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Differences in risk perception at personal and societal level during Middle East Respiratory Syndrome Coronavirus (MERS-CoV) outbreak in South Korea

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Abstract

Objectives: This study aimed to assess the risk perception in the general population of Middle East respiratory syndrome (MERS) during the 2015 MERS coronavirus (MERS-CoV) outbreak in South Korea and the influencing factors.

Design: Serial cross-sectional design with five consecutive surveys.

Setting: Nationwide general population in South Korea.

Participants: These included 5,015 respondents (aged 19 years) from the general population during the MERS-CoV epidemic.

Primary and secondary outcome measures: The main outcome measures were 1) personal-level risk perception and 2) societal-level risk perception. Multivariate logistic regression models were used to identify the factors associated with risk perceptions.

Results: During the MERS-CoV epidemic, overall risk perception gradually decreased with the level of risk perception. Proportions of personal-level risk perception were nearly doubled and slowly declined compared to societal-level perception. Females (adjusted OR [aOR] 1.72-2.00; 95% confidence interval [CI] 1.14-2.86) and older adults (aOR 2.84-3.29; 95% CI 1.27-6.66) were more likely to perceive the personal-level risk, while younger adults were more likely to perceive the societal-level risk. The respondents who had low trust in the president or the ruling party had a higher risk perception at both levels.

Conclusions: Risk perceptions appear to be noticeably different between the personal- and societal-level, during outbreak. Gender, age, presidential approval rating, and party identification were significantly associated with risk perception, while the direction and intensity of involvement varied according to the level of risk perception. There is need of further efforts to understand the mechanism regarding the general public's risk perception for effective risk communication.

Keywords: Middle East respiratory syndrome coronavirus, risk and perception, epidemics, surveys

Strengths and limitations of this study:

- This is the first study to evaluate the difference in risk perception between the personal- and societal-level during MERS-CoV outbreak in South Korea.
- We used five consecutive cross-sectional surveys using nationwide representative samples.
- The validity of the questionnaire used in the survey was not evaluated because of the urgency of the outbreak.
- This study could not confirm causal relationship between personal characteristics and risk perception due to the limitation of the cross-sectional study design.

BACKGROUND

The risk perception of disease can contribute to behaviors related to disease.[1] During contagious disease epidemics, perceived risk can have a significant impact on precautionary behaviors that might affect disease transmission.[2 3] Therefore, understanding characteristics of risk perception and factors relating to how people perceive the risk is important in terms of minimizing the impact of spread of infectious disease.

According to the Health Belief Model and Impersonal Impact Hypothesis, risk perception can be separated into personal and societal levels objectively.[2 4 5] Personal-level risk perception refers to subjective assessment of one's own vulnerability or probability of contracting a disease. Societal-level risk perception, however, is the global estimation of a serious risk to other people, i.e., probability of outbreak. Generally, precautionary behaviors are likely to depend directly upon personal-level risk perception; however that of societal-level risk perception may not affect behaviors directly.[6-8] Some researchers have suggested that individuals tend to be optimistic about personal-level risk and pessimistic about societal-level risk.[9]

Newly emerging contagious diseases have created a novel chance to examine how people perceive risk during an epidemic. Since the occurrence of the index case of Middle East Respiratory Syndrome (MERS) on 20 May 2015, a total of 186 persons were diagnosed with the disease, 38 of whom had died, and 16,693 patients were quarantined in South Korea.[10] The epidemic of MERS coronavirus (MERS-CoV) has had its largest outbreak outside of the Middle East in South Korea.[11] The occurrence of multiple transmissions after the first secondary infection and the failure of the government's on risk communication resulted in the increased concern of the general public.[12-15]

However, many studies have not distinguished between personal and societal level of risk perception regarding contagious diseases during outbreaks.[15-18] The first objective of the present study was to assess the personal-level and societal-level risk perception of MERS in the general population, during the MERS outbreak period. The second objective was to identify trends and factors associated with risk perception across the epidemic period.

METHODS

Participants

Between June 3 and July 2, 2015, a total of 5,015 participants who were older than 19 years were monitored using a serial cross-sectional study design in five consecutive surveys, covering the MERS epidemic. All surveys were conducted by Gallup Korea, an affiliation of Gallup International. The first survey was conducted between June 2 and 4, 2015 after the June 1, 2015 occurrence of the first tertiary infected case. The last was conducted just two days before the last confirmed patient on July 4, 2015. Additional details (period, number of respondents successfully interviewed, and response rate) for each of the five surveys are provided in Table 1. All surveys were conducted using mobile (85%) or landline (15%) random digit dialing numbers in eight regions which was representative of nationwide. Samples were selected post-stratification by gender, age, and province. The total number of weighted cases in this survey equals the total number of unweighted cases at the national level. The weights were normalized in order to calculate proportions and ratios; however; not for estimating the number of the subtotal populations. Trained interviewers conducted all interviews using computer assisted telephone interviewing (CATI). This study was reviewed and approved by the Institutional Review Board (IRB) of Seoul Metropolitan Government–Seoul National

University Boramae Medical Center (IRB No. 20190515/07 - 2019 - 11/062). The need for informed consent was waived by the board.

Table 1 Details of five consecutive surveys regarding the 2015 MERS-CoV outbreak in South Korea

Survey	period	Number of respondents sampled	Number of respondents successfully interviewed	Response rate (%)
1	June 2-4	6,494	1,005	15.5
2	June 9-11	5,482	1,002	18.3
3	June 16-18	5,585	1,000	17.9
4	June 23-25	5,680	1,004	17.7
5	June 30 to July 2	5,345	1,004	18.8

MERS-CoV, Middle East Respiratory Syndrome Coronavirus

Survey instruments

The interviews were conducted based on two levels of the risk perception, which are personal-level and societal-level risk perceptions.[17] Personal-level risk perception was assessed using the question "How worried are you that you may contract MERS-COV infection?" Responses were assessed on a four-point scale, with four points indicating "very worried" and one point indicating "not worried at all" (reclassified as 1-2 points = "not worried"; 3–4 points = "worried"). Personal-level risk perception proportion was defined as the number of participants who were "worried" by the number of eligible respondents. Societal-level risk perception was evaluated using the question "Do you think the MERS epidemic will subside or spread within a few days?" and required the following responses: "controlled," "uncontrolled," or "no opinion". Questions about societal-level perception were included since the survey 2. Societal-

level risk perception proportion was defined as the number of participants whose response was "uncontrolled" by the number of eligible respondents.

Demographic factors evaluated as respondents' characteristics included gender, age, educational attainment, occupation, perceived household economic status, residential area, and political orientation/party (party identification). Educational attainment was classified into five levels (less than middle school, high school, university, graduate school or higher). Educational attainment was investigated in all surveys except survey 1. Occupation was classified as either unemployed, farming and fishery, self-employed, blue-collar worker, white-collar worker, full-time housewife, or student. Perceived household economic status was classified into five levels (lower, lower middle, middle, upper middle, upper). Respondents were classified as either metropolitan or non-metropolitan residents; and distinguished by whether they resided in an area where MERS had occurred or not. Party identification was classified based on the support for the president or the political parties. Support or lack of support for the president was assessed using the options of "approval", "disapproval", or "no opinion", while support for the party identification was assessed based on alignment either with the ruling party, with the opposition party, or no opinion.

Patient and public involvement

Analysis

Response rates according to personal-level or societal-level risk perception were calculated over time. Univariate analyses using chi-square test were performed in the five consecutive surveys, entirely and respectively, to identify the relationships between risk perception and each demographic variable. We used multivariable logistic regression analyses to explore

factors influencing risk perception in the five surveys, entirely and respectively. All multivariable logistic regression models were adjusted for age, sex, educational attainment, occupation, perceived household economic status, residential area, presidential approval rating, and party identification. However educational attainment and perceived household economic status were excluded from survey 1 model in personal-level risk reception analysis, and in survey 5 model in societal-level analysis, respectively. This was because there was no data on educational attainment in survey 1 and small sample size of those who perceived societal-level risk in the upper economic level in survey 5. Missing values of any variable except societal-level risk reception (27.3%) were ≤2.7%; hence, these were dropped from both the descriptive and logistic regression analyses. Using logistic regression analysis for each personal-level and societal level risk perception, "y = 1" was used respectively when "worried" in personal-level and when "uncontrolled" in societal-level, otherwise "y = 0" was used.

RESULTS

Demographic factors

The general characteristics of the participants are shown in Table 2. There were no statistically significant differences between surveys. Nearly half of the participants were female, aged <50 years, were educated up to high school or below, were from the affected area, showed disapproval of the president or the ruling party, and had personal-level risk perception. Majority of the participants were employed, were in the middle economic status, metropolitan, without societal-level risk perception (controlled).

Table 2 Basic characteristics of the participants

Variables	Overall	Survey 1[a]	Survey 2	Survey 3	Survey 4	Survey 5
Gender						
Male	49.6	49.7	49.4	49.6	49.7	49.5

Female	50.4	50.3	50.6	50.4	50.3	50.5
Age (years)						
19-29	17.6	17.6	18.2	17.1	17.8	17.3
30-39	18.8	19.4	18.2	18.5	18.8	19.1
40-49	21.6	21.4	20.7	22.5	21.5	22.1
50-59	19.6	19.6	20.0	19.4	19.4	19.7
60-69	13.2	14.0	14.0	13.1	11.8	13.1
≥ 70	9.1	8.0	8.9	9.4	10.8	8.7
Educational attainment						
Middle school or below	15.1	u.a.	13.6	15.4	15.7	15.6
High school	28.1	u.a.	27.2	28.9	27.5	29.0
University	50.2	u.a.	53.9	48.5	50.0	48.4
Graduate school	6.6	u.a.	5.3	7.2	6.8	7.0
Occupation						
Unemployed	8.5	8.1	8.9	8.7	7.8	9.3
Farming / fishery	3.8	3.5	3.6	3.2	5.0	3.6
Self-employed	15.4	15.9	13.6	14.1	18.7	14.7
Blue-collar	11.8	12.2	11.8	12.4	10.8	11.7
White-collar	28.6	30.0	28.9	26.8	29.1	28.0
Housewife	8.9	22.2	23.1	26.1	19.6	24.3
Student	8.5	8.1	10.1	8.7	9.0	8.4
Perceived economic status						
Upper	1.8	1.7	1.9	1.9	2.1	1.2
Upper middle	10.9	10.7	13.0	11.4	8.5	10.8
Middle	42.1	39.0	44.5	43.0	39.3	44.5
Lower middle	26.3	28.8	24.2	26.6	27.5	24.6
Lower	19.0	19.8	16.4	17.1	22.6	18.9
MERS-CoV affected area						
Non-affected area	49.0	49.8	47.6	49.5	49.0	49.0
Affected area	51.0	50.2	52.4	50.5	51.0	51.0
Area						
Non-metropolitan	29.2	29.1	28.4	28.4	29.2	31.0
Metropolitan	70.8	70.9	71.6	71.6	70.8	69.0
Presidential approval rating						
Approval	32.7	34.3	33.1	29.1	32.6	34.2
Disapproval	57.9	54.9	57.6	60.6	58.4	57.9
No opinion	9.5	10.8	9.3	10.3	9.0	7.9
Party identification						
Ruling party	40.1	41.3	39.9	39.7	39.6	40.2
Opposition party	27.9	25.1	26.2	28.5	29.4	30.2
No opinion	32.0	33.6	33.9	31.8	31.0	29.6
Personal-level risk perception						
Worried	56.5	67.3	55.0	62.8	52.2	44.9
Not worried	43.5	32.7	45.0	37.2	47.8	55.1
Societal-level risk perception						
Uncontrolled	30.3	u.a.	35.4	52.6	26.3	9.0
Controlled	69.7	u.a.	64.6	47.4	73.7	91.0

* $P < 0.05$ calculated by chi-square test; u.a.: unavailable data; MERS-CoV, Middle East Respiratory Syndrome Coronavirus. [a]Educational attainment and societal-level risk perception were not investigated in survey 1.

Epidemic curve and time trends of risk perception

Figure 1 reports how the outbreak proceeded, with three overlapping transmission periods, the timing of the five independent surveys, and the risk perception rates. Noticeable differences were investigated between personal-level and societal-level risk proportions throughout the epidemic periods. Overall risk perception at personal-level proportion (56.5%) was nearly two times higher than at societal-level (30.3%). Personal-level risk perception proportions were always higher than societal-level during the present study periods. Of the personal-level risk perception, proportion was initially high during survey 1 (67.3%), declined during survey 2 (55.1%), temporally rose during survey 3 (62.8%), and declined again during surveys 4 and 5 (52.2% and 44.9%, respectively). A similar trend was observed in the societal-level risk perception proportions. The percentages of respondents who reported as being "worried" or "uncontrolled" decreased gradually after survey 3. Societal-level risk perception proportions decreased more rapidly than personal-level, over time, from 52.6% and 62.8% in survey 3 to 9.0% and 44.9% in survey 5, respectively. At the beginning of the occurrences of tertiary and quaternary cases, we identified high perceived risk in both the personal-level and societal-level proportions.

Factors associated with the personal-level risk perception

Table 3 shows the association between variables and risk perception of MERS-CoV at the personal-level. The result showed that gender, age, educational attainment, perceived economic status, area, presidential approval rating, and party identification were significantly associated with personal-level risk perception. Women (adjusted OR [aOR] 1.72-2.00; 95% confidence interval [CI] 1.14-2.86) were more likely to perceive MERS-CoV risk at personal level, which

decreased with time, and subsequently increased again. Respondents aged >40 years were less aware of the risk (aOR 0.74-0.98; 95% CI 0.39-2.27) in survey 1; however, they perceived the risk more over time (aOR 2.84-3.29; 95% CI 1.27-6.66). Higher level of education was also associated with lower level of risk perception at the personal-level, but was not statistically significant except university degree in the overall survey (aOR 0.73; 95% CI 0.55-0.96). Lower economic status and those living in metropolitan cities paid more attention to the personal-level risk of MERS-CoV in the overall model. Those who disapproved of the president and the ruling party had higher risk perception at the personal-level; the peak of disapproval was found in survey 2.

Table 3 Factors associated with personal-level risk perception of MERS-CoV

Variables	Overall aOR (95% CI)	Survey 1[a] aOR (95% CI)	Survey 2 aOR (95% CI)	Survey 3 aOR (95% CI)	Survey 4 aOR (95% CI)	Survey 5 aOR (95% CI)
Gender						
Male	1.00	1.00	1.00	1.00	1.00	1.00
Female	1.78* (1.49-2.13)	1.97* (1.35-2.88)	1.83* (1.26-2.66)	1.72* (1.14-2.60)	1.72* (1.26-2.42)	2.00* (1.40-2.86)
Age (years)						
19-29	1.00	1.00	1.00	1.00	1.00	1.00
30-39	1.76* (1.30-2.40)	1.51 (0.77-2.95)	0.80 (0.41-1.56)	1.81 (0.94-3.46)	2.19* (1.17-4.10)	3.21* (1.76-5.85)
40-49	1.57* (1.17-2.10)	0.74 (0.39-1.42)	0.76 (0.40-1.45)	1.60 (0.88-2.90)	1.72 (0.95-3.11)	3.00* (1.64-5.51)
50-59	1.36 (1.00-1.84)	0.89 (0.46-1.72)	0.58 (0.30-1.11)	1.85 (0.96-3.55)	1.10 (0.59-2.03)	2.93* (1.54-5.54)
60-69	1.35 (0.95-1.92)	0.93 (0.44-1.95)	0.73 (0.34-1.56)	1.42 (0.69-2.93)	0.86 (0.42-1.75)	3.29* (1.62-6.66)
≥ 70	1.67* (1.13-2.48)	0.98 (0.43-2.27)	0.66 (0.28-1.52)	2.60* (1.13-5.98)	1.55 (0.71-3.38)	2.84* (1.27-6.36)
Educational attainment						
Middle school or below	1.00	u.a.	1.00	1.00	1.00	1.00
High school	0.78 (0.60-1.01)	u.a.	0.68 (0.39-1.19)	1.25 (0.74-2.09)	0.66 (0.40-1.08)	0.68 (0.41-1.15)
University	0.73* (0.55-0.96)	u.a.	0.64 (0.36-1.15)	1.22 (0.68-2.17)	0.59 (0.34-1.03)	0.60 (0.34-1.07)
Graduate school	0.77 (0.52-1.12)	u.a.	0.89 (0.38-2.05)	0.94 (0.44-2.00)	0.67 (0.30-1.49)	0.64 (0.31-1.35)
Occupation						
Unemployed	1.00	1.00	1.00	1.00	1.00	1.00
Farming / fishery	0.89	0.65	0.99	0.65	1.53	0.69

