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The Role of Risk Perception and Affective Response in the COVID-19 Preventive Behaviors of Young Adults: a mixed methods study

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Objectives: Due to an increased infection rate among young adults, they need to adhere to the preventive guidelines in order to stop the spread of COVID-19 and protect vulnerable others. The purpose of this mixed methods study was to explore the role of risk perception and affective response in the preventive behaviors of higher education young adults during the COVID-19 outbreak.

Setting: This study followed a convergent mixed methods design, in which a quantitative online survey (N=1081) and ten qualitative in-depth semi-structure video-interviews were conducted separately in the Netherlands during April-August 2020.

Participants: 1081 participants filled in the online survey, and ten participants participated in the interviews. Eligibility criteria included being a student.

Primary and secondary outcome measures: Data on risk perception, affective response, i.e. worry, and adherence to preventive guidelines were combined and analyzed during this study. There were no secondary outcome measures.

Results: The results showed that young adults perceived their risk as low. Their affective response for their own well-being was also low, however their affective response was high with regards to vulnerable others in their surroundings. Due to their high impersonal risk perception (i.e. perceived risk to others) and high affective response, young adults adhered to most preventive guidelines relatively frequently. However, young adults sometimes neglected social distancing due to the negative effects on mental health and the uncertainty of the duration of the situation.

Conclusions: In conclusion, high impersonal risk and high affective response with regards to vulnerable others are key motivators in young adults' preventive behavior. In order to maximize adherence to the preventive guidelines, risk communication should be consistent and put emphasis on the benefits to vulnerable others' health when young adults adhere to the preventive guidelines.

Keywords: Risk perception, affective response, preventive behavior, COVID-19, young adults

Word count: 284

Strengths and limitations of this study

- By conducting a mixed methods study, the results of the interviews support and explain the survey findings.
- The quantitative study sample was large, increasing the external validity of this study.
- The study group was higher education students, hence findings are limited to higher education young adults.
- Although the qualitative study included a limited number of interviewees, it added to the quantitative insights by providing insights into the perceptions and behaviors of young adults.

Introduction

On January 30th 2020, the World Health Organization declared COVID-19 as a Global Public Health Emergency.[1] Following this declaration, preventive guidelines have been implemented in order to prevent the spread of COVID-19.[2] These preventive guidelines include for example frequently washing one's hands and social distancing.[3] In order to prevent the spread of the COVID-19 and flatten the curve of infections, it is important for all people to adhere to the preventive guidelines.[2, 4]

However, not everyone seems to be at high risk of the dangerous consequences of COVID-19. Young adults (between ages 20-40) appear to be at lower risk than older adults and adults with co-morbidity (e.g. cardiovascular diseases).[5-8] Moreover, ICU admission and death rate among younger adults was considerably low.[6] Nevertheless, it is still important for young adults to adhere to the preventive guidelines, as research shows that most new COVID-19 infections originate from the younger population (ages 20-49).[9, 10] In order to help stop the spread and protect vulnerable others, young adults must therefore adhere to the preventive guidelines more strictly.[5, 6]

Due to a lower percentage of hospitalization and death induced by COVID-19, young adults might underestimate their risk of COVID-19.[11] According to models of behavior change, perceived risk of COVID-19 can motivate preventive behavior, such as adherence to the preventive guidelines.[12-17] Perceived risk can be divided into two psychological dimensions, namely perceived vulnerability and perceived severity.[2, 18] Perceived vulnerability includes how likely one thinks one can be infected with COVID-19, whereas perceived severity encompasses the perceived seriousness of the symptoms of COVID-19 and whether one would survive the disease.[2, 18]

In addition to personal risk, individuals might also consider the impersonal risk which might motivate them to engage in preventive behavior, namely the risk COVID-19 poses to

the social surroundings and loved ones.[16] Risk perception, personal and impersonal, is therefore a key component in understanding whether young adults take preventive action against COVID-19 and how to motivate them to do so.[19, 20] Next to risk perception, affective response (e.g. worry) also plays a relevant role in stimulating preventive behavior.[19, 21, 22] Studies have shown that risk perceptions may evoke an affective response which can in turn elicit preventive behaviors.[23, 24] A recent study has found fear to be an important driver of preventive behavior in the COVID-19 outbreak.[25]

A knowledge gap exists on the factors which drive young adults' preventive behaviors and adherence to COVID-19 guidelines, while an increased infection rate amongst young adults is found and consequences of spreading COVID-19 are serious.[9, 10] The aim of this study is to gain insights into the role of risk perception and affective response in young adults' preventive behavior during the COVID-19 outbreak.

Methods

Study design and setting

This study followed a convergent mixed methods design, which means that quantitative and qualitative data collection occurred in a similar time frame.[26] An online survey was carried out in May-August 2020, and qualitative semi-structured in-depth interviews were conducted in April-May 2020. Both methods of data collection inquired about similar topics. After separate data collection was completed, these two data bases were merged for analysis. Data from the quantitative survey was used in order to investigate the relationships between the central concepts of this study, namely risk perception, affective response and preventive behavior.[26, 27] Then, the qualitative interviews were used to further explore these

relationships. Integration of both quantitative and qualitative data was done to further enhance the validity of the results.[26]

Due to the legal field in the Netherlands and the inclusion of adults for whom ability to consent was assumed, no ethical approval was necessary for the quantitative study. The qualitative study was reviewed and approved by the Erasmus School of Health Policy and Management Examination Board. Medical ethical approval was not required under the Dutch act on Medical Research Involving Human Subjects. Patients or the public were not involved in the design, or conduct, or reporting, or disseminations plans of our research.

Quantitative methodology

Participants

A total of 1081 (applied) university students were included in the online survey. They were asked to fill out the online questionnaire. Participants were recruited using a combination of mailing distribution (via mailing lists of the universities), distribution via Canvas digital environment and targeted distribution (announcements during lectures and classes, requested to participate). The participants were informed about the aim of the study, the methods of data collection and data protection and storage. Prior to data collection participants gave their informed consent digitally. The mean age of participating students was 22.87. About half of the sample were male (n = 537), 7 classified as 'other' and 4 students did not indicate their gender.

