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Which predicts worker's health behavior more strongly in the COVID-19 pandemic, anticipated regret or risk perception?

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ABSTRACT

This study aims to determine the predictive power of risk perception and anticipated regret on health behavior under uncertainty in the context of the COVID-19 pandemic. The research was conducted utilizing a predictive-correlational design and survey method to 224 Indonesian (156 women, 68 men; M_{age} = 37 years old). Multiple linear regression analysis demonstrated that risk perception has greater weight than anticipated regret in predicting health behavior. Additionally, mediation analysis showed that risk perception can partially mediate the prediction relationship between anticipated regret and health behavior.

Keywords: anticipated emotion; health psychology; perceived risk; pandemic; Indonesian

1. Introduction

The COVID-19 pandemic has undoubtedly had a psychological effect on employees, particularly those in high-risk positions who come into direct contact with clients or customers daily[1]. They may suffer from anxiety, fear, depression, or stress. They were inundated with news, primarily via social media about the high number of confirmed positives and the high number of people who have been forced to deal with adversity and loss. The psychological impact manifested as anxiety and stress, is detrimental to the organization, as it can exacerbate employee burnout and poor performance[1].

At the start of the COVID-19' spread in Indonesia, residents were plagued by uncertainty; first, they were unaware of the virus's characteristics, and second, they received information from a less consistent authority[2]. It created an extraordinary emotional fear, which can manifest as worry about infection, avoidance of the virus, anxiety, and even depression[3]. Psychological factors such as the cognitive and affective ones heavily influence the health behavior of the community, including workers. Uncertainty about vaccine programs designed to prevent the transmission of the COVID-19 virus, for example, causes people to anticipate regret while also perceiving the risks associated with vaccine participation.

These uncertain circumstances contribute to a great deal of unusual behavior, such as a local officials

meeting while sunbathing in a field. A family must sit far apart in the car and has a limited number of seats. Such unusual behavior was entirely possible because people anticipate regret[4,5]. Regret is a negative cognitive-based emotion that occurs when we consider how different our current situation might be if we had taken a different action previously[6–8]. Regret is a predictor of future decision making. That is, people consider the impact of their actions before making them, so that the decision or behavior taken attempts to mitigate the negative emotions (regret) felt[9].

However, anticipated regret is distinct from other negative emotions[8]. While they both anticipate a future event, anticipated regret is distinct from other negative emotional anticipation models, such as anxiety about the future, guilt about someone else's actions, disappointment and anger at oneself for the bad results. The distinction is that regret will never be experienced if there is no causal actor, or no alternate action that leads to a better result. but all bad feelings may be experienced without a "decision"[10]. Individuals can anticipate regret in the context of expecting unpleasant emotional experiences in order to avoid them. They are then motivated to change their behavior, such as frequently washing their hands and diligently wearing masks. This behavioral shift not only anticipates regret but also changes how risk is perceived[11]. The role of anticipated regret is relevant not only for health behaviors aimed at prevention, such as vaccinations or medical tests but also for health behaviors aimed at promotion, such as healthy eating or physical activity[12].

Uncertainty conditions have also elicited cognitive responses in the form of risk perceptions[11,13,14]. Because risk perception is inextricably linked to health behavior, many health behavior intervention programs make risk perception a primary target for change[15]. The volume of news regarding the spread of COVID-19 in the form of statistical data can automatically create a risk perception. Individuals who rely heavily on numerical information will base their decisions on the principles of these numbers. Risk perception is not solely based on numerical data, but also on personal experience[15–17]. For instance, through personal experience, individuals can act extremely cautiously in order to anticipate the occurrence of regret and reduce risk perception.

The literatures mentioned above introduces the idea of expected regret as a predictor of future decision-making, including in health behavior domain, which has generated controversies. They emphasize the distinction between expected regret and other unfavorable feelings like worry, guilt, disappointment, and rage. This raises concerns regarding the distinction between anticipated regret and other negative emotions in terms of behavior shaping. Unlike other negative emotions, expected remorse depends on the existence of a causal actor or an alternative action that will produce a better outcome. The disagreement over the precise processes by which anticipated regret affects conduct and its relative significance in comparison to other psychological elements like sense of risk is implied by this theoretical distinction.

