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The impact of the COVID-19 pandemic on rural communities: A case study of Sichuan Province, China

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Abstract

Objective: China has experienced a considerable influence of the COVID-19 pandemic on the local people's health and economy since the last few months. Therefore, this study aims to examine the psychological and socio-economic impact of COVID-19 on rural communities in the Sichuan Province of China.

Methods: A total of 499 participants (village representatives of Sichuan Province) were approached to partake in a cross-sectional online survey and share their experience regarding the ongoing pandemic. The descriptive statistics and OLS regression were used to analyze the data.

Results: Our analysis revealed that the pandemic has significantly affected local people psychologically, leading to socio-economic vulnerability. Notably, we find that local households are worried about their income losses regardless of their socio-economic status (40%-43%), level of income (37%-43%), and industry involvement (38%-43%). However, as income increases, the level of stress decreases. The results further show that government transfer payment is a significant factor in reducing stress due to its reliable and uninterrupted income flow. Contrary to our proposition, the pandemic stress was less observed, which might be because of people's trust in government and effective anti-epidemic countermeasures to contain the disease.

Conclusion: This study finds that COVID-19 has a significant impact on local people's health, psychology, and income. This study is one of the first to provide empirical evidence regarding early health and socio-economic effects of COVID-19 at the household level in rural communities, which are very important to devise policies to ease the outbreak and prevent further losses at the local community level.

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Strengths and limitations of this study

- This study provides empirical evidence related to the psychological and socio-economic impact of COVID-19 on rural communities.
- Data were collected from rural village representatives because they are considered potential key respondents, reliable, and primary data sources.
- The sampling technique (snowball) employed in this study reduces the population's representativeness and generalizability of study findings.
- This study did not differentiate between the psychological and socio-economic impact of the COVID-19 pandemic in rural and urban communities.

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1. Introduction

The impact of the recent outbreak of coronavirus disease 2019 (COVID-19) on health, society, and economy is far-reaching, significant, and devastating (1). Globally, the disease's impact on local people and businesses is still increasing day by day and is far beyond expectation due to high uncertainty. In comparison to other natural disasters, various scholars argue that COVID-19 is unique in terms of its predictability and effects on society; moreover, poor households, especially in rural areas, have been adversely affected to a greater extent (2-6). Additionally, due to unprecedented measures taken to contain the spread of disease, including isolating people and lockdowns, local communities suffered a high level of tensions related to wage and employment losses, increased expenses, and business survival, among others (7-9). Due to the rapid increase in the number of new cases, the COVID-19 created panic, anxiety, income, and expenditure pressures leading to psychological and socio-economic imbalance (4). Besides, isolation, uncertainty, and fear of contracting the infection also exacerbated the situation, as most people were worried about being infected (9).

Further, rural economies are usually based on self-employment (mostly home-based), small or micro-businesses, which means they are highly vulnerable due to less cash in hand and low resilience (5). Similarly, Phillipson, Gorton (6) argue that rural communities are usually less prepared to weather the storm during highly uncertain situations like COVID-19. The literature also indicates that past crises such as Foot and Mouth Disease outbreak in the U.K significantly affected rural economies (10, 11).

We only targeted rural areas for various reasons: First, rural communities usually face financial constraints, and the ongoing pandemic has exacerbated the financial stress in rural economies around the globe. Further, in rural areas, usually, healthcare infrastructure is also relatively low,

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including limited diagnostic facilities, healthcare staff, isolation rooms, and personal protective equipment (12, 13), which may have adversely affected rural communities.

Since COVID-19 is a very different and unprecedented disease, its adverse effects on local communities in China were much higher during its initial spread period. Moreover, given the devastation caused by the pandemic in China and other parts of the world, it is necessary to explore its psychological, social, and economic effects on local households. Therefore, we are particularly interested in investigating the health and socio-economic impact of COVID-19 on local communities in rural areas of the Sichuan Province of China. We hypothesize that the COVID-19 pandemic psychologically and socio-economically affected local people considerably regardless of their socio-economic status, income level, and industry involvement.

This study is theoretically and practically important because we attempt to help maintain the sustainable well-being and livelihood of local communities. Most previous studies are focused on health, medical research, and healthcare workers because they are more exposed to the disease (14, 15). However, less attention has been paid to local communities in rural areas. To the best of our knowledge, this study is one of the first to provide empirical evidence regarding the early health and socio-economic impact of COVID-19 at the household level in rural communities in Sichuan, which is very important to devise policies to ease the burden of the outbreak and prevent further losses at the local community level. Additionally, it is also essential to retain everyday socio-economic life for sustainable development.

The remaining part of the paper is as follows. Section 2 briefly discusses the research methodology adopted in this study, including study design, setting, data collection, and analysis. In section 3, we have explained the results, followed by discussion and implications in section 4. Finally, section 5 outlines the study conclusion.

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2. Materials and Methods

2.1. Research context, sample, and data collection

The data was collected from Sichuan province because it is one of the largest provinces with nearly 85% resemblance to mainland China regarding city divisions, population density, and developmental level. The province includes least, middle, and highly developed regions similar to mainland China. Due to the Chinese government's measures to contain the spread of the virus, including social-distancing and travel restrictions, the data was collected through administering an online questionnaire, which is also consistent with previous studies (2, 4, 16). The questionnaire comprised several questions regarding the effect of COVID-19 on the health and livelihoods of rural communities. Notably, we asked the respondents to share their household experience in the context of COVID-19, including psychological impact, wage and income losses, and shortage of agricultural input supplies. The psychological impact was measured in terms of income concern, spending concern, health concern, and pandemic concern. The questionnaire was initially developed in Chinese and subsequently back translated into English by two bilingual expert researchers. In following the guidelines of Huber and Power (17), the potential key respondents (i.e., village representatives) were approached to participate in the study because they are considered reliable and primary data sources.

The data was collected through the convenience and snowball sampling technique due to its time and resources saving advantages, as argued by various researchers (2, 5, 18). Nowadays, WeChat (a very famous social media APP) is considered a necessity in China due to its abundant advantages. Therefore, considering its extensive use, the online questionnaire was administered through WeChat to encourage a large number of rural households (village representatives) to participate in the survey. Additionally, Bo Liu, McCarthy (16) argue that snowball sampling is

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commonly used by Chinese researchers to reduce search costs and find hidden populations. Due to financial resources constraints and to avoid any possible bias into study findings, no incentives were offered to participants, as suggested in previous studies (2, 16). Efforts were made to ensure a representative sample by targeting local households (village representatives) at every village in rural areas across Sichuan province. A total of 499 complete and useable responses were received.

2.2. Patient and Public Involvement

Since the study focuses on examining the effect of COVID-19 pandemic on rural communities, no patient was involved in setting the research question or the outcome measures. However, local community members were involved in the design and conduct of this research.

2.3. Participants

Participants were all residents of different rural villages across the Sichuan Province of China. This cross-sectional study's criteria included a minimum of 18 years of age, resident of Sichuan province, and, most notably, a village representative. The data was collected during mid of April for two weeks; at that time COVID-19 pandemic had already affected a large number of local people in terms of socio-economic and health effects. Total 499 participants took part in the study and completed the prescribed survey questionnaire. Before administering the questionnaire, the permission of the community leader of each village was sought. In addition, we also sought the consent of every rural village representative before taking part in the study. Every participant was permitted not to answer any question accordingly.

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2.4. Data analysis

This study used descriptive statistics and Ordinary Least Squares (OLS) regression to analyze the data. The descriptive statistics were employed to describe the sample characteristics, psychological and socio-economic impact on local households by the level of income, socio-economic status, and main sources of income. The OLS regression was performed to determine the effects of psychological and pandemic stress by income level, main income sources, and industry-wise. Furthermore, we also assessed the reliability of the data using Cronbach's Alpha. The value of Cronbach's Alpha was 70.7, which shows sufficient reliability of our data.

3. Results

3.1. Sample description

Most participants' annual income was less than 13000 RMB, while only 3.61% of respondents earn more than 25000 RMB per year. Additionally, in our sample, 72.34% of participants belong to high socio-economic status, while 27.66% belong to low socio-economic status. Furthermore, in terms of primary sources of income, most of the respondents reported that they are mainly engaged in farming (29.80%), followed by employment outside of the county (28.64%), while 21.83% are locally employed, and 15.25% do business. However, only 4.49% of survey participants reported that they receive government transfer payment[1]. The detail of the sample is presented in **Table 1**.

[1] It is a kind of subsidies and financial support provided by the Chinese government to rural communities. These subsidies are mainly used for the natural environment and ecological restoration such as water conservation construction, forest construction, wind prevention, conversion of farmland to forests and grasslands, rural basic education, primary medical care, basic pension insurance, agricultural production subsidies, and other farmer welfare system expenditures. It also includes the provision of high-quality seeds, high-efficiency pesticides, fertilizers, and other agricultural technology research, development, and promotion, as well as loan subsidies and interest discounts for farmers to build small agricultural products processing factories.

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Table 1. Sample description

Yearly Income Level (RMB)	Percentage	Industry*	Percentage
<10000	29.46%	Agriculture	20.80%
10001-13000	33.27%	Food	32.54%
13001-15000	17.43%	Livestock	24.33%
15001-20000	10.22%	Tourism	4.58%
20001-25000	6.01%	Others	17.75%
>25000	3.61%		
Main sources of income	**Percentage**	**Socio-economic status**	**Percentage**
Family farming	29.80%	High	72.34%
Business	15.25%	Low	27.66%
Local employment (salaried/wages)	21.83%		
Employment outside of the village	28.64%		
Government Transfer Payment	4.49%		

Note: Main industries where villagers (participants) are involved.

3.2. Psychological impact of COVID-19

The results reveal that the most significant psychological pressure on the local community is related to income (40.8%), followed by an increase in spending (28.6%), health concern (23.9%), and finally, COVID-19 pandemic concern (6.8%). Similarly, when we analyzed the data in terms of socio-economic status, the results indicate that most participants are concerned about income regardless of their socio-economic status. Notably, people with low socio-economic status were mostly worried about their income (43%), followed by increased expenses (27%), health (23%), and pandemic (7%). The situation of people with high socio-economic status also remains relatively similar **(see Table 2).** It infers that local people are anxious about their income because some industries were partially operating due to the COVID-19 pandemic, while others were closed

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entirely. Moreover, many products' demand tremendously decreased, leading to economic and employment loss globally (19). Additionally, due to business closures and supply chain disruptions, the price of many commodities increased, which resulted in psychological stress among local people about meeting the increased expenditures.

We further analyzed the impact of COVID-19 on rural people's psychology by income level. We find that income remained the most crucial driver of psychological stress. Mainly, people with an annual earning of <13000 RMB were facing a higher level of stress. However, as income increases, the level of stress reduces, the value ranges between 37-43% of the total, which is followed by the pressure of spending (23-28%), health concern (23-26%), and the least worry about the pandemic (3-10%). These results suggest uniformity of the values of the different types of pressure/worry across the given income levels. It can be inferred that regardless of the income level, everyone is more concerned and worried about the income in crisis times. The results are presented in **Table 2.**

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Table 2. Psychological impact on local communities

Psychological pressure			
Income Pressure	**Spending Pressure**	**Health Pressure**	**Pandemic Pressure**
40.8%	28.6%	23.9%	6.8%

Psychological pressures by socio-economic status				
HH Status	**Income Pressure**	**Spending Pressure**	**Health Pressure**	**COVID-19 Pressure**
High	40%	29%	24%	7%
Low	43%	27%	23%	7%

Psychological impact on different factors by Income Level				
Annual Income Level	**Income Pressure**	**Spending Pressure**	**Health Pressure**	**COVID-19 Pandemic Pressure**
<10000	43%	27%	23%	6%
10001-13000	41%	28%	23%	8%
13001-15000	37%	28%	26%	10%
15001-20000	30%	40%	26%	4%
20001-25000	41%	33%	23%	3%
>25000	37%	33%	26%	5%

3.3. Psychological impact by main sources of income

Figure 1 shows the detail of the psychological impact by the main sources of income of households. The results reveal that the worry of income is given the highest priority, followed by spending, health, and pandemic, with the range of values in percentages given as 36-40%, 28-30%, 24-25%, and 7-10%, respectively. It can be noted that the source of income does not change

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drastically for the stress/worry levels. Moreover, the government transfer payment shows lower income stress/worry at 36% compared to the rest of the sources. It suggests that people receiving government transfer payments are less stressed due to the reliable and continuous income flow.

