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The public perception of food and non-food related risks of infection and trust in the risk communication during COVID-19 crisis: A study on selected countries from the Arab region

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ABSTRACT

The coronavirus pandemic caused a state of panic worldwide. Mixed messages were given about its risk and how to contain it, when trust in authorities and reliable scientific information are essential to reduce unnecessary scares and inappropriate risk perceptions. We know little about public concerns and opinions in health authorities in the Arab world. Thus, an attempt was made to generate such information through a web-based survey. A total of 1074 subjects from Lebanon, Jordan, and Tunisia were recruited to explore their perception of food and non-food risks of infection and the influence of the source of information, trust, and attitudes towards the local authorities' communication of risk. Seventy percent of the respondents were concerned that COVID-19 may be transmitted through food. The perception of risk from touching contaminated surfaces and food packaging and being exposed to infected people during food shopping was even higher. For only less than half of the respondents, the information from local authorities was considered trustworthy and the associated risk communication and response to false rumors were timely, effective, and clear. But the satisfaction level among the Jordanians was remarkably stronger than for the Lebanese and Tunisian respondents. The demographic factors, trust in information, and attitudes towards authorities' performance in risk communication did not influence risk perceptions. Respondents' knowledge was limited based on their chief sources of information, such as social media, local news media broadcasts, and announcements by the World Health Organization. Our conclusion is that unnecessary fear increases among the public when risks that impact health are unknown. More research in the Arab region is needed to understand the determinants of risk perceptions considering psychological factors on the risk to health. Unfortunately, it is difficult to restrict or contain misleading information from various forms of social media. We recommend that for reducing fear and building confidence with the public for appropriate action during the pandemic, local authorities should enhance the quality and level of details of the information that they share during such crises.

1. Introduction

In late 2019 and early 2020, infections from the coronavirus disease 2019 (COVID-19) spread rapidly around the world and is expected to rise substantially until a vaccine can be widely distributed in 2021. As of September 4, 2020, 26 335 685 cases have been reported, including 869

209 deaths (ECDC, 2020) making it the worst pandemic in modern history since the Great Influenza Pandemic (popularly known as the Spanish Flu) (Barro et al., 2020). Whereas governments in some countries discounted the impact and were slow to react to contain infections of COVID-19, most people globally were increasingly concerned about the pandemic and many were in a state of panic as the media continually

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emphasized the rapid spread of this virus, both among immunocompromised persons but also among the general population.

Different countries adopted different policies, varying degrees of strict prevention of infection measures, and lockdown rules for limited exposure (CDC, 2020; WHO, 2020b). Compounded by conflicting advice for consumers and the public in general from different government agencies, the media, and social platforms on COVID-19 and how to contain it, people's risk perception can be strongly influenced by external messages and hazards that are new, uncontrollable, and catastrophic in consequences (Haas, 2020; Slovic, 2016) even when the likelihood of occurrence of risks is considered by experts low (Abraham, 2009).

Although the food was early demonstrated not to be a vehicle of transmission of COVID-19 virus particles, many shoppers were leery of purchasing any item that could be in contact with the virus including raw and packaged products. Much of the public began an unprecedented hoarding of food, sanitizers, and other necessary commodities for lockdown survival (Lufkin, 2020).

The social media platforms such as Facebook started working with local agencies, international organizations such as the Centers for Disease Control and Prevention (CDC), and United Nations organizations like the WHO and UNICEF to dispel rumors by conveying timely, accurate information on the coronavirus, although not as early as it should have occurred (Tasnim et al., 2020; WHO, 2020a; Zuckerberg, 2020). In contrast, Taiwan in particular contained the spread of the virus at the early stage of the outbreak following a strategy of three pillars: real-time surveillance with rapid risk assessment, border control, and quarantine, and laboratory capacity building. Besides, a surveillance team monitored social media for new information about the spread of COVID-19 in China and elsewhere. Most other countries including those in the Arab region, especially those which had reduced its public health infrastructure over the years, were unable to initiate one or more of these criteria.

Trust in authorities and reliable scientific information are essential to reduce unnecessary scares and inappropriate risk perceptions. The WHO has developed guidelines on outbreak communication in response to the communication challenges posed by the Severe acute respiratory syndrome (SARS) epidemic of 2003 (FAO/WHO, 2005). The guidelines consist of five principles to guide communication during outbreaks and other emergencies: building trust, announcing early, transparency and dissemination of information, respecting public concerns, and planning. These principles are based on the psychometric paradigm of risk which focuses on individual perceptions of risk, rather than the social and cultural environment in which risk perceptions are formed. Thus, It is important to understand how people think about and respond to risk for the well-intended policies to be effective (Slovic, 1987).

Many Arab countries rely on international recommendations concerning health measures during the COVID-19 pandemic to have consistent repeated messages for the public (Al Watan, 2020; Arab Center Washington, 2020; Youm7, 2020). However, there is a lack of collaboration between government agencies and public health and food safety experts in the Arab world which has deterred effective communication of culturally relevant health messages to the public (Al Fanar Media, 2020).

The devastating impact that the COVID-19 pandemic might have on the Arab countries continues to be a matter of concern among experts because of ineffective and untimely reporting related to the COVID-19 pandemic (UNDP, 2020), the fragility and in some countries the scarcity of the health services, the limited financial resources, dysfunction of state institutions, the limited trust of people in the communication of their countries' leaders/governments, the lack of transparency in crisis communication and management (Arab Center Washington, 2020; El-Jardali, 2020).

Several studies found that trust and the source of information acquisitions are among the key drivers of risk perception and that trust in information provided by media and independent sources increase risk

perception and anxieties, whilst trust in public authorities decreases it (Liu et al., 2014a; Lobb et al., 2007; Rutsaert et al., 2013). Individual and societal perceptions of risks and food-related health risks are multidimensional and complex, but also location-specific (Feindt & Poortvliet, 2020; Han & Liu, 2018). There is a dearth of studies on public or consumers' perception of risks in the Arab countries as affected by their knowledge, trust, and opinions in their local authorities, and the source of information.

Despite the common socio-cultural and linguistic similarities, Arab countries are disparate in their political and economic conditions, hence the approaches in handling the COVID-19 pandemic differed between the rich Gulf countries and the developing economies in North-Africa, or in conflict-affected countries and regions such as Syria, Iraq, the Gaza Strip, Yemen and Libya (Arab Center Washington, 2020; OECD, 2020). Little is published on the performance of risk communication in Arab countries and the public's trust in the way national institutions manage or communicate risks during health emergencies or food outbreaks.

Understanding public concerns of the pandemic are key for risk management and risk communication policies about obtaining and preparing food, and this survey offers an opportunity to fill this knowledge gap in the region with the following objectives:

1. To present an overview of the public perception of food and non-food risks of infection during the COVID-19 crisis and investigate the role of demographic characteristics as predictors.
2. To explore public trust and assessment of the local authorities' performance in risk communication during the pandemic.
3. To investigate the relationship between risk perception and (I) trust in the information from local authorities, and (II) attitudes towards the national guidance and local authorities' performance in risk communication.
4. To shed light on the differences of the above among selected Middle East North African (MENA) countries, namely Jordan, Lebanon, and Tunisia. These were chosen because each is considered to be a middle-income country with limited resources but has a relatively well-developed public health system, mature education systems, good human resources in science and technology, and consists of the native-born population compared to wealthier or poorer countries in the region.

