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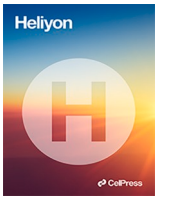

Research article

Poultry consumption and perceptions in Tehsil Shakargarh, Punjab, Pakistan: Implications for public health during COVID-19

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ABSTRACT

This study investigated the habits and attitudes of individuals towards poultry consumption, utilizing primary data collected through a survey of 5 households from 285 localities in Tehsil Shakargarh, Punjab, Pakistan (n = 1425). Household selection was randomized, and personal visits were conducted for data collection via formal interviews employing a structured questionnaire. Coordinates for each site were obtained using a Garmin eTrex device, in conjunction with meteorological data, to determine global positioning system (GPS) coordinates. A notable portion of respondents (38.8 %) possessed basic knowledge, while the majority (61.2 %) demonstrated intermediate knowledge regarding commercial broilers (chickens raised for meat production). A significant proportion (70.3 %) harbored misconceptions about the inclusion of hormones/antibiotics in poultry feed, with a minority (0.2 %) misinformed about broiler chickens' leg weakness. Some respondents (17.3 %) held both misconceptions, while others (12.2 %) had none. The majority (97.6 %) favored egg consumption, with 51.7 % preferring commercial chicken eggs and 48.3 % opting for domestic chicken eggs. Preference for white-colored eggs (51.5 %) slightly outweighed that for brown-colored eggs (48.5 %). A minority (1.3 %) speculated that poultry consumption could be a potential cause of COVID-19, while the majority (65.7 %) disagreed, and a portion (33.0 %) remained uncertain. Nearly all respondents (99.9 %) believed in the immunity-boosting properties of protein intake, with 65 % associating such benefits with poultry meat and eggs. Similarly, 99.7 % did not encounter difficulties in accessing poultry products during lockdowns. Approximately half (46.3 %) of respondents believed that consuming well-cooked and safely handled poultry meat was safe during outbreaks. Poultry meat and eggs emerged as potentially efficient sources of nutrition during the COVID-19 pandemic, especially for protein-deficient populations like Pakistan. Therefore, initiatives should focus on enhancing commercial poultry production and educating the populace about its advantages.

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1. Introduction

In response to the massive demand, food production has increased rapidly over the last 35 years; however, the per capita increase is only 20 % in response to a 70 % increase in the global human population [1]. In developing countries, the population has almost doubled, while the per capita food supply has increased by almost 30 %. As a result, the number of hungry and malnourished people is constantly increasing. A rapidly increasing population can lead to strict competition for food resources, especially in developing countries, and Pakistan is no exception. Pakistan is considered a protein-deficient (66 % of the population) nation with severe consequences for the overall health status of the masses [2].

The World Health Organization (WHO) suggested that the requirement for animal protein per individual per day is 27 g, but in Pakistan, this value is only 17 g [3,4]. Considering the animal protein sources, the poultry industry is playing a pivotal role in overcoming the gap between the demand and supply of animal proteins. Poultry contributes substantially to food security and nutrition by providing energy, protein, and essential micronutrients to humans; additionally, poultry have short production cycles and the ability to convert a wide range of agri-food byproducts and wastes into edible meat and eggs [5].

Based on recent statistics [6] and data from the Pakistan Poultry Association, Pakistan has emerged as the 11th largest poultry producer globally. The contribution from commercial poultry includes 2.028 million tons of meat and 19.170 billion eggs. However, the per capita availability of poultry meat in Pakistan remains at 5 kg per year, with 51 eggs, significantly lower than the figures seen in developed countries, where it stands at 41 kg of meat and 300 eggs annually [7].

While the poultry sector plays a significant role in providing animal protein, there exist numerous misconceptions among the general public regarding both commercial broiler meat and eggs from commercial layers. People are showing concern about raising chickens with a large number of antibiotics, which is stimulating the rise of antibiotic resistance in human pathogens [8]. Additionally, chickens are treated with hormones to ensure that they grow quickly to large sizes, but little is known about the fact that such progress in the growth, liveability, and health of chickens is also attributable to genetic selection and improved environmental settings [9]. People are also worried that eating eggs raises cholesterol, brown and white eggs offer nutritional differences, egg yolks should not be eaten, and eating eggs every day is bad for you [10]. Furthermore, another study reported that the UK public expressed a relatively high level of concern for poultry welfare and felt that standards were mid-range to low. In general, the public appears to want improvements in welfare but does not understand what this would entail [11].

During the COVID-19 pandemic, commercial chicken meat and eggs must be considered the food of choice for people to increase or boost immunity, although the misconception that chicken eggs and meat are a source of COVID-19 has spread through social media. There are different concepts and misconceptions about chicken meat and eggs in each segment of society. If one segment has the issue of affordability, others may have the issue of product quality. Others may have misconceptions about the use of antibiotics, hormones,

