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Optimistic Youth: Young Adults Predicted a Faster Decrease in Risk during COVID-19 Emergency State in Portugal

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Keywords
Risk perception · Public health · COVID-19 · Age differences

Abstract
Perception of risk is known to change throughout the lifespan. Previous studies showed that younger adults are more prone to risk behaviours than older adults. Do these age-related differences influence risk perception during a pandemic crisis? Here, we investigated how age influenced predicted risk during the COVID-19 emergency state in Portugal. We show that time-projected estimations (e.g., appraisals based on 'now' vs. 'in two weeks' time', or 'in four weeks' time') of both risk behaviour and importance of transmission prevention decrease over time. Importantly, projected risk decreased more steeply for younger than older adults. Our findings suggest that younger adults have a different perception of epidemic-related risk than older adults. This seems to support the view that public health policy making during epidemics should differentially target younger adults.

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Juventude otimista: Os jovens adultos previram uma diminuição mais rápida do risco durante o estado de emergência relativo à COVID-19 em Portugal

Palavras Chave
Perceção do risco · Saúde pública · COVID-19 · Diferenças de idade

Resumo
A perceção do risco muda ao longo da vida. Estudos anteriores mostraram que os jovens adultos são mais propensos a comportamentos de risco do que os adultos mais velhos. Será que estas diferenças relacionadas com a idade influenciam a perceção de risco durante uma crise pandémica? Aqui, investigámos como a idade influenciou o risco previsto durante o estado de emergência da COVID-19 em Portugal. Demonstramos que as estimativas de tempo projetadas (e.g., avaliações baseadas em agora vs. "daqui a duas semanas", ou "daqui a quatro semanas") tanto do comportamento de risco como da importância da prevenção da transmissão diminuem ao longo do tempo. É importante notar que o risco projetado diminuiu mais acentuadamente para os jovens adultos do que para os adultos mais velhos. Os nossos resultados sugerem que os jovens adultos têm

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uma perceção do risco relacionado com epidemias diferente do que os adultos mais velhos e parecem corroborar a perspetiva de que a elaboração de políticas de saúde pública durante epidemias deve visar de forma diferente os jovens adultos.
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Introduction

Risk perception refers to an individual's subjective judgements about the likelihood of negative occurrences, such as injury, illness, disease, and death. Risk perception is important in health and risk communication because it determines which hazards people care about and how they deal with them [1]. A common assumption is that knowledge and certainty about risk determine how it is perceived. Based on rational decision-making, this assumption is predominantly ascribed to experts, who rely on scientific information and objective assessment [2]. By contrast, laypeople commonly evaluate risks by using heuristics. Few studies have examined the age-related differences in risk perception using hypothetical real-life situations [3, 4]. Recent work has focused on risk in the context of the COVID-19 pandemic [5–8]. These studies revealed mixed results, i.e., perceived vulnerability to COVID-19 tended to decrease with older age, yet older adults perceived higher risk of dying because of COVID-19 [5]. Rosi et al. [9] also found that older adults (70+ years) perceived higher risk severity of COVID-19 compared to the other age groups, and, conversely, younger adults (18–29 years) perceived lower risk severity of COVID-19 compared to all other age groups.

Risk perception and risk attitude are often treated as distinct yet interdependent concepts by many authors (however, these terms are sometimes used interchangeably in the literature [10]). Risk attitude refers to a broader concept – beyond mere risk-taking (i.e., the likelihood of engaging in risky behaviours) – that involves additional factors, such as risk perception and the perceived benefits of engaging in risky behaviour [11]. Although risk attitude is considered a relatively stable psychological trait, there is evidence that it may change over time; people tend to become more risk-averse as they age [12], although there can be variations depending on the domain. For example, younger adults were found to be more likely to take risks in the domain of health and safety, compared to older adults [13]. Additionally, previous work shows that risk-taking declines with age across several different domains, including health [14]. These age-related differences in risk attitude may be important when considering public health guidelines in situations such as the recent COVID-19 pandemic.

Most theoretical models on risk perception recognize that it has two main dimensions [1]: the cognitive dimension, which relates to how much people know and understand about the risk, and the emotional dimension, which relates to how they feel about risk. Individuals often evaluate risk according to subjective appraisals, intuitive judgements, and inferences drawn from the media [15]. Furthermore, certain cognitive biases may also potentially influence risk perception (e.g., the optimism bias – the tendency to believe that risks pose a less serious threat to oneself than they do to other people [16]).

The amplification of perceived risk during a pandemic is partially accounted for by a model proposed by Poletti et al. [17] that describes the dynamics of risk perception during the H1N1 influenza pandemic in Italy, in 2009. These authors proposed the susceptible-infected-recovered model [17], which emphasizes that susceptible individuals may perform "normal" or "altered" behaviours, based on the perceived risk of infection. In particular, the authors propose that, based on the perceived risk of infection, some individuals adopt "altered" behaviours to reduce viral exposure and infection. These behaviours include a reduction in physical contact with others, frequent hand washing, strong adherence to respiratory etiquette (e.g., minimizing sneezing or coughing in public places), avoidance of crowded environments, or limiting travel. The authors describe an initial overestimation of risk, accompanied by "altered" behaviours (such as purchasing larger amounts of cold/flu medicine) aimed at reducing the spread of the infection. Subsequently, there was a noted decrease in perceived risk, due to the slow increase in the number of cases, that was accompanied by a reduction in "altered" behaviours which, in turn, contributed to a re-acceleration of infection rate.