Health behavior, anticipated regret, and perceived risk

Health behavior is critical to study because it is one of the factors that contribute to the spread of the COVID-19 virus throughout the world, including Indonesia. Health behavior is defined as actions taken to prevent or detect disease, as well as to improve one's health and well-being[18]. Health behavior is a pattern of behavior, actions, and habits associated with efforts to maintain health[18].

The health belief model (HBM) is an existing psychological model that can be used to explain health behavior[19] by focusing on individual's attitudes and beliefs. It assumes that a person acts healthfully in order to avoid contracting a disease or minimizing a health risk based on his/her perception of disease vulnerability and threat[20].

The HBM is used in this study not only because it is widely employed in psychological research, but also because it is relevant for work-related research[21]. According to the HBM model's postulate, health behavior

is determined by two cognitions: perception of the threat of illness and evaluating behavior to mitigate the threat's negative influence[18]. Threat perception is based on two beliefs: the individual's perceived susceptibility to disease and the difficulty of experiencing the illness[22]. Accordingly, a person's risk perception plays a critical role in the development of healthy behavior[15]. Risk perception was initially recognized in economics and management as the concept used by von Neumann and Morgenstern, as cited in Somasundaram & Diecidue[23] to explain the decision-making process under conditions of uncertainty via his theory called the expected utility theory, whereas anticipation of regret is a psychological concept developed by economists and psychologists.

Individuals are extremely adept at anticipating regret and visualizing themselves contracting the flu if they are not immediately get vaccinated[17,24]. The anticipated regret is a reliable predictor of the intention to engage in health-promoting behavior[22].

Janz and Becker[25] reported that 30 out of 37 studies using the health belief model (HBM) demonstrated a significant relationship between risk perception and health behavior, particularly in terms of perceived likelihood. There is a significant relationship between perceived severity and health behavior in 24 out of 30 studies. While numerous studies have demonstrated a positive correlation between perceived risk and health behavior, other studies have also revealed a low correlation or no correlation at all[26]. According to Harrison[27], the results of a meta-analysis of 17 studies on the relationship between risk perception and health behavior using the HBM indicated that the effect size for the relationship between perceived likelihood and health behavior was 0.15 percent.

The literatures mentioned above brings to light the lack of consensus among experts in the field on the intensity and constancy of the link between risk perception and health-related behavior. It mentions that whereas some HBM studies demonstrate a strong association between risk perception and health behavior, other studies indicate conflicting or no association results[27].

This present study contributes to theoretical resolutions of such controversies in the COVID-19 pandemic. Resolving the controversies related to the predictive relationship between perceived risk, anticipated regret, and health behavior is essential for advancing our understanding of these factors. They emphasize how there is no agreement and contradictory evidence regarding the relationship between risk perception and health-related behavior, which makes this a crucial and pertinent study subject. They also cover the idea of anticipated regret as a predictor of future choices around health behavior. Investigating the relative predictive value of perceived risk and anticipated regret on health behavior is therefore consistent with the urgency raised by the state-of-the-art.

According to the study cited earlier, anticipated regret alters how risk is perceived in addition to anticipating regret. This suggests that there may be controversy over the relationship between predicted regret and risk perception. It implies that anticipated regret can influence changes in risk perception, but it doesn't state clearly whether anticipated regret can influence changes in risk perception. This calls into question how these variables interact with one another and how much they affect one another. By examining a mediational model, the current work makes a theoretical contribution to the theoretical resolutions of the issues in the pandemic age.

The aim of this study is to examine the predictive relationship between perceived risk, anticipated regret, and health behavior, as well as to determine which of the two has a greater prediction on healthy behavior, as both are based on uncertain conditions. An additional analysis was conducted to see whether the association between anticipated regret and health behavior could be mediated by risk perception.

Regarding the COVID-19 pandemic, it's crucial to comprehend how risk perception and anticipated regret affect health behavior. These psychological aspects have a considerable impact on people's adherence to public health recommendations, including vaccination, wearing masks, and physical distancing. Individuals' perceptions of risk affect how serious they perceive the epidemic to be, and the fear of regret is a potent incentive to take preventative action. Recognizing these factors enables public health professionals to develop more efficient communication plans, foresee the requirements for healthcare resources, and handle vaccine reluctance. It also offers insightful information for long-term pandemic readiness, enabling evidence-based methods for behavioral modification and public involvement.