Data collection and variables

The online survey examined how young adults were dealing with the COVID-19 outbreak. The survey included the following concepts: risk perception, affective response, adherence to

preventive measures and background characteristics including age and gender. Risk perception was operationalized in the survey as vulnerability: "Do you estimate yourself to be in a risk/vulnerable group for COVID-19?" Choices included: no and yes, why?. Next to that, the online survey measured the affective response as worry: "How worried are you about getting COVID-19?" on a 6-point Likert scale, ranging from *0 = not at all to 5 = highly worried.* Moreover, preventive behavior was measured by inquiring about the adherence to six preventive measures on a 5-point Likert-scale from always (1) to never (5). This was recoded in order of a higher score to indicate a higher adherence. The following measures were included: staying at home as much as possible, maintaining distance when meeting others, using masks and/or gloves in public places, avoiding meeting friends and family, washing hands frequently and avoiding touching eyes, nose and mouth. And finally, participants were asked about their age (in years) and gender (male, female and other).

Qualitative methodology

Participants

The qualitative methodology that was used in this study was phenomenology. Data was collected by interviewing ten young adults. These young adults studied at the Erasmus University Rotterdam and were recruited via multichannel strategy as the campus was in full lock-down during this study. Potential participants were recruited using convenience sampling and snowball strategies. Due to this, some of the interviewees were acquaintances of the interviewer (JK). Prior to entering the qualitative study, all participants were informed about the aim of the study, the methods of data collection and received information about data protection, usage and storage. Participants gave verbal informed consent.

The interviewed participants were on average about 24 years old (ranging from 21 to 29). Most were born in the Netherlands (80%). Half of the interviewees had parents with

migrant background or were born abroad themselves (50%). More than half of the participants were female (60%). Half of the participants were bachelor students and half were master students. An overview of participant characteristics can be found in Appendix A.

Data collection

Interviews were conducted online via Skype. The interview guide was structured around the concepts risk perception,[2] affective response,[23, 24] and preventive behavior.[28, 29] In order to avoid bias, the questions have been posed as open-endedly and neutrally as possible. The interviews were audio-recorded and transcribed. For anonymity, the names of participants were changed. Data collection continued until data saturation of main themes occurred. After that, three additional interviews were conducted to ensure saturation. This resulted in a total of ten in-depth interviews with a duration of approximately one hour. To enhance trustworthiness of the qualitative data, a member check was performed after transcription of the interviews.

Data analysis

Survey data was analyzed using IBM SPSS (version 26 for Macintosh). Firstly, frequencies of each variable and the mean and standard deviation of affective response and preventive behavior were calculated. Secondly, a multiple regression analysis was run in order to examine the relationships between the independent variables (namely risk perception, affective response, age and gender) and the dependent variable (namely adherence to measures). Any missing values were excluded from the analysis. After having determined the existence of these relationships, the qualitative data from the interviews was used to further explore these relationships.

The interviews were analyzed by performing a thematic analysis using the program ATLAS.ti version 8. In order to facilitate the analysis, the first author (JK) created a

codebook based on the concepts risk perception, affective response and preventive behavior. Additionally, open-coding from the answers of the participants was used to further develop the codebook. Subsequently, two coders (JK and FH) coded two interviews independently. Differences were discussed until consensus was reached. The remaining interviews were coded by one coder (JK) and discussed with the research team to enhance reliability.

Results

Quantitative results

90% (*n*=660) of participants reported not to be at risk of COVID-19. Some young adults (*n*=74, 10%) who perceived that they were at risk of COVID-19 reported that they had pre-existing respiratory conditions. Young adults also reported little worry with regard to COVID-19 (*M*=1.81, *SD*=1.24, range 0-5).

[insert Figure 1. here]

Figure 1. shows the adherence of young adults to the preventive guidelines. It shows that young adults adhered more frequently to three out of six guidelines, including washing hands frequently, staying home as much as possible and maintaining distance when meeting others. They adhered less frequently to avoiding touching eyes, nose and mouth, avoiding meeting with friends and family, and wearing masks and/or gloves in public places. The latter is understandable, it was not an official guideline when this study took place. Overall, young adults adhered to the guidelines relatively frequently.

Next to that, a significant regression was found: ($F(4, 679) = 33.44$, $p<.001$, $r2=.165$). The regression showed that risk perception, affective response and gender have significant

relationships with preventive behavior. This means that the more young adults perceived to be at risk of COVID-19 (*B*=-,074, *p*=.039) and the more they worried about it (*B*=-,354, p<.001), the higher their adherence to the preventive guidelines was. Moreover, the regression model showed that women adhered to the preventive guidelines more often than men did (*B*=-,107, *p*=.002). Age was not significantly related to preventive behavior (*B*=-,029, *p*=.420).

Qualitative results

Risk perception

In the interviews, young adults perceived their chance of being infected with COVID-19, when adhering to the preventive guidelines, as low. One student explained: *'Seeing the fact that I am mostly home and just have contact with my family, the chances are very low.'* – Andrea. When not taking any preventive measures, young adults perceived that their chances of being infected with COVID-19 would be high: *'I think the chance of contamination without following the guidelines would be ninety-eight percent.'* – Roxanne.

Most young adults perceived that the symptoms of COVID-19 could be serious, but that it also depended on the person how serious it could be. Mark explained: *'They [the symptoms] can be very serious. But there is a spectrum. I see it as a semi lottery, a lottery that you can influence with your body.'* Most of the young adults concluded that they would be cured if they were infected: *'I am relatively healthy. Seeing my age and history I think I would only get a cold and be cured.'* – Jessica.