	(0.55-1.42)	(0.25-1.69)	(0.35-2.81)	(0.23-1.85)	(0.62-3.78)	(0.27-1.08)
Self-employed	0.84 (0.61-1.17)	1.00 (0.51-1.93)	0.90 (0.47-1.72)	0.56 (0.28-1.11)	1.53 (0.78-3.03)	0.68 (0.36-1.31)
Blue-collar	1.21 (0.87-1.70)	1.63 (0.81-3.29)	1.20 (0.59-2.45)	1.08 (0.54-2.18)	2.08 (1.0-4.35)	0.84 (0.44-1.64)
White-collar	1.10 (0.81-1.51)	1.34 (0.71-2.56)	1.26 (0.68-2.35)	0.86 (0.44-1.68)	1.84 (0.92-3.66)	0.81 (0.44-1.46)
Housewife	1.03 (0.74-1.44)	1.42 (0.72-2.80)	1.01 (0.53-1.92)	1.01 (0.49-2.09)	1.81 (0.89-3.67)	0.62 (0.32-1.18)
Student	1.01 (0.66-1.54)	0.61 (0.25-1.50)	0.55 (0.24-1.30)	0.78 (0.33-1.85)	1.66 (0.64-4.34)	1.46 (0.64-3.33)
Perceived economic status						
Upper	1.00	1.00	1.00	1.00	1.00	1.00
Upper middle	1.91* (1.05-3.50)	1.06 (0.31-3.65)	1.95 (0.59-6.48)	1.71 (0.63-4.70)	2.20 (0.62-7.85)	2.14 (0.51-8.93)
Middle	1.84* (1.03-3.27)	1.06 (0.32-3.48)	1.83 (0.57-5.89)	1.91 (0.74-4.96)	2.60 (0.79-8.55)	1.84 (0.46-7.35)
Lower middle	2.14* (1.19-3.85)	1.02 (0.31-3.38)	1.97 (0.60-6.47)	2.12 (0.81-5.58)	2.94 (0.88-9.78)	2.30 (0.56-9.40)
Lower	2.28* (1.25-4.14)	1.20 (0.35-4.11)	2.24 (0.66-7.64)	2.78* (1.10-7.65)	3.45* (1.02-11.69)	1.98 (0.48-8.14)
MERS-CoV affected area						
Non-affected area	1.00	1.00	1.00	1.00	1.00	1.00
Affected area	0.92 (0.77-1.09)	1.32 (0.94-1.85)	1.10 (0.76-1.59)	0.93 (0.65-1.32)	1.01 (0.71-1.43)	0.74 (0.53-1.02)
Area						
Non-metropolitan	1.00	1.00	1.00	1.00	1.00	1.00
Metropolitan	1.26* (1.04-1.54)	0.80 (0.53-1.21)	1.15 (0.77-1.72)	1.83* (1.21-2.76)	0.99 (0.66-1.49)	1.19 (0.82-1.74)
Presidential approval rating						
Approval	1.00	1.00	1.00	1.00	1.00	1.00
Disapproval	2.63* (2.17-3.20)	2.35* (1.56-3.54)	3.11* (2.07-4.67)	2.19* (1.44-3.33)	2.69* (1.81-4.01)	2.88* (1.93-4.30)
No opinion	1.59* (1.19-2.12)	2.28* (1.31-3.96)	2.40* (1.32-4.37)	0.86 (0.49-1.53)	1.78 (0.93-3.41)	1.74 (0.97-3.14)
Party identification						
Ruling party	1.00	1.00	1.00	1.00	1.00	1.00
Opposition party	1.68* (1.36-2.08)	0.95 (0.60-1.50)	2.06* (1.30-3.25)	2.37* (1.48-3.79)	1.15 (0.75-1.76)	1.56* (1.01-2.40)
No opinion	1.19 (0.98-1.44)	1.27 (0.86-1.89)	1.17 (0.78-1.74)	1.64* (1.10-2.46)	0.98 (0.66-1.46)	1.07 (0.72-1.60)

MERS-CoV, Middle East Respiratory Syndrome Coronavirus; aOR: adjusted odds ratio, CI: confidence interval; u.a.: unavailable data; * $P < 0.05$. [a]Educational attainment was all investigated except survey 1.

Factors associated with the societal-level risk perception

Unlike the personal-level risk perception, no difference was found by gender in the societal-level risk perception (Table 4). Furthermore, respondents aged >30 years were consistently less aware of the societal-level risk during MERS-CoV epidemic. Generally, no not statistically

significant association was found with educational attainment, occupation, perceived economic status, MERS-CoV affected area, and metropolitan area. Similar to the personal-level, those who disapproved of the president and the ruling party had higher risk perceptions at the societal-level.

Table 4 Factors associated with societal-level risk perception of MERS-CoV

Variables	Overall aOR (95% CI)	Survey 2 aOR (95% CI)	Survey 3 aOR (95% CI)	Survey 4 aOR (95% CI)	Survey 5[a] aOR (95% CI)
Gender					
Male	1.00	1.00	1.00	1.00	1.00
Female	0.98 (0.80-1.20)	1.14 (0.73-1.70)	0.97 (0.64-1.46)	0.81 (0.54-1.21)	1.19 (0.63-2.25)
Age (years)					
19-29	1.00	1.00	1.00	1.00	1.00
30-39	0.76 (0.55-1.05)	0.26* (0.13-0.54)	1.26 (0.67-2.37)	0.91 (0.47-1.75)	0.84 (0.33-2.11)
40-49	0.64* (0.47-0.88)	0.21* (0.10-0.42)	0.99 (0.53-1.83)	0.81 (0.42-1.57)	0.65 (0.27-1.57)
50-59	0.44* (0.32-0.62)	0.12* (0.06-0.25)	1.19 (0.63-2.28)	0.35* (0.17-0.72)	0.25* (0.08-0.73)
60-69	0.30* (0.20-0.46)	0.13* (0.06-0.31)	0.35* (0.16-0.77)	0.26* (0.11-0.65)	0.17* (0.04-0.69)
≥ 70	0.26* (0.16-0.44)	0.08* (0.03-0.23)	0.61 (0.26-1.41)	0.20* (0.06-0.63)	0.12* (0.02-0.65)
Educational attainment					
Middle school or below	1.00	1.00	1.00	1.00	1.00
High school	0.81 (0.58-1.13)	0.58 (0.30-1.12)	1.41 (0.75-2.68)	0.45* (0.21-0.97)	0.56 (0.20-1.55)
University	0.93 (0.65-1.32)	0.47* (0.24-0.95)	2.11 (1.06-4.21)	0.73 (0.34-1.57)	0.42 (0.13-1.36)
Graduate school	0.92 (0.58-1.46)	0.12* (0.04-0.38)	1.83 (0.78-4.34)	1.27 (0.47-3.43)	0.64 (0.17-2.37)
Occupation					
Unemployed	1.00	1.00	1.00	1.00	1.00
Farming / fishery	1.51 (0.85-2.68)	1.72 (0.59-5.06)	1.52 (0.49-4.68)	3.04 (0.93-1.0)	1.12 (0.22-5.75)
Self-employed	0.94 (0.63-1.40)	1.08 (0.49-2.35)	0.92 (0.43-1.96)	1.76 (0.70-4.38)	0.31 (0.09-1.12)
Blue-collar	1.22 (0.81-1.84)	1.38 (0.61-3.15)	1.07 (0.51-2.22)	1.75 (0.66-4.67)	0.84 (0.28-2.56)
White-collar	1.05 (0.72-1.52)	1.46 (0.71-3.02)	0.94 (0.48-1.87)	1.64 (0.68-3.95)	0.56 (0.21-1.55)
Housewife	1.22 (0.81-1.83)	1.23 (0.55-2.74)	1.37 (0.65-2.92)	1.86 (0.71-4.92)	0.85 (0.29-2.50)
Student	0.81 (0.51-1.30)	0.68 (0.26-1.75)	0.78 (0.33-1.84)	1.01 (0.34-2.98)	0.47 (0.12-1.84)
Perceived economic status					

Upper	1.00	1.00	1.00	1.00	u.a.
Upper middle	0.96 (0.51-1.81)	1.17 (0.34-4.05)	0.71 (0.27-1.85)	0.71 (0.19-2.61)	u.a.
Middle	0.81 (0.44-1.47)	1.26 (0.39-4.05)	0.59 (0.25-1.40)	0.86 (0.26-2.87)	u.a.
Lower middle	1.22 (0.66-2.25)	1.76 (0.53-5.86)	0.98 (0.40-2.38)	1.13 (0.33-3.88)	u.a.
Lower	1.06 (0.57-1.99)	2.22 (0.64-7.74)	0.82 (0.32-2.12)	1.12 (0.32-4.0)	u.a.
MERS-CoV affected area					
Non-affected area	1.00	1.00	1.00	1.00	1.00
Affected area	1.05 (0.86-1.28)	1.43 (0.94-2.19)	0.79 (0.54-1.16)	1.02 (0.69-1.52)	1.18 (0.66-2.11)
Area					
Non-metropolitan	1.00	1.00	1.00	1.00	1.00
Metropolitan	0.91 (0.72-1.14)	0.57* (0.35-0.93)	1.34 (0.84-2.12)	1.08 (0.67-1.75)	0.69 (0.38-1.33)
Presidential approval rating					
Approval	1.00	1.00	1.00	1.00	1.00
Disapproval	3.55* (2.77-4.55)	5.41* (3.25-9.01)	3.00 (1.96-4.59*)	3.77* (2.13-6.68)	4.05* (1.44-11.41)
No opinion	1.75* (1.22-2.52)	2.00 (0.96-4.16)	0.94 (0.49-1.80)	3.26 (1.46-7.30)	1.55 (0.37-6.45)
Party identification					
Ruling party	1.00	1.00	1.00	1.00	1.00
Opposition party	1.38* (1.09-1.75)	2.01* (1.19-3.39)	1.86* (1.21-2.88)	1.09 (0.65-1.84)	1.08 (0.48-2.45)
No opinion	1.23 (0.98-1.55)	1.55 (0.97-2.48)	1.82* (1.20-2.76)	0.79 (0.47-1.34)	0.91 (0.40-2.08)

MERS-CoV, Middle East Respiratory Syndrome Coronavirus; aOR: adjusted odds ratio, CI: confidence interval; u.a.: unavailable data; * $P < 0.05$. [a]There was small sample size of those who perceived societal-level risk those in the upper economic level in survey 5, the perceived household economic status was excluded from the survey 5 model.

DISCUSSION

The present study found that personal-level risk perception was more than twice the level at the societal-level. Risk perception increased with new generations of transmission, such as with the tertiary and quaternary infection. Both risk perceptions tended to decrease over time and the societal-level risk perception declined more rapidly. Given that external stimuli are extreme events, two different reactions can occur: the affective reaction (risk-as-feelings) and cognitive reaction (risk-as-analysis).[19 20] Previous studies suggest that affective reaction is quick, intuitive, automatic, while cognitive reaction is slow, deliberate, and probability calculative. In the early phase of the outbreak, people may be experiencing challenges when attempting to

quantify the risk, which might lead to an affective reaction.[3 21] In contrast, cognitive reaction may occur during the late stage of the epidemic. The traditional impersonal-impact hypothesis proposes that cognitive reaction is more likely to correlate with societal-level risk perception than that of the personal-level.[5 8] Because the societal-level risk perception decreased rapidly, this study does not seem to support that cognitive reaction is more closely related to societal-level risk perception. While the affective or cognitive reaction do not individually make an impact on the different stages of epidemic; however, they can affect it together, simultaneously, indicating both personal and societal level risk perceptions.[17] Additional research is needed to understand why the personal-level risk perception was doubled and lasted longer than that of the societal-level.

According to multiple logistic regression analyses, being female was predisposed to greater risk perception at the personal-level, but not at the societal level. Previous studies that investigated risk perception by gender also showed that a higher risk perception was associated with the female gender.[15 16 22-24] However, previous studies did not distinguish between the level of risk perception. Possible explanation for the higher perception of risk by the female may be explained by worldviews and culture-identity protection.[25] Further research is needed to determine why the same female group showed differences in perceived risk for personal and societal levels.

The older the respondents, the higher the perceived personal-level risk, but the opposite occurred at the societal-level. In the early stage of the epidemic, the older the respondent, the lower the risk perception, but this increased with time at the personal-level. Some researchers suggested that numeracy skills may be correlated with risk perception.[26 27] It is necessary to further investigate the impact of age on risk perception.

There were no significant differences in the proportions of those with risk perception according to the major socioeconomic characteristics (education, income level, occupation, or area). However, given that some hierarchy-specific trends in income level were observed in the overall model of personal-level risk perception, these results might be due to the limited number of study participants

Those who did not support the president, or the ruling party were reported to have had higher risk perception in both the personal and societal levels. In the group that did not approve of the president, the probabilities of risk perception were higher at the individual-level than at the societal-level, but not for the party identification. In the early days of the MERS-COV outbreak, the government did not specify details regarding scientifically uncertain information in order to reduce public anxiety over the crisis, nor did the government disclose which hospitals the confirmed patients had visited. This resulted in increased public distrust in the government.[12] [13] Similar pattern of distrust in the government was associated with the spread of infection, during the outbreak of Ebola.[28] [29]

This study, which used a serial cross-sectional study design had some limitations. First, the study used a cross-sectional study design. Thus, causal relations between personal characteristics and risk perceptions could not be determined—rather, it could only suggest their relevance. Particularly, it was difficult to consider that presidential approval rating and party identification would actually lead to greater risk perception. Nevertheless, consecutive cross-sectional surveys may be a better option than a single cross-sectional survey. Second, this study could not evaluate the intensity of risk perception, because it only included questions focusing on whether or not participants recognized the risk at the different levels. It would be useful to

evaluate risk perceptions of respondents qualitatively if questions about the circumstances and characteristics of risk perception were surveyed in future studies. Third, because of the rapidly evolving epidemic, this study could not evaluate the validity of the questionnaire using a test-retest design. Fourth, small sample size of some variables once stratified, i.e. perceived household economic status, led to the exclusion of major socioeconomic characteristics from further analyses.

Conclusions

This study is the first to evaluate the differences in risk perception between the personal- and societal-level during the MERS-CoV outbreak in South Korea; and also reported various factors influencing risk perception. Quality of risk communication can create conditions for modulating the easy spread of emerging contagious diseases. To prevent the failure of epidemic management, further efforts are needed to understand the mechanism behind the general public's risk perception by the governmental public health sector as well as by the society of academy. Planning and implementation of strategies that consider the risk awareness mechanism will be a significant step in the right direction during national infectious disease crises.

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Competing interests

None declared.

Authors' contributions

WMJ participated and analyzed the data, interpreted the data, drafted and amended the manuscript. UNK contributed to the analysis of the data, interpreted the data, drafted and amended the manuscript. DHJ contributed to questionnaire design, coordinated data collection, and data interpretation. SJE contributed to study design, supervised the research, data interpretation, and amended the manuscript. JYL contributed to study design, supervised the research, data interpretation, and amended the manuscript.

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Data Availability Statement

No additional data are available.

