

Effects of Ginger on Disgust, Sexual Arousal, and Sexual Engagement

Citation for published version (APA):

Wen, G. J., Zhang, Y., Nyman, T. J., Jern, P., & Santtila, P. (2024). Effects of Ginger on Disgust, Sexual Arousal, and Sexual Engagement: A Placebo-Controlled Experiment. *Journal of Sex Research*, 61(4), 658-670. <https://doi.org/10.1080/00224499.2023.2175191>

Document status and date:

Published: 01/01/2024

DOI:

[10.1080/00224499.2023.2175191](https://doi.org/10.1080/00224499.2023.2175191)

Document Version:

Publisher's PDF, also known as Version of record

Document license:

Taverne

Please check the document version of this publication:

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

[Link to publication](#)

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license above, please follow below link for the End User Agreement:

www.umlib.nl/taverne-license

Take down policy

If you believe that this document breaches copyright please contact us at:

repository@maastrichtuniversity.nl

providing details and we will investigate your claim.




Effects of Ginger on Disgust, Sexual Arousal, and Sexual Engagement: A Placebo-Controlled Experiment

Guangju Wen, Yikang Zhang, Thomas J. Nyman, Patrick Jern & Pekka Santtila


To cite this article: Guangju Wen, Yikang Zhang, Thomas J. Nyman, Patrick Jern & Pekka Santtila (21 Feb 2023): Effects of Ginger on Disgust, Sexual Arousal, and Sexual Engagement: A Placebo-Controlled Experiment, The Journal of Sex Research, DOI: [10.1080/00224499.2023.2175191](https://doi.org/10.1080/00224499.2023.2175191)


To link to this article: <https://doi.org/10.1080/00224499.2023.2175191>

 View supplementary material 

 Published online: 21 Feb 2023.

 Submit your article to this journal 

 Article views: 345






 View related articles 

 View Crossmark data 

 Citing articles: 1 View citing articles 



Effects of Ginger on Disgust, Sexual Arousal, and Sexual Engagement: A Placebo-Controlled Experiment

Guangju Wen ^{a,b}, Yikang Zhang ^{c,d}, Thomas J. Nyman ^b, Patrick Jern ^e, and Pekka Santtila ^{a,b}

^aSchool of Psychology and Cognitive Science, East China Normal University; ^bFaculty of Arts and Sciences, NYU Shanghai; ^cFaculty of Psychology and Neuroscience, Maastricht University; ^dNYU-ECNU Institute for Social Development, NYU Shanghai; ^eDepartment of Psychology, Åbo Akademi University

ABSTRACT

Sexual problems are common complaints across countries and cultures, and behavioral immune system theory suggests disgust plays an essential role in sexual functioning. The current study investigated 1) if disgust induced by sexual body fluids would reduce sexual arousal, reduce the likelihood of sexual engagement, and enhance disgust toward subsequent erotic stimuli, and 2) if the administration of ginger would affect these reactions. We administered either ginger or placebo pills to a sample of 247 participants ($M_{age} = 21.59$, $SD = 2.52$; 122 women) and asked them to complete either behavioral approach tasks with sexual body fluids or with neutral fluids. Next, participants viewed and responded to questions concerning erotic stimuli (nude and seminude pictures of opposite-sex models). As expected, the sexual body fluids tasks induced disgust. The elevated disgust induced by sexual body fluids tasks resulted in lower sexual arousal in women, whereas ginger consumption counteracted this inhibiting effect of disgust on sexual arousal. Disgust elicited by sexual body fluids also increased disgust toward the subsequent erotic stimuli. Ginger increased sexual arousal toward the erotic stimuli in both men and women who had completed the neutral fluids tasks. Findings provide further evidence of the role of disgust in sexual problems, and, importantly, that ginger may improve the sexual function of individuals via its sexual arousal-enhancing effect.

Introduction

Sexuality is an essential part of human beings and sexual problems are associated with a series of negative outcomes, including depression, anxiety, personal distress, as well as low well-being, and have negative effects on sexual and relationship satisfaction in couples (Hendrickx et al., 2014; Laurent & Simons, 2009; McCabe & Connaughton, 2017; Sanchez-Zarza et al., 2020). Lack of sexual desire is a common sexual difficulty and the risk of low sexual desire increases as people age (Araujo et al., 2004; Bacon et al., 2003; Khani et al., 2021). In fact, 30–50% of women (for a recent review, see, Khani et al., 2021) and 20–30% of men (Brotto et al., 2012; Laumann et al., 2005; Mercer et al., 2003) report low sexual desire. However, when the specific severity and duration diagnostic criteria from the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association, 2013) are applied, the prevalence rates markedly reduce (4.2%; Laumann et al., 2005; Mitchell et al., 2016). Given the prevalence and the widespread negative impact of low sexual desire on individuals' physical and psychological health, it is important to investigate the underlying factors and find effective ways of restoring sexual function.

Disgust and Sexual Function

Disgust likely evolves as a behavioral immune system reaction to avoid contagion risk (Crosby et al., 2019; Hlay et al., 2021;

Koleva et al., 2012; Oaten et al., 2009). However, maladapted disgust reactions are a potential cause of sexual problems through decreasing individuals' sexual desire, sexual arousal, and increasing sexual avoidance (Al-Shawaf et al., 2019; Crosby et al., 2019; Fleischman et al., 2015). In fact, research has found an association between disgust and sexual problems, especially in women (de Jong et al., 2013). For example, women with vaginismus reported higher disgust propensity and increased disgust reactions to sexual stimuli (e.g., automatic associations with disgust and enhanced subjective disgust; Borg et al., 2010, 2011; de Jong et al., 2009).

Experimental investigations in non-clinical populations have also found that disgust inhibited sexual arousal and increased avoidance of sexual stimuli. For example, research has shown that disgust reduced the subjective feelings of sexual arousal toward sexual stimuli (Fleischman et al., 2015), reduced objectively measured genital sexual arousal (Andrews et al., 2015), and increased intentions to use condoms (Tybur et al., 2011). Besides experimental manipulation of disgust, trait disgust sensitivity, which has been divided into moral disgust, sexual disgust, and pathogen disgust (Tybur et al., 2011), has also been found to be related to individuals' sexual function. For example, studies have found that moral disgust and sexual disgust suppressed potentially risky sexual behaviors such as not using condoms or having a large number of sexual partners (Zhang et al., 2017), whereas core disgust sensitivity,

dispositional concerns about disease (Duncan et al., 2009; Olatunji et al., 2008), was associated with risky sexual decision-making such as the willingness to have sex with sex workers (Oaten et al., 2019).

The behavioral immune system theory suggests that sexual stimuli can induce both sexual arousal and disgust, given that sexual intercourse includes exchanges of body fluids such as saliva and semen that increase the likelihood of transmitting infection (Ackerman et al., 2018; Crosby et al., 2019; de Jong et al., 2013; Stevenson et al., 2011). The risk is particularly salient during sexual interactions, as the bodily apertures involved in sexual interactions (such as the mouth or the vagina) present high contamination risk (Rozin et al., 1995). According to de Jong et al. (2013), a healthy sexual function loop occurs when sexual arousal outweighs disgust from sexual stimuli and facilitates sexual approach behavior. In contrast, if individuals experience higher disgust than sexual arousal, a sexually dysfunctional loop (disgust inhibiting sexual arousal and increasing sexual avoidance behavior) can result.

However, although limited research has explored the association between disgust and sexual arousal (Borg & de Jong, 2012; Borg et al., 2019; Stevenson et al., 2011), the stimuli used to induce sexual disgust (pictures of scars on naked women, disgusting odor containing elements similar to skunk odor, rotten garlic, and smelly feet, or a behavioral approach task to lubricate a vibrator with one's own hands) do not adequately match the contamination risk related to stimuli during actual sexual encounters. Therefore, the first aim of this experiment was to test this hypothesis by examining whether body fluids that specifically relate to sexual activity induce feelings of disgust, which could in turn inhibit the sexual arousal toward and willingness to sexually engage with subsequently presented erotic stimuli.

Potential Effect of Ginger on Sexual Function

As suggested by de Jong et al. (2013), a sexual dysfunction loop occurs when disgust overwhelms sexual arousal. Hence, the down-regulation of disgust might be a potentially effective pathway to prevent sexual problems from occurring. Several studies have found that ginger can be used to reduce nausea (Marx et al., 2013, 2017; Toth et al., 2018). Ginger can reduce both the incidence and severity of nausea and vomiting during chemotherapy (Li et al., 2018; Thamlikitkul et al., 2017), in surgical patients (Montazeri et al., 2013; Toth et al., 2018), in pregnant women (Lete & Allue, 2016) as well as in patients undergoing antiretroviral therapy (Dabaghzadeh et al., 2014), but other evidence shows that the antiemetic effects of ginger are not statistically significant compared to placebo (Li et al., 2018; Toth et al., 2018). Additionally, research has also found that ginger can reduce psychological disgust as well as subsequent moral condemnation (severity of participants' judgments of moderately severe purity violations, e.g., "A man who is not in a romantic relationship orders an inflatable sex doll that looks like his secretary"; Tracy et al., 2019). Due to the suppressing effect of disgust on sexual arousal, we hypothesized that ginger might reduce disgust toward sexual body fluids and toward the erotic stimuli directly, thereby counteracting the inhibitory effects of disgust on sexual arousal toward

and willingness to sexually engage with subsequently presented erotic stimuli.

