

EMPIRICAL PAPER

# Mothers' Perceptions of their Daughters' Susceptibility to HPV-related Risk Factors: An Experimental Pretest Comparing Narrative and Statistical Risk Information

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**Background:** In order to promote HPV-vaccination acceptability among mothers of invited girls, we developed a web-based, tailored intervention. This study reports on an experimental pretest for the component of this intervention targeting mothers' perceptions of their daughters' susceptibility towards HPV-related risk factors. Statistical versus narrative risk information was pretested as research results remain to be mixed on the surplus value of one type over the other in influencing mothers' perceptions of their daughters' susceptibility.

**Methods:** We used data from 375 mothers of girls-to-be invited to the HPV-vaccination round 2014, who were derived from the Dutch National Immunization Register. They were randomly assigned to one of four conditions in a 2 (statistical information: yes or no) × 2 (narrative information: yes or no) between-subjects factorial design.

**Findings:** Mothers who received statistical information felt their daughters were more susceptible towards HPV than mothers who received no statistical information. No main or interaction effects with narrative information were found. The effect of statistical information on mothers' perceptions of their daughters' susceptibility towards HPV was not moderated by perceived comprehensibility, credibility or novelty of the risk information, nor mediated by message-induced imaginability, elaboration, personal relevance, or defensive reactions. However, in secondary analyses, in which we only included the statistical and narrative condition, we found personal relevance to mediate the effect of statistical information (independent variable) on mothers' perceptions of their daughters' susceptibility towards HPV (dependent variable).

**Discussion:** Statistical risk information appeared most effective in increasing mothers' perceptions of their daughters' susceptibility towards HPV and was therefore included in the web-based, tailored intervention promoting HPV-vaccination acceptability.

**Keywords:** experimental pretesting; risk communication; narratives; perceived susceptibility; HPV; cervical cancer

## Introduction

In the Netherlands, HPV-vaccination uptake remains to be low (46%) (Van Lier et al., 2018). Hence, a need exists for evidence-based interventions aimed at increasing HPV-vaccination uptake. Several studies have provided insight in factors constituting HPV-vaccination acceptability (e.g., Alberts et al., 2017; Hofman et al., 2014; Pot et al., 2017; Van Keulen et al., 2013). Results from two Dutch studies among mothers of girls to-be-invited showed that 'modifiable' social-psychological determinants (e.g.,

perceived daughters' susceptibility towards HPV-related risks) accounted for large proportions of variance in HPV-vaccination intention (Van Keulen et al., 2013; Pot et al., 2017). Mothers' intention, in turn, was found to be the main and stable predictor of their daughters' actual uptake (Pot et al., 2017). This was also found by Hofman and colleagues (2014) among parents of invited girls and is in line with social cognitive models such as the Reasoned Action Approach (Fishbein & Ajzen, 2010). Furthermore, mothers appeared most important in the process of decision-making about their daughters' HPV-vaccination (Van Keulen et al., 2013). These insights led to the development of an innovative, interactive, web-based, tailored intervention promoting HPV-vaccination acceptability among mothers of invited girls (Pot et al., 2018).

One of the determinants to be targeted in the intervention was perceived daughters' susceptibility towards

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HPV-related risks because this appeared an important determinant of mothers' HPV-vaccination intention (Van Keulen et al., 2017; Pot et al., 2017). Besides, perceived susceptibility has been shown to be an important factor of preventive behavior according to health theory (e.g., the Health Belief Model; e.g., Schwarzzer, 2001) and research (e.g., Brewer & Fazekas, 2007; Brewer et al., 2007). However, research findings are mixed about the surplus value of either using statistical or narrative risk information in affecting perceived susceptibility (for a review, see Winterbottom et al., 2008).

Therefore, this study is about an online experimental pretest of the effects of statistical versus narrative risk information on mothers' perceptions of their daughters' susceptibility towards HPV-related risks. Experimental pretesting enables researchers to draw reliable conclusions about the feasibility and effectiveness of developed materials in influencing predetermined objectives (Whittingham et al., 2008a; Whittingham et al., 2008b). Hence, this experimental pretest enables (a) drawing a reliable conclusion about which type of risk information is preferred when promoting mothers' perceived daughters' susceptibility towards HPV-related risks, and (b) making an evidence-based decision on which type of risk information to include in the intervention promoting HPV-vaccination acceptability.