Affective response

Young adults did not worry for their own health. *'I am still fairly young and generally I am in good health so I am not afraid of getting sick.'* – James. However, they were aware of the

high risk of COVID-19 to vulnerable others, which led to a high affective response for these vulnerable others:

> I really started to think about what it meant for my direct surroundings. Not really what it means for me. Imagine if I were to get the virus, then I would contaminate my parents and little brothers too. The idea that I can infect someone else, that really scares me. – Andrea

Fey, Lianne and Mark expressed anxiety when perceiving risk information on COVID-19. Due to this anxiety and worry that arose due to COVID-19 risk information, they let go of actively searching for this information. Fey elaborated: *'I think if I go deep into it – like my mother does – I will create deep anxiety for it and I will probably go crazy.'*

Preventive behavior

Generally, young adults adhered to the preventive guidelines. James elaborated: *'I definitely keep the one and a half meter distance, especially when I see an elderly person. I do try to use the information about the guidelines in order to guide my life.'* Next to the impersonal risk and high affective response because of vulnerable others, the information young adults received on COVID-19 also motivated them to adhere to the preventive guidelines. Fey explained how the information she received influenced her behavior: *'You get so many messages about it…. It keeps you occupied and you hope nobody in your family gets infected. So every time I go to visit my family, I wash my hands extra carefully and keep my distance.'*

Moreover, young adults' social surroundings motivated them to adhere to the guidelines by seeing their parents or family adhere to the guidelines: *'In the beginning I thought it was very extreme what my parents were doing, but on the other hand I do think it is*

good what they are doing [keeping to the preventive guidelines very strictly]. You reduce the chance of getting it [COVID-19].' – Lianne.

However, even though young adults seemed to understand the urgency and efficacy of adhering to the preventive guidelines, some young adults experienced frustration when others showed a high level of adherence to the guidelines: *'Some people are so panicky about it, it is too much. I just want to do my groceries calmly without being reminded constantly "corona corona corona"'* - Fey. Julius agreed: *'Sometimes I get a little annoyed. Sometimes it is somebody I know and I think they are overreacting. Personally I don't feel like it is as severe as they tend to make it out to be.'*

In addition, young adults did not always practice social distancing with family and friends: *'With my mum, sister and dad I don't practice the one and a half meter rule. I still visit my dad.'* – Paige. Mark experienced COVID-19 close to him, as two family members were infected by it and one consequently passed away. However, he still did not keep distance when meeting with friends: *'I'll be honest, when I see my friends I don't keep to those rules. Of course, I keep to them in the sense that I don't see more than two people at the same time. But then I am not super aware of keeping the distance.'*

Possible reasons for young adults' negative attitude towards others' adherence and young adults' low adherence to social distancing could be the negative effect it had for some on their mental health. Mark explained that he experienced some mental health problems before, and that keeping to the guidelines would mean sacrificing his mental well-being: *'I am not willing to sacrifice my mental health purely for the little bit more reassurance of being well physically.'* The uncertainty of the duration of the guidelines also made it hard to stick to the guidelines. Paige elaborated on this:

> I think the biggest barrier would be the uncertainty of how long. If they would just say till the first of June this is it, and afterwards it will be fine. I think then it would be so much easier for

people to adhere to all of it. But as soon as they say we really don't know how much longer, people become more ignorant or impatient to the rules.

Discussion

This study explored the risk perceptions, affective responses and preventive behaviors of higher education young adults during the COVID-19 outbreak using a mixed-methods design.

We found that risk perception, i.e. perceived vulnerability, was associated with higher adherence to preventive measures. However, the results of the qualitative study add that specifically a high impersonal risk perception for vulnerable others evokes preventive behavior. The same was found for affective response, where worry for personal health was low but worry for the health of vulnerable others was high. This shows that worry for infecting others may be a more important motivator for young adults to adhere to preventive measures than worry for their own health.

According to several studies, individuals who are female show a higher degree of compliance to preventive guidelines.[30-32] This is in line with our survey, namely that female young adults showed higher adherence to preventive guidelines than male young adults. Moreover, individuals are more likely to engage in preventive behavior if they perceive that they or others are at high risk of a disease.[12-17, 33] Risk perception might also evoke an affective response, which can also motivate individuals to adhere to preventive guidelines.[19-25] Our survey confirms that risk perception and affective response are determinants of preventive behavior by showing that the higher the perceived risk and worry of COVID-19, the more young adults adhered to the preventive guidelines. However, our study adds that it is high perceived risk and worry for vulnerable others that increases young adults' motivation and adherence to preventive measures. This is an important addition to understanding the motivations of young adults behind their COVID-19 preventive behavior.

Nevertheless, we also saw a discrepancy between young adults' intention to adhere to the guidelines and their actual adherence. Despite perceiving a high risk and worry for vulnerable others, young adults also stated that they did not always adhere to social distancing when meeting friends or family. This discrepancy between young adults' intention and behavior is also known as the intention-behavior gap, where there is a difference in one's intent to perform a behavior and one's actual behavior.[34]

Young adults did not always adhere to social distancing because they felt it negatively impacted their mental health. Marroquín, Vine and Morgan[35] found something similar in their study, suggesting that social distancing correlates with negative mental health such as depression and stress. As humans are social beings, it is not surprising that longer periods of isolation or distancing can cause psychological distress.[36] Additionally, young adults felt uncertain about the duration of the pandemic and the guidelines, leading to a lesser adherence to social distancing. Williams et al.[37] found similar results in their qualitative study.

Strengths and limitations

By conducting a mixed methods study, the quantitative survey confirmed the results of the qualitative interviews. Additionally, the qualitative interviews resulted in finding more aspects and explanations regarding preventive behavior that were not found in the quantitative survey. In order to increase internal validity, this study based the survey and topic list on validated questionnaires and theoretical models.[38] Moreover, this study makes it possible to generalize these findings across higher education young adults due to the sample size and the diversity in characteristics of the interviewees.

However, one might argue that ten interviews were not enough to draw conclusions from. Nevertheless, according to Dworkin[39] and Hennick, Kaiser and Marconi,[40] the

sample size of interviews in qualitative research can vary between five up to 50. In addition to fitting in this proposed margin, saturation was reached within ten interviews.