[Insert Figure 1 here]

Figure 1 Psychological impact by main sources of income

3.4. Psychological impact by main industries

Figure 2 depicts the impact of different types of worry on local households related to main industries. The trends in primary sectors and types of anxiety are similar to previous results. It is clear that income worry is the main issue for all the respondents in every industry (39-42%), and the lowest level of concern was the pandemic itself (5-9%). These results suggest that for most households, the worry about income puts more pressure than other types of concerns. This might be because people assume that if they have enough money, they can probably manage their household expenses, including health and pandemic related expenditures. Most importantly, one of the main reasons for high stress related to income is that rural communities are usually financially fragile, and the COVID-19 pandemic has exacerbated their financial tension; therefore, they are highly concerned about the flow of income and expenditures.

[Insert Figure 2 here]

Figure 2 Psychological impact by main industries

3.5. OLS Regression results

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An OLS regression was undertaken to estimate the impact of psychological and pandemic stress by income level, main income sources, and industry-wise (Table 3). The results reveal a significant negative effect of income level on psychological stress (-0.014, $p < 0.05$). In other words, it can be argued that the higher the level of income, the lower be the stress level. The value of Durbin Watson is 1.925, which is very close to the critical value of 2.0, predicting that the issue of auto-correlation in the model is insignificant.

When examined for the impact of pandemic stress on respondents based on the level of income, the results computed were insignificant (-0.007), which explains that individuals are least worried about the epidemic. There can be several possible explanations of low pandemic stress on local households in rural areas. Chinese people primarily believe and trust in the government's effective anti-epidemic countermeasures taken to contain the disease. For instance, the construction of hospitals in record-breaking time increased the morale of Chinese people and trust in government concerning the fight against the deadly virus. Additionally, the timely decisions taken by the government were also found very effective in controlling the disease.

Further, in terms of main sources of income, the impact of psychological stress on respondents across main sources of income was significantly negative: family farm (-0.055, $p = 0.05$), business (-0.053, $p = 0.05$), local employment (-0.054, $p = 0.01$), migrant workers (-0.051, $p = 0.05$), and government transfer payment (-0.058, $p = 0.05$). However, the effect of pandemic stress by the main sources of income was significantly negative only for local employment (-0.080, $p = 0.05$), migrant workers (-0.067, $p = 0.05$). The results show that regardless of income sources, the respondents' psychological stress is high; in contrast, pandemic stress was higher for persons locally employed or working out of the village. These results are not surprising since the gravity

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of the pandemic is much higher than in past crises. Moreover, due to lockdowns, business closures, and travel restrictions, many people lost their jobs.

The results are presented in Table 3 further show that the impact of psychological and pandemic stress on people involved in the agricultural industry was negatively significant (-0.076, $p = 0.01$; -0.088, $p = 0.01$, respectively). Additionally, in terms of the effects of the supply of agricultural commodities by income level, OLS estimates' output predicts a positive relationship with the level of income at a 1% significance level (0.084, $p = 0.01$). It can be interpreted as the higher the income level, the higher the supply of agricultural products for households. To put it simply, higher income can ensure the continuous supply of products for the local households.

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Table 3 OLS Regression Estimations

Variables	Psychological Stress			Pandemic Stress		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Income	-0.014**	-	-	-0.007	-	-
	(0.007)			(0.012)		
Family farm	-	-0.055**	-		-0.047	-
		(0.024)			(0.042)	
Business	-	-0.053**	-		-0.057	-
		(0.021)			(0.036)	
Local employment	-	-0.054***	-		-0.080**	-
		(0.021)			(0.036)	
Migrant workers	-	-0.051**	-		-0.067*	-
		(0.022)			(0.038)	
Govt. TP	-	-0.058**	-		-0.066	-
		(0.030)			(0.052)	
Industry_Agri	-	-	-0.076***	-	-	-0.088***
			(0.019)			(0.032)
IndOther	-	-	-0.058***	-	-	-0.099***
			(0.019)			(0.033)
(Constant)	-0.541***	0.422***	-0.506***	0.162***	0.009	-0.077***
	(0.014)	(0.029)	(0.015)	(0.023)	(0.051)	(0.025)
Durbin-Watson	1.925	1.885	1.904	1.725	1.707	1.710
F-Statistics	4.123	7.988	11.963	0.312	4.010	7.626
Observations	499	499	499	499	499	499

Note: Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4. Discussion

Due to the unprecedented outbreak of coronavirus disease (COVID-19), various measures were taken to curb the disease, including business closures, travel restrictions, lockdowns, and people are required to maintain social distancing, which resulted in psychological stress related to income, increased expenditure, and health (2-6, 19). Additionally, during the initial outbreak period, many businesses were closed wholly or partially, and the economy was slowed down. The rural economies often strive for financial stability, and in times of highly uncertain and unpredictable situations such as the COVID-19 pandemic, the rural communities are highly

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vulnerable mainly due to loss of income and employment (6, 10, 11). This study sought to examine these issues by taking a sample of 499 rural village representatives in the Sichuan Province of China. To the best of our knowledge, this research is one of the first to provide empirical evidence regarding the early health and socio-economic impact of COVID-19 at the household level in rural communities, which is very important to devise policies to ease the burden of the outbreak and prevent further losses at the local community level.

This study's findings reveal that the lockdowns, travel restrictions, increased expenses, uncertainty, and fear of contracting the infection significantly affected local people psychologically, leading to economic vulnerability. Particularly, the results reveal that people are worried about their income losses regardless of their socio-economic status, level of income, and industry involvement. In line with these findings, the World Bank also pointed out that local households face the challenge of losing income and employment, leading to financial stress (20). We also find that the level of income has a direct negative relationship with stress. The study results show that lower income level poses higher pressure; however, as income increases, the level of stress reduces. Similarly, El-Zoghby, Soltan (9), by investigating the pandemic's impact on mental health and social support among adult Egyptians, also reported that over 55% of respondents were under financial stress. Moreover, in a recent report, the International Labour Organization (ILO) also argued that the pandemic had brought a massive drop in labor income around the world (19).

The findings of the study further indicate that regardless of industry where local communities are involved, the loss of income is their main issue (39-42%, see Figure 2). The possible reasons for high-stress of income are attributed to the loss of income and employment, increased expenditure, and commodity price hikes, among others. Further, the local people that receive

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government transfer payment showed lesser stress due to the reliable and uninterrupted flow of income and various subsidies provided by the government. However, contrary to our hypothesis, the findings show that local communities are less worried about the pandemic stress, which is in contrast to the results of previous studies that reported a highly significant impact of pandemic stress during the severe acute respiratory syndrome outbreak in 2003 (felt horrified) (21-23). Due to the Chinese government's untiring efforts to control the spread of disease and mitigate its adverse effects, the psychological impact of the pandemic was considerably reduced.

4.1 Implications

The measures taken by the Chinese government to fight against the deadly virus have been praised globally because China successfully controlled the spread of the disease. Therefore, this study occupies an important position for policymakers, research scholars, and practitioners. Since our research reveals that people are mostly worried about their income, therefore, policies must be focused on ensuring continuous income to ease the impact of the pandemic. The government should devise policies where sustainable sources of income for households can be secured. Such policies can reduce the level of stress and worry of the rural households in case of similar socio-economic crisis or shock. Since the pandemic is not over and even after controlling the spread of COVID-19 cases in China, still some risk exists for the second wave (24). Therefore, it is necessary to ensure income flow, especially in rural areas.

Moreover, to boost the economy and employment, the Chinese government has already taken various steps, including allowing local peoples to establish small stalls/vending shops. Mainly, it has been reported that 100,000 jobs were created overnight by setting up 36,000 street vending units in Chengdu city alone (25). Therefore, other cities must follow similar strategies to boost

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income and employment. Additionally, psychological support is also vital during such heightened and uncertain situations. Moreover, it is necessary to continue to protect the general population because 'prevention is better than cure'. Additionally, wearing a facemask potentially reduces the chances of disease spread (transmitting and catching).

Furthermore, although the Sichuan province has a high resemblance to other parts of mainland China, the findings of this study may not be generalized across China due to several factors. Primarily, the situation of COVID-19 across China was very diverse, with Hubei (Wuhan) being the epicenter, while in Tibet, only one case was reported. Moreover, according to the epidemic situation, some cities of China were completely under lockdown, while in other parts, people were advised to stay at home, maintain social distancing, and avoid going out unnecessarily to contain the spread of disease. Besides, the size, income, and development levels also vary in different rural villages across China. Additionally, this research mainly focused on rural areas; therefore, findings cannot be extended to urban areas.

5. Conclusion

Due to the recent outbreak of the COVID-19 pandemic, China has experienced a significant impact of the COVID-19 pandemic on the local people's health and economy since the last few months. Moreover, due to lockdowns, restrictions on goods' movement and supply chain disruptions resulted in considerable socio-economic losses. Additionally, the rising price of agricultural input, livestock feed, and other commodities lead to decreased cash in hand and raised concern about income. Overall, the COVID-19 resulted in a psychological and socio-economic impact on local peoples. The findings of this study show that the pandemic adversely affected the health and livelihoods of rural communities in the Sichuan Province of China. The prime concern

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of respondents was the loss of income across industries and socio-economic status. We further find that continuous and higher income levels can significantly reduce stress among local households because people believe that income is essential for sustaining well-being and livelihoods during such heightened and unpredictable situations.

This study has some limitations that provide opportunities for future research. The sample was mainly collected through convenience and snowball sampling techniques, which offers room for future research. Future studies can compare the difference between the psychological and socio-economic impact of the COVID-19 pandemic in rural and urban communities. Further, researchers can explore other factors that are psychologically affecting local communities in other countries with different cultural settings because new COVID-19 cases are still increasing globally.

Data availability statement: Data are available upon reasonable request.

Contributors: All four authors contributed in writing and editing of the draft. MS and IUR performed conceptual analyses and wrote the first draft. LJ and CX also supervised and improved the quality of the article. All authors participated in the revision and final approval of the article.

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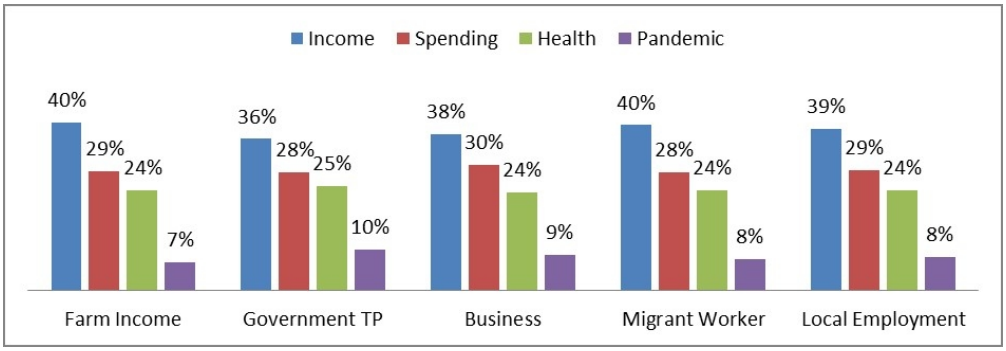

Figure 1

160x54mm (150 x 150 DPI)

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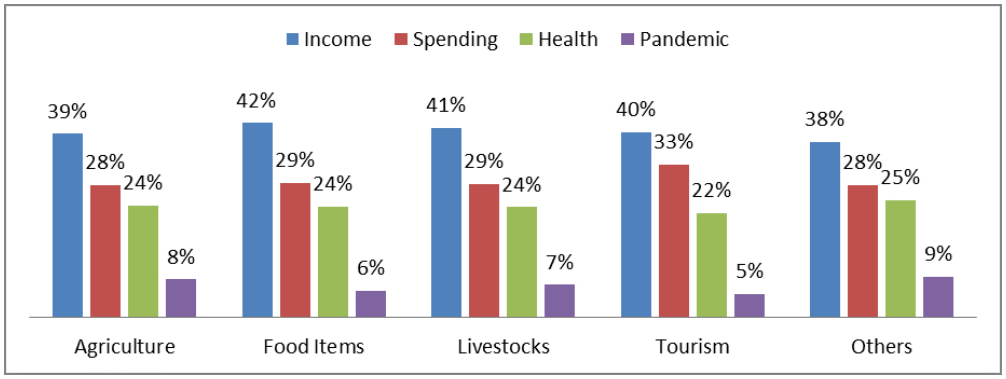

Figure 2

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	8
		(*c*) Explain how missing data were addressed	N/A
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	7
		(*e*) Describe any sensitivity analyses	N/A
Results			

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Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	8
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7
		(b) Indicate number of participants with missing data for each variable of interest	7
Outcome data	15*	Report numbers of outcome events or summary measures	8-14
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-14
		(*b*) Report category boundaries when continuous variables were categorized	8-14
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	8-14
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	8-14
Discussion			
Key results	18	Summarise key results with reference to study objectives	15
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	19
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15-19
Generalisability	21	Discuss the generalisability (external validity) of the study results	15-19
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	19

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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The impact of the COVID-19 pandemic on rural communities: A Cross-sectional Study in the Sichuan Province of China

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Secondary Subject Heading:	Health economics
Keywords:	COVID-19, PUBLIC HEALTH, Public health < INFECTIOUS DISEASES

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The impact of the COVID-19 pandemic on rural communities: A Cross-sectional Study in the Sichuan Province of China

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Keywords: COVID-19; pandemic; psychological effects; socio-economic issues; rural communities.