Little is known about whether the dynamics of risk perception (and risk attitude), as described in the model of Poletti et al. [17], differ across different age groups. Previous research has shown that younger adults take more risks, especially health-associated risks (e.g., using drugs or alcohol or having unprotected sex) [18–24] when compared to other adults [21, 25]. This tendency for risk-taking might also influence future predictions of risk among young adults during the pandemic.

Adherence to the government-mandated preventive measures is shown to be critical to curb the spread of the infection, but there are individual differences in the ex-

tent people apply these preventive measures. For example, a survey by University College London including data from over 10 weeks showed that guideline adherence decreased substantially, from 70% at the start of the survey, to 50% at the end [26]. However, this decline differed between age groups: while more than 60% of adults reported following the guidelines entirely, approximately only 40% of younger adults reported doing the same. Other studies during prior epidemics have shown similar results; during the SARS epidemic in Canada in 2003, younger adults reported following the guidelines less, and also perceived the situation to be less risky, compared with older adults [27]. Prior research also shows that older adults perceive higher risk and behave more cautiously than younger adults concerning health-related activities [28] and that self-reported risk perception in social, financial and recreational domains increases with age [29]. Furthermore, older adults report perceiving more risk of mortality if infected with COVID-19 [5]. Together, these findings indicate a clear trend for lower risk perception in younger adults, relative to older adults.

The government-mandated preventive measures and the effect of the pandemic more generally caused dramatic changes in the lives of all citizens [30]. These measures have been particularly hard to accept for the younger people, namely, those who could not attend classes, meet friends, or engage in sport [30, 31]. Older people were likewise instructed to remain at home and self-isolate since they constitute a high-risk group for COVID-19 [31, 32]. These social restrictions may in turn play an important role in how the population perceives the changes of the pandemic situation and the risk of infection over time.

In this work, we investigated age differences regarding the perception of risk related to everyday behaviours during the early epidemic emergency state in Portugal (Portugal was in a state of emergency from March 18 to May 2, 2020). Specifically, we focus on individual judgements of risk and other factors during the COVID-19 pandemic: (1) behaviours carrying risk infection (*risk behaviours,* e.g. "visiting friends", "using an elevator"); (2) behaviours aimed at preventing disease spreading and preparedness for crises (*prevention behaviours,* e.g. "using a face mask", "having enough medical supplies"); and (3) tolerance to deprivation of social needs (*social needs,* e.g. "social distancing from family", "not going to work"). We investigated individuals' subjective perception across 4 time-projected intervals: (1) 2 weeks ago; (2) now; (3) in 2 weeks; and (4) in 4 weeks. Specifically, we compare differences in the perception of projected risk prevention behaviours and social needs deprivation among two age groups: *emerging adults* (younger adults in the 18–25 years age range) and *adults* (adults aged 26 years and older). We hypothesize that: (1) the projected perception of risk will decrease over future-projected time points [17], and that this reduction will be enhanced (i.e., decrease more sharply) for younger adults; (2) the importance given to prevention behaviours will decrease across future-projected time points, and that this decrease will be enhanced for younger adults; (3) the deprivation of social needs will be perceived to be less tolerable over successive projected time points, and that this will be more pronounced (i.e., tolerance reduces more sharply) among younger adults.