Previous research on the effects of ginger on sexual function in humans is limited. Only two studies have been conducted previously, one involving men with erectile dysfunction and one involving women with decreased sexual desire. Specifically, the first experimental study found that ginger consumption improved erectile function and sexual satisfaction in older men with mild erectile dysfunction after 30-day treatment with ginger (Stein et al., 2018). However, the lack of a placebo control group in this study limits the conclusions that can be drawn. Shabanian et al. (2018) conducted a placebo-controlled study to compare the effects of ginger, cinnamon, rose drops, and placebo on the sexual function of depressed women with decreased sexual desire. Results showed that compared with baseline, participants reported significant improvements in desire, arousal, lubrication, orgasm, and satisfaction (five subscales of the Female Sexual Function Index; Rosen et al., 2000) after treatment with ginger for two months. Regarding the differences between ginger and placebo groups, the improvements in desire and arousal (differences between baseline and scores after two months of intervention) in the ginger group were higher than the placebo group. However, women in the placebo group also had significant improvements in arousal and showed non-significant improvements in lubrication ($p = .069$) and satisfaction ($p = .054$) compared to baseline. This appears to provide evidence of efficacy for secondary sexual problems given that depressed people are two to three times more likely to develop sexual dysfunction than those without depression (Bonierbale et al., 2003; Shabanian et al., 2018). Given that there are significant sex differences in disgust and sexual arousal reactions (Crosby et al., 2021), as well as differences in sexual desire level and sexual arousal patterns between men and women (Basson, 2002; Santtila et al., 2008), placebo-controlled experiments recruiting both men and women without health problems or healthy people with sexual complaints are needed to further explore the effect of ginger on sexual function and compare the treatment effect of ginger in men and women.

Moderation of the Effects of Sexual Body Fluids by Sex and Ginger

We also expected that sex and ginger could moderate the effects of sexual body fluids on the feelings toward subsequent erotic stimuli. According to the sexual function loop model suggested by de Jong et al. (2013), disgust propensity and sexual excitability moderate the strength of sexual arousal and disgust toward sexual stimuli. Due to differences in minimum obligatory costs of parental investment between men and women (Bjorklund & Kipp, 1996; Trivers, 1972) as well as women's higher likelihood of being infected by a sexually transmitted infection (Coombs et al., 2003; Panchanadeswaran et al., 2006), and of being sexually assaulted (Schou-Bredal et al., 2022), women are expected to display higher disgust sensitivity, higher sexual inhibition, and lower sexual excitation (Crosby et al., 2021). Previous studies have found that men scored higher on measures of sexual excitation and lower on measures of sexual inhibition compared to women, while women reported higher

disgust sensitivity and disgust propensity compared to men (Crosby et al., 2021). Therefore, we expected that women would experience more disgust from sexual body fluids than men, and that the inhibiting effect of sexual body fluids on sexual arousal toward and willingness to sexually engage with subsequent erotic stimuli would be stronger in women than in men. Given that ginger was expected to reduce feelings of disgust toward sexual body fluids, we hypothesized that ginger would reduce feelings of disgust induced by sexual body fluids, thereby attenuating the inhibiting effects of sexual body fluids on sexual arousal toward and willingness to sexually engage with subsequently presented erotic stimuli.

The Current Study

Our main hypotheses were as follows:

H1: Exposing participants to sexual body fluids will result in feelings of disgust. This disgust-eliciting effect of sexual body fluids will be stronger in women than in men.

H1b: Ginger will attenuate this disgust-eliciting effect of sexual body fluids, with the effect being weaker in those who consumed ginger than those who consumed placebo.

H2: Exposing participants to sexual body fluids will also result in feelings of sexual arousal. This sexual arousal-eliciting effect of sexual body fluids will be stronger in men than in women.

H2b: Ginger will enhance this sexual arousal-eliciting effect of sexual body fluids, with the effect being stronger in those who consumed ginger than those who consumed placebo.

H3: Sexual arousal elicited by erotic stimuli and willingness to sexually engage with the persons in erotic stimuli will be reduced if preceded by exposure to sexual body fluids. This inhibiting effect of sexual body fluids will be stronger in women than in men.

H3b: Ginger will attenuate this inhibiting effect of sexual body fluids, with the effect being weaker in those who consumed ginger than those who consumed placebo.

H4: The level of disgust elicited by erotic stimuli will be increased if preceded by exposure to sexual body fluids. This disgust-eliciting effect of sexual body fluids will be stronger in women than in men.

H5: Finally, ginger will also directly increase sexual arousal, increase the likelihood of sexual engagement, and directly decrease disgust elicited by erotic stimuli.

Method

Participants

The final sample included 247 Chinese participants (125 men) with a mean age of 21.59 ± 2.52 recruited at East China Normal

University and through social media (e.g., QQ, WeChat). Other background information is presented in Table 1.

The inclusion criteria were: 1) older than 18; 2) Chinese (nationality); 3) heterosexual; 4) not a psychology student/researcher; 5) not pregnant or currently breastfeeding; 6) have eaten ginger before and have no allergy against ginger; 7) no rhinitis, nasosinusitis or other illness that has those symptoms, such as fever, cough, and others; 8) without severe physical or mental illness (e.g., hepatic and renal dysfunction, anemia or diabetes). Four participants who participated in the lab experiment did not answer the online questionnaire the next day. Data from twelve participants who reported being heterosexual in the screening test but reported their orientation as non-heterosexual in the online questionnaire were removed.

Materials and Measures

Study Edibles

Ginger. Ginger powder in gelatin-coated capsules with a total dose of 1500 mg ginger was administered to the participants in the experimental group to attain the anti-emetic effect (Tracy et al., 2019).

Calcium. An equivalent dose of 1500 mg calcium in capsules was administered to the participants in the placebo group.

Erotic Stimuli Material

The erotic stimuli consisted of eight 1-minute erotic videos (four videos presenting static pictures of nude and seminude Asian male models for female participants and four videos presenting static pictures of nude and seminude Asian female models for male participants). Each video included 15 pictures (seven or eight were pictures of nude models) and each picture was presented for 4 seconds.

The pictures used were derived from a Chinese erotic picture database and have been shown to successfully induce feelings of sexual arousal in Chinese populations (Cui et al., 2021). We selected 120 sexually arousing pictures randomly from this database (60 nude models and 60 seminude models). The usage of the pictures was approved by the owner.

Behavioral Approach Tasks

A behavioral approach task paradigm was used to induce sexuality-related disgust. To induce these feelings, we created four behavioral tasks that the participants in the sexual body fluids group were asked to carry out. The tasks ostensibly involved body fluids related to sexual activities, including sweat (sweat from the head and neck), saliva, body odor (sweat from an armpit), semen (only for female participants), and vaginal secretions (only for male participants). Participants were asked to smell and touch the body fluids of the opposite sex while wearing plastic gloves.

The four ostensibly disgusting body fluids were all fake. Specifically, sweat and body odor used the same fluids but with different labels. They were made of a mixture of water and an odorless, watery, and yellowish skin care product. We placed a few drops of this mixture on the surface of a cotton ball. Water was used for fake saliva. We used a plastic spray bottle to spray the water into the dish so that this fake saliva

Table 1. Demographic variables of the sample ($N = 247$).

		Women				Men			
		Neutral fluids		Sexual body fluids		Neutral fluids		Sexual body fluids	
		Ginger	Placebo	Ginger	Placebo	Ginger	Placebo	Ginger	Placebo
Age		20.87(1.80)	22.07(2.27)	21.28(1.73)	20.68(2.02)	21.76(3.23)	21.63(3.04)	21.94(2.56)	22.48(2.90)
Lifetime number of sexual partners		0.55(0.81)	0.78(2.01)	1.56(3.44)	0.48(0.85)	0.86(0.92)	1.15(1.56)	1.00(1.25)	1.64(2.63)
Sex	Women	31	28	32	31	-	-	-	-
	Men	-	-	-	-	29	30	33	33
Education	≤ Senior high school	0	0	1	2	0	0	0	0
	> Senior high school	31	27	31	29	29	27	33	33
Occupation	Student	30	24	32	30	25	27	33	31
	Employed worker	1	3	0	1	3	0	0	2
	Other	0	0	0	0	1	0	0	0
Relationship length	Single	22	16	26	18	16	13	16	20
	Less than 1 month	1	0	0	1	2	1	1	0
	1–3 months	1	1	2	0	3	1	4	2
	4–6 months	0	0	0	1	2	3	6	2
	7–12 months	1	4	2	1	1	2	4	4
	1–2 years	3	5	1	6	4	3	2	2
	3–5 years	3	0	1	4	1	2	0	2
	6–10 years	0	1	0	0	0	2	0	1
Income (¥)	No	18	9	15	13	18	16	16	16
	Less than 5k	12	14	16	16	6	9	14	15
	5k-8k	1	3	1	1	3	2	2	1
	9k-15k	0	1	0	1	2	0	1	1
Health condition	Excellent	8	6	6	8	8	9	10	12
	Very good	11	9	16	13	14	10	9	12
	Good	8	6	7	5	6	7	11	6
	Fair	4	6	3	4	1	1	3	3
	Poor	0	0	0	1	0	0	0	0

would include small bubbles, thus making it appear more realistic. Semen-like lubricant (white) gel, used frequently in adult videos, was used to achieve the effect of fake semen, while colorless and transparent lubricant was used for vaginal secretions. All these stimuli were put in a dish with a label, indicating the type of fluid. In contrast, four neutral fluids (sweet water, saline water, soda water, and water) were used for participants in the control group. These four neutral fluids were real.

Each task included three steps with the participant being asked to 1) Observe the fluid in the dish; 2) Lift the dish and smell the fluid; and 3) Touch the fluid using their finger (while wearing a plastic glove). After finishing each task, the PANAS-R was used to assess participants' feelings (see Measures).

