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A study on the knowledge, attitude, and practice of food handlers on food safety at household level among indigenous people of Nagaland Northeast India

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ABSTRACT

One the major concerns in health issues is food safety. Foodborne illnesses can be easily prevented through proper knowledge, a positive attitude and effective food safety practices. While many people recognise the important of food safety, this knowledge is not often put into action. Therefore, this cross-sectional study explores the knowledge, attitudes and practices regarding food safety among food handlers at household level. It also examines the barriers to adopting good food safety habits. In-person interviews were conducted with 158 respondents from the indigenous people or Naga tribes of Nagaland, India, using structured interview schedule to gathers insight. Findings revealed that most respondents possessed a good level of knowledge and held a positive attitude towards food safety. The overall average score for knowledge was 22.6 (SD = 2.75) while the average attitude score was 32.8 (SD = 2.45). Despite their strong knowledge and positive attitudes, only a small number of respondents (14.6%) practiced good food safety methods, with a mean score of 28.1 (SD = 7.67), indicating a partial adherence to food safety practices. The study found a positive correlation between perceived food safety knowledge, positive attitudes, and a better food safety practice. Although many respondents demonstrated a high understanding of food safety, 66.5% indicated they need further education on the topic. Additionally, 33.5% cited financial constraints as a barrier to maintain food safety. Though awareness of food safety exists, further education and intervention programs are essential to promote better practices. Utilising natural resources, such as *Sapindus mukorossi* or soap nut, native to the region and water harvesting techniques, can provide the community with effective cleaning agents, thereby improving food safety practices.

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1. Introduction

There are many global health concerns in the world which food safety is one of them (1). Foodborne diseases occur when a person consumes food Contaminated during any steps of food preparation: production, transportation, storing and utilization of the food, commonly known as food poisoning (2). Some of the common symptoms relating to food poisoning includes stomach pain, vomiting and diarrhoea, and these have a serious negative impact on

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a person's health contributing to the increase morbidity and mortality rates (3).

According to the Centre for Disease Control and Prevention, homes stand as the second most recurrent place for the outbreak of foodborne disease (4). This risk is commonly associated with unsafe food-handling practices, including lack of personal cleanliness, incorrect cooking methods, improper storage of food items, and the mixing of raw and cooked foods, which can lead to cross-contamination (5). Some of the harmful microorganisms that can be spread through a food handler's hands, skin, face or hair include *Salmonella Typhi*, Hepatitis A, *Shigella* species, *Staphylococcus aureus* and norovirus (6).

Within indigenous communities, the responsibilities of food handlers are especially important, as these populations frequently encounter challenges like poor access to clean water, inadequate sanitation, and limited exposure to formal education on food safety (7, 8). Many families use traditional methods to prepare food, but such practices may not fully align with current food safety guidelines, thereby increasing the risk of contamination and foodborne diseases (9, 10).

When a food handler has good knowledge and a positive attitude about food safety, they are more likely to follow safe practices, which helps protect the health and well-being of their families. However, if they lack awareness and education about food safety, they may unknowingly follow unsafe and unhygienic practices (11,12).

Thus, collecting the data of the food safety knowledge, attitudes, and practices of a food handler is vital for making various effective steps to prevent foodborne illnesses (13). In Nagaland, India, there is limited research pertaining to this topic. Hence, based on the WHO's Five keys for food safety, this study aims to assess the knowledge, examine the attitude, identify practices of the indigenous people (IP) regarding food safety at the household level. The study also aims to examine the barriers to adopting effective food safety habits.

2. Materials and Methods

2.1. Research area

The area selected for the study was Huker Village of the Shamator region in Nagaland. It is an area occupied by the IP or the Naga. There is no official definition of IP but according to the United Nation, IP can self-identify and are accepted as a member in their community, they are strongly linked to their territories, surrounded by natural resources, have distinct language, culture, social, economic and political system, and maintain their ancestral environment and systems. In India, the Nagas are the tribal people of Northeast India (14).

2.2. Research design

A quantitative and cross-sectional study was used. Quantitative research measures variables and tests theories using numerical data such as surveys and experiments. Cross sectional is used when a researcher wants to collect data from different individuals at a single point in time.