Methods

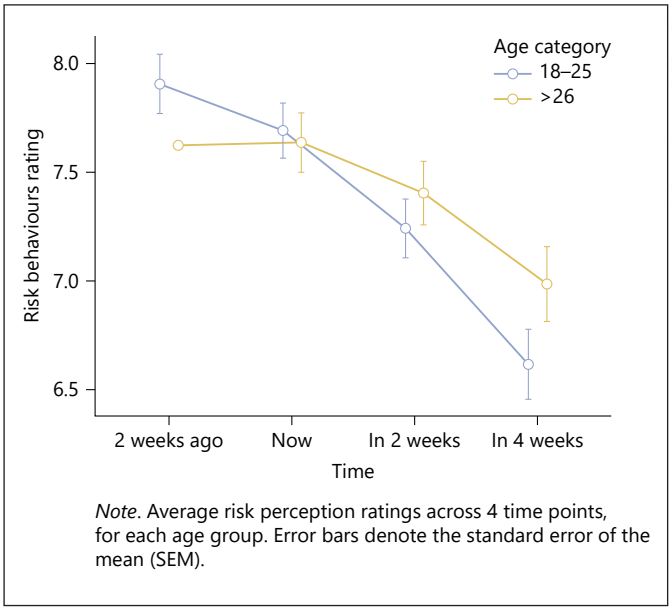
Participants

Ethical approval was granted from the Faculty of Psychology and Educational Sciences of the University of Coimbra, Portugal. Initially, a total of 199 online participants were recruited. Due to the quickly evolving nature of the pandemic situation, participants were recruited through different channels (e.g., email, social media) and the response rate was not measured. Subjects gave consent and were informed of their right to withdraw their participation at any time and that their data would be anonymous. Subjects were debriefed about the aims of the study upon completion of the questionnaire to not systematically influence their answers. 26 subjects were excluded for not residing in Portugal. Additionally, another 16 were excluded for missing demographic information. The final sample consisted of 157 participants residing in Portugal, across various regions of the country. Most participants resided in towns between 5,000 and 150,000 (n = 101) inhabitants, about a fifth in towns with 150,000 or more inhabitants (n = 33), and the remaining participants resided in towns with 5,000 or less (n = 23). Participants within the age range of 18–25 (n = 85) were designated as "younger adults" [33], while participants aged 26+ (n = 72) were designated as "adults". The total sample comprised 33 male and 124 female participants.

Procedure

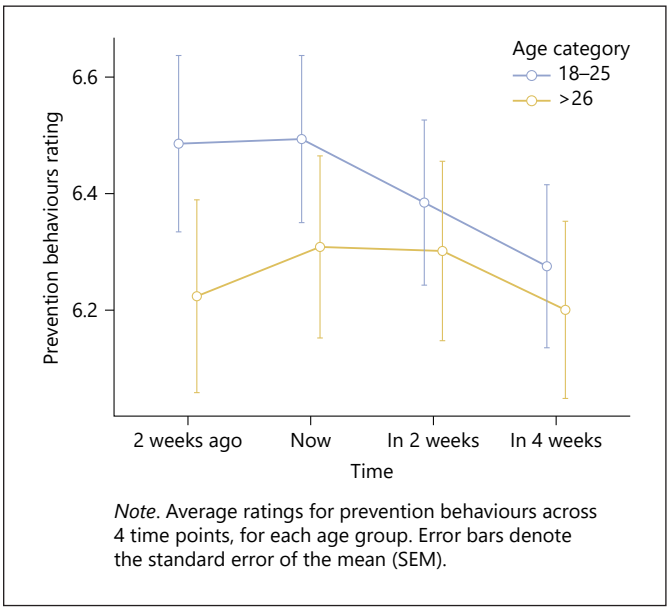
Three questionnaires were constructed for our survey. For each of these questionnaires, we pooled several representative items for different risk behaviours, prevention behaviours and social needs. Items for the questionnaires were based on public health information available at the time from health authorities and media (e.g., washing hands, maintaining physical distance from others). Those items were then translated into Portuguese. After the definition of the pool of questions to be included in the survey, the English and Portuguese versions were set up in the platform PsyToolKit [34, 35].

The recruitment process consisted of two parallel phrases. University students were recruited via email. Additionally, the links for the survey were shared on social media to reach a broader sample (in terms of age range and geographical location). Data collection took place between April 13 and May 15, 2020, approximate-



Note. Average risk perception ratings across 4 time points, for each age group. Error bars denote the standard error of the mean (SEM).

Fig. 1. Risk perception across projected time points.



Note. Average ratings for prevention behaviours across 4 time points, for each age group. Error bars denote the standard error of the mean (SEM).

Fig. 2. Perceived importance of prevention behaviours across projected time points.

ly 4–9 weeks after the onset of the national state of emergency (i.e., mandatory self-quarantine). We verified that the date of data collection did not bias the obtained ratings (see online suppl. material 2, for all online suppl. material, see www.karger.com/doi/10.1159/000524076). We adopted a cross-sectional design; all data from a given individual were obtained in a single session, where they produced projected estimates across the following 4 time points: (1) 2 weeks ago, (2) now, (3) in 2 weeks, (4) in 4 weeks. As such, we investigated changes in the projected risk perception across time.

Questionnaire

Participants were asked to complete a questionnaire that took approximately 15 min. First, they answered several demographic questions (see below, also see online suppl. Appendix 2), followed by the three main questionnaires. We devised items based on relevant public health advice (e.g., minimizing the risk of infection by washing hands, social distancing, etc.). Because these items were not previously validated, and because we had no prior knowledge of which specific contexts were most relevant for estimating each measure (e.g., hand washing for risk minimization), we sought to capture each measure in a relatively broad fashion. To this end, we generated a relatively large set of items for each measure, to retain items that collectively yielded high Cronbach's alpha. Due to high inter-item correlations for each questionnaire, we retained all items within and generated a single score per participant (per each questionnaire and time point).

Demographic Data

We collected subjects' basic demographic information, such as age, gender, profession, religion, and town size (population) and whether they had a known medical condition that might place them at higher risk for COVID-19. The impact of the media upon their perception of questionnaire outcome measures was evaluated with dichotomous yes/no questions regarding the use of various sources of information (TV/radio, internet, social media or others, further asking which other sources they used) and with a 5-point Likert scale for the perceived credibility of national news in general.