Introductory Videos for Fluids in Behavioral Approach Tasks

For each fluid in the tasks, we recruited two research assistants (a man and a woman) to record two 30-second introductory videos to present fake information concerning how we acquired the fluids (<https://osf.io/89m2k/>). The content of each of the two videos was the same, the only difference being the gender of the research assistant in the videos. We presented the female version of the videos (recorded by a female research assistant) to the male participants, while we showed the male version of the videos (recorded by a male research assistant) to the female participants.

For the introductory videos of sweat, we recorded the process where the assistants wiped the sweat on their forehead, face, and neck using a cotton ball and put the ball into a dish. For the introductory videos of body odors, the assistants put the cotton ball under their armpit and took it out after 15 seconds (we informed the participants in writing that the cotton ball had been placed under the armpit for 5 minutes) and then

placed it in a dish. Semen and vaginal secretions (lubricant) were put in a medical sterile sampling cup. In the introductory video for the semen sample, the video displayed a research assistant who pipetted and dropped a sample of "semen" from a sterile sampling cup into a dish. In the video for vaginal secretions sample, the video displayed a research assistant who took the secretions out of the medical sterile sampling cup using a cotton swab.

As for the water and soda water, we recorded the assistants pouring some water or soda water into a beaker and then dropping small amounts of water/soda water into the dish via a dropper. Regarding the saline water and sweet water, the videos included the assistants pouring salt or sugar as well as water into the beaker, and dropping some mixtures into the dish after stirring well via a glass rod.

Neutral Stimuli

Three BBC movies were selected (Snow Bears; Wonders of the Moon; Earth from Space) and participants would watch these films randomly when they were waiting for the administered treatment to take effect. *Snow Bears* presents a migration journey of polar bear cubs and their mother; *Wonders of the Moon* shows detailed images of the moon and gives descriptions on how it shapes life on Earth. *Earth from Space* tells stories of life on Earth from a new perspective using cameras in space.

Measures

Background information questions included sex, age, relationship status, sexual orientation, education, occupation, relationship length, monthly income, general physical health, and the lifetime number of sexual partners (see Table 1 for response options).

Positive and Negative Affect Schedule-Revised (The PANAS-R; Watson et al., 1988). The PANAS-R is a self-report questionnaire that consists of two 10-item scales to measure both positive and negative affects. Each item is rated on a 5-point scale of 1 (not at all) to 5 (very much). To measure participants' affects after viewing the videos and completing the behavioral approach tasks, we selected 9 items (including 4 positive items, 4 negative items, and 1 neutral item) from the PANAS and added two additional items (disgusting, sexually arousing). Only items measuring disgust and sexual arousal after completing the behavioral approach tasks and viewing the erotic stimuli were used in the data analysis, while measurement of other items was used to disguise our experiment's purpose.

Likelihood of Sexual Engagement. After viewing the erotic stimuli, the participants had to mark their intention on a graphic slider that ranged from 0 (not at all) to 10 (very) to indicate their likelihood of sexual engagement ("If now an attractive opposite-sex you met in the videos wants to have sex with you, how likely are you to accept this invitation?").

Measures of Trait Characteristics. The Sexual Desire Inventory developed by Spector et al. (SDI; 1996) was used to measure people's dyadic ($\alpha = .90$) and solitary ($\alpha = .78$) sexual desire. The Sexual Inhibition/Sexual Excitation Scales – Short Form (SIS/SES-SF; Janssen et al., 2020) was used to measure participants' sexual inhibition 1 (Inhibition because of the threat of performance failure; $\alpha = .29$), sexual inhibition 2 (Inhibition because of the threat of performance consequences; $\alpha = .62$), and sexual excitation ($\alpha = .80$).

The Disgust Propensity and Disgust Sensitivity Scale (DPDSS; van Overveld et al., 2006) was used to measure the disgust propensity ($\alpha = .78$) and disgust sensitivity ($\alpha = .74$) of participants. The Three-Domain Disgust Scale (TDDS; Tybur et al., 2009) was used to measure participants' pathogen disgust ($\alpha = .68$), sexual disgust ($\alpha = .82$), and moral disgust ($\alpha = .75$). The Disgust Scale-Revised (DS-R; Olatunji et al., 2007) was used to measure individual differences in disgust sensitivity ($\alpha = .78$).

Procedure

The study was advertised as an experiment exploring the effects of different food on individuals' emotions. The potential participants needed to answer a survey that we used to assess their eligibility. In addition, to avoid any unexpected affects, the participants were asked not to drink/take alcohol, coffee, or other drugs and not to have masturbated or engaged in any other sexual activities for at least 12 hours before the experiment. Eligible participants were informed about the nature of the tasks (taking 1.5 g of one of the fifteen food items and finishing the behavioral approach tasks) and questionnaires they needed to complete.

The experiment took place in a quiet lab with a public working area and two small rooms. These two small rooms were equipped with computers and were used for the formal experiment. The lab is close to the East China Normal University hospital and all the research assistants as well as experimenters have received CPR (cardiopulmonary

resuscitation) training to avoid any unwanted health risks (e.g., allergic reactions against ginger).

After reading and signing the consent form, participants were assigned a participation ID and were administered the ginger pills or placebos randomly. This was a double-blind experiment. Ginger pills and placebo were put in two different bottles with different labels ("N.2" and "N.3") assigned by a person not involved in this experiment. Microsoft Excel created a random number for each participant, with participants having even numbers taking the pills in the bottle labeled "N.2" (ginger). Previous studies regarding the absorption of ginger as well as ginger's efficacy on nausea reduction suggested a delay of 30 minutes to 1 hour before testing its efficacy (Jiang et al., 2008; Lien et al., 2003; Tracy et al., 2019). To allow the ginger pills to be absorbed completely, each participant was asked to have a rest for 1 hour after taking the pills. During this rest time, they were asked to watch a sample video showing the process of the later formal experiment (around 10 mins) and a BBC movie (around 50 mins).

One hour later after taking the pills, the participants went back to the lab and started the formal experiment. There were eight dishes and a laptop on the table in each small room. Four dishes held the neutral fluids and had labels with numbers (1 ~ 4), while the other four dishes held body fluids and had labels with letters (A ~ D).

All the processes in the lab were presented via *Qualtrics*® software (www.qualtrics.com). The participants answered two background questions recording their assigned participation ID and the label of the pills ("N.2" or "N.3") they had eaten and then were assigned to the sexual body fluids tasks group or the neutral fluids tasks group randomly by *Qualtrics*. Next, the participants were asked to finish the corresponding four behavioral tasks in their group one by one.

For each behavioral task, the participants were first asked to complete the PANAS-R measuring their baseline emotion, and then they were informed of the type of the fluid in this round and viewed the introductory video for the corresponding fluid (e.g., "In this round, you need to smell and touch water; now watch the video below and learn how we get this fluid"). Then, they were informed to open the corresponding dish and complete the task (e.g., "The dish with label 'N.1' holds water, now please uncover the dish and finish the following tasks: 1) pick up the dish and observe; 2) move the dish close to your nose and smell the fluid; 3) put the dish down, wear a plastic glove and touch the fluid with your finger; 4) now please put the dish back and take off the glove"). After touching the fluid, they were asked to complete the PANAS-R again to measure their disgust and sexual arousal after receiving our manipulation. They were then asked to view a 1-min erotic stimulus aimed at eliciting sexual arousal. After viewing the erotic stimuli, they needed to answer the PANAS-R again as well as a one-item scale measuring their likelihood of sexual engagement. In short, participants needed to complete one behavioral approach task and then view one erotic stimulus in each behavior task. A flowchart of the experiment is presented in [Figure 1](#).

Following this, all tasks in the lab were over and the participants were asked to complete an online survey measuring their trait characters via *Wenjuanxing* (www.wjx.cn; a popular

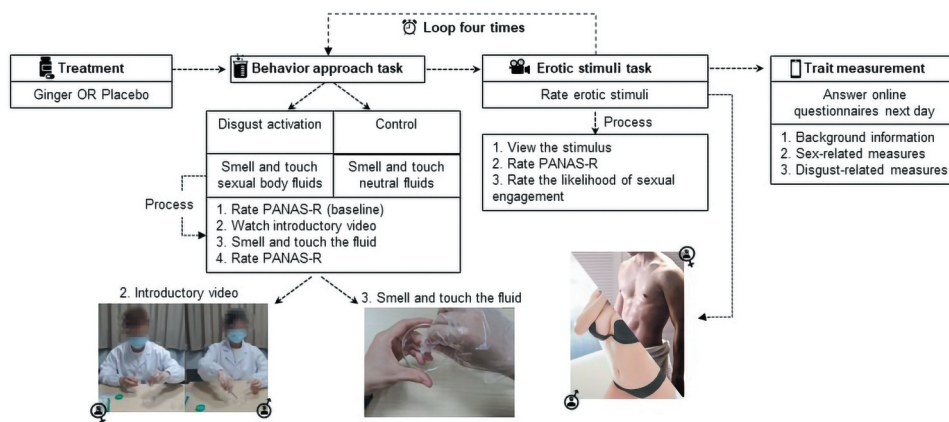


Figure 1. Flowchart of the study procedures.

Chinese online survey website) the next day. At the end of the survey, we debriefed the participants and explained the purpose of the study and the deception used.

Data Analyses

All data analyses using simple mixed linear model were conducted in IBM SPSS v25.0. In these mixed linear models, participants' IDs were used as Subjects variables and the different task types were used as Repeated variables. Random factors measuring individual differences, including trait characteristics, were not included in these models because we ran the exploratory moderation analyses to examine if and how trait characteristics affect the effects of ginger. Bonferroni corrections were used for multiple comparisons in mixed linear models and p -values less than .05 indicated a nominal significance.

