

**Who is more vulnerable to health misperception?:
The role of uncertainty, prior belief consistency,
and health literacy in the context of dewormer use***

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This study aimed to clarify the psychological mechanism by which individuals accept health misinformation from social media and how health misperceptions affect subsequent unhealthy behavior in the context of dewormer use. An online survey was conducted with 307 South Korean adults exposed to dewormer use information on social media. The positive association between the respondents' uncertainty about their health and factual misbeliefs about dewormer use was moderated by their pre-existing attitude toward complementary and alternative medicine (CAM) vs. standard treatments, suggesting that individuals who are uncertain but more favorable toward CAM tend to accept factual misbeliefs more easily. Individuals'

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uncertainty about their health and treatment for the health management was positively associated with conspiracy beliefs. Factual misbeliefs were the key mediator in the association between the interaction of uncertainty and pre-existing attitude toward CAM vs. standard treatments and dewormer-taking intention.

Key words : health misinformation, health misperception, uncertainty, pre-existing attitude, health literacy

1. Introduction

Since the first Korean YouTube video of the Joe Tippens protocol was uploaded in September 2019, YouTube has been considered the main source of dewormer misinformation by many South Korean journalists and healthcare providers (Yoon et al., 2022). In this first video, the Joe Tippens protocol was introduced as a miracle cure for cancer patients, and information on the efficacy and safety of fenbendazole—a deworming drug for dogs used in the protocol—bombed Korean social media.

On social media, some cancer patients started sharing their interest in and experience with dewormers as an inexpensive and effective alternative to anti-cancer drugs (Yoon et al., 2022). One well-known case was Chulmin Kim, a Korean comedian who tried the fenbendazole protocol after being diagnosed with Stage 4 lung cancer. He first shared his fenbendazole use and progress on Facebook in hopes of a full recovery;

however, his symptoms became even worse after a very short period of recovery. He had to stop and return to the standard treatment procedure. He shared his experience with dewormer as a complementary and alternative medicine (CAM) in a 2020 annual government audit and contended that healthcare providers should provide more detailed information and guidelines for cancer patients on CAM (Hong, 2021). However, even after his death in 2021, the dewormer protocol was still utilized by people with cancer. A survey conducted by Korean oncologists revealed that 16% of cancer patients reported that they had tried the fenbendazole protocol as CAM (Min, 2022).

One of the interesting aspects of the dewormer use boom in South Korea is that the use of dewormers as CAM is not restricted to cancer patients. Misperceptions of dewormer's efficacy with diseases such as diabetes, atopic dermatitis, and chronic rhinitis are also spread through social media, leading some individuals to regard it as a new type of CAM for these and other diseases (Lee, 2020; Yoon et al., 2022). Even healthy individuals started trying dewormers as dietary supplements for general health management (e.g., Fit Couple TV, 2020; Nalgutida, 2020). Misperceptions of the efficacy of dewormers as CAM resulted in fenbendazole being sold out in veterinary clinics. Even other dewormers approved for humans, such as Albendazole, were sold out as supplements to fenbendazole in many pharmacies in South Korea (Park, 2020). The dewormer boom persisted during the coronavirus disease 2019 pandemic (COVID-19) after one study showed the efficacy of Ivermectin, a type of dewormer, for individuals with COVID-19 (Park, 2020). The dewormer

intake boom in South Korea is not just a short-lived trend among cancer patients; it has become a persistent public health issue. Many healthcare providers and public health administrators have constantly raised their concerns about consumers' off-label use of dewormers. The Korean Medical Association (KMA), the Korean Society of Medical Oncology (KSMO), and the Korean Ministry of Food and Drug Safety (KMFD) also recommend avoiding dewormers for cancer patients because of their unprecedented dangerous side effects on the liver (Kim, 2019). The KSMO has even reported emergency cases due to the off-label use of dewormers (Kim, 2019).

Some individuals still embrace health misperceptions about dewormers as legitimate CAM despite warnings from healthcare experts, such as healthcare providers and public health administrators, and the reporting of actual adverse events and side-effect cases. Previous studies on the effects of misinformation (Pennycook & Rand, 2019; Yum & Jeong, 2018, 2019) investigated the individual differences that make people more vulnerable to health misinformation acceptance. The two most frequently studied psychological mechanisms were the motivated reasoning tendency and literacy level (Pennycook & Rand, 2021; van der Linden, 2022). However, motivated reasoning, a goal-directed reasoning tendency, has been extensively studied in the context of politically divided health issues, such as COVID-19 vaccinations (e.g., Sylvester, 2021), and has illustrated mixed results (van der Linden, 2022). Pennycook and Rand (2019, 2021) suggested a low literacy level, which consists of low analytical thinking and a lack of knowledge, as another psychological

mechanism for judging the accuracy of information. However, more empirical evidence must be provided on whether literacy level affects health misperception acceptance.

The acceptance of misbeliefs regarding dewormer use can be understood as a sense-making process through information management, often found among individuals overwhelmed by uncertain health conditions (Brashers, 2001). Previous studies on health misinformation acceptance mechanisms tend not to consider the role of uncertainty in individuals' health. According to the uncertainty in illness theory (Mishel, 1990), the uncertainty of people with an illness rises when the meaning of health events cannot be defined. An uncertain situation is ambiguous, complicated, inconsistent, unpredictable, lacking information, or unfamiliar (Babrow, Hines, & Kasch, 2000; McCormick, 2002), and discomfort from such uncertainty lead individuals to apply various strategies to alleviate the discomfort feeling (Brashers, Goldsmith, & Hsieh, 2002). Information management is one such strategies to alleviate one's uncertainty. However, not all individuals actively seek and utilize accurate information to alleviate their uncertainty. Some individuals, who feel overwhelmed by their health concerns, may employ a goal-directed information management strategy to protect their self-concept. They may selectively use supporting information that aligns with their beliefs, even if its actual accuracy is questionable. Furthermore, individuals experiencing high levels of uncertainty about their health can be more vulnerable to health misinformation, particularly if their pre-existing attitudes towards standard treatments provided by the conventional healthcare system are

less favorable compared to their attitudes towards alternative approaches, such as CAM. Additionally, limited access to proper medical knowledge can further exacerbate this susceptibility.