Risk Perception

Risk perception was measured with a 10-point scale, where 1 was "low perceived risk" and 10 was "high perceived risk". The questionnaire consisted of 29 items – corresponding to 29 risk behaviours. For each item, responses were required for separate 4 time points (2 weeks ago, now, in 2 weeks, and in 4 weeks). See online supplementary Table 1 for most and least rated items for all time points (Fig. 1).

Infection Prevention Behaviours

The importance attributed to 9 infection prevention behaviours was measured in a similar way to the previous questionnaire (e.g., across all 4 time points), where 1 was "low importance" and 10 was "high importance". See online supplementary Table 2 for most and least highly rated items for all time points (Fig. 2).

Social Needs

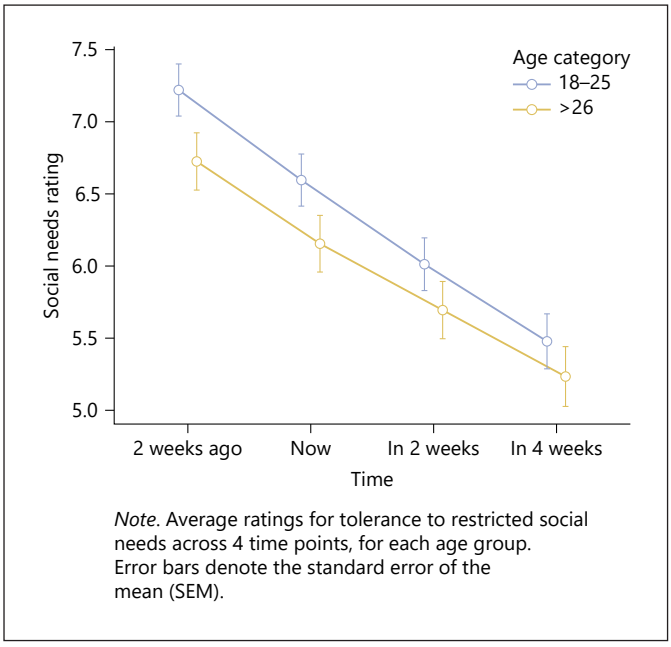
The measurement of social needs (i.e., tolerance to restricted social contact) was assessed with 6 items where 1 was "low tolerance" and 10 was "high tolerance". Again, ratings were obtained for all 4 time points. See online supplementary Table 3 for most and least highly rated items for all time points.

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics (version 25). Missing values were replaced using the 'series means'

method (i.e., replacing missing values with column means). For each questionnaire, the interitem correlations (Cronbach's alpha) were conducted (for each time point separately) to evaluate the internal consistency across items (the frequencies for the highest-scored and lowest-scored items are presented in the Results section). Because interitem correlations were consistently high for each questionnaire (and time point), we calculated item mean values per questionnaire, time point, and subject, and used these data in the main analyses.

Two-way mixed ANOVAs (age group × time point) were performed on subjects' mean questionnaire item values (per time point and questionnaire). For conciseness, we report only the highest significant ANOVA terms (e.g., interactions but not main effects when interactions are significant; and when not, both interactions and main effects are reported instead). Follow-up analyses were conducted to test if linear trends (i.e., a linear reduction in projected rating across the 4 time points) was significant; specifically, for each subject, a linear regression slope (i.e., beta coefficient) was generated for the 4 time points (i.e., decreasing linear trends yield negative values), and group level effects were tested via *t* tests on subjects' regression slope values. Lastly, exploratory analyses were conducted to see if the observed age differences in risk perception and prevention behaviours interacted with other demographic variables (see online supplement 1) and also, whether these measures interacted with the date of subjects' data collection (online supplement 2).



Note. Average ratings for tolerance to restricted social needs across 4 time points, for each age group. Error bars denote the standard error of the mean (SEM).

Fig. 3. Tolerance of deprivation of social needs across time points.

Results

Risk Perception

First, we analysed the risk perception (Cronbach's alpha values ranged from 0.952 to 0.967 for the 4 separate time points, indicating very high inter-item correlations, thus justifying mean averaging of items into individual measures [per time point]). A two-way mixed ANOVA revealed a significant interaction between age group and time point ($F(1.36, 210.65) = 7.39$, $p = 0.003$). A follow-up independent samples *t* test on linear slopes for each age group demonstrated a greater decrease in projected risk ratings for younger adults than for adults ($t(155) = -2.957$, $p = 0.002$).

Infection Prevention Behaviours

Next, we analysed infection prevention behaviours (high Cronbach's alpha values for each time point were observed, ranging between 0.782 and 0.814). A two-way mixed ANOVA revealed a significant interaction effect between age group and time point ($F(1.56, 242.36) = 4.96$, $p = 0.013$). A follow-up independent *t* test on subjects' linear slopes yielded a significant group difference, indicating a sharper reduction in the perceived importance of prevention behaviours in younger adults ($t(155) = -2.438$, $p = 0.008$).