A series of 2 (Task type: Sexual body fluids tasks vs. Neutral fluids tasks) \times 2 (Ginger: Yes vs. No) \times 2 (Sex: Women vs. Men) mixed linear models were conducted to explore 1) if the sexual body fluids tasks successfully induced feelings of disgust and if sex and ginger would moderate this disgust-eliciting effect of sexual body fluids tasks, 2) if the sexual body fluids tasks also induced feelings of sexual arousal and if sex and ginger would moderate this sexual arousal-eliciting effect of sexual body fluids tasks, 3) if the sexual body fluids tasks would inhibit feelings of sexual arousal and the likelihood of sexual engagement toward the subsequent erotic stimuli and if sex and ginger would moderate this inhibiting effect of sexual body fluids tasks, 4) if the sexual body fluids tasks would enhance feelings of disgust toward subsequent erotic stimuli and if sex would moderate this disgust-enhancing effect of sexual body fluids tasks.

The sexual body fluids tasks were expected to affect feelings and reactions toward subsequent erotic stimuli. To eliminate the effects of sexual body fluids tasks on feelings and reactions toward the erotic stimuli, a series of 2 (Ginger: Yes vs. No) \times 2 (Sex: Women vs. Men) mixed linear models restricting the data only to participants who completed the neutral fluids tasks were conducted to explore if ginger would increase sexual arousal, increase the likelihood of

sexual engagement, and directly decrease disgust elicited by erotic stimuli and if sex would moderate the effect of ginger.

Ethical Approval and Pre-Registration

The current study received approval from the Institutional Review Board of New York University Shanghai (Approval Number is 2021–019-NYUSH-Zhongbei). Before the data collection began, a pre-registration was submitted to ASPREDICTED.COM (<https://aspredicted.org/ci59t.pdf>).

Results

Attrition

None of the participants dropped out of the experiment.

H1: Do Sexual Body Fluids Induce Feelings of Disgust?

Table 2 presents the means and standard deviations of feelings and reactions toward the fluids tasks and the erotic stimuli grouped by task type (Sexual body fluids tasks vs. Neutral fluids tasks), ginger (Yes vs. No), and sex (Men vs. Women).

Table 3 presents the effects of task type and the moderating effects of sex and ginger from the mixed linear models.

There was a main effect of task type on feelings of disgust toward the fluids tasks ($p < .001$). Participants who completed the sexual body fluids tasks reported more disgust than those who completed the neutral fluids tasks. This was in line with our Hypothesis 1.

There was also a significant interaction between sex and task type on feelings of disgust ($p < .001$), which was in line with Hypothesis 1. Post hoc analyses showed that both men ($p < .001$) and women ($p < .001$) who completed the sexual body fluids tasks reported more disgust than those who completed the neutral fluids tasks. However, women who completed the sexual body fluids tasks reported more disgust than men who completed the sexual body fluids tasks ($p < .001$), while there was no sex difference among participants who completed the neutral fluids tasks ($p = .629$).

Table 2. Means for participants' feelings and reactions toward the fluids tasks and the erotic stimuli grouped by sex, task type, and ginger.

Outcomes	Women								Men							
	Neutral fluids				Sexual body fluids				Neutral fluids				Sexual body fluids			
	Ginger		Placebo		Ginger		Placebo		Ginger		Placebo		Ginger		Placebo	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Disgust toward the fluids tasks	1.06	0.25	1.13	0.44	2.72	1.16	2.67	1.32	1.18	0.50	1.10	0.35	2.22	1.16	2.30	1.23
Sexual arousal toward the fluids tasks	1.07	0.29	1.03	0.16	1.05	0.26	1.07	0.29	1.08	0.27	1.08	0.33	1.45	0.78	1.24	0.57
Sexual arousal toward the erotic stimuli	1.82	0.82	1.73	0.70	1.71	0.78	1.49	0.73	2.53	1.00	2.28	1.04	2.38	0.96	2.43	0.93
Likelihood of sexual engagement	2.44	2.55	2.76	2.86	3.53	2.91	2.18	2.42	6.36	2.83	5.85	3.24	5.93	2.94	6.37	2.77
Disgust toward the erotic stimuli	1.84	0.94	2.04	1.13	2.09	1.04	2.35	1.18	1.26	0.62	1.24	0.50	1.37	0.71	1.33	0.64

Table 3. Mixed linear models showing effects of task type and the moderating effects of sex and ginger on feelings and reactions toward the fluids tasks and the erotic stimuli.

Outcomes	Predictors	<i>df</i>	<i>f</i>	<i>p</i>
Disgust toward the fluids tasks	Task type	948.93	505.51	< .001
	Task type*Sex	948.93	15.49	< .001
	Task type*Ginger	948.93	0.02	.893
	Task type*Sex*Ginger	948.93	0.97	.325
	Task type	749.83	9.28	.002
Sexual arousal toward the fluids tasks	Task type*Sex	749.83	12.60	< .001
	Task type*Ginger	749.83	4.43	.036
	Task type*Sex*Ginger	749.83	7.34	.007
	Task type	968.09	2.76	.097
	Task type*Sex	968.09	2.16	.142
Sexual arousal toward the erotic stimuli	Task type*Ginger	968.09	0.69	.405
	Task type*Sex*Ginger	968.09	4.39	.036
	Task type	979.08	0.70	.404
	Task type*Sex	979.08	0.34	.562
	Task type*Ginger	979.08	0.99	.319
Likelihood of sexual engagement toward the erotic stimuli	Task type*Sex*Ginger	979.08	13.38	< .001
	Task type	954.69	10.59	.001
	Task type*Sex	954.69	2.70	.101
	Task type*Ginger	954.69	0.12	.731
	Task type*Sex*Ginger	954.69	0.27	.607

H1b: Does Ginger Attenuate This Disgust-Eliciting Effect of Sexual Body Fluids?

There was no interaction between task type and ginger ($p = .893$) or between task type, ginger, and sex ($p = .325$) on feelings of disgust, which did not support Hypothesis 1b.

H2: Do Sexual Body Fluids Induce Feelings of Sexual Arousal?

There was a main effect of task type ($p = .002$) and a significant interaction between task type and sex ($p < .001$) on feelings of sexual arousal toward the fluids tasks, supporting Hypothesis 2. Men who completed the sexual body fluids tasks reported stronger sexual arousal than men who completed the neutral fluids tasks ($p < .001$), while there was no task type difference in women ($p = .723$).

H2b: Does Ginger Enhance This Sexual Arousal-Eliciting Effect of Sexual Body Fluids?

There were significant interactions between task type and ginger ($p = .036$), and between task type, ginger, and sex ($p = .007$). Men who completed the sexual body fluids tasks reported stronger sexual arousal than men who completed the neutral fluids tasks ($p < .001$) in the ginger group, while there was no task type difference in men who consumed the placebo

($p = .368$). There was no task type difference in women who consumed the ginger ($p = .575$) or the placebo ($p = .961$).

H3: Do Sexual Body Fluids Inhibit Feelings of Sexual Arousal and the Likelihood of Sexual Engagement toward the Subsequent Erotic Stimuli?

H3.1 Do Sexual Body Fluids Inhibit Feelings of Sexual Arousal toward the Erotic Stimuli?

There was no main effect of task type on feelings of sexual arousal ($p = .097$) or interaction between task type and sex ($p = .142$), which did not support Hypothesis 3, although the means were in the expected direction. Participants who completed the sexual body fluids tasks showed a non-significant tendency to report weaker sexual arousal than those who completed the neutral fluids tasks.

H3.1b Does Ginger Attenuate This Inhibiting Effect of Sexual Body Fluids on Sexual Arousal toward the Erotic Stimuli?

There was no significant interaction between task type and ginger ($p = .405$), whereas there was a significant interaction between task type, ginger, and sex ($p = .036$), supporting Hypothesis H3b. Post hoc analyses showed that women who completed the sexual body fluids tasks reported weaker sexual arousal toward the erotic stimuli than women who completed the neutral fluids tasks ($p = .032$; see, Figure 2) in the placebo group, whereas there was no task type difference in women

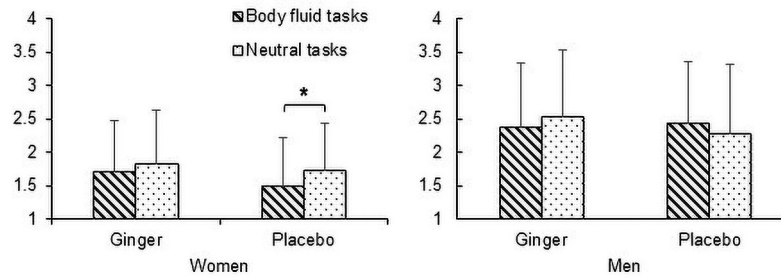


Figure 2. The effects of task type on feelings of sexual arousal toward the erotic stimuli and the moderating effects of sex and ginger. * $p < .05$

who consumed ginger ($p = .345$). There was no task type difference in men who consumed the placebo ($p = .167$) or ginger ($p = .118$).

H3.2 Do Sexual Body Fluids Inhibit the Likelihood of Sexual Engagement toward the Erotic Stimuli?

There was no main effect of task type on the likelihood of sexual engagement with the subsequent erotic stimuli ($p = .404$) or significant interaction between task type and sex ($p = .562$), which did not support Hypothesis 3.

H3.2b Does Ginger Attenuate This Inhibiting Effect of Sexual Body Fluids on the Likelihood of Sexual Engagement toward the Erotic Stimuli?