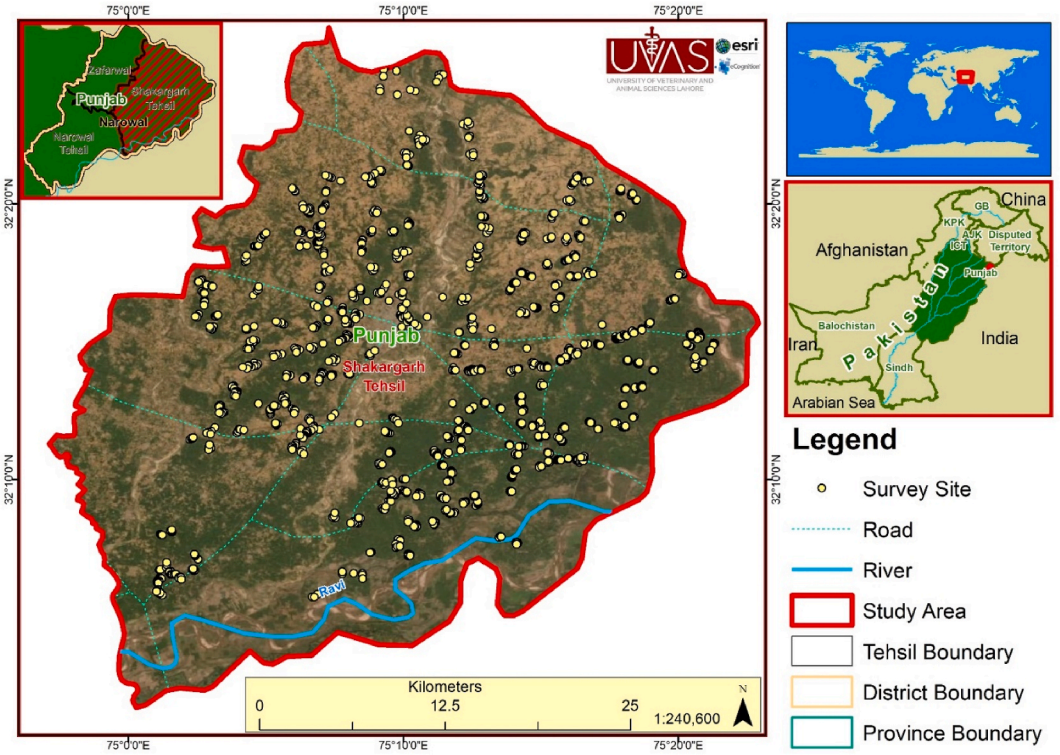

Fig. 1. Study area Map.

and poultry products as a source of early maturity in females. Conducting surveys can help identify the factors that influence the consumption of poultry meat and eggs and can provide insights into how to improve their consumption. Currently, it is unclear which facts or misconceptions need to be addressed and for which segments of society; hence, a thorough study is needed. The objective of the proposed study was to evaluate the perceptions of people in different segments of society about commercial poultry meat and eggs, especially during post-COVID-19 scenarios.

2. Materials and methods

The study was conducted in Tehsil Shakargarh, Punjab, Pakistan (Fig. 1). Shakargarh is located at 32°16′0 N 75°10′0E at an altitude of 268 m (879 ft). The city experiences a sweltering, humid, and mostly clear climate with temperatures ranging from 6 °C in winter to 39 °C in summer.

2.1. Data collection

The research encompassed gathering primary data by conducting a survey among 5 households from 285 villages and cities (n = 1425) within Tehsil Shakargarh, Punjab, Pakistan. The households were randomly selected, and personal visits were made to conduct formal interviews and administer questionnaires for data collection. Informed consent was obtained from all participants in this study. The global positioning system (GPS) coordinates of each site were taken through the Garmin e Trex device, and meteorological data were incorporated.

2.2. Statistical analysis

The data were collected from the respondents (from October 2022 to February 2023) through a structured questionnaire; for logical interpretation, the data were compiled, tabulated, and subjected to appropriate statistical analysis, such as frequency distribution and percentage analysis, by using SAS software (version 9.1.). The associations between variables were computed through the chi-square test.

3. Results

3.1. Demographic profile

Of the 1425 respondents, 1396 (98.0 %) were male and 29 (2.0 %) were female. The majority of the respondents (43.0 %) were between 38 and 47 years of age. People of Tehsil Shakargarh are predominantly educated (high school and college or university level); when evaluating the respondents according to job distribution, 42.1 % were private employees, while 23.6 % were govt. employees, 28.5 % were businessmen, 1.0 % were students and 4.8 % were jobless. The monthly income of average responders was in the range of 130–162 USD, while small proportions of people (0.1 %) were below 60 USD. The majority of the people reside in rural areas, as the rural population comprises 98.5 %, compared to the urban population, which comprises just 1.5 %.

3.2. Responses to meat-related Questions

About 38.8 % of respondents displayed basic knowledge, whereas 61.2 % exhibited intermediate knowledge regarding commercial broilers (chickens raised for meat production). The majority of individuals (70.3 %) held misconceptions concerning the addition of hormones/antibiotics to poultry feed. Only 0.2 % harbored misconceptions regarding leg weakness in broiler chickens, whereas 17.3 % had misconceptions about both antibiotic/hormone addition and leg weakness in broiler chickens. Additionally, 12.2 % of respondents did not hold any misconceptions about broiler meat. Most of the respondents (87.4 %) thought that steroids or hormones and antibiotics are being added to chicken feed and that they have an impact on human health; 12.6 % did not think of them the same way. Almost 20.5 % of people thought that the broiler matures earlier and has a negative impact on human health; in contrast, 79.4 % of people thought against this idea, and 0.1 % of people were not sure about it. Only 20.2 % of the responders reported misconception that broilers do not have enough energy to stand on their legs or to give energy to a human being after consumption, while 79.7 % did not have this misconception, and 0.1 % were not sure. Approximately 20.1 % of the respondents were in favor of the statement that chicken feed contains harmful ingredients, 43.4 % were against this statement, and 36.5 % were not sure. The majority of people (74.4 %) preferred chicken meat because it is convenient to cook, 25.3 % of people preferred it because of its nutritional profile, and 0.3 % preferred it because of children's preferences. Approximately 38.5 % of the respondents preferred the thigh portion, 37.9 % preferred the chest portion, and 23.6 % preferred whole meat. Approximately 43.3 % of people liked to eat chicken in curry form, 50.6 % liked to eat in karahi form, and 6.2 % liked to eat roasted chicken. Almost all the responders (99.9 %) had nearby poultry meat shops in their vicinity, while only 0.1 % had far access to poultry meat shops. Most of the responders (72.9 %) consumed chicken once a week, 27.0 % consumed it twice a week, and only 0.1 % consumed it thrice a week. The broiler market price affected the purchasing power of 9.1 % of people but did not affect the majority of the people (89.3 %), and 1.5 % of people were not sure about it. Approximately 76.2 % of people had an idea about processed chicken meat, 23.6 % did not have any idea, and 0.2 % were not sure. The majority of respondents (76.0 %) thought media had played an effective role in broiler meat consumption, 2.7 % did not think the same, and 21.3 % were not sure about it. Only 0.5 % of the respondents played an effective role in chicken consumption, and 99.5 % did not play any role.

Table 1
People's knowledge about commercial poultry meat and eggs (N = 1425).