Social Needs

Finally, we analysed tolerance of deprivation of social needs resulting from mandatory quarantine and other preventive policies (time point-specific Cronbach's alpha values ranged between 0.827 and 0.855). A two-way mixed ANOVA revealed that the interaction between age group and time point was not significant ($F(1.263, 195.742) = 1.03$, $p = 0.329$). The trend towards a main effect of age group was also not significant ($F(1, 155) = 2.17$, $p = 0.143$), while the main effect of time point was significant ($F(1.263, 195.74) = 152.15$, $p < 0.001$). A follow-up one-sample *t* test on all subjects' slope values revealed a linear decrease in tolerance towards deprived social needs over time ($t(156) = -13.451$, $p < 0.001$; Fig. 3).

Discussion

The central aim of the present study was to investigate potential age-related differences in the perception of risk, along with preventative behaviour, and deprivation of social needs related to everyday behaviours during the COVID-19 pandemic. Our results provide evidence for age-related differences in how risk perception is projected across different time points. Both the adults and younger adults groups showed a similar level of perceived present

risk (i.e., at the time the survey was filled in). Importantly, however, the projected risk perception decreased over time and this decrease was significantly more pronounced for the younger adults. Prevention behaviours also showed the same effect, suggesting that emergent adults, as compared to older adults, tend to perceive the time-projected importance of prevention behaviours to decrease more sharply over time. Finally, unlike the 2 preceding measures, when considering deprivation of social needs, both groups showed a similar decrease in intolerance across projected time points.

Regarding risk perception, the observed decreases over time parallel changes in real risk behaviour described by Poletti et al. [17] during the H1N1 influenza pandemic in Italy, in 2009, demonstrating that for both real and projected data, perceived risk tends to be higher at the beginning of pandemic states, before gradually reducing. More specifically, the observed age difference in the projected risk perception is in agreement with previous work showing that older adults tend to be more cautious than younger adults in health-related contexts [28], and that older adults tend to show a higher level of self-reported risk [29] and are more risk-averse in general [12].

This sharper reduction in projected risk in younger adults is potentially related to experiential differences between the two age groups during the COVID-19 pandemic. Birditt et al. [36] found that younger adults reported higher levels of pandemic-related stress, more life changes, and a greater sense of social isolation, and that contributed to overall poorer psychological well-being. Potentially, these findings indicate that the COVID-19 pandemic was overall less tolerable for younger adults than for older adults, which might contribute to a sharper decrease of the projected risk perception. It is important to note, however, that while Birditt et al. [36] measured the actual well-being of their subjects, in the present study we used time-projected measures, showing people's perceptions about the future; here, we did not find a substantial age difference in projected tolerance to deprived social needs across time (Fig. 3). We propose an alternative explanation for our result, considering personality differences between age groups, potentially affecting their estimations about the future. Several studies have found that older adults are less optimistic about the future in general [37–39]. According to these findings, differences in trait levels of dispositional optimism might be a better explanation for the presently observed sharper decrease in projected risk perception among the younger adults.

Several other factors may also explain age differences in risk perception. It has been suggested that infection-related risk is modulated by the perceived seriousness of a particular disease, such that the perceived likelihood of developing a disease may partly depend on how serious its consequences are considered to be [30]. This could happen for many reasons, such as a general tendency to underestimate harmful exposure in younger adults [20], or a failure to recognize personal vulnerability to negative outcomes associated with the risk behaviours – so-called "unrealistic optimism" [16, 25, 40]. Similarly, Commodari and La Rosa [30] and Commodari et al. [41] showed that younger adults underestimate the risk of infection because of the widespread evidence that younger people are generally less vulnerable to the adverse consequences of COVID-19.

In addition to dispositional optimism, differences in risk perception are potentially influenced by socio-demographic factors, such as gender, education and employment. Indeed, recent studies conducted during the COVID-19 pandemic found that these factors predicted both risk perception [5, 42] and the adoption of preventive/protective behaviours [43, 44]. Another variable that is likely to influence risk perception (and subsequent decision-making) is an individual's emotional state [45]. Indeed, individuals in a negative emotional state tend to evaluate events more negatively than individuals in a positive emotional state [46]. These findings are relevant to the current results because changes in the emotional experience are observed with age: older adults attribute greater importance to emotions than younger adults [47]. In particular, individuals with high levels of anxiety tend to perceive negative outcomes as more likely and severe [48]. We, therefore, speculate that older adults exhibited a less steep decline in the projected estimates of risk perception based on these socio-emotional factors. Finally, we speculate that risk perception (in the present study) also depends on knowledge and previous experience: The "availability heuristic" suggests that people with a recent personal experience of a specific event have a higher risk perception of that event [49]. In particular, previous work shows that individuals who knew someone infected with COVID-19 may show an increased perception of risk [7, 50].

It is worth noting that subjective risk perception is a key factor in modulating health behaviours and might influence the adoption of preventive measures [30, 41, 51, 52], such as social distancing. As such, it is of vital importance to address subjective aspects of risk perception across populations that might perceive it differently.