References

1. Sheeran P, Harris PR, Epton T. Does heightening risk appraisals change people's intentions and behavior? A meta-analysis of experimental studies. *Psychol Bull* 2014;140:511. doi:10.1037/a0033065

2. Leppin A, Aro AR. Risk perceptions related to SARS and avian influenza: theoretical foundations of current empirical research. *Int J Behav Med* 2009;16:7-29. doi: 10.1007/s12529-008-9002-8 doi:10.1007/s12529-008-9002-8

3. Liao Q, Cowling BJ, Lam WW, et al. Anxiety, worry and cognitive risk estimate in relation to protective behaviors during the 2009 influenza A/H1N1 pandemic in Hong Kong: ten cross-sectional surveys. *BMC Infect Dis* 2014;14:169. doi:10.1186/1471-2334-14-169

4. Coleman C-L. The influence of mass media and interpersonal communication on societal and personal risk judgments. *Commun Res* 1993;20:611-28. doi:10.1177/009365093020004006

5. Tyler TR, Cook FL. The mass media and judgments of risk: Distinguishing impact on personal and societal level judgments. *J Pers Soc Psychol* 1984;47:693. doi: 10.1037/0022-3514.47.4.693

6. Rosenstock IM, Strecher VJ, Becker MH. Social learning theory and the health belief model. *Health Educ Q* 1988;15:175-83. doi:10.1177/109019818801500203

7. Sjöberg L. The different dynamics of personal and general risk. *Risk Management* 2003;5:19-34. doi:10.1057/palgrave.rm.8240154

8. Snyder LB, Rouse RA. The media can have more than an impersonal impact: The case of AIDS risk perceptions and behavior. *Health Commun* 1995;7:125-45. doi: 10.1207/s15327027hc0702_3

9. Culbertson HM, Stempel GH. " Media malaise": Explaining personal optimism and societal

pessimism about health care. *J Commun* 1985 doi:10.1111/j.1460-2466.1985.tb02242.x

10. Ministry of Health and Welfare. The 2015 MERS Outbreak in the Republic of Korea: Learning from MERS. Sejong, Korea: Ministry of Health and Welfare, 2016. http://www.cdc.go.kr/CDC/cms/content/mobile/39/70039_view.html (accessed 16 Jun 2019).
11. World Health Organization. WHO MERS-CoV global summary and assessment of risk. *Geneva: WHO* 2018 https://www.who.int/csr/disease/coronavirus_infections/risk-assessment-august-2018.pdf (accessed 17 Jun 2019).
12. Choi JW, Kim KH, Moon JM, et al. Public health crisis response and establishmentof a crisis communication system in South Korea: lessons learned from the MERS outbreak. *J Korean Med Assoc* 2015;58:624-34. doi:10.5124/jkma.2015.58.7.624
13. Kim E, Liao Q, Yu E, et al. Middle East respiratory syndrome in South Korea during 2015: risk-related perceptions and quarantine attitudes. *Am J Infect Control* 2016;44:1414-16. doi:10.1016/j.ajic.2016.03.014
14. Lee S-i. Costly lessons from the 2015 Middle East respiratory syndrome coronavirus outbreak in Korea. *J Prev Med Public Health* 2015;48:274. doi:10.3961/jpmph.15.064
15. Ro J-S, Lee J-S, Kang S-C, et al. Worry experienced during the 2015 Middle East respiratory syndrome (MERS) pandemic in Korea. *PloS One* 2017;12:e0173234. doi:10.1371/journal.pone.0173234
16. Ibuka Y, Chapman GB, Meyers LA, et al. The dynamics of risk perceptions and precautionary behavior in response to 2009 (H1N1) pandemic influenza. *BMC Infect Dis* 2010;10:296. doi:10.1186/1471-2334-10-296
17. Oh S-H, Paek H-J, Hove T. Cognitive and emotional dimensions of perceived risk characteristics, genre-specific media effects, and risk perceptions: The case of H1N1

influenza in South Korea. *Asian J Commun* 2015;25:14-32. doi:10.1080/01292986.2014.989240

18. Sadique MZ, Edmunds WJ, Smith RD, et al. Precautionary behavior in response to perceived threat of pandemic influenza. *Emerg Infect Dis* 2007;13:1307. doi:10.3201/eid1309.070372

19. Cameron LD, Leventhal H. The self-regulation of health and illness behaviour: psychology press 2003.

20. Slovic P, Finucane ML, Peters E, et al. Risk as analysis and risk as feelings: Some thoughts about affect, reason, risk, and rationality. *Risk Anal* 2004;24:311-22. doi:10.1111/j.0272-4332.2004.00433.x

21. Liao Q, Cowling B, Lam WT, et al. Situational awareness and health protective responses to pandemic influenza A (H1N1) in Hong Kong: a cross-sectional study. *PLoS One* 2010;5:e13350. doi:10.1371/journal.pone.0013350

22. de Zwart O, Veldhuijzen IK, Elam G, et al. Perceived threat, risk perception, and efficacy beliefs related to SARS and other (emerging) infectious diseases: results of an international survey. *Int J Behav Med* 2009;16:30-40. doi:10.1007/s12529-008-9008-2

23. Leung GM, Ho L-M, Chan SK, et al. Longitudinal assessment of community psychobehavioral responses during and after the 2003 outbreak of severe acute respiratory syndrome in Hong Kong. *Clin Infect Dis* 2005;40:1713-20. doi:10.1086/429923

24. Finucane ML, Slovic P, Mertz CK, et al. Gender, race, and perceived risk: The'white male'effect. *Health Risk Soc* 2000;2:159-72. doi:10.1080/713670162

25. Kahan DM, Braman D, Gastil J, et al. Culture and identity-protective cognition: Explaining the white-male effect in risk perception. *J Empir Leg Stud* 2007;4:465-505. doi:10.1111/j.1740-1461.2007.00097.x

26. Galesic M, Garcia-Retamero R, Gigerenzer G. Using icon arrays to communicate medical risks: overcoming low numeracy. *Health Psychol* 2009;28:210. doi:10.1037/a0014474

27. Davids SL, Schapira MM, McAuliffe TL, et al. Predictors of pessimistic breast cancer risk perceptions in a primary care population. *J Gen Intern Med* 2004;19:310-15. doi:10.1111/j.1525-1497.2004.20801.x

28. Vinck P, Pham PN, Bindu KK, et al. Institutional trust and misinformation in the response to the 2018–19 Ebola outbreak in North Kivu, DR Congo: a population-based survey. *Lancet Infect Dis* 2019;19:529-36. doi:10.1016/S1473-3099(19)30063-5

29. Tsai L, Blair R, Morse B. Patterns of trust and compliance in the fight against Ebola: Results from a population-based survey of Monrovia, Liberia. *Economic Impacts of Ebola, Bulletin Three* 2015. https://www.theigc.org/wp-content/uploads/2015/05/Economic-impacts-of-Ebola-Bulletin-3.pdf (accessed 20 Jun 2019).

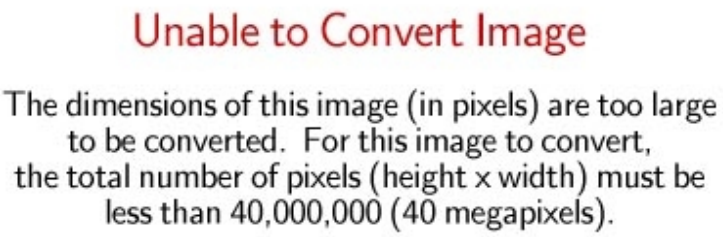

Figure 1 Epidemiologic curve of MERS-CoV, timing of surveys, and personal and societal level of risk perception
MERS-CoV, Middle East Respiratory Syndrome Coronavirus

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

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

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8, 9
		(b) Indicate number of participants with missing data for each variable of interest	8
Outcome data	15*	Report numbers of outcome events or summary measures	9
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10-14
		(*b*) Report category boundaries when continuous variables were categorized	10-14
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	16-17
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14-17
Generalisability	21	Discuss the generalisability (external validity) of the study results	17
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	

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

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

BMJ Open

Influence of trust on two different risk perception as an affective and cognitive dimension during Middle East Respiratory Syndrome Coronavirus (MERS-CoV) outbreak in South Korea: serial cross-sectional surveys

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Influence of trust on two different risk perception as an affective and cognitive dimension during Middle East Respiratory Syndrome Coronavirus (MERS-CoV) outbreak in South Korea: serial cross-sectional surveys

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Abstract

Objectives: This study aimed to assess the affective and cognitive risk perceptions in the general population of Middle East respiratory syndrome (MERS) during the 2015 MERS coronavirus (MERS-CoV) outbreak in South Korea and the influencing factors.

Design: Serial cross-sectional design with five consecutive surveys.

Setting: Nationwide general population in South Korea.

Participants: These included 5,015 respondents (aged 19 years) from the general population during the MERS-CoV epidemic.

Primary and secondary outcome measures: The main outcome measures were 1) affective risk perception, 2) cognitive risk perception, and 3) trust. Multivariate logistic regression models were used to identify the factors (demographic, socioeconomic, area, political orientation) associated with risk perceptions.

Results: Both affective and cognitive risk perceptions decreased as the MERS-CoV epidemic progressed. Proportions of affective risk perception were higher in all surveys and slowly decreased compared to cognitive risk perception over time. Females (adjusted OR [aOR] 1.72-2.00; 95% confidence interval [CI] 1.14-2.86) and lower perceived economic status respondents (aOR 1.84-2.28; 95% CI 1.03-4.14) were more likely to perceive the affective risk. The older adults, the higher the affective risk perception, but the lower the cognitive risk perception compared to the younger adults. The respondents who had low trust in the president or the ruling party had a higher risk perception in both affective and cognitive..

Conclusions: This study suggests that even if cognitive risk perception is dissolved, affective risk perception can continue during MERS-CoV epidemic. Risk perceptions associating factors (ie gender, age, perceived economic status) appear to be noticeably different between the affective and cognitive dimensions. It also adds findings that trust in the president not only affective risk perception but also cognitive risk perception. There is need of further efforts to

understand the mechanism regarding the general public's risk perception for effective risk communication.

Keywords: Middle East respiratory syndrome coronavirus, risk and perception, epidemics, surveys

Strengths and limitations of this study:

- This is the first study to evaluate the difference in risk perception between the affective and cognitive dimensions during MERS-CoV outbreak in South Korea.
- We used five consecutive cross-sectional surveys using nationwide representative samples.
- The validity of the questionnaire used in the survey was not evaluated because of the urgency of the outbreak.
- This study could not confirm causal relationship between personal characteristics and risk perception due to the limitation of the cross-sectional study design.

BACKGROUND

Newly emerging contagious diseases have created a novel chance to examine how people perceive risk during an epidemic. Since the occurrence of the index case of Middle East Respiratory Syndrome (MERS) on 20 May 2015, a total of 186 persons were diagnosed with the disease, 38 of whom had died, and 16,693 patients were quarantined in South Korea.[1] The epidemic of MERS coronavirus (MERS-CoV) has had its largest outbreak outside of the Middle East in South Korea.[2] The occurrence of multiple transmissions after the first secondary infection and the failure of the government's on risk communication resulted in the increased concern of the general public. [3-6] The Korean government did not disclose timely information about the outbreak of MERS-CoV, such as lists of affected medical institutions. [7] Due to increased public anxiety about MERS-CoV, the trust in the Korean government had fallen and the image of the Korean president as leader had been damaged. [8 9]

During contagious disease epidemics, perceived risk can have a significant impact on precautionary behaviors that might affect disease transmission.[10-12] Relevant empirical study was emphasized that informing public about the disease outbreak, such as the Ebola virus, could reduce worry about contracting the virus and take more preventive measures. [13]Evaluating the public risk perception of disease helps us know what knowledge the public needs. Therefore, understanding characteristics of risk perception and factors relating to how people perceive the risk is important in terms of minimizing the impact of spread of infectious disease.

Given that external stimuli are extreme events, two different reactions can occur: the affective reaction (risk-as-feelings) and cognitive reaction (risk-as-analysis). [14-16] Previous studies suggest that affective reaction is quick, intuitive, automatic, while cognitive reaction is slow,

deliberate, and probability calculative. In the early phase of the outbreak, people may be experiencing challenges when attempting to quantify the risk, which might lead to an affective reaction.[12 17] In contrast, cognitive reaction may occur during the late stage of the epidemic.

Most people may not conduct deliberate risk analysis when they cope with lack of knowledge about risk, such as new disease outbreak, but rely on simple heuristics. [18 19] Heuristic processing can be understood as simple decision rule of thumb or mental shortcut that can reduce the complexity of decision making. When risk management decisions are needed, trust in the institutions can be used as one of the heuristics. [20] People having trust in the responsible risk manager, such as the government, may perceive less risk in a particular issue than people not having trust. [21 22] Regarding the MERS epidemic in South Korea, less trust in the government affected increasing of individuals` risk perception. [23-25]Trust is known to be related not only to cognitive risk perception but also to affective risk perception. [26 27]

However, when assessing the influence of trust in risk perception, many studies have not distinguished between affective and cognitive reaction regarding contagious diseases during outbreaks. [3 12 23 24 28-30]We hypothesized that (1) affective risk perception would increase and decrease faster than cognitive risk perception over time and that (2) low trust in government would be related with high risk perception (both affective and cognitive).

METHODS

Participants

Between June 3 and July 2, 2015, a total of 5,015 participants who were older than 19 years were monitored using a serial cross-sectional study design in five consecutive surveys, covering the MERS epidemic. All surveys were conducted using mobile (85%) or landline

(15%) random digit dialing numbers in eight regions which was representative of nationwide. Samples were selected post-stratification by gender, age, and province. The total number of weighted cases in this survey equals the total number of unweighted cases at the national level. The weights were normalized in order to calculate proportions and ratios; however; not for estimating the number of the subtotal populations. Trained interviewers conducted all interviews using computer assisted telephone interviewing (CATI). The first survey was conducted between June 2 and 4, 2015 after the June 1, 2015 occurrence of the first tertiary infected case. The last was conducted just two days before the last confirmed patient on July 4, 2015. The surveys were conducted by Gallup Korea, an affiliation of Gallup International. Details including period, number of respondents successfully interviewed, and response rate for each of the five surveys are provided in Table 1.

Table 1 Details of five consecutive surveys regarding the 2015 MERS-CoV outbreak in South Korea

Survey	period	Number of respondents sampled	Number of respondents successfully interviewed	Response rate (%)
1	June 2-4	6,494	1,005	15.5
2	June 9-11	5,482	1,002	18.3
3	June 16-18	5,585	1,000	17.9
4	June 23-25	5,680	1,004	17.7
5	June 30 to July 2	5,345	1,004	18.8

MERS-CoV, Middle East Respiratory Syndrome Coronavirus

Demographic factors evaluated as respondents' characteristics included gender, age, educational attainment, occupation, perceived household economic status, residential area, and trust in president, party identification. Age was classified in to 6 levels (19-29, 30s, 40s, 50s, 60s, 70 age and older). Educational attainment was classified into five levels (less than middle

school, high school, university, graduate school or higher). Educational attainment was investigated in all surveys except survey 1. Occupation was classified as either unemployed, farming and fishery, self-employed, blue-collar worker, white-collar worker, full-time Homemaker, or student. Perceived household economic status was classified into five levels (lower, lower middle, middle, upper middle, upper). Respondents were classified as either metropolitan or non-metropolitan residents; and distinguished by whether they resided in an area where MERS had occurred or not. Party identification was classified based on the support for the political parties. Support for the party identification was assessed based on alignment either with the ruling party, with the opposition party, or no opinion.

Survey instruments

The interviews were conducted based on two aspects of the risk perception, which are affective and cognitive risk perceptions (Supplementary file). Affective risk perception was assessed using the question "How much worried are you that you could get MERS?" Responses were assessed on a four-point scale, with four points indicating "very worried" and one point indicating "not worried at all" (reclassified as 1-2 points = "not worried"; 3–4 points = "worried"). Affective risk perception proportion was defined as the number of participants who were "worried" by the number of eligible respondents. Cognitive risk perception was evaluated using the question "Do you think MERS epidemic will settled down in the next few days or spread further?" and required the following responses: "will settle down," "will spread further". Questions about cognitive perception were included since the survey 2. Cognitive risk perception proportion was defined as the number of participants whose response was "will spread further" by the number of eligible respondents. Trust in government was assessed using presidential job approval rating. Trust in government includes expectations of government`s competence to prevent people from risk and develop and implement follow-up measures. [31] It

can be termed this trust concept as competence-based trust. [32 33] We tried to assess the competence-based trust using presidential job approval rating. Presidential job approval was evaluated using the question "Do you approve or disapprove of the way President Park Geun-hye is handling her job as president?" and required the following responses: "approval", "disapproval". The development of questionnaires on risk perception and trust in the government had not gone through a valid procedure due to the urgency of the outbreak. We also imposed survey items on existing questionnaire developed by Gallup Korea, an affiliation of Gallup International.

Analysis

Response rates according to affective or cognitive risk perceptions were calculated over time. Univariate analyses using chi-square test were performed in the five consecutive surveys, entirely and respectively, to identify the relationships between risk perception and each demographic variable. We used multivariable logistic regression analyses to explore factors influencing risk perceptions (affective and cognitive) in the five surveys, entirely and respectively. Basic multivariable logistic regression model was adjusted for gender, age, educational attainment, occupation, perceived household economic status, affected area, residential area, presidential job approval, and party identification. Basic model was used in survey 2, 3, 4, 5, and overall models with affective perception and survey 2, 3, 4, overall models with cognitive perception. The basic model excluding educational attainment was used in survey 1 with affective risk perception. The perceived household economic status was also excluded in survey 5 model with cognitive risk perception. These exclusions were because there was no data on educational attainment in survey 1 and small sample size of those who perceived cognitive risk in the upper economic level in survey 5. Further, there was omission

of cognitive risk perception in survey 1 therefore survey 1 model with cognitive perception was excluded. The missing values due to non-inclusion of cognitive risk perception in survey 1 accounted for 73.5% of total missing values of cognitive risk perception. Missing values of any variable except cognitive risk perception (27.3%) were ≤2.7%. Using logistic regression analysis for each affective and cognitive risk perception, "y = 1" was used respectively when "worried" in affective and when "spread" in cognitive, otherwise "y = 0" was used.

This study was reviewed and approved by the Institutional Review Board (IRB) of Seoul Metropolitan Government–Seoul National University Boramae Medical Center (IRB No. 20190515/07 - 2019 - 11/062). The need for informed consent was waived by the board.

Patient and public involvement

No patient or public was involved in the design or planning of this study.

RESULTS

Demographic factors

The general characteristics of the participants are shown in Table 2. There were no statistically significant differences between surveys except perceived economic status, affective risk perception, cognitive risk perception. Nearly half of the participants were female, aged <50 years, were educated up to high school or below, were from the affected area, showed disapproval of the president or the ruling party. Majority of the participants were employed, were in the middle economic status, metropolitan. More than half of participants were worried, but had views that epidemic will subside.

