark regression model. The significance of the regression results for the rural intra-group income gap is basically consistent with the original model and passes the robustness test. The widening of the income gap between rural groups is not conducive to the upgrading of food consumption, and it has an inhibitory effect on the consumption of vegetables, edible fungi, tubers, eggs, poultry, fruits, and nuts, as well as a promotion effect on the consumption of cereals; that is, the income gap between rural communities in the same province and the income gap within rural areas in the same province have a relatively opposite effect on food consumption. There are geographical distance problems and differences in consumption habits and customs among rural communities. Different communities are more independent and belong to different administrative and economic collectives. The communication density of rural residents is much lower than that in the community, and it is difficult to form internal observation, learning, imitation, and comparison behaviors (see Table 4).

On the basis of the baseline regression model, the control variables of the income gap between urban and rural groups in the same province are added. The regression results of the income gap in the rural group were consistent with the original model and passed the robustness test. The widening of the income gap between urban and rural groups in the same province is not conducive to the upgrading of food consumption and has an inhibitory effect on the consumption of vegetables and edible fungi, tubers, eggs, fruits, and nuts, as well as a promotion effect on the consumption of grains and legumes. That is, the income gap between urban and rural groups in the same province and the income gap within the countryside have relatively opposite effects on food consumption. There are significant differences in household registration between urban and rural areas, with substantial disparities in income levels. Lifestyles and consumption behaviors are fundamentally different, and geographical distance isolates urban areas from rural ones. Additionally, urban residents live in more enclosed environments and have fewer frequent interactions with rural residents, making it difficult to observe and emulate rural food consumption patterns.

4.3.3. Alternative Methods

Referring to the latest food consumption research methodology by Xiao et al. (2023) [46], this study employs machine learning causal inference analysis to conduct an empirical investigation of the ten food categories. The results of the nonlinear model indicate that income inequality promotes the consumption of all food categories except fruits and nuts. The linear model results show that income inequality promotes the consumption of all food categories except tubers (see Table 5). Given the entirely different methodologies, some variation in results is observed, but they corroborate the notion that within-group income inequality in rural areas promotes food consumption. Total utility represents the average impact of income inequality on the consumption of various food items. The low limit and high limit indicate the minimum and maximum values of the impact of income inequality on each individual. This means that income inequality may have a positive impact on some individuals and a negative impact on others, but the overall average effect is positive, indicating that income inequality promotes food consumption among rural residents. The vertical axis of the graph represents the impact of income inequality on food consumption, while the horizontal axis represents the logarithm of income levels. Causal analysis is initially employed to determine the impact of income inequality on food consumption, with different individuals experiencing varying effects. The results in the table display the linear, nonlinear, and average effects of income inequality on food consumption, as well as the upper and lower limits. The graph illustrates the impact of income inequality on food consumption quantified by income levels on the horizontal axis (although other variables could be used for quantification), laying the groundwork for subsequent heterogeneity

analysis based on income levels. As can be seen from Figure 2, at very low and very high income levels, the impact of income inequality on food consumption is relatively small. This is because individuals at the lowest income levels are constrained by their income and purchasing power, limiting their ability to emulate others' consumption behaviors. Conversely, individuals at the highest income levels may already exhibit conspicuous consumption or have reached the peak of their consumption capacity. Thus, they do not need to emulate others, resulting in a relatively stable impact of income inequality on their consumption patterns. However, for residents at intermediate income levels, the impact of income inequality on food consumption fluctuates significantly.

Table 5. Robustness check: Empirical results table of the impact of changes in rural residents' intra-group income disparities on various food consumption using machine learning causal inference approach.