To clarify the underlying mechanism of health misperception acceptance and its impact on health behaviors, this study investigates how individuals' uncertainty about health affects their health misperception acceptance and intention to take misbehavior, intention to take dewormer as CAM. In addition, this study examines the moderating role of pre-existing attitude toward standard treatments and its alternatives, such as CAM and health literacy in the relationship in the health misperception acceptance and its consequences.

2. Literature Review

1) Health misperception as the outcome of health misinformation

Health misinformation has been defined as publicly accessible health information that is inaccurate or misleading based on the best possible scientific evidence (Southwell et al., 2022; Swire-Thompson & Lazer, 2020; Vraga & Bode, 2020). Social media information regarding dewormers as CAM contains misleading claims about dewormers' efficacy for various diseases based on inaccurate interpretations of scientific or pseudo-scientific evidence (Yoon et al., 2022). Consequently, dewormer

information from social media can be considered health misinformation.

Many public health experts are concerned about the potentially detrimental effects of health misinformation on individual's misperceptions of health behaviors (Swire-Thompson & Lazer, 2020). The World Health Organization (WHO) systematically reviewed online health misinformation and revealed that health misinformation exposure on social media is related to harmful effects on individuals' information sharing, misperceptions, and behaviors (Borges do Nascimento et al., 2022). The most recent example originated from the COVID-19 pandemic, with the results of an online survey of South Korean adults revealing that individuals exposed to COVID-19 misinformation through social media were less willing to take COVID-19 vaccinations (Yoo et al., 2023). Similarly, another survey study found that individuals with conspiracy beliefs about COVID-19 tend to demonstrate low intention to take the vaccine (Romer & Jamieson, 2020).

One of the outcomes of health misinformation exposure is health misperception. Although empirical evidence of the negative impacts of health misinformation still must be provided (Nan, Wang, & Thier, 2022), some studies have illustrated that health misinformation influences individuals' health beliefs, which is closely connected to health misperception. Tan et al. (2015) found that respondents exposed to health misinformation linking plastic bottle use with cancer tended to harbor health misbeliefs. However, the relationship between misinformation exposure and misperception was not found in the other health contexts they tested. In their experimental study, Gratale et al.

(2019) demonstrated that participants in misleading advertising conditions displayed misperceptions about tobacco products.

2) Types of health misperceptions: Factual misbeliefs vs. conspiracy misbeliefs

More recently, health communication scholars have started to distinguish misinformation from misperception (Southwell et al., 2022). Based on Vraga and Bode (2020), Southwell et al. (2022) pointed out that health misinformation is a observable phenomenon, while misperception is one's belief about something based on inaccurate or misleading evidence. Following Southwell et al. (2022), this study defines *health misperception* as individuals' beliefs about health-related issues due to their acceptance of inaccurate or misleading misinformation.

As the definition suggests, health misperception consists of two types of health misbeliefs: factual and conspiracy. *Factual misbelief* has been widely studied in political and health communication (e.g., Southwell et al., 2022; Vraga & Bode, 2020). In the case of dewormer misinformation on social media, constant exposure to inaccurate or misleading facts stating that dewormers are effective and safe medications for various diseases can influence social media users' adoption of incorrect beliefs concerning dewormer use as CAM. In addition, conspiracy beliefs are another form of health misperceptions based on misleading health misinformation. *Conspiracy beliefs* refer to judgments regarding the likelihood of harmful actions that a certain actor or institution secretly

undermine a society (Albarracín et al., 2022). Examples of conspiracy health beliefs are anti-vaccine movements, such as the measles, mumps, and rubella autism controversy (Smith et al., 2008), the Zika virus (Lyon, Merola, & Reifler, 2019), and COVID-19 vaccine protests (Lee et al., 2022; van Prooijen et al., 2021).

While not all beliefs about conspiracies are inaccurate, some can be misleading. In their case study of the Pizza Gate theory, Albarracín et al. (2022) found that conspiracy beliefs are usually based on unfalsifiable premises and that conspiracy supporters typically live in an echo chamber that protects their beliefs. Anti-vaccine movements exemplify groups that mimic the standard healthcare system, scientists, and pharmaceutical companies. Therefore, supporters of anti-vaccine movements tend to have conspiracy beliefs that vaccines are created and promoted for others' financial gain rather than to benefit individuals' health (Johnson et al., 2020). Accepting conspiracy beliefs about vaccines results in vaccine hesitancy and in seeking alternative and complementary medicine as a substitute treatment (Attwell et al., 2019). Applying this to dewormer off-label use, people who support dewormer use as CAM are likely to have low trust in or unfavorable attitudes toward doctors and to have favorable stances of CAM. Because of their distrust of conventional healthcare, they may perceive off-label dewormer use as an alternative treatment option for their health.

3) The role of uncertainty in health misperception

One possible reason behind individuals' acceptance of health misperceptions can be understood as a sense-making process for their uncertain health condition. According to the uncertainty in illness theory (Mishel, 1990), individuals' uncertainty increases when the meaning of their health events cannot be defined. An uncertain situation is ambiguous, complicated, inconsistent, unpredictable, lacking in information, or unfamiliar (Babrow, Hines, & Kasch, 2000; McCormick, 2002). Brashers (2001) pointed out that when individuals encounter uncertainty, they respond to situations with different emotional reactions based on their cognitive appraisals. Some feel positive or neutral about their uncertain situation and move forward, while others experience negative emotions (e.g., anxiety) and attempt to alleviate their negative state. The expected outcome motivates individuals to feel more negative emotions from uncertainty (Morriss et al., 2022). Morriss et al. (2022) demonstrated that individuals tend to feel more negative emotions, such as fear and anxiety, when the expected outcome is negative. Such an uncertain situation makes individuals feel uncomfortable and motivates them to try to alleviate their discomfort using coping strategies (Brashers, Goldsmith, & Hsieh, 2002; Mishel, 1990).

Although the concept of uncertainty in uncertainty in illness management theory (Mishel, 1990) and uncertainty management theory (Brashers, 2001) or were developed from the observation of patients, it can explain the individuals with health uncertainty in general, since the

uncertainty can be also come from one's perception as well. For example, individuals with high health anxiety, which is based on one's perception rather than an actual physical health condition, tend to use information management strategies more actively online (Lagoë & Atkin, 2015). Therefore, this study defined uncertainty about one's health condition as an individuals' perception of their health as ambiguous and complicated situation.