Table 2 Basic characteristics of the participants

Variables	Overall	Survey 1[a]	Survey 2	Survey 3	Survey 4	Survey 5
Gender						
Male	49.6	49.7	49.4	49.6	49.7	49.5
Female	50.4	50.3	50.6	50.4	50.3	50.5
Age (years)						
19-29	17.6	17.6	18.2	17.1	17.8	17.3
30-39	18.8	19.4	18.2	18.5	18.8	19.1
40-49	21.6	21.4	20.7	22.5	21.5	22.1
50-59	19.6	19.6	20.0	19.4	19.4	19.7
60-69	13.2	14.0	14.0	13.1	11.8	13.1
≥ 70	9.1	8.0	8.9	9.4	10.8	8.7
Educational attainment						
Middle school or below	15.1	u.a.	13.6	15.4	15.7	15.6
High school	28.1	u.a.	27.2	28.9	27.5	29.0
University	50.2	u.a.	53.9	48.5	50.0	48.4
Graduate school	6.6	u.a.	5.3	7.2	6.8	7.0
Occupation						
Unemployed	8.5	8.1	8.9	8.7	7.8	9.3
Farming / fishery	3.8	3.5	3.6	3.2	5.0	3.6
Self-employed	15.4	15.9	13.6	14.1	18.7	14.7
Blue-collar	11.8	12.2	11.8	12.4	10.8	11.7
White-collar	28.6	30.0	28.9	26.8	29.1	28.0
Homemaker	8.9	22.2	23.1	26.1	19.6	24.3
Student	8.5	8.1	10.1	8.7	9.0	8.4
Perceived economic status*						
Upper	1.8	1.7	1.9	1.9	2.1	1.2
Upper middle	10.9	10.7	13.0	11.4	8.5	10.8
Middle	42.1	39.0	44.5	43.0	39.3	44.5
Lower middle	26.3	28.8	24.2	26.6	27.5	24.6
Lower	19.0	19.8	16.4	17.1	22.6	18.9
MERS-CoV affected area						
Non-affected area	49.0	49.8	47.6	49.5	49.0	49.0
Affected area	51.0	50.2	52.4	50.5	51.0	51.0
Residential area						
Non-metropolitan	29.2	29.1	28.4	28.4	29.2	31.0
Metropolitan	70.8	70.9	71.6	71.6	70.8	69.0
Presidential job approval rating						
Approval	32.7	34.3	33.1	29.1	32.6	34.2
Disapproval	57.9	54.9	57.6	60.6	58.4	57.9
No opinion	9.5	10.8	9.3	10.3	9.0	7.9
Party identification						
Ruling party	40.1	41.3	39.9	39.7	39.6	40.2
Opposition party	27.9	25.1	26.2	28.5	29.4	30.2
No opinion	32.0	33.6	33.9	31.8	31.0	29.6
Affective risk perception*						
Worried	56.5	67.3	55.0	62.8	52.2	44.9
Not worried	43.5	32.7	45.0	37.2	47.8	55.1
Cognitive risk perception*						

Spread further	30.3	u.a.	35.4	52.6	26.3	9.0
Settle down	69.7	u.a.	64.6	47.4	73.7	91.0

* $P < 0.05$ calculated by chi-square test; u.a.: unavailable data; MERS-CoV, Middle East Respiratory Syndrome Coronavirus. [a]Educational attainment and societal-level risk perception were not investigated in survey 1.

Epidemic curve and time trends of risk perception

Figure 1 reports how the outbreak proceeded, with three overlapping transmission periods, the timing of the five independent surveys, and the risk perception rates. Differences were investigated between affective and cognitive risk proportions throughout the epidemic periods. Overall risk perception of the five surveys at affective proportion (56.5%) was nearly two times higher than at cognitive dimension (30.3%). Affective risk perception proportions were always higher than cognitive dimension during the present study periods. Of the affective risk perception, proportion was initially high during survey 1 (67.3%), declined during survey 2 (55.1%), temporally rose during survey 3 (62.8%), and declined again during surveys 4 and 5 (52.2% and 44.9%, respectively). A similar trend was observed in the cognitive risk perception proportions. The percentages of respondents who reported as being "worried" or "spread further" decreased gradually after survey 3. Cognitive risk perception proportions decreased more rapidly than affective aspect, over time, from 52.6% and 62.8% in survey 3 to 9.0% and 44.9% in survey 5, respectively. At the beginning of the occurrences of tertiary and quaternary cases, we identified high perceived risk in both the affective and cognitive aspects proportions.

Factors associated with the affective risk perception

Table 3 shows the association between variables and risk perception of MERS-CoV at the affective dimension. The result showed that gender, age, educational attainment, perceived economic status, area, presidential job approval rating, and party identification were significantly associated with affective risk perception. Women (adjusted OR [aOR] 1.72-2.00; 95% confidence interval [CI] 1.14-2.86) were more likely to perceive MERS-CoV risk at affective dimension, which decreased with time, and subsequently increased again. Groups of

older than 40 years were less aware of the risk (aOR 0.74-0.98; 95% CI 0.39-2.27) in survey 1; however, they perceived the risk more over time (aOR 2.84-3.29; 95% CI 1.27-6.66). The association of education with affective risk perception was non-significant except university degree in the overall survey (aOR 0.73; 95% CI 0.55-0.96). Lower economic status and those living in metropolitan cities paid more attention to the affective risk of MERS-CoV in the overall model. Those who disapproved of the president and the ruling party had higher risk perception at the affective dimension; the peak of disapproval was found in survey 2.

Table 3 Factors associated with affective risk perception of MERS-CoV

Variables	Overall aOR (95% CI)	Survey 1[a] aOR (95% CI)	Survey 2 aOR (95% CI)	Survey 3 aOR (95% CI)	Survey 4 aOR (95% CI)	Survey 5 aOR (95% CI)
Gender						
Male	1.00	1.00	1.00	1.00	1.00	1.00
Female	1.78* (1.49-2.13)	1.97* (1.35-2.88)	1.83* (1.26-2.66)	1.72* (1.14-2.60)	1.72* (1.26-2.42)	2.00* (1.40-2.86)
Age (years)						
19-29	1.00	1.00	1.00	1.00	1.00	1.00
30-39	1.76* (1.30-2.40)	1.51 (0.77-2.95)	0.80 (0.41-1.56)	1.81 (0.94-3.46)	2.19* (1.17-4.10)	3.21* (1.76-5.85)
40-49	1.57* (1.17-2.10)	0.74 (0.39-1.42)	0.76 (0.40-1.45)	1.60 (0.88-2.90)	1.72 (0.95-3.11)	3.00* (1.64-5.51)
50-59	1.36 (1.00-1.84)	0.89 (0.46-1.72)	0.58 (0.30-1.11)	1.85 (0.96-3.55)	1.10 (0.59-2.03)	2.93* (1.54-5.54)
60-69	1.35 (0.95-1.92)	0.93 (0.44-1.95)	0.73 (0.34-1.56)	1.42 (0.69-2.93)	0.86 (0.42-1.75)	3.29* (1.62-6.66)
≥ 70	1.67* (1.13-2.48)	0.98 (0.43-2.27)	0.66 (0.28-1.52)	2.60* (1.13-5.98)	1.55 (0.71-3.38)	2.84* (1.27-6.36)
Educational attainment						
Middle school or below	1.00	u.a.	1.00	1.00	1.00	1.00
High school	0.78 (0.60-1.01)	u.a.	0.68 (0.39-1.19)	1.25 (0.74-2.09)	0.66 (0.40-1.08)	0.68 (0.41-1.15)
University	0.73* (0.55-0.96)	u.a.	0.64 (0.36-1.15)	1.22 (0.68-2.17)	0.59 (0.34-1.03)	0.60 (0.34-1.07)
Graduate school	0.77 (0.52-1.12)	u.a.	0.89 (0.38-2.05)	0.94 (0.44-2.00)	0.67 (0.30-1.49)	0.64 (0.31-1.35)
Occupation						
Unemployed	1.00	1.00	1.00	1.00	1.00	1.00
Farming / fishery	0.89 (0.55-1.42)	0.65 (0.25-1.69)	0.99 (0.35-2.81)	0.65 (0.23-1.85)	1.53 (0.62-3.78)	0.69 (0.27-1.08)
Self-employed	0.84 (0.61-1.17)	1.00 (0.51-1.93)	0.90 (0.47-1.72)	0.56 (0.28-1.11)	1.53 (0.78-3.03)	0.68 (0.36-1.31)
Blue-collar	1.21 (0.87-1.70)	1.63 (0.81-3.29)	1.20 (0.59-2.45)	1.08 (0.54-2.18)	2.08 (1.0-4.35)	0.84 (0.44-1.64)

White-collar	1.10 (0.81-1.51)	1.34 (0.71-2.56)	1.26 (0.68-2.35)	0.86 (0.44-1.68)	1.84 (0.92-3.66)	0.81 (0.44-1.46)
Homemaker	1.03 (0.74-1.44)	1.42 (0.72-2.80)	1.01 (0.53-1.92)	1.01 (0.49-2.09)	1.81 (0.89-3.67)	0.62 (0.32-1.18)
Student	1.01 (0.66-1.54)	0.61 (0.25-1.50)	0.55 (0.24-1.30)	0.78 (0.33-1.85)	1.66 (0.64-4.34)	1.46 (0.64-3.33)
Perceived economic status						
Upper	1.00	1.00	1.00	1.00	1.00	1.00
Upper middle	1.91* (1.05-3.50)	1.06 (0.31-3.65)	1.95 (0.59-6.48)	1.71 (0.63-4.70)	2.20 (0.62-7.85)	2.14 (0.51-8.93)
Middle	1.84* (1.03-3.27)	1.06 (0.32-3.48)	1.83 (0.57-5.89)	1.91 (0.74-4.96)	2.60 (0.79-8.55)	1.84 (0.46-7.35)
Lower middle	2.14* (1.19-3.85)	1.02 (0.31-3.38)	1.97 (0.60-6.47)	2.12 (0.81-5.58)	2.94 (0.88-9.78)	2.30 (0.56-9.40)
Lower	2.28* (1.25-4.14)	1.20 (0.35-4.11)	2.24 (0.66-7.64)	2.78* (1.10-7.65)	3.45* (1.02-11.69)	1.98 (0.48-8.14)
MERS-CoV affected area						
Non-affected area	1.00	1.00	1.00	1.00	1.00	1.00
Affected area	0.92 (0.77-1.09)	1.32 (0.94-1.85)	1.10 (0.76-1.59)	0.93 (0.65-1.32)	1.01 (0.71-1.43)	0.74 (0.53-1.02)
Residential area						
Non-metropolitan	1.00	1.00	1.00	1.00	1.00	1.00
Metropolitan	1.26* (1.04-1.54)	0.80 (0.53-1.21)	1.15 (0.77-1.72)	1.83* (1.21-2.76)	0.99 (0.66-1.49)	1.19 (0.82-1.74)
Presidential job approval rating						
Approval	1.00	1.00	1.00	1.00	1.00	1.00
Disapproval	2.63* (2.17-3.20)	2.35* (1.56-3.54)	3.11* (2.07-4.67)	2.19* (1.44-3.33)	2.69* (1.81-4.01)	2.88* (1.93-4.30)
No opinion	1.59* (1.19-2.12)	2.28* (1.31-3.96)	2.40* (1.32-4.37)	0.86 (0.49-1.53)	1.78 (0.93-3.41)	1.74 (0.97-3.14)
Party identification						
Ruling party	1.00	1.00	1.00	1.00	1.00	1.00
Opposition party	1.68* (1.36-2.08)	0.95 (0.60-1.50)	2.06* (1.30-3.25)	2.37* (1.48-3.79)	1.15 (0.75-1.76)	1.56* (1.01-2.40)
No opinion	1.19 (0.98-1.44)	1.27 (0.86-1.89)	1.17 (0.78-1.74)	1.64* (1.10-2.46)	0.98 (0.66-1.46)	1.07 (0.72-1.60)

MERS-CoV, Middle East Respiratory Syndrome Coronavirus; aOR: adjusted odds ratio, CI: confidence interval; u.a.: unavailable data; * $P < 0.05$. [a]Educational attainment was all investigated except survey 1.

Factors associated with the cognitive risk perception

Unlike the cognitive risk perception, no difference was found by gender in the cognitive risk perception (Table 4). Furthermore, respondents aged >30 years were consistently less aware of the cognitive risk during MERS-CoV epidemic. Generally, no not statistically significant association was found with educational attainment, occupation, perceived economic status, MERS-CoV affected area, and metropolitan area. Similar to the affective dimension, those who

disapproved of the president and the ruling party had higher risk perceptions at the cognitive dimension.

Table 4 Factors associated with cognitive risk perception of MERS-CoV

Variables	Overall aOR (95% CI)	Survey 2 aOR (95% CI)	Survey 3 aOR (95% CI)	Survey 4 aOR (95% CI)	Survey 5[a] aOR (95% CI)
Gender					
Male	1.00	1.00	1.00	1.00	1.00
Female	0.98 (0.80-1.20)	1.14 (0.73-1.70)	0.97 (0.64-1.46)	0.81 (0.54-1.21)	1.19 (0.63-2.25)
Age (years)					
19-29	1.00	1.00	1.00	1.00	1.00
30-39	0.76 (0.55-1.05)	0.26* (0.13-0.54)	1.26 (0.67-2.37)	0.91 (0.47-1.75)	0.84 (0.33-2.11)
40-49	0.64* (0.47-0.88)	0.21* (0.10-0.42)	0.99 (0.53-1.83)	0.81 (0.42-1.57)	0.65 (0.27-1.57)
50-59	0.44* (0.32-0.62)	0.12* (0.06-0.25)	1.19 (0.63-2.28)	0.35* (0.17-0.72)	0.25* (0.08-0.73)
60-69	0.30* (0.20-0.46)	0.13* (0.06-0.31)	0.35* (0.16-0.77)	0.26* (0.11-0.65)	0.17* (0.04-0.69)
≥ 70	0.26* (0.16-0.44)	0.08* (0.03-0.23)	0.61 (0.26-1.41)	0.20* (0.06-0.63)	0.12* (0.02-0.65)
Educational attainment					
Middle school or below	1.00	1.00	1.00	1.00	1.00
High school	0.81 (0.58-1.13)	0.58 (0.30-1.12)	1.41 (0.75-2.68)	0.45* (0.21-0.97)	0.56 (0.20-1.55)
University	0.93 (0.65-1.32)	0.47* (0.24-0.95)	2.11 (1.06-4.21)	0.73 (0.34-1.57)	0.42 (0.13-1.36)
Graduate school	0.92 (0.58-1.46)	0.12* (0.04-0.38)	1.83 (0.78-4.34)	1.27 (0.47-3.43)	0.64 (0.17-2.37)
Occupation					
Unemployed	1.00	1.00	1.00	1.00	1.00
Farming / fishery	1.51 (0.85-2.68)	1.72 (0.59-5.06)	1.52 (0.49-4.68)	3.04 (0.93-1.0)	1.12 (0.22-5.75)
Self-employed	0.94 (0.63-1.40)	1.08 (0.49-2.35)	0.92 (0.43-1.96)	1.76 (0.70-4.38)	0.31 (0.09-1.12)
Blue-collar	1.22 (0.81-1.84)	1.38 (0.61-3.15)	1.07 (0.51-2.22)	1.75 (0.66-4.67)	0.84 (0.28-2.56)
White-collar	1.05 (0.72-1.52)	1.46 (0.71-3.02)	0.94 (0.48-1.87)	1.64 (0.68-3.95)	0.56 (0.21-1.55)
Homemaker	1.22 (0.81-1.83)	1.23 (0.55-2.74)	1.37 (0.65-2.92)	1.86 (0.71-4.92)	0.85 (0.29-2.50)
Student	0.81 (0.51-1.30)	0.68 (0.26-1.75)	0.78 (0.33-1.84)	1.01 (0.34-2.98)	0.47 (0.12-1.84)
Perceived economic status					
Upper	1.00	1.00	1.00	1.00	u.a.
Upper middle	0.96 (0.51-1.81)	1.17 (0.34-4.05)	0.71 (0.27-1.85)	0.71 (0.19-2.61)	u.a.
Middle	0.81 (0.44-1.47)	1.26 (0.39-4.05)	0.59 (0.25-1.40)	0.86 (0.26-2.87)	u.a.