In essence, preventing the spread of the virus, lessening the burden on healthcare systems, and obtaining better outcomes for public health all depend on an understanding of the role of risk perception and anticipated regret in health behavior during the COVID-19 pandemic. It provides information for customized interventions, improves messaging tactics, and paves the way for future pandemic responses that are better prepared.

Numerous studies have been conducted to establish a link between risk perception and anticipated regret. Li et al.[28] established a link between risk perception, regret anticipation and gambling intentions. Kurniawati's[29] research discovered that regret anticipation has an effect on risk perception and that risk perception has a significant effect on risky decision making as a mediator. Ritov and Baron[30] explain that, while the risk of vaccination is less than the threat of contracting a disease that can be fatal, anticipated regret behavior can cause people to refuse vaccination. As a result, anticipating regret plays a significant role in the risky decision-making process.

Therefore, this present study will examine the significance of perceived risk, or risk perception, as a mediator of the predictive relationship between anticipated regret and health behavior.

The urgency of discussing health behavior in the face of uncertainty stems from the fact that the behavior can be a source of virus transmission, including some that result in death. Health behavior is concerned with the direct biological changes associated with health risks and directs efforts toward early detection and treatment of disease[18].

This study is expected to provide a better understanding of workers' health behaviors, which is critical in the context of the country's economic performance during the COVID-19 pandemic.

Anticipated regret assists us in anticipating how we will feel about a decision after it has been made, whereas risk perception assists us in assessing the likelihood and potential implications of various scenarios. When determining whether or not to take particular actions to protect oneself and others from infection in the context of the COVID-19 pandemic, anticipated regret may come into play. For example, if a person does not wear a mask and then contracts the virus, or if they do not get vaccinated and then pass the infection on to someone who is more vulnerable, they may experience regret.

Risk perception, on the other hand, may play a role in deciding whether or not to engage in activities that may expose a person to the virus. For example, a person may perceive the risk of attending a huge indoor party to be greater than the risk of going for a walk outside, and thus make a decision based on their risk perception.

The purpose of this study is to ascertain the predictive relationship between anticipated regret, perceived risk, and health behavior. By knowing which contribution is greater—between risk perception and anticipated regret—we can target the right interventions and resources to influence people's daily decisions on healthy behavior. Various social campaigns and advertising can present various narratives that magnify one (risk perception or anticipated regret) based on the results of this study. This kind of priority will make efficient use of the state budget at the macro level in preventing the spread of the pandemic.

2. Materials and methods

2.1. Design and participants

The design of this present study is quantitative cross-sectional using survey. The research subjects included lecturers, teachers, civil servants, and private-sector employees in the Indonesian provinces of Yogyakarta and Central Java. There were 224 subjects, 156 females and 68 males, ranging in age from 25 to 60 years, with an average of 37 years old.

Yogyakarta and Central Java are two provinces on the island of Java, Indonesia whose economies rely heavily on tourist visits, but have been hit hard by the COVID-19 pandemic[31]. By knowing the psychological factors that influence health behavior, public health interventions can be carried out which are expected to increase the tourism resilience of the two provinces during the COVID-19 pandemic or the next pandemic.

The research participants responded to an online questionnaire (Google Form). This research was prepared since the early stages of COVID's spread in Indonesia, in mid-May 2020, when many Indonesians and the rest of the world were still plagued by relatively high levels of uncertainty.

In the current study, convenience sampling was used. WhatsApp and other social media were used to get in touch with the participants. There is no name recording during data collecting for data protection reasons. Indonesian residents starting the age of 25 who reside in Yogyakarta and Central Java meet the inclusion criteria. Due to the fact that teenagers have distinct vulnerabilities and characteristics in the context of health behavior that differ significantly from adults[32], this study excluded late teens and those younger than that (less than 25 years old).

This study was approved by Research and Technology Transfer, Bina Nusantara University as a part of Bina Nusantara University's Research Project entitled "Urban Well-Being: Measurement and Conceptualization" No. 017/VR.RTT/III/2021, which included ethical statement. All participants provided consent by ticking the checkbox stating that they have read and understood the study's terms and conditions and agree to participate in this research by completing a questionnaire in Indonesian.