Uncertain individuals' acceptance of dewormer misperceptions can be understood as information management, one way to cope with the distress resulting from negative appraisals of uncertainty. Examples include information seeking or avoidance, chronic uncertainty adaptation, and seeking social support (Brashers et al., 2002). Information management for uncertainty reduction does not always result in seeking new, accurate health information because individuals tend to utilize information to maintain their uncertainty in the desired way (Heyman, Henrikson, & Maughan, 1998). In this goal-directed uncertainty management with information, individuals can seek and accept certain beliefs that support their pre-existing beliefs or even some alternatives that can maintain one's uncertainty at the desired level (Kruglanski, 1989).

Health misperceptions accepted by individuals with high uncertainty can be related to problematic health behaviors that are not recommended by healthcare providers. Previous studies on health misbeliefs suggest the possibility of a detrimental effect of factual misbeliefs and conspiracy beliefs on behavioral outcomes. For example, Sobeck et al. (2022) showed

that having factual misbeliefs about antibiotics tend to lead individuals' misuse of the drug. In the context of human papillomavirus (HPV) vaccine, factual misbeliefs about HPV were negatively associated with individuals' support for HPV vaccine mandating policy (Oh, Lee, & Park, 2022). Previous study also showed that conspiracy beliefs, another form of health misperception, can lead patients to hesitate to take vaccines and seek substitute treatments instead (Attwell et al., 2019).

Applying this to dewormer use as a CAM case, individuals who expect more negative outcomes from their health condition are likelier to feel negative emotions, which in turn leads them to try coping strategies to alleviate their uncertainty about their health condition. Individuals may accept the misperception of a dewormer as CAM because they want it to be effective for their health. Dewormers are one such result of this quest. In this process, individuals with high uncertainty about their health may adopt factual misbeliefs and conspiracy beliefs regarding dewormer use, subsequently leading them to use them accordingly. Overall, the following hypotheses are posed:

- H1.** Individuals' uncertainty about their health is positively associated with (a) factual misbeliefs and (b) conspiracy beliefs about dewormer use as CAM.

- H2.** Individuals' uncertainty about their health is negatively associated with individuals' intentions to take dewormers.

- H3.** (a) Factual misbeliefs and (b) conspiracy beliefs about off-label dewormers are positively associated with individuals' intentions to

take dewormers.

H4. (a) Factual misbeliefs and (b) conspiracy beliefs about dewormers positively mediate the association between individuals' uncertainty about their health and their intentions to take dewormers.

4) Pre-existing attitude toward CAM vs. standard treatment as a possible moderator of the role of uncertainty in health misperception

Even though misinformation regarding dewormer use as CAM bombards social media, not all social media users accept the misinformation and shape misperceptions. Previous studies on misinformation have widely sought the individual differences that make people more susceptible to misinformation acceptance (Pennycook & Rand, 2018; Yum & Jeong, 2018, 2019). Motivated reasoning or goal-directed reasoning tendencies have been studied extensively as the underlying mechanism of misinformation effects (Pennycook & Rand, 2018; van der Linden, 2022).

Motivated reasoning, which is based on belief defense motivation or identity protection motivation, has been widely tested and confirmed to be the underlying mechanism of misinformation and fake news acceptance (Albarracín et al., 2022; Pennycook & Rand, 2021). This occurs when individuals' directional motivation is activated: Individuals with activated directional motivation tend to process information in the direction that meets their preference (Kunda, 1990). Belief defense

motivation, such as political motivation, which consists of goals to protect one's self-concept (Albarracin et al., 2022) or identity (Kahan, 2013), is a typical example of such directed motivation (Albarracin et al., 2022; van der Linden, 2022; Kunda, 1990). Applying this to the health context, ill individuals' belief defense motivation can be activated when they are overwhelmed by their health condition, which causes them to seek and accept information that only supports their pre-existing beliefs. Research on belief bias (Evans, 2017) and myside thinking studies (Stanovich, 2021) have demonstrated that distal beliefs (i.e., beliefs according to one's worldview) tend to lead to directional reasoning to protect those distal beliefs.

Motivated reasoning as a psychological mechanism of health misperception acceptance has been tested mostly in a politically divided context. For example, Sylvester (2021) conducted a survey about COVID-19 knowledge with the American public and showed that political ideology was significantly related to the accuracy of COVID-19 knowledge. Compared to Republicans, Democrats get higher accuracy scores on COVID-19 knowledge questions. However, the effects of motivated reasoning have been mixed in the context of health misinformation, and empirical tests concerning the effects on non-politically divided health issues are scant (van der Linden, 2022).

Health misperception regarding dewormer use as CAM is not a politically divided issue in South Korea. However, the public view of dewormer use is closely linked to attitudinal beliefs about standard treatment vs. CAM. CAM has been defined as a diverse form of

healthcare practice that is not included in the standard healthcare system (World Health Organization, 2023). CAM has been categorized into five types: whole medical systems (e.g., Ayurveda and homeopathy), mind-body medicine (e.g., hypnosis and medication), biologically based therapies (e.g., natural products and supplements), manipulative and body-based practices (e.g., chiropractic and massage), and energy therapies (e.g., therapeutic touch and magnets; Millstine, 2022). Dewormer, itself, is clinically approved for deworming purposes, but the current usage of dewormers is unique because it is used as CAM for health management. Because of its popularity as CAM among cancer patients, Korean oncologists now consider dewormers a type of CAM for cancer patients (Min, 2022).

In the case of dewormer misperception, individuals' pre-existing attitudinal beliefs about the standard healthcare system and its alternatives, such as CAM, can moderate the directional uncertainty management process. Previous studies on CAM users have shown that CAM users tend to have disappointing experiences with their standard treatments. Laiyemo et al. (2015) revealed that American adults who perceived that their healthcare quality was poor were likelier to try CAM. In the context of asthma, Ogbu et al. (2023) demonstrated that asthma patients' conditions are not well controlled tend to use CAM more than their counterparts. Individuals with negative and positive attitudes toward conventional medical treatment and CAM, respectively, can accept dewormer misperceptions more easily because dewormer misinformation from social media is consistent with their pre-existing

beliefs. In contrast, individuals with positive attitudes toward standard treatment may show high hopes in conventional healthcare system, which does not activate the directional motivation to accept dewormer misperceptions. Thus, the following hypotheses and research questions are posed:

- H5.** Pre-existing attitudes toward CAM vs. standard treatment moderate the positive association between individuals' uncertainty about their health and (a) factual misbeliefs and (b) conspiracy beliefs about dewormer use as CAM.
- H6.** Pre-existing attitudes toward CAM vs. standard treatment moderate the positive association between individuals' health uncertainty and their intention to take dewormers.
- RQ1.** Will pre-existing attitudes toward CAM vs. standard treatments moderate the association between individuals' uncertainty about their health and dewormer-taking intentions, mediated by (a) factual misbeliefs and (b) conspiracy beliefs about off-label dewormer use?