Lower middle	1.22 (0.66-2.25)	1.76 (0.53-5.86)	0.98 (0.40-2.38)	1.13 (0.33-3.88)	u.a.
Lower	1.06 (0.57-1.99)	2.22 (0.64-7.74)	0.82 (0.32-2.12)	1.12 (0.32-4.0)	u.a.
MERS-CoV affected area					
Non-affected area	1.00	1.00	1.00	1.00	1.00
Affected area	1.05 (0.86-1.28)	1.43 (0.94-2.19)	0.79 (0.54-1.16)	1.02 (0.69-1.52)	1.18 (0.66-2.11)
Residential area					
Non-metropolitan	1.00	1.00	1.00	1.00	1.00
Metropolitan	0.91 (0.72-1.14)	0.57* (0.35-0.93)	1.34 (0.84-2.12)	1.08 (0.67-1.75)	0.69 (0.38-1.33)
Presidential job approval rating					
Approval	1.00	1.00	1.00	1.00	1.00
Disapproval	3.55* (2.77-4.55)	5.41* (3.25-9.01)	3.00 (1.96-4.59*)	3.77* (2.13-6.68)	4.05* (1.44-11.41)
No opinion	1.75* (1.22-2.52)	2.00 (0.96-4.16)	0.94 (0.49-1.80)	3.26 (1.46-7.30)	1.55 (0.37-6.45)
Party identification					
Ruling party	1.00	1.00	1.00	1.00	1.00
Opposition party	1.38* (1.09-1.75)	2.01* (1.19-3.39)	1.86* (1.21-2.88)	1.09 (0.65-1.84)	1.08 (0.48-2.45)
No opinion	1.23 (0.98-1.55)	1.55 (0.97-2.48)	1.82* (1.20-2.76)	0.79 (0.47-1.34)	0.91 (0.40-2.08)

MERS-CoV, Middle East Respiratory Syndrome Coronavirus; aOR: adjusted odds ratio, CI: confidence interval; u.a.: unavailable data; * $P < 0.05$. [a]There was small sample size of those who perceived societal-level risk those in the upper economic level in survey 5, the perceived household economic status was excluded from the survey 5 model.

DISCUSSION

The aims of the present study were to explore the differences in risk perception at affective and cognitive dimension and examine the relationship between trust in government and the both risk perceptions. To do this end, we investigated the pattern of affective and cognitive risk perception proportions during MERS-CoV epidemic, respectively; analyzed the correlations of presidential job approval rating, party identification and risk perceptions (affective and cognitive).

First, we found that affective risk perception responded faster and lasts longer. The affective risk perception proportions were always higher than at the cognitive dimension. Risk

perception increased with new generations of transmission, such as with the tertiary and quaternary infection. Both risk perceptions tended to decrease over time and the cognitive risk perception declined more rapidly.

However, our results are inconsistent with previous studies that affective reaction tends to appear in early epidemic periods. [12 17] Relevant research in risk perception have proposed that affective reaction is fast, efficient, automatic, experiential compared to cognitive reaction. [14-16] We can consider the possibility that damaged trust in government as a responsible risk manager may had further evoked the emotional risk perception. [8 9 23-25] While the affective or cognitive reaction do not individually make an impact on the different stages of epidemic; however, they can affect it together, simultaneously, indicating both affective and cognitive risk perceptions. [12 17 26 29] Additional research is needed to understand why the affective risk perception was higher and lasted longer than that of the cognitive risk perception during MERS-CoV epidemic in South Korea.

Second, our study shows that low trust in government had influenced both affective and cognitive risk perceptions. We tried to assess the competence-based trust using presidential job approval rating. After party identification was adjusted, we examine correlation with trust and risk perception. It is consistent with previous studies that trust in government could shape the public`s risk perception (both affective and cognitive). [21 22 26 27] However, the previous studies have not distinguished between affective and cognitive reaction when evaluating the impact of trust regarding contagious diseases during outbreaks. [3 12 23 24 28-30] Our findings suggest that trust in government is correlated with both affective and cognitive risk perception and it is important to understand the relationship between trust in government and two different aspects of risk perceptions. Those who did not support the president were reported to have had higher

risk perception in both the affective and cognitive levels. In the group that did not approve of the president, the probabilities of risk perception were higher at the cognitive dimension than at affective dimension. In the early days of the MERS-COV outbreak, the government did not specify details regarding scientifically uncertain information in order to reduce public anxiety over the crisis, nor did the government disclose which hospitals the confirmed patients had visited. This resulted in increased public distrust in the government. [4 5 8 9] Similar pattern of distrust in the government was associated with the spread of infection, during the outbreak of Ebola.[34 35] Those who disapproved of the ruling party had also higher risk perceptions. Identification of party is can be classified in the political aspect of trust. [36] It need to investigate further comprehensive understanding of trust`s effect on risk perception.

Third, we found that gender, age, perceived economic status, residential area, party identification correlated significantly with risk perception. According to multiple logistic regression analyses, being female was predisposed to greater risk perception at the affective risk perception, but not at the cognitive dimension. Previous studies that investigated risk perception by gender also showed that a lower risk perception was associated with the male gender.[3 28 37-39] Possible explanation for lower perception of risk by male are that male have more to gain from risky behaviors. [40] However, previous studies did not distinguish between the level of risk perception. Further research is needed to determine why the same female group showed differences in perceived risk for affective and cognitive levels. The older the respondents, the lower the perceived cognitive dimension, but the opposite occurred weakly at the affective risk perception. The correlation with age and affective risk perception was not significant in the most model (survey 1, survey 2, survey 3, survey 4 models). We found that the higher the age, the higher president's job approval rating. The effect of trust may lead to a

reduction in the cognitive risk perception among older respondents. Further research is needed as to why the effect of trust in government had not been shown in the affective risk perception.

Given that some hierarchy-specific trends in income level were observed only in the overall model of personal-level risk perception, these results consistent with previous studies. [41-43] The location effect on risk perception also was evaluated in this study, however it was not clear the correlate with risk proximity and risk perception. [44] There were no significant differences in the proportions of those with risk perception according to the major socioeconomic characteristics (education, income level, occupation). It is necessary to further investigate the correlation with demographic factors and risk perception.

This study, which used a serial cross-sectional study design had some limitations. First, the study used a cross-sectional study design. Thus, causal relations between personal characteristics and risk perceptions could not be determined—rather, it could only suggest their relevance. Second, this study could not evaluate the intensity of risk perception, because it only included questions focusing on whether or not participants recognized the risk at the different levels. It would be useful to evaluate risk perceptions of respondents qualitatively if questions about the circumstances and characteristics of risk perception were surveyed in future studies. Third, because of the rapidly evolving epidemic, this study could not evaluate the validity of the questionnaire using a test-retest design. Fourth, small sample size of some variables once stratified, i.e. perceived household economic status, led to the exclusion of major socioeconomic characteristics from further analyses.

Conclusions

This study is the first to evaluate the differences in risk perception at affective and cognitive dimension and the relationship between trust in government and the both risk perceptions. during the MERS-CoV outbreak in South Korea; and also reported various factors influencing risk perception. We found that affective risk perception responded faster and lasts longer; and low trust in government had influenced both affective and cognitive risk perceptions. Quality of risk communication can create conditions for modulating the easy spread of emerging contagious diseases. To prevent the failure of epidemic management, further efforts are needed to understand the mechanism behind the general public's risk perception by the governmental public health sector as well as by the society of academy. Planning and implementation of strategies that consider the risk awareness mechanism will be a significant step in the right direction during national infectious disease crises.

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Competing interests

None declared.

Authors' contributions

WMJ participated and analyzed the data, interpreted the data, drafted and amended the manuscript. UNK, SC and HJ contributed to the analysis of the data, interpreted the data, drafted and amended the manuscript. DHJ contributed to questionnaire design, coordinated data collection, and data interpretation. SJE and JYL contributed to study design, supervised the research, data interpretation, and amended the manuscript.

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Data Availability Statement

No additional data are available.

Figure legends

Figure 1 Epidemiologic curve of MERS-CoV, timing of surveys, and personal and societal level of risk perception
MERS-CoV, Middle East Respiratory Syndrome Coronavirus

References

1. Welfare MoHa. The 2015 MERS Outbreak in the Republic of Korea: Learning from MERS. Sejong, Korea: Ministry of Health and Welfare, 2016.

2. Organization WH. WHO MERS-CoV global summary and assessment of risk. *Geneva: WHO* 2018

3. Ro J-S, Lee J-S, Kang S-C, et al. Worry experienced during the 2015 Middle East respiratory syndrome (MERS) pandemic in Korea. *PloS one* 2017;12(3):e0173234. doi: 10.1371/journal.pone.0173234

4. Choi JW, Kim KH, Moon JM, et al. Public health crisis response and establishmentof a crisis communication system in South Korea: lessons learned from the MERS outbreak. *Journal of the Korean Medical Association* 2015;58(7):624-34. doi: 10.5124/jkma.2015.58.7.624

5. Kim E, Liao Q, Yu E, et al. Middle East respiratory syndrome in South Korea during 2015: risk-related perceptions and quarantine attitudes. *American journal of infection control* 2016;44(11):1414-16. doi: 10.1016/j.ajic.2016.03.014

6. Lee S-i. Costly lessons from the 2015 Middle East respiratory syndrome coronavirus outbreak in Korea. *Journal of Preventive Medicine and Public Health* 2015;48(6):274. doi: 10.3961/jpmph.15.064

7. Yang S, Cho S-I. Middle East respiratory syndrome risk perception among students at a university in South Korea, 2015. *American journal of infection control* 2017;45(6):e53-e60.

8. Sang-hun C. MERS tarnishes Korean president's image as leader. *The New York Times* 2015 12 June.

9. Lee SY, Yang HJ, Kim G, et al. Preventive behaviors by the level of perceived infection

sensitivity during the Korea outbreak of Middle East Respiratory Syndrome in 2015. *Epidemiology and health* 2016;38 doi: 10.4178/epih.e2016051

10. Sheeran P, Harris PR, Epton T. Does heightening risk appraisals change people's intentions and behavior? A meta-analysis of experimental studies. *Psychol Bulletin* 2014;140(2):511. doi: 10.1037/a0033065
11. Leppin A, Aro AR. Risk perceptions related to SARS and avian influenza: theoretical foundations of current empirical research. *Int J Behav Med* 2009;16(1):7-29. doi: 10.1007/s12529-008-9002-8
12. Liao Q, Cowling BJ, Lam WW, et al. Anxiety, worry and cognitive risk estimate in relation to protective behaviors during the 2009 influenza A/H1N1 pandemic in Hong Kong: ten cross-sectional surveys. *BMC Infect Dis* 2014;14(1):169. doi: 10.1186/1471-2334-14-169
13. Rolison JJ, Hanoch Y. Knowledge and risk perceptions of the Ebola virus in the United States. *Preventive medicine reports* 2015;2:262-64. doi: 10.1016/j.pmedr.2015.04.005
14. Lerner JS, Li Y, Valdesolo P, et al. Emotion and decision making. *Annual review of psychology* 2015;66:799-823. doi: 10.1146/annurev-psych-010213-115043
15. Cameron LD, Leventhal H. The self-regulation of health and illness behaviour: psychology press 2003.
16. Slovic P, Finucane ML, Peters E, et al. Risk as analysis and risk as feelings: Some thoughts about affect, reason, risk, and rationality. *Risk Analysis: An International Journal* 2004;24(2):311-22. doi: 10.1111/j.0272-4332.2004.00433.x
17. Liao Q, Cowling B, Lam WT, et al. Situational awareness and health protective responses to pandemic influenza A (H1N1) in Hong Kong: a cross-sectional study. *PLoS One* 2010;5(10):e13350. doi: 10.1371/journal.pone.0013350
18. Kahneman D, Slovic SP, Slovic P, et al. Judgment under uncertainty: Heuristics and biases:

Cambridge university press 1982.

19. Gee S, Skovdal M. The role of risk perception in willingness to respond to the 2014–2016 West African Ebola outbreak: a qualitative study of international health care workers. *Global health research and policy* 2017;2(1):21.
20. Siegrist M. Trust and risk perception: a critical review of the literature. *Risk analysis* 2019 doi: 10.1111/risa.13325
21. Siegrist M. The influence of trust and perceptions of risks and benefits on the acceptance of gene technology. *Risk analysis* 2000;20(2):195-204. doi: 10.1111/0272-4332.202020
22. Siegrist M, Cvetkovich G. Perception of hazards: The role of social trust and knowledge. *Risk analysis* 2000;20(5):713-20. doi: 10.1111/0272-4332.205064
23. Choi D-H, Shin D-H, Park K, et al. Exploring Risk Perception and Intention to Engage in Social and Economic Activities During the South Korean MERS Outbreak. *International Journal of Communication* 2018;12:21.
24. Kim S, Kim S. Exploring the determinants of perceived risk of Middle East Respiratory Syndrome (MERS) in Korea. *International journal of environmental research and public health* 2018;15(6):1168. doi: 10.3390/ijerph15061168
25. Kim CW, Song HR. Structural relationships among public's risk characteristics, trust, risk perception and preventive behavioral intention: The case of MERS in Korea. *Crisisnomy* 2017;13:85-95. doi: 10.14251/crisisonomy.2017.13.6.85
26. Altarawneh L, Mackee J, Gajendran T. The influence of cognitive and affective risk perceptions on flood preparedness intentions: A dual-process approach. *Procedia engineering* 2018;212:1203-10. doi: 10.1016/j.proeng.2018.01.155
27. Terpstra T. Emotions, trust, and perceived risk: Affective and cognitive routes to flood preparedness behavior. *Risk Analysis: An International Journal* 2011;31(10):1658-75.

doi: 10.1111/j.1539-6924.2011.01616.x

28. Ibuka Y, Chapman GB, Meyers LA, et al. The dynamics of risk perceptions and precautionary behavior in response to 2009 (H1N1) pandemic influenza. *BMC Infectious Diseases* 2010;10(1):296. doi: 10.1186/1471-2334-10-296
29. Oh S-H, Paek H-J, Hove T. Cognitive and emotional dimensions of perceived risk characteristics, genre-specific media effects, and risk perceptions: The case of H1N1 influenza in South Korea. *Asian Journal of Communication* 2015;25(1):14-32. doi: 10.1080/01292986.2014.989240
30. Sadique MZ, Edmunds WJ, Smith RD, et al. Precautionary behavior in response to perceived threat of pandemic influenza. *Emerging infectious diseases* 2007;13(9):1307. doi: 10.3201/eid1309.070372
31. Griffin RJ, Neuwirth K, Dunwoody S, et al. Information sufficiency and risk communication. *Media Psychology* 2004;6(1):23-61. doi: 10.1207/s1532785xmep0601_2
32. Terwel BW, Harinck F, Ellemers N, et al. Competence-based and integrity-based trust as predictors of acceptance of carbon dioxide capture and storage (CCS). *Risk Analysis: An International Journal* 2009;29(8):1129-40. doi: 10.1111/j.1539-6924.2009.01256.x
33. Allum N. An empirical test of competing theories of hazard-related trust: The case of GM food. *Risk Analysis: An International Journal* 2007;27(4):935-46. doi: 10.1111/j.1539-6924.2007.00933.x
34. Vinck P, Pham PN, Bindu KK, et al. Institutional trust and misinformation in the response to the 2018–19 Ebola outbreak in North Kivu, DR Congo: a population-based survey. *The Lancet Infectious Diseases* 2019;19(5):529-36. doi: 10.1016/S1473-3099(19)30063-5
35. Tsai L, Blair R, Morse B. Patterns of trust and compliance in the fight against Ebola: Results

from a population-based survey of Monrovia, Liberia. *Economic Impacts of Ebola, Bulletin Three* 2015

36. Moy P, Pfau M. With Malice Toward All? The Media and Public Confidence in Democratic Institutions: The Media and Public Confidence in Democratic Institutions: ABC-CLIO 2000.

37. de Zwart O, Veldhuijzen IK, Elam G, et al. Perceived threat, risk perception, and efficacy beliefs related to SARS and other (emerging) infectious diseases: results of an international survey. *International journal of behavioral medicine* 2009;16(1):30-40. doi: 10.1007/s12529-008-9008-2

38. Leung GM, Ho L-M, Chan SK, et al. Longitudinal assessment of community psychobehavioral responses during and after the 2003 outbreak of severe acute respiratory syndrome in Hong Kong. *Clinical Infectious Diseases* 2005;40(12):1713-20. doi: 10.1086/429923

39. Finucane ML, Slovic P, Mertz CK, et al. Gender, race, and perceived risk: The'white male'effect. *Health, risk & society* 2000;2(2):159-72. doi: 10.1080/713670162

40. Davidson DJ, Freudenburg WR. Gender and environmental risk concerns: A review and analysis of available research. *Environment and behavior* 1996;28(3):302-39. doi: 10.1177/0013916596283003

41. Weber EU, Blais AR, Betz NE. A domain-specific risk-attitude scale: Measuring risk perceptions and risk behaviors. *Journal of behavioral decision making* 2002;15(4):263-90. doi: 10.1002/bdm.414

42. Huang L, Zhou Y, Han Y, et al. Effect of the Fukushima nuclear accident on the risk perception of residents near a nuclear power plant in China. *Proceedings of the National Academy of Sciences* 2013;110(49):19742-47. doi: 10.1073/pnas.1313825110

43. Benford RD, Moore HA, Williams Jr JA. In whose backyard?: Concern about siting a

nuclear waste facility. *Sociological Inquiry* 1993;63(1):30-48. doi: 10.1111/j.1475-682X.1993.tb00200.x

44. Johnson BB. Residential Location and Psychological Distance in Americans' Risk Views and Behavioral Intentions Regarding Zika Virus. *Risk Analysis* 2018;38(12):2561-79. doi: 10.1111/risa.13184

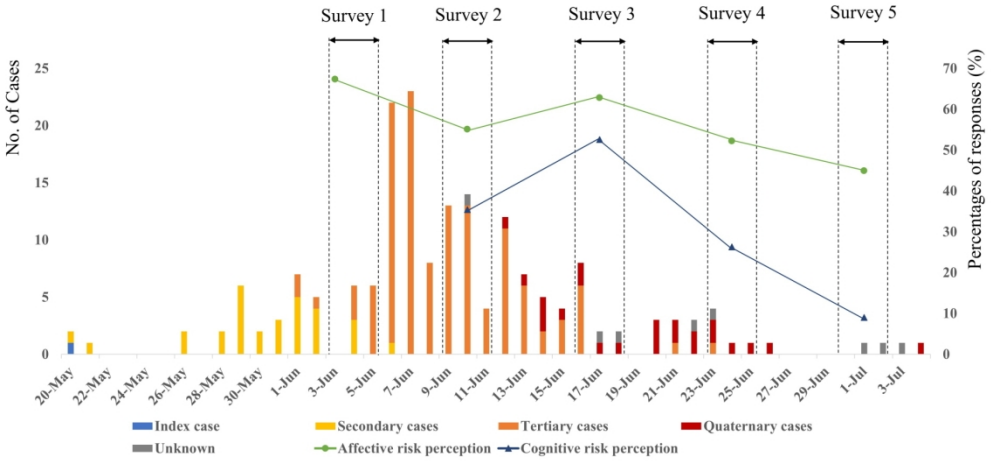

Figure 1 Epidemiologic curve of MERS-CoV, timing of surveys, and personal and societal level of risk perception
MERS-CoV, Middle East Respiratory Syndrome Coronavirus

160x90mm (300 x 300 DPI)

Questionnaire

Affective risk perception

Recently, the number of MERS patients, suffering from Middle East respiratory syndrome is increasing in Korea.