What is the frequency of your chicken meat consumption?						
Gender	N	Once a week (%)	Twice a week (%)	Thrice a week (%)	χ^2	*p*-value[a]
Male	1396	72.9	27.0	0.1	0.03	0.987
Female	29	72.4	27.6	0.0		
Age (years)						
18–27	58	94.8	5.2	0.0	44.21	0.000
28–37	405	78.8	21.2	0.0		
38–47	613	70.8	29.2	0.0		
48–57	253	65.6	34.4	0.0		
58–67	96	67.7	31.2	1.0		
Job						
Govt. Employee	337	71.8	28.2	0.0	47.32	0.000
Private Employee	600	78.3	21.7	0.0		
Personal Business	406	62.3	37.4	0.2		
Student	14	100.0	0.0	0.0		
Jobless	68	88.2	11.8	0.0		
Monthly Income						
Below 15000 PKR	1	100.0	0.0	0.0	617.78	0.000
15000-25000 PKR	185	97.3	2.7	0.0		
26000-35000 PKR	454	99.6	0.4	0.0		
36000-45000 PKR	587	38.3	61.7	0.0		
46000+ PKR	198	91.4	8.1	0.5		
Which meat portion do you prefer?						
Gender	N	Thigh (%)	Chest (%)	Whole (%)	χ^2	*p*-value
Male	1396	38.5	37.9	23.6	0.32	0.854
Female	29	34.5	37.9	27.6		
Age (years)						
18–27	58	48.3	37.9	13.8	8.89	0.351
28–37	405	37.8	36.3	25.9		
38–47	613	36.4	39.3	24.3		
48–57	253	39.5	38.7	21.7		
58–67	96	45.8	33.3	20.8		
Does the broiler market price affect your purchasing power?						
Job	N	Yes (%)	No (%)	Not Sure (%)	χ^2	*p*-value[a]
Govt. Employee	337	10.7	88.1	1.2	87.53	0.000
Private Employee	600	10.7	87.8	1.5		
Personal Business	406	1.0	96.8	2.2		
Student	14	28.6	71.4	0.0		
Jobless	68	32.4	67.6	0.0		
Does the broiler market price affect your purchasing power?						
Monthly Income						
Below 15000 PKR	1	0.0	100.0	0.0	829.07	0.000
15000-25000 PKR	185	64.9	35.1	0.0		
26000-35000 PKR	454	0.4	99.3	0.2		
36000-45000 PKR	587	1.4	97.1	1.5		
46000+ PKR	198	0.0	93.9	6.1		
Do you have any knowledge about processed chicken meat?						
Gender	N	Yes (%)	No (%)	Not Sure (%)	χ^2	*p*-value[a]
Male	1396	76.3	23.5	0.2	0.32	0.852
Female	29	72.4	27.6	0.0		
Education						
Illiterate	77	64.9	35.1	0.0	78.95	0.000
Primary School	280	60.4	38.9	0.7		
High School	656	76.8	23.0	0.2		
College/University	412	88.1	11.9	0.0		
Do you like to consume eggs?						
Gender						
Male	1396	97.6	2.4	0.0	0.14	0.507
Female	29	96.6	3.4	0.0		
Age (years)						
18–27	58	96.6	3.4	0.0	5.35	0.253
28–37	405	96.5	3.5	0.0		
38–47	613	97.7	2.3	0.0		
48–57	253	98.4	1.6	0.0		
58–67	96	100.0	0.0	0.0		
What is your egg consumption frequency?						
Age	N	Daily (%)	Twice a week (%)	Five times a week (%)	χ^2	*p*-value[a]
18–27	58	48.2	51.8	0.0	21.73	0.000
28–37	405	58.4	41.6	0.0		

(*continued on next page*)

Table 1 (*continued*)

What is the frequency of your chicken meat consumption?						
Gender	N	Once a week (%)	Twice a week (%)	Thrice a week (%)	χ^2	*p*-value[a]
38–47	613	66.1	33.9	0.0		
48–57	253	73.1	26.9	0.0		
58–67	96	66.7	33.3	0.0		
Job						
Govt. Employee	337	63.1	36.9	0.0	33.18	0.000
Private Employee	600	62.2	37.8	0.0		
Personal Business	406	73.2	26.8	0.0		
Student	14	30.8	69.2	0.0		
Jobless	68	43.5	56.5	0.0		
Monthly Income						
Below 15000 PKR	1	0.0	100	0.0	402.20	0.000
15000-25000 PKR	185	5.9	94.1	0.0		
26000-35000 PKR	454	61.6	38.4	0.0		
36000-45000 PKR	587	88.1	11.9	0.0		
46000+ PKR	198	47.0	53.0	0.0		
What is your egg consumption frequency in summer?						
Gender	N	Increases (%)	Decreases (%)	Remains Constant (%)	χ^2	*p*-value
Male	1396	0.4	99.3	0.3	0.19	0.911
Female	29	0.0	100.0	0.0		
Education						
Illiterate	77	0.0	100.0	0.0	0.95	0.988
Primary School	280	0.4	99.2	0.4		
High School	656	0.5	99.2	0.3		
College/University	412	0.2	99.6	0.2		

[a] Significant at $p \leq 0.05$.

3.3. Responses to egg-related Questions

All the respondents (100 %) had basic knowledge about egg sources. Almost 91.4 % had basic knowledge, while 8.6 % had advanced knowledge about egg nutritional profiles. A large majority (97.6 %) of respondents expressed a preference for consuming eggs, while a minority (2.4 %) did not favor egg consumption. Nearly all responders (99.9 %) indicated a preference for chicken eggs, with only a negligible fraction (0.1 %) favoring duck eggs. Around 51.7 % of participants favored commercially sourced eggs, while 48.3 % preferred eggs from local sources. Preferences for eggshell color were split, with 51.5 % of respondents favoring white eggs and 48.5 % expressing a preference for brown eggs. All the responders (100 %) liked to eat an egg for breakfast. Most of the responders (48.1 %) liked to eat hard-boiled, 0.6 % liked soft-boiled, 35.3 % liked fried, and 15.9 % liked the omelette form of eggs. The majority of the respondents (64.5 %) consumed eggs daily, while 35.5 % consumed them twice a week. Only 0.4 % of people believed that the frequency of eating eggs in summer increased, 99.4 % believed that the frequency of eating eggs decreased, and 0.3 % believed that the frequency of eating eggs remained constant. All the respondents (100 %) favored an increase in the frequency of eating eggs in winter. Approximately 93.0 % of the respondents favored and 7.0 % did not favor the consumption of eggs by young females. Only 7.4 % of people believed that females mature earlier after eating eggs, while the majority (65.9 %) did not believe so, and 26.7 % of people were not sure about it. The majority of respondents (92.6 %) favored the consumption of eggs by pregnant women, 2.8 % of respondents did not favor it, and 4.6 % were not sure. The majority of the people (86.1 %) expected that birds were injected with hormones to help with egg laying, 13.4 % did not think the same, and 0.5 % were not sure about it. Approximately 3.3 % of people favored the existence of artificial eggs (made by using various types of raw materials, colors and flavors) on the market, in contrast with 56.8 % of people who were against this favor, and 39.9 % were not sure. Most of the respondents (99.6 %) had nearby poultry egg shops in their vicinity, while only 0.4 % had remote access to poultry egg shops. The majority of respondents (66.9 %) thought media had played an effective role in chicken egg consumption, 2.9 % did not think about the same, and 30.2 % were not sure about it. Only 0.5 % of the respondents believed they themselves played an effective role in egg consumption, 99.0 % did not play any role, and 0.5 % were not sure about egg consumption.