5) Health literacy as another possible moderator of the role of uncertainty in health misperception

Health literacy is another potential moderator of the relationship between individuals' uncertainty about their health and health misperceptions. *Health literacy* is one's ability to seek, understand, and

use health information properly to make health-related decisions (Centers for Disease Control and Prevention, 2022). In other words, individuals with high health literacy can search for the suitable health information required for informed health decision making and properly, carefully process and assess the health information they discover.

Literacy is also frequently investigated as the underlying mechanism of fake news and misinformation detection in the political communication context. Pennycook and Rand (2021) argued that misinformation or fake news acceptance results from inattentive reasoning and a lack of knowledge that encourages individuals to verify misinformation. In their 2019 study, they empirically demonstrated that one's inability to scrutinize facts from false information can lead to fake news acceptance (Pennycook & Rand, 2019).

As many social media users, particularly patients, are not medically trained, healthcare providers and public health experts have pointed out that individuals can misinterpret and misapply study results (Tian & Robinson, 2022). The lack of medical knowledge and the ability to process it can make individuals more susceptible to accepting health misperceptions and experiencing the associated consequences. In public health research, one study showed an association between health literacy and health fake news detection in the COVID-19 context. Montagni et al. (2021) demonstrated that respondents with high health literacy can distinguish fake news more easily and have higher COVID-19 vaccination intentions than those with low health literacy.

Applying this to dewormer off-label use misperception acceptance,

individuals with low health literacy may not be able to distinguish accurate and inaccurate information on social media and may be incapable of engaging in a careful reasoning process to differentiate conspiracies from facts. Furthermore, if individuals are highly uncertain about their health, they are likely to use conveniently accessible information on social media to cope with their uncertainty, regardless of the truth. This can make them more susceptible to accepting misperceptions of dewormers as CAM and vulnerable to potentially detrimental effects on their health behaviors, such as initiating off-label dewormer use despite healthcare providers' disapproval. Therefore, the following hypotheses and research questions are posed:

H8. Individuals' health literacy levels moderate the positive association between individuals' uncertainty about their health and (a) factual misbeliefs and (b) conspiracy beliefs about off-label dewormer use.

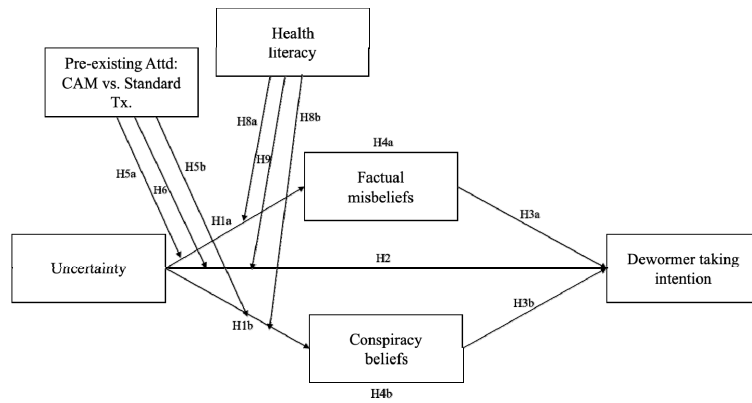
H9. Individuals' health literacy levels moderate the positive association between individuals' health uncertainty and dewormer-taking intentions.

RQ2. Will health literacy moderate the association between individuals'

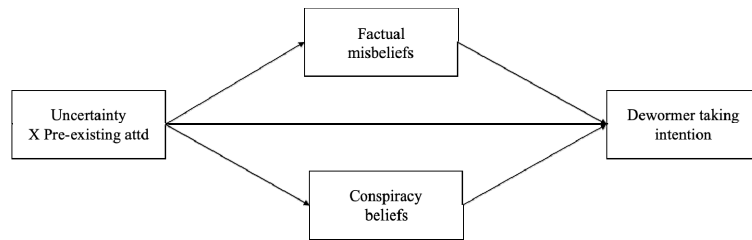
uncertainty about their health and dewormer-taking intention mediated by (a) factual misbeliefs and (b) conspiracy beliefs about the off-label use of dewormers?

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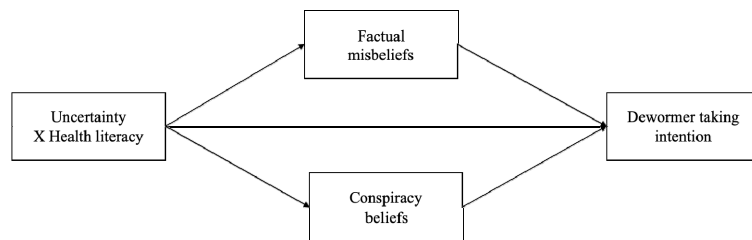
Figure 1 summarizes the hypothesized model.



<Figure 1> Hypothesis Model



<Figure 2> Research Question 1 Model



<Figure 3> Research Question 2 Model

3. Methods

1) Sample characteristics & data collection process

To test hypotheses and investigate research questions, an online survey was conducted with a sample of 307 Koreans. As the purpose of this study is clarify the role of individual differences that makes people more susceptible to health misperception of dewormer as CAM, this study recruited social media users who are 1) 18 years or older, 2) had viewed dewormer videos on YouTube in the last year. In addition, to investigate the role of uncertainty in more general health conditions, this study did not restrict to recruit respondents with specific diseases and use this questions as additional criteria: Respondents who reported a five or more in agreement with the statement “I have many questions regarding my health conditions without answers.” Respondents were recruited through Embrain, the Korean online panel service, which consisted of Koreans aged 18 years or older who agreed to participate. The email containing survey links was randomly sent to potential respondents in the panel, and those who provided consent and qualified through two screening questions participated in the survey. Data collection took place from August 20th to 25th, 2021. This study was approved by the Institutional Review Board of Dankook University (2021-06-040).