"How much worried are you that you could get MERS?"

1. Very much concerned
2. Somewhat concerned
3. Not that concerned
4. Not concerned at all

Cognitive risk perception

"Do you think MERS epidemic will settled down in the next few days or spread further?"

1. Will settle down
2. Will spread further

Trust in government (presidential job approval rating)

"Do you approve or disapprove of the way President Park Geun-hye is handling her job as president?"

1. Approval
2. Disapproval

Party identification

"These days, there are Saenuri Party, New Politics Alliance for Democracy, and Justice party in South Korea?"

1. Saenuri Party
2. New Politics Alliance for Democracy
3. Justice party
4. Other parties

Occupation

"What is your occupation?"

1. farming/forestry/fishery
2. Self-employed

3. Blue collar (Sales/services, Functional/skilled workers, general workers)
4. White collar (office/technical position, management, professional/freelancer)
5. Homemaker
6. Student
7. Unemployed
8. Retired
9. Other

Perceived economic status

"If you divide the standards of living of Korean people into five levels: High, Medium high, Medium, Medium low, and Low, where do you think your standard of living belongs?"

1. Upper
2. Upper middle
3. Meddle
4. Lower middle
5. Lower

Educational attainment

"What is the highest degree or level of school you have completed?"

1. Middle school or below
2. High school
3. University
4. Graduate school

Area

Which region you live in? Please tell me based on your address. *I don't have your location information because we've randomly generated your telephone number.

1. Seoul
2. Busan
3. Daegu
4. Incheon
5. Gwangju

6. Daejeon
7. Ulsan
8. Sejong
9. Gyeonggi
10. Gangwon
11. Chungbuk
12. Chungnam
13. Jeonbuk
14. Jeonnam
15. Gyeongbuk
16. Gyeongnam
17. Jeju

Age

What is your age?

Gender

What is your gender?

1. Male
2. Female

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

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

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8, 9
		(b) Indicate number of participants with missing data for each variable of interest	8
Outcome data	15*	Report numbers of outcome events or summary measures	9
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10-14
		(*b*) Report category boundaries when continuous variables were categorized	10-14
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	16-17
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14-17
Generalisability	21	Discuss the generalisability (external validity) of the study results	17
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	

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

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

BMJ Open

Influence of trust on two different risk perception as an affective and cognitive dimension during Middle East respiratory syndrome coronavirus (MERS-CoV) outbreak in South Korea: serial cross-sectional surveys

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Influence of trust on two different risk perception as an affective and cognitive dimension during Middle East respiratory syndrome coronavirus (MERS-CoV) outbreak in South Korea: serial cross-sectional surveys

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ABSTRACT

Objectives: This study aimed to assess the affective and cognitive risk perceptions in the general population of Middle East respiratory syndrome (MERS) during the 2015 MERS coronavirus (MERS-CoV) outbreak in South Korea and the influencing factors.

Design: Serial cross-sectional design with four consecutive surveys.

Setting: Nationwide general population in South Korea.

Participants: Overall 4,010 respondents (aged 19 years) from the general population during the MERS-CoV epidemic were included.

Primary and secondary outcome measures: The main outcome measures were 1) affective risk perception, 2) cognitive risk perception, and 3) trust in the government. Multivariate logistic regression models were used to identify factors (demographic, socioeconomic, area, political orientation) associated with risk perceptions.

Results: Both affective and cognitive risk perceptions decreased as the MERS-CoV epidemic progressed. Proportions of affective risk perception were higher in all surveys and slowly decreased compared to cognitive risk perception over time. Females (adjusted OR [aOR] 1.72-2.00; 95% confidence interval [CI] 1.14-2.86) and lower self-reported economic status respondents were more likely to perceive the affective risk. The older the adults, the higher the affective risk perception, but the lower the cognitive risk perception compared to younger adults. The respondents who had low trust in the government had higher affective (aOR 2.19-3.11; 95 CI 1.44-4.67) and cognitive (aOR 3.55-5.41; 95 CI 1.44-9.01) risk perceptions.

Conclusions: This study suggests that even if cognitive risk perception is dissolved, affective risk perception can continue during MERS-CoV epidemic. Risk perception associating factors (i.e. gender, age, self-reported economic status) appear to be noticeably different between affective and cognitive dimensions. It also indicates that trust in the government influence not only affective risk perception but also cognitive risk perception. There is a need for further

efforts to understand the mechanism regarding the general public's risk perception for effective risk communication.

Keywords: Middle East respiratory syndrome coronavirus, risk and perception, epidemics, surveys

STRENGTHS AND LIMITATIONS OF THIS STUDY:

- This is the first study to evaluate the difference in risk perception between the affective and cognitive dimensions during MERS-CoV outbreak in South Korea.
- We used four consecutive cross-sectional surveys using nationwide representative samples.
- The validity of the questionnaire used in the survey was not evaluated because of the urgency of the outbreak.
- This study could not confirm causal relationship between personal characteristics and risk perception due to the limitation of the cross-sectional study design.

BACKGROUND

Newly emerging contagious diseases have created a novel chance to examine how people perceive risk during an epidemic. In South Korea, since the occurrence of the index case of Middle East respiratory syndrome (MERS) on May 20, 2015, a total of 186 persons were diagnosed with the disease, 38 of whom had died, and 16,693 patients were quarantined.[1] The epidemic of MERS coronavirus (MERS-CoV) has had its largest outbreak outside of the Middle East in South Korea.[2] The occurrence of multiple transmissions after the first secondary infection and the failure of the government on risk communication resulted in the increased concern of the general public.[3-6] The Korean government did not disclose timely information about the outbreak of MERS-CoV, such as lists of affected medical institutions.[7] Due to increased public anxiety about MERS-CoV, the trust in the Korean government had fallen and the image of the Korean president as a leader had been damaged.[8 9]

During contagious disease epidemics, perceived risk can have a significant impact on precautionary behaviors that might affect disease transmission.[10-12] A relevant empirical study emphasized that informing public about the disease outbreak, such as the Ebola virus, could reduce worry about contracting the virus and take more preventive measures.[13] The evaluation of public risk perception of disease helps us to know what knowledge the public needs. Therefore, understanding characteristics of risk perception and factors relating to how people perceive the risk is important in terms of minimizing the impact of spread of infectious disease.

Given that external stimuli are extreme events, two different reactions can occur: the affective reaction (risk-as-feelings) and cognitive reaction (risk-as-analysis).[14-16] Previous studies suggest that affective reaction is quick, intuitive, automatic, while cognitive reaction is slow, deliberate, and probably calculative. In the early phase of the outbreak, people may experience

challenges when attempting to quantify the risk, which may lead to an affective reaction.[12 17] In contrast, cognitive reaction may occur during the late stage of the epidemic.

Most people may not conduct deliberate risk analysis when they cope with lack of knowledge about risk, such as new disease outbreak, but rely on simple heuristics. [18 19] Heuristic processing can be understood as simple decision rule of thumb or mental shortcut that can reduce the complexity of decision making. When risk management decisions are needed, trust in the institutions can be used as one of the heuristics. [20] People having trust in the responsible risk manager, such as the government, may perceive less risk in a particular situation than people not having trust. [21 22] Regarding the MERS epidemic in South Korea, less trust in the government affected increasing number of individuals` risk perception. [23-25]Trust is known to be related not only to cognitive risk perception but also to affective risk perception. [26 27]

However, when assessing the influence of trust in risk perception, many studies have not distinguished between affective and cognitive reaction regarding contagious diseases during outbreaks. [3 12 23 24 28-30]We hypothesized that (1) affective risk perception would increase and decrease faster than cognitive risk perception over time and that (2) low trust in government would be related with high risk perception (both affective and cognitive).

METHODS

Participants

Between June 9 and July 2, 2015, a total of 4,010 participants who were older than 19 years were monitored using a serial cross-sectional study design in four consecutive surveys, covering the MERS epidemic. All surveys were conducted using mobile (85%) or landline (15%) random digit dialing numbers in eight regions which was representative of nationwide.

Samples were selected post-stratification by gender, age, and province. The total number of weighted cases in this survey equals the total number of unweighted cases at the national level. The weights were normalized in order to calculate proportions and ratios; however; not for estimating the number of the subtotal populations. Trained interviewers conducted all interviews using computer assisted telephone interviewing (CATI). The first survey was conducted between June 9 and 11, 2015 after the June 1, 2015 occurrence of the first tertiary infected case. The last was conducted just two days before the last confirmed patient on July 4, 2015. The surveys were conducted by Gallup Korea, an affiliation of Gallup International. Details including period, number of respondents successfully interviewed, and response rate for each of the four surveys are provided in Table 1.

Table 1 Details of four consecutive surveys regarding the 2015 MERS-CoV outbreak in South Korea

Survey	period	Number of respondents sampled	Number of respondents successfully interviewed	Response rate (%)
1	June 9-11	5,482	1,002	18.3
2	June 16-18	5,585	1,000	17.9
3	June 23-25	5,680	1,004	17.7
4	June 30 to July 2	5,345	1,004	18.8

MERS-CoV, Middle East respiratory syndrome coronavirus

Demographic factors evaluated as respondents' characteristics included gender, age, educational attainment, occupation, self-reported household economic status, residential area, and trust in president, party identification. Age was classified in to 6 levels (19-29, 30s, 40s, 50s, 60s, 70 years and older). Educational attainment was classified into four levels (less than middle school, high school, university, graduate school or higher). Occupation was classified as either unemployed, farming and fishery, self-employed, blue-collar worker, white-collar

worker, full-time Homemaker, or student. Self-reported household economic status was classified into five levels (lower, lower middle, middle, upper middle, upper). Respondents were classified as either metropolitan or non-metropolitan residents; and distinguished by whether they resided in an area where MERS had occurred or not. Party identification was classified based on the support for the political parties. Support for the party identification was assessed based on alignment either with the ruling party, with the opposition party, or no opinion.

Survey instruments

The interviews were conducted based on two aspects of the risk perception, which are affective and cognitive risk perceptions (Supplementary file). Affective risk perception was assessed using the question "How much worried are you that you could get MERS?" Responses were assessed on a four-point scale, with four points indicating "very worried" and one point indicating "not worried at all" (reclassified as 1-2 points = "not worried"; 3–4 points = "worried"). Affective risk perception proportion was defined as the number of participants who were "worried" by the number of eligible respondents. Cognitive risk perception was evaluated using the question "Do you think MERS epidemic will settled down in the next few days or spread further?" and required the following responses: "will settle down," "will spread further". Cognitive risk perception proportion was defined as the number of participants whose response was "will spread further" by the number of eligible respondents. Trust in government was assessed using presidential job approval rating. Trust in government includes expectations of government`s competence to prevent people from risk and develop and implement follow-up measures. [31] This trust concept can be termed competence-based trust. [32 33] We tried to assess the competence-based trust in the government using presidential job approval rating. Presidential job approval was evaluated using the question "Do you approve or disapprove of

the way President Park Geun-hye is handling her job as president?" and required the following responses: "approval", "disapproval". The development of questionnaires on risk perception and trust in the government had not gone through a validity procedure due to the urgency of the outbreak. We also imposed survey items on existing questionnaire developed by Gallup Korea, an affiliation of Gallup International.

Analysis

Response rates according to affective or cognitive risk perceptions were calculated over time. Univariate analyses using chi-square test were performed in the four consecutive surveys, entirely and respectively, to identify the relationships between risk perception and each demographic variable. We used multivariable logistic regression analyses to explore factors influencing risk perceptions (affective and cognitive) in the four surveys, entirely and respectively. Multivariable logistic regression model was adjusted for gender, age, educational attainment, occupation, self-reported household economic status, affected area, residential area, presidential job approval, and party identification. The self-reported household economic status was excluded in survey 4 model with cognitive risk perception. These exclusions were because there was small sample size of those who perceived cognitive risk in the upper economic level in survey 4. Missing values of any variable were ≤2.7%. Using logistic regression analysis for each affective and cognitive risk perception, "y = 1" was used respectively when "worried" in affective and when "spread" in cognitive, otherwise "y = 0" was used.

This study was reviewed and approved by the Institutional Review Board (IRB) of Seoul Metropolitan Government–Seoul National University Boramae Medical Center (IRB No. 20190515/07 - 2019 - 11/062). The need for informed consent was waived by the board.

Patient and public involvement

No patient or public was involved in the design or planning of this study.

RESULTS

Demographic factors

The general characteristics of the participants are shown in Table 2. There were no statistically significant differences between surveys except self-reported economic status, affective risk perception, cognitive risk perception. Nearly half of the participants were female, aged <50 years, educated up to high school or below, from the affected area, and showed disapproval of the president or the ruling party. Majority of the participants were employed, of middle economic status, and metropolitan. More than half of participants were worried but had views that the epidemic would subside.

Table 2 Basic characteristics of the participants

Variables	Overall	Survey 1	Survey 2	Survey 3	Survey 4
Gender					
Male	49.5	49.4	49.6	49.7	49.5
Female	50.5	50.6	50.4	50.3	50.5
Age (years)					
19-29	17.6	18.2	17.1	17.8	17.3
30-39	18.6	18.2	18.5	18.8	19.1
40-49	21.7	20.7	22.5	21.5	22.1
50-59	19.6	20.0	19.4	19.4	19.7
60-69	13.0	14.0	13.1	11.8	13.1
≥ 70	9.4	8.9	9.4	10.8	8.7
Educational attainment					
Middle school or below	15.1	13.6	15.4	15.7	15.6
High school	28.1	27.2	28.9	27.5	29.0
University	50.2	53.9	48.5	50.0	48.4
Graduate school	6.6	5.3	7.2	6.8	7.0
Occupation					
Unemployed	8.7	8.9	8.7	7.8	9.3
Farming / fishery	3.9	3.6	3.2	5.0	3.6

Self-employed	15.3	13.6	14.1	18.7	14.7
Blue-collar	11.7	11.8	12.4	10.8	11.7
White-collar	28.2	28.9	26.8	29.1	28.0
Homemaker	23.3	23.1	26.1	19.6	24.3
Student	9.1	10.1	8.7	9.0	8.4
Self-reported economic status*					
Upper	1.8	1.9	1.9	2.1	1.2
Upper middle	10.9	13.0	11.4	8.5	10.8
Middle	42.8	44.5	43.0	39.3	44.5
Lower middle	25.7	24.2	26.6	27.5	24.6
Lower	18.8	16.4	17.1	22.6	18.9
MERS-CoV affected area					
Non-affected area	48.8	47.6	49.5	49.0	49.0
Affected area	51.2	52.4	50.5	51.0	51.0
Residential area					
Non-metropolitan	29.3	28.4	28.4	29.2	31.0
Metropolitan	70.7	71.6	71.6	70.8	69.0
Presidential job approval rating					
Approval	32.3	33.1	29.1	32.6	34.2
Disapproval	58.6	57.6	60.6	58.4	57.9
No opinion	9.1	9.3	10.3	9.0	7.9
Party identification					
Ruling party	39.8	39.9	39.7	39.6	40.2
Opposition party	28.6	26.2	28.5	29.4	30.2
No opinion	31.6	33.9	31.8	31.0	29.6
Affective risk perception*					
Worried	53.8	55.0	62.8	52.2	44.9
Not worried	46.2	45.0	37.2	47.8	55.1
Cognitive risk perception*					
Spread further	30.3	35.4	52.6	26.3	9.0
Settle down	69.7	64.6	47.4	73.7	91.0

* $P < 0.05$ calculated by chi-square test; u.a.: unavailable data; MERS-CoV, Middle East respiratory syndrome coronavirus.