3.4. Responses to the pandemic COVID-19 Questions

The majority of respondents (67.2 %) had primary knowledge about COVID-19, and 32.8 % had intermediate knowledge about COVID-19. Most of the respondents (68.9 %) believed that COVID-19 was present, 18.5 % did not believe that it was present, and 12.6 % of the respondents were neutral. Only a small fraction (1.3 %) of individuals anticipated that consuming poultry could potentially lead to COVID-19, while the majority (65.7 %) did not share this belief, and 33.0 % remained uncertain. Nearly all respondents (99.9 %) held the belief that protein intake contributes to strengthening immunity, with only 0.1 % expressing doubt. All participants (100 %) acknowledged poultry meat and eggs as the most affordable protein sources. Sixty-five percent of respondents believed that poultry meat and eggs could enhance immunity, while 2.5 % disagreed, and 32.5 % remained undecided. Approximately 98.9 % of the responders expected the frequency of eating eggs during the pandemic to be the same; 0.1 % thought this frequency increased, and 0.9 %

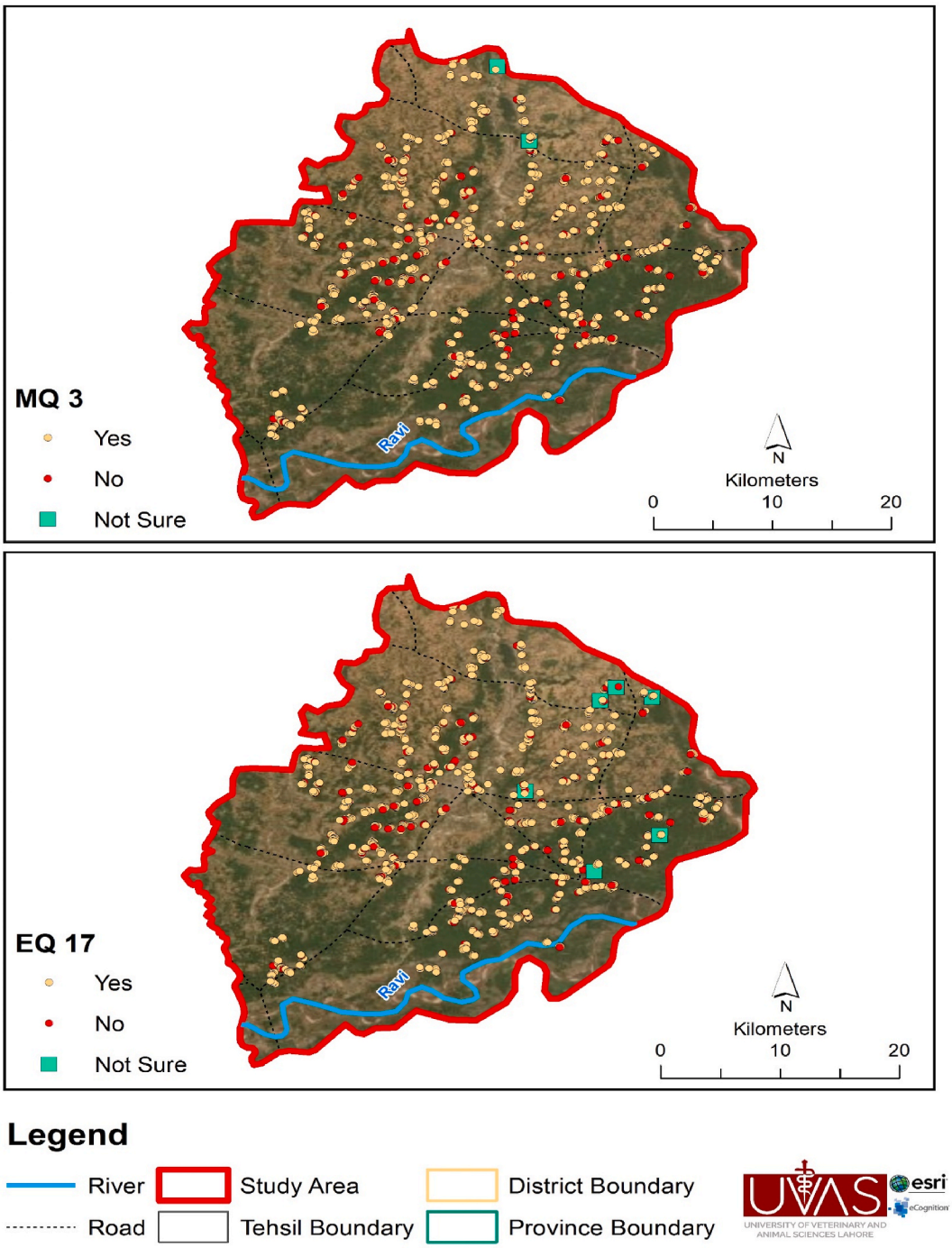

Fig. 2. Trend of people's perception about commercial poultry meat and eggs; MQ3 = Do you think steroids or hormones are being added to chicken feed and it has an impact on human health? EQ17 = Do you think hormones are being injected into the birds to take eggs.?.

thought it decreased. Merely 0.3 % of individuals encountered challenges in accessing poultry, while an overwhelming 99.7 % reported no difficulty in accessing poultry meat and eggs during the lockdown. Approximately 46.3 % of respondents held the belief that consuming well-cooked and safely handled meat during an outbreak was safe, contrasting with 0.5 % who did not share this belief, and 53.2 % who were unsure.