2) Measurements

(1) Uncertainty about one's health

To measure uncertainty regarding health conditions, parts of Mishel's measurement of uncertainty in illness were adopted (Mishel, 1981). Mishel's original version consisted of five subsections (uncertainty in symptoms, diagnosis, treatment, relationship with caregiver, and future planning) with 30 items. Among them, this study used eight items that measure the uncertainty in diagnosis and treatment and thus are relevant to this study. Among the eight items, one item from uncertainty in diagnosis (i.e., "I have many questions regarding my health conditions without answers.") was used as a screening question. The remaining seven items (e.g., "I do not know what is wrong with me," "My treatment is too complex to figure out.") were used as the final uncertainty items for the health variables. Each item was measured using a 7-point Likert scale (1 = totally disagree, 7 = totally agree), and the scores of the seven items were averaged to create the uncertainty about health variable ($M = 3.67$, $SD = 1.18$, Cronbach's $\alpha = .91$).

(2) Pre-existing attitude toward CAM vs. standard treatments

Considering the likelihood that individuals who have a more favorable attitude towards CAM compared to standard treatments is more receptive to the misperception that dewormers can aid in health management as a form of CAM, as well as conspiracy theories related to dewormers, we aimed to compare the effects of uncertainty by dividing the participants

into groups based on their pre-existing attitudes toward CAM versus standard treatment) in order to explore the differences between those who are favorable towards CAM and those who are favorable towards standard treatments. Therefore, pre-existing attitude toward CAM vs. standard treatments was operationalized as the discrepancy between one's attitudinal beliefs about non-standard treatments (e.g., CAM) and those about standard treatments, and categorized into two groups: CAM favors vs. standard treatment favors. To create the variable, respondents' attitudinal beliefs about CAM and standard treatments were analyzed. Attitude toward CAM and standard treatments were adopted from the Complementary, Alternative, and Conventional Medicine Attitude Scale (CACMAS; McFadden, Hernandez, & Ito, 2010). Agreement with 13 attitudinal belief statements about CAM (e.g., "I feel that complementary treatment is a more natural form of healing than orthodox medicine") and five statements about standard treatments (e.g., "I found it difficult to talk to my doctor" (reverse code)) were measured using a 7-point Likert scale (1 = totally disagree, 7 = totally agree). The scores of the 13 beliefs about CAM items were averaged ($M = 3.99$, $SD = .74$, Chronbach's $\alpha = .81$), as were those of the five statements regarding standard treatment ($M = 4.45$, $SD = 1.0$, Chronbach's $\alpha = .72$). Pre-existing attitude was calculated by subtracting the scores of attitudinal beliefs about standard treatment from those about CAM ($M = -.43$, $SD = 1.42$, range: -6 - 6). To compare the relationship between uncertainty and health misperception more clearly, pre-existing attitude toward CAM vs. standard treatments were divided into two groups.

CAM favor groups consists of respondents whose score is higher than or equal to 0, while standard treatment groups consist of respondents whose score is lower than 0.

(3) Health literacy

Health literacy was measured using the Korean Health Literacy Assessment Tool (KHLAT; Lee et al., 2011). Based on the idea of rapid estimate of adult literacy in medicine (REALM; Davis et al., 1993), the KHLAT consists of 66 health-related words. A 4-point Likert scale (1 = I know the word definitely so that I can explain its meaning to others, 4 = I do not know the word) was used for each word, and a score of 1 was regarded as the respondent actually knowing the meaning of the word. The number of 1 was calculated for health literacy score ($M = 37.15$, median = 43.0, $SD = 21.45$, range: 0 - 66). In order to provide a clearer comparison of the relationship between uncertainty and health misperception, respondents were categorized to high- and low health literacy groups based on median scores.

(4) Misperceptions about dewormer use

Misperceptions about dewormer use were operationalized as factual misbeliefs about dewormer use and conspiracy beliefs. Both types of health misperceptions were measured using a series of belief statements regarding dewormers and dewormer-taking behavior taken from Korean YouTube videos uploaded between September 4, 2019 and September 31, 2020. A total of 149 videos were collected using NodeXL, and the

common content regarding dewormers as CAM was summarized with seven statements. (e.g., “Dewormers are a cost-effective way to manage my health condition,” “Dewormers are not accepted as a standard treatment because pharmaceutical companies do not want them to be,” and “Dewormers are not accepted as a standard treatment because doctors do not want them to be.” Respondents indicated their level of agreement with each statement on a 7-point scale (1 = totally disagree, 7 = totally agree). Next, this study conducted exploratory factor

〈Table 1〉 Misperception Statements by Belief Types

Statements		Factor loading	
		1	2
Factual misbeliefs	Dewormers are a cost-effective way to manage my health condition.	.85	.24
	Dewormers are a safe and risk-free treatment option.	.83	.23
	Taking dewormers regularly will help improve my health condition.	.79	.17
	I will get better if I take dewormers.	.80	.27
Conspiracy beliefs	Dewormers are not accepted as a standard treatment because pharmaceutical companies do not want them to be.	.31	.81
	Dewormers are not accepted as a standard treatment because doctors do not want them to be.	.30	.84
	The standard treatment regimen provided by doctors is painful because it is bad for my health.	.12	.81

Note. $N = 307$. ⁺ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$. The results are from principal component analysis using varimax with Kaiser normalization. Factor scores above .50 are in bold.

analysis, resulting in two components. Based on the results of the factor analysis, the scores of the four statements were averaged to create the factual misbeliefs about dewormers variable ($M = 4.19$, $SD = 1.27$, Chronbach's $\alpha = .87$). The other three statements scores were averaged to create the conspiracy beliefs variable ($M = 3.31$, $SD = 1.30$, Chronbach's $\alpha = .81$). Table 1 summarizes the statements for each type of misperceptions.

(5) Intention to take dewormer

The dewormer-taking intention was measured by asking the level of agreement to the following statement: “ I am willing to take dewormer for my health management. A 7-point Likert scale (1 = not at all likely, 7 = very likely) was used to measure the items.