	Nonlinear Model	Linear Model	Total Utility	Low Limit	High Limit
Grains	71.69	73.34	57.21544	−144.825	259.2561
Vegetables and edible fungi	103.82	51.27	57.71213	−98.4196	213.8439
Beans	20.93	19.73	38.34891	−35.0994	111.7972
Tubers	1.46	−0.33	5.039404	−148.828	158.9068
Eggs	3.25	2.74	6.556812	−26.7925	39.90616
Meat	22.48	16.21	41.66597	−155.745	239.0773
Aquatic products	3.22	4.04	2.179254	−130.329	134.6873
Poultry	27.74	13.59	36.5173	−46.2366	119.2712
Dairy products	1.45	9.08	17.13377	−91.9957	126.2633
Fruits and nuts	−12.10	8.00	3.304978	−75.4168	82.02672
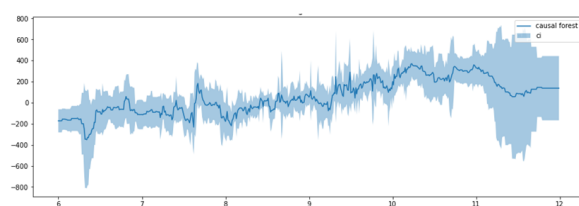
(**a**) Grains
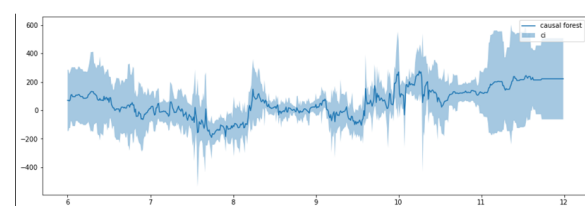
(**b**) Vegetables and edible fungi
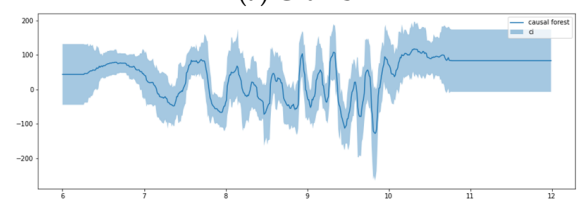
(**c**) Beans
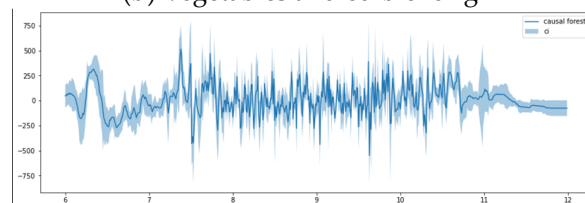
(**d**) Tubers
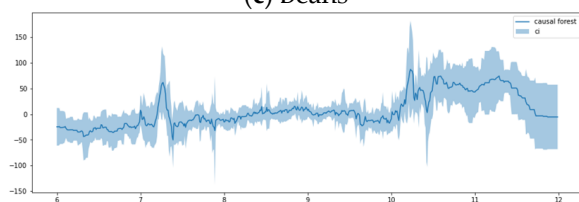
(**e**) Poultry

(**f**) Eggs

Figure 2. *Cont.*

(**g**) Meat

(**h**) Aquatic products

(**i**) Dairy products

(**j**) Fruits and nuts
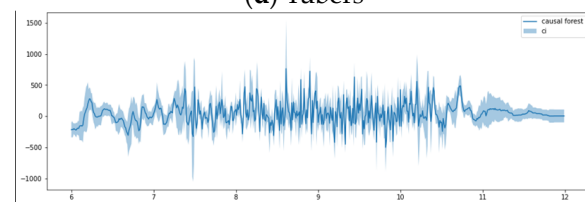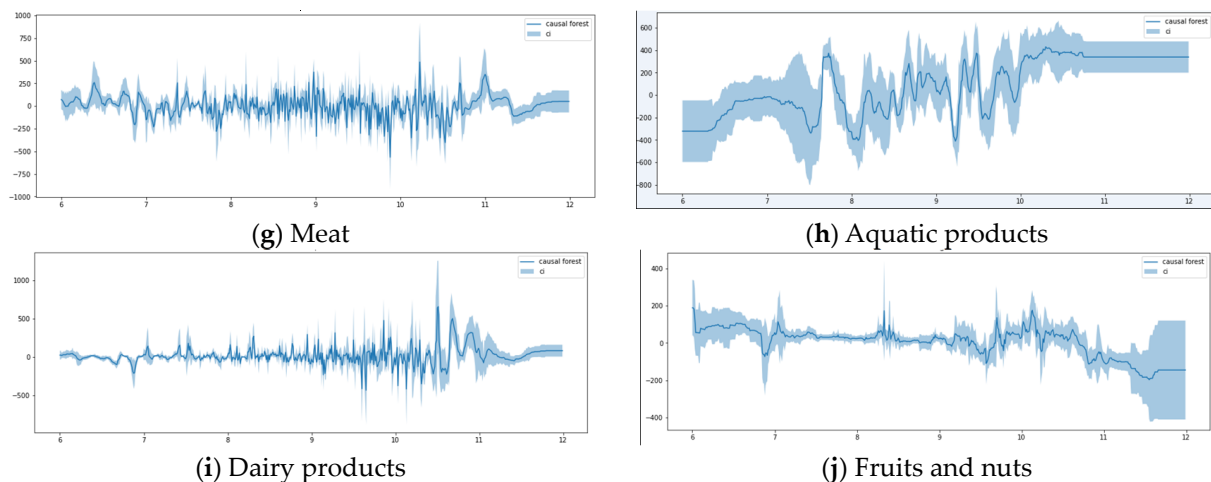
Figure 2. Robustness check: Empirical results figure of the impact of changes in rural residents' intra-group income disparities on various food consumption using machine learning causal inference approach.