Implications for practice

Our study has relevant implications for risk communicators, considering young adults' relative perceived vulnerability and worry for others in the environment. In addition to communication about the importance of personal protection for the virus, risk communicators should also consider impersonal risk and worry for others by emphasizing the possibility of saving vulnerable others of the dangers of COVID-19, while especially emphasizing the importance of social distancing.

Moreover, considering the limited search and consumption of COVID-19 risk information due to its worry-inducing properties, risk communicators should consider providing more positive risk information that is motivating and reassuring by showing the benefits and statistics of the effectiveness of the preventive guidelines, rather than solely focusing on statistics of death and infection rates. This might reduce worry and in turn reassure and motivate young adults to adhere more strictly to the guidelines.

Also, longer periods of isolation can cause psychological distress. Hence it is important to allow regular social contact for the mental well-being of young adults. Risk communicators should take this into account by instilling guidelines such as allowing a group of young adults to gather, as long as they adhere to certain guidelines such as social distancing and wearing face masks.

Implications for research

Combining both quantitative and qualitative research methods allowed for us to experience the benefits of both. We therefore recommend a combination of both methods for a more

comprehensive view. The results of this study provide valuable knowledge regarding young adults' perceptions, however more research needs to be done in order to fully understand the underlying reasons why young adults do not always adhere to social distancing whilst they understand the importance and urgency of adhering to this guideline.

Conclusion

This study showed that young adults adhered to the preventive guidelines relatively frequently, with factors such as (impersonal) risk perception and affective response being important motivators for adherence. Perceiving a high risk in vulnerable others sparked worry in young adults, which motivated them to adhere to the preventive guidelines to protect vulnerable others around them. However, due to barriers such as negative effects on mental health and uncertainty regarding the pandemic, young adults sometimes neglected social distancing. These findings suggest that risk communication should focus even more so on the importance of adherence to preventive guidelines for the well-being of vulnerable loved ones, and especially on the importance of social distancing. This might lead to an increase in young adults' awareness of the positive impact their preventive behavior can have on vulnerable others' health, and in turn increase their adherence to the preventive measures.

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Ethics statement

This study was carried out in accordance with the ethical guidelines of the Declaration of Helsinki with digital informed consent (survey) and verbal informed consent (interviews)

provided by all participants. In addition, the qualitative part was reviewed and approved by the Erasmus School of Health Policy and Management Examination Board. Medical ethical approval was not required under the Dutch act on Medical Research Involving Human Subjects, because the study did not involve manipulation or data of patients. Participants could withdraw from the study at any time without negative consequences and data was processed anonymously.

Contributorship statement

JK, PK, ES and FH conceptualized the study. ES collected data for the quantitative part; JK collected data for the qualitative part as part of her masters' program at Erasmus University Rotterdam, the Netherlands. ES and FH analyzed the quantitative data. JK analyzed the qualitative data with support of FH, prepared the first draft of the manuscript with feedback and suggestions of PK and FH, and acted as corresponding author. PK, ES and FH critically revised the manuscript and provided feedback. All authors read and approved the final manuscript.

Competing interests

None declared.

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Data sharing statement

Due to privacy reasons and anonymity concerns, the data will not be made available to the public.

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Figure legend (x-axis)

1: Washing hands frequently

2: Staying home as much as possible

3: Maintaining distance when meeting others

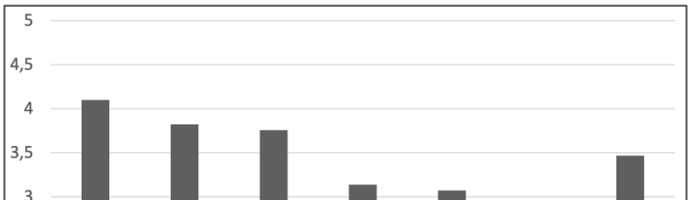
4: Avoiding touching eyes, nose and mouth

5: Avoiding meeting with friends and family

6: Wearing masks and/or gloves in public places

7: Overall adherence

Figure 1. Young adults' adherence to the preventive guidelines



Source: online survey (means of item scores with a range of 1-5)

Figure legend (x-axis)

1: Washing hands frequently

2: Staying home as much as possible

3: Maintaining distance when meeting others

4: Avoiding touching eyes, nose and mouth

5: Avoiding meeting with friends and family

6: Wearing masks and/or gloves in public places

7: Overall adherence

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

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*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	3-4
Objectives	3	State specific objectives, including any prespecified hypotheses	4
Methods			
Study design	4	Present key elements of study design early in the paper	5-6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6-7
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	8
Study size	10	Explain how the study size was arrived at	6-8
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	n/a
		(*c*) Explain how missing data were addressed	8
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	n/a
		(*e*) Describe any sensitivity analyses	n/a
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 & 9
		(b) Give reasons for non-participation at each stage	n/a
		(c) Consider use of a flow diagram	n/a
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	6
		(b) Indicate number of participants with missing data for each variable of interest	n/a
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	9-10

		(*b*) Report category boundaries when continuous variables were categorized	9
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	n/a
Discussion			
Key results	18	Summarise key results with reference to study objectives	13-14
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	14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13-16
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
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	16 (n/a)

*Give information separately for exposed and unexposed groups.

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

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The Role of Risk Perception and Affective Response in the COVID-19 Preventive Behaviors of Young Adults: a Mixed Methods Study of University Students in the Netherlands

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The Role of Risk Perception and Affective Response in the COVID-19 Preventive Behaviors of Young Adults: a Mixed Methods Study of University Students in the Netherlands

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The Role of Risk Perception and Affective Response in the COVID-19 Preventive Behaviors of Young Adults: a Mixed Methods Study of University Students in the Netherlands

Objectives: Due to an increased infection rate among young adults, they need to adhere to the preventive guidelines to stop the spread of COVID-19 and protect vulnerable others. The purpose of this mixed methods study was to explore the role of risk perception and affective response in the preventive behaviors of young adults during the COVID-19 outbreak.