(6) Control variables

This study controlled for demographics such as age, sex, education, job status, and average social media usage time per week.

3) Data Analysis

To explore the relationships between the hypotheses and the research questions, two mediation analyses were conducted using Hayes' PROCESS macro model 10. Overall, three hierarchical regression analyses were performed to test the hypothesized relationships among uncertainty, dewormer health misperceptions and intention to take dewormer. In

addition, a series of bootstrapping tests with 5,000 samples were conducted to test the significance of the conditional indirect effects.

4. Results

1) Sample characteristics and descriptive statics of main variables

The average age of respondents was 44.23 years old ($SD = 13.45$), and 50.2% were male. Most respondents (68.7%) had earned a bachelor's degree or higher, and more than half were fully employed (53.1%) at the time of data collection. On average, respondents reported using social media (i.e., online news services, messaging apps, social networks, and video sharing services) for 67.92 minutes daily ($SD = 82.51$). A total of 122 respondents who showed more or similarly favorable attitudes toward CAM than standard treatments were identified as the CAM favor group, while 185 respondents showed a more favorable attitude toward standard treatments than CAM. The average KHLAT score was 37.15 out of 66 ($SD = 21.45$). <Table 2> summarizes detailed information on the independent, mediation, and dependent variables.

〈Table 2〉 Descriptive Statistics and Bivariate Correlations of Uncertainty, Dewormer Misperceptions, and Intention to Take Dewormers

	1	2	3	4
	Uncertainty	Factual misbeliefs	Conspiracy beliefs	Intention
2	.11*	—	—	—
3	.35***	.53***	—	—
4	.10	.70***	.33***	—
Range	1 to 7	1 to 7	1 to 7	1 to 7
<i>N</i>	307	307	307	307
<i>M</i>	3.67	4.19	3.31	4.57
<i>SD</i>	1.18	1.27	1.30	1.62

Note. *N* = 307. [†]*p* < .10, **p* < .05, ***p* < .01, ****p* < .001.

2) Association between uncertainty and dewormer misperceptions, moderated by pre-existing attitude toward CAM vs. standard treatment and health literacy

H1a and b predicted positive relationships between uncertainty and dewormer factual misbeliefs and conspiracy beliefs, and H5a and b and H8a and b predicted the moderating role of pre-existing attitude toward CAM vs. standard treatments and health literacy on the association hypothesized in H1a and b. To test H1a, H1b, H5a, H5b, H8a and H8b, two separate hierarchical regression analyses were performed to investigate the relationship between uncertainty and two types of dewormer misperceptions. One analysis focused on factual misbeliefs,

whereas the other analyzed conspiracy beliefs. In both models, uncertainty was entered as an independent variable, while the pre-existing attitude and health literacy were entered as moderators. Age, sex, education, and average social media usage were controlled.

Although the results of the analysis of the relationship between uncertainty and factual misbeliefs did not demonstrate the predicted direct effects of uncertainty, it provided supporting evidence for the role of pre-existing attitude. Uncertainty was not significantly associated with factual misbelief acceptance ($B = .06$, $SE = .12$, $p = .56$), contrary to H1a's prediction. As proposed in H5a, a statistically significant interaction effect of uncertainty and pre-existing attitude toward CAM vs. standard treatment on factual misbelief was found ($B = .34$, $SE = .14$, $p < .05$). However, the interaction effect of uncertainty and health literacy ($B = -.22$, $SE = .01$, $p = .09$) was not significant. Among the control variables, age was positively associated with factual beliefs ($B = .02$, $SE = .01$, $p < .001$), which suggests that older individuals tend to accept factual misbeliefs about dewormer use more easily. Overall, H1a and H8a were not supported, but H5a was supported. <Table 3> provides detailed information of the regression analysis results.

The second regression analysis tested the relationship between uncertainty and conspiracy beliefs about dewormers, focusing on how this relationship is moderated by pre-existing attitude toward CAM vs. standard treatment and health literacy. As predicted in H1b, there were significant positive relationship between uncertainty and conspiracy beliefs ($B = .24$, $SE = .11$, $p < .05$). However, no significant moderating

〈Table 3〉 Hierarchical Regression Analysis Results for the Moderated Mediation Effects of Uncertainty on Dewormer-Taking Intention Misperceptions of Dewormer Use

	Model 1		Model 2		Model 3	
	Factual misbeliefs		Conspiracy misbeliefs		Intention	
	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>	<i>b</i>	<i>SE</i>
Constant	3.06	.68	2.28	.64	1.76	.66
Uncertainty	.07	.12	.24*	.11	-.04	.11
Factual misbeliefs					.89***	.06
Conspiracy beliefs					-.04	.07
Pre-existing attitude toward CAM vs. standard treatment (1 = CAM favor)	-1.00	.58	.13	.55	.23	.55
Health literacy (1 = High)	.75	.49	.01	.46	.16	.46
Uncertainty X Pre-existing attitude	.34*	.14	.12	.13	-.04	.14
Uncertainty X Health literacy	-.22	.13	-.10	.12	-.09	.12
Age	.02***	.01	.01	.01	.01	.01
Sex (1 = Men)	.05	.14	.22	.14	-.20	.14
Education	-.05	.08	-.06	.08	-.20*	.09
Social media usage	.00	.00	-.00	.00	.00	.00
R^2	.10		.22		.52	

Note. $N = 307$. * $p < .05$, ** $p < .01$, *** $p < .001$.

effects of the pre-existing attitudes ($B = .12$, $SE = .13$, $p = .38$) or health literacy ($B = -.10$, $SE = .12$, $p = .39$) on the relationship between uncertainty and evaluative misbelief were found. The results suggest that individuals who are uncertain about their health condition tend to rely more on conspiracy beliefs about dewormers, which consists

of conspiracy theory about the healthcare system. Therefore, H1b was supported, while H5b and H8b were not.

3) Association between dewormer misperception and intention to take dewormer

H2 predicted the positive association between uncertainty and individuals' intention to take dewormer as CAM, and H3a and b hypothesized the positive association between dewormer misperception and dewormer taking intention. H4a and b, H6a and b, RQ1, H9, and RQ2 predicted the mediation effects of uncertainty on dewormer taking intention through factual misbeliefs and conspiracy beliefs, moderated by pre-existing attitude toward CAM vs. standard treatments and health literacy. A regression analysis was carried out to investigate the hypothesized moderated mediation effects. In this model, dewormer-taking intention was considered as the dependent variable, uncertainty as an independent variable, factual misbeliefs as a mediator, and motivated reasoning and health literacy as moderators. The model also controlled for age, sex, education, and average social media usage, as in the previous regression model.