2. Materials and methods

2.1. Survey instrument

A structured web-based survey tool was developed in which respondents were asked to answer questions related to their knowledge on the Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) survival in food, level of concerns about getting COVID-19 disease from food and other sources during food shopping, hygiene and food handling practices, the source of information about COVID-19, trust in the information of local governments, and their opinion on the local authorities' risk communication during the pandemic.

The questionnaire consisted of 23 questions and comprised 3 sections.

(i) Section 1: Demographic information

The demographic section contained five questions related to age, gender, education, employment sector, and country of residence.

(ii) Section 2: risk perception and behavioral changes

This section comprises fourteen questions built around three themes (risk perception and knowledge, food shopping behavior, hygiene practices). Only the theme of "knowledge on the coronavirus and risk perception" was included in this paper. It aimed at assessing

respondents' perception of food and non-food risks by indicating on a 5-point scale (1 = Not at all concerned, 5 = extremely concerned) their level of concerns for the five statements on the risks of contracting COVID-19 disease from food and other sources during food and grocery shopping.

Risk perception can be measured by worry (Rosati & Saba, 2004) which is defined by Sjöberg (1998) as an unpleasant state of mind with thoughts about uncertain and unpleasant events. Many researchers established that worry and concern are moderate to highly related and associated with perceived risk (Rosati & Saba, 2004; Rundmo, 2002; Siegrist; Cvetkovich, 2000). In this study, we use the term risk perception interchangeably with "level of concern" and "level of worry".

This section also contained three multiple-choice closed-ended questions on the coronavirus survival in different temperature conditions. To avoid chances that food handlers select any answer by chance, the multiple-choice answers included "I do not know".

(iii) Section 3: Risk communication

This part contains four questions. Two multiple-choice questions on the source of information respondents rely on to understand the COVID-19 risks and measures to take, and whether the source provides enough information on food safety during the COVID-19 crisis. Respondents were asked to check all that applied.

This section also aimed to explore to what extent the participants agree with the national guidance on the protection measures against coronavirus, the timely information, and updates on COVID-19 received from local authorities, and the use of different platforms on a 5-point Likert scale (1 = strongly disagree and 5 = strongly agree).

To gain an understanding of the public view of risk communication and trust in local authorities' information, participants were asked to rate the seven statements related to local authorities' performance in risk communication during the pandemic on a five-point Likert scale (1 = poor, 5 = excellent). The statements were adapted from the WHO guidance on communicating risk during health emergencies (WHO, 2020).

The questionnaire was originally designed in English. To ensure the quality of the translation, native Arabic speakers performed a back-translation. The survey and the procedure to be followed were approved by the Ethical Approval Committee of the Institutional Review Board of the University of Plymouth and by Jordan University of Science and Technology in Jordan, and the Regional Research Center of Oasis Agriculture of Degache, Tozeur in Tunisia.

2.2. Survey procedure

2.2.1. Pre-test stage

Before the actual data collection, the survey was piloted by 36 respondents from Lebanon, Jordan, and UAE to assess readability, examine content reliability, and ensure it provided the desired information. The length of the survey was evaluated as well. UAE was later excluded from the study due to some restrictions.

The participants were contacted via social media applications (Facebook Messenger and Whatsapp) and by emails. Feedback and comments on the survey were sent by email or via a WhatsApp message. All suggested changes were considered besides small adaptations for terminology. The survey was also reviewed for content validity and clarity by two food safety experts: 1) a native Arabic speaker in Iraq with a substantial academic has a professional background in food safety; 2) a Canada-based scientist with a long track record in survey research in the field of food safety and public health. The questionnaire was revised based on their recommendations.

2.2.2. Survey administration and participants recruitment

We used a convenience sample of general consumers with various backgrounds in Lebanon, Jordan, and Tunisia. We aimed to collect data

from 400 people in each country to achieve ten respondents per variable as the lower limit to ensure an acceptable margin of error within each country (Hair et al., 2010; Kotrlík and Higgins, 2001, pp. 46–49).

The survey was conducted as an anonymous online survey through Google Forms, a survey administration app that is included in the Google Drive office suite. It is a cloud-based data management tool used for designing and developing web-based questionnaires and provides various options for capturing the data from the multiple answers.

The invitation for participating in the web survey was sent via Facebook, LinkedIn, and Whatsapp. In the interest of reaching out to wider participants, simultaneously the web link was also shared via emails to contacts living/residing in Lebanon, Jordan, and Tunisia. The invitation was posted again as a reminder on several Facebook groups. We did not post in public groups categorized by gender or specific profession to avoid biased sampling.

Sampling relied mainly on the snowball technique, i.e., referrals from initial subjects to generate additional subjects. Hence, participants were also encouraged to invite family, friends, and colleagues to participate by forwarding the online survey link.

The survey instrument was distributed in English and Arabic, it was open for participation from April 28 to June 1, 2020. On the first page of the web survey, participants were provided with the study details including their right to discontinue participating at any time. Screening questions were used to ensure that participants were over 18 years and reside or live in one of the three countries. To continue with the survey, informed consent was obtained from participants through a check to the box "Agree" required to confirm reading the consent information for participation and that they are above 18 years and living (residing) in Lebanon, Jordan, or Tunisia".

Data on Google Forms were exported to SPSS 26 for statistical analysis.

2.3. Statistical analysis

All data were analyzed using the Windows version of SPSS 26, Statistical Package for Social Sciences.

Descriptive statistical analysis (frequencies, percentages) were performed to summarize the socio-demographic characteristics of respondents and the distribution.

Cross tabulations and chi-square with Fisher's exact tests were used for proportions tests and the analysis of associations between test variables and categorical groups. We also use the Kruskal-Wallis test, a nonparametric test, which does not require the assumption of normality, to compare levels of concern about COVID-19 risks between the different dependent variables (countries, age, gender, education, work) and to validate the obtained results of association tests.

One-Way ANOVA test was used to compare the mean scores on selected test parameters between countries (i.e., respondents' concerns about COVID-19 risks, their attitudes towards, and ratings of local authorities' performance in risk communication). Parametric tests such as Analysis of Variance were used to summarize the Likert scales rating using means and standard deviations (Norman, 2010). The inspection Q-Q plots, tests for normality, examining standardized skewness, and the Shapiro-Wilk tests were performed to check assumptions. As the analysis of variance is robust to violations of the homogeneity of variances, provided that the ratio of the largest group is not more than 3 times the smallest group, data were interpreted by Welch robust test and Games-Howell post hoc testing (Howell, 2007).

Somers' delta (or Somers'd), a nonparametric test, was run to determine the strength and direction of the association between public concerns of getting infected with COVID-19 and their (1) trust in the information of the local authorities, (2) attitudes towards the national guidance during the pandemic, and (3) assessment of the local authorities' risk communication. Our data passed the assumptions required for Somers'd for the types of variables (i.e., dependent and independent variables are measured on an ordinal scale) and the monotonic

relationship between the dependent and independent variables).