#### **Statistical versus Narrative Risk Information**

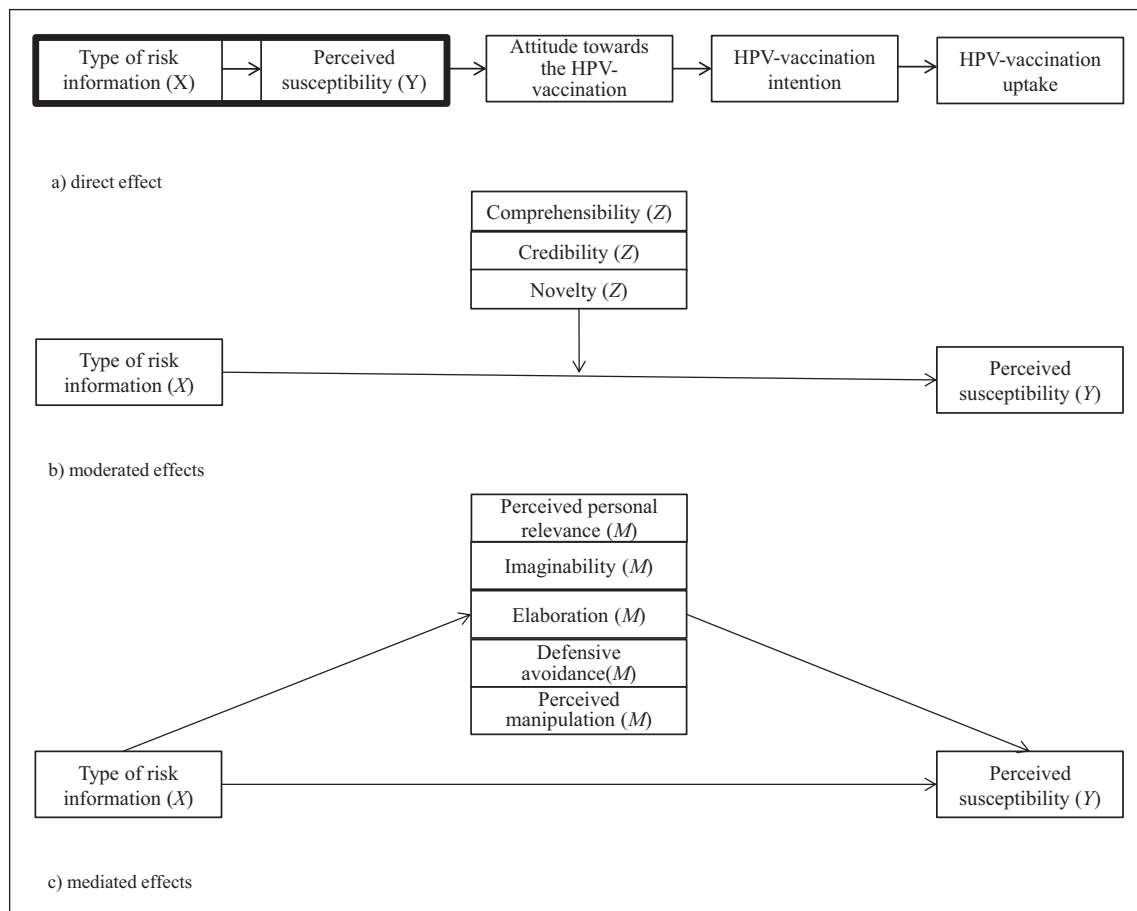
Statistical risk information includes abstracts of numerical data and factual assertions (e.g., prevalence rates) about the probability of contracting a certain health-related outcome (De Wit et al., 2008). It is assumed that confrontation with the likelihood of contracting a risk, people are willing to take preventive actions. For instance, Cox and colleagues (2010) found that parents who received statistical information reported significantly stronger intentions to have their daughter vaccinated against HPV compared to parents who did not receive statistical information. However, there is also evidence for the impact of narratives. A narrative consists of a personal experience of an event, such as somebody getting a disease (Hinyard & Kreuter, 2007). Narratives are suggested to trigger the simulation heuristic (Kahnemann & Tversky, 1982). According to this heuristic, the perceived likelihood of an event is based on the ease to picture the event mentally (Gregory, Cialdini, & Carpenter, 1982; Kahnemann & Tversky, 1982). Narratives are suggested to increase this ease and, therefore, are likely to increase likelihood estimates (Tversky & Kahneman, 1974). De Wit and colleagues (2008) showed that among men who have sex with men, narrative risk information resulted in higher intentions to get the HBV-vaccination than information that only mentioned an increased risk of infection. Finally, Hopfer (2012) found that when college women were exposed to a hybrid message (i.e., a message containing *both* statistical and narrative information), their HPV-vaccination uptake was nearly double compared to when exposed to non-narrative controls (i.e., messages lacking personal decision narratives); 22% versus 12%, respectively. Nan

and colleagues (2015) found that undergraduate students perceived their susceptibility towards HPV to be higher after reading a hybrid message compared to narrative-only and statistics-only messages.