Word count: 7322

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Abstract

Objective: Recently, China has experienced a considerable influence of the COVID-19 pandemic on the local people's health and economy. Hence, the current research aims to investigate the psychological and socio-economic impact of COVID-19 on rural communities in the Sichuan Province of China.

Methods: A total of 499 participants (village representatives of Sichuan Province) were approached to partake in a cross-sectional online survey and share their experience regarding the ongoing pandemic. The descriptive statistics and OLS regression were used to analyze the data.

Results: Our analysis revealed that the pandemic has significantly affected local people psychologically, leading to socio-economic vulnerability. Notably, we find that local households are worried about their income losses regardless of their socio-economic status (40%-43%), level of income (37%-43%), and industry involvement (38%-43%). However, as income increases, the level of stress decreases. The results further show that government transfer payment is a significant factor in reducing stress due to its reliable and uninterrupted income flow. Contrary to our proposition, the pandemic stress was less observed, which might be because of people's trust in government and effective anti-epidemic countermeasures to contain the disease.

Conclusion: This study finds that COVID-19 has a significant impact on local people's health, psychology, and income. This study is one of the first to provide empirical evidence regarding the early health and socio-economic effects of COVID-19 at the household level in rural communities, which are very important to devise policies to ease the outbreak and prevent further losses at the local community level.

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Strengths and limitations of this study

- This study provides empirical evidence related to the psychological and socio-economic impact of COVID-19 on rural communities.
- Data were collected from rural village representatives because they are considered potential key respondents, reliable, and primary data sources.
- The sampling technique (snowball) employed in this study reduces the population's representativeness and generalizability of study findings.
- This study did not differentiate between the psychological and socio-economic impact of the COVID-19 pandemic in rural and urban communities.

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1. Introduction

The impact of the recent outbreak of coronavirus disease 2019 (COVID-19) on health, society, and the economy is far-reaching, significant, and devastating (1). Globally, the disease's impact on local people and businesses is still increasing day by day and is far beyond expectation due to high uncertainty. In comparison to other natural disasters, various scholars argue that COVID-19 is unique in terms of its predictability and effects on society; moreover, poor households, especially in rural areas, have been adversely affected to a greater extent (2-6). Additionally, due to unprecedented measures taken to contain the spread of disease, including isolating people and lockdowns, local communities suffered a high level of tensions related to wage and employment losses, increased expenses, and business survival, among others (7-9). Due to the rapid increase in the number of new cases, the COVID-19 created panic, anxiety, income, and expenditure pressures leading to psychological and socio-economic imbalance (4). Besides, isolation, uncertainty, and fear of contracting the infection also exacerbated the situation, as most people were worried about being infected (9).

Further, rural economies are usually based on self-employment (mostly home-based), small or micro-businesses, which means they are highly vulnerable due to less cash in hand and low resilience (5). Similarly, Phillipson, Gorton (6) argue that rural communities are usually less prepared to weather the storm during highly uncertain situations like COVID-19. The literature also indicates that past crises such as Foot and Mouth Disease outbreak in the U.K. significantly affected rural economies (10, 11).

We only targeted rural areas for various reasons: First, rural communities usually face financial constraints, and the ongoing pandemic has exacerbated the financial stress in rural economies around the globe. Further, in rural areas, usually, healthcare infrastructure is also relatively low,

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including limited diagnostic facilities, healthcare staff, isolation rooms, and personal protective equipment (12, 13), which may have adversely affected rural communities.

Since COVID-19 is a very different and unprecedented disease, its adverse effects on local communities in China were much higher during its initial spread period. Moreover, given the devastation in China and other parts of the world caused by the pandemic, it is necessary to explore its psychological, social, and economic effects on local households. Therefore, we are particularly interested in investigating the health and socio-economic impact of COVID-19 on local communities in rural areas of the Sichuan Province of China. We hypothesize that the COVID-19 pandemic psychologically and socio-economically affected local people considerably regardless of their socio-economic status, income level, and industry involvement.

This study is theoretically and practically important because we attempt to help maintain the sustainable well-being and livelihood of local communities. Most previous studies are focused on health, medical research, and healthcare workers because they are more exposed to the disease (14, 15). However, less attention has been paid to local communities in rural areas. To the best of our knowledge, this study is one of the first to provide empirical evidence regarding the early health and socio-economic impact of COVID-19 at the household level in rural communities in Sichuan, which is very important to devise policies to ease the burden of the outbreak and prevent further losses at the local community level. Additionally, it is also essential to retain everyday socio-economic life for sustainable development for all people in a similar situation worldwide.

The remaining part of the paper is as follows. Section 2 presents the theoretical review and develops hypotheses. Section 3 briefly discusses the research methodology adopted in this study, including study design, setting, data collection, and analysis. Section 4 explains the results,

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followed by a discussion and implications for theory and practice in section 5. Lastly, section 6 outlines the study conclusion.

2. Theoretical Review and Hypotheses Development

2.1 Psychological and socio-economic impact on local people during COVID-19

The outbreak of coronavirus disease (COVID-19) has caused significant damage to health, businesses, and societies globally. Since the outbreak of the COVID-19 pandemic, the local residents worldwide have faced various psychological and socio-economic problems. For example, lockdowns have disrupted social mobility with restricted access to basic human needs like food and other resources, affecting local people's livelihood opportunities, especially in rural areas, globally. In addition, given the supply chain disruption, the cost of living has been high. Since individuals are required to maintain social distancing and stay indoors, people are left lonely, away from their friends and families, thereby increasing anxiety, depression, and other psychological disorders. The World Health Organization (WHO), according to their survey of 130 countries (16), also reported that COVID-19 is undermining mental health programs in 93% of countries globally.

Since the outbreak of COVID-19, many businesses, including self-employed (micro business), went bankrupt or faced liquidity issues due to social distancing measures and lockdowns (2), resulting in psychological stress. The WHO has voiced its worry about the mental well-being and psychosocial effects of the pandemic, claiming that the isolation policies would lead to uncertainty, fear, distress, and sleeping disorders (17). The COVID-19 pandemic has significantly increased the degree of panic, worry, anxiety, and concern in the rural population (17).

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In the case of China, Government took unprecedented measures to curb the spread of COVID-19 and minimize its adverse effects on local people, businesses, and the economy. Due to measures taken to isolate people and lockdowns, the individuals became vulnerable to alienation, anxiety, and depression triggered by social distancing and concern of contracting the disease (18-20). A study conducted by Wang, Pan (20) reported that most people were afraid of being infected (75.2%), and 53.8% of participants expressed moderate or severe psychological effect, including signs of depression (16.5%), anxiety (28.8%) and higher stress level (8.1%). Similarly, during the outbreak of similar contagious diseases, people were also worried about being infected (21).

Further, due to the exponential increase in COVID-19 cases, the demand for PPE (personal protective equipment) and medical equipment increased unprecedently. Consequently, the shortage of PPE, including facemasks and sanitizers, resulted in panic buying, fear, and psychological stress among the general public (13, 18). The COVID-19 has spread rapidly across various regions and continents, and the uncertain future of this pandemic has been compounded by Internet rumors and disinformation, triggering fear, distress, and desperation among local people. Previous studies related to relevant health emergency crises, such as Severe Acquired Respiratory Syndrome (22) in 2003 and Ebola virus disease outbreaks, also reported psychological and socio-economic effects on local people (23-25). To sum up, COVID-19 has disrupted the normal daily life of local people globally (26).

2.2 Impact of COVID-19 pandemic on rural economies

The effects of COVID-19 are not beyond agricultural crops, livestock, and fisheries. The disease preventive measures significantly disrupted food supply chains worldwide, resulting in a

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temporary shortage of food supply and a rise in costs. On the one hand, the social distancing measures helped control the spread of disease; on the other hand, it disturbed normal life and increased psychological and socio-economic pressure among local peoples. The lockdowns and closure of many business activities reduced income sources and increased income insecurity and expenditure.

Notably, in the case of rural communities, most people are involved in small business activities such as the production of crafts, small vending shops, small restaurants, and tourism, etc. Ali, Ahmed (5) argue that since most businesses in rural economies are either self-employed or operate at the small, often micro level, they are considered extremely vulnerable due to lower cash and poor resilience. Similarly, it has been argued that during increasingly unpredictable circumstances such as COVID-19, rural populations are typically less able to survive the storm (6). The literature also reveals that previous relevant health outbreaks such as the Foot and Mouth Disease have had a huge effect on rural economies (10, 11). Due to disease controlling measures, their business activities were affected significantly worldwide. The travel restrictions, especially public places such as tourism destinations, massively affected the hotel and tourism sectors, and many workers lost their jobs. Considering the income insecurity and increased expenses, the Chinese government took unprecedented measures to reduce anxiety, income and expenditure pressures, such as government transfer payment[1].

[1] It is a kind of subsidies and financial support provided by the Chinese government to rural communities. These subsidies are mainly used for the natural environment and ecological restoration such as water conservation construction, forest construction, wind prevention, conversion of farmland to forests and grasslands, rural basic education, primary medical care, basic pension insurance, agricultural production subsidies, and other farmer welfare system expenditures. It also includes the provision of high-quality seeds, high-efficiency pesticides, fertilizers, and other agricultural technology research, development, and promotion, as well as loan subsidies and interest discounts for farmers to build small agricultural products processing factories.

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The purpose of the current research is to examine the psychological and socio-economic impact of COVID-19 on rural communities in the Sichuan Province of China. This study will contribute to useful preventive methods and guidelines for reducing the rural population's psychological and socio-economic problems. Based on the above discussion, we hypothesize that COVID-19 has resulted in a psychological and socio-economic impact on local peoples regardless of their socio-economic status, income level, and industry involvement. In other words, the outbreak of pandemic has significant adverse effects on rural people irrespective of their earning level, business sector involvement, social and economic position. We further predicted that government transfer payment could significantly reduce the psychological and socio-economic effects of COVID-19.

3. Materials and Methods

3.1. Research context, sample, and data collection

The data was collected during March-April 2020 from Sichuan province because it is one of the largest provinces with nearly 85% resemblance to mainland China regarding the pandemic situation, lockdown policy, developmental level, population density, and urban-rural pattern. The province includes least, middle, and highly developed regions similar to mainland China. Due to the Chinese government's measures to contain the spread of the virus, including social-distancing and travel restrictions, the data was collected through administering an online questionnaire, which is also consistent with previous studies (2, 4, 27). The questionnaire comprised several questions regarding the effect of COVID-19 on the health and livelihoods of rural communities. Notably, we asked the respondents to share their household experience in the context of COVID-19, including psychological impact, wage and income losses, and shortage of agricultural input supplies. The

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psychological impact was measured in terms of income concern, spending concern, health concern, and pandemic concern. The questionnaire was initially developed in Chinese and subsequently back-translated into English by two bilingual expert researchers. In following the guidelines of Huber and Power (28), the potential key respondents (i.e., village representatives) were approached to participate in the study because they are considered reliable and primary data sources.

The data was collected through the convenience and snowball sampling technique due to its time and resources saving advantages, as argued by various researchers (2, 5, 29). Nowadays, WeChat (a very famous social media APP) is considered a necessity in China due to its abundant advantages. Therefore, considering its extensive use, the online questionnaire was administered through WeChat to encourage a large number of rural households (village representatives) to participate in the survey. Additionally, Bo Liu, McCarthy (27) argue that Chinese researchers commonly use snowball sampling to reduce search costs and find hidden populations. Due to financial resources constraints and to avoid any possible bias into study findings, no incentives were offered to participants, as suggested in previous studies (2, 27). Efforts were made to ensure a representative sample by targeting local households (village representatives) at every village in rural areas across Sichuan province. A total of 499 complete and useable responses were received.