Setting: This study followed a convergent mixed methods design, in which a quantitative online survey (N=1081) and ten qualitative in-depth semi-structured video-interviews were conducted separately in the Netherlands during April-August 2020.

Participants: 1081 participants filled in the online survey, and ten participants participated in the interviews. Eligibility criteria included being a university student.

Primary and secondary outcome measures: Data on risk perception, affective response, i.e. worry, and adherence to preventive guidelines were combined and analyzed during this study. There were no secondary outcome measures.

Results: The results showed that young adults perceived their risk as low. Their affective response for their own well-being was also low, however their affective response was high with regards to vulnerable others in their surroundings. Due to their high impersonal risk perception (i.e. perceived risk to others) and high affective response, young adults adhered to most preventive guidelines relatively frequently. However, young adults sometimes neglected social distancing due to the negative effects on mental health and the uncertainty of the duration of the situation.

Conclusions: In conclusion, high impersonal risk perception and high affective response regarding others are key motivators in young adults' preventive behavior. To maximize adherence to the preventive guidelines, risk communication should put emphasis on the benefits to vulnerable others' health when young adults adhere to the preventive guidelines.

Keywords: Risk perception, affective response, preventive behavior, COVID-19, young adults

Word count: 274

Strengths and limitations of this study

- By using a mixed methods approach, results of the qualitative analysis support the quantitative results and provide insight into risk perception, affective response and preventive behavior.
- The quantitative study sample was large and diverse in participant characteristics, increasing the external validity of this study.
- The study group was university students in the Netherlands, hence findings may not be generalizable to other age groups or to lower educational levels.

Introduction

On January 30th 2020, the World Health Organization declared COVID-19 as a Global Public Health Emergency.[1] Following this declaration, preventive guidelines have been implemented in order to prevent the spread of COVID-19.[2] These preventive guidelines include, for example, frequently washing one's hands and social distancing.[3] In order to prevent the spread of the COVID-19 and flatten the curve of infections, it is important for everyone to adhere to these guidelines.[2]

However, not everyone seems to be at high risk of the dangerous consequences of COVID-19. Young adults (between ages 20-40) appear to be at lower risk than older adults and adults with co-morbidity (e.g. cardiovascular diseases).[4-6] Moreover, ICU admission and death rate among younger adults was considerably low.[5] Nevertheless, it is still important for young adults to adhere to the preventive guidelines, as research shows that most new COVID-19 infections originate from the younger population (ages 20-49).[7, 8] In order to help stop the spread and protect vulnerable others, young adults must therefore adhere to the preventive guidelines more strictly.[4, 5]

Due to a lower percentage of hospitalization and death induced by COVID-19, young adults might underestimate their risk of COVID-19.[9] According to models of behavior change, perceived risk of COVID-19 can motivate preventive behavior, such as adherence to the preventive guidelines.[10-12] Perceived risk can be divided into two psychological dimensions, namely perceived vulnerability and perceived severity.[2, 13] Perceived vulnerability includes how likely one thinks one can be infected with COVID-19, whereas perceived severity encompasses the perceived seriousness of the symptoms of COVID-19 and whether one would survive the disease.[2, 13] Distinguishing perceived severity and perceived vulnerability is relevant, as research shows an overestimation of harm regarding COVID-19, and an underestimation of capabilities to minimize infection.[14]

In addition to personal risk, individuals might also consider the impersonal risk which could motivate them to engage in preventive behavior, namely the risk COVID-19 poses to other individuals.[11] Risk perception, personal and impersonal, is therefore a key component in understanding whether young adults take preventive action against COVID-19 and how to motivate them to do so.[15, 16] Next to risk perception, affective response (e.g. worry) also plays a relevant role in stimulating preventive behavior.[15, 17] Studies have shown that risk perceptions may evoke an affective response which can in turn elicit preventive behaviors.[18, 19] A recent study has found fear to be an important driver of preventive behavior in the COVID-19 outbreak.[20]

A knowledge gap exists on the factors which drive young adults' preventive behaviors and adherence to COVID-19 guidelines, while an increased infection rate amongst young adults is found and consequences of spreading COVID-19 are serious.[7, 8] Moreover, it is important to investigate predictors of COVID-19-related behaviors, as some predictors of this behavior appear to be unique to the COVID-19 pandemic.[21] The aim of this study is to gain insights into the role of risk perception and affective response in young adults' preventive behavior during the COVID-19 outbreak.

Methods

Study design and setting

This study followed a convergent mixed methods design, which means that quantitative and qualitative data collection occurred in a similar time frame.[22] An online survey was carried out in May-August 2020, and qualitative semi-structured in-depth interviews were conducted in April-May 2020. Both methods of data collection inquired about similar topics. After separate data collection was completed, these two data bases were merged for analysis. Data

from the quantitative survey was used in order to investigate the relationships between the central concepts of this study, namely risk perception, affective response and preventive behavior.[22, 23] Then, the qualitative interviews were used to further explore these relationships. Integration of both quantitative and qualitative data was done to further enhance the validity of the results.[22]

Due to the legal field in the Netherlands and the inclusion of adults for whom ability to consent was assumed, no ethical approval was necessary for the quantitative study. The qualitative study was reviewed and approved by the Erasmus School of Health Policy and Management Examination Board. Medical ethical approval was not required under the Dutch act on Medical Research Involving Human Subjects.

Patient and Public Involvement

Neither patients nor the public were involved in the design, or conduct, or reporting, or dissemination plans of our research.

Quantitative methodology

Participants

A total of 1081 (applied) university students were included in the online survey. They were asked to fill out the online questionnaire. Participants were recruited using a combination of mailing distribution (via mailing lists of the universities), distribution via Canvas digital environment and targeted distribution (announcements during lectures and classes, requested to participate). The participants were informed about the aim of the study, the methods of data collection and data protection and storage. Prior to data collection participants gave their informed consent digitally. The mean age of participating students was 22.87. About half of

the sample were male (n=537), 7 classified as 'other' and 4 students did not indicate their gender.