2.2. Instrument

Regarding the questionnaire design, this study makes use of psychological scales to assess health behavior, anticipated regret, and risk perception; the elaborations are as follows:

The health behavior scale is designed based on Janz and Becker's[25] health belief model (HBM). The measurement is relevant to health behavior in general and then adjusted or contextualized into health maintenance behavior in the setting of a pandemic by incorporating healthful habits such as washing hands and maintaining a distance. The survey questions dimensions of Health Behavior are (1) Perceived susceptibility (PES), i.e. behavior or lifestlye performed based on one's belief about their susceptible to a disease; e.g. "Did you avoid shaking hands with strangers at the start of the COVID-19 pandemic?" and (2) Potential of Benefit (POB), i.e. behavior performed based on one's belief that behavioral moodifications affect their health; e.g. "Did you prefer to wash your hands with water and soap at the start of the COVID-19 pandemic, or with hand sanitizer?". The response options were Yes (scored 1) or No (scored 0) (Cronbach's Alpha, or internal consistency reliability = 0.670).

The anticipated regret scale is designed based on Roseman et al.[33]. The concept encompasses five dimensions: (1) emotional response, (2) cognitive response, (3) action tendency response, (4) behavioral response, and (5) motivational response. Zeelenberg et al.[5] expanded on these five aspects to create ten items, which include the following: (1) experience a sinking feeling, (2) believe that one should have known better,

(3) consider what a mistake has been made, (4) consider a missed opportunity, (5) experience the tendency to kick oneself, (6) experience the tendency to correct your mistake, (7) do something differently, (8) change the situation, (9) desire to undo the event, and (10) desire to get a second chance.

The dimensions of Anticipated Regret are (1) Cognitive; e.g. "I can only imagine how much time will be lost if I do contract COVID-19 and lack the discipline to wash my hands, wear masks, and maintain a safe distance."; and (2) Affective; e.g. "I'm embarrassed if I catch COVID-19 because I lack the discipline to wash my hands, wear a mask, and maintain a safe distance." The response options ranged from *Strongly Disagree* to *Strongly Agree* (scored 1–5) (Cronbach's Alpha, or internal consistency reliability = 0.917).

The risk perception scale is designed based on Brewer et al.[17]. It has three dimensions: (1) perceived likelihood (the perception of the extent of the level of danger that will be at stake and severity (the perception of the extent of the danger level that will occur); (2) perceived susceptibility (the extent to which an individual perceives danger).

The dimensions of Risk Perception are (1) Exposure, (2) Familiarity and (3) Preventability. *The first* is perceived severity related to *Exposure*, which refers to the perception of degree to which a specific disease will ultimately affect an individual's physical and social well-being, e.g. "At the start of the COVID-19 pandemic, did you feel infected with symptoms consistent with a sore throat for several weeks, despite the fact that you did not?". *The second* is perceived susceptibility related to *Familiarity*, which refers to an individual's perception of his/her likelihood of contracting a disease. "Are you concerned about your health or the health of your relatives despite the fact that you're not leaving the house?" is an example of the items. *The third* is perceived likelihood related to *Preventability*. "Are you certain you can prevent infection with the Covid-19 virus?" is an example of the items. The response options were Yes (scored 1) or No (scored 0) (Cronbach's Alpha, or internal consistency reliability = 0.770).

To find out the construct validity of all scales confirmatory factor analyses (structural validity) were carried out. The validation results to obtain structural validity (with the criteria of Standardized root mean square residual/$SRMR < 0.08$ or Goodness of fit Index/$GFI > 0.90$) are as follows: For the Health Behavior scale, the goodness of fit results are: $SRMR = 0.059$ and $GFI = 0.997$. For the Anticipated Regret scale, the goodness of fit results are: $SRMR = 0.072$ and $GFI = 0.819$. For the Risk Perception scale, the goodness of fit results are: $SRMR = 0.085$ and $GFI = 0.998$.