5. Mechanism Analysis

5.1. Heterogeneity Analysis

5.1.1. Grouping by Income

The impact of income inequality varies among different food categories and income levels (see Table 6). For the low-income group, an increase in income inequality promotes the consumption of meat, aquatic products, poultry, tubers, and dairy products while suppressing the consumption of vegetables and edible fungi, as well as fruits and nuts. Due to their lower income levels, the low-income group has a lower initial level of food consumption and fewer types of food consumed. Therefore, income inequality encourages the growth of more food categories for the low-income group, with the increase in animal-based foods replacing the consumption of plant-based foods, leading to a decrease in vegetable and fruit consumption and a transformation in food consumption.

For the lower-middle-income group, an increase in income inequality promotes the consumption of aquatic products but suppresses the consumption of grains, beans, vegetables, edible fungi, and fruits and nuts; for the middle-income group, it promotes the consumption of meat and dairy products but suppresses the consumption of grains and vegetables and edible fungi; for the upper-middle-income group, it promotes the consumption of meat and tubers suppresses the consumption of grains and vegetables and edible fungi. The lower-middle, middle, and upper-middle-income groups, affected by income inequality, show a significant decrease in the consumption of grains and vegetables and a significant increase in meat consumption, indicating that the transformation in food consumption involves the replacement of staple food consumption with animal-based foods, upgrading the source of energy intake from staple foods to meat, and thus transforming and upgrading food consumption.

For the high-income group, income inequality promotes the consumption of dairy products, fruits, nuts, and tubers while suppressing the consumption of aquatic products and beans. The high-income group may have already completed the aforementioned food consumption transformation, and given their higher income and food consumption levels, income inequality is more reflected in the impact on food categories, promoting a significant increase in the consumption of high-priced, calcium-rich dairy products, a significant increase in vitamin-rich fruits, and an increase in fiber-rich tuber consumption, while suppressing the consumption of aquatic products and beans.

Table 6. Heterogeneity analysis: Empirical results of the impact of changes in rural residents' intra-group income disparities on various food consumption, stratified by quintiles of income groups.

	(1)	(2)	(3)	(4)	(5)
	Low-Income Group 20%	Lower-Middle-Income Group 20%	Middle-Income Group 20%	Upper-Middle-Income Group 20%	High-Income Group 20%
Grains	−30.60	−285.4 ***	−258.4 ***	−100.1 ***	−12.38
	(28.52)	(33.25)	(34.74)	(33.81)	(34.73)
Vegetables and edible fungi	−129.1 ***	−248.5 ***	−135.0 ***	−105.6 ***	−137.8 ***
	(24.12)	(27.71)	(29.08)	(28.72)	(28.48)
Beans	−4.435	−25.74 ***	−6.557	16.47	−48.96 ***
	(8.326)	(9.473)	(10.42)	(10.86)	(12.07)
Tubers	13.36 *	−0.272	3.965	23.89 ***	22.10 **
	(7.956)	(8.537)	(8.983)	(8.793)	(9.266)
Eggs	−5.191	−6.384	−6.770	−2.460	0.826
	(4.290)	(4.848)	(5.299)	(5.537)	(5.976)
Meat	20.26 ***	15.06	21.14 **	22.09 **	16.47
	(7.708)	(9.419)	(10.22)	(10.75)	(11.56)
Aquatic products	12.61 ***	16.74 ***	6.357	−8.113	−26.66 ***
	(4.676)	(6.123)	(7.214)	(7.607)	(8.656)
Poultry	6.572 **	1.102	5.974	5.349	7.440
	(3.041)	(3.917)	(4.629)	(4.812)	(5.544)
Dairy products	8.919 **	0.888	16.33 ***	9.940	31.45 ***
	(4.068)	(4.312)	(5.721)	(7.640)	(9.058)
Fruits and nuts	−19.73 *	−37.09 ***	−14.46	23.84	37.61 **
	(10.45)	(12.90)	(14.83)	(14.81)	(17.31)
Control	Y	Y	Y	Y	Y
Obs.	6014	6336	6335	6335	6332