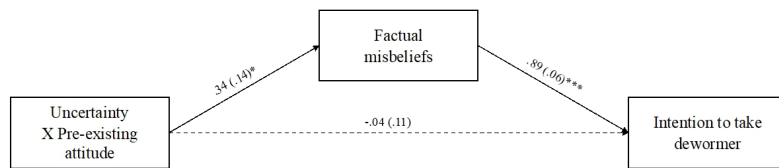
The predicted positive relationship between uncertainty and dewormer taking intention was not significant ($B = -.04$, $SE = .11$, $p = .74$). Among health misperceptions, factual misbeliefs showed significant association with individuals' intention to take dewormers. As predicted in H3a, factual misbeliefs had a significantly positive relationship with

dewormer-taking intention ($B = .89$, $SE = .06$, $p < .001$), suggesting that respondents who hold factual misbeliefs about dewormers are more likely to use them for their health management. However, conspiracy beliefs were not significantly associated with dewormer-taking intention ($B = -.04$, $SE = .07$, $p = .51$). The results demonstrated no interaction effects (uncertainty \times pre-existing attitude toward CAM vs. standard treatment: $B = -.04$, $SE = .14$, $p = .78$, and uncertainty \times health literacy: $B = -.09$, $SE = .12$, $p = .47$). Among the control variables, education showed a significant negative relationship with the intention to use dewormers ($B = -.15$, $SE = .07$, $p < .05$), indicating that respondents with lower educational attainment had a higher intention to use dewormers for their health management.

Overall, H3a was supported, whereas H2, H3b, H6 and H9 were not. In addition, as positive interaction effects of uncertainty and pre-existing attitudes were found on factual misbeliefs, which is positively associated with dewormer-taking intention, the predicted mediation effects of health misperceptions on the direct relationship between uncertainty and dewormer taking behaviors in H4a and b were also not supported. As direct relationship between conspiracy beliefs and dewormer-taking intention were not found, suggested moderating role of health literacy on the mediation effects of misperceptions in RQ2 was also not found. Table 3 presents detailed information regarding the regression analysis.

To test the moderated mediation effects of uncertainty assumed in RQ1, the significance of the conditional indirect effects of uncertainty on dewormer-taking intention through factual misbeliefs was examined using

a bootstrapping test with 5,000 samples. The results revealed a significant indirect effect of uncertainty on dewormer-taking intention moderated by pre-existing attitude toward CAM vs. standard treatment (moderated mediation index = .31, BootSE = .12, CI = .04 - .57). This suggests that the interaction effect of uncertainty and pre-existing attitude toward CAM vs. standard treatments on the intention to use dewormers is significantly mediated by factual misbeliefs about them. Figure 2 summarizes the moderated mediation effects of uncertainty on the intention to use a dewormer via factual misbeliefs.



〈Figure 4〉 Mediation Effects of the Interaction of Uncertainty and Motivated Reasoning on Dewormer-taking Intention via Factual Misbelief Acceptance

5. Discussion

1) Summary of Results

The purpose of this study is to investigate the role of individual differences that make individuals more susceptible to health misperceptions. In the context of the Korean dewormer boom, this study

examined the role of uncertainty in two types of health misperceptions, factual misbeliefs and conspiracy beliefs, and how the misperceptions affect the subsequent health-related behavior. The moderating role of individuals' pre-existing attitude toward CAM versus standard treatments and health literacy in the aforementioned relationship was also explored.

The results from an online survey demonstrated that the role of uncertainty is differed by the types of health misperception. Uncertainty was directly associated with conspiracy beliefs about dewormers but not factual misbeliefs about dewormer off-label use. This finding suggests that individuals who are uncertain about their health condition and treatment are more susceptible to conspiracy beliefs, a propensity that stems from their low trust in the conventional healthcare system. The possible low trust in conventional healthcare could also be found in the interaction effects of uncertainty and pre-existing attitude toward CAM vs. standard treatments, which significantly moderated the association between patient uncertainty and factual misbeliefs about dewormer use. Specifically, the results indicate that individuals who are more favorable to CAM than to standard treatment provided by the conventional healthcare system become more susceptible to factual misbeliefs about dewormers as their uncertainty level increases. This finding suggests the possibility that individuals with low hopes for standard treatment from the conventional healthcare system and high hopes for its alternatives try to manage relevant information in a way they want to believe. The results provide the empirical evidence for the arguments from previous research on uncertainty and directed cognition (e.g., Brashers, 2001;

Heyman et al., 1998), which pointed out that information management for uncertainty reduction can be goal-directed to support one's pre-existing beliefs or attitude.

A series of moderated mediation analysis results supported the mediating role of factual beliefs in the association between individuals' uncertainty and dewormer-taking intention, moderated by their pre-existing attitude toward CAM vs. standard treatments. Among the two types of dewormer use misperceptions, factual misbeliefs were directly associated with the intention to use dewormers, suggesting that inaccurate information about dewormer use can drive drug misuse more than conspiracy beliefs. The results also provide supporting evidence for the mediating role of factual misbeliefs in the association between the interaction of uncertainty and pre-existing attitude toward CAM vs. standard treatments and dewormer-taking intention. This outcome implies that individuals who are uncertain about their health and have a more favorable attitude toward CAM than standard treatments do tend to accept inaccurate misbeliefs about dewormers, which in turn, lead the drug misuse.

One interesting finding in this study concerns the role of health literacy in the relationship between uncertainty and health misperceptions. Literacy has long been considered an influencing factor of misinformation effects in the context of political communication (Pennycook & Rand, 2021), and some supporting evidence was found in the context of COVID-19 (e.g., Montagni et al., 2021). However, the findings from the present study showed no significant direct or indirect effects of health

literacy on both types of health misperceptions and intention to take dewormers.