After structural validation, procedures to find the item validity were done by calculating the corrected item-total correlations. The validation results to obtain item validity are as follows:

- For the Health Behavior scale, out of a total of 13 items, 8 items were dropped, with item-total correlations ranging from 0.227 to 0.375. Items that are valid based on the criteria for item validity ($r_{it} > 0.250$) are item nos 3, 5, 6, 9, 12.
- For the Anticipated Regret scale, out of a total of 10 items, no items were dropped, with item-total correlations (r_{it}) ranging from 0.588 to 0.783.
- For the Risk Perception scale, out of a total of 13 items, 7 items were dropped, with item-total correlations ranging from 0.230 to 0.357. Items that are valid based on the criteria for item validity ($r_{it} > 0.250$) are item nos 6, 7, 8, 9, 10, 12.

2.3. Data analysis

JASP for Windows version 0.16.4 was used to analyze the data. Multiple linear regression of the total score of the variables was used in this study to determine the predictive power of anticipated regret and risk perception toward health behavior. According to Roberts and King[34], "When we have more than a single

variable in cross-sectional applications, we can use regression tools in much the same way as for time-series data, but we have to be even more cautious about causal interpretation."

As an additional analysis, mediation analysis was done to know whether the risk perception could mediate the relationship between anticipated regret and health behavior.

3. Results

There are positive correlations between anticipated regret and health behavior ($r = 0.184$, $p = 0.013$), and between risk perception and health behavior ($r = 0.456$, $p = 0.000$).

Table 1 presents the multiple linear regression analysis (stepwise method) results. The table shows that the two predictors (vs. one predictor) explained more of the variance in health behavior, even though the additions were not very large (only 2.5%). When the predictor was only one, i.e. risk perception, the R^2 was 28.1%. When the predictor is added to the anticipated regression, the R^2 becomes 30.6%. Further results showed that, in **Table 2**, risk perception can significantly predict health behavior ($\beta = 0.473$, $t = 7.918$, $p < 0.01$) with greater weight than anticipated regret ($\beta = 0.168$, $t = 2.81$, $p < 0.01$). **Table 3** and **Figure 1** shows that risk perception is functional as a mediator (partial mediation) between anticipated regret and health behavior.

Table 1. Multiple linear regression analysis (Stepwise method) predicting health behavior ($N = 224$).

Model	R	R^2	Adjusted R^2	Std. error of the Estimate	Change Statistics				
					R^2 Change	F Change	$df1$	$df2$	Sig. F Change
Model 1 (Predictor: Risk Perception)	0.530	0.281	0.278	1.399	0.281	86.803	1.000	222	0.000
Model 2 (Predictor: Risk Perception, and Anticipated Regret)	0.553	0.306	0.300	1.377	0.025	7.901	1.000	221	0.005

Note: Tolerance = 0.882, *VIF* = 1.134.

4. Discussion

This study demonstrates that both risk perception and anticipated regret are capable of significantly predicting health behavior at the start of the COVID-19 pandemic in Indonesia when the government and society faced uncertainty, such as using masks, washing hands, and maintaining a safe distance.

However, risk perception ($\beta = 0.473$) has a greater predictive weight on health behavior than anticipated regret (see **Table 2**). The Beta coefficient for anticipated regret was extremely low ($\beta = 0.168$), which is close to zero. The significantly greater predictive power of risk perception can be explained by previous research findings of Chavarría et al.[35] that "impatience and willingness to take risks are commonly expected to decrease the likelihood to invest in protective health measure". This means, on the contrary, if a person has a high risk perception (without being accompanied by a willingness to take the risk), then his/her health behavior will also be higher[16]. Meanwhile, the term "regret" refers to a relatively mild category of one's sad emotions[36]. To illustrate regret's position within the spectrum of sadness, the following can be said: When a member of the nuclear family dies, the nuclear family members (husband, wife, and children) experience "grief" or profound

sadness, while relatives (such as cousins) of the deceased experienced "sadness," and neighbors or other people experience "regret." Thus, the emotional state of regret can be deemed less significant for the subject because it may have little effect on the subject's psychological, let alone physical, state in the COVID-19 pandemic.