Table 2
Steroids, hormones, and antibiotics related poultry myths (N = 1425).

Do you think steroids or hormones are being added to chicken feed and it has an impact on human health?						
Gender	N	Yes (%)	No (%)	Not Sure (%)	χ^2	*p*-value[a]
Male	1396	87.4	12.5	0.1	0.06	0.970
Female	29	86.2	13.8	0.0		
Age (years)						
18–27	58	94.8	5.2	0.0	15.51	0.050
28–37	405	90.1	9.9	0.0		
38–47	613	87.3	12.7	0.0		
48–57	253	83.0	16.6	0.4		
58–67	96	83.3	16.7	0.0		
Education						
Illiterate	77	93.5	6.5	0.0	12.09	0.060
Primary School	280	90.0	9.6	0.4		
High School	656	87.3	12.7	0.0		
College/University	412	84.5	15.5	0.0		
Do you think antibiotics are being added to chicken feed and it has an impact on human health?						
Gender						
Male	1396	87.4	12.6	0.0	0.04	0.849
Female	29	86.2	13.8	0.0		
Age (years)						
18–27	58	94.8	5.2	0.0	11.57	0.021
28–37	405	90.1	9.9	0.0		
38–47	613	87.3	12.7	0.0		
48–57	253	83.4	16.6	0.0		
58–67	96	82.3	17.7	0.0		
Education						
Illiterate	77	93.5	6.5	0.0	9.18	0.027
Primary School	280	90.7	9.3	0.0		
High School	656	87.2	12.8	0.0		
College/University	412	84.2	15.8	0.0		
Do you think broiler chicken matures earlier and has a bad impact on human health?						
Gender	N	Yes (%)	No (%)	Not Sure (%)	χ^2	*p*-value[a]
Male	1396	20.6	79.4	0.1	0.21	0.898
Female	29	17.2	82.8	0.0		
Age (years)						
18–27	58	27.6	72.4	0.0	7.33	0.50
28–37	405	19.5	80.2	0.2		
38–47	613	19.1	80.9	0.0		
48–57	253	21.7	78.3	0.0		
58–67	96	26.0	74.0	0.0		
Education						
Illiterate	77	33.8	66.2	0.0	18.64	0.005
Primary School	280	26.1	73.9	0.0		
High School	656	18.1	81.7	0.2		
College/University	412	18.0	82.0	0.0		
Do you think chicken feed contains haram (Religiously Prohibited) ingredients?						
Gender						
Male	1396	20.2	43.5	36.3	0.89	0.641
Female	29	17.2	37.9	44.8		
Age (years)						
18–27	58	27.6	17.2	55.2	42.14	0.0001
28–37	405	18.8	37.3	44.0		
38–47	613	18.9	46.0	35.1		
48–57	253	21.3	51.4	27.3		
58–67	96	26.0	46.9	27.1		
Education						
Illiterate	77	32.5	32.5	35.1	27.68	0.0001
Primary School	280	25.7	36.4	37.9		
High School	656	17.8	43.0	39.2		
College/University	412	17.7	50.7	31.6		
Do you think hormones are being injected into the birds for egg production?						
Gender						
Male	1396	86.1	13.4	0.5	0.15	0.928
Female	29	86.2	13.8	0.0		
Age (years)						
18–27	58	93.1	6.9	0.0	16.21	0.039
28–37	405	89.6	10.1	0.2		
38–47	613	86.3	13.2	0.5		
48–57	253	80.6	18.6	0.8		

(*continued on next page*)

Table 2 (*continued*)

Do you think steroids or hormones are being added to chicken feed and it has an impact on human health?						
Gender	N	Yes (%)	No (%)	Not Sure (%)	χ^2	*p*-value[a]
58–67	96	80.2	18.8	1.0		
Education						
Illiterate	77	89.6	10.4	0.0	11.30	0.080
Primary School	280	88.6	10.0	1.4		
High School	656	85.8	13.9	0.3		
College/University	412	84.2	15.5	0.2		
Do you think females physically mature earlier after eating eggs?						
Gender	N	Yes (%)	No (%)	Not Sure (%)	χ^2	*p*-value[a]
Male	1396	7.4	65.9	26.7	0.41	0.816
Female	29	10.3	65.5	24.1		
Education						
Illiterate	77	16.9	54.5	28.6	58.46	0.000
Primary School	280	15.4	56.4	28.2		
High School	656	6.1	66.6	27.3		
College/University	412	2.4	73.3	24.3		

[a] Significant at $p \leq 0.05$.

3.5. People's knowledge about commercial poultry meat and eggs

In general, age ($\chi^2 = 44.21$; $p = 0.0001$), job ($\chi^2 = 47.32$; $p = 0.0001$), and monthly income ($\chi^2 = 617.78$; $p = 0.0001$) were positively correlated with the frequency of chicken meat consumption. Interestingly, sex ($\chi^2 = 0.32$; $p = 0.854$) and age ($\chi^2 = 8.89$; $p = 0.351$) had no association with the preference for the meat portion (Table 1). In addition, there was a significant correlation between job ($\chi^2 = 87.53$; $p = 0.0001$) and monthly income ($\chi^2 = 829.07$; $p = 0.0001$) on the purchasing power of broiler meat according to the market price. Broiler market price fluctuations did not affect the purchasing power of almost every job or monthly income group, except for those with an income ranging from 15000 to 25000 PKR. Educated people, irrespective of sex, were more inclined toward processed chicken meat ($\chi^2 = 78.95$; $p = 0.0001$). Neither sex ($\chi^2 = 0.14$; $p = 0.507$) nor age ($\chi^2 = 5.35$; $p = 0.253$) was related to the likelihood of egg consumption. In general, age group ($\chi^2 = 21.73$; $p = 0.0001$), job ($\chi^2 = 33.18$; $p = 0.0001$), and monthly income ($\chi^2 = 402.20$; $p = 0.0001$) were positively correlated with the frequency of egg consumption. Most of the age and job groups preferred

Table 3
Role of media in poultry meat and eggs consumption (N = 1425).