Ordinal regression analysis was used to model the dependence of respondents' level of concerns about getting infected with the COVID-19 from food and other sources (ordinal variables) with a set of predictors: (a) demographic characteristics and (b) their trust in the local authorities' information, and attitudes towards the national guidance for public protection and risk communication.

Results with a p-value < 0.05 were considered statistically significant.

A reliability analysis test was performed by the use of Cronbach's Alpha to measure the internal consistency of the survey questionnaire. Cronbach's Alpha values ranged from 0.797 to 0.927 for all categorical questions of all constructs which indicate a high level of internal consistency for our scale.

3. Results and discussion

The survey respondents totaled 1074 valid responses. Table 1 shows the demographic characteristics of the respondents for each country. As part of the ethical approval requirements, the survey form was set to allow respondents to continue the survey even when they choose not to answer any of the questions. This explains the few missing answers to some of the questions.

Most of the respondents were women (68.3%), with men constituting 31.1% of the sample. Less than 1% preferred not to mention their gender and were excluded from gender comparisons. Four respondents chose not to answer this question.

For the three countries, less than half (43.5%) of those who responded to age were between 19 and 34 years, almost a half (48.2%) between 35 and 54, and 8.3% of the respondents were 55 and above. The demographic distribution in our sample resembles that of the yearly public opinion survey conducted by The Arab Center for Research and Policy Studies (ACRPS) across the Arab world (Arab Center Washington DC, 2016). This is the largest public opinion poll of its kind in the Arab region which provides scholars and policymakers with information on the Arab citizen views concerning a wide array of social and political issues. The high proportion of women participation in this survey might be explained by gender differences in interests when navigating social media. A regional online study on Arab women's use of social media indicated that 41–46% of Facebook users are female in Lebanon, Tunisia, and Jordan (Mourtada & Salem, 2011). This study is about 10 years old and the proportion has likely risen since, particularly under the quarantine period imposed by many countries.

The education level of the respondents was higher than expected where 85–92% of the respondents in the three countries had levels higher than a high school diploma. The sample is biased towards higher educated participants and is not representative of the population data of the analyzed countries (Buckner, 2019; Institut National; de la Statistique, 2017; World Bank, 2009). However, there are no studies that showed socio-demographic characteristics affect the public concerns of getting infected with the coronavirus.

3.1. Risk perception of COVID-19

The respondents' levels of concern about contracting the coronavirus disease from food and other sources are presented in Table 2.

In total, 42% of the respondents were moderately to extremely concerned about buying food that may contain the coronavirus. Less than a third (20%) were slightly concerned compared to only 8% who were not at all concerned about the safety of their purchased food. Moreover, eating food that may contain the virus was perceived by 70% of the respondents as a risk of being infected compared to 18% and 12% who were slightly and not at all concerned, respectively.

The data show increased proportion levels of extreme concern over getting COVID-19 from sources other than food. Almost a third (27%) were extremely concerned about touching contaminated surfaces during

Table 1
Sample characteristics.

		Country			TOTAL N
		Lebanon	Jordan	Tunisia	
		N (%)	N (%)	N (%)	
TOTAL SAMPLE SIZE (N=1074)		346 (32.2)	410 (38.2)	318 (29.6)	1074
Gender	Female	236 (68.2)	307 (75.2)	188 (59.5)	731
	Male	109 (31.5)	98 (24.0)	126 (39.9)	333
	I prefer not to say	1 (0.3)	3 (0.7)	2 (0.6)	6
	Total (%)^a	346 (32.3)	408 (38.1)	316 (29.5)	1070
Age	19–24	21 (6.1)	144 (35.1)	34 (10.7)	199
	25–34	91 (26.4)	75 (18.3)	102 (32.1)	268
	35–44	101 (29.3)	90 (22.0)	121 (38.1)	312
	45–54	97 (28.1)	69 (16.8)	39 (12.3)	205
	55–64	21 (6.1)	22 (5.4)	20 (6.3)	63
	65+	14 (4.1)	10 (2.4)	2 (0.6)	26
	Total (%)^a	345 (32.2)	410 (38.2)	318 (29.6)	1073
Education	Less than a high school degree	0 (0.0)	8 (2.0)	2 (0.6)	10
	Specialist/professional training	4 (1.2)	7 (1.7)	11 (3.5)	22
	High school degree/Diploma	23 (6.6)	44 (10.9)	35 (11.2)	102
	Bachelor degree	114 (32.9)	272 (67.3)	94 (30.2)	480
	Master degree	163 (47.1)	56 (13.9)	107 (34.4)	326
	Doctorate	42 (12.1)	17 (4.2)	62 (19.9)	121
	Total (%)^a	346 (32.6)	404 (38.1)	311 (29.3)	1061
Field of work	Food and Agriculture	93 (28.2)	46 (12.0)	106 (35.3)	245
	Trade and business	65 (19.7)	42 (11.0)	32 (10.7)	139
	Biological, medical, healthcare	31 (9.4)	90 (23.5)	26 (8.7)	147
	Other related natural sciences	20 (6.1)	5 (1.3)	20 (6.7)	45
	Education	49 (14.8)	100 (26.1)	38 (12.7)	187
	Unemployed	28 (8.5)	67 (17.5)	49 (16.3)	144
	Total (%)^a	44 (13.3) (32.6)	33 (8.6) (37.8)	29 (9.7) (29.6)	106

^a The percentage of respondents from the total sample size (Total N) within the same row.

food shopping. Similarly, a third were moderately concerned (31%) and 26% were worried to a limited extent. Only 3% were not all concerned. Along the same line, for less than a third of the respondents (23%), touching contaminated food packaging also causes extreme worries, while 16% to 27% was slight to somewhat concerned, respectively. The perception of risk from exposure to infected people during food or grocery shopping increased among the respondents, with 33% to 34%, very worried about being infected from others during shopping.

The increased perception of risk related to touching contaminated surfaces and exposure to infected people is likely to be related to the virus being an unknown hazard, but also to its transmission via the respiratory route which has been conclusively determined from the early stages of the pandemic. Perceptions are based on hazards and risk

Table 2
The proportion of respondents' level of concern about getting the coronavirus disease during food and grocery shopping.

Risk Characteristic	Level of concern	N (%)
To buy food that may contain the Coronavirus	Not at all concerned	81 (8)
	Slightly concerned	213 (20)
	Somewhat concerned	322 (30)
	Moderately concerned	257 (24)
	Extremely concerned	193 (18)
	Total	1066
To eat food that may contain the Coronavirus	Not at all concerned	131 (12)
	Slightly concerned	188 (18)
	Somewhat concerned	271 (26)
	Moderately concerned	253 (24)
	Extremely concerned	218 (20)
	Total	1061
To become infected from touching contaminated surfaces	Not at all concerned	35 (3)
	Slightly concerned	137 (13)
	Somewhat concerned	272 (26)
	Moderately concerned	335 (31)
	Extremely concerned	285 (27)
	Total	1064
To contract the disease from touching contaminated food packages	Not at all concerned	48 (5)
	Slightly concerned	173(16)
	Somewhat concerned	290 (27)
	Moderately concerned	312 (29)
	Extremely concerned	242 (23)
	Total	1065
To contract the disease from infected people	Not at all concerned	43 (4)
	Slightly concerned	110 (10)
	Somewhat concerned	205 (19)
	Moderately concerned	346 (33)
	Extremely concerned	363 (34)
	Total	1067

characteristics (Slovic, 1987), and both physiological and psychological factors may influence how people process new information and respond to potential risks (Stone, 2014). For instance, some studies found that familiarity with the hazards decreases the perceptions of risk (Siegrist & Cvetkovich, 2000).