2.3. Sampling unit

The sampling units are the Indigenous people called the Naga residing in Huker village, Shamator region, Nagaland. Their ages are between 18 to 60 years and they are the primary food handlers/preparers in their households.

The total sample size included 158 respondents (Yamane's formula n=N/1+Ne2) between the age group of 18-60 years.

2.4. Sampling method

A systematic sampling method was used in this study. Systematic sampling is a probability sampling method where the researchers select the respondents of the population at a regular interval (or *k*) determined in advance. In this study, firstly, the sampling interval (k) was calculated by dividing the total households (216) by the sample size (158), which gives about 1.37, and rounding it to 2. Therefore, every 2nd household was selected. The number of households was provided by the headman.

2.5. Method of data collection

An in-person interview was conducted to collect the data using an interview schedule. The interview schedule was developed from 5 keys to safer food of the world health organisation (15). It consisted of 5 sections: Socio-demographic characteristics, food safety knowledge (11 questions), food safety attitudes (12 questions), and practices (14 questions) and barriers. The questions on knowledge, attitudes and practices were assessed on Likert scale.

The first section collected data on the socio-economic characteristics and had items for gender, age, sex, marital status, education level, occupation, monthly income number of family members above 1 year and socio-economic status using the B.G. Prasad's Social Economic Scale (SES) 2024. This is a commonly used SES scales measuring the SES of people in urban and rural areas in India. BG Prasad's classification was first introduced in 1961 (16).

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2.6. Data entry and analysis

The data was entered in Microsoft exceland Jamovi software 2.6.44. Descriptive statistics were used to describe the data and inferential statistics such as Pearson correlation coefficient (*r*) was used to determine the relationship of the variables.

2.7. Ethical considerations

The study was approved by the Ethics Committee, Faculty of Social Sciences, Martin Luther Christian University Letter no. III/DDSR/REC-FSS/58/2021-108. Permission was granted by the Headman to conduct the study in Huker village. Informed consent was secured from each respondent before data collection.

3. Results

3.1. Socio-demographic

Table 1 shows the socio demographics details of the respondents. Almost all of them were women, aged between 25 and 34, married, and are farmers. The highest education level for just under a third of them

was primary school and almost all of them are from a low social economic class.

3.2. Food safety knowledge

Table 2 and table 3 indicate that the respondents have good knowledge regarding food safety. Around 86% of respondents showed good understanding, and over 13% had excellent knowledge. They were generally aware of important hygiene rules and cooking safety. Only a minimal percentage (0.6%) was classified as having average knowledge. The overall average score is 22.6 (SD = 2.75) reflects a relatively high understanding of food safety concepts among respondents. However, there were a few statements that they were not confident. A huge majority of the respondents (84.8%) were not confident of not using the same cutting board and knife even if it looks clean. A large proportion of respondents (70.9%) reported low confidence on the statement "Cooked meat cannot be safely left at room temperature overnight."

3.3. Food safety attitude

The respondents also showed a strong positive attitude towards food safety as indicated in Table 2. Nearly 95% agreed with key principles, such as the importance of washing hands, throwing away spoiled food, and boiling drinking water. The mean score (M = 32.8, SD = 2.45) further confirms a positive alignment toward food safety behaviours. However, their attitudes were not as strong when it came to temperature-related habits, such as reheating food thoroughly or not leaving cooked food out overnight as shown in Table 4. More than half of the respondents (51.3%) disagreed that leaving cooked food at room temperature overnight is an unsafe practice.

3.4. Food safety practices

Despite having good knowledge and positive attitudes, only a small number of people (14.6%) actually followed good food safety practices. The mean score (M = 28.1, SD = 7.67) reflects this partial adherence. Most showed only moderate or poor food safety practice. Common issues included not reheating food properly where only 1.9% reported doing it always. No respondents reported covering waste bins daily, and over half of the respondents (53.2%) reported storing leftovers food in a cool place within 2 h.

3.5. Correlation test

The Pearson correlation analysis showed a negligible and statistically non-significant relationship between Food Safety Knowledge and Food Safety Attitude ($r = 0.02$, $p = 0.803$). This indicates that variations in food safety knowledge are not meaningfully associated with differences in food safety attitudes.