Data collection and variables

The online survey examined how young adults were dealing with the COVID-19 outbreak. The survey included the following concepts: risk perception, affective response, adherence to preventive measures and background characteristics including age and gender. Risk perception was operationalized in the survey as vulnerability: "Do you estimate yourself to be in a risk/vulnerable group for COVID-19?" Choices included: no and yes, why?. Next to that, the online survey measured affective response as worry: "How worried are you about getting COVID-19?" on a 6-point Likert scale, ranging from *0 = not at all to 5 = highly worried.* Moreover, preventive behavior was measured by inquiring about the adherence to six preventive measures on a 5-point Likert-scale ranging from always (1) to never (5). This was recoded for a higher score to indicate a higher adherence. The following measures were included: staying at home as much as possible, maintaining distance when meeting others, using masks and/or gloves in public places, avoiding meeting friends and family, washing hands frequently and avoiding touching eyes, nose, and mouth. And finally, participants were asked about their age (in years) and gender (male, female and other).

Qualitative methodology

Participants

The qualitative methodology that was used in this study was phenomenology. Data was collected by interviewing ten young adults. These young adults studied at the Erasmus University Rotterdam and were recruited via multichannel strategy as the campus was in full lock-down during this study. Potential participants were recruited using convenience

sampling and snowball strategies. Due to this, some of the interviewees were acquaintances of the interviewer (JK). Prior to entering the qualitative study, all participants were informed about the aim of the study, the methods of data collection and received information about data protection, usage and storage. Participants gave verbal informed consent.

The interviewed participants were on average about 24 years old (ranging from 21 to 29). Most were born in the Netherlands (native) (80%). However, half of the interviewees had parents with a non-native background or were born abroad themselves (50%). More than half of the participants were female (60%). Half of the participants were bachelor students and half were master students. Participant characteristics can be found in table 1.

Table 1: Characteristics of the interviewed participants (n=10)

Participant	**Gender**	**Ethnicity**
James	Male	Native
Tom	Male	Non-native
Roxanne	Female	Non-native
Fey	Female	Non-native
Lianne	Female	Non-native
Jessica	Female	Native
Andrea	Female	Non-native
Julius	Male	Native
Paige	Female	Native
Mark	Male	Native

Data collection

Interviews were conducted online via Skype. The interview guide was structured around the concepts risk perception,[2] affective response,[18, 19] and preventive behavior.[24, 25] In order to avoid bias, the questions have been posed as open-endedly and neutrally as possible. The interviews were audio-recorded and transcribed. For anonymity, pseudonyms were used in the transcriptions of the interviews and in this manuscript.

Data collection continued until data saturation of main themes occurred. After that, three additional interviews were conducted to ensure saturation. This resulted in a total of ten in-depth interviews with a duration of approximately one hour. To enhance trustworthiness of the qualitative data, a member check was performed after transcription of the interviews.

Data analysis

Survey data was analyzed using IBM SPSS (version 26). Firstly, frequencies of each variable and the mean and standard deviation of affective response and preventive behavior were calculated. Secondly, a multiple regression analysis was run to examine the relationships between the independent variables (namely risk perception, affective response, age and gender) and the dependent variable (namely adherence to measures). Any missing values were excluded from the analysis. After having determined the existence of these relationships, the qualitative data from the interviews was used to further explore these relationships.

The interviews were analyzed by performing a thematic analysis using the program ATLAS.ti (version 8). To facilitate the analysis, the first author (JK) created a codebook based on the concepts risk perception, affective response and preventive behavior. Additionally, open coding from the answers of the participants was used to further develop the codebook. Subsequently, two coders (JK and FH) coded one interview independently.

The intercoder reliability was calculated in ATLAS.ti using the Krippendorf's alpha coefficient. This resulted in a coefficient range of 0.48-0.67, which is considered sufficient for exploratory academic research as such.[26] Differences were discussed until consensus was reached. The remaining interviews were coded by one coder (JK) and discussed with the research team to enhance reliability.

Results

Quantitative results

90% (n=660) of participants reported not to be at risk of COVID-19. Some young adults (n=74, 10%) who perceived that they were at risk of COVID-19 reported that they had pre-existing respiratory conditions. Young adults also reported little worry about COVID-19 (*M*=1.81, *SD*=1.24, range 0-5).

[insert Figure 1. here]

Figure 1. shows the adherence of young adults to the preventive guidelines. It shows that young adults adhered more frequently to three out of six guidelines, including washing hands frequently, staying home as much as possible and maintaining distance when meeting others. They adhered less frequently to avoiding touching eyes, nose and mouth, avoiding meeting with friends and family, and wearing masks and/or gloves in public places. The latter is understandable, as it was not an official guideline when this study took place. Overall, young adults adhered to the guidelines relatively frequently.

Next to that, a significant regression was found: ($F(4, 679) = 33.44$, $p<.001$, $r2=.165$). The regression showed that risk perception, affective response and gender have significant

relationships with preventive behavior. This means that the more young adults perceived to be at risk of COVID-19 (B=-.074, p=.039) and the more they worried about it (B=-.354, p<.001), the higher their adherence to the preventive guidelines was. Moreover, the regression model showed that women adhered to the preventive guidelines more often than men did (B=-.107, p=.002). Age was not significantly related to preventive behavior (B=-.029, p=.420).

Qualitative results

Risk perception

In the interviews, young adults perceived their chance of being infected with COVID-19, when adhering to the preventive guidelines, as low. One student explained: *'Seeing the fact that I am mostly home and just have contact with my family, the chances are very low.'* – Andrea. When not taking any preventive measures, young adults perceived that their chances of being infected with COVID-19 would be high: *'I think the chance of contamination without following the guidelines would be ninety-eight percent.'* – Roxanne.