In parallel to the projected decrease in risk, we observed a projected decrease in the importance of infection prevention behaviours, especially in younger adults. This could be a by-product of the decrease in perceived risk, in turn, leading to a reduction in the need for adopting preventive measures. Contrary to what one might intuitively expect, and what the data from Birditt et al. [36] would suggest, we did not find any age-related differences in the tolerance of social deprivation (although a weak trend was evident for the main effect of age; see Fig. 3). We suggest that this may relate to the general use of digital communication (e.g., video calls or instant messaging) by the two age groups that was widely used to reduce feelings of social isolation during the earlier stages of the COVID-19 pandemic [53]. We further speculate that the lack of group differences may arise from differences in the frequency of use between ages groups; that is, younger adults, who tend to use digital communication more frequently to support relatively wider social networks, may rely more on digital communication to regulate feelings of social isolation, compared to other adults that tend to use it less, and may have more restrictive social networks.

Limitations

We acknowledge several limitations to our findings. First, we used time-projected measures to assess how participants predicted that risk would change throughout time and the extent to which these responses reflect real-time perception (i.e., appraisals obtained at different time intervals). Second, we deployed an internet-based self-report questionnaire that may partially be subject to a degree of self-report bias. Third, the technical challenge of conducting a survey and collecting data quickly during the state of emergency resulted in a relatively low sample size, thus limiting the generalizability of our results to the overall population; further, because of these constraints, we did not perform extensive validation of the questionnaire items (although we did demonstrate high inter-item reliability within each questionnaire). Lastly, since participants were recruited predominantly through university-related channels, our findings are largely confined to a sample of university-affiliated individuals (students and staff).

Future Directions

The observed sharper reduction of projected risk perception in younger adults is particularly important in the context of vaccination campaigns. Indeed, although many people received a COVID-19 vaccine, a high rate of non-compliant people could undermine vaccine efforts. Caserotti et al. [54] demonstrate that a perceived higher risk of the virus predicted vaccine uptake and that as emergency measures were lifted (e.g., lockdown), individuals were less likely to opt for vaccination. We, therefore, highlight the importance of risk perception in a policy-making context. These results are particularly important given that adherence to recommended safety practices depends on individuals' risk perception, according to several health behaviour models, such as the Health Belief Model [55], the Theory of Reasoned Action [56], the Theory of Planned Behaviour [57], and the Subjective Expected Utility Theory [58], which, together, demonstrate that risk perception is a crucial factor in shaping risk behaviour.

Concluding Remarks

The present results have several social, psychological, and political implications. In particular, these findings may serve to influence policymakers and other social organizations for design campaigns that consider age-related differences in the perception of risk [20] thus enhancing the effectiveness of health campaigns targeting young people [59, 60].

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Statement of Ethics

Study approval statement: Ethical approval was granted by the Faculty of Psychology and Educational Sciences of the University of Coimbra and the study was conducted ethically in accordance with the World Medical Association Declaration of Helsinki.

Consent to participate statement: Subjects gave consent and were informed of their right to withdraw their participation at any time and that their data would be anonymised. Subjects were debriefed about the aims of the study upon completion of the questionnaire in order to not systematically influence their answers.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

S.S. analyzed data, co-wrote and reworked the manuscript. I.D. and C.S. collected data, co-analyzed data, drafted the manuscript. J.A. and A.J.F. contributed to manuscript writing. J.W. and A.P. designed the study, co-analyzed data, co-wrote and reworked the manuscript.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author.