Despite the lack of consensus about the surplus value of statistical versus narrative risk communication, research has pointed at conditions for effectiveness (e.g., Breakwell, 2000; Priester & Petty, 2003). Eagly and Chaiken (1993) pointed at factors moderating or mediating the effectiveness of persuasive (risk) communication. Higher *comprehensibility* (Eagly & Chaiken, 1993, p. 263) and *credibility* (Eagly & Chaiken, 1993, p. 352) of the message are suggested to improve message effects. In addition, information that is perceived as more *novel*, is suggested to increase the likelihood of attitude change (Wyer, 1974, p. 223). Therefore, we explore whether the effectiveness of type of risk communication is moderated by comprehensibility, credibility, and novelty of the message. In other words, we explore whether the effects of risk information depend on the information being believed as more or less comprehensible, credible, and/or novel.

Besides, factors constituting information processing can mediate the effects of risk communication, which is imaginability, elaboration, relevance, and defensive reactions. For instance, Janssen, Van Osch, De Vries, and Lechner (2013) reported that sunbed users who were exposed to narrative information could better imagine themselves contracting skin cancer. Models of attitude change, such as the Elaboration Likelihood Model (Petty & Cacioppo, 1986), state that message *relevance* increases active processing of information, which enhances message effects. However, a growing body of literature also suggests that messages about health risks may evoke *defensive reactions* such as message derogation (i.e., denying the relevance of the message or preventing it from reaching consciousness), denial of one's susceptibility (i.e., defensive avoidance), and/or perceived manipulation (Van't Riet & Ruiter, 2013; Block & Williams, 2002; Liberman & Chaiken, 1992; Ruiter, Verplanken, de Cremer, & Kok, 2004). Defensive reactions reduce message effects because it distracts the recipient's attention to the message (cf. Kessels, Harris, Ruiter, & Klein, 2016). Therefore, the present study also explores whether the effects of risk information are mediated by imaginability, elaboration, relevance, and defensive reactions. In other words, we explore whether the effects of risk information can be explained by how mothers processed the information (e.g., by being perceived as more imaginable). See **Figure 1** for an overview of the theoretical framework.

To summarize, this study is an online experimental pretest of materials developed for an intervention promoting HPV-vaccination acceptability targeting mothers of invited girls. Specifically, we aim to assess the effectiveness of statistical versus narrative risk information in influencing perceived daughters' susceptibility towards HPV and cervical cancer. To our knowledge, the effects of risk information on the latter remain to be unexplored. Another novel aspect of this study is that it explores underlying conditions and mechanisms.



**Figure 1:** A schematic overview of the theoretical framework of perceived susceptibility in which the direct **(a)**, moderation **(b)** and mediation effects are depicted **(c)**.

*Notes:* The focus of this study can be found within the bold square (direct effects; a); variables within this study:  $X$  = predictor variable;  $Y$  = outcome variable;  $Z$  = moderator;  $M$  = mediator.

## Methods

### Recruitment

Participants were recruited by postal mail via Praeventis, the Dutch vaccination register. Praeventis has the name, sex, address and birth date of all Dutch children up until 18 years old. A computer program was used to draw a random sample of mothers of girls born in 2001 from Praeventis (i.e., girls to-be-invited for the HPV-vaccination round of 2014).

### Design

Mothers were randomly assigned by the computer to one of four conditions in a 2 (statistical information: yes vs no)  $\times$  2 (narrative information: yes vs no) between-subjects factorial design.

### Procedure

An invitational letter was sent to selected participants' home addresses. This included information about the study, contact details of the researchers, a link to the website, and a personal entrance code. As a reimbursement, a subscription to a magazine was raffled among eligible participants. When participants logged in to the experiment, they were first informed about the study purpose, followed by instructions for completing the

experiment. After having provided informed consent, participants were assigned to one of four conditions. All participants received general information about HPV, cervical cancer, and the HPV-vaccination. Next, mothers in the experimental conditions additionally received risk information (See 'manipulations'). After this, participants proceeded with self-report questionnaires that accounted for the dependent variables, proposed mediators and moderators, and socio-demographics. Finally, mothers were debriefed and thanked for their participation. On average, mothers needed 15 minutes to complete the experiment.