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

5.1.2. Grouping by Educational Level

Looking at the detailed food categories (see Table 7), an expansion of income inequality promotes the consumption of meat among individuals with primary education or below while reducing the consumption of grains, vegetables, edible fungi, fruits, and nuts. In rural areas, individuals with primary education or below are more likely to engage in physical labor, have a higher initial consumption of staple foods, and mainly increase energy intake by substituting staple foods with animal-based foods.

An expansion of income inequality promotes the consumption of meat, poultry, tubers, and dairy products among individuals with junior high to vocational high school education while suppressing the consumption of grains, beans, vegetables, and edible fungi. This group, with junior high to vocational high school education, is significantly affected by income inequality across most food categories. They have a certain level of cultural knowledge, focus on the diversity of food consumption, and can more acutely adjust the substitution between different food consumptions.

An expansion of income inequality promotes the consumption of meat, aquatic products, and tubers among individuals with a college education or higher. The group with the highest level of education has the largest significant coefficients for food consumption affected by income inequality. Higher educational attainment correlates with stronger learning abilities and a greater capacity to emulate food consumption patterns. Additionally, individuals with higher education have a greater understanding of nutritional diets, consumption health, and food structure, which enhances the promoting effect.

Table 7. Heterogeneity analysis: Empirical results of the impact of changes in rural residents' intragroup income disparities on various food consumption by educational attainment.

	(1)	(2)	(3)
	Primary School Graduation or Below	**Junior High School–Vocational High School**	**Associate Degree, Bachelor's Degree, or Higher**
Grains	−237.9 ***	−154.7 ***	104.9
	(32.50)	(21.85)	(97.36)
Vegetables and edible fungi	−156.9 ***	−151.5 ***	−51.53
	(27.97)	(18.24)	(73.69)
Beans	2.809	−20.02 ***	−6.476
	(10.02)	(7.052)	(34.58)
Tubers	−0.855	22.32 ***	91.51 ***
	(8.863)	(5.815)	(23.95)
Eggs	−4.673	3.382	−13.78
	(5.097)	(3.537)	(16.51)
Meat	35.36 ***	28.71 ***	59.34 *
	(9.766)	(6.878)	(31.19)
Aquatic products	0.839	3.494	41.29 *
	(6.815)	(4.841)	(24.91)
Poultry	4.675	10.84 ***	−18.90
	(4.366)	(3.135)	(17.24)
Dairy products	4.100	11.70 ***	36.59
	(5.080)	(4.161)	(30.32)
Fruits and nuts	−23.76 *	−3.500	41.59
	(14.08)	(9.873)	(52.40)
Control	Y	Y	Y
Obs.	17522	13830	924

Standard errors in parentheses. *** $p < 0.01$, * $p < 0.1$.

5.2. Mediation Mechanism Test

In accordance with relative income theory, which posits that residents' consumption is influenced by the "ratchet effect" and the "demonstration effect," this paper verifies the impact of income inequality on rural residents' food consumption through these two effects using a mediation effect model and the bootstrap method. The results show (see Table 8) that, except for eggs, which do not exhibit a ratchet effect, all other food categories demonstrate both demonstration and ratchet effects. This indicates that income inequality promotes food consumption through both the demonstration effect and the ratchet effect.

Table 8. Mediation analysis of demonstration effect and ratchet effect on various food consumption.