There was no significant interaction between task type and ginger ($p = .319$), whereas there was a significant interaction between task type, ginger, and sex ($p < .001$). Post hoc analyses showed that women who completed the sexual body fluids tasks reported higher likelihood of sexual engagement than women who completed the neutral fluids tasks ($p = .002$; see Figure 3) in the ginger group, whereas there was no task type difference in women who consumed the placebo ($p = .114$). There was no task type difference in men who consumed the placebo ($p = .141$) or ginger ($p = .228$).

H4: Do Sexual Body Fluids Enhance Feelings of Disgust toward the Erotic Stimuli?

There was a main effect of task type on feelings of disgust toward the erotic stimuli ($p = .001$), which supported Hypothesis 4. Participants who completed the sexual body fluids tasks reported more disgust than those who completed the neutral fluids tasks.

There was no significant interaction between task type and sex ($p = .101$), between task type and ginger ($p = .731$), or between task type, ginger, and sex ($p = .607$) on feelings of disgust toward the erotic stimuli.

H5: Does Ginger Affect Feelings and Reactions toward the Subsequent Erotic Stimuli?

Table 4 presents the effects of ginger and the moderating effects of sex on feelings toward the erotic stimuli from the mixed linear models.

There was a main effect of ginger on feelings of sexual arousal toward the erotic stimuli ($p = .04$), which was in line with Hypothesis 5. Participants who consumed ginger reported stronger feelings of sexual arousal than those who consumed placebo (see Figure 4). There was no significant interaction between ginger and sex ($p = .293$).

There was no main effect of ginger or interaction between ginger and sex on the likelihood of sexual engagement ($p = .719$; $p = .122$) or disgust ($p = .230$; $p = .145$) toward the erotic stimuli.

Discussion

We employed a novel paradigm using (fake) sexual body fluids encountered during sexual activities to explore if increases in feelings of disgust induced by such fluids could decrease feelings of sexual arousal, decrease the likelihood of sexual engagement, and increase disgust toward subsequent erotic stimuli. We also investigated whether sex and administration of ginger could moderate these effects of task type. Exploratory analyses were conducted to examine if ginger could affect feelings and reactions toward the erotic stimuli.

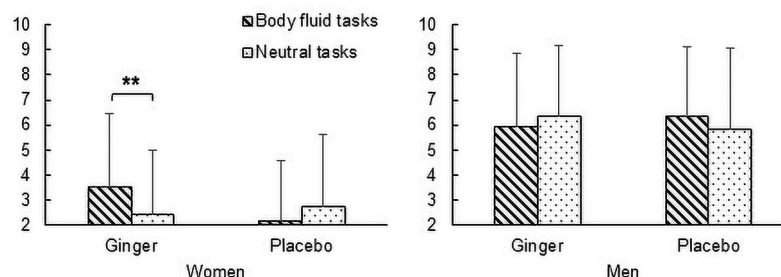


Figure 3. The effects of task type on the likelihood of sexual engagement toward the erotic stimuli and the moderating effects of sex and ginger. ** $p < .01$.

Table 4. Mixed linear models showing effects of ginger and the moderating effects of sex on feelings and reactions toward the erotic stimuli.

Outcomes	Predictors	<i>df</i>	<i>f</i>	<i>p</i>
Sexual arousal toward the erotic stimuli	Ginger	461.38	4.23	.040
	Ginger*Sex	461.38	1.11	.293
Likelihood of sexual engagement toward the erotic stimuli	Ginger	465.09	0.13	.719
	Ginger*Sex	465.09	2.40	.122
Disgust toward the erotic stimuli	Ginger	462.16	1.45	.230
	Ginger*Sex	462.16	2.13	.145

Note: The analysis restricted data only to participants who completed the neutral fluids tasks.

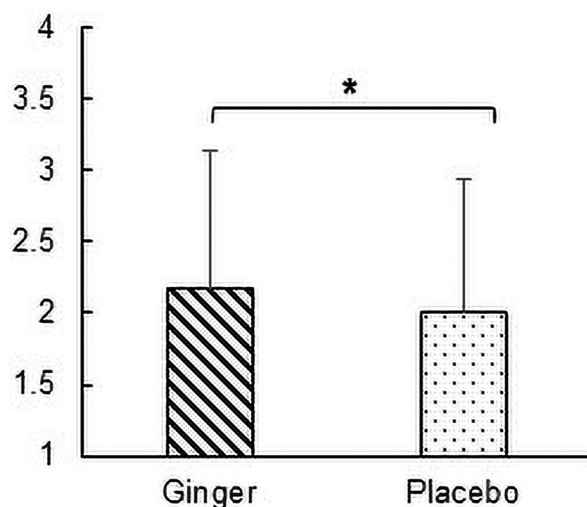


Figure 4. The effects of ginger on feelings of sexual arousal toward the erotic stimuli in participants who completed the neutral fluids tasks. * $p < .05$.

Disgust and Sexual Arousal Induced by Sexual Body Fluids

Participants who completed the sexual body fluids tasks reported higher levels of disgust, which was consistent with our expectations. The exchange of sexual body fluids (e.g., saliva, sweat, semen, and vaginal fluids) carries contagion risk which might activate the behavioral immune system, increasing feelings of disgust to activate avoidance (Crosby et al., 2019; Stevenson et al., 2011). Sexual body fluids are also perceived as powerful disgust elicitors in non-sex-related situations (Borg & de Jong, 2012; Rozin et al., 1995). We found that this manipulation requiring the participants to smell and touch the sexual body fluids also induced feelings of sexual arousal in men. These results were in line with the behavioral immune system theory, suggesting that sexual stimuli can induce both disgust and sexual arousal (Crosby et al., 2019; de Jong et al., 2013).

The Effect of Sexual Body Fluids on Subsequent Sexual Arousal and the Likelihood of Sexual Engagement

Although disgust induced by sexual body fluids did not reduce feelings of sexual arousal and the likelihood of sexual engagement toward the erotic stimuli as we had expected, we did find that participants who completed the sexual body fluids tasks reported non-significantly weaker sexual arousal toward the erotic stimuli compared to those who completed the neutral fluid tasks ($p = .097$). The lack of significant

findings are surprising given that a series of studies have shown that sexual arousal and disgust have a strong negative relationship with up-regulated disgust, inhibiting sexual arousal and increasing sexual avoidance behavior toward sexual stimuli (Andrews et al., 2015; Borg & de Jong, 2012; Fleischman et al., 2015). Research has found that women report less sexual arousal toward erotic stimuli if they have first been exposed to disgusting pictures (Fleischman et al., 2015) and men also have a lowered genital sexual arousal response after having been exposed to a highly disgusting odor (Borg et al., 2019). One possible explanation for this failure would be that the intensity of disgust induced by sexual body fluids was not strong enough to down-regulate the sexual arousal toward the erotic stimuli.

We also found that sex and ginger moderated the effect of task type on feelings of sexual arousal toward the erotic stimuli. Women who completed the sexual body fluids tasks reported weaker sexual arousal than women who completed the neutral fluids tasks in the placebo group, as we had expected, whereas in women who consumed ginger there was no task type difference. Contrary to our hypothesis, we found that in the ginger group, women who completed the sexual body fluids tasks reported higher likelihood of sexual engagement compared to women who completed the neutral fluids tasks, while in the placebo group there was no task type difference in women. These findings indicated that ginger might affect the effect of sexual body fluids on sexual arousal and the likelihood of sexual engagement toward the erotic stimuli. Given that there was no effect of ginger on feelings of disgust or sexual arousal toward the sexual body fluids in either women or men, the possible mechanism still remains unclear but it could possibly be that ginger affected the process whereby disgust affected feelings and reactions toward the erotic stimuli rather than directly decreasing experienced disgust induced by sexual body fluids.

In addition, sexual body fluids failed to affect the feelings of sexual arousal or likelihood of sexual engagement toward erotic stimuli in men who consumed the ginger or the placebo; sex differences in feelings toward sexual body fluids may be one of the possible reasons. Parental investment theory suggests that when choosing their potential partner, the sex that invests more in their offspring would be more selective because of the higher potential costs from sexual activity (Bjorklund & Kipp, 1996; Trivers, 1972). As a result, women may have developed higher disgust and sexually inhibiting tendencies, while men may have developed more sensitive reactions to sexual stimuli. In line with this, men were more likely to experience higher sexual arousal and lower disgust when

exposed to sexual body fluids. We found that women experienced only increased feelings of disgust toward sexual body fluids, whereas men experienced both sexual arousal and disgust toward sexual body fluids, which both would have an impact on feelings and reactions toward subsequent erotic stimuli.

Another reason why the effects of task type on men and women differed may be that the erotic stimuli used for men and women in the current study were different. Moderation by sex on erotic stimuli could be an artifact as a result of the different stimuli sets, which limits the conclusions about sex differences that can be drawn.

The Effect of Sexual Body Fluids on Subsequent Disgust toward Erotic Stimuli

Results showed that participants who completed the sexual body fluids tasks reported more disgust toward the erotic stimuli than those who completed the neutral fluids tasks. The increase in disgust toward the erotic stimuli after receiving disgust manipulation may indicate how the negative relationship between sexual arousal and disgust works. Disgust induced by sexual body fluids increased feelings of disgust toward the erotic stimuli, acting as a priming disgusting cue on the accumulative effect of disgust from sexual body fluids to the erotic stimuli. This increase in disgust toward the erotic stimuli would reduce sexual arousal toward the erotic stimuli. In other words, disgust caused by sexual body fluids could not only interfere with feelings of sexual arousal toward the erotic stimuli directly, but it could also reduce sexual arousal indirectly via the mediating effect of disgust toward the erotic stimuli. A corresponding pattern should exist when exploring the inhibiting effect of sexual arousal on sex-related disgust. Specifically, sexual arousal induced by erotic stimuli would be expected to increase feelings of sexual arousal toward sexually disgusting stimuli because, similar to a priming effect, the prior sexual arousal would allow people to extract sex-relevant information rapidly and easily. This increase in sexual arousal toward the sexually disgusting stimuli would then reduce disgust toward the sexually disgusting stimuli.