References

1 Slovic P. Perception of risk. In: Slovic P, editor. The perception of risk. Sterling, VA: Earthscan; 2000. p. 220–31. Original work published in 1987.
2 Kahneman D, Slovic P, Tversky A. Judgment under uncertainty: heuristics and biases. Cambridge, UK: Cambridge University Press; 1982.
3 Hanoch Y, Rolison JJ, Freund AM. Does medical risk perception and risk taking change with age? Risk Anal. 2018;38(5):917–28.
4 Sun Y, Sun J. Perception, preparedness, and response to tsunami risks in an aging society: evidence from Japan. Saf Sci. 2019;118:466–74.
5 Bruine de Bruin W. Age differences in COVID-19 risk perceptions and mental health: evidence from a national U.S. survey conducted in March 2020. J Gerontol. 2020;76:e24–9.
6 Pasion R, Paiva TO, Fernandes C, Barbosa F. The AGE effect on protective behaviors during the COVID-19 outbreak: sociodemographic, perceptions and psychological accounts. Front Psychol. 2020;11:561785.
7 Guastafierro E, Toppo C, Magnani FG, Romano R, Facchini C, Campioni R, et al. Older adults' risk perception during the COVID-19 pandemic in Lombardy region of Italy: a cross-sectional survey. J Gerontol Soc Work. 2021;64(6):585–98.
8 Kivi M, Hansson I, Bjälkebring P. Up and about: older adults' well-being during the COVID-19 pandemic in a Swedish longitudinal study. J Gerontol B Psychol Sci Soc Sci. 2021;76(2):e4–9.
9 Rosi A, van Vugt FT, Lecce S, Ceccato I, Vallarino M, Rapisarda F, et al. Risk perception in a real-world situation (COVID-19): how it changes from 18 to 87 years old. Front Psychol. 2021;12:e646558.
10 van Winsen F, Wauters E, Lauwers LH, de May Y, Van Passel S, Vancauteren M. Combining risk perception and risk attitude: a comprehensive individual risk behavior model. In: International Congress of the European Association of Agricultural Economists (EAAE), August 30-September 2, 2011, Zurich, Switzerland. Change and uncertainty challenges for agriculture, food and natural resources. Wageningen, The Netherlands: European Association of Agricultural Economists; 2011. p. 1–12.
11 Weber EU, Blais AR, Betz NE. A domain-specific risk-attitude scale: measuring risk perceptions and risk behaviors. J Behav Decis Making. 2002;15(4):263–90.
12 Dohmen T, Falk A, Golsteyn BHH, Huffman D, Sunde U. Risk attitudes across the life course. Econ J. 2017;127(605):F95–116.
13 Rolison JJ, Hanoch Y, Wood S, Liu PJ. Risk-taking differences across the adult life span: a question of age and domain. J Gerontol B Psychol Sci Soc Sci. 2014;69(6):870–80.
14 Josef AK, Richter D, Samanez-Larkin GR, Wagner GG, Hertwig R, Mata R. Stability and change in risk-taking propensity across the adult life span. J Pers Soc Psychol. 2016;111(3):430–50.
15 Skjong R, Wentworth BH. Expert judgment and risk perception. In: 11th International Offshore and Polar Engineering Conference, Stavanger, Norway, June 17-22, 2001. Proceedings. Mountain View, CA: International Society of Offshore and Polar Engineers; 2001. p. 537–44.
16 Weinstein ND. Unrealistic optimism about future life events. J Pers Soc Psychol. 1980;39(5):806–20.
17 Poletti P, Ajelli M, Merler S. The effect of risk perception on the 2009 H1N1 pandemic influenza dynamics. PLoS One. 2011;6(2):e16460.
18 Donohew L, Lorch EP, Palmgreen P. Sensation seeking and targeting of televised anti-drug PSAs. In: Donohew L, Sypher HE, Bukoski WJ, editors. Persuasive communication and drug abuse prevention. Hillsdale, NJ: Lawrence Erlbaum Associates; 1991. p. 209–26.
19 Donohew L, Lorch EP, Palmgreen P. Applications of a theoretic model of information exposure to health interventions. Hum Commun Res. 1998;24(3):454–68.
20 Johnson RJ, McCaul KD, Klein WM. Risk involvement and risk perception among adolescents and young adults. J Behav Med. 2002;25(1):67–82.
21 Miller CH, Quick BL. Sensation seeking and psychological reactance as health risk predictors for an emerging adult population. Health Commun. 2010;25(3):266–75.
22 Sheer VC, Cline RW. Individual differences in sensation seeking and sexual behavior: implications for communication intervention for HIV/AIDS prevention among college students. Health Commun. 1995;7(3):205–23.
23 Skara S, Sussman S, Dent CW. Predicting regular cigarette use among continuation high school students. Am J Health Behav. 2001;25(2):147–56.
24 Stephenson M, Palmgreen P. Sensation seeking, perceived message sensation value, personal involvement, and processing of anti-marijuana PSAs. Commun Monogr. 2001;68(1):49–71.
25 Cohn LD, MacFarlane S, Yanez C, Imai WK. Risk-perception: differences between adolescents and adults. Health Psychol. 1995;14(3):217–22.
26 Fancourt D, Steptoe A. COVID-19 social study [Internet]. London: University College London; 2020 [cited 2021 Dec 10]. Available from: https://www.covidsocialstudy.org/.
27 Blendon RJ, Benson JM, DesRoches CM, Raleigh E, Taylor-Clark K. The public's response to severe acute respiratory syndrome in Toronto and the United States. Clin Infect Dis. 2004;38(7):925–31.
28 Bonem EM, Ellsworth PC, Gonzalez R. Age differences in risk: perceptions, intentions and domains: age differences in risk taking. J Behav Decis Mak. 2015;28(4):317–30.
29 Rolison JJ, Hanoch Y, Freund AM. Perception of risk for older adults: differences in evaluations for self versus others and across risk domains. Gerontology. 2019;65(5):547–59.
30 Commodari E, La Rosa VL. Adolescents in quarantine during COVID-19 pandemic in Italy: perceived health risk, beliefs, psychological experiences and expectations for the future. Front Psychol. 2020;11:559951.
31 Pedrosa AL, Bitencourt L, Fróes ACF, Cazumbá MLB, Campos RGB, Brito SBC, et al. Emotional, behavioral, and psychological impact of the COVID-19 pandemic. Front Psychol. 2020;11:e566212.
32 Armitage R, Nellums LB. COVID-19 and the consequences of isolating the elderly. Lancet Public Health. 2020;5(5):e256.