In Arab countries, the communication of food safety and health issues with the public is generally new due to limited research outputs (Mheidly & Fares, 2020). During the pandemic, countries in the region were not providing sufficient information on cases of infection and their efforts in managing the crisis were considered by the WHO as insufficient to prevent and control the spread of the virus (Amirah-Fernández, 2020). Thus, with limited credible information on the safety of their food, concerning the hazards and their health, consumers tend to increase their anxiety about the risks associated with food and the environment. It is possible that these concerns would be even higher for populations with lower educational levels or living in rural areas with limited access to various types of social media, groups that we did not efficiently access for our survey.

3.2. The effect of demographic factors on respondents' level of concern about COVID-19

Chi-square analysis showed a significant association of respondents' education level with their level of concern about getting infected with the coronavirus ($p < 0.05$). In all the education groups, the proportion of respondents who believed that touching contaminated surfaces and exposure to infected people are risk factors for COVID-19 transmission was higher than their counterparts who had no worries at all. Interestingly, unlike other educational levels, for those achieving high school diplomas, the level of respondents who believed COVID-19 is a

foodborne disease was higher than those who did not (Supplementary materials- Table S1).

Accordingly, the association of education with the perception of risk was not substantiated by Somer's d analysis ($p > 0.05$) as being directional in the sense that education level could be a variable that will enhance our prediction of public worries about COVID-19 risks.

Our results corroborate with Chan et al. (2020) who found no significant association between education and worries about COVID-19. But also, the relation of education with risk perception could be affected by the skewness of our sample distribution which warrants further research work in the Arab region.

There was no significant difference in the levels of concern between gender across all variables (risk characteristic) ($p > 0.05$). This non-significance was also confirmed by the Kruskal Wallis test ($p > 0.05$) and in line with Chan et al. (2020) who reported that except for age, sociodemographic factors including gender, chronic disease status, education, marital status, household income, household floor area and the district of residence were not significantly associated with the concern of becoming infected with COVID-19. In another study on food safety, none of the demographic variables were statistically significant demonstrating as well that demographic characteristics did not determine the level of worry (Ha et al., 2019).

The age of the respondents was significantly associated with their level of concern about contracting COVID-19 from eating contaminated food and touching contaminated surfaces ($p < 0.05$) (Supplementary materials- Table S2). A greater percentage of respondents below the age of 44 years was much more concerned about getting infected from consuming contaminated food or touching contaminated surfaces than those who were older. Our results are substantiated by Chan et al. (2020) who demonstrated that respondents at a young age were more likely to express the anxiety of being infected with COVID-19 and perceived significant COVID-19 impact on their physical, mental health, and/or social life.

The food-related risk perception of COVID-19 was lower among respondents in the food and agriculture sector than those in other sectors. However, Kruskal Wallis confirmed no significant difference in the levels of concern among other different work categories ($p > 0.05$) as shown in the distribution of proportions across and within the work groups (Supplementary materials- Table S3).

The results showed that respondents' worries and anxieties were affected by complex factors other than demographics. This was evident in the ordinal regression analysis conducted to predict the risk perception for each of the risk characteristics variables (e.g., eating food that may contain the virus, touching contaminated food packages, touching contaminated surfaces, etc.) given each demographic factor. For interpreting the models, we checked the model fitting information, the significance of the overall regression (chi-square statistic), and the tests of parallel lines to ensure the assumption of proportional odds holds. Multicollinearity was measured by variance inflation factors (VIF) with VIF values < 3.0 .

In general, the improvement in fit of the final model over the null model was not significant ($p > 0.05$) and the models were relatively poor fit suggesting that demographic factors are not statistically significant as predictors of public perception of infection risks from food and non-food sources. For instance, in modeling the dependence of public concerns about buying food that may contain the coronavirus on each factor (i.e. age, the field of work, education), no significant improvement in fit of the final model over the null model was observed, [$\chi^2(5) = 125.535$, $p = 0.200$], [$\chi^2(6) = 155.356$, $p = 0.386$], [$\chi^2(5) = 115.905$, $p = 0.677$], respectively; We found a significant improvement over the baseline intercept-only model for gender, [$\chi^2(1) = 44.321$, $p = 0.007$]; nonetheless, when estimating models with a large number of categorical ordinal predictors, other methods such as measures of association (Pseudo R^2) are appropriate to consider. Thus, we also checked the Nagelkerke pseudo R^2 ; the corresponding pseudo R^2 values (e.g. Nagelkerke = 0.2%) indicated a poor model fit and that the gender

explains a relatively very small proportion of the observed variability.

Moreover, modeling the relationship between the perception of risk of contracting COVID-19 from food and contaminated food packages, and demographic factors showed that respondents' field of work is an insignificant predictor [$\chi^2(6) = 165.275, p = 0.08$] and [$\chi^2(6) = 151.380, p = 0.173$], respectively; However, as the PO assumption was rejected ($p < 0.000$), generalized linear models (GLM) using ordinal logistic transformation was used (Williams, 2016). The results were confirmed by the outputs of the tests of model effect and omnibus test of GLM ($p > 0.05$) suggesting that the contribution of type of work on public perception of risk was not significant ($p > 0.05$).

Extensive studies on the influence of sociodemographic predictors on the risk perception presented inconsistent findings across the literature as they varied in location, conditions, and factors (Anderson et al., 2011; Dosman et al., 2001; Ha et al., 2020, 2019; Hull-Jackson & Adesiyun, 2018; Mcintosh et al., 1994; Tonsor et al., 2009). COVID-19 pandemic is an emerging public health issue, the unfamiliarity of people with the disease and the potentially frightening health effects of an unknown virus can increase risk perception irrespective of education, age, or work.

3.3. Level of concerns by country

A great majority of the Lebanese (80%), Jordanian (92%), and Tunisian respondents (91%) believed that COVID-19 is a foodborne disease (Fig. 1). Whereas almost all respondents from Lebanon, Jordan, and Tunisia reported varying degrees of concern about contracting COVID-19 from touching contaminated food packages (94%, 95%, 97%), contaminated surfaces (97%, 96%, 97%), and from infected people (97%, 93%, 98%), respectively (Figs. 2-4).

Kruskal Wallis test showed significant differences in the level of concerns among the three countries. These differences were specifically observed within the different categorical levels of respondents' concerns. For example, more Lebanese reported extreme concerns about getting infected from contaminated surfaces and infected people (39% and 49%) than Jordanians (21% and 25%) and Tunisians (20% and 30%) (Fig. 3 and 4). On the other hand, a higher proportion of the Lebanese (20%) perceived no risk of infection from food than Jordanians (8%) and Tunisians (9%) (Fig. 1).