The Effect of Ginger on Feelings and Reactions toward the Erotic Stimuli

As expected, we found that ginger increased the feelings of sexual arousal toward the erotic stimuli in both men and women who completed the neutral fluids tasks. These findings were consistent with previous evidence suggesting that consumption of ginger may have a positive effect on human sexual function, including improvement in self-reported erectile function and intercourse satisfaction in older men (Stein et al., 2018) and better sexual function in depressed women with low sexual desire (Shabaniyan et al., 2018). However, ginger did not reduce feelings of disgust toward sexual body fluids or decreased disgust toward the erotic stimuli, which was not in line with our hypotheses. Although post hoc analyses showed that women who consumed ginger showed a non-significant tendency to report less disgust toward erotic stimuli than women who consumed placebo ($p = .06$), this decrease in

disgust might be due to the disgust-inhibiting effects of elevated sexual arousal caused by ginger consumption.

The mechanism of the effects of ginger on sexual function has not yet been investigated systematically. Previous evidence has shown that ginger can reduce physical vomiting and nausea as well as subjective feelings of disgust in humans (Li et al., 2018; Thamlikitkul et al., 2017; Tracy et al., 2019). Thus, the consumption of ginger was expected to reduce disgust elicited by sexual body fluids and erotic stimuli, thereby increasing sexual arousal and sexual behaviors (D model). However, in contrast to our hypothesis, ginger had no effect on feelings of disgust toward the erotic stimuli (only a non-significant reduction in women) and sexual body fluids. One possible reason was that ginger acts on disgust in ways that are not reflected in the conscious experience of disgust. Ginger has been proven to be an effective antiemetic and could directly suppress physical nausea and vomiting by interfering with the 5-HT₃ signaling pathway and inhibiting activation of human 5-HT_{3A} and 5-HT_{3AB} receptors (resulting in physical nausea and vomiting; Marx et al., 2015; Toth et al., 2018; Walstab et al., 2013), which may, in turn, decrease subjective feelings of disgust indirectly.

Given the increase in sexual arousal toward the erotic stimuli as well as the lack of change in disgust, a more probable mechanism would be that ginger increased sexual arousal and sexual behaviors via its enhancing effects on testosterone, which then inhibited the feelings of disgust during sexual activities due to the negative interaction between sexual arousal and disgust. Testosterone has been associated with individuals' sexual behaviors, and it has been suggested that testosterone could improve men's and women's sexual desire, sexual behaviors, and sexual function (de Jong et al., 2013; Lunenfeld et al., 2015; Panay et al., 2010). Although the impact of ginger on testosterone has not been confirmed in humans, empirical evidence has found a robust effect of ginger on testosterone in non-human mammals (Banihani, 2018), which suggests the possibility of ginger's effect on human sexuality via its enhancing effects on testosterone. However, we did not measure testosterone in the current study and therefore further investigation regarding the effect of ginger on testosterone in humans is needed.

Another reason why the effects of ginger were weak could be that participants with sexual problems would benefit more from ginger compared to healthy participants without sexual problems. The only two experiments focusing on the effects of ginger on sexual functioning were conducted in men aged 50–68 years with mild erectile dysfunction (Stein et al., 2018) and depressed women with decreased sexual desire (Shabaniyan et al., 2018). Our exploratory analyses (see non-peer-reviewed Appendix A in the online supplementary material; <https://osf.io/89m2k/>) showed that participants with vulnerable traits (high disgust propensity and disgust sensitivity and low sexual desire), which were closely related to sexual problems (Crosby et al., 2019; de Jong et al., 2013; Nowosielski et al., 2021; Quinta-Gomes et al., 2021), who consumed ginger were more likely to report less disgust, stronger sexual arousal, and a higher likelihood of sexual engagement toward the erotic stimuli compared to participants who consumed the placebo. However, the lack of recruitment of participants with sexual problems in this study means that further research is needed.

Strengths and Limitations

The current experiment is the first to have used sex-related body fluids as disgust-inducing stimuli to explore the suppressing effect of disgust on sexual arousal. We also measured both sexual arousal and disgust for disgust elicitors and erotic stimuli. This allowed us to explore how sexual arousal and disgust interact. In addition, the placebo-controlled design in healthy men and women also overcomes the limitations of previous studies. Further, we advanced two possible pathways on how ginger affects sexual behaviors and functioning of individuals.

The present study had some limitations. First, all participants in our experiment were heterosexual, and most of them were university students, which limits our ability to generalize the findings to other populations. Future experiments should include participants with a wider range of ages and sexual orientations. Second, the sexual body fluids we used were fake. The authenticity of the body fluids may have been doubted by some participants, which may have reduced the effectiveness of the manipulation. Further experiments should investigate whether the participants believe the sexual body fluids in the tasks are real. Also, this was a repeated measurement design in which participants completed the tasks one by one. The feelings of sexual arousal toward the erotic stimuli from a prior trial could affect feelings of disgust toward the sexual body fluids in the next trial. Moreover, due to restrictions on the use of sexual stimuli in China, the erotic stimuli we used only presented nude and seminude pictures of models, which might not induce sexual arousal in all participants. In addition, men and women watched different erotic stimuli, which makes the interpretation of sex differences in feelings toward the erotic stimuli difficult. Future experiments should consider using the same set and more sexually explicit stimuli across sexes.

Conclusion

Sexual problems are common complaints for both men and women, negatively affecting individuals' quality of life and well-being. The current study showed that sexual body fluids successfully induced disgust and resulted in a stronger disgust reaction toward the subsequent erotic stimuli. Sexual body fluids reduced sexual arousal toward subsequent erotic stimuli presented to women who consumed placebo but increased the likelihood of sexual engagement in women who consumed ginger. Administering ginger enhanced sexual arousal toward the erotic stimuli in both men and women. Ginger may be a potential treatment for sexual problems, while long-term interventions are needed to test the effects of ginger on sexual function in people with and without sexual difficulties.

Acknowledgments

The authors would like to thank Yikang Zhang and Qianhui Gao for their powerful help on materials preparation. The authors also wish to thank Dr. Li for the use of the picture database and Chengshi Huang for his help on investigation.

Disclosure Statement

No potential conflict of interest was reported by the authors.

Funding

This study is supported by New York University Shanghai Internal Funding under Grant [Startup 10109STARTUPFUND NYU Shanghai].

ORCID

Guangju Wen  <http://orcid.org/0000-0001-6514-9146>
 Yikang Zhang  <http://orcid.org/0000-0001-5173-562X>
 Thomas J. Nyman  <http://orcid.org/0000-0002-6409-2528>
 Patrick Jern  <http://orcid.org/0000-0001-9044-7604>
 Pekka Santtila  <http://orcid.org/0000-0002-0459-1309>

Data Availability Statement

The authors confirm that the data supporting the findings of this study are available in its supplementary materials <https://osf.io/89m2k/>.

References

- Ackerman, J. M., Hill, S. E., & Murray, D. R. (2018). The behavioral immune system: Current concerns and future directions. *Social and Personality Psychology Compass*, 12(2), e12371. <https://doi.org/10.1111/spc3.12371>
- Al-Shawaf, L., Lewis, D. M. G., Ghossainy, M. E., & Buss, D. M. (2019). Experimentally inducing disgust reduces desire for short-term mating. *Evolutionary Psychological Science*, 5(3), 267–275. <https://doi.org/10.1007/s40806-018-0179-z>
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.).
- Andrews, A. R., Crone, T., Cholka, C. B., Cooper, T. V., & Bridges, A. J. (2015). Correlational and experimental analyses of the relation between disgust and sexual arousal. *Motivation and Emotion*, 39(5), 766–779. <https://doi.org/10.1007/s11031-015-9485-y>
- Araujo, A. B., Mohr, B. A., & McKinlay, J. B. (2004). Changes in sexual function in middle-aged and older men: Longitudinal data from the Massachusetts male aging study. *Journal of the American Geriatrics Society*, 52(9), 1502–1509. <https://doi.org/10.1111/j.0002-8614.2004.52413.x>
- Bacon, C. G., Mittleman, M. A., Kawachi, I., Giovannucci, E., Glasser, D. B., & Rimm, E. B. (2003). Sexual function in men older than 50 years of age: Results from the health professionals follow-up study. *Annals of Internal Medicine*, 139(3), 161–168. <https://doi.org/10.7326/0003-4819-139-3-200308050-00005>
- Banihani, S. A. (2018). Ginger and testosterone. *Biomolecules*, 8(4), 119. <https://doi.org/10.3390/biom8040119>
- Basson, R. (2002). Rethinking low sexual desire in women. *BJOG: An International Journal of Obstetrics & Gynaecology*, 109(4), 357–363. <https://doi.org/10.1111/j.1471-0528.2002.01002.x>
- Bjorklund, D. F., & Kipp, K. (1996). Parental investment theory and gender differences in the evolution of inhibition mechanisms. *Psychological Bulletin*, 120(2), 163–188. <https://doi.org/10.1037/0033-2909.120.2.163>
- Bonierbale, M., Lançon, C., & Tignol, J. (2003). The ELIXIR study: Evaluation of sexual dysfunction in 4557 depressed patients in France. *Current Medical Research and Opinion*, 19(2), 114–124. <https://doi.org/10.1185/030079902125001461>
- Borg, C., & de Jong, P. J. (2012). Feelings of disgust and disgust-induced avoidance weaken following induced sexual arousal in women. *PLOS One*, 7(9). <https://doi.org/10.1371/journal.pone.0044111>
- Borg, C., de Jong, P. J., & Schultz, W. W. (2010). Vaginismus and dyspareunia: Automatic vs. deliberate disgust responsiveness. *The Journal of*