The Pearson correlation analysis revealed a moderate positive relationship and statistically significant between Food Safety Knowledge and Food Safety Practice ($r = 0.399$, $p<0.001$). This indicates that individuals with higher levels of food safety knowledge are more likely to demonstrate better food safety practices. Conversely, those with lower knowledge tend to exhibit poorer practices.

While the relationship is not very strong, it suggests that enhancing food safety knowledge could contribute meaningfully to improving food safety practices.

The Pearson correlation analysis revealed a weak positive relationship and statistically significant between Food Safety Practice and Food Safety Attitude ($r = 0.274$, $p<0.001$). This suggests that individuals with more positive attitudes toward food safety are

somewhat more likely to engage in better food safety practices.

3.6. Barriers

The study also identified the barriers and solutions to food safety habits in the community as shown in Table 7. According to them, the lack of education (66.5%) and financial problems (33.5%) are the barriers to food safety knowledge, attitude and practices. These factors make it harder for people to learn about or apply safe food practices, and this limit the access to resources such as clean water, soap for hand hygiene, proper kitchen tools, or refrigerators.

Table 1. Socio-demographics of the respondents (N=158)

Characteristics	Categories	N	%
Gender	Male	1	0.6
	Female	157	99.4
Age	18-24	11	7.0
	25-34	49	31.0
	35-44	37	23.4
	45-54	33	20.9
	Above 55	28	17.7
Marital status	Married	136	86.1
	Unmarried	12	7.6
	Widow	10	6.3
Education status	No formal education	46	29.1
	Primary	56	35.4
	Middle	49	31.0
	High school	6	3.8
	Graduate	1	0.6
Occupation	Homemaker	46	29.1
	Farmer	110	69.6
	Others	2	1.3
Monthly income	<1364	156	98.7
	1364-2728	-	-
	2728-4548	-	-
	4548-9097	1	0.6
	Above 9097	1	0.6
Socio-economic status (B.G Prasad SES Scale)	Lower class	157	99.4
	Middle class	1	0.6

Table 2. Perceived scores of food safety knowledge, attitude and practices

Perceived score	Range	N	%	M±SD
Food safety knowledge	Average	1	0.6	22.6±2.75
	Good	136	86.1	
	Excellent	21	13.3	
Food safety attitude	Neutral	4	2.5	32.8±2.45
	Positive	150	94.9	
	Very positive	4	2.5	
Food safety practices	Poor	3	1.9	28.1±7.67
	Moderate	132	83.5	
	Good	23	14.6	

Table 3. Perceived food safety knowledge (N=158)

Q. No	Questions about perceived knowledge	Very confident		Confident		Not sure		Not confident		Not very confident		M±SD
		N	%	N	%	N	%	N	%	N	%	
	Keep clean:											
1	Reusing the same cloth to wipe spillage of food/kitchen surface can spread germs.	3	1.9	126	79.7	12	7.6	14	8.9	3	1.9	2.71±0.734
2	We must wash hand with soap and water after touching animals or working on the farm before handling food is important.	8	5.1	**137**	**86.7**	8	5.1	5	3.2	0	0	2.9±0.475
	Separate raw and cooked:											
3	We cannot use the same cutting board (*shihkhappung*) and knife *(nok*) to cut our food (either raw or cooked) even if it looks clean.	0	0	0	0	17	4.4	**134**	**84.8**	7	10.8	1.06±0.386
4	Raw meat must be stored separately from fruits and vegetables by using different containers.	7	4.4	**82**	**51.9**	44	27.8	23	14.6	2	1.3	2.44±0.840
	Cook thoroughly:											
5	The texture of the meat or chicken should be soft and not pink in the middle after cooking. It needs to be cooked for a longer time.	38	24.1	**117**	**74.1**	1	0.6	1	0.6	1	0.6	3.20±0.538
6	Leftover food needs thorough reheating before consumption/eating.	0	0	0	0	19	12	**126**	**79.7**	13	8.2	1.04±0.450
	Keep food at safe temperatures:											
7	Cooked meat cannot be left at room temperature overnight.	0	0	0	0	38	24.1	**112**	**70.9**	8	5.1	1.19±0.507
8	Cooked food should be kept very hot before serving.	5	3.2	48	30.4	**55**	**34.8**	47	29.7	3	1.9	2.03±0.899
	Use safe water and raw materials:											
9	Safe water cannot be identified by appearance.	0	0	0	0	12	7.6	**120**	**75.9**	26	16.5	0.911±0.484
10	Boiling water before drinking helps kill harmful germs that can cause diseases.	33	20.9	**114**	**72.2**	9	5.7	2	1.3	0	0	3.13±0.550
11	Fruits & vegetables, raw meat/fish should be washed before storing for future use.	4	2.5	**51**	**32.3**	43	27.2	46	29.1	14	8.9	1.91±1.03