**Table 2.** Multiple linear regression analysis result (Enter method) predicting health behavior ($N = 224$).

Model		Unstandardized Coefficients		Standardized Coefficients	t	p	Correlations			Collinearity Statistics	
		B	$SE\ B$	β			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	5.426	0.271		19.994	0.000					
	Risk perception	0.364	0.039	0.530	9.317	0.000	0.530	0.530	0.530	1.000	1.000
2	(Constant)	4.658	0.382		12.193	0.000					
	Risk perception	0.324	0.041	0.473	7.918	0.000	0.530	0.470	0.444	0.882	1.134
	Anticipateed regret	0.028	0.010	0.168	2.811	0.005	0.330	0.186	0.158	0.882	1.134

Note: Dependent Variable: Health Behavior; $p < 0.05$ is considered statistically significant.

Table 3. Mediation analysis ($N = 224$).

							95% CI	
			Estimate	Std. Error	z-value	p	Lower	Upper
Anticipated regret	Risk perception	Health behavior	0.012	0.003	4.036	<0.001	0.006	0.020

Note: Delta method standard errors, bias-corrected percentile bootstrap confidence intervals, ML estimator; $p < 0.05$ is considered statistically significant.
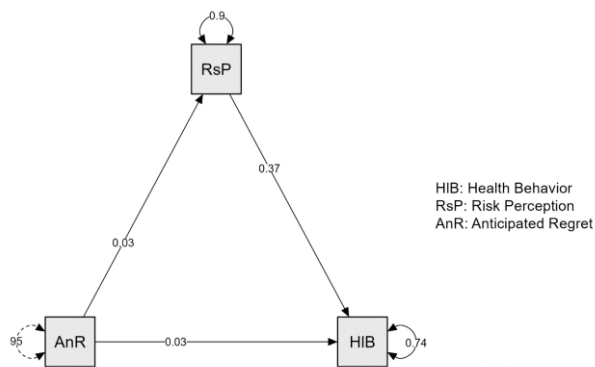
Figure 1. Mediation analysis result.

The smaller effect size of the predictive power of anticipated regret—compared to perceived risk (see **Table 1**) may also be due to the fact that expressed by Gaube et al.[37] that "anticipated emotions such as regret ... are usually not felt immediately in the presence of potential threats to a person's safety". In addition, from a cultural perspective, the explanation from Statman[38] is also relevant why for people who live in Indonesia - a collectivistic country - anticipated regret plays less of a role than risk perception. Statman[38] stated that the likelihood of regret is higher in individualistic nations where people can't rely on friends and family to ease their burden by sharing responsibility for choices, as well as in nations with high levels of intellectual autonomy, which increases individual accountability for decisions. Meanwhile, Bontempo et al.[39] found that in countries with Chinese cultural roots (collectivistic countries—like Indonesia), namely Taiwan and Hong Kong, people in these countries have more sensitive risk judgments (to the size of prospective losses and less attenuated by the likelihood of success) compared to Western countries.

The debate about the predictive power of risk perception vs. anticipated regret has been going on for decades in various contexts. In terms of gambling intention, for example, Li et al.[28] in a sample in Macau found that both can reduce the intention to gamble, but risk aversion plays a greater role in certain types of gambling, while anticipated regret plays a greater role in other types of gambling. That is, the gambling type acts as a moderator variable. This can also inspire further research as a follow-up to this present study, whether types of health behavior can also function as moderating variables. In the context of the behavior of preventing a tire-related accident on the road, Chen and Yeh[40] did not even find the predictive power of anticipated regret, although they did find the predictive power of risk perception. He concluded that an individual's risk aversion and willingness to take preventative measures may be reliably explained by their perception of risk. To put it another way, people are more likely to take precautions if they think that doing nothing will considerably raise their risk. Meanwhile, it has not consistently been demonstrated that anticipated regret steers participants toward the safe choice when it comes to driving safety. Although they do not include an adequate theoretical explanation, they emphasize that risk perception is a more consistent predictor than anticipated regret.

However, knowing that the addition of anticipated regret can increase the variance explained from 28.1% to 30.6% (**Table 1**), we can empower anticipated regret to increase the positive effect of risk perception on health behavior. In the context of cancer risk communication, for example, Klein et al.[41] showed that by emphasizing to participants how they could feel if they choose not to engage in a clearly suggested behavior, like screening, and subsequently incurred negative effects, anticipated regret can be used effectively in risk communication. People are not only driven to avoid regret, but they also tend to exaggerate their emotional reactions in the future, which may lead them to engage in the advised health behavior even more. This proposition is strengthened by suggestions from Cox et al.[42] and Gaube et al.[37] that targeting anticipated regret only works as a health-related behavior-changing tool if the intervention's target could easily understand the potential hazards of the health concern (for example, by graphically depicted statistical messaging).