	Demonstration Effect			**Ratchet Effect**		
	Total Effect	**Confidence Interval**		**Conclusion**	**Total Effect**	**Confidence Interval**		**Conclusion**

	Total Effect	Confidence Interval		Conclusion	Total Effect	Confidence Interval		Conclusion
Grains	5.5165 ***	3.424836	7.608351	Mediating Effect	30.98 ***	19.65046	42.32058	Mediating Effect
Vegetables and edible fungi	4.2948 **	1.863913	6.725749	Mediating Effect	13.090 ***	6.624426	19.55711	Mediating Effect
Beans	10.298 ***	7.733236	12.86426	Mediating Effect	8.7671 ***	6.245304	11.28903	Mediating Effect
Tubers	5.9634 ***	3.928116	7.998826	Mediating Effect	15.386 ***	11.87048	18.90248	Mediating Effect
Eggs	1.4790 **	1.014835	1.943268	Mediating Effect	0.7725	−0.59471	2.139804	Dose not exhibit a Mediating Effect
Meat	9.185 ***	5.13822	23.23186	Mediating Effect	5.4826 ***	1.50477	9.460422	Mediating Effect
Aquatic products	1.2558 **	0.3141786	2.197547	Mediating Effect	3.9069 ***	1.943817	5.870068	Mediating Effect
Poultry	0.6680 **	0.2174477	1.118662	Mediating Effect	1.8350 ***	1.066931	2.60312	Mediating Effect
Dairy products	0.6986 ***	0.3657516	1.031629	Mediating Effect	0.8527 *	0.123332	1.828925	Mediating Effect
Fruits and nuts	1.6547 *	0.3989474	2.910584	Mediating Effect	12.492 ***	9.419205	15.5666	Mediating Effect

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Based on the baseline regression results, income inequality has a suppressive effect on the consumption of grains, vegetables, edible fungi, and beans. These three categories of

food are subsistence foods, the most basic foods to satisfy hunger, located at the bottom of the dietary pyramid. The higher the income group, the lower the consumption of these foods. Therefore, the demonstration and ratchet effects, being opposite in sign to the baseline results, precisely indicate a reduction in the consumption of these types of food due to the emulation of higher-income groups. Additionally, the upgrading of food consumption, leading to increased consumption of higher-level foods, naturally results in a decrease in the consumption of lower-level foods. In the baseline results, income inequality has no significant impact on the consumption of fruits and nuts, aquatic products, and eggs, while the demonstration and ratchet effects for fruits and nuts and aquatic products are significant. This suggests that income inequality does not directly affect the consumption of these two categories of food but indirectly influences them through the two effects. For eggs, only the demonstration effect is significant, indicating that egg consumption is indirectly affected solely through the demonstration effect.

6. Further Discussion

In addition to the analysis of food consumption quantity discussed above, this paper further adopts Yuan's [47] analytical framework to construct a Chinese Healthy Eating Index (CHEI) for analyzing the dietary health of rural adults. The CHEI is based on food consumption quantity and is used to study the impact of income inequality on healthy food intake [48]. In the table, food consumption is scored based on energy density (intake per 1000 calories), with the standard unit for each food being standard portions (SP)/1000 kcal. The definition and conversion principles of standard portions refer to the explanation on page 336 in the appendix of the "Dietary Guidelines for Chinese Residents 2022" (source of materials: https://www.cnsoc.org/, accessed on 20 April 2024). The CHEI in this paper includes 10 food indicators, each with a minimum score of 0 and a maximum score of 10, totaling 100 points. Individual scores for each item are proportionally allocated based on the difference between the upper and lower scoring standards, and individual dietary health scores are calculated by summing the specific scores for each indicator based on personal food consumption quantity. The upper scoring boundary for all types of food is set at the minimum recommended amount in the Chinese Dietary Pagoda (2022). Meat, being a component that should be consumed in moderation, has its lower boundary of 0 points set at the 90th percentile of the sample group to ensure that a large proportion of the sample does not score 0 for this item. The lower boundary of 0 points for the remaining indicators corresponds to no consumption of the respective foods (see Table 9).

Table 9. Scoring standards of the food intake health index.

Food Group	CHEI Ingredient	Recommended Intakes (g/d)	Score	
			Lower Limit 0 Points	Maximum 10 Points
Subsistence type	Grain	50~150	0	≥2.5 SP/1000 kcal
	Vegetables and edible fungi	300~500	0	≥1.9 SP/1000 kcal
Well-off type	Tubers	50~100	0	≥0.3 SP/1000 kcal
	Legumes	25~35	0	≥0.4 SP/1000 kcal
	Egg	40~50	0	≥0.5 SP/1000 kcal
	Livestock meat	40~75	≥5.6 SP/1000 kcal	≤0.4 SP/1000 kcal
Enjoyment type	Aquatic products	40~75	0	≥0.6 SP/1000 kcal
	Poultry	40~75	0	≥0.3 SP/1000 kcal
	Fruits and nuts	200~350	0	≥1.1 SP/1000 kcal
	Dairy products	300~500	0	≥0.5 SP/1000 kcal