Also, the mean scores of the level of concerns of the Lebanese respondents with regards to touching contaminated surfaces, contaminated food packages, and getting infected by being exposed to infected people during food shopping ($3.83 \pm 1.17, 3.63 \pm 1.26, 4.12 \pm 1.08$)

were significantly higher than the Jordanians ($3.55 \pm 1.10, 3.39 \pm 1.11, 3.60 \pm 1.16$), and Tunisians ($3.60 \pm 1.0, 3.49 \pm 1.02, 3.77 \pm 1.07$), respectively, suggesting greater concerns among the Lebanese (Table 3). Table 3 shows that the mean scores of the level of concern about contracting COVID-19 from food were relatively lower in the three countries than those related to non-food associated risks. These results show that respondents generally perceived the risk of transmission of the coronavirus from non-food related sources and infected people greater than through food.

3.4. Knowledge about the COVID-19 virus and the source for information acquisition

Overall, more than two-thirds of the surveyed subjects (63%) correctly believed that the COVID-19 virus doesn't survive the cooking process. However, more than two-thirds, 64% and 60% did not know and incorrectly answered the questions on the virus's survival under refrigeration and freezing temperatures, respectively. The Lebanese respondents were generally more informed than the Jordanian and Tunisian groups; perhaps this explains the lower perception of food safety risks among the Lebanese respondents when compared with the other groups (Table 4).

The coronavirus is highly stable at 4 °C and is expected to have similar behavior to SARS-CoV at freezing temperatures, meaning it could remain infectious at -20 °C for up to 2 years (WHO, 2020b). Besides, it was reported that the coronavirus is inactive after 5 min of incubation at 70 °C. These outcomes suggest that normal cooking temperatures (>70 °C) are sufficient for viral inactivation, but transmission from frozen food may still be possible.

There are no published data on the food safety knowledge of consumers in Lebanon, Jordan, or Tunisia to explain the reasons for these differences. Nonetheless, eating and cooking habits may be a risk factor for the reemergence of the virus into the human population. As such, informing the public using simple and easy to understand messages is necessary to avoid the transmission of coronavirus which appears to be possible if the virus is transferred shortly via the hands or the food itself to the mucous membranes of the mouth, throat, or eyes (Rizou et al., 2020).

The surveyed subjects were asked to indicate their sources of information on COVID-19. Local news, social media, and the WHO were the chief source of information. Whereas local authorities' notices in newspapers served as a source of information for only 308 respondents: 40% from Jordan, 34% from Lebanon, and 26% from Tunisia (Table 5).

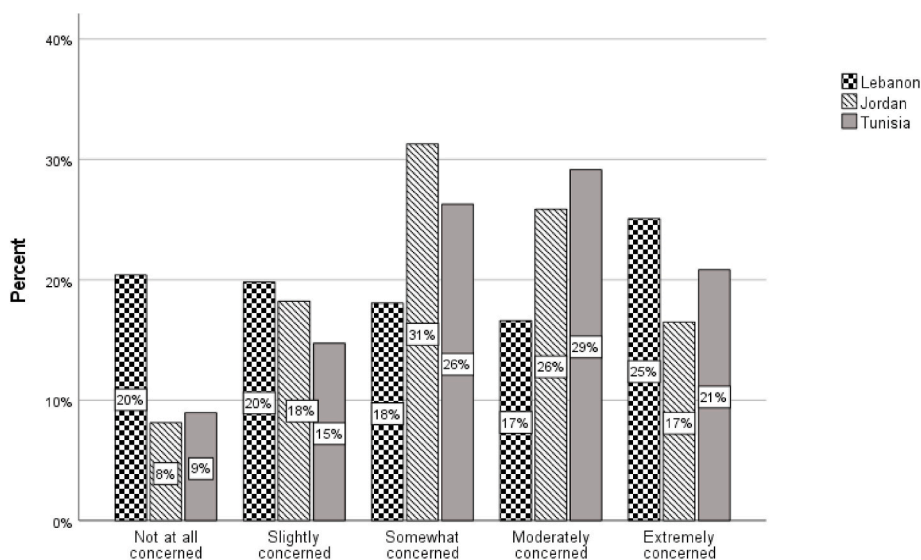


Fig. 1. Respondents' level of concern about getting the coronavirus disease from touching contaminated surfaces during food and grocery shopping.

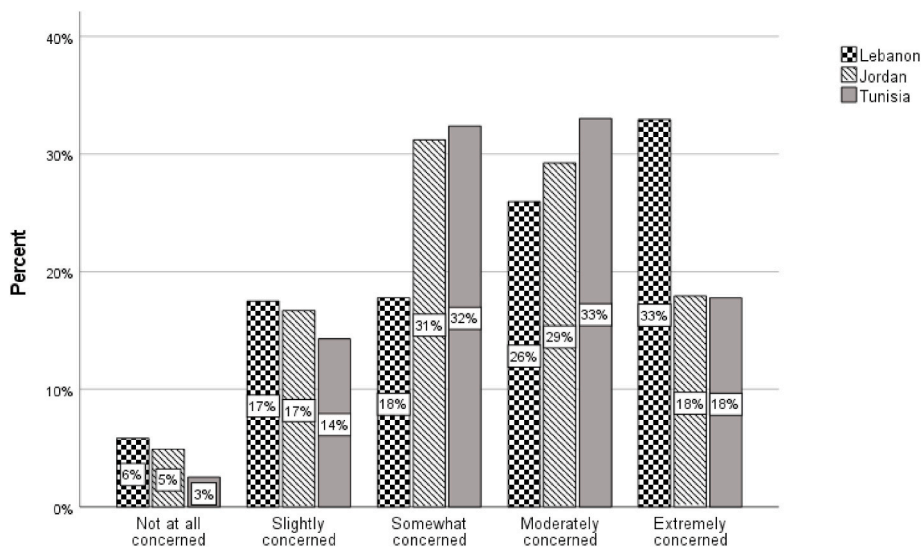


Fig. 2. Respondents' level of concern about contracting the coronavirus disease from infected people during food and grocery shopping.

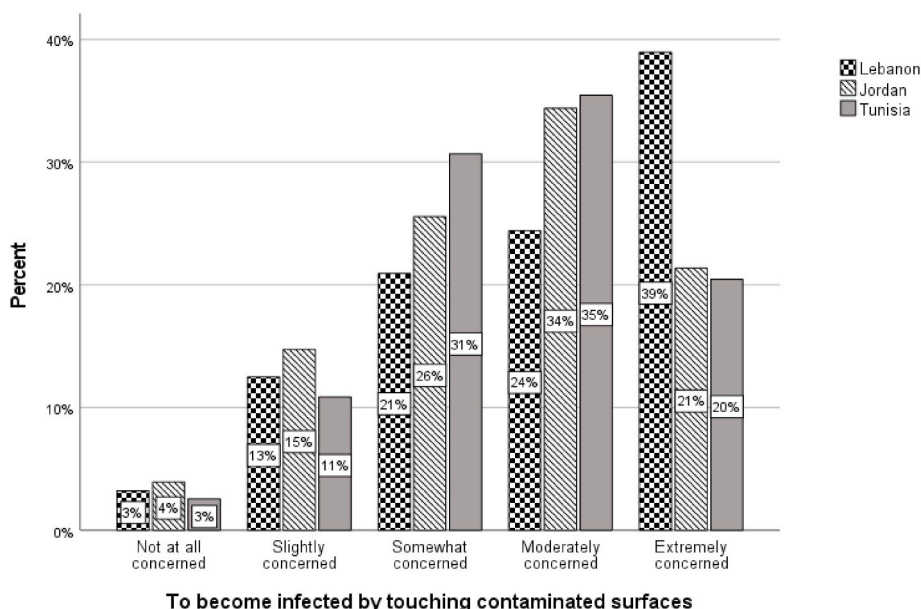


Fig. 3. Respondents' level of concern about getting the coronavirus disease from eating contaminated food.