### Required Sample Size

Based on the literature (e.g., Mevissen et al., 2009; De Wit et al., 2008), we expected a medium effect size on primary outcomes ( $\eta^2 = .06$ ; Cohen, 1988). In our design with 2 means per factor, this effect size value corresponds to a  $d$ -value of 0.50, and an  $f$ -value of 0.25. Power analysis showed that a minimal sample size of 32 participants per condition was needed (with power = 0.80, and two-sided = 0.05; Hintze, 2004). We took into account an attrition rate of 30% and a response rate of 5%, based on previous experiences (Van Keulen et al., 2013). Consequently, 3,680 mothers were invited.

### Data Collection Period

The experimental pretest was conducted between September and October 2013.

### Operationalisations

#### Measurements

Socio-demographics included participants' age, gender, educational level, country of birth, and religion. Level of education accounted for mothers' highest level of education they had completed. This was classified as low (less than secondary or vocational education), intermediate (secondary through pre-university education), or high (professional or university education) (Van Keulen et al., 2013). Mothers were asked about their religious conviction (Protestant, Roman Catholic, Muslim, Jewish, Buddhist, Hindu, other, or no religion) (Van Keulen et al., 2013). Research has shown that more Dutch Protestants refrain from vaccination compared to the other (non) religious groups (Van Keulen et al., 2013). This was confirmed in our sample, hence religion was dichotomized into 'Protestant' versus 'not Protestant'. Country of birth was dichotomized into 'Netherlands' versus 'other' as in our sample only 6% participants were born in a country other than the Netherlands.

Criteria for effectiveness. The outcome criteria were mothers' perceived daughters' susceptibility and mothers' HPV-vaccination intention. Mothers' perceived daughters' susceptibility towards HPV and towards cervical cancer was measured by 7-point scaled item, each: 'Without the HPV-vaccination, the chances of my daughter for getting infected with HPV (getting cervical cancer) are ...' (1 = very small; to 7 = very big) (Pot et al., 2017; Van Keulen et al., 2013). HPV-vaccination intention was measured as a composite of two items: 'Are you planning to have your daughter vaccinated against HPV?' and 'What are the chances that you will get your daughter vaccinated against HPV?' (Pot et al., 2017; Van Keulen et al., 2013). Responses were given on a 7-point scale ranging from (1) certainly not/very small/to (7) certainly/very big (Pearson's  $r = .95$ ).

Items measuring the moderating and mediating factors (except for 'defensive avoidance, see below) referred to the specific type(s) of information the mothers had received (i.e., general and/or statistical and/or narrative risk information). Thus, mothers evaluated each specific type of information separately. For mothers in the experimental conditions, a mean score per moderating and mediating factor had to be calculated. This means that, for instance, credibility for mothers in the statistical information condition represents the mean score of perceived credibility of the general and the statistical information.

Moderating factors. Comprehensibility was assessed by a composite of three items accounting for the extent to which mothers understood the information, and whether they considered the text to be clear and readable (Mevisen et al., 2009). Responses were given on a seven-point scale ranging from (1) not at all understandable/very unclear/very readable to (7) fully understandable/very clear/very readable (Cronbach's  $\alpha = .87$ ). Credibility was measured with the single-item: 'To what extent do you believe the content of the text is credible?'

(1 = very incredible; to 7 = very credible) (Mevisen et al., 2009). Novelty was measured with a single-item: 'To what extent does the text contain new information for you?' (1 = much new information; to 7 = much known information) (Mevisen et al., 2009).

Mediating factors. Imaginability was measured with one item for HPV and one item for cervical cancer: 'Because of the text, I could imagine my daughter getting HPV/cervical cancer' (1 = totally disagree; to 7 = totally agree) (Broemer, 2004; Janssen et al., 2013; Mevisen et al., 2010). Elaboration was assessed by a single item 'How well did you read the information?' (1 = not carefully at all; to 7 = very carefully) (Chaiken, 1980). Personal relevance was measured with the item 'I considered the text to be personally relevant' (1 = totally disagree; to 7 = totally agree) (Mevisen et al., 2009). Defensive avoidance was accounted for by two 7-point scaled items (one referring to HPV and the other to for cervical cancer): 'I'd rather not think about my daughter getting infected with HPV/developing cervical cancer' (1 = totally disagree; to 7 = totally agree) (Van't Riet & Ruiter, 2013). Perceived manipulation of the information was measured by the item 'I considered the text to manipulate my beliefs' (1 = totally disagree; to 7 = totally agree) (Mevisen et al., 2009; Van't Riet et al., 2010).

#### Manipulations

The text messages were pretested among a sample of mothers ( $N = 10$ ) to assure comprehensibility, and, for the narrative message, to assure that mothers were able to imagine the situation.

*General information* (see Appendix A). All participants received general information about HPV, cervical cancer, and the HPV-vaccination, to ensure their background knowledge was similar.

*Statistical risk information* (see Appendix B). The statistical message was based on data from the