Table 4. Scores of perceived attitudes (N=158)

Q. No	Questions about perceived attitude	Strongly agree		Agree		Not sure		Disagree		Strongly disagree		M±SD
		N	%	N	%	N	%	N	%	N	%	
	Keep clean											
1	Frequent handwashing with soap and water is worth the extra time.	13	8.2	**139**	**88**	4	2.5	2	1.3	0	0	3.03±0.398
2	Frequently wiping the kitchen surfaces with cleaned wiping cloth and keeping it clean reduces illness risk and prevents illnesses.	6	3.8	**138**	**87.3**	13	8.2	1	0.6	0	0	2.94±0.378
	Separate raw and cooked											
3	Separating raw & cooked food prevents illness.	9	5.7	**144**	**91.1**	3	1.9	2	1.3	0	0	3.01±0.357
4	Using different knives & cutting boards is important.	3	1.9	**115**	**72.8**	32	20.4	8	5.1	0	0	2.71±0.587
	Cook thoroughly:											
5	Cooking food thoroughly is essential for preventing sickness in my family.	27	17.1	**131**	**82.9**	0	0	0	0	0	0	3.17±0.378
6	Soups & stews should always be boiled.	38	24.1	**119**	**75.3**	1	0.6	0	0	0	0	3.23±0.440
	Keep food at safe temperatures:											
7	Leaving cooked food at room temperature overnight during winter as well as summer is an unsafe practice.	4	2.5	10	6.3	59	37.3	**81**	**51.3**	4	2.5	1.55±0.762
8	Cooked food left at room temperature (winter and summer) for up to 2 h is unsafe for consumption.	0	0	0		60	38	**88**	**55.7**	10	6.3	1.32±0.587
	Use safe water and raw materials:											
9	Unboiled water from any source (rivers, streams, wells, water tanks) is unsafe for drinking and cooking purpose.	7	4.4	**136**	**86.1**	4	2.5	9	5.7	2	1.3	2.87±0.629
10	Checking food freshness (not damaged or rotting) is important.	11	7	**140**	**88.6**	7	4.4	0	0	0	0	3.03±0.338
11	Throwing away spoiled food (damaged, rotten, smells bad) is important.	15	9.5	**141**	**89.2**	2	1.3	0	0	0	0	3.08±0.319
12	Throwing away expired products is important.	3	1.9	**137**	**86.7**	17	10.8	1	0.6	0	0	2.90±0.3728

Table 5. Scores of perceived practices (N=158)