Do you think media has played an effective role in broiler meat consumption?						
Gender	N	Yes (%)	No (%)	Not Sure (%)	χ^2	*p*-value[a]
Male	1396	76.1	2.7	21.3	0.23	0.893
Female	29	72.4	3.4	24.1		
Age (years)						
18–27	58	46.6	3.4	50.0	92.05	0.000
28–37	405	65.2	3.7	31.1		
38–47	613	78.6	2.8	18.6		
48–57	253	86.6	1.6	11.9		
58–67	96	94.8	0.0	5.2		
Education						
Illiterate	77	66.2	6.5	27.3	82.55	0.000
Primary School	280	59.6	5.4	35.0		
High School	656	76.5	2.3	21.2		
College/University	412	88.1	0.7	11.2		
Do you think media has played a specific role in chicken egg consumption?						
Gender						
Male	1396	66.8	2.9	30.2	1.05	0.592
Female	29	72.4	0.0	27.6		
Age (years)						
18–27	58	37.9	5.2	56.9	108.62	0.000
28–37	405	52.8	4.0	43.2		
38–47	613	69.7	2.8	27.6		
48–57	253	79.8	2.0	18.2		
58–67	96	92.7	0.0	7.3		
Education						
Illiterate	77	58.4	5.2	36.4	72.68	0.000
Primary School	280	50.4	6.1	43.6		
High School	656	67.1	2.4	30.5		
College/University	412	79.6	1.0	19.4		

[a] Significant at $p \leq 0.05$.

eating eggs daily, except for people with an income ranging below 15000 and 15000–25000 PKR, who preferred to consume eggs twice a week. Gender ($\chi^2 = 0.19$; $p = 0.911$) and age ($\chi^2 = 0.95$; $p = 0.988$) did not influence the frequency of eating eggs in summer, and educated people of both genders thought that the frequency of eating eggs decreased in summer (Table 1).

3.6. Steroid-, hormone-, and antibiotic-related poultry myths

All the people in different age groups ($\chi^2 = 15.51$; $p = 0.050$), ($\chi^2 = 42.14$; $p = 0.0001$) thought that steroids, hormones and religiously prohibited ingredients are being added to chicken feed and that they have an impact on human health (Fig. 2). People in different age groups ($\chi^2 = 11.57$; $p = 0.021$) and education levels ($\chi^2 = 9.18$; $p = 0.027$) also thought that antibiotics were being added to chicken feed. Furthermore, people of different education levels ($\chi^2 = 18.64$; $p = 0.005$) believe that broilers mature earlier due to specialized feed, which can affect human health. Education was positively correlated ($\chi^2 = 58.46$; $p = 0.0001$) with people's perception that frequent eating of poultry meat and eggs may cause early physical maturity in females (Table 2).

3.7. Role of media in poultry meat and egg consumption

Age ($\chi^2 = 92.05$; $p = 0.0001$), age ($\chi^2 = 108.62$; $p = 0.0001$), education ($\chi^2 = 82.55$; $p = 0.0001$), and education ($\chi^2 = 72.68$; $p = 0.0001$) were positively correlated people's perceptions of commercial poultry, and they generally believed that media has played an effective role in increasing the consumption of meat and eggs (Table 3).

3.8. People's perceptions of poultry meat and eggs during a pandemic

Gender, age and education were positively correlated with people's perception of eating poultry during the COVID-19 pandemic. Most people of different genders ($\chi^2 = 6.96$; $p = 0.031$), age groups ($\chi^2 = 16.93$; $p = 0.031$) and education levels ($\chi^2 = 25.49$; $p = 0.0001$) did not think that eating poultry is a potential cause of COVID-19. Moreover, there are general beliefs among people of different ages ($\chi^2 = 29.42$; $p = 0.0001$) and education levels ($\chi^2 = 37.73$; $p = 0.0001$) that poultry meat and eggs are effective at enhancing immunity; however, the majority of people aged 18–27 years are not sure about these issues. However, the relationship among people of different ages ($\chi^2 = 4.29$; $p = 0.830$), jobs ($\chi^2 = 5.57$; $p = 0.696$) and monthly incomes ($\chi^2 = 7.44$; $p = 0.490$) with the frequency of eating poultry meat and eggs during the pandemic were not statistically significant (Fig. 3) (Table 4).