Epidemic curve and time trends of risk perception

Figure 1 reports how the outbreak proceeded, with three overlapping transmission periods, the timing of the four independent surveys, and the risk perception rates. Differences were investigated between affective and cognitive risk proportions throughout the epidemic periods. Overall risk perception of the four surveys at affective proportion (53.8%) was nearly two times higher than at cognitive dimension (30.3%). Affective risk perception proportions were always higher than cognitive dimension during the present study periods. Of the affective risk perception, proportion was initially high during survey 1 (55.0%), rose during survey 2 (62.8%),

and declined again during surveys 3 and 4 (52.2% and 44.9%, respectively). A similar trend was observed in the cognitive risk perception proportions. The percentages of respondents who reported as being "worried" or "spread further" decreased gradually after survey 2. Cognitive risk perception proportions decreased more rapidly than affective aspect, over time, from 52.6% and 62.8% in survey 2 to 9.0% and 44.9% in survey 4, respectively. At the beginning of the occurrences of tertiary and quaternary cases, we identified high perceived risk in both the affective and cognitive aspects proportions.

Factors associated with the affective risk perception

Table 3 shows the association between variables and risk perception of MERS-CoV at the affective dimension. The result showed that gender, age, educational attainment, self-reported economic status, area, presidential job approval rating, and party identification were significantly associated with affective risk perception. Women (adjusted OR [aOR] 1.72-2.00; 95% confidence interval [CI] 1.14-2.86) were more likely to perceive MERS-CoV risk at affective dimension, which decreased with time, and subsequently increased again. Groups of older than 40 years were less aware of the risk (aOR 0.58-0.76; 95% CI 0.28-1.56) in survey 1; however, they perceived the risk more over time (aOR 2.84-3.29; 95% CI 1.27-6.66) in survey 4. The association of education with affective risk perception was non-significant except university degree in the overall survey (aOR 0.73; 95% CI 0.55-0.96). Lower economic status and those living in metropolitan cities paid more attention to the affective risk of MERS-CoV in the overall model. Those who disapproved of the president and the ruling party had higher risk perception at the affective dimension; the peak of disapproval was found in survey 1.

Table 3 Factors associated with affective risk perception of MERS-CoV

Variables	Overall aOR (95% CI)	Survey 1 aOR (95% CI)	Survey 2 aOR (95% CI)	Survey 3 aOR (95% CI)	Survey 4 aOR (95% CI)

Gender					
Male	1.00	1.00	1.00	1.00	1.00
Female	1.78* (1.49-2.13)	1.83* (1.26-2.66)	1.72* (1.14-2.60)	1.72* (1.26-2.42)	2.00* (1.40-2.86)
Age (years)					
19-29	1.00	1.00	1.00	1.00	1.00
30-39	1.76* (1.30-2.40)	0.80 (0.41-1.56)	1.81 (0.94-3.46)	2.19* (1.17-4.10)	3.21* (1.76-5.85)
40-49	1.57* (1.17-2.11)	0.76 (0.40-1.45)	1.60 (0.88-2.90)	1.72 (0.95-3.11)	3.00* (1.64-5.51)
50-59	1.36 (1.00-1.84)	0.58 (0.30-1.11)	1.85 (0.96-3.55)	1.10 (0.59-2.03)	2.93* (1.54-5.54)
60-69	1.35 (0.95-1.92)	0.73 (0.34-1.56)	1.42 (0.69-2.93)	0.86 (0.42-1.75)	3.29* (1.62-6.66)
≥ 70	1.67* (1.13-2.48)	0.66 (0.28-1.52)	2.60* (1.13-5.98)	1.55 (0.71-3.38)	2.84* (1.27-6.36)
Educational attainment					
Middle school or below	1.00	1.00	1.00	1.00	1.00
High school	0.78 (0.60-1.01)	0.68 (0.39-1.19)	1.25 (0.74-2.09)	0.66 (0.40-1.08)	0.68 (0.41-1.15)
University	0.73* (0.55-0.96)	0.64 (0.36-1.15)	1.22 (0.68-2.17)	0.59 (0.34-1.03)	0.60 (0.34-1.07)
Graduate school	0.77 (0.52-1.12)	0.89 (0.38-2.05)	0.94 (0.44-2.00)	0.67 (0.30-1.49)	0.64 (0.31-1.35)
Occupation					
Unemployed	1.00	1.00	1.00	1.00	1.00
Farming / fishery	0.89 (0.55-1.42)	0.99 (0.35-2.81)	0.65 (0.23-1.85)	1.53 (0.62-3.78)	0.69 (0.27-1.08)
Self-employed	0.84 (0.61-1.17)	0.90 (0.47-1.72)	0.56 (0.28-1.11)	1.53 (0.78-3.03)	0.68 (0.36-1.31)
Blue-collar	1.21 (0.87-1.70)	1.20 (0.59-2.45)	1.08 (0.54-2.18)	2.08 (1.0-4.35)	0.84 (0.44-1.64)
White-collar	1.10 (0.81-1.51)	1.26 (0.68-2.35)	0.86 (0.44-1.68)	1.84 (0.92-3.66)	0.81 (0.44-1.46)
Homemaker	1.03 (0.74-1.44)	1.01 (0.53-1.92)	1.01 (0.49-2.09)	1.81 (0.89-3.67)	0.62 (0.32-1.18)
Student	1.01 (0.66-1.54)	0.55 (0.24-1.30)	0.78 (0.33-1.85)	1.66 (0.64-4.34)	1.46 (0.64-3.33)
Self-reported economic status					
Upper	1.00	1.00	1.00	1.00	1.00
Upper middle	1.91* (1.05-3.50)	1.95 (0.59-6.48)	1.71 (0.63-4.70)	2.20 (0.62-7.85)	2.14 (0.51-8.93)
Middle	1.84* (1.03-3.27)	1.83 (0.57-5.89)	1.91 (0.74-4.96)	2.60 (0.79-8.55)	1.84 (0.46-7.35)
Lower middle	2.14* (1.19-3.85)	1.97 (0.60-6.47)	2.12 (0.81-5.58)	2.94 (0.88-9.78)	2.30 (0.56-9.40)
Lower	2.28* (1.25-4.14)	2.24 (0.66-7.64)	2.78* (1.10-7.65)	3.45* (1.02-11.69)	1.98 (0.48-8.14)
MERS-CoV affected area					
Non-affected area	1.00	1.00	1.00	1.00	1.00
Affected area	0.92 (0.77-1.09)	1.10 (0.76-1.59)	0.93 (0.65-1.32)	1.01 (0.71-1.43)	0.74 (0.53-1.02)
Residential area					

Non-metropolitan	1.00	1.00	1.00	1.00	1.00
Metropolitan	1.26* (1.04-1.54)	1.15 (0.77-1.72)	1.83* (1.21-2.76)	0.99 (0.66-1.49)	1.19 (0.82-1.74)
Presidential job approval rating					
Approval	1.00	1.00	1.00	1.00	1.00
Disapproval	2.63* (2.17-3.20)	3.11* (2.07-4.67)	2.19* (1.44-3.33)	2.69* (1.81-4.01)	2.88* (1.93-4.30)
No opinion	1.59* (1.19-2.12)	2.40* (1.32-4.37)	0.86 (0.49-1.53)	1.78 (0.93-3.41)	1.74 (0.97-3.14)
Party identification					
Ruling party	1.00	1.00	1.00	1.00	1.00
Opposition party	1.68* (1.36-2.08)	2.06* (1.30-3.25)	2.37* (1.48-3.79)	1.15 (0.75-1.76)	1.56* (1.01-2.40)
No opinion	1.19 (0.98-1.44)	1.17 (0.78-1.74)	1.64* (1.10-2.46)	0.98 (0.66-1.46)	1.07 (0.72-1.60)

MERS-CoV, Middle East respiratory syndrome coronavirus; aOR: adjusted odds ratio, CI: confidence interval, * $P<0.05$.

Factors associated with the cognitive risk perception

Unlike the cognitive risk perception, no difference was found by gender in the cognitive risk perception (Table 4). Furthermore, respondents aged >30 years were consistently less aware of the cognitive risk during MERS-CoV epidemic. Generally, no not statistically significant association was found with educational attainment, occupation, self-reported economic status, MERS-CoV affected area, and metropolitan area. Similar to the affective dimension, those who disapproved of the president and the ruling party had higher risk perceptions at the cognitive dimension.

Table 4 Factors associated with cognitive risk perception of MERS-CoV

Variables	Overall aOR (95% CI)	Survey 1 aOR (95% CI)	Survey 2 aOR (95% CI)	Survey 3 aOR (95% CI)	Survey 4[a] aOR (95% CI)
Gender					
Male	1.00	1.00	1.00	1.00	1.00
Female	0.98 (0.80-1.20)	1.14 (0.73-1.70)	0.97 (0.64-1.46)	0.81 (0.54-1.21)	1.19 (0.63-2.25)
Age (years)					
19-29	1.00	1.00	1.00	1.00	1.00
30-39	0.76 (0.55-1.05)	0.26* (0.13-0.54)	1.26 (0.67-2.37)	0.91 (0.47-1.75)	0.84 (0.33-2.11)
40-49	0.64* (0.47-0.88)	0.21* (0.10-0.42)	0.99 (0.53-1.83)	0.81 (0.42-1.57)	0.65 (0.27-1.57)
50-59	0.44* (0.32-0.62)	0.12* (0.06-0.25)	1.19 (0.63-2.28)	0.35* (0.17-0.72)	0.25* (0.08-0.73)

60-69	0.30* (0.20-0.46)	0.13* (0.06-0.31)	0.35* (0.16-0.77)	0.26* (0.11-0.65)	0.17* (0.04-0.69)
≥ 70	0.26* (0.16-0.44)	0.08* (0.03-0.23)	0.61 (0.26-1.41)	0.20* (0.06-0.63)	0.12* (0.02-0.65)
Educational attainment					
Middle school or below	1.00	1.00	1.00	1.00	1.00
High school	0.81 (0.58-1.13)	0.58 (0.30-1.12)	1.41 (0.75-2.68)	0.45* (0.21-0.97)	0.56 (0.20-1.55)
University	0.93 (0.65-1.32)	0.47* (0.24-0.95)	2.11 (1.06-4.21)	0.73 (0.34-1.57)	0.42 (0.13-1.36)
Graduate school	0.92 (0.58-1.46)	0.12* (0.04-0.38)	1.83 (0.78-4.34)	1.27 (0.47-3.43)	0.64 (0.17-2.37)
Occupation					
Unemployed	1.00	1.00	1.00	1.00	1.00
Farming / fishery	1.51 (0.85-2.68)	1.72 (0.59-5.06)	1.52 (0.49-4.68)	3.04 (0.93-1.0)	1.12 (0.22-5.75)
Self-employed	0.94 (0.63-1.40)	1.08 (0.49-2.35)	0.92 (0.43-1.96)	1.76 (0.70-4.38)	0.31 (0.09-1.12)
Blue-collar	1.22 (0.81-1.84)	1.38 (0.61-3.15)	1.07 (0.51-2.22)	1.75 (0.66-4.67)	0.84 (0.28-2.56)
White-collar	1.05 (0.72-1.52)	1.46 (0.71-3.02)	0.94 (0.48-1.87)	1.64 (0.68-3.95)	0.56 (0.21-1.55)
Homemaker	1.22 (0.81-1.83)	1.23 (0.55-2.74)	1.37 (0.65-2.92)	1.86 (0.71-4.92)	0.85 (0.29-2.50)
Student	0.81 (0.51-1.30)	0.68 (0.26-1.75)	0.78 (0.33-1.84)	1.01 (0.34-2.98)	0.47 (0.12-1.84)
Self-reported economic status					
Upper	1.00	1.00	1.00	1.00	u.a.
Upper middle	0.96 (0.51-1.81)	1.17 (0.34-4.05)	0.71 (0.27-1.85)	0.71 (0.19-2.61)	u.a.
Middle	0.81 (0.44-1.47)	1.26 (0.39-4.05)	0.59 (0.25-1.40)	0.86 (0.26-2.87)	u.a.
Lower middle	1.22 (0.66-2.25)	1.76 (0.53-5.86)	0.98 (0.40-2.38)	1.13 (0.33-3.88)	u.a.
Lower	1.06 (0.57-1.99)	2.22 (0.64-7.74)	0.82 (0.32-2.12)	1.12 (0.32-4.0)	u.a.
MERS-CoV affected area					
Non-affected area	1.00	1.00	1.00	1.00	1.00
Affected area	1.05 (0.86-1.28)	1.43 (0.94-2.19)	0.79 (0.54-1.16)	1.02 (0.69-1.52)	1.18 (0.66-2.11)
Residential area					
Non-metropolitan	1.00	1.00	1.00	1.00	1.00
Metropolitan	0.91 (0.72-1.14)	0.57* (0.35-0.93)	1.34 (0.84-2.12)	1.08 (0.67-1.75)	0.69 (0.38-1.33)
Presidential job approval rating					
Approval	1.00	1.00	1.00	1.00	1.00
Disapproval	3.55* (2.77-4.55)	5.41* (3.25-9.01)	3.00 (1.96-4.59*)	3.77* (2.13-6.68)	4.05* (1.44-11.41)
No opinion	1.75* (1.22-2.52)	2.00 (0.96-4.16)	0.94 (0.49-1.80)	3.26 (1.46-7.30)	1.55 (0.37-6.45)
Party identification					
Ruling party	1.00	1.00	1.00	1.00	1.00

Opposition party	1.38* (1.09-1.75)	2.01* (1.19-3.39)	1.86* (1.21-2.88)	1.09 (0.65-1.84)	1.08 (0.48-2.45)
No opinion	1.23 (0.98-1.55)	1.55 (0.97-2.48)	1.82* (1.20-2.76)	0.79 (0.47-1.34)	0.91 (0.40-2.08)

MERS-CoV, Middle East respiratory syndrome coronavirus; aOR: adjusted odds ratio, CI: confidence interval; u.a.: unavailable data; * $P < 0.05$. [a]There was small sample size of those who perceived cognitive risk those in the upper economic level in survey 4, the self-reported household economic status was excluded from the survey 4 model.

DISCUSSION

The aims of the present study were to explore the differences in risk perception at affective and cognitive dimension and examine the relationship between trust in government and both risk perceptions. To do this end, we investigated the pattern of affective and cognitive risk perception proportions during MERS-CoV epidemic, respectively; analyzed the correlations of presidential job approval rating and risk perceptions (affective and cognitive).

First, we found that affective risk perception responded faster and lasts longer. The affective risk perception proportions were always higher than at the cognitive dimension. Risk perception increased with new generations of transmission, such as with the tertiary and quaternary infection. Both risk perceptions tended to decrease over time and the cognitive risk perception declined more rapidly.

However, our results that affective reaction tends to decrease before cognitive reaction are inconsistent with those of previous studies. [12 17] Relevant research in risk perception have proposed that affective reaction is fast, efficient, automatic, experiential compared to cognitive reaction. [14-16] We can consider the possibility that damaged trust in government as a responsible risk manager might have further evoked the emotional risk perception. [8 9 23-25] While the affective or cognitive reaction do not individually have an impact on the different stages of the epidemic; they can, however, affect it together, simultaneously, indicating both affective and

cognitive risk perceptions. [12 17 26 29] Additional research is needed to understand why the affective risk perception was higher and lasted longer than that of the cognitive risk perception during MERS-CoV epidemic in South Korea.

Second, our study shows that low trust in government had influenced both affective and cognitive risk perceptions. After party identification was adjusted for, we examined correlation with trust and risk perception. It is consistent with previous studies that trust in government could shape the public`s risk perception (both affective and cognitive). [21 22 26 27] However, the previous studies have not distinguished between affective and cognitive reaction when evaluating the impact of trust regarding contagious diseases during outbreaks. [3 12 23 24 28-30] Our findings suggest that trust in government is correlated with both affective and cognitive risk perception and it is important to understand the relationship between trust in government and two different aspects of risk perceptions. Those who did not support the president were reported to have had higher risk perception in both the affective and cognitive levels. In the group that did not approve of the president, the probabilities of risk perception were higher at the cognitive dimension than at affective dimension. In the early days of the MERS-COV outbreak, the government did not specify details regarding scientifically uncertain information in order to reduce public anxiety over the crisis, nor did the government disclose which hospitals the confirmed patients had visited. This resulted in increased public distrust in the government. [4 5 8 9] Similar patterns of distrust in the government was associated with the spread of infection, during the outbreak of Ebola.[34 35] Those who disapproved of the ruling party had also higher risk perceptions. Identification of party can be classified in the political aspect of trust. [36] There is need to investigate further comprehensive understanding of trust`s effect on risk perception.