3.2. Patient and Public Involvement

Since the study focuses on examining the effect of the COVID-19 pandemic on rural communities, no patient was involved in setting the research question or the outcome measures. However, local community members were involved in the design and conduct of this research.

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3.3. Participants

Participants were all residents of different rural villages across the Sichuan Province of China. This cross-sectional study's criteria included a minimum of 18 years of age, a resident of Sichuan province, and, most notably, a village representative. The data was collected during mid of April for two weeks; at that time COVID-19 pandemic had already affected a large number of local people in terms of socio-economic and health effects. Total 499 participants took part in the study and completed the prescribed survey questionnaire. Before administering the questionnaire, the permission of the community leader of each village was sought. In addition, we also sought the consent of every rural village representative before taking part in the study. Every participant was permitted not to answer any question accordingly. The Ethics Committee of Leshan Normal University has approved this study. Informed consent from each participant was received prior to taking part in the online questionnaire. Before taking part in the survey, the objective and aim of the research were first presented to the potential participants. The participants were asked to fill the questionnaire only after assuring them of absolute anonymity, confidentiality, and other ethical considerations. Although no electronic record of the consent of the participant was given, all respondents agreed on the purpose of the study and willingly participated in the online survey.

3.4. Survey Scale and Measurement Instruments

In this research, we have used closed-ended questions (dichotomous scales) having two choices (Yes or No) for the measurement of the variables (30). Self-reports of subjective stress relative to a particular stressor or one's living conditions are one of the best ways to assess stress responses (31). To determine and measure the presence or absence of psychological stress and pandemic stress, we divided the dichotomous responses based on different income levels, sources of income,

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and industries. We took into account the presence or absence of pressure or stress based on the perception of the respondents about their condition under COVID-19. The respondents were asked if they were stressed due to COVID 19 (yes or no). The perceived stress by the respondent gave us the opportunity to further classify the pressure or stress on respondents by asking the follow-up questions divided on the basis of income levels, sources of income, and industries to which the respondents were related.

3.5 Reliability Tests

3.5.1 Cronbach's Alpha

For the reliability or consistency of data, the value of cronbach's alpha is measured. The threshold value of Cronbach's alpha should be above 0.7 in order for the data to be reliable. In our case, the value is **0.712** for the questionnaire, which is above the threshold value and thus is acceptable. The value suggests that the factors used are internally consistent and reliable.

3.5.2 Convergent Validity and Correlation Matrix

Convergent validity checks if the items or factors converge to measure a specific construct. In our case, we test the convergence reliability of different income sources and industries. We check if these two constructs are different from one another. For estimating the convergence reliability, we use a correlation matrix approach (32). The outcomes of the test are presented as follows (Table 1):

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Table 1 Correlation Matrix

Variables	Family Farm	Business	Local Employment	Migrant Workers	Govt. TP	Industry_Agri	Industry_Other
Family Farm	1						
Business	0.673***	1					
Local Employment	0.691***	0.690***	1				
Migrant Workers	0.670***	0.671***	0.676***	1			
Govt. TP	0.611***	0.615***	0.605***	0.613***	1		
Industry_Agri	0.173***	0.175***	0.164***	0.226***	0.191***	1	
Industry_Other	0.186***	0.131***	0.151***	0.186***	0.163***	0.614***	1

Table 1 clearly shows the correlation between the variables and clearly presents the distinction between the factors. The variables of Income sources are highly correlated with one another (Minimum correlation of 0.611 for Govt. TP) compared to the factors representing households related to different industries. Similarly, the correlation between the industrial variables is high (0.614) in comparison to the maximum correlation value of 0.191 with sources of income. The values of correlations are above 0.5 and significant for the group, suggesting that the convergent validity between the two constructs is valid and reliable.

For further testing of convergent validity, we use Factor Analysis in order to check if the factors load distinctly or not. Table 2 shows the loading of the main components:

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Table 2: Rotated Component Matrix

Variables	Component	
	1	2
Family Farm	0.846	0.092
Business	0.863	0.078
Local Employment	0.875	0.009
Migrant Workers	0.853	0.141
Govt. TP	0.791	0.086
Industry_Agri	0.119	0.846
Industry_Other	0.093	0.831

Table 2 clearly depicts that the factors load distinctly for the two groups; thus, it confirms the convergent validity among the main factors in each of the two groups. The average factor loading for both groups is also estimated to be higher than the 0.7 threshold levels, suggesting convergent validity.

3.5.3 Data Cleaning

A total of 555 questionnaires were filled by the respondents. The questionnaires were checked and sorted for incomplete data or area relevance. A total of 31 questionnaires were found to be incomplete, while 25 questionnaires were filled by respondents belonging to areas other than Sichuan Province. As our research focuses on Sichuan province, therefore, 25 questionnaires filled by respondents of different provinces were left out. Additionally, the data was also screened out

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for outliers. After sorting and excluding fifty-six (56) incomplete and out of the province questionnaires, a total of 499 questionnaires remained for the analysis and estimation purpose.

3.6. Data analysis

The current research used descriptive statistics and Ordinary Least Squares (OLS) regression to analyze the data. The descriptive statistical analyses of all demographic and other variables of interest were performed through Statistical Package for Social Science (SPSS), and Microsoft Excel was used to produce graphs and charts. The descriptive statistics were employed to explain the sample features, psychological and socio-economic impact on local households by the level of income, socio-economic status, and main sources of income. The OLS regression was performed to determine the impacts of psychological and pandemic stress by income level, main income sources, and industry-wise. Furthermore, we also assessed the reliability of the data using Cronbach's Alpha. The value of Cronbach's Alpha was 70.7, which shows sufficient reliability of our data.

4. Results

4.1. Sample description

Most participants' annual income was less than 13000 RMB, while only 3.61% of respondents earn more than 25000 RMB per year. Additionally, in our sample, 72.34% of participants belong to high socio-economic status, while 27.66% belong to low socio-economic status. Furthermore, in terms of primary sources of income, most of the respondents reported that they are mainly engaged in farming (29.80%), followed by employment outside of the county (28.64%), while 21.83% are locally employed, and 15.25% do business. However, only 4.49% of survey

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participants reported that they receive government transfer payment. The detail of the sample is presented in **Table 3**.

Table 3. Sample description

Yearly Income Level (RMB)	Percentage	Industry*	Percentage
<10000	29.46%	Agriculture	20.80%
10001-13000	33.27%	Food	32.54%
13001-15000	17.43%	Livestock	24.33%
15001-20000	10.22%	Tourism	4.58%
20001-25000	6.01%	Others	17.75%
>25000	3.61%		
Main sources of income	**Percentage**	**Socio-economic status**	**Percentage**
Family farming	29.80%	High	72.34%
Business	15.25%	Low	27.66%
Local employment (salaried/wages)	21.83%		
Employment outside of the village	28.64%		
Government Transfer Payment	4.49%		

Note: Main industries where villagers (participants) are involved.

4.2. Psychological impact of COVID-19

The results reveal that the most significant psychological pressure on the local community is related to income (40.8%), followed by an increase in spending (28.6%), health concern (23.9%), and finally, COVID-19 pandemic concern (6.8%). Similarly, when we analyzed the data in terms of socio-economic status, the results indicate that most participants are concerned about income regardless of their socio-economic status. Notably, people with low socio-economic status were mostly worried about their income (43%), followed by increased expenses (27%), health (23%), and pandemic (7%). The situation of people with high socio-economic status also remains

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relatively similar **(see Table 4).** It infers that local people are anxious about their income because some industries were partially operating due to the COVID-19 pandemic, while others were closed entirely. Moreover, many products' demand tremendously decreased, leading to economic and employment loss globally (33). Additionally, due to business closures and supply chain disruptions, the price of many commodities increased, which resulted in psychological stress among local people about meeting the increased expenditures.

We further analyzed the impact of COVID-19 on rural people's psychology by income level. We find that income remained the most crucial driver of psychological stress. Mainly, people with an annual earning of <13000 RMB were facing a higher level of stress. However, as income increases, the level of stress reduces, the value ranges between 37-43% of the total, which is followed by the pressure of spending (23-28%), health concern (23-26%), and the least worry about the pandemic (3-10%). These results suggest uniformity of the values of the different types of pressure/worry across the given income levels. It can be inferred that regardless of the income level, everyone is more concerned and worried about the income in crisis times. The results are presented in **Table 4.**

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Table 4. Psychological impact on local communities

Psychological pressure			
Income Pressure	**Spending Pressure**	**Health Pressure**	**Pandemic Pressure**
40.8%	28.6%	23.9%	6.8%

Psychological pressures by socio-economic status				
HH Status	**Income Pressure**	**Spending Pressure**	**Health Pressure**	**COVID-19 Pressure**
High	40%	29%	24%	7%
Low	43%	27%	23%	7%

Psychological impact on different factors by Income Level				
Annual Income Level	**Income Pressure**	**Spending Pressure**	**Health Pressure**	**COVID-19 Pandemic Pressure**
<10000	43%	27%	23%	6%
10001-13000	41%	28%	23%	8%
13001-15000	37%	28%	26%	10%
15001-20000	30%	40%	26%	4%
20001-25000	41%	33%	23%	3%
>25000	37%	33%	26%	5%

4.3. Psychological impact by main sources of income

Figure 1 shows the detail of the psychological impact by the main sources of income of households. The results reveal that the worry of income is given the highest priority, followed by spending, health, and pandemic, with the range of values in percentages given as 36-40%, 28-30%, 24-25%, and 7-10%, respectively. It can be noted that the source of income does not change

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drastically for the stress/worry levels. Moreover, the government transfer payment shows lower income stress/worry at 36% compared to the rest of the sources. It suggests that people receiving government transfer payments are less stressed due to the reliable and continuous income flow.

[Insert Figure 1 here]

Figure 1 Psychological impact by main sources of income

4.4. Psychological impact by main industries

Figure 2 depicts the impact of different types of worry on local households related to main industries. The trends in primary sectors and types of anxiety are similar to previous results. It is clear that income worry is the main issue for all the respondents in every industry (39-42%), and the lowest level of concern was the pandemic itself (5-9%). These results suggest that for most households, the worry about income puts more pressure than other types of concerns. This might be because people assume that if they have enough money, they can probably manage their household expenses, including health and pandemic related expenditures. Most importantly, one of the main reasons for high stress related to income is that rural communities are usually financially fragile, and the COVID-19 pandemic has exacerbated their financial tension; therefore, they are highly concerned about the flow of income and expenditures.

[Insert Figure 2 here]

Figure 2 Psychological impact by main industries

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4.5. OLS Regression results

An OLS regression was undertaken to estimate the impact of psychological and pandemic stress by income level, main income sources, and industry-wise (Table 5). The results reveal a significant negative effect of income level on psychological stress (-0.014, $p < 0.05$). In other words, it can be argued that the higher the level of income, the lower be the stress level. The value of Durbin Watson is 1.925, which is very close to the critical value of 2.0, predicting that the issue of auto-correlation in the model is insignificant.

When examined for the impact of pandemic stress on respondents based on the level of income, the results computed were insignificant (-0.007), which explains that individuals are least worried about the epidemic. There can be several possible explanations of low pandemic stress on local households in rural areas. Chinese people primarily believe and trust in the government's effective anti-epidemic countermeasures taken to contain the disease. For instance, the construction of hospitals in record-breaking time increased the morale of Chinese people and trust in the government concerning the fight against the deadly virus. Additionally, the timely decisions taken by the government were also found very effective in controlling the disease.

Further, in terms of main sources of income, the impact of psychological stress on respondents across main sources of income was significantly negative: family farm (-0.055, $p = 0.05$), business (-0.053, $p = 0.05$), local employment (-0.054, $p = 0.01$), migrant workers (-0.051, $p = 0.05$), and government transfer payment (-0.058, $p = 0.05$). However, the effect of pandemic stress by the main sources of income was significantly negative only for local employment (-0.080, $p = 0.05$), migrant workers (-0.067, $p = 0.05$). The results show that regardless of income sources, the respondents' psychological stress is high; in contrast, pandemic stress was higher for persons locally employed or working out of the village. These results are not surprising since the gravity

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of the pandemic is much higher than in past crises. Moreover, due to lockdowns, business closures, and travel restrictions, many people lost their jobs.