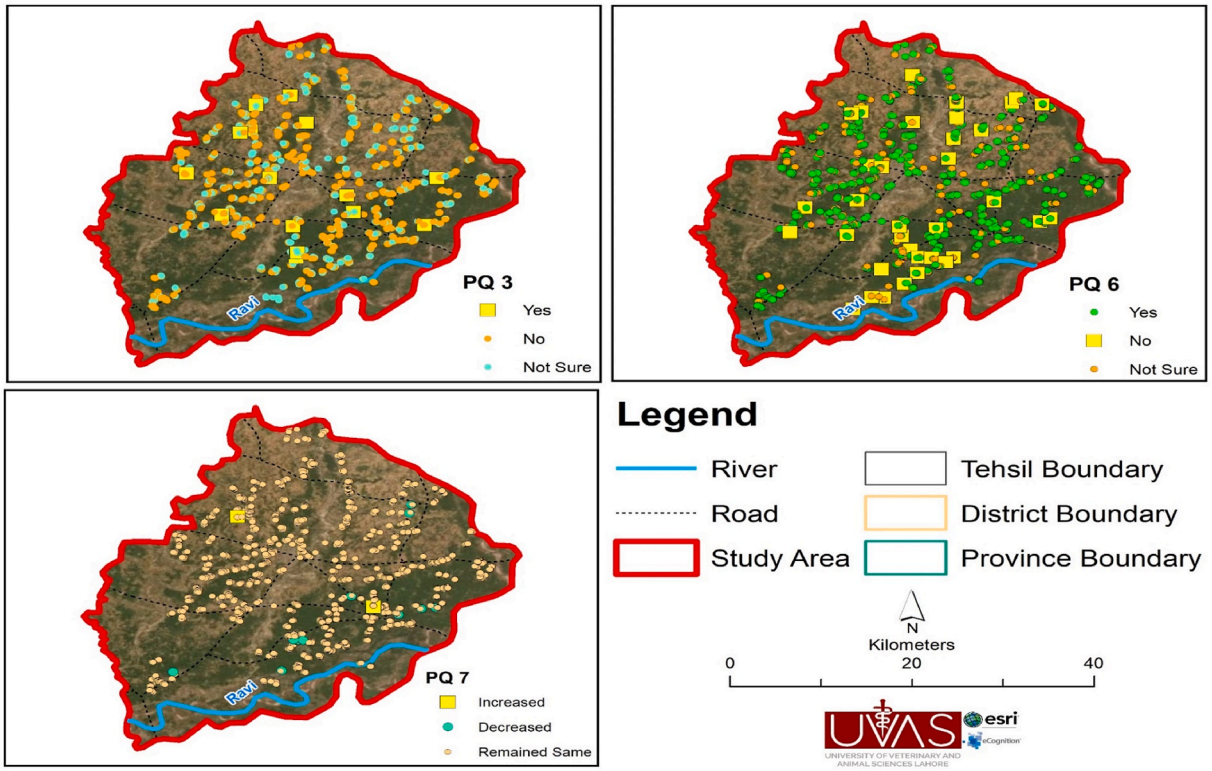

Fig. 3. Trend of people's perception about commercial poultry meat and eggs during pandemic (COVID-19); PQ3 = Do you think eating poultry is a potential cause of corona? PQ6 = Do you think poultry meat and eggs are effective to enhance immunity? PQ7 = In Pandemic, eating frequency of eggs.?.

4. Discussion

A survey was conducted in Tehsil Shakargarh, Punjab, Pakistan, to evaluate the perceptions of the general public about commercial poultry meat and eggs. Tehsil Shakargarh had a dense population of people between 38 and 47 years of age. People predominantly reside in rural areas and perform private jobs with an average monthly income of 36000–45000/- PKR. Moreover, Tehsil Shakargarh is famous for its literacy rate, where the majority of the people are highly educated to high school and college or university level. Most of the population has moderate knowledge about commercial broilers, but often have misconceptions that the addition of antibiotics and hormones to feed is a major cause of rapid growth in broiler chickens and has adverse effects on human health. Some people also believe that steroids are major constituents of chicken feed. To promote the consumption of commercial chickens in this area, people should be educated through consumer awareness campaigns/programs because steroids and hormones are generally found in nature and cannot be added to chicken diets due to the high temperature in the pelleting machine. The only way by which one can administer steroids and hormones is by injection, and it is impossible to inject approximately 1.4 billion broilers annually without increasing the cost of production [12]. In some areas, despite concerns about the addition of antibiotics or hormones to feed, the majority of people do not believe that the rapid growth of broiler chickens has a negative impact on human health. They even did not believe in the statement that broilers do not have enough energy to stand on their legs, as this is how they can give energy to a human being after consumption.

Table 4
People perception about poultry meat and eggs during the pandemic COVID-19 (N = 1425).

Do you think eating poultry is a potential cause of corona (COVID-19)?						
Gender	N	Yes (%)	No (%)	Not Sure (%)	χ^2	*p*-value[a]
Male	1396	1.2	65.8	33.0	6.96	0.031
Female	29	6.9	62.1	31.0		
Age (years)						
18–27	58	3.4	44.8	51.7	16.93	0.031
28–37	405	1.2	63.0	35.8		
38–47	613	1.3	67.7	31.0		
48–57	253	0.8	68.8	30.4		
58–67	96	2.1	68.8	29.2		
Education						
Illiterate	77	1.3	53.2	45.5	25.49	0.000
Primary School	280	2.1	57.1	40.7		
High School	656	0.8	66.8	32.5		
College/University	412	1.7	72.1	26.2		
Do you think poultry meat and eggs are effective to enhance immunity?						
Male	1396	65.0	2.4	32.6	2.46	0.293
Female	29	65.5	6.9	27.6		
Age (years)						
18–27	58	39.7	3.4	56.9	29.42	0.000
28–37	405	60.0	3.0	37.0		
38–47	613	68.2	2.8	29.0		
48–57	253	69.6	2.0	28.5		
58–67	96	68.8	0.0	31.2		
Education						
Illiterate	77	53.2	6.5	40.3	37.73	0.000
Primary School	280	56.4	5.7	37.9		
High School	656	65.5	1.7	32.8		
College/University	412	72.1	1.0	26.9		
In Pandemic, eating frequency of eggs:						
Age	N	Increased (%)	Decreased (%)	Remained Same (%)	χ^2	*p*-value
18–27	58	0.0	0.17	98.3	4.29	0.830
28–37	405	0.0	0.5	99.5		
38–47	613	0.3	1.1	98.5		
48–57	253	0.0	0.8	99.2		
58–67	96	0.0	1.0	99.0		
Job						
Govt. Employee	337	0.3	1.5	98.2	5.57	0.696
Private Employee	600	0.2	0.3	99.5		
Personal Business	406	0.0	1.2	98.8		
Student	14	0.0	0.0	100.0		
Jobless	68	0.0	1.5	98.5		
Monthly Income						
Below 15000 PKR	1	0.0	0.0	100.0	7.44	0.490
15000-25000 PKR	185	0.0	2.2	97.8		
26000-35000 PKR	454	0.2	0.4	99.3		
36000-45000 PKR	587	0.2	1.2	98.6		
46000+ PKR	198	0.0	0.0	100.0		

[a] Significant at $p \leq 0.05$.