Third, we found that gender, age, self-reported economic status, residential area, party identification correlated significantly with risk perception. According to multiple logistic regression analyses, being female predisposed to greater risk perception at the affective risk perception, but not at the cognitive dimension. Previous studies that investigated risk perception by gender also showed that a lower risk perception was associated with the male gender.[3 28 37-39] Possible explanation for lower perception of risk by male are that male have more to gain from risky behaviors. [40] However, previous studies did not distinguish between the level of risk perception. Further research is needed to determine why the same female group showed differences in perceived risk for affective and cognitive levels. The older the respondents, the lower the perceived cognitive dimension, but the opposite occurred weakly in the affective risk perception. The correlation with age and affective risk perception was not significant in most model (survey 1, survey 2, survey 3 models). After trust in government was adjusted for, we found correlation between older age and lower cognitive risk perception. Further research is needed as to why the effect of trust in the government had not been shown in the affective risk perception.

Given that some hierarchy-specific trends in income level were observed only in the overall model of affective risk perception, these results were consistent with previous studies. [41-43]
The location effect on risk perception also was evaluated in this study, but it was not clear the correlation with risk proximity and risk perception. [44] There were no significant differences in the proportions of those with risk perception according to the major socioeconomic characteristics (education, income level, occupation). It is necessary to further investigate the correlation with demographic factors and risk perception.

This study, which used a serial cross-sectional study design had some limitations. First, the study used a cross-sectional study design. Thus, causal relations between personal characteristics and risk perceptions could not be determined—rather, it could only suggest their relevance. Second, this study could not evaluate the intensity of risk perception, because it only included questions focusing on whether or not participants recognized the risk at the different levels. It would be useful to evaluate risk perceptions of respondents qualitatively if questions about the circumstances and characteristics of risk perception were surveyed in future studies. Third, because of the rapidly evolving epidemic, this study could not evaluate the validity of the questionnaire using a test-retest design. Fourth, small sample size of some variables once stratified (e.g., self-reported household economic status)_led to the exclusion of major socioeconomic characteristics from further analyses.

Conclusions

This study is the first to evaluate the differences in risk perception at affective and cognitive dimension and the relationship between trust in the government and both risk perceptions during the MERS-CoV outbreak in South Korea. The study also reported various factors influencing risk perception. We found that affective risk perception responded faster and lasts longer; and low trust in the government influenced both affective and cognitive risk perceptions. Quality of risk communication can create conditions for modulating the easy spread of emerging contagious diseases. To prevent the failure of epidemic management, further efforts are needed to understand the mechanism behind the general public's risk perception, the governmental public health sector, as well as the society of academy. Planning and implementation of strategies that consider the risk awareness mechanism will be a significant step in the right direction during national infectious disease crises.

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Competing interests

None declared.

Authors' contributions

WMJ participated and analyzed the data, interpreted the data, drafted and amended the manuscript. UNK, SC and HJ contributed to the analysis of the data, interpreted the data, drafted and amended the manuscript. DHJ contributed to questionnaire design, coordinated data collection, and data interpretation. SJE and JYL contributed to study design, supervised the research, data interpretation, and amended the manuscript.

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Data Availability Statement

No additional data are available.

Figure legends

Figure 1 Epidemiologic curve of MERS-CoV, timing of surveys, and affective and cognitive risk perception
MERS-CoV, Middle East respiratory syndrome coronavirus

References

1. Welfare MoHa. The 2015 MERS Outbreak in the Republic of Korea: Learning from MERS. Sejong, Korea: Ministry of Health and Welfare, 2016.

2. Organization WH. WHO MERS-CoV global summary and assessment of risk. *Geneva: WHO* 2018

3. Ro J-S, Lee J-S, Kang S-C, et al. Worry experienced during the 2015 Middle East respiratory syndrome (MERS) pandemic in Korea. *PloS one* 2017;12(3):e0173234. doi: 10.1371/journal.pone.0173234

4. Choi JW, Kim KH, Moon JM, et al. Public health crisis response and establishmentof a crisis communication system in South Korea: lessons learned from the MERS outbreak. *Journal of the Korean Medical Association* 2015;58(7):624-34. doi: 10.5124/jkma.2015.58.7.624

5. Kim E, Liao Q, Yu E, et al. Middle East respiratory syndrome in South Korea during 2015: risk-related perceptions and quarantine attitudes. *American journal of infection control* 2016;44(11):1414-16. doi: 10.1016/j.ajic.2016.03.014

6. Lee S-i. Costly lessons from the 2015 Middle East respiratory syndrome coronavirus outbreak in Korea. *Journal of Preventive Medicine and Public Health* 2015;48(6):274. doi: 10.3961/jpmph.15.064

7. Yang S, Cho S-I. Middle East respiratory syndrome risk perception among students at a university in South Korea, 2015. *American journal of infection control* 2017;45(6):e53-e60.

8. Sang-hun C. MERS tarnishes Korean president's image as leader. *The New York Times* 2015 12 June.

9. Lee SY, Yang HJ, Kim G, et al. Preventive behaviors by the level of perceived infection

sensitivity during the Korea outbreak of Middle East Respiratory Syndrome in 2015. *Epidemiology and health* 2016;38 doi: 10.4178/epih.e2016051

10. Sheeran P, Harris PR, Epton T. Does heightening risk appraisals change people's intentions and behavior? A meta-analysis of experimental studies. *Psychol Bulletin* 2014;140(2):511. doi: 10.1037/a0033065
11. Leppin A, Aro AR. Risk perceptions related to SARS and avian influenza: theoretical foundations of current empirical research. *Int J Behav Med* 2009;16(1):7-29. doi: 10.1007/s12529-008-9002-8
12. Liao Q, Cowling BJ, Lam WW, et al. Anxiety, worry and cognitive risk estimate in relation to protective behaviors during the 2009 influenza A/H1N1 pandemic in Hong Kong: ten cross-sectional surveys. *BMC Infect Dis* 2014;14(1):169. doi: 10.1186/1471-2334-14-169
13. Rolison JJ, Hanoch Y. Knowledge and risk perceptions of the Ebola virus in the United States. *Preventive medicine reports* 2015;2:262-64. doi: 10.1016/j.pmedr.2015.04.005
14. Lerner JS, Li Y, Valdesolo P, et al. Emotion and decision making. *Annual review of psychology* 2015;66:799-823. doi: 10.1146/annurev-psych-010213-115043
15. Cameron LD, Leventhal H. The self-regulation of health and illness behaviour: psychology press 2003.
16. Slovic P, Finucane ML, Peters E, et al. Risk as analysis and risk as feelings: Some thoughts about affect, reason, risk, and rationality. *Risk Analysis: An International Journal* 2004;24(2):311-22. doi: 10.1111/j.0272-4332.2004.00433.x
17. Liao Q, Cowling B, Lam WT, et al. Situational awareness and health protective responses to pandemic influenza A (H1N1) in Hong Kong: a cross-sectional study. *PLoS One* 2010;5(10):e13350. doi: 10.1371/journal.pone.0013350
18. Kahneman D, Slovic SP, Slovic P, et al. Judgment under uncertainty: Heuristics and biases:

Cambridge university press 1982.

19. Gee S, Skovdal M. The role of risk perception in willingness to respond to the 2014–2016 West African Ebola outbreak: a qualitative study of international health care workers. *Global health research and policy* 2017;2(1):21.

20. Siegrist M. Trust and risk perception: a critical review of the literature. *Risk analysis* 2019 doi: 10.1111/risa.13325

21. Siegrist M. The influence of trust and perceptions of risks and benefits on the acceptance of gene technology. *Risk analysis* 2000;20(2):195-204. doi: 10.1111/0272-4332.202020

22. Siegrist M, Cvetkovich G. Perception of hazards: The role of social trust and knowledge. *Risk analysis* 2000;20(5):713-20. doi: 10.1111/0272-4332.205064

23. Choi D-H, Shin D-H, Park K, et al. Exploring Risk Perception and Intention to Engage in Social and Economic Activities During the South Korean MERS Outbreak. *International Journal of Communication* 2018;12:21.

24. Kim S, Kim S. Exploring the determinants of perceived risk of Middle East Respiratory Syndrome (MERS) in Korea. *International journal of environmental research and public health* 2018;15(6):1168. doi: 10.3390/ijerph15061168

25. Kim CW, Song HR. Structural relationships among public's risk characteristics, trust, risk perception and preventive behavioral intention: The case of MERS in Korea. *Crisisnomy* 2017;13:85-95. doi: 10.14251/crisisonomy.2017.13.6.85

26. Altarawneh L, Mackee J, Gajendran T. The influence of cognitive and affective risk perceptions on flood preparedness intentions: A dual-process approach. *Procedia engineering* 2018;212:1203-10. doi: 10.1016/j.proeng.2018.01.155

27. Terpstra T. Emotions, trust, and perceived risk: Affective and cognitive routes to flood preparedness behavior. *Risk Analysis: An International Journal* 2011;31(10):1658-75.

doi: 10.1111/j.1539-6924.2011.01616.x

28. Ibuka Y, Chapman GB, Meyers LA, et al. The dynamics of risk perceptions and precautionary behavior in response to 2009 (H1N1) pandemic influenza. *BMC Infectious Diseases* 2010;10(1):296. doi: 10.1186/1471-2334-10-296

29. Oh S-H, Paek H-J, Hove T. Cognitive and emotional dimensions of perceived risk characteristics, genre-specific media effects, and risk perceptions: The case of H1N1 influenza in South Korea. *Asian Journal of Communication* 2015;25(1):14-32. doi: 10.1080/01292986.2014.989240

30. Sadique MZ, Edmunds WJ, Smith RD, et al. Precautionary behavior in response to perceived threat of pandemic influenza. *Emerging infectious diseases* 2007;13(9):1307. doi: 10.3201/eid1309.070372

31. Griffin RJ, Neuwirth K, Dunwoody S, et al. Information sufficiency and risk communication. *Media Psychology* 2004;6(1):23-61. doi: 10.1207/s1532785xmep0601_2

32. Terwel BW, Harinck F, Ellemers N, et al. Competence-based and integrity-based trust as predictors of acceptance of carbon dioxide capture and storage (CCS). *Risk Analysis: An International Journal* 2009;29(8):1129-40. doi: 10.1111/j.1539-6924.2009.01256.x

33. Allum N. An empirical test of competing theories of hazard-related trust: The case of GM food. *Risk Analysis: An International Journal* 2007;27(4):935-46. doi: 10.1111/j.1539-6924.2007.00933.x

34. Vinck P, Pham PN, Bindu KK, et al. Institutional trust and misinformation in the response to the 2018–19 Ebola outbreak in North Kivu, DR Congo: a population-based survey. *The Lancet Infectious Diseases* 2019;19(5):529-36. doi: 10.1016/S1473-3099(19)30063-5

35. Tsai L, Blair R, Morse B. Patterns of trust and compliance in the fight against Ebola: Results

from a population-based survey of Monrovia, Liberia. *Economic Impacts of Ebola, Bulletin Three* 2015

36. Moy P, Pfau M. With Malice Toward All? The Media and Public Confidence in Democratic Institutions: The Media and Public Confidence in Democratic Institutions: ABC-CLIO 2000.

37. de Zwart O, Veldhuijzen IK, Elam G, et al. Perceived threat, risk perception, and efficacy beliefs related to SARS and other (emerging) infectious diseases: results of an international survey. *International journal of behavioral medicine* 2009;16(1):30-40. doi: 10.1007/s12529-008-9008-2

38. Leung GM, Ho L-M, Chan SK, et al. Longitudinal assessment of community psychobehavioral responses during and after the 2003 outbreak of severe acute respiratory syndrome in Hong Kong. *Clinical Infectious Diseases* 2005;40(12):1713-20. doi: 10.1086/429923

39. Finucane ML, Slovic P, Mertz CK, et al. Gender, race, and perceived risk: The'white male'effect. *Health, risk & society* 2000;2(2):159-72. doi: 10.1080/713670162

40. Davidson DJ, Freudenburg WR. Gender and environmental risk concerns: A review and analysis of available research. *Environment and behavior* 1996;28(3):302-39. doi: 10.1177/0013916596283003

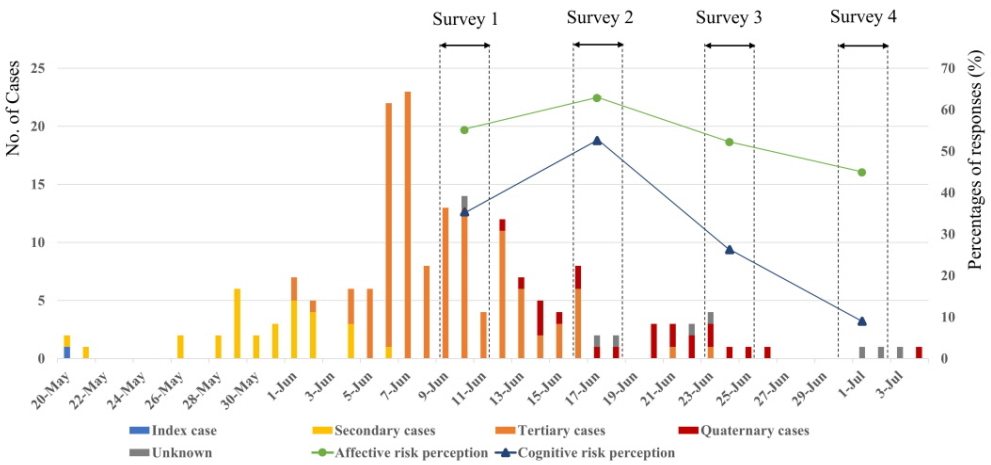
41. Weber EU, Blais AR, Betz NE. A domain-specific risk-attitude scale: Measuring risk perceptions and risk behaviors. *Journal of behavioral decision making* 2002;15(4):263-90. doi: 10.1002/bdm.414

42. Huang L, Zhou Y, Han Y, et al. Effect of the Fukushima nuclear accident on the risk perception of residents near a nuclear power plant in China. *Proceedings of the National Academy of Sciences* 2013;110(49):19742-47. doi: 10.1073/pnas.1313825110

43. Benford RD, Moore HA, Williams Jr JA. In whose backyard?: Concern about siting a

nuclear waste facility. *Sociological Inquiry* 1993;63(1):30-48. doi: 10.1111/j.1475-682X.1993.tb00200.x

44. Johnson BB. Residential Location and Psychological Distance in Americans' Risk Views and Behavioral Intentions Regarding Zika Virus. *Risk Analysis* 2018;38(12):2561-79. doi: 10.1111/risa.13184



Epidemiologic curve of MERS-CoV, timing of surveys, and affective and cognitive risk perception
MERS-CoV, Middle East respiratory syndrome coronavirus

90x50mm (300 x 300 DPI)

Questionnaire

Affective risk perception

Recently, the number of MERS patients, suffering from Middle East respiratory syndrome is increasing in Korea.

"How much worried are you that you could get MERS?"

1. Very much worried
2. Somewhat worried
3. Not that worried
4. Not worried at all

Cognitive risk perception

"Do you think MERS epidemic will settled down in the next few days or spread further?"

1. Will settle down
2. Will spread further

Trust in government (presidential job approval rating)

"Do you approve or disapprove of the way President Park Geun-hye is handling her job as president?"

1. Approval
2. Disapproval

Party identification

"These days, there are Saenuri Party, New Politics Alliance for Democracy, and Justice party in South Korea?"

1. Saenuri Party
2. New Politics Alliance for Democracy
3. Justice party
4. Other parties

Occupation

"What is your occupation?"

1. farming/forestry/fishery
2. Self-employed

3. Blue collar (Sales/services, Functional/skilled workers, general workers)
4. White collar (office/technical position, management, professional/freelancer)
5. Homemaker
6. Student
7. Unemployed
8. Retired
9. Other

Self-reported economic status

"If you divide the standards of living of Korean people into five levels: High, Medium high, Medium, Medium low, and Low, where do you think your standard of living belongs?"

1. Upper
2. Upper middle
3. Meddle
4. Lower middle
5. Lower

Educational attainment

"What is the highest degree or level of school you have completed?"

1. Middle school or below
2. High school
3. University
4. Graduate school

Area

Which region you live in? Please tell me based on your address. *I don't have your location information because we've randomly generated your telephone number.

1. Seoul
2. Busan
3. Daegu
4. Incheon
5. Gwangju

6. Daejeon
7. Ulsan
8. Sejong
9. Gyeonggi
10. Gangwon
11. Chungbuk
12. Chungnam
13. Jeonbuk
14. Jeonnam
15. Gyeongbuk
16. Gyeongnam
17. Jeju

Age

What is your age?

Gender

What is your gender?

1. Male
2. Female

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

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

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	6
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8, 9
		(b) Indicate number of participants with missing data for each variable of interest	8
Outcome data	15*	Report numbers of outcome events or summary measures	9
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10-14
		(*b*) Report category boundaries when continuous variables were categorized	10-14
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
Discussion			
Key results	18	Summarise key results with reference to study objectives	14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	16-17
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14-17
Generalisability	21	Discuss the generalisability (external validity) of the study results	17
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	

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

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