The results are presented in Table 5 further show that the impact of psychological and pandemic stress on people involved in the agricultural industry was negatively significant (-0.076, p = 0.01; -0.088, p = 0.01, respectively). Additionally, in terms of the effects of the supply of agricultural commodities by income level, OLS estimates' output predicts a positive relationship with the level of income at a 1% significance level (0.084, p = 0.01). It can be interpreted as the higher the income level, the higher the supply of agricultural products for households. To put it simply, higher income can ensure the continuous supply of products for the local households.

Table 5 OLS Regression Estimations

Variables	Psychological Stress			Pandemic Stress		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Income	-0.014** (0.007)	-	-	-0.007 (0.012)	-	-
Family farm	-	-0.055** (0.024)	-		-0.047 (0.042)	-
Business	-	-0.053** (0.021)	-		-0.057 (0.036)	-
Local employment	-	-0.054*** (0.021)	-		-0.080** (0.036)	-
Migrant workers	-	-0.051** (0.022)	-		-0.067* (0.038)	-
Govt. TP	-	-0.058** (0.030)	-		-0.066 (0.052)	-
Industry_Agri	-	-	-0.076*** (0.019)	-	-	-0.088*** (0.032)
IndOther	-	-	-0.058*** (0.019)	-	-	-0.099*** (0.033)
(Constant)	-0.541*** (0.014)	0.422*** (0.029)	-0.506*** (0.015)	0.162*** (0.023)	0.009 (0.051)	-0.077*** (0.025)
Durbin-Watson	1.925	1.885	1.904	1.725	1.707	1.710
F-Statistics	4.123	7.988	11.963	0.312	4.010	7.626
Observations	499	499	499	499	499	499

Note: Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

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5. Discussion

Due to the unprecedented outbreak of coronavirus disease (COVID-19), various measures were taken to curb the disease, including business closures, travel restrictions, lockdowns, and people are required to maintain social distancing, which resulted in psychological stress related to income, increased expenditure, and health (2-6, 33). Additionally, during the initial outbreak period, many businesses were closed wholly or partially, and the economy was slowed down. The rural economies often strive for financial stability, and in times of highly uncertain and unpredictable situations such as the COVID-19 pandemic, the rural communities are highly vulnerable, mainly due to loss of income and employment (6, 10, 11). This study sought to examine these issues by taking a sample of 499 rural village representatives in the Sichuan Province of China. To the best of our knowledge, this research is one of the first to provide empirical evidence regarding the early health and socio-economic impact of COVID-19 at the household level in rural communities, which is very important to devise policies to ease the burden of the outbreak and prevent further losses at the local community level.

This study's findings reveal that the lockdowns, travel restrictions, increased expenses, uncertainty, and fear of contracting the infection significantly affected local people psychologically, leading to economic vulnerability. Particularly, the results reveal that people are worried about their income losses regardless of their socio-economic status, level of income, and industry involvement. In line with these findings, the World Bank also pointed out that local households face the challenge of losing income and employment, leading to financial stress (34). We also find that the level of income has a direct negative relationship with stress. The study results show that lower-income level poses higher pressure; however, as income increases, the level of stress reduces. Similarly, El-Zoghby, Soltan (9), by investigating the pandemic's impact

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on mental health and social support among adult Egyptians, also reported that over 55% of respondents were under financial stress. Moreover, in a recent report, the International Labour Organization (ILO) also argued that the pandemic had brought a massive drop in labor income around the world (33).

The findings of the study further indicate that regardless of industry where local communities are involved, the loss of income is their main issue (39-42%, see Figure 2). The possible reasons for high-stress of income are attributed to the loss of income and employment, increased expenditure, and commodity price hikes, among others. Further, the local people that receive government transfer payment showed lesser stress due to the reliable and uninterrupted flow of income and various subsidies provided by the government. However, contrary to our hypothesis, the findings show that local communities are less worried about pandemic stress, which is in contrast to the results of previous studies that reported a highly significant impact of pandemic stress during the severe acute respiratory syndrome outbreak in 2003 (felt horrified) (23, 25, 35). Due to the Chinese government's untiring efforts to control the spread of disease and mitigate its adverse effects, the psychological impact of the pandemic was considerably reduced.

5.1 Theoretical Implications

This study presents an impact mechanism of a particular public crisis (COVID-19) on local people's mentality, with which economic and industrial indicators and social status function over local people and family psychologically; thus, governmental policies find their theoretic ground from a psychological perspective. The measures taken by the Chinese government to fight against the deadly virus have been praised globally because China successfully controlled the spread of the disease. Therefore, this study occupies an important position for policymakers, research

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scholars, and practitioners. Since our research reveals that people are mostly worried about their income, therefore, policies must be focused on ensuring continuous income to ease the impact of the pandemic. The government should devise policies where sustainable sources of income for households can be secured. Such policies can reduce the level of stress and worry of the rural households in case of a similar socio-economic crisis or shock. Since the pandemic is not over and even after controlling the spread of COVID-19 cases in China, still some risk exists for the second wave (36). Therefore, it is necessary to ensure income flow, especially in rural areas.

Moreover, to boost the economy and employment, the Chinese government has already taken various steps, including allowing local peoples to establish small stalls/vending shops. Mainly, it has been reported that 100,000 jobs were created overnight by setting up 36,000 street vending units in Chengdu city alone (37). Therefore, other cities must follow similar strategies to boost income and employment. Additionally, psychological support is also vital during such heightened and uncertain situations.

5.2 Practical Implications

Since the outbreak of the COVID-19 pandemic, a huge number of people around the world have been affected greatly, and the number of confirmed COVID-19 cases has been rising day-by-day, with serious implications for the lives of humans on earth. Hence, there is a need to consider the adverse effects of COVID-19 on rural people seriously. Tourism and agriculture are the primary sources of livelihood for the rural people in Sichuan. However, the tourism industry was badly affected by the spread of the COVID-19 cases, and several individuals have already lost their jobs. There is a need to provide more job opportunities and secure income sources for the revitalization of the sector. Moreover, it is necessary to educate people about managing stress to

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reduce the psychological impact on rural peoples and protect the general population because "prevention is better than cure." Additionally, wearing a facemask potentially reduces the chances of disease spread (transmitting and catching).

5.3 Limitations and avenues for future research

This research has some limitations which provide room for further research. First, the current research was cross-sectional in nature; it is thus not feasible to draw causal inferences. Longitudinal studies are needed to make causal inferences. Second, the sample was mainly collected through convenience and snowball sampling techniques, which offers room for future research. Future studies can compare the difference between the psychological and socio-economic impact of the COVID-19 pandemic in rural and urban communities. Additionally, this study did not differentiate between the psychological and socio-economic impact of the COVID-19 pandemic in rural and urban communities. Further, researchers can explore other factors that are psychologically affecting local communities in other countries with different cultural settings because new COVID-19 cases are still increasing globally.

Furthermore, although the Sichuan province has a high resemblance to other parts of mainland China, the findings of this study may not be generalized across China due to several factors. Primarily, the situation of COVID-19 across China was very diverse, with Hubei (Wuhan) being the epicenter, while in Tibet, only one case was reported. Moreover, according to the epidemic situation, some cities of China were completely under lockdown, while in other parts, people were urged to remain at home, maintain social distancing, and avoid going out unnecessarily to contain the spread of disease. Besides, the size, income, and development levels also vary in different rural

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villages across China. Additionally, this research mainly focused on rural areas; therefore, findings cannot be extended to urban areas.

6. Conclusion

Due to the outbreak of the COVID-19 pandemic, China has recently experienced a significant impact of the COVID-19 pandemic on the local people's health and economy. Moreover, due to lockdowns, restrictions on goods' movement, and supply chain disruptions resulted in considerable socio-economic losses. Additionally, the rising price of agricultural input, livestock feed, and other commodities lead to decreased cash in hand and raised concern about income. Overall, the COVID-19 resulted in a psychological and socio-economic impact on local peoples. The findings of this study show that the pandemic adversely affected the health and livelihoods of rural communities in the Sichuan Province of China. The prime concern of respondents was the loss of income across industries and socio-economic status. We further find that continuous and higher income levels can significantly reduce stress among local households because people believe that income is essential for sustaining well-being and livelihoods during such heightened and unpredictable situations.

Data availability statement: Data are available upon reasonable request.

Contributors: All five authors contributed to the writing and editing of the draft. MS and IUR performed conceptual analyses and wrote the first draft. DJ, LJ, and CX also supervised and improved the quality of the article. All authors participated in the revision and final approval of the article.

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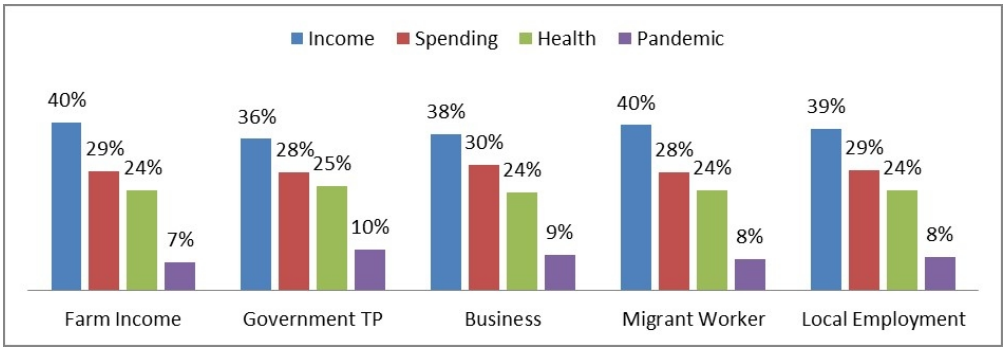

Figure 1

160x54mm (150 x 150 DPI)

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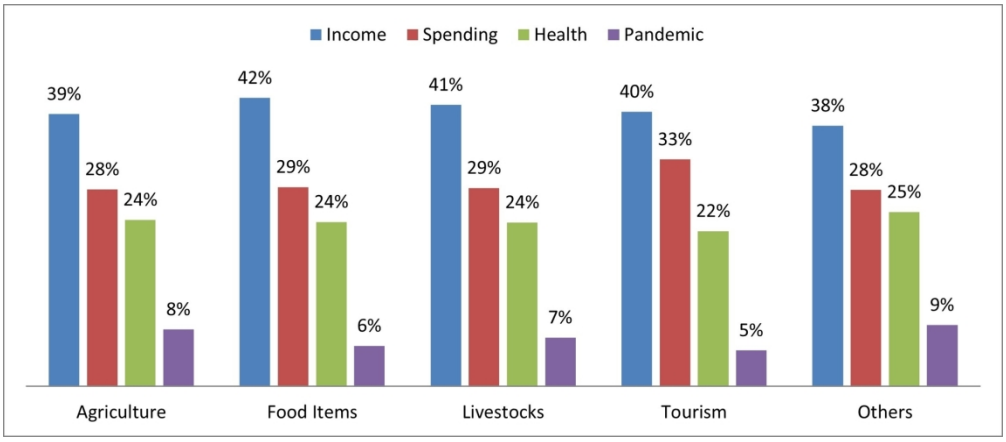

Figure 2

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	8
		(*c*) Explain how missing data were addressed	N/A
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	7
		(*e*) Describe any sensitivity analyses	N/A
Results			

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Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	8
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7
		(b) Indicate number of participants with missing data for each variable of interest	7
Outcome data	15*	Report numbers of outcome events or summary measures	8-14
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-14
		(*b*) Report category boundaries when continuous variables were categorized	8-14
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	8-14
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	8-14
Discussion			
Key results	18	Summarise key results with reference to study objectives	15
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	19
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15-19
Generalisability	21	Discuss the generalisability (external validity) of the study results	15-19
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	19

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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The impact of the COVID-19 pandemic on rural communities: A Cross-sectional Study in the Sichuan Province of China

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Keywords: COVID-19; pandemic; psychological effects; socio-economic issues; rural communities.

Word count: 8197

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Abstract

Objective: Recently, China has experienced a considerable influence of the COVID-19 pandemic on the local people's health and economy. Hence, the current research aims to investigate the psychological and socio-economic impact of COVID-19 on rural communities in the Sichuan Province of China.

Methods: A total of 499 participants (village representatives of Sichuan Province) were approached to partake in a cross-sectional online survey and share their experience regarding the ongoing pandemic. The descriptive statistics and OLS regression were used to analyze the data.

Results: Our analysis revealed that the pandemic has significantly affected local people psychologically, leading to socio-economic vulnerability. Notably, we find that local households are worried about their income losses regardless of their socio-economic status (40%-43%), level of income (37%-43%), and industry involvement (38%-43%). However, as income increases, the level of stress decreases. The results further show that government transfer payment is a significant factor in reducing stress due to its reliable and uninterrupted income flow. Contrary to our proposition, the pandemic stress was less observed, which might be because of people's trust in government and effective anti-epidemic countermeasures to contain the disease.