Moreover, people were not sure about the presence of *haram* or religiously prohibited ingredients in chicken feed. An Islamic Scholar in Pakistan, Mufti Muneeb-ur-Rehman, stated in an interview that broiler meat is *halal* in Islam, but it is not mentioned whether poultry feed was *halal* or *pakeeza* (pure or high-quality). If a bird feeds itself with waste material, then it is better to keep that bird under human captivity for at least 3 days before slaughtering, and that bird should be fed a hygienic diet. Commercial poultry feed is hygienic and free from any type of waste material because when different types of ingredients are mixed to give it a proper form, the original shape changes [13]. The majority of the people in Tehsil Shakargarh preferred chicken meat (especially chicken curry), as it is convenient to cook. The major reason for this demand could be that people had nearby access to poultry meat shops in their vicinity. Similarly, another study carried out at a university in the UK reported that flesh color/appearance and convenience were the most important factors for choosing chickens. Flesh appearance was taken to indicate product freshness and healthfulness (including fat content). Convenience was discussed with reference to the preferred cutoff of chickens and product versatility [14]. In contrast, in a study in the Kumi District of Uganda, 70 % of individual consumers considered taste to be the priority when choosing chickens [15]. People in Tehsil Shakargarh usually liked to eat thigh portions of chicken meat, which could be attributed to their personal choices established over the years; however, a contradictory study at the University of the UK reported consumer preferences for buying meat in portions, particularly in fillets, with no bones or skin. Chicken breasts were favored because they were not as evidently or visibly part of an animal [14]. Most of the population of Tehsil Shakargarh consumes chickens once a week, and the broiler market price does not affect their purchasing power. These findings are in agreement with the findings of studies carried out in the Kumi district of Uganda and in the Phnom Penh and Siem Reap Cambodia, which revealed that 57.5 % of the consumers preferred chicken once a week [15], and overall, 56 % of respondents reported that the current prices of poultry products are reasonable and acceptable for their income levels [16]. As most of the people are highly educated in Tehsil Shakargarh, they had the knowledge of processed chicken meat. Similarly, findings from West Bengal, India, reported that the demand for chicken meat, eggs and processed chicken products by consumers was also augmented during the later phase of the lockdown due to increased faith in animal protein as an immune booster [17]. The people of Tehsil Shakargarh believe that media has played an effective role in broiler meat consumption over the decade. A similar study in Phnom Penh and Siem Reap, Cambodia, also reported that over the past two years, almost all respondents have received recommendations about food and poultry safety from media and sources such as television, radio, billboards and relatives or neighbors; television (97 percent); radio (64 percent); billboards (45 percent); and relatives or neighbors (34 percent) [16].

Almost all the population of Tehsil Shakargarh had basic knowledge about egg sources, and the majority had basic knowledge about egg nutritional profiles. Most of the population liked to consume eggs, and they preferred commercial chicken white boiled eggs at breakfast on a daily basis. Similarly, a study in the Kumi district of Uganda revealed that 75 % of consumers bought exotic egg laying birds due to the easy availability of chicken eggs [15]. In another study of Phnom Penh and Siem Reap Cambodia, the purchase of chicken eggs for home consumption was found to be less common than the purchase of duck eggs. Approximately 40 % of the respondents of Phnom Penh and Siem Reap reported that they purchased chicken eggs, usually weekly. These consumers were reported from all household sizes and income levels. Cooking convenience was the main reason for purchasing chicken eggs, ahead of other preference criteria such as price, safety and freshness. Consumers purchase mainly from markets and grocery stores near their homes [16]. The people of Tehsil Shakargarh thought that the frequency of eating eggs decreases in summer and increases in winter. Most of the people favored the consumption of eggs by young and pregnant females, and they believed that neither the earlier physical maturity of females after eating eggs nor excessive hair growth on the female face was linked to the consumption of eggs. A recent study of pregnant women and schoolchildren in India indicated that rearing backyard poultry increased the frequency of weekly egg consumption and reduced the percentage of malnourished children [17]. The majority of people still believe the concept that hormones are injected into birds for egg production, and they do not accept the existence of artificial eggs on the market. Egg shops are available in nearby vicinity in almost all the areas.

The majority of residents are well aware of COVID-19, have primary knowledge about it, and believe in the existence of this disease. Most people believe that eating poultry is not a potential source of this disease. However, a study from West Bengal, India, reported that rumors about the spread of the SARS-CoV-2 virus through poultry meat caused a further collapse in the domestic market economy [17]. The majority of people know that poultry meat and eggs are the cheapest sources of protein available for enhancing the immunity required these days. This finding is in agreement with a study in which inexpensive poultry meat and eggs contributed comparatively more protein than cow milk, mutton, pork and beef per unit of human intake [17]. Throughout the COVID-19 pandemic, the reported frequency of egg consumption in Tehsil Shakargarh has remained consistent, and individuals have not encountered any challenges regarding the availability of poultry meat and eggs. However, contradictory studies have also reported increased egg consumption during the pandemic (COVID-19) due to the frequent use of eggs for cooking at home and stockpiling necessary food items [18]. The potential growth of the poultry industry was globally halted during the COVID-19 pandemic, despite poultry birds not being directly affected by the virus [17].

5. Conclusions

From the above discussion, it can be concluded that people residing in Tehsil Shakargarh, Punjab, Pakistan, are well aware of commercial poultry meat and eggs. In this predominantly educated area, there is a notable interest among people in Pakistan in discussing myths related to commercial poultry, often spread through social media. As we enter the post-COVID-19 period, poultry meat and eggs could emerge as the most effective resources for bolstering the immunity of the general population, particularly in protein-deficient nations like Pakistan. Most people are concerned about the addition of hormones, steroids and antibiotics to commercial poultry meat and eggs. Therefore, strategies are needed to address consumer concerns and educate them about their benefits and ultimately enhance consumption. However, it is important to acknowledge the limitation of the study, which is the focus on a

specific area (Tehsil Shakargarh) of Pakistan. This narrow geographic scope may limit the generalizability of the findings to the broader population of Pakistan. While the findings offer important insights into the perceptions of residents in Tehsil Shakargarh, they may not fully represent the perspectives of individuals in other regions or districts of the country. Thus, future research should aim to include a more diverse sample that encompasses a broader geographical range within Pakistan to ensure the robustness and applicability of the findings on a national scale.

Data availability statement

Data were not deposited into a publicly available repository and will be made available on request.

CRediT authorship contribution statement

Murrawat Hussain: Writing – original draft, Visualization, Validation, Resources, Methodology, Investigation, Data curation, Conceptualization. **Jibran Hussain:** Writing – review & editing, Supervision, Project administration, Conceptualization. **Muhammad Usman:** Writing – review & editing, Conceptualization. **Muhammad Tahir Naseem:** Writing – review & editing. **Mian Mubashar Saleem:** Resources, Data curation. **Syed Ghulam Mohayud Din Hashmi:** Visualization, Supervision, Software, Investigation, Conceptualization. **Hafiz Rao Abdul Latif:** Resources, Methodology, Data curation. **Kinza Saleem:** Writing – review & editing, Visualization, Software. **Sohail Ahmad:** Writing – review & editing, Visualization, Validation, Supervision, Software, Investigation, Funding acquisition, Formal analysis, Conceptualization.

Declaration of competing interest

No potential conflict of interest was found by the authors.

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