Most young adults perceived that the symptoms of COVID-19 could be serious, but that the seriousness also depended on the person. Mark explained: *'They [the symptoms] can be very serious. But there is a spectrum. I see it as a semi lottery, a lottery that you can influence with your body.'* Most of the young adults concluded that they would be cured if they were infected: *'I am relatively healthy. Seeing my age and history I think I would only get a cold and be cured.'* – Jessica.

Affective response

Young adults did not worry for their own health. *'I am still fairly young and generally I am in good health so I am not afraid of getting sick.'* – James. However, they were aware of the

high risk of COVID-19 to vulnerable others, which led to a high affective response for these vulnerable others:

> I really started to think about what it meant for my direct surroundings. Not really what it means for me. Imagine if I were to get the virus, then I would contaminate my parents and little brothers too. The idea that I can infect someone else, that really scares me. – Andrea

Fey, Lianne and Mark expressed anxiety when receiving risk information on COVID-19. Due to this anxiety and worry that arose due to COVID-19 risk information, they let go of actively searching for this information. Fey elaborated: *'I think if I go deep into it – like my mother does – I will create deep anxiety for it and I will probably go crazy.'*

Preventive behavior

Generally, young adults adhered to the preventive guidelines. James elaborated: *'I definitely keep the one-and-a-half-meter distance, especially when I see an elderly person. I do try to use the information about the guidelines to guide my life.'* In addition to the impersonal risk and high affective response because of vulnerable others, the information young adults received on COVID-19 also motivated them to adhere to the preventive guidelines. Fey explained how the information she received influenced her behavior: *'You get so many messages about it…. It keeps you occupied and you hope nobody in your family gets infected. So every time I go to visit my family, I wash my hands extra carefully and keep my distance.'*

Moreover, young adults' social surroundings motivated them to adhere to the guidelines by seeing family adhere to the guidelines: *'In the beginning I thought it was very extreme what my parents were doing, but on the other hand I do think it is good what they are doing [keeping to the preventive guidelines very strictly]. You reduce the chance of getting it [COVID-19].'* – Lianne.

However, even though young adults seemed to understand the urgency and efficacy of adhering to the preventive guidelines, some young adults experienced frustration when others showed a high level of adherence to the guidelines: *'Some people are so panicky about it, it is too much. I just want to do my groceries calmly without being reminded constantly "corona corona corona"'* - Fey. Julius agreed: *'Sometimes I get a little annoyed. Sometimes it is somebody I know and I think they are overreacting. Personally I don't feel like it is as severe as they tend to make it out to be.'*

In addition, young adults did not always practice social distancing with family and friends: *'With my mum, sister and dad I don't practice the one-and-a-half-meter rule. I still visit my dad.'* – Paige. Mark experienced COVID-19 close to him, as two family members were infected by it and one consequently passed away. However, he still did not keep distance when meeting with friends: *'I'll be honest, when I see my friends I don't keep to those rules. Of course, I keep to them in the sense that I don't see more than two people at the same time. But then I am not super aware of keeping the distance.'*

Possible reasons for young adults' negative attitude towards others' adherence and young adults' low adherence to social distancing could be the negative effect it had for some on their mental health. Mark explained that he experienced some mental health problems before, and that keeping to the guidelines would mean sacrificing his mental well-being: *'I am not willing to sacrifice my mental health purely for the little bit more reassurance of being well physically.'* The uncertainty of the duration of the guidelines also made it hard to stick to the guidelines. Paige elaborated on this:

> I think the biggest barrier would be the uncertainty of how long. If they would just say till the first of June this is it, and afterwards it will be fine. I think then it would be so much easier for people to adhere to all of it. But as soon as they say we really don't know how much longer, people become more ignorant or impatient to the rules.

Discussion

This study explored the risk perceptions, affective responses and preventive behaviors of young adults during the COVID-19 outbreak using a mixed methods design.

Individuals are more likely to engage in preventive behavior if they perceive that they or others are at high risk of a disease.[10-12] Risk perception might also evoke an affective response, which can also motivate individuals to adhere to preventive guidelines.[15-20] Our survey confirms that risk perception and affective response are determinants of preventive behavior by showing that the higher the perceived risk and worry of COVID-19, the more young adults adhered to the preventive guidelines. However, our study adds that it is high perceived risk and worry for vulnerable others that increases young adults' motivation and adherence to preventive measures. This is an important addition to understanding the motivations of young adults behind their COVID-19 preventive behavior.

While reported adherence to the guidelines was relatively high, we also saw a discrepancy between young adults' intention to adhere to the guidelines and their actual adherence. Despite perceiving a high risk and worry for vulnerable others, young adults also stated that they did not always adhere to social distancing when meeting friends or family. Notably, a low adherence to social distancing was also found by Park and Oh.[27] This discrepancy between intention and behavior, that we found in our study, is also known as the intention-behavior gap.[28] It is important for risk communicators to be aware of this intention-behavior gap and consider possible intervening variables, such as emotion, that prevent young adults from transforming their intentions into behavior.

One reason, found in this study, why young adults did not always turn their intention into behavior by adhering to social distancing, is because they felt that it negatively impacted their mental health. Marroquín, Vine, and Morgan found something similar in their study,[29] suggesting that social distancing correlates with negative mental health such as depression

and stress. As humans are social beings, it is not surprising that longer periods of isolation or distancing can cause psychological distress.[30] Additionally, research conducted during a previous infectious disease outbreak, namely severe acute respiratory syndrome (SARS), has shown that especially young people are at risk of psychological complaints due to an outbreak.[31]

Another barrier between intention and behavior, was that young adults felt uncertain about the duration of the pandemic and the guidelines, leading to a lesser adherence to social distancing. Williams et al.[32] found similar results in their qualitative study.