Conclusion: This study finds that COVID-19 has a significant impact on local people's health, psychology, and income. This study is one of the first to provide empirical evidence regarding the early health and socio-economic effects of COVID-19 at the household level in rural communities, which are very important to devise policies to ease the outbreak and prevent further losses at the local community level.

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Strengths and limitations of this study

- This study provides empirical evidence related to the psychological and socio-economic impact of COVID-19 on rural communities.
- Data were collected from rural village representatives because they are considered potential key respondents, reliable, and primary data sources.
- The sampling technique (snowball) employed in this study reduces the population's representativeness and generalizability of study findings.
- This study did not differentiate between the psychological and socio-economic impact of the COVID-19 pandemic in rural and urban communities.

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1. Introduction

The impact of the recent outbreak of coronavirus disease 2019 (COVID-19) on health, society, and the economy is far-reaching, significant, and devastating (1). Globally, the disease's impact on local people and businesses is still increasing day by day and is far beyond expectation due to high uncertainty. In comparison to other natural disasters, various scholars argue that COVID-19 is unique in terms of its predictability and effects on society; moreover, poor households, especially in rural areas, have been adversely affected to a greater extent (2-6). Additionally, due to unprecedented measures taken to contain the spread of disease, including isolating people and lockdowns, local communities suffered a high level of tensions related to wage and employment losses, increased expenses, and business survival, among others (7-9). Due to the rapid increase in the number of new cases, the COVID-19 created panic, anxiety, income, and expenditure pressures leading to psychological and socio-economic imbalance (4). Besides, isolation, uncertainty, and fear of contracting the infection also exacerbated the situation, as most people were worried about being infected (9).

Further, rural economies are usually based on self-employment (mostly home-based), small or micro-businesses, which means they are highly vulnerable due to less cash in hand and low resilience (5). Similarly, Phillipson, Gorton (6) argue that rural communities are usually less prepared to weather the storm during highly uncertain situations like COVID-19. The literature also indicates that past crises such as Foot and Mouth Disease outbreak in the U.K. significantly affected rural economies (10, 11).

We only targeted rural areas for various reasons: First, rural communities usually face financial constraints, and the ongoing pandemic has exacerbated the financial stress in rural economies around the globe. Further, in rural areas, usually, healthcare infrastructure is also

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relatively low, including limited diagnostic facilities, healthcare staff, isolation rooms, and personal protective equipment (12, 13), which may have adversely affected rural communities.

Since COVID-19 is a very different and unprecedented disease, its adverse effects on local communities in China were much higher during its initial spread period. Moreover, given the devastation in China and other parts of the world caused by the pandemic, it is necessary to explore its psychological, social, and economic effects on local households. Therefore, we are particularly interested in investigating the health and socio-economic impact of COVID-19 on local communities in rural areas of the Sichuan Province of China. We hypothesize that the COVID-19 pandemic psychologically and socio-economically affected local people considerably regardless of their socio-economic status, income level, and industry involvement.

This study is theoretically and practically important because we attempt to help maintain the sustainable well-being and livelihood of local communities. Most previous studies are focused on health, medical research, and healthcare workers because they are more exposed to the disease (14, 15). However, less attention has been paid to local communities in rural areas. To the best of our knowledge, this study is one of the first to provide empirical evidence regarding the early health and socio-economic impact of COVID-19 at the household level in rural communities in Sichuan, which is very important to devise policies to ease the burden of the outbreak and prevent further losses at the local community level. Additionally, it is also essential to retain everyday socio-economic life for sustainable development for all people in a similar situation worldwide.

The remaining part of the paper is as follows. Section 2 presents the theoretical review and develops hypotheses. Section 3 briefly discusses the research methodology adopted in this study, including study design, setting, data collection, and analysis. Section 4 explains the results,

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followed by a discussion and implications for theory and practice in section 5. Lastly, section 6 outlines the study conclusion.

2. Theoretical Review and Hypotheses Development

2.1 Psychological and socio-economic impact on local people during COVID-19

The outbreak of coronavirus disease (COVID-19) has caused significant damage to health, businesses, and societies globally. Since the outbreak of the COVID-19 pandemic, the local residents worldwide have faced various psychological and socio-economic problems. For example, lockdowns have disrupted social mobility with restricted access to basic human needs like food and other resources, affecting local people's livelihood opportunities, especially in rural areas, globally. In addition, given the supply chain disruption, the cost of living has been high. Since individuals are required to maintain social distancing and stay indoors, people are left lonely, away from their friends and families, thereby increasing anxiety, depression, and other psychological disorders. The World Health Organization (WHO), according to their survey of 130 countries (16), also reported that COVID-19 is undermining mental health programs in 93% of countries globally.

Since the outbreak of COVID-19, many businesses, including self-employed (micro business), went bankrupt or faced liquidity issues due to social distancing measures and lockdowns (2), resulting in psychological stress. The WHO has voiced its worry about the mental well-being and psychosocial effects of the pandemic, claiming that the isolation policies would lead to uncertainty, fear, distress, and sleeping disorders (17). The COVID-19 pandemic has significantly increased the degree of panic, worry, anxiety, and concern in the rural population (17).

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In the case of China, Government took unprecedented measures to curb the spread of COVID-19 and minimize its adverse effects on local people, businesses, and the economy. Due to measures taken to isolate people and lockdowns, the individuals became vulnerable to alienation, anxiety, and depression triggered by social distancing and concern of contracting the disease (18-20). A study conducted by Wang, Pan (20) reported that most people were afraid of being infected (75.2%), and 53.8% of participants expressed moderate or severe psychological effect, including signs of depression (16.5%), anxiety (28.8%) and higher stress level (8.1%). Similarly, during the outbreak of similar contagious diseases, people were also worried about being infected (21).

Further, due to the exponential increase in COVID-19 cases, the demand for PPE (personal protective equipment) and medical equipment increased unprecedently. Consequently, the shortage of PPE, including facemasks and sanitizers, resulted in panic buying, fear, and psychological stress among the general public (13, 18). The COVID-19 has spread rapidly across various regions and continents, and the uncertain future of this pandemic has been compounded by Internet rumors and disinformation, triggering fear, distress, and desperation among local people. Previous studies related to relevant health emergency crises, such as Severe Acquired Respiratory Syndrome (22) in 2003 and Ebola virus disease outbreaks, also reported psychological and socio-economic effects on local people (23-25). To sum up, COVID-19 has disrupted the normal daily life of local people globally (26).

2.2 Impact of COVID-19 pandemic on rural economies

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The effects of COVID-19 are not beyond agricultural crops, livestock, and fisheries. The disease preventive measures significantly disrupted food supply chains worldwide, resulting in a temporary shortage of food supply and a rise in costs. On the one hand, the social distancing measures helped control the spread of disease; on the other hand, it disturbed normal life and increased psychological and socio-economic pressure among local peoples. The lockdowns and closure of many business activities reduced income sources and increased income insecurity and expenditure.

Notably, in the case of rural communities, most people are involved in small business activities such as the production of crafts, small vending shops, small restaurants, and tourism, etc. Ali, Ahmed (5) argue that since most businesses in rural economies are either self-employed or operate at the small, often micro level, they are considered extremely vulnerable due to lower cash and poor resilience. Similarly, it has been argued that during increasingly unpredictable circumstances such as COVID-19, rural populations are typically less able to survive the storm (6). The literature also reveals that previous relevant health outbreaks such as the Foot and Mouth Disease have had a huge effect on rural economies (10, 11). Due to disease controlling measures, their business activities were affected significantly worldwide. The travel restrictions, especially public places such as tourism destinations, massively affected the hotel and tourism sectors, and many workers lost their jobs. Considering the income insecurity and increased expenses, the Chinese government took unprecedented measures to reduce anxiety, income and expenditure pressures, such as government transfer payment[1].

[1] It is a kind of subsidies and financial support provided by the Chinese government to rural communities. These subsidies are mainly used for the natural environment and ecological restoration such as water conservation construction, forest construction, wind prevention, conversion of farmland to forests and grasslands, rural basic education, primary medical care, basic pension insurance, agricultural production subsidies, and other farmer welfare system expenditures. It also includes the provision of high-quality seeds, high-efficiency pesticides,

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The purpose of the current research is to examine the psychological and socio-economic impact of COVID-19 on rural communities in the Sichuan Province of China. This study will contribute to useful preventive methods and guidelines for reducing the rural population's psychological and socio-economic problems. Based on the above discussion, we hypothesize that COVID-19 has resulted in a psychological and socio-economic impact on local peoples regardless of their socio-economic status, income level, and industry involvement. In other words, the outbreak of pandemic has significant adverse effects on rural people irrespective of their earning level, business sector involvement, social and economic position. We further predicted that government transfer payment could significantly reduce the psychological and socio-economic effects of COVID-19.

3. Materials and Methods

3.1. Research context, sample, and data collection

The data was collected during March-April 2020 from Sichuan province because it is one of the largest provinces with nearly 85% resemblance to mainland China regarding the pandemic situation, lockdown policy, developmental level, population density, and urban-rural pattern. The province includes least, middle, and highly developed regions similar to mainland China. Due to the Chinese government's measures to contain the spread of the virus, including social-distancing and travel restrictions, the data was collected through administering an online questionnaire, which is also consistent with previous studies (2, 4, 27). The questionnaire was initially developed in Chinese and subsequently back-translated into English by two bilingual expert researchers. In following the guidelines of Huber and Power (28), the potential key respondents

fertilizers, and other agricultural technology research, development, and promotion, as well as loan subsidies and interest discounts for farmers to build small agricultural products processing factories.

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(i.e., village representatives) were approached to participate in the study because they are considered reliable and primary data sources.

The data was collected through the convenience and snowball sampling technique due to its time and resources saving advantages, as argued by various researchers (2, 5, 29). Nowadays, WeChat (a very famous social media APP) is considered a necessity in China due to its abundant advantages. Therefore, considering its extensive use, the online questionnaire was administered through WeChat to encourage a large number of rural households (village representatives) to participate in the survey. Additionally, Bo Liu, McCarthy (27) argue that Chinese researchers commonly use snowball sampling to reduce search costs and find hidden populations. Due to financial resources constraints and to avoid any possible bias into study findings, no incentives were offered to participants, as suggested in previous studies (2, 27). Efforts were made to ensure a representative sample by targeting local households (village representatives) at every village in rural areas across Sichuan province. A total of 499 complete and useable responses were received.

3.2. Patient and Public Involvement

Since the study focuses on examining the effect of the COVID-19 pandemic on rural communities, no patient was involved in setting the research question or the outcome measures. However, local community members were involved in the design and conduct of this research.

3.3. Participants

Participants were all residents of different rural villages across the Sichuan Province of China. This cross-sectional study's criteria included a minimum of 18 years of age, a resident of

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Sichuan province, and, most notably, a village representative. The data was collected during mid of April for two weeks; at that time COVID-19 pandemic had already affected a large number of local people in terms of socio-economic and health effects. Total 499 participants took part in the study and completed the prescribed survey questionnaire. Before administering the questionnaire, the permission of the community leader of each village was sought. In addition, we also sought the consent of every rural village representative before taking part in the study. Every participant was permitted not to answer any question accordingly. The Ethics Committee of Leshan Normal University has approved this study. Informed consent from each participant was received prior to taking part in the online questionnaire. Before taking part in the survey, the objective and aim of the research were first presented to the potential participants. The participants were asked to fill the questionnaire only after assuring them of absolute anonymity, confidentiality, and other ethical considerations. Although no electronic record of the consent of the participant was given, all respondents agreed on the purpose of the study and willingly participated in the online survey.

3.4. Survey Scale and Measurement Instruments

In this research, we have used closed-ended questions (dichotomous scales) having two choices (Yes or No) for the measurement of the variables, which is evident from past pieces of literature (30-36). Previous studies argue that self-reports of subjective stress related to a particular stressor or one's living conditions are one of the best ways to assess stress responses (37-39). Similarly, some studies also measured stress as a representation of perceived strains using the Perceived Stress Questionnaire (PSQ) as a tool to measure internal and external stress among the sample (40, 41). The PSQ instrument proposed by Levenstein, Prantera (41) evaluates

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stress that is subjectively perceived rather than a concrete and objective event. We used the same approach to assess the value of stress based on the respondents' self-reported stress levels under COVID-19 in relation to the various factors.