In most of the countries of the Arab region, specifically in the studied countries, scientific and risk assessment agencies do not exist; hence, risk communication with the public by governments on food safety and health matters or press releases in the form of official notices from health authorities is not well developed. Most countries manage their food and health risks largely based on the scientific knowledge and information obtained from international organizations and health agencies in developed countries such as the WHO and the CDC.

Interestingly, a large number of respondents from Jordan (87%), Lebanon (77%), and Tunisia (75%) indicated that their information sources clarified the food-related risks during the pandemic. Even so, concerns about food safety were still high and knowledge was limited. A high number of respondents from Lebanon (n = 181), Jordan (n = 256), and Tunisia (n = 194) obtained their information from a scientifically unsubstantiated source, i.e., social media. Recent studies in Jordan showed that most of the students' information about COVID-19 in Jordan came from social media (Alzoubi et al., 2020; Olaimat et al., 2020) with 77.1% of the university students in Jordan relying on the internet

(electronic news websites and social media) and 68% on mass media (TV, newspapers, magazines, and radio) and only 24% seeking updates from scientific websites and articles (Olaimat et al., 2020). The media is a powerful channel that frequently exaggerates events and turns a small risk to a major food scare when it repeatedly reports news about food hazards that are reportedly negative (Rutsaert et al., 2013). In comparison, 64% of U.S. adults have seen at least some news and information on COVID-19 that seemed made up and inaccurate (Mitchell et al., 2020).

3.5. National guidance on the protection measures during the pandemic

A great majority of respondents from the three countries rated the national guidance on the protection measures against the coronavirus, the timely information, and updates on COVID-19, and the use of local authorities for different platforms (social media, newspaper, radio, etc) as average to above average. These results were surprising in the case of Lebanon given the political conflicts and the economical crisis that is

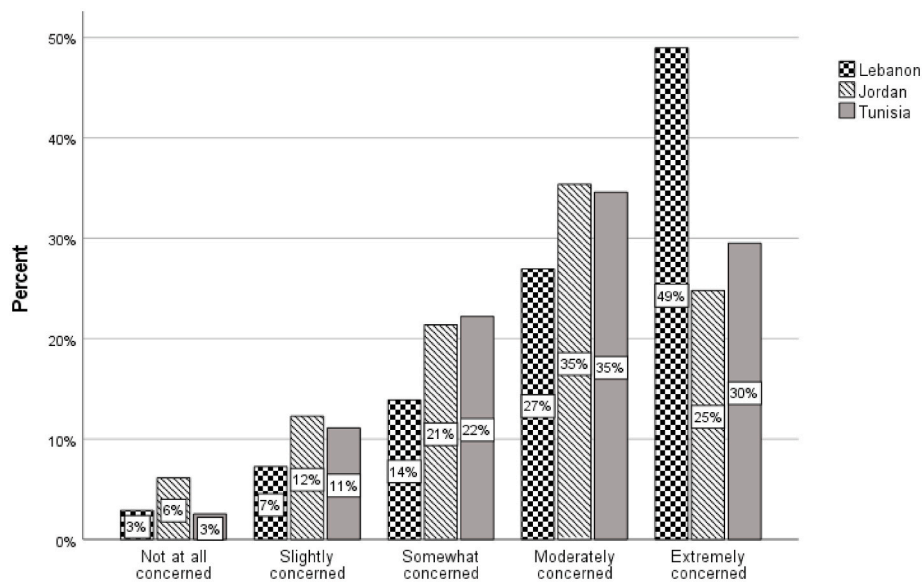


Fig. 4. The percentage of levels of concern about getting the coronavirus disease from infected people during food shopping of total respondents in each country.

Table 3

The mean score of the respondents' level of concern during food shopping amidst the pandemic. Means with the same superscript letter are significantly different ($p < 0.05$).

Risk Characteristic	Country	N	Mean ^a	SD
(1) To buy food contaminated with the virus	Lebanon	344	3.15 ^a	1.37
	Jordan	407	3.23	1.11
	Tunisia	315	3.40 ^a	1.06
	Total	1066	3.25	1.19
(2) To eat food contaminated with the virus	Lebanon	343	3.06 ^a	1.48
	Jordan	406	3.24	1.17
	Tunisia	312	3.38 ^a	1.22
	Total	1061	3.23	1.23
(3) To become infected from touching contaminated surfaces	Lebanon	344	3.83 ^{ab}	1.17
	Jordan	407	3.55 ^b	1.10
	Tunisia	313	3.60 ^a	1.01
	Total	1064	3.66	1.10
(4) To contract the disease by touching contaminated food packages	Lebanon	343	3.63 ^{ab}	1.26
	Jordan	407	3.39 ^b	1.11
	Tunisia	315	3.49 ^a	1.02
	Total	1065	3.49	1.14
(5) To contract the disease from infected people	Lebanon	345	4.12 ^{ab}	1.08
	Jordan	407	3.60 ^b	1.16
	Tunisia	315	3.77 ^a	1.07
	Total	1067	3.82	1.13

Means with the same superscript letter are significantly different ($p < 0.05$).

^a Mean score of the level of concern on a 5-Likert scale: 1 "not at all concerned", 2 "Slightly concerned", 3 "Somewhat concerned", 4 "Moderately concerned", 5 "Extremely concerned".

overtaking the country and deepening public waves of anger against the existing government.

Kruskal Wallis test showed a significant difference between countries ($p < 0.05$). The Jordanian group believed more strongly than those in Lebanon and Tunisia in the timely information provided by local authorities and a substantially higher proportion of them rated the local authorities' guidance for the public on protection measures excellent (Table 6). This was evident in the mean scores of the Jordanian group's rating of the national guidance and the timely information and updates, (4.63 ± 0.63) (4.53 ± 0.69), which were significantly higher than the Lebanese (4.11 ± 0.81) (4.09 ± 0.87) and the Tunisian group (4.03 ± 0.90) (3.81 ± 0.97), respectively, while the Tunisian respondents' assessment rates were significantly lower than the Lebanese (Table 6).

Previous studies showed that trust in institutions that manage food

safety is an important predictor of the perception of food safety risk (Frewer et al., 2009; Lobb et al., 2007). However, although trust in public authorities moderates the scare impact, trust in the information provided by sources such as media and risk information was found to be the key driver that alter perceptions and significantly change behavior (Liu et al., 2014b; Lobb et al., 2007; Rutsaert et al., 2013). Regression analysis was used to identify the strength of the effect that respondents' attitudes towards local authorities' risk communication have on their risk perception. The results showed that respondents' perception of risk of infections from eating food that may contain the coronavirus [$\chi^2(8) = 248.936$, $p = 0.056$], touching food packages [$\chi^2(8) = 243.360$, $p = 0.594$], touching contaminated surfaces [$\chi^2(8) = 226.184$, $p = 0.832$], and from infected people [$\chi^2(8) = 237.833$, $p = 0.901$] were not influenced by any information from national to local authorities. The relevant assumptions for the multicollinearity (VIF values < 0.3 and PO ($p < 0.05$) verified the validity of the test.