Moreover, in our survey, we found that female young adults showed higher adherence to preventive guidelines than male young adults. This is in line with earlier studies.[33-36] One reason for this might be males' higher reactance to direction, such as following preventive guidelines against COVID-19.[37]

Strengths and limitations

By conducting a mixed methods study, the results of the qualitative analysis support the quantitative results and provide insight into risk perception, affective response and preventive behavior. In order to increase internal validity, this study based the survey and topic list on validated questionnaires and theoretical models.[38] Moreover, the sample size and diversity of the participant characteristics of the quantitative study may increase the generalizability of our results.

However, one might argue that ten interviews in the qualitative study were not enough from which to draw conclusions. Nevertheless, according to Dworkin and Hennick, Kaiser, and Marconi,[39, 40] the sample size of interviews in qualitative research can vary between five up to 50. In addition to fitting in this proposed margin, saturation was reached within ten interviews.

Implications for practice

Our study has relevant implications for risk communicators, considering young adults' relative perceived vulnerability and worry for others in the environment. In addition to communication about the importance of personal protection from the virus, risk communicators should also consider impersonal risk and worry for others by emphasizing the possibility of saving vulnerable others of the dangers of COVID-19, while especially emphasizing the importance of social distancing.

Moreover, considering the limited search and consumption of COVID-19 risk information due to its worry-inducing properties, risk communicators should consider providing more positive risk information that is motivating and reassuring by showing the benefits and statistics of the effectiveness of the preventive guidelines, rather than solely focusing on statistics of death and infection rates. This might reduce worry and in turn reassure and motivate young adults to adhere more strictly to the guidelines.

Also, longer periods of isolation can cause psychological distress. Hence it is important to allow regular social contact for the mental well-being of young adults. Risk communicators should take this into account by instilling guidelines such as allowing a group of young adults to gather, if they adhere to certain guidelines such as keeping distance and wearing face masks. Moreover, psychological support should be available for young adults in order to diminish the negative impact on their mental health.

Implications for research

Combining both quantitative and qualitative research methods allowed us to experience the benefits of both. We therefore recommend a combination of both methods for a more comprehensive view.

The results of this study provide valuable knowledge regarding young adults' perceptions, however more research needs to be done to fully understand the underlying reasons why young adults do not always adhere to social distancing whilst they understand the importance and urgency of adhering to this guideline.

Conclusion

This study showed that young adults adhered to the preventive guidelines relatively frequently, with factors such as (impersonal) risk perception and affective response being important motivators for adherence. Perceiving a high risk in vulnerable others sparked worry in young adults, which motivated them to adhere to the preventive guidelines to protect vulnerable others around them. However, due to barriers such as negative effects on mental health and uncertainty regarding the duration of the pandemic, young adults sometimes neglected social distancing. Psychological support should be accessible for this group to mitigate the negative effects of social distancing. These findings also suggest that risk communication should focus even more so on the importance of adherence to preventive guidelines for the well-being of vulnerable loved ones, and especially on the importance of social distancing. This might lead to an increase in young adults' awareness of the positive impact their preventive behavior can have on vulnerable others' health, and in turn increase their adherence to the preventive measures.

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Ethics statement

This study was carried out in accordance with the ethical guidelines of the Declaration of Helsinki with digital informed consent (survey) and verbal informed consent (interviews) provided by all participants. In addition, the qualitative part was reviewed and approved by the Erasmus School of Health Policy and Management Examination Board. Medical ethical approval was not required under the Dutch act on Medical Research Involving Human Subjects, because the study did not involve manipulation or data of patients. Participants could withdraw from the study at any time without negative consequences and data was processed anonymously.

Contributorship statement

JK, PK, ES and FH conceptualized the study. ES collected data for the quantitative part; JK collected data for the qualitative part as part of her masters' program at the Erasmus University Rotterdam, the Netherlands. ES and FH analyzed the quantitative data. JK analyzed the qualitative data with support of FH, prepared the first draft of the manuscript with feedback and suggestions of PK and FH, and acted as corresponding author. PK, ES and FH critically revised the manuscript and provided feedback. All authors read and approved the final manuscript.

Competing interests

None declared.

Funding

Not applicable.

Data availability statement

All data relevant to the study are included in the article or uploaded as supplementary information.

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Figure legend (x-axis)

1: Washing hands frequently

2: Staying home as much as possible

3: Maintaining distance when meeting others

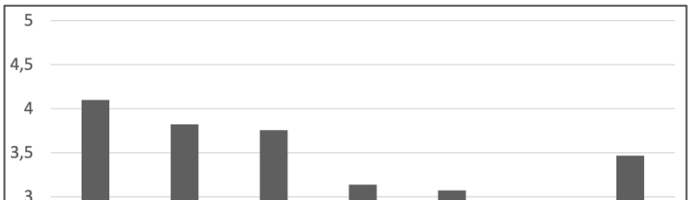
4: Avoiding touching eyes, nose and mouth

5: Avoiding meeting with friends and family

6: Wearing masks and/or gloves in public places

7: Overall adherence

Figure 1. Young adults' adherence to the preventive guidelines



Source: online survey (means of item scores with a range of 1-5)

Figure legend (x-axis)

1: Washing hands frequently

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7: Overall adherence

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

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*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	4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5-6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5-9
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6-8
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	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	7
Bias	9	Describe any efforts to address potential sources of bias	9
Study size	10	Explain how the study size was arrived at	6 & 9
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	9
		(*b*) Describe any methods used to examine subgroups and interactions	n/a
		(*c*) Explain how missing data were addressed	9
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	n/a
		(*e*) Describe any sensitivity analyses	n/a
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	6-8
		(b) Give reasons for non-participation at each stage	n/a
		(c) Consider use of a flow diagram	n/a
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	6-8
		(b) Indicate number of participants with missing data for each variable of interest	n/a
Outcome data	15*	Report numbers of outcome events or summary measures	10-11
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	10-11

		(*b*) Report category boundaries when continuous variables were categorized	10
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11-13
Discussion			
Key results	18	Summarise key results with reference to study objectives	14-15
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15
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	15
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	18 (n/a)

*Give information separately for exposed and unexposed groups.

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.