The mediational role of risk perception in the relationship between anticipated regret and behavior (e.g., unsafe sex, ecstasy use) has been concluded in empirical research by Nordgren et al.[43] by stating "voluntary appraisals elicit anticipated regret, which, in turn, increases perceived risk". Combined with the terminology of Guo et al.[44], it can be said that emotional path (in this case anticipated emotion, i.e., regret) influences cognitive path (perceived risk) in encouraging health behavior. However, there is one valuable note from the study by Lagerkvist et al.[45] which can also be used as material for further studies. Quoting Peters et al.[46], they stated that threatening communication (which increases the risk perception) should only be used in treatments that increase self-efficacy. Subsequent research can use self-efficacy as a moderator in the health behavior model in a pandemic setting involving perceived risk and anticipated regret.

5. Conclusion

In the COVID-19 pandemic, risk perception is more predictive of health behavior than anticipated regret. Culturally, regret for Indonesians translates as "sad in the light category," implying that the concept of anticipated regret has a high psychological distance.

It is increasingly important to maintain Indonesians' perceptions of risk through effective risk communication, as recommended by Fillaili and Tamyis[2]. This safeguard remains important in the current era which is referred to as "post-pandemic" or "the road to endemic" when we are in the midst of inconsistent empirical research results, which stated that the perception of the Indonesian people about the risk of COVID-19 is high[47,48] and low[2,49]. A health behavior model that considers risk perception and anticipated risk will be useful in dealing with prospective "disease X"[50], i.e. the disease that is yet undiscovered but might start the next pandemic, in the future.

The study clarifies the variables predicting pandemic health behavior, including as mask use, hand washing, and keeping a safe distance. It implies that these behaviors are predicted by both risk perception and anticiapted regret, which can be important information for public health initiatives. The study emphasizes how important risk perception is in affecting people's health behaviors and implies that public health efforts may be more successful if they emphasize raising awareness of the dangers of ignoring advised health precautions. The study emphasizes that collectivistic cultures may favor risk perception over anticipated regret while also acknowledging the cultural context in Indonesia. This cultural understanding can help create customized public health messages for various nations and locations. Although research indicates that risk perception has a better capacity for prediction, it is possible to increase the influence of risk perception on health behavior by include anticipated regret in health communication tactics. This discovery can direct the creation of health programs that are more successful.

The following are some of this study's limitations: The sample size for the study is just 224 participants, most of them are lecturers, teachers, government professionals, and workers in the private sector from particular provinces in Indonesia. The results may not be applicable to a larger population due to the sample's lack of diversity. A cross-sectional survey is used in the study to capture data at a certain moment in time. It is unable to determine the cause of behavioural changes or monitor them over time. The study also uses self-reported information from an online survey. Self-reporting could induce bias because individuals might give answers they think are acceptable in society. The study concentrates on handwashing, keeping one's distance, and wearing a mask as healthy behaviors. It does not dive into a broader variety of practices or behaviors relevant to health. Last but not least, the study's findings are unique to Indonesia's early experience with the COVID-19 pandemic. They might not be specifically relevant to other situations or health concerns. They may not be directly applicable to other contexts or health crises.

Author contributions

Conceptualization, FF, JA, FN, NS, MDRR, ADAP and APJW; methodology, FF, JA and HEW; software, HEW and JA; validation, FF, JA, HEW, ADAP and APJW; formal analysis, FF, JA and HEW; investigation, FF, FN, NS and MDRR; resources, FN, MDRR, ADAP and APJW; data curation, FF, HEW and NS; writing—original draft preparation, FF, JA, FN, HEW, NS, MDRR, ADAP and APJW; writing—review and editing, FF, JA, FN, HEW, NS, MDRR, ADAP and APJW; visualization, HEW and JA; supervision, FF and JA; project administration, HEW, NS, MDRR, ADAP and APJW; funding acquisition, FF, FN and ADAP. All authors have read and agreed to the published version of the manuscript.

Conflict of interest

The authors declare no conflict of interest.

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