In like manner, in examining the relationship between respondents trust in the information received from local authorities about the outbreak and their level of concerns over contracting COVID-19 from food and non-food sources, improvement in the final model outputs over the null model was not significant for the different risk variables (i.e. risk characteristics) ($p > 0.05$). We inferred from this that public trust in the information obtained from their local authorities did not significantly impact their risk perception.

Similarly, although Somer's d test showed a significant association between respondents' perception of risk and their attitudes towards the national guidance on protection measures, the timely information, and the use of different platforms to communicate risks to the public, Somer's d value was very low. This confirmed that there is no confidence that these variables will help or improve our prediction of risk perceptions. The convenience sampling of our study probably influenced the regression output, but it is also plausible that such a relation was not established because of the propagated fear and anxieties resulting from facing an emerging public health issue and the divergences within the scientific community (Cori et al., 2020). The scientific understanding of the novel virus is continuously developing and local authorities' advice and decisions are in turn changing with no reassuring solutions.

3.6. Risk communication and trust in the information

The respondents' agreement with the statements related to their trust in the information and their attitudes towards the risk communication

Table 4
Knowledge of the respondents about the coronavirus.

		Lebanon	Jordan	Tunisia	TOTAL
		N (%) [‡]	N (%) [‡]	N (%) [‡]	N (%) [‡]
Can the coronavirus survive cooking temperatures?	Yes	30 (8.7)	31 (7.7)	24 (7.6)	85(7.9)
	No	257 (74.7) ^a	220 (54.3) ^a	198 (62.9) ^b	675(63.4)
	I dont know	57 (16.6) ^{ab}	154 (38.0) ^a	93 (29.5) ^b	304(28.7)
	TOTAL	344 (32)	405(38)	315 (30)	1064
Can the coronavirus survive freezer temperatures?	Yes	162 (48.0) ^{ab}	125 (30.8) ^a	96 (30.5) ^b	383(36.0)
	No	52(15.2)	63(15.5)	37(11.7)	152(14.5)
	I dont know	127 (37.2) ^{ab}	218 (53.7) ^a	182 (57.8) ^b	527(49.5)
	TOTAL	341 (32)	406 (38)	315 (30)	1062
Can the coronavirus survive refrigerator temperatures (below 5 ° C)?	Yes	179 (52.0) ^{ab}	137 (33.8) ^a	108 (34.3) ^b	424(39.9)
	No	34(9.9)	42(10.4)	29(9.2)	105(9.9)
	I dont know	131 (38.1) ^{ab}	226 (55.8) ^a	178 (56.5) ^b	535(50.2)
	TOTAL	344(32)	405(38)	315(38)	1064

Values within the same raw with similar superscript are significantly different ($p < 0.05$).

[‡] % of total respondents in each country.

[†] % of the total sample size.

Table 5
The source of information about COVID-19.

Source of information	Lebanon N (%)	Jordan N (%)	Tunisia N (%)	Total N
Local authorities' notices in newspaper	106 (34)	122 (40)	80 (26)	308
Social media	181 (29)	256 (40)	194 (31)	631
Local news (TV)	193 (30)	245 (38)	206 (32)	644
Local news (radio)	63 (22)	114 (39)	115 (39)	292
World Health Organization	234 (38)	207 (34)	173 (28)	614
International Media	129 (38)	111 (33)	96 (29)	336
Other ^a	13 (68)	4 (21)	2 (11)	19

^a Scientific journals, CDC, FDA, EFSA, FAO, academic institution, physicians.

Table 6
The mean scores of the respondents' assessment rate^a of the national guidance of the local authorities during the pandemic.

		N	Mean ^a	SD
National guidance on protection measures	Lebanon	341	4.11 ^a	0.82
	Jordan	402	4.63 ^{ab}	0.63
	Tunisia	316	4.03 ^b	0.90
	Total	1059	4.29	0.82
Timely information and update on COVID-19	Lebanon	341	4.09 ^a	0.87
	Jordan	405	4.53 ^a	0.69
	Tunisia	313	3.81 ^a	0.97
	Total	1059	4.18	0.89
The use of different platforms to communicate risks to public	Lebanon	339	3.93 ^a	0.99
	Jordan	401	4.52 ^{ab}	0.74
	Tunisia	313	3.92 ^b	1.06
	Total	1053	4.15	0.97

Means with the same superscript letter are significantly different at $p < 0.05$.

^a The mean score of the respondents' assessment rate on a 5-points Likert scale: 5 "excellent", 4 "Above average", 3 "Average", 2 "Below average", 1 "Poor".

was not strong. Less than half of the respondents were satisfied with the communication of risk (Fig.5) with a total mean score ranging from 3.84 ± 0.95 to 4.10 ± 0.80 (Table 7). The Kruskal Wallis test showed that the respondents from Jordan scored significantly higher than the Lebanese and Tunisian group ($p < 0.05$) and always showed a stronger agreement and positive attitude toward the local risk communication during the pandemic than their counterparts (Table 6).

When the respondents were asked if they agree with the clarity of the

information from the local authorities, whether they trust it, and if preparedness and respond of the local agencies lead to effective communication with the public, the Jordanian group scored significantly higher (4.44 ± 0.65) (4.41 ± 0.71) (4.40 ± 0.73) than the respondents from Lebanon (4.00 ± 0.81) (3.80 ± 0.94) (3.87 ± 0.80) and Tunisia (3.77 ± 0.80) (3.78 ± 0.87) (3.50 ± 0.90), respectively, indicating a stronger agreement among the Jordanians with the way local governments managed risk communication with the public than those in the other countries. Similarly, they tended to strongly agree that the local authorities are fast in disseminating information, intervening to protect the public, and sharing scientific information in an easy-to-understand way (4.37 ± 0.76) ($4.53 < 0.67$) (4.38 ± 0.71) more than the Tunisian (3.54 ± 0.92) (3.64 ± 0.96) (3.83 ± 0.84) and the Lebanese respondents (3.75 ± 0.87) (3.77 ± 0.96) (3.91 ± 0.84), respectively.

Surprisingly, Tunisians' attitudes recorded lower scores than the Lebanese for most of the variables (Fig. 5). As for the local authorities' response to rumors on social media, the Lebanese and Tunisian groups were significantly less satisfied compared to the Jordanian group, (3.63 ± 0.94) (3.57 ± 0.86) (4.22 ± 0.91), respectively. Tunisia is considered the only democratic country in the Arab region, but also stable when compared to Lebanon. There is no clear indication of the reasons for the lower satisfaction rates among the Tunisians when compared to the Lebanese.

The trust and content of the public in the local authorities' performance depend on the way authorities managed food safety and health risks and communicate with their people. The Lebanese government was lax in handling the pandemic situation until it imposed restrictions on movement by enacting a state of emergency measures, while Tunisia has launched a campaign asking for donations from the population to meet the expenses that the State could not cover in the fight against the coronavirus due to persistent economic problems resulting from the interruptions in tourism and trade with Europe during the pandemic. On the other hand, Jordan imposed medical tests on the border and a national defense law took effect on March 17, which allowed the deployment of the Jordanian army and gave the government absolute authority to ensure public safety (Amirah-Fernández, 2020; Arab Center Washington, 2020). This resulted in 79% of the Jordanians being satisfied with government performance during the corona crisis (Al Rai newspaper, 2020).