Q. No	Questions about perceived practices	Always		Most times		Sometimes		Not often		Never		M±SD
		N	%	N	%	N	%	N	%	N	%	
	Keep clean:											
1	Wash hands including nails with soap and water before & during food preparation for family and preparation of fermented products.	10	6.3	38	24.1	**64**	**40.5**	44	27.8	2	1.3	2.06±0.908
2	Clean food preparation surfaces with a cleaned wiping cloth before reuse.	0	0	30	19	**73**	**46.2**	54	34.2	1	0.6	1.84±0.730
3	Keep the waste basket in the kitchen covered.	0	0	23	14.6	33	20.9	**64**	**40.5**	38	24.1	1.26±0.985
4	Wash hands including nails with soap and water before serving food to the family.	0	0	19	12	**75**	**47.5**	61	38.6	3	1.9	1.70±0.702
	Separate raw and cooked:											
5	Use separate utensils, cutting boards & knife.	0	0	33	20.9	**62**	**39.2**	48	30.4	15	9.5	1.72±0.904
6	Store raw & cooked food separately.	15	9.5	53	33.5	**61**	**38.6**	29	18.4	0	0	2.34±0.887
	Cook thoroughly:											
7	Check that meat or poultry is not pink and soft before serving it.	**104**	**65.8**	27	17.1	17	10.8	10	6.3	0	0	3.42±0.919
8	Reheating cooked food until it is piping hot throughout.	3	1.9	19	12	34	21.5	**57**	**36.1**	45	28.5	1.23±1.05
	Keep food at safe temperatures:											
9	Keep meat and vegetables in a shaded area or covered container to prevent overheating.	0	0	42	26.6	47	29.7	**69**	**43.7**	0	0	1.83±0.823
10	Store leftovers in a cool place within two hours.	3	1.9	15	9.5	40	25.3	**84**	**53.2**	16	10.1	1.40±0.867
	Use safe water and raw materials:											
11	Check & discard expired food.	12	7.6	28	17.7	**65**	**41.1**	39	24.7	14	8.9	1.91±1.04
12	Wash fruits & vegetables before eating.	12	7.6	48	30.4	**65**	**41.1**	33	20.9	0	0	2.25±0.872
13	Boil drinking water until bubble formation is seen.	**139**	**88**	17	10.8	1	0.6	1	0.6	0	0	3.86±0.414
14	Regular (daily) washing of the utensil in which drinking water is kept.	0	0	9	5.7	34	21.5	**106**	**67.1**	9	5.7	1.27±0.655

Table 6. Pearson's correlation matrix

		Food safety practice		Food safety attitude	Food safety knowledge
Food safety practice	Pearson's r	—			
	df	—			
	p-value	—			
	N	—			
Food safety attitude	Pearson's r	0.274	***	—	
	df	156		—	
	p-value	< .001		—	
	N	158		—	
Food safety knowledge	Pearson's r	0.399	***	0.020	—
	df	156		156	—
	p-value	< .001		0.803	—
	N	158		158	—

Note. * p < .05, ** p < .01, *** p < .001

Table 7. Barrier to practicing good food safety habits

Barrier	N	%
1. Lack of education. Awareness and training to be provided	105	66.5
2. Financial instability. Schemes and incentives should be provided	53	33.5

4. Discussion

It is quite common in rural communities to see women engaged and manage both agricultural and household tasks. Alongside fieldwork, they often cook, fetch water, and care for their families, typically carrying a heavier workload than men (17). For most of them, the highest educational level is primary education and because of this, many may struggle to understand key food safety information, which can affect their ability to follow safe food handling practices at the household. People with lower socioeconomic status often have poorer food safety practices (18, 19). Their limited income means they may not be able to afford internet or digital devices, making it harder for them to access information on safe food handling, preparation, and storage

Interestingly, with most of them attended primary education, the respondent in the present study has a high level of food safety knowledge. This may be explained by how well food safety information is shared within the local community (20). In this area, people may learn good hygiene and cooking habits from family members, neighbours, or community traditions (21). These local ways of learning may be more effective than formal public health campaigns in Other places, where the information does not always match what people believe or practice. Another possible reason may be the way the study was conducted. The questions may have been easier to understand, when compared to other research that used more complex questions or relied on direct observation methods (22- 24).

Although most respondents showed good overall knowledge about food safety, they were less confident in some specific areas like cross-contamination and storing cooked food safely. These topics can be harder to understand because the dangers (pathogens like *Salmonella* or *E. coli*) are not visible and not often talked about in everyday life. People may not learn about them from family or local traditions. This shows that more focused education is needed in the particular contexts.

Regarding food safety attitude, respondents are positive toward basic food safety practices, like washing hands, throwing away spoiled food, and boiling water before drinking. These habits are commonly learned from the community and are often taught by parents, or through cultural traditions. Similar results have been found in other countries, like Saudi Arabia and Jordan, where many people also

understand the importance of good hygiene to prevent food poisoning (25, 26). However, there was a clear gap in how respondents felt about food safety when it came to temperature-related practices. More than half of them did not believe that leaving cooked food out overnight is unsafe. This is a serious issue because keeping cooked food at room temperature for too long can cause bacteria to grow quickly and lead to food poisoning. Similar results were found in a study in Palestine that showed only 28.2% of people avoided eating food left out for a long time, and many judged food safety based on how it looked or smelled (27).