33 Arnett JJ. Socialization in emerging adulthood: from the family to the wider world, from socialization to self-socialization. In: Grusec JE, Hastings PD, editors. Handbook of socialization: theory and research. New York, NY: The Guilford Press; 2007. p. 208–31.
34 Stoet G. PsyToolkit: a software package for programming psychological experiments using Linux. Behav Res Methods. 2010;42(4): 1096–104.
35 Stoet G. PsyToolkit: a novel web-based method for running online questionnaires and reaction-time experiments. Teach Psychol. 2017;44(1):24–31.
36 Birditt KS, Turkelson A, Fingerman KL, Polenick CA, Oya A. Age differences in stress, life changes and social ties during the COVID-19 pandemic: implications for psychological well-being. Gerontologist. 2021;61(2):2015–216.
37 Chessell ZJ, Rathbone CJ, Souchay C, Charlesworth L, Moulin CJA. Autobiographical memory, past and future events, and self-images in younger and older adults. Self Identity. 2014;13(4):380–97.
38 Kotter-Grühn D, Smith J. When time is running out: changes in positive future perception and their relationships to changes in well-being in old age. Psychol Aging. 2011; 26(2):381–7.
39 Ryf CD. Possible selves in adulthood and old age: a tale of shifting horizons. Psychol Aging. 1991;6(2):286–95.
40 Weinstein ND, Klein WM. Unrealistic optimism: present and future. J Soc Clin Psychol. 1996;15(1):1–8.
41 Commodari E, La Rosa VL, Coniglio MA. Health risk perceptions in the era of the new coronavirus: are the Italian people ready for a novel virus? A cross sectional study on perceived personal and comparative susceptibility for infectious diseases. Public Health. 2020;187:8–14.
42 Dryhurst S, Schneider CR, Kerr J, Freeman AL, Recchia G, Van Der Bles AM, et al. Risk perceptions of COVID-19 around the world. J Risk Res. 2020;23(7–8):994–1006.
43 Carlucci L, D'Ambrosio I, Balsamo M. Demographic and attitudinal factors of adherence to quarantine guidelines during COVID-19: the Italian model. Front Psychol. 2020;11: 559288.
44 Li S, Feng B, Liao W, Pan W. Internet use, risk awareness, and demographic characteristics associated with engagement in preventive behaviors and testing: cross-sectional survey on COVID-19 in the United States. J Med Internet Res. 2020;22(6):e19782.
45 Loewenstein GF, Weber EU, Hsee CK, Welch N. Risk as feelings. Psychol Bull. 2001;127(2): 267–86.
46 Slovic P, Peters E. Risk perception and affect. Curr Dir Psychol Sci. 2006;15(6):322–5.
47 Carstensen LL, Shavit YZ, Barnes JT. Age advantages in emotional experience persist even under threat from the COVID-19 pandemic. Psychol Sci. 2020;31(11):1374–85.
48 Stöber J. Trait anxiety and pessimistic appraisal of risk and chance. Pers Individ Diff. 1997;22(4):465–76.
49 Slovic P, Finucane ML, Peters E, MacGregor DG. Risk as analysis and risk as feelings: some thoughts about affect, reason, risk, and rationality. Risk Anal. 2004;24(2):311–22.
50 Liu M, Zhang H, Huang H. Media exposure to COVID-19 information, risk perception, social and geographical proximity, and self-rated anxiety in China. BMC Public Health. 2020;20:1649.
51 Brewer NT, Weinstein ND, Cuite CL, Herrington JE. Risk perceptions and their relation to risk behavior. Ann Behav Med. 2004;27(2): 125–30.
52 Ibuka Y, Chapman GB, Meyers LA, Li M, Galvani AP. The dynamics of risk perceptions and precautionary behavior in response to 2009 (H1N1) pandemic influenza. BMC Infect Dis. 2010;10:296.
53 Sharma RA, Maheshwari S, Bronsther R. COVID-19 in the era of loneliness. Curr Psychiatr. 2020;19(5):31–3.
54 Caserotti M, Girardi P, Rubaltelli E, Tasso A, Lotto L, Gavaruzzi T. Associations of COVID-19 risk perception with vaccine hesitancy over time for Italian residents. Soc Sci Med. 2021;272:113688.
55 Rosenstock IM. Historical origins of the health belief model. Health Educ Monogr. 1974;2(4):328–35.
56 Fishbein M, Ajzen I. Belief, attitude, intention, and behavior: an introduction to theory and research. Reading, MA: Addison-Wesley; 1975.
57 Ajzen I. The theory of planned behavior. Organ Behav Hum Decis Process. 1991;50(2): 179–211.
58 Edwards W. The theory of decision making. Psychol Bull. 1954;51(4):380–417.
59 Maibach EW, Rothschild ML, Novelli WD. Social marketing. In: Glanz K, Rimer BK, Lewis FM, editors. Health behavior and health education: theory, research, and practice. San Francisco, CA: Jossey-Bass; 2002. p. 437–61.
60 Rimar BK, Kreuter MW. Advancing tailored health communication: a persuasion and message effects perspective. J Commun. 2006; 56(Suppl 1):S184–201.