Some studies have emphasized the consequences of economic shocks such as income reduction or job loss, on the household's standing (42-44). Researchers have previously identified the link between household status and shocks (45). According to previous studies, disadvantaged households are more vulnerable to economic shocks due to a lack of cash to shield against external shocks (46). Others have explored the impact of health shock on individual health and, as a result, worker productivity, ultimately leading to a decrease in household income (44). There are still few studies in the literature about the effects of shocks in developing countries depending on the households' socioeconomic aspects.

In line with the aim of the study, we adopted various factors from previous studies to investigate the psychological and socio-economic impact of COVID-19 on rural communities in the Sichuan Province of China (31-36). The questionnaire comprised several questions regarding the effect of COVID-19 on the health and livelihoods of rural communities. Notably, by following previous studies, we asked the respondents to share their household experience in the context of COVID-19, including psychological impact, wage and income losses, and shortage of agricultural input supplies. The psychological impact was measured in terms of income concern, spending concern, health concern, and pandemic concern. Likewise, in a recent study, Mueller, McConnell (35) examined the impact of COVID-19 pandemic on rural America; they measured the pandemic's impact on overall life, household finances, mental health and physical health.

To determine and measure the presence or absence of psychological stress and pandemic stress, we divided the dichotomous responses based on different income levels, sources of

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income, and industries. We took into account the presence or absence of pressure or stress based on the perception of the respondents about their condition under COVID-19. The respondents were asked if they were stressed due to COVID 19 (Yes or No). The perceived stress by the respondent gave us the opportunity to further classify the pressure or stress on respondents by asking the follow-up questions divided on the basis of income levels, sources of income, and industries to which the respondents were related. For further measurements and estimations, the responses were quantified by converting them into dummy variables with values of '0' indicating a response 'No' and '1' depicting a response 'Yes.' Similar approach of measurement based on the respondents' perceptions through questionnaire were also utilized by various authors (31-36).

Further, using various socioeconomic indicators, we aim to evaluate the impacts of the COVID-19 shock on households in this study. We asked participants a variety of questions, including family income (poor or not), disposable income, key income sources, industry participation, agriculture supply level, and cost of livestock rearing, among other things. In terms of measurement, some scholars contend that, while consumption and income are typically used to assess the welfare of families, they are not the sole proxy variables for expressing wellbeing and living standards (Massari, 2005). As suggested by Massari (47), new proxy variables may be estimated better to describe changes and consequences on families (47). Therefore, we believe that the socio-economic impacts of the home might serve as a better proxy for the wellbeing of the households in this research.

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3.5 Reliability Tests

3.5.1 Cronbach's Alpha

For the reliability or consistency of data, the value of cronbach's alpha is measured. The threshold value of Cronbach's alpha should be above 0.7 in order for the data to be reliable. In our case, the value is **0.712** for the questionnaire, which is above the threshold value and thus is acceptable. The value suggests that the factors used are internally consistent and reliable.

3.5.2 Convergent Validity and Correlation Matrix

Convergent validity checks if the items or factors converge to measure a specific construct. In our case, we test the convergence reliability of different income sources and industries. We check if these two constructs are different from one another. For estimating the convergence reliability, we use a correlation matrix approach (48). The outcomes of the test are presented as follows (Table 1):

Table 1 Correlation Matrix

Variables	Family Farm	Business	Local Employment	Migrant Workers	Govt. TP	Industry _ Agri	Industry _ Other
Family Farm	1						
Business	0.673***	1					
Local Employment	0.691***	0.690***	1				
Migrant Workers	0.670***	0.671***	0.676***	1			
Govt. TP	0.611***	0.615***	0.605***	0.613***	1		
Industry_Agri	0.173***	0.175***	0.164***	0.226***	0.191***	1	
Industry_Other	0.186***	0.131***	0.151***	0.186***	0.163***	0.614***	1

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Table 1 shows the correlation between the variables and clearly presents the distinction between the factors. The variables of Income sources are highly correlated with one another (Minimum correlation of 0.611 for Govt. TP) compared to the factors representing households related to different industries. Similarly, the correlation between the industrial variables is high (0.614) in comparison to the maximum correlation value of 0.191 with sources of income. The values of correlations are above 0.5 and significant for the group, suggesting that the convergent validity between the two constructs is valid and reliable.

For further testing of convergent validity, we use Factor Analysis in order to check if the factors load distinctly or not. Table 2 shows the loading of the main components:

Table 2: Rotated Component Matrix

Variables	Component	
	1	2
Family Farm	0.846	0.092
Business	0.863	0.078
Local Employment	0.875	0.009
Migrant Workers	0.853	0.141
Govt. TP	0.791	0.086
Industry_Agri	0.119	0.846
Industry_Other	0.093	0.831

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Table 2 clearly depicts that the factors load distinctly for the two groups; thus, it confirms the convergent validity among the main factors in each of the two groups. The average factor loading for both groups is also estimated to be higher than the 0.7 threshold levels, suggesting convergent validity.

3.5.3 Data Cleaning

A total of 555 questionnaires were filled by the respondents. The questionnaires were checked and sorted for incomplete data or area relevance. A total of 31 questionnaires were found to be incomplete, while 25 questionnaires were filled by respondents belonging to areas other than Sichuan Province. As our research focuses on Sichuan province, therefore, 25 questionnaires filled by respondents of different provinces were left out. Additionally, the data was also screened out for outliers. After sorting and excluding fifty-six (56) incomplete and out of the province questionnaires, a total of 499 questionnaires remained for the analysis and estimation purpose.

3.6. Data analysis

The current research used descriptive statistics and Ordinary Least Squares (OLS) regression to analyze the data. The descriptive statistical analyses of all demographic and other variables of interest were performed through Statistical Package for Social Science (SPSS), and Microsoft Excel was used to produce graphs and charts. The descriptive statistics were employed to explain the sample features, psychological and socio-economic impact on local households by the level of income, socio-economic status, and main sources of income. The OLS regression was performed to determine the impacts of psychological and pandemic stress by income level, main

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income sources, and industry-wise. Furthermore, we also assessed the reliability of the data using Cronbach's Alpha. The value of Cronbach's Alpha was 70.7, which shows sufficient reliability of our data.

4. Results

4.1. Sample description

Most participants' annual income was less than 13000 RMB, while only 3.61% of respondents earn more than 25000 RMB per year. Additionally, in our sample, 72.34% of participants belong to high socio-economic status, while 27.66% belong to low socio-economic status. Furthermore, in terms of primary sources of income, most of the respondents reported that they are mainly engaged in farming (29.80%), followed by employment outside of the county (28.64%), while 21.83% are locally employed, and 15.25% do business. However, only 4.49% of survey participants reported that they receive government transfer payment. The detail of the sample is presented in **Table 3**.

Table 3. Sample description

Yearly Income Level (RMB)	Percentage	Industry*	Percentage
<10000	29.46%	Agriculture	20.80%
10001-13000	33.27%	Food	32.54%
13001-15000	17.43%	Livestock	24.33%
15001-20000	10.22%	Tourism	4.58%
20001-25000	6.01%	Others	17.75%
>25000	3.61%		
Main sources of income	**Percentage**	**Socio-economic status**	**Percentage**
Family farming	29.80%	High	72.34%

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Business	15.25%	Low	27.66%
Local employment (salaried/wages)	21.83%		
Employment outside of the village	28.64%		
Government Transfer Payment	4.49%		

Note: Main industries where villagers (participants) are involved.

4.2. Psychological impact of COVID-19

The results reveal that the most significant psychological pressure on the local community is related to income (40.8%), followed by an increase in spending (28.6%), health concern (23.9%), and finally, COVID-19 pandemic concern (6.8%). Similarly, when we analyzed the data in terms of socio-economic status, the results indicate that most participants are concerned about income regardless of their socio-economic status. Notably, people with low socio-economic status were mostly worried about their income (43%), followed by increased expenses (27%), health (23%), and pandemic (7%). The situation of people with high socio-economic status also remains relatively similar **(see Table 4).** It infers that local people are anxious about their income because some industries were partially operating due to the COVID-19 pandemic, while others were closed entirely. Moreover, many products' demand tremendously decreased, leading to economic and employment loss globally (49). Additionally, due to business closures and supply chain disruptions, the price of many commodities increased, which resulted in psychological stress among local people about meeting the increased expenditures.

We further analyzed the impact of COVID-19 on rural people's psychology by income level. We find that income remained the most crucial driver of psychological stress. Mainly, people with an annual earning of <13000 RMB were facing a higher level of stress. However, as income increases, the level of stress reduces, the value ranges between 37-43% of the total, which is followed by the pressure of spending (23-28%), health concern (23-26%), and the least worry

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about the pandemic (3-10%). These results suggest uniformity of the values of the different types of pressure/worry across the given income levels. It can be inferred that regardless of the income level, everyone is more concerned and worried about the income in crisis times. The results are presented in **Table 4.**

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Table 4. Psychological impact on local communities

Psychological pressure			
Income Pressure	**Spending Pressure**	**Health Pressure**	**Pandemic Pressure**
40.8%	28.6%	23.9%	6.8%

Psychological pressures by socio-economic status				
HH Status	**Income Pressure**	**Spending Pressure**	**Health Pressure**	**COVID-19 Pressure**
High	40%	29%	24%	7%
Low	43%	27%	23%	7%

Psychological impact on different factors by Income Level				
Annual Income Level	**Income Pressure**	**Spending Pressure**	**Health Pressure**	**COVID-19 Pandemic Pressure**
<10000	43%	27%	23%	6%
10001-13000	41%	28%	23%	8%
13001-15000	37%	28%	26%	10%
15001-20000	30%	40%	26%	4%
20001-25000	41%	33%	23%	3%
>25000	37%	33%	26%	5%

4.3. Psychological impact by main sources of income

Figure 1 shows the detail of the psychological impact by the main sources of income of households. The results reveal that the worry of income is given the highest priority, followed by spending, health, and pandemic, with the range of values in percentages given as 36-40%, 28-30%, 24-25%, and 7-10%, respectively. It can be noted that the source of income does not

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change drastically for the stress/worry levels. Moreover, the government transfer payment shows lower income stress/worry at 36% compared to the rest of the sources. It suggests that people receiving government transfer payments are less stressed due to the reliable and continuous income flow.

[Insert Figure 1 here]

Figure 1 Psychological impact by main sources of income

4.4. Psychological impact by main industries

Figure 2 depicts the impact of different types of worry on local households related to main industries. The trends in primary sectors and types of anxiety are similar to previous results. It is clear that income worry is the main issue for all the respondents in every industry (39-42%), and the lowest level of concern was the pandemic itself (5-9%). These results suggest that for most households, the worry about income puts more pressure than other types of concerns. This might be because people assume that if they have enough money, they can probably manage their household expenses, including health and pandemic related expenditures. Most importantly, one of the main reasons for high stress related to income is that rural communities are usually financially fragile, and the COVID-19 pandemic has exacerbated their financial tension; therefore, they are highly concerned about the flow of income and expenditures.

[Insert Figure 2 here]

Figure 2 Psychological impact by main industries

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4.5. OLS Regression results

An OLS regression was undertaken to estimate the impact of psychological and pandemic stress by income level, main income sources, and industry-wise (Table 5). The results reveal a significant negative effect of income level on psychological stress (-0.014, $p < 0.05$). In other words, it can be argued that the higher the level of income, the lower be the stress level. The value of Durbin Watson is 1.925, which is very close to the critical value of 2.0, predicting that the issue of auto-correlation in the model is insignificant.

When examined for the impact of pandemic stress on respondents based on the level of income, the results computed were insignificant (-0.007), which explains that individuals are least worried about the epidemic. There can be several possible explanations of low pandemic stress on local households in rural areas. Chinese people primarily believe and trust in the government's effective anti-epidemic countermeasures taken to contain the disease. For instance, the construction of hospitals in record-breaking time increased the morale of Chinese people and trust in the government concerning the fight against the deadly virus. Additionally, the timely decisions taken by the government were also found very effective in controlling the disease.

Further, in terms of main sources of income, the impact of psychological stress on respondents across main sources of income was significantly negative: family farm (-0.055, $p = 0.05$), business (-0.053, $p = 0.05$), local employment (-0.054, $p = 0.01$), migrant workers (-0.051, $p = 0.05$), and government transfer payment (-0.058, $p = 0.05$). However, the effect of pandemic stress by the main sources of income was significantly negative only for local employment (-0.080, $p = 0.05$), migrant workers (-0.067, $p = 0.05$). The results show that regardless of income sources, the respondents' psychological stress is high; in contrast, pandemic stress was higher for

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persons locally employed or working out of the village. These results are not surprising since the gravity of the pandemic is much higher than in past crises. Moreover, due to lockdowns, business closures, and travel restrictions, many people lost their jobs.