Although many respondents have good knowledge and positive attitudes about food safety, they often don't consistently follow the recommended practices. There are several reasons for this gap between what people know and what they actually do. First, knowing the right steps doesn't always mean safe food handling becomes a habit, especially when people underestimate the risk of foodborne illness or think occasional mistakes won't cause problems (28). Also, some people lack the skills or resources, like proper refrigerators or heating materials which makes it hard to follow safety guidelines, particularly in places with fewer resources (29). Cultural and social habits also influence food safety behaviours. In many communities, certain unsafe practices are widely accepted and passed down through generations. For example, a study in Turkey found that many traditional food preparation methods did not align with modern food safety guidelines, highlighting the need for education that considers local customs and beliefs (30, 31). Finally, many people don't feel personally at risk for foodborne illnesses, especially if they haven't gotten sick before. A study conducted in Brazil supports this idea. It found that both restaurant customers and food handlers believed they were less likely than others to get food poisoning. This way of thinking, known as optimistic bias, can lead to risky food-related decisions and unsafe behaviour (32).

The results of the correlation analysis showed a moderate positive relationship between people's perceived food safety knowledge and their actual practices. This means that individuals who think they know more about food safety are more likely to follow safe food handling practices (33). However, since the correlation is only moderate, it also suggests that knowledge by itself is not enough to ensure good behaviour. Other things, like habits, time pressure, or environment, may also affect whether people apply what they know (34).

The study also found a weak and non-significant link between knowledge and attitude. In other words, just knowing about food safety does not automatically lead to a positive attitude towards it (35). This may be because attitudes are influenced by other factors, such as culture, beliefs, and social norms, not just knowledge (36).

Despite the weak connection between knowledge and attitude, the study showed that a positive attitude still helps improve food safety practices. In summary, all three factors, knowledge, attitude, and practice, were positively related to the overall food safety score, but actual practices had the strongest impact, showing that behaviour matters most when it comes to ensuring food safety.

This study showed that the main obstacles to practicing safe food habits in the community are a lack of education and financial challenges. These barriers

make it hard to access basic resources like clean water, soap, proper kitchen tools, and refrigerators. These shortages limit people's ability to practice safe food handling and increase the risk of food-related illnesses To overcome the barrier, available resources need to be explored and identified. A few solutions are water harvesting techniques to get access to water and using natural soap for handwashing and cleaning. The study area is situated in the Indo Burma biodiversity hotspot where Sapindus mukorossi or soap nut, commonly known as Reetha is easily available and is native to the region (37). It is known that the fruit of the soap berry have huge amount of saponins and commonly have been used as natural detergents and shampoos because of the ability to foam in water (38). Saponins are glycosides which are commonly derived from plants and are non-volatile compounds found in a wide range of plant species (39). Additionally, saponins have different functional properties such as pharmacological, insecticidal, antibiotic etc., (40). Saponins derived from Reetha are safe for human use as it does not show many harmful effects on the skin or eyes when it is used as a washing agent (41).

5. Conclusion

The study found that most IP in Huker Village have a good understanding and hold positive attitudes toward food safety. However, there is a noticeable gap between what household food handlers know and what they practice in their daily lives. Major barriers to following safe food habits are education and financial challenges that make it difficult for them to get access to necessary resources like clean water, proper storage, and hygiene supplies. Lastly, providing education and awareness programs relating to food safety and utilising natural soap, such as *Sapindus mukorossi* or soapnut found in the study area, can be used as an alternative to soap to ensure people have access to cleaning agents that can further improve food safety practices. Hence, by addressing both awareness and accessibility, lasting improvements in food safety can be achieved, leading to healthier and more resilient community.

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Author contribution

The authors worked collaboratively on the research and this is the outcome of the post graduate thesis of Kumrila Yimchunger.

Kumrila Yimchunger: wrote the original draft, conceptualization, methodology, investigation, data entry, curation and analysis.

Melodynia Marpna: supervision, conceptualization, methodology, review, editing and critical revision of the manuscript.

Declaration of competing interest

The author declares no competing interest

Data availability

The data used and/or analysed during the study are available from the corresponding author upon reasonable request**.**

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