- Sexual Medicine*, 7(6), 2149–2157. <https://doi.org/10.1111/j.1743-6109.2010.01800.x>
- Borg, C., de Jong, P. J., & Schultz, W. W. (2011). Vaginismus and dyspareunia: Relationship with general and sex-related moral standards. *The Journal of Sexual Medicine*, 8(1), 223–231. <https://doi.org/10.1111/j.1743-6109.2010.02080.x>
- Borg, C., Oosterwijk, T. A., Lisy, D., Boesveldt, S., & de Jong, P. J. (2019). The influence of olfactory disgust on (genital) sexual arousal in men. *PLOS One*, 14(2). <https://doi.org/10.1371/journal.pone.0213059>
- Brotto, L. A., Woo, J. S. T., & Gorzalka, B. B. (2012). Differences in sexual guilt and desire in East Asian and Euro-Canadian men. *The Journal of Sex Research*, 49(6), 594–602. <https://doi.org/10.1080/00224499.2011.618956>
- Coombs, R. W., Reichelderfer, P. S., & Landay, A. L. (2003). Recent observations on HIV type-1 infection in the genital tract of men and women. *AIDS*, 17(4), 455–480. <https://doi.org/10.1097/00002030-200303070-00001>
- Crosby, C. L., Buss, D. M., Cormack, L. K., & Meston, C. M. (2021). Sex, sexual arousal, and sexual decision making: An evolutionary perspective. *Personality and Individual Differences*, 177, 110826. <https://doi.org/10.1016/j.paid.2021.110826>
- Crosby, C. L., Buss, D. M., & Meston, C. M. (2019). Sexual disgust: Evolutionary perspectives and relationship to female sexual function. *Current Sexual Health Reports*, 11(4), 300–306. <https://doi.org/10.1007/s11930-019-00219-6>
- Cui, Q., Wang, Z., Zhang, Z., & Li, Y. (2021). The East Asian erotic picture dataset and gender differences in response to opposite-sex erotic stimuli in Chinese college students. *Frontiers in Psychology*, 12, 648271. <https://doi.org/10.3389/fpsyg.2021.648271>
- Dabaghzadeh, F., Khalili, H., Dashti-Khavidaki, S., Abbasian, L., & Moenifard, A. (2014). Ginger for prevention of antiretroviral-induced nausea and vomiting: A randomized clinical trial. *Expert Opinion on Drug Safety*, 13(7), 859–866. <https://doi.org/10.1517/14740338.2014.914170>
- de Jong, P. J., van Overveld, M., & Borg, C. (2013). Giving in to arousal or staying stuck in disgust? Disgust-based mechanisms in sex and sexual dysfunction. *The Journal of Sex Research*, 50(3–4), 247–262. <https://doi.org/10.1080/00224499.2012.746280>
- de Jong, P. J., van Overveld, M., Schultz, W. W., Peters, M. L., & Buwalda, F. M. (2009). Disgust and contamination sensitivity in vaginismus and dyspareunia. *Archives of Sexual Behavior*, 38(2), 244–252. <https://doi.org/10.1007/s10508-007-9240-x>
- Duncan, L. A., Schaller, M., & Park, J. H. (2009). Perceived vulnerability to disease: Development and validation of a 15-item self-report instrument. *Personality and Individual Differences*, 47(6), 541–546. <https://doi.org/10.1016/j.paid.2009.05.001>
- Fleischman, D. S., Hamilton, L. D., Fessler, D. M. T., & Meston, C. M. (2015). Disgust versus lust: Exploring the interactions of disgust and fear with sexual arousal in women. *PLOS One*, 10(6), e0118151. <https://doi.org/10.1371/journal.pone.0118151>
- Hendrickx, L., Gijs, L., & Enzlin, P. (2014). Prevalence rates of sexual difficulties and associated distress in heterosexual men and women: Results from an internet survey in Flanders. *The Journal of Sex Research*, 51(1), 1–12. <https://doi.org/10.1080/00224499.2013.819065>
- Hlay, J. K., Albert, G., Batres, C., Richardson, G., Placek, C., Arnocky, S., Lieberman, D., & Hodges-Simeon, C. R. (2021). The evolution of disgust for pathogen detection and avoidance. *Scientific Reports*, 11(1), 13468. <https://doi.org/10.1038/s41598-021-91712-3>
- Janssen, E., Carpenter, D., Graham, C., Vorst, H., & Wicherts, J. (2020). The Sexual Inhibition/Sexual Excitation Scales-Short Form. In R. R. Milhausen, J. K. Sakaluk, T. D. Fisher, C. M. Davis, & W. L. Yarber (Eds.), *Handbook of sexuality-related measures* (pp. 77–80). Routledge.
- Jiang, S., Wang, N., & Mi, S. (2008). Plasma pharmacokinetics and tissue distribution of [6]-gingerol in rats. *Biopharmaceutics & Drug Disposition*, 29(9), 529–537. <https://doi.org/10.1002/bdd.638>
- Khani, S., Azizi, M., Elyasi, F., Kamali, M., & Moosazadeh, M. (2021). The prevalence of sexual dysfunction in the different menopausal stages: A systematic review and meta-analysis. *International Journal of Sexual Health*, 33(3), 439–472. <https://doi.org/10.1080/19317611.2021.1926039>
- Koleva, S. P., Graham, J., Iyer, R., Ditto, P. H., & Haidt, J. (2012). Tracing the threads: How five moral concerns (especially purity) help explain culture war attitudes. *Journal of Research in Personality*, 46(2), 184–194. <https://doi.org/10.1016/j.jrp.2012.01.006>
- Laumann, E. O., Nicolosi, A., Glasser, D. B., Paik, A., Gingell, C., Moreira, E., & Wang, T. (2005). Sexual problems among women and men aged 40–80 y: Prevalence and correlates identified in the global study of sexual attitudes and behaviors. *International Journal of Impotence Research*, 17(1), 39–57. <https://doi.org/10.1038/sj.ijir.3901250>
- Laurent, S. M., & Simons, A. D. (2009). Sexual dysfunction in depression and anxiety: Conceptualizing sexual dysfunction as part of an internalizing dimension. *Clinical Psychology Review*, 29(7), 573–585. <https://doi.org/10.1016/j.cpr.2009.06.007>
- Lete, I., & Allue, J. (2016). The effectiveness of ginger in the prevention of nausea and vomiting during pregnancy and chemotherapy. *Integrative Medicine Insights*, 11, 11–17. <https://doi.org/10.4137/IMI.S36273>
- Lien, H. C., Sun, W. M., Chen, Y. H., Kim, H., Hasler, W., & Owyang, C. (2003). Effects of ginger on motion sickness and gastric slow-wave dysrhythmias induced by circular vection. *American Journal of Physiology-Gastrointestinal and Liver Physiology*, 284(3), G481–G489. <https://doi.org/10.1152/ajpgi.00164.2002>
- Li, X., Qin, Y., Liu, W., Zhou, X., Li, Y., & Wang, L. (2018). Efficacy of ginger in ameliorating acute and delayed chemotherapy-induced nausea and vomiting among patients with lung cancer receiving cisplatin-based regimens: A randomized controlled trial. *Integrative Cancer Therapies*, 17(3), 747–754. <https://doi.org/10.1177/1534735417753541>
- Lunenfeld, B., Mskhalaya, G., Zitzmann, M., Arver, S., Kalinchenko, S., Tishova, Y., & Morgentaler, A. (2015). Recommendations on the diagnosis, treatment and monitoring of hypogonadism in men. *The Aging Male*, 18(1), 5–15. <https://doi.org/10.3109/13685538.2015.1004049>
- Marx, W., Kiss, N., & Isenring, L. (2015). Is ginger beneficial for nausea and vomiting? An update of the literature. *Current Opinion in Supportive and Palliative Care*, 9(2), 189–195. <https://doi.org/10.1097/SPC.0000000000000135>
- Marx, W., Ried, K., McCarthy, A. L., Vitetta, L., Sali, A., McKavanagh, D., & Isenring, L. (2017). Ginger-Mechanism of action in chemotherapy-induced nausea and vomiting: A review. *Critical Reviews in Food Science and Nutrition*, 57(1), 141–146. <https://doi.org/10.1080/10408398.2013.865590>
- Marx, W. M., Teleni, L., McCarthy, A. L., Vitetta, L., McKavanagh, D., Thomson, D., & Isenring, E. (2013). Ginger (*Zingiber officinale*) and chemotherapy-induced nausea and vomiting: A systematic literature review. *Nutrition Reviews*, 71(4), 245–254. <https://doi.org/10.1111/nure.12016>
- McCabe, M. P., & Connaughton, C. (2017). Sexual dysfunction and relationship stress: How does this association vary for men and women? *Current Opinion in Psychology*, 13, 81–84. <https://doi.org/10.1016/j.copsyc.2016.05.007>
- Mercer, C. H., Fenton, K. A., Johnson, A. M., Wellings, K., Macdowall, W., McManus, S., Nanchahal, K., & Erens, B. (2003). Sexual function problems and help seeking behavior in Britain: National probability sample survey. *British Medical Journal*, 327(7412), 426–427. <https://doi.org/10.1136/bmj.327.7412.426>
- Mitchell, K. R., Jones, K. G., Wellings, K., Johnson, A. M., Graham, C. A., Datta, J., Copas, A. J., Bancroft, J., Sonnenberg, P., Macdowall, W., Field, N., & Mercer, C. H. (2016). Estimating the prevalence of sexual function problems: The impact of morbidity criteria. *The Journal of Sex Research*, 53(8), 955–967. <https://doi.org/10.1080/00224499.2015.1089214>
- Montazeri, A., Hamidzadeh, A., Raei, M., Mohammadi, M., Montazeri, A. S., Mirshahi, R., & Rohani, H. (2013). Evaluation of oral ginger efficacy against postoperative nausea and vomiting: A randomized, double-blinded clinical trial. *Iranian Red Crescent Medical Journal*, 15(12), e12268. <https://doi.org/10.5812/ircmj.12268>
- Nowosielski, K., Kurpisz, J., & Kowalczyk, R. (2021). Sexual inhibition and sexual excitation in a sample of Polish women. *PLOS One*, 16(4), e0249560. <https://doi.org/10.1371/journal.pone.0249560>