About 60% of the respondents, with a great majority having a high university degree, sought their information from social media. Siegrist (2000) posited that when individuals possess or acquire knowledge about a hazard they do not need to rely on managing authorities to judge risks and benefits. Nevertheless, the threat is new and the health effects are still not fully understood; hence, our results can not be compared with or explained based on previous studies conducted on other forms of

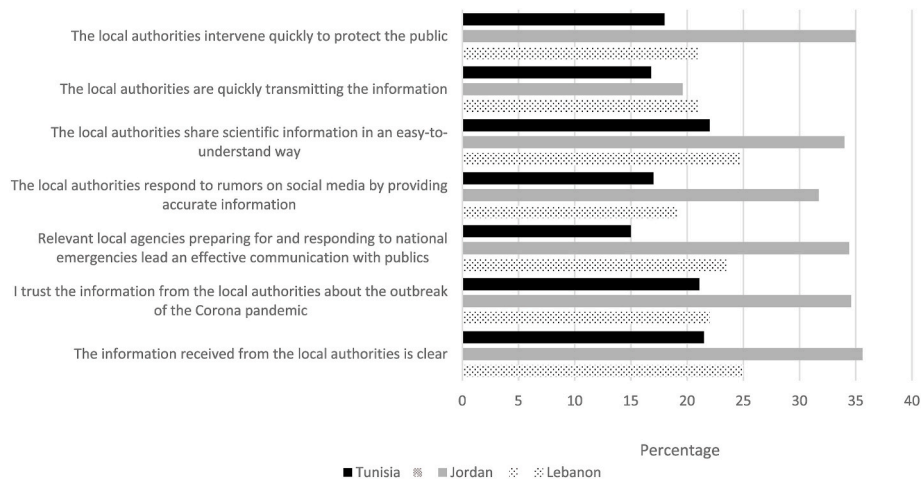


Fig. 5. The percentage of respondents who agreed and strongly agreed with the statements related to local authorities' communication of risk.

Table 7

The mean scores of the respondents' attitudes towards the effectiveness of local authorities in risk communication.

		N	Mean ^a	SD
(A) The information received from the local authorities is clear	Lebanon	341	4.00 ^a	0.81
	Jordan	404	4.44 ^a	0.65
	Tunisia	315	3.77 ^a	0.80
	Total	1060	4.10	0.80
(B) I trust the information from the local authorities about the outbreak of the Corona pandemic	Lebanon	340	3.80 ^a	0.94
	Jordan	405	4.41 ^a	0.71
	Tunisia	315	3.78 ^a	0.87
	Total	1060	4.03	0.89
(C) Relevant local agencies preparing for and responding to national emergencies lead to effective communication with the public	Lebanon	335	3.87 ^a	0.80
	Jordan	401	4.40 ^{ab}	0.73
	Tunisia	312	3.50 ^b	0.90
	Total	1048	3.96	0.89
(D) The local authorities respond to rumors on social media by providing accurate information	Lebanon	336	3.63 ^a	0.94
	Jordan	401	4.22 ^{ab}	0.91
	Tunisia	307	3.57 ^b	0.86
	Total	1044	3.84	0.95
(E) The local authorities share scientific information in an easy-to-understand way	Lebanon	337	3.91 ^a	0.84
	Jordan	399	4.39 ^{ab}	0.71
	Tunisia	306	3.83 ^b	0.84
	Total	1042	4.07	0.83
(F) The local authorities are quickly transmitting the information	Lebanon	340	3.75 ^a	0.87
	Jordan	401	4.37 ^{ab}	0.76
	Tunisia	307	3.54 ^b	0.92
	Total	1048	3.93	0.99
(G) The local authorities intervene quickly to protect the public	Lebanon	338	3.77 ^a	0.96
	Jordan	400	4.53 ^a	0.67
	Tunisia	312	3.64 ^a	0.96
	Total	1050	4.02	0.95

Means with the same superscript letter are significantly different ($p < 0.05$).

^a The mean score of the respondents' attitudes on a 5-points Likert scale: 5 "Strongly agree", 4 "Agree", 3 "Neither agree nor disagree", 2 "Disagree", 1 "Strongly disagree".

hazards.

4. Limitations of the study

There are a few limitations to this study. The convenience sample with a high proportion of highly educated respondents is unlikely to be representative of the general Lebanese, Jordanian, and Tunisian populations. Although generalizing the findings is limited in this case, they will still provide an insight into the risk perceptions and opinions of an existing segment of the Arab populations and that will serve as baseline information for similar studies in different areas of the Arab region.

Besides, given that internet use is still low compared to developed

countries, identifying potential samples for the web-based survey and reaching out for a larger sample size while avoiding a skewed sample was not an easy task. Several researchers have also examined the low response rates of many online surveys (Schonlau et al., 2002; Wilson & Laskey, 2003).

There are significant variations in the availability and access to technological tools and connectivity across Arab countries with low- and middle-income countries at a disadvantage (Arab Center Washington, 2020; UNESCWA, 2019). A fraction of populations have lower accessibility and quality of access, hence were not represented in this survey.

5. Conclusion

This study showed that the respondents in Lebanon, Tunisia, and Jordan had limited knowledge of SARS-CoV-2 and were concerned about getting the coronavirus disease from food. The way the local authorities of the three countries managed the pandemic, risk communication, and conveyed scientific information has gained the trust of only less than half of the surveyed subjects with a remarkably stronger agreement and positive opinions among the Jordanians than with the Lebanese and Tunisians. Even so, the uncertainty around COVID-19 has sparked anxiety and increased perception of food and non-food related risks of infection. This was independent of the respondents' demographic characteristics and their trust in the local authority's information and risk management in the three countries. For a great majority, social media was still among the chief sources of information, a channel that contributed to misleading information and that is difficult to contain unless surveilled and monitored.

The results emphasized the importance for local authorities to enhance the quality and level of details of the information and control the propagation of the viral rumors by involving all stakeholders in the food safety and public health sectors. To reduce fear and build confidence with the public, it is necessary for local governments to monitor the pandemic situation and provide the public with facts, educational messages, and timely updates as necessary using multiple social media platforms, their updated websites, and by networking with local communities to reach out widely for the general public.

To the best of our knowledge, this study is the first in the Arab countries that contributed to the understanding of the public perception of risks and their attitudes towards the local authorities' performance during the COVID-19 pandemic, which is key to an effective risk communication policy.

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Conflicts of interest

There are no conflicts to declare.

CRedit authorship contribution statement

Dima Faour-Klingbeil: Conceptualization, Methodology, Formal analysis, Investigation, Writing - original draft. **Tareq M. Osaili:** Investigation, Writing - original draft. **Anas A. Al-Nabulsi:** Investigation, Writing - original draft. **Monia Jemni:** Investigation, Writing - original draft. **Ewen C.D. Todd:** Writing - review & editing, Supervision.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.foodcont.2020.107617>.

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