The basic regression results indicate (see Table 10) that internal income inequality among rural residents promotes healthier food consumption, with every 0.1 increase in within-group income inequality leading to a 0.1143 point increase in the healthy intake score. Different types of food provide varying amounts of calories and nutrients. For

instance, animal-based foods are rich in protein, fat, vitamin A, thiamine, and riboflavin; vegetables and fruits are rich in vitamin C; and dairy products and aquatic products contain calcium, vitamin A, and riboflavin, among others. Therefore, an increase in income inequality promotes the growth of consumption across various food categories, which in turn increases the intake of fats, proteins, and micronutrients, thereby improving the diversity and healthiness of food consumption.

Table 10. Empirical regression results of the impact of changes in rural residents' intra-group income gap on health intake.

Variable	(1)
	CHEI
Rural Thiel index	1.143 ***
	(0.332)
Logarithmic income	1.276 ***
	(0.0707)
Educational level	1.165 ***
	(0.0617)
Have you been sick in the last week	0.368 *
	(0.201)
Whether they have health insurance	−0.0245
	(0.195)
Gender	−0.790 ***
	(0.136)
Marital status	0.591 ***
	(0.219)
Age	−0.172 ***
	(0.0184)
Quadratic term for age	0.00157 ***
	(0.000205)
Household size	0.227 ***
	(0.0458)
Constant	41.03 ***
	(0.912)
Obs.	31352
R2	0.602

Standard errors in parentheses. *** $p < 0.01$, * $p < 0.1$.

7. Conclusions and Implications

7.1. Conclusions

The internal income inequality within rural resident communities has a suppressive effect on the consumption of grains, vegetables, edible fungi, beans, and eggs, while it promotes the consumption of tubers, meat, poultry, and dairy products. There is no significant impact on the consumption of eggs, fruits, and aquatic products, as these three types of food have stronger individual preferences. Income inequality has facilitated the transformation and upgrading of food consumption among rural residents. Different types of food provide varying amounts of calories and nutrients, and the expansion of income inequality has led to increased consumption of various food categories, thereby increasing the intake of fats, proteins, and micronutrients and thus improving the diversity and healthiness of food consumption. The impact of income inequality varies among different food categories and across different income and educational levels. Income inequality has encouraged the growth of more food categories for the low-income group, with the increase in animal-based foods replacing the consumption of plant-based foods, leading to a transformation in food consumption. The middle three income groups have replaced staple food consumption with animal-based foods, upgrading the source of energy intake from staple foods to meat, thus transforming and upgrading food consumption. The high-income group has increased their consumption of more expensive, nutrient-rich foods.

The group with the highest level of education has the largest significant coefficients for food consumption affected by income inequality; those with junior high to vocational high school education are most affected by income inequality across most food categories and are more sensitive in adjusting the substitution between different food consumptions; individuals with primary education or below increase energy intake by substituting staple foods with animal-based foods.

This paper also points out that income disparities between communities and between urban and rural areas suppress food consumption, consistent with the findings of most literature studies such as Liu (2018) [48] and Xu et al. (2021) [22]. However, existing literature has not focused on the impact of internal income inequality within communities on consumption, especially based on an in-depth study of social behavior and relative income theory, which is an innovation of this paper. Large sample data show that internal income inequality in rural areas is much greater than that between urban and rural areas and within cities, yet internal disparity is often overlooked in research. Therefore, perhaps it is the focus on external income inequality while neglecting the impact of internal income inequality on consumption that has led to the "Chinese consumption puzzle."

7.2. Discussion

In addition to the findings mentioned above, this paper has two innovative aspects: firstly, it uses food consumption quantity as the dependent variable rather than food consumption expenditure. Consumption expenditure is affected by inflation and prices, and total expenditure does not describe the substitution, transition, and upgrading of various food consumptions. In the survey, it was found that rural residents grow their own grains, vegetables, fruits, and livestock for family consumption, but this part of food consumption is not included in food consumption expenditure. Therefore, this paper directly uses the more realistic measure of various food consumption quantities. Secondly, this paper selects a special stage of rapid economic development and rapid expansion of income inequality in China, uses a large sample database, and, through theoretical analysis and empirical testing, demonstrates the promoting effect of internal income inequality on food consumption. Food consumption is the most basic need for personal consumption. China has 510 million rural residents whose income levels are rapidly increasing, and their consumption is constantly upgrading and changing. The study of food consumption provides experience and ideas for the research of other consumptions, such as industrial products.