- Oaten, M., Stevenson, R. J., & Case, T. I. (2009). Disgust as a disease-avoidance mechanism. *Psychological Bulletin*, 135(2), 303–321. <https://doi.org/10.1037/a0014823>
- Oaten, M., Stevenson, R. J., Tapp, C., Case, T. I., & Cousins, A. (2019). The role of disgust in male sexual decision-making. *Frontiers in Psychology*, 9, 2602. <https://doi.org/10.3389/fpsyg.2018.02602>
- Olatunji, B. O., Haidt, J., McKay, D., & David, B. (2008). Core, animal reminder, and contamination disgust: Three kinds of disgust with distinct personality, behavioral, physiological, and clinical correlates. *Journal of Research in Personality*, 42(5), 1243–1259. <https://doi.org/10.1016/j.jrp.2008.03.009>
- Olatunji, B. O., Williams, N. L., Tolin, D. F., Abramowitz, J. S., Sawchuk, C. N., Lohr, J. M., & Elwood, L. S. (2007). The Disgust Scale: Item analysis, factor structure, and suggestions for refinement. *Psychological Assessment*, 19(3), 281–297. <http://doi.org/10.1037/1040-3590.19.3.281>
- Panay, N., Al-Azzawi, F., Bouchard, C., Davis, S. R., Eden, J., Lodhi, I., Rees, M., Rodenberg, C. A., Rymer, J., Schwenkhausen, A., & Sturdee, D. W. (2010). Testosterone treatment of HSDD in naturally menopausal women: The ADORE study. *Climacteric*, 13(2), 121–131. <https://doi.org/10.3109/13697131003675922>
- Panchanadeswaran, S., Johnson, S. C., Mayer, K. H., Srikrishnan, A. K., Sivaram, S., Zelaya, C. E., Go, V. F., Solomon, S., Bentley, M. E., & Celentano, D. D. (2006). Gender differences in the prevalence of sexually transmitted infections and genital symptoms in an urban setting in southern India. *Sexually Transmitted Infections*, 82(6), 491–495. <https://doi.org/10.1136/sti.2006.020768>
- Quinta-Gomes, A. L., Janssen, E., Adaikan, G., & Nobre, P. J. (2021). Sexual inhibition and sexual excitation profiles in men with and without erectile disorder. *Urology*, 161, 71–75. <https://doi.org/10.1016/j.urology.2021.12.004>
- Rosen, R., Brown, C., Heiman, J., Leiblum, S., Meston, C., Shabsigh, R., Ferguson, D., & D'Agostino, R. (2000). The Female Sexual Function Index (FSFI): A multidimensional self-report instrument for the assessment of female sexual function. *Journal of Sex & Marital Therapy*, 26(2), 191–208. <https://doi.org/10.1080/009262300278597>
- Rozin, P., Nemeroff, C., Horowitz, M., Gordon, B., & Voet, W. (1995). The borders of the self: Contamination sensitivity and potency of the body apertures and other body parts. *Journal of Research in Personality*, 29(3), 318–340. <https://doi.org/10.1006/jrpe.1995.1019>
- Sanchez-Zarza, S. C., Mezones-Holguin, E., Lopez-Baena, M. T., Soto-Bcerra, P., Perez-Lopez, F. R., Gavilanes, A. W. D., & Chedraui, P. (2020). Association between depressed mood and sexual function among mid-aged Paraguayan women. *Climacteric*, 23(6), 566–573. <https://doi.org/10.1080/13697137.2020.1742684>
- Santtila, P., Wager, I., Witting, K., Harlaar, N., Jern, P., Johansson, A., Varjonen, M., & Sandnabba, N. K. (2008). Discrepancies between sexual desire and sexual activity: Gender differences and associations with relationship satisfaction. *Journal of Sex & Marital Therapy*, 34(1), 31–44. <https://doi.org/10.1080/00926230701620548>
- Schou-Bredal, I., Bonsaksen, T., Ekeberg, Ø., Skogstad, L., Grimholt, T. K., Lerdal, A., & Heir, T. (2022). Sexual assault and the association with health, quality of life, and self-efficacy in the general Norwegian population. *Journal of Interpersonal Violence*, 37(3–4), 1878–1901. <https://doi.org/10.1177/0886260520926307>
- Shabani, S., Ebrahimbabaei, M., Safavi, P., & Lotfizadeh, M. (2018). Comparing the effect of rose drop, ginger, and cinnamon on sexual function in depressed women with sexual dysfunction. *Pharmacognosy Research*, 10(3), 314–318. https://doi.org/10.4103/pr.pr_150_17
- Spector, I. P., Carey, M. P., & Steinberg, L. (1996). The Sexual Desire Inventory: Development, factor structure, and evidence of reliability. *Journal of Sex & Marital Therapy*, 22(3), 175–190. <https://doi.org/10.1080/00926239608414655>
- Stein, R. A., Schmid, K., Bolivar, J., Swick, A. G., Joyal, S. V., & Hirsh, S. P. (2018). Kaempferia parviflora ethanol extract improves self-assessed sexual health in men: A pilot study. *Journal of Integrative Medicine*, 16(4), 249–254. <https://doi.org/10.1016/j.joim.2018.05.005>
- Stevenson, R. J., Case, T. I., & Oaten, M. J. (2011). Effect of self-reported sexual arousal on responses to sex-related and non-sex-related disgust cues. *Archives of Sexual Behavior*, 40(1), 79–85. <https://doi.org/10.1007/s10508-009-9529-z>
- Thamlikitkul, L., Srimuninnimit, V., Akewanlop, C., Ithimakin, S., Techwathanawanna, S., Korphaisarn, K., Chantharasamee, J., Danchaiwijitr, P., & Soparattanapisarn, N. (2017). Efficacy of ginger for prophylaxis of chemotherapy-induced nausea and vomiting in breast cancer patients receiving Adriamycin-cyclophosphamide regimen: A randomized, double-blind, placebo-controlled, crossover study. *Supportive Care in Cancer*, 25(2), 459–464. <https://doi.org/10.1007/s00520-016-3423-8>
- Toth, B., Lantos, T., Hegyi, P., Viola, R., Vasas, A., Benko, R., Gyongyi, Z., Vincze, A., Csecsei, P., Miko, A., Hegyi, D., Szentesi, A., Matu, M., & Csupor, D. (2018). Ginger (Zingiber officinale): An alternative for the prevention of postoperative nausea and vomiting. A meta-analysis. *Phytomedicine*, 50, 8–18. <https://doi.org/10.1016/j.phymed.2018.09.007>
- Tracy, J. L., Steckler, C. M., & Heltzel, G. (2019). The physiological basis of psychological disgust and moral judgments. *Journal of Personality and Social Psychology*, 116(1), 15–32. <https://doi.org/10.1037/pspa0000141>
- Trivers, R. L. (1972). Parental investment and sexual selection. In B. Campbell (Ed.), *Sexual selection and the descent of man* (pp. 136–179). Aldine.
- Tybur, J. M., Bryan, A. D., Magnan, R. E., & Hooper, A. E. C. (2011). Smells like safe sex: Olfactory pathogen primes increase intentions to use condoms. *Psychological Science*, 22(4), 478–480. <https://doi.org/10.1177/0956797611400096>
- Tybur, J. M., Lieberman, D., & Griskevicius, V. (2009). Microbes, mating, and morality: Individual differences in three functional domains of disgust. *Journal of Personality and Social Psychology*, 97(1), 103–122. <https://doi.org/10.1037/a0015474>
- van Overveld, W. J. M., de Jong, P. J., Peters, M. L., Cavanagh, K., & Davey, G. C. L. (2006). Disgust propensity and disgust sensitivity: Separate constructs that are differentially related to specific fears. *Personality and Individual Differences*, 41(7), 1241–1252. <https://doi.org/10.1016/j.paid.2006.04.021>
- Walstab, J., Krüger, D., Stark, T., Hofmann, T., Demir, I. E., Ceyhan, G. O., Feistel, B., Schemann, M., & Niesler, B. (2013). Ginger and its pungent constituents non-competitively inhibit activation of human recombinant and native 5-HT₃ receptors of enteric neurons. *Neurogastroenterology and Motility*, 25(5), 439–447, e302. <https://doi.org/10.1111/nmo.12107>
- Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, 54(6), 1063–1070. <https://doi.org/10.1037//0022-3514.54.6.1063>
- Zhang, J., Zheng, L., & Zheng, Y. (2017). Moral and sexual disgust suppress sexual risk behaviors among men who have sex with men in China. *Frontiers in Psychology*, 7, 2045. <https://doi.org/10.3389/fpsyg.2016.02045>