The possible reason of the inconsistency is the fact that dewormer-use misperception is not a politically divided issue. Previous studies tested health literacy in the context of politically divided issues, such as COVID-19 vaccination in the US. (Montagni et al., 2021). Pennycook and Rand (2021) contended that a low literacy level can lead individuals to pay less careful attention to misinformation and use heuristics to judge truth from the misinformation, an argument which some studies showed supporting evidence for (e.g., Pennycook & Rand, 2019; Yum & Jeong, 2018). However, no significant role of health literacy was found in this study, suggesting that literacy, in particular information-processing tendency and skill, plays an important role in a politically divided issue but not in a non-political issue.

2) Theoretical Implications

While many healthcare providers and public health officials have cautioned against the detrimental effects of health misinformation on individuals' health-related perceptions and behaviors, public health officials (Swire-Thompson & Lazer, 2020; Tian & Robinson, 2022) still require empirical evidence supporting these claims. In line with previous empirical studies that tested and demonstrated the negative impacts of health misperceptions (Albarracin et al., 2022; Getman et al., 2018; Lee et al., 2022; Lyons et al., 2019; Smith et al., 2008; van Proijen et al.,

2021; Yoo et al., 2023), the present study also provides supporting evidence for the detrimental effects of health misinformation on the health misperceptions and health behavior in the context of YouTube contents of dewormer use.

This study also contributes theoretically to clarifying the psychological mechanism of acceptance of health misperceptions. Previous research on misinformation and fake news primarily focused on identifying the psychological mechanisms that contribute to the public acceptance of such misinformation (Pennycook & Rand, 2021; van der Linden, 2022). In particular, factors such as motivated reasoning and insufficient reasoning abilities, including low literacy levels, have been extensively studied in the context of political misinformation acceptance and its effects on public perceptions and behaviors (Pennycook & Rand, 2021; van der Linden, 2022). These studies in the political context tend to focus on empirical testing, which accounts for more of the misinformation effects. However, individuals' acceptance of health misinformation can be understood differently, as uncertainty about one's health can be a key variable that drives health and medical misperceptions (Albarracin et al., 2022). The findings from this study suggest that individuals' health misperceptions are an outcome of their sense-making process to manage their uncertainty about health. In addition, the moderating role of pre-existing attitude toward CAM vs. standard treatment found in this study suggests that the goal-directed cognitive process driven by one's pre-existing attitude may play an important role in the acceptance of health misperceptions, which

subsequently drive individuals to try potentially harmful behaviors, such as misuse of dewormers.

The study results also contribute to the understanding of the effects of health misperceptions on individuals' health behavior by specifying the types of health misbeliefs. Previous studies on health misinformation tended to not distinguish types of health misperceptions, which may explain their mixed results (Gratale et al., 2019; Tan et al., 2015). The present study tested the mediating role of factual misbeliefs and conspiracy beliefs separately and found that their roles in the uncertainty management process differ. Specifically, we found that factual beliefs were key mediators of the interaction effect of uncertainty and moderators on dewormer-taking intention, suggesting that they can drive patients' drug misuse. On the other hand, conspiracy beliefs are the result of individuals' uncertainty about their health, indicating that the beliefs are a cognitive outcome of the patients' sense-making processes regarding their uncertain health conditions.

3) Practical Implications

The results of this study provide valuable practical insights in the design of public health campaign messages to prevent drug misuse or overuse and the acceptance of health misinformation. Some scholars suggested providing accurate factual information to debunk parental health information as an effective and crucial intervention to prevent an infodemic (Nan et al., 2022; Swire-Thompson & Lazer, 2020). However,

the result from this study suggests that addressing the uncertainty and pre-existing attitude of individuals toward the health system is a more important step. This study's findings suggest that patients who have more faith in CAM than in standard treatments from conventional healthcare tend to be more vulnerable to the detrimental effects of health misinformation. The discrepancy between patients' attitudes toward CAM and standard treatments reflects their trust in the conventional healthcare system in general. Therefore, drug misuse prevention and health misinformation prevention campaign messages must be considered to achieve patient education and campaign message development.

4) Limitations and future research suggestion

Despite its theoretical and practical contributions, this study has several limitations. First, as the survey design was cross-sectional, the associations in the results need to be interpreted as correlations, not causation. Experimental studies must be conducted to empirically test this potential causal relationship. Second, the associations found in this study were tested on YouTube videos of dewormer use in South Korea. For the purpose of generalization, the associations need to be further tested under a variety of health conditions and social media channels. Third, because of the sample characteristics in this study, the results may not be directly applicable to patients with specific diseases. As the purpose of this study is to investigate the relationship between uncertainty and health misperception in general, the sample consisted of individuals with

a wide variety of health conditions. However, it is possible that the cognitive processing of misperception and trial of CAM can be differed by specific diseases and symptoms that patients have. For example, Fjaer et al. (2020) showed that residents in European countries tend to try CAM more when they have a long-standing health condition. To address this limitation, future research should empirically test the role of uncertainty and pre-existing attitude toward the healthcare system in specific health conditions. Finally, the health literacy measurement used in this study is largely focusing on medical knowledge. However, as health literacy consists of analytical thinking and systematic processing ability as well, the results from this study should be interpreted cautiously. Future research needs to address the whole aspects of health literacy to investigate its role on health misperception.

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소셜미디어 상 잘못된 구충제 복용정보 인식에 관한 연구:
불확실성, 보완대체요법과 표준치료에 대한
기존 태도 및 건강 리터러시의 역할을 중심으로

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본 연구는 소셜미디어 이용자들이 잘못된 건강정보에 노출되어 이를 통해 잘못된 인식을 형성하는 과정에서 불확실성, 보완대체요법과 표준치료에 대해서 가지고 있던 기존 태도건강 리터러시의 역할을 살펴보고자 하였다. 소셜미디어 상 구충제 정보 이용자 307명을 대상으로 한 설문조사 결과, 응답자의 건강에 대한 불확실성과 구충제 사용에 대한 부정확한 사실 정보 인식 사이의 관계를 보완대체요법과 표준치료에 대한 기존 태도가 조절하는 것으로 나타났다. 이는 자신의 건강에 불확실성이 높은 환자들이 잘못된 건강 정보를 더 잘 받아들이는 경향이 있음을 보여준다. 이러한 잘못된 건강 인식은 실제로 구충제의 오프라벨 복용 의도를 높이는 것으로 나타났다.

주제어 : 잘못된 건강정보, 건강 오인식, 불확실성 관리, 기존 태도, 건강 리터러시