Compared with existing literature, the findings of this study are consistent with Dokova et al.'s (2022) [49] research on dietary consumption changes in Europe, indicating a reduction in the consumption of traditional foods and a transition towards healthier dietary behaviors. The results also align with Wang et al.'s (2012) [50] study in China, illustrating a shift from predominantly plant-based food consumption patterns to animal-based ones with higher fat and protein content and lower fiber and grain content. Regarding income heterogeneity analysis, this study's findings are in line with Wu et al. (2019) [51] research, demonstrating significant differences in food consumption levels and structures among different income groups. In terms of related control variables, the empirical results are similar to the analysis conducted by Conrad et al. (2022) [52] on Zimbabwean households, indicating higher fruit expenditures for female household heads, while male household heads exhibit a preference for animal-based foods.

Furthermore, the existing literature has studied the impact of income disparity on consumption expenditure, but there is controversy regarding which types of consumption expenditure are increased by income inequality. Chen et al. (2023) [11] found that increased income inequality led to increased parental spending on children's education. Chai et al. (2019) [17] found, based on South African household expenditure data, that income disparity increased household spending on tangible goods such as jewelry and clothing. Jesse et al. (2013) [12], based on a study of household consumption in 18 major metropolitan statistical areas (MSAs) in the United States, showed that income disparity promoted an

increase in total expenditure, with the increase primarily concentrated on housing and food rather than on jewelry, cars, clothing, and entertainment. Regarding the impact of income disparity on food consumption, Zhu et al. (2021) [53] found, based on urban household data from six provinces, that narrowing income disparity and enhancing the growth pattern of household income for middle-income families significantly increased residents' demand for beef. However, the existing literature lacks research on the impact of income disparity on the consumption quantity of all food items. Therefore, this study, consistent with other literature findings, posits that income disparity promotes consumption and, further building on existing research, fills a gap in the field of food consumption.

In the literature on using the Theil index to study issues in China, Lou et al. (2009) [54] constructed a provincial-level dynamic panel data model for empirical analysis, finding that the "spiral effect" of urban residents' consumption is significant. Han et al. (2012) [55] used the Theil index to measure income disparity between provinces and found that the impact of income disparity on rural consumption is more significant compared to urban areas. Building on the findings of the aforementioned two articles, this study validates the presence of internal demonstration and spiral effects on rural residents' food consumption.

Overall, the findings of this study are consistent with those of the majority of the existing literature. However, this study investigates the impact of income disparity on the consumption quantity of all food items, filling a research gap in this area. In terms of research subject, this study examines internal income disparity among rural residents, making a marginal contribution to the existing literature.

The limitation is that this paper studies food consumption from the perspective of physical quantity and does not delve into the nutritional elements (such as calories, proteins, vitamins, etc.), nutritional structure (proportion of various food consumptions), and dietary health (obesity, malnutrition, etc.) issues. The main considerations are also based on the situation understood during the survey: Firstly, most people are not clear about the recommended consumption of various foods by the dietary nutrition guidelines; secondly, even if they are aware of the recommended consumption of various foods by the dietary nutrition guidelines, few people consume according to the recommended amount. Real data from developed countries also show that despite increasing evidence of the unhealthy aspects of high-meat diets, the consumption of meat and animal-based foods continues to rise in the United States and many countries around the world. The American Heart Association recommends an upper limit of 62.6 kg of lean meat per person per year, or more than 36.3 kg less than the current average US intake of 100.7 kg [56]; thirdly, the relationship between the recommended consumption of various food groups in dietary guidelines and health, longevity, and well-being remains unclear. Therefore, this study did not delve into the aspect of nutritional diets. Additionally, this study only utilized micro-level data for empirical research. Future endeavors will involve the use of provincial-level panel data to explore food consumption and its various influencing factors from a macro perspective.

Institutional Review Board Statement: Not applicable.

Data Availability Statement: The original data presented in the study are openly available in China Health and Nutrition Survey at https://www.cpc.unc.edu/projects/china, accessed on 20 April 2024.

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