The results are presented in Table 5 further show that the impact of psychological and pandemic stress on people involved in the agricultural industry was negatively significant (-0.076, $p = 0.01$; -0.088, $p = 0.01$, respectively). Additionally, in terms of the effects of the supply of agricultural commodities by income level, OLS estimates' output predicts a positive relationship with the level of income at a 1% significance level (0.084, $p = 0.01$). It can be interpreted as the higher the income level, the higher the supply of agricultural products for households. To put it simply, higher income can ensure the continuous supply of products for the local households.

Table 5 OLS Regression Estimations

Variables	Psychological Stress			Pandemic Stress		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Income	-0.014** (0.007)	-	-	-0.007 (0.012)	-	-
Family farm	-	-0.055** (0.024)	-		-0.047 (0.042)	-
Business	-	-0.053** (0.021)	-		-0.057 (0.036)	-
Local employment	-	-0.054*** (0.021)	-		-0.080** (0.036)	-
Migrant workers	-	-0.051** (0.022)	-		-0.067* (0.038)	-
Govt. TP	-	-0.058** (0.030)	-		-0.066 (0.052)	-
Industry_Agri	-	-	-0.076*** (0.019)	-	-	-0.088*** (0.032)
IndOther	-	-	-0.058*** (0.019)	-	-	-0.099*** (0.033)
(Constant)	-0.541*** (0.014)	0.422*** (0.029)	-0.506*** (0.015)	0.162*** (0.023)	0.009 (0.051)	-0.077*** (0.025)
Durbin-Watson	1.925	1.885	1.904	1.725	1.707	1.710
F-Statistics	4.123	7.988	11.963	0.312	4.010	7.626

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Observations	499	499	499	499	499	499

Note: Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5. Discussion

Due to the unprecedented outbreak of coronavirus disease (COVID-19), various measures were taken to curb the disease, including business closures, travel restrictions, lockdowns, and people are required to maintain social distancing, which resulted in psychological stress related to income, increased expenditure, and health (2-6, 49). Additionally, during the initial outbreak period, many businesses were closed wholly or partially, and the economy was slowed down. The rural economies often strive for financial stability, and in times of highly uncertain and unpredictable situations such as the COVID-19 pandemic, the rural communities are highly vulnerable, mainly due to loss of income and employment (6, 10, 11). This study sought to examine these issues by taking a sample of 499 rural village representatives in the Sichuan Province of China. To the best of our knowledge, this research is one of the first to provide empirical evidence regarding the early health and socio-economic impact of COVID-19 at the household level in rural communities, which is very important to devise policies to ease the burden of the outbreak and prevent further losses at the local community level.

This study's findings reveal that the lockdowns, travel restrictions, increased expenses, uncertainty, and fear of contracting the infection significantly affected local people psychologically, leading to economic vulnerability. Particularly, the results reveal that people are worried about their income losses regardless of their socio-economic status, level of income, and industry involvement. In line with these findings, the World Bank also pointed out that local households face the challenge of losing income and employment, leading to financial stress (50). We also find that the level of income has a direct negative relationship with stress. The study

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results show that lower-income level poses higher pressure; however, as income increases, the level of stress reduces. Similarly, El-Zoghby, Soltan (9), by investigating the pandemic's impact on mental health and social support among adult Egyptians, also reported that over 55% of respondents were under financial stress. Moreover, in a recent report, the International Labour Organization (ILO) also argued that the pandemic had brought a massive drop in labor income around the world (49).

The findings of the study further indicate that regardless of industry where local communities are involved, the loss of income is their main issue (39-42%, see Figure 2). The possible reasons for high-stress of income are attributed to the loss of income and employment, increased expenditure, and commodity price hikes, among others. Further, the local people that receive government transfer payment showed lesser stress due to the reliable and uninterrupted flow of income and various subsidies provided by the government. However, contrary to our hypothesis, the findings show that local communities are less worried about pandemic stress, which is in contrast to the results of previous studies that reported a highly significant impact of pandemic stress during the severe acute respiratory syndrome outbreak in 2003 (felt horrified) (23, 25, 51). Due to the Chinese government's untiring efforts to control the spread of disease and mitigate its adverse effects, the psychological impact of the pandemic was considerably reduced.

5.1 Theoretical Implications

This study presents an impact mechanism of a particular public crisis (COVID-19) on local people's mentality, with which economic and industrial indicators and social status function over local people and family psychologically; thus, governmental policies find their theoretic ground from a psychological perspective. The measures taken by the Chinese government to fight

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against the deadly virus have been praised globally because China successfully controlled the spread of the disease. Therefore, this study occupies an important position for policymakers, research scholars, and practitioners. Since our research reveals that people are mostly worried about their income, therefore, policies must be focused on ensuring continuous income to ease the impact of the pandemic. The government should devise policies where sustainable sources of income for households can be secured. Such policies can reduce the level of stress and worry of the rural households in case of a similar socio-economic crisis or shock. Since the pandemic is not over and even after controlling the spread of COVID-19 cases in China, still some risk exists for the second wave (52). Therefore, it is necessary to ensure income flow, especially in rural areas.

Moreover, to boost the economy and employment, the Chinese government has already taken various steps, including allowing local peoples to establish small stalls/vending shops. Mainly, it has been reported that 100,000 jobs were created overnight by setting up 36,000 street vending units in Chengdu city alone (53). Therefore, other cities must follow similar strategies to boost income and employment. Additionally, psychological support is also vital during such heightened and uncertain situations.

5.2 Practical Implications

Since the outbreak of the COVID-19 pandemic, a huge number of people around the world have been affected greatly, and the number of confirmed COVID-19 cases has been rising day-by-day, with serious implications for the lives of humans on earth. Hence, there is a need to consider the adverse effects of COVID-19 on rural people seriously. Tourism and agriculture are the primary sources of livelihood for the rural people in Sichuan. However, the tourism industry

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was badly affected by the spread of the COVID-19 cases, and several individuals have already lost their jobs. There is a need to provide more job opportunities and secure income sources for the revitalization of the sector. Moreover, it is necessary to educate people about managing stress to reduce the psychological impact on rural peoples and protect the general population because "prevention is better than cure." Additionally, wearing a facemask potentially reduces the chances of disease spread (transmitting and catching).

5.3 Limitations and avenues for future research

This research has some limitations which provide room for further research. First, the current research was cross-sectional in nature; it is thus not feasible to draw causal inferences. Longitudinal studies are needed to make causal inferences. Second, the sample was mainly collected through convenience and snowball sampling techniques, which offers room for future research. Future studies can compare the difference between the psychological and socio-economic impact of the COVID-19 pandemic in rural and urban communities. Additionally, this study did not differentiate between the psychological and socio-economic impact of the COVID-19 pandemic in rural and urban communities. Further, researchers can explore other factors that are psychologically affecting local communities in other countries with different cultural settings because new COVID-19 cases are still increasing globally.

Furthermore, although the Sichuan province has a high resemblance to other parts of mainland China, the findings of this study may not be generalized across China due to several factors. Primarily, the situation of COVID-19 across China was very diverse, with Hubei (Wuhan) being the epicenter, while in Tibet, only one case was reported. Moreover, according to the epidemic situation, some cities of China were completely under lockdown, while in other

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parts, people were urged to remain at home, maintain social distancing, and avoid going out unnecessarily to contain the spread of disease. Besides, the size, income, and development levels also vary in different rural villages across China. Additionally, this research mainly focused on rural areas; therefore, findings cannot be extended to urban areas.

6. Conclusion

Due to the outbreak of the COVID-19 pandemic, China has recently experienced a significant impact of the COVID-19 pandemic on the local people's health and economy. Moreover, due to lockdowns, restrictions on goods' movement, and supply chain disruptions resulted in considerable socio-economic losses. Additionally, the rising price of agricultural input, livestock feed, and other commodities lead to decreased cash in hand and raised concern about income. Overall, the COVID-19 resulted in a psychological and socio-economic impact on local peoples. The findings of this study show that the pandemic adversely affected the health and livelihoods of rural communities in the Sichuan Province of China. The prime concern of respondents was the loss of income across industries and socio-economic status. We further find that continuous and higher income levels can significantly reduce stress among local households because people believe that income is essential for sustaining well-being and livelihoods during such heightened and unpredictable situations.

Data availability statement: Data are available upon reasonable request.

Contributors: All five authors contributed to the writing and editing of the draft. MS and IUR performed conceptual analyses and wrote the first draft. DJ, LJ, and CX also supervised and

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improved the quality of the article. All authors participated in the revision and final approval of the article.

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Conflict of interest: The authors declare that there is no conflict of interests.

Ethics approval: The current research was approved by the Ethics Committee of Leshan Normal University. Prior to taking part in the online questionnaire, informed consent was obtained from each participant. The purpose and content of the study were first introduced to the potential participants before partaking in the survey. After assuring respondents of complete anonymity, confidentiality, and other ethical considerations, they filled the online questionnaire. There was no electronic record of the participant's consent, but all respondents agreed on the purpose of the research and took part in the online survey voluntarily.

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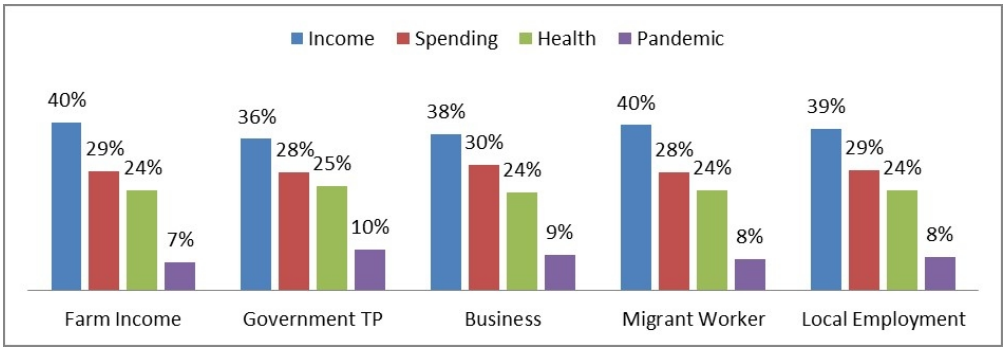

Figure 1

160x54mm (150 x 150 DPI)

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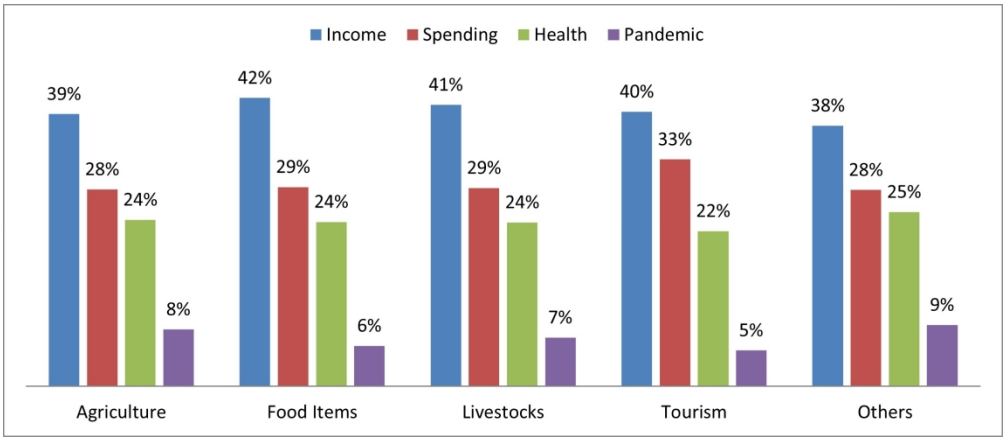

Figure 2

176x76mm (330 x 330 DPI)

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STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	7
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	8
		(*c*) Explain how missing data were addressed	N/A
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	7
		(*e*) Describe any sensitivity analyses	N/A
Results			

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Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	8
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7
		(b) Indicate number of participants with missing data for each variable of interest	7
Outcome data	15*	Report numbers of outcome events or summary measures	8-14
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-14
		(*b*) Report category boundaries when continuous variables were categorized	8-14
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	8-14
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	8-14
Discussion			
Key results	18	Summarise key results with reference to study objectives	15
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	19
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15-19
Generalisability	21	Discuss the generalisability (external validity) of the study results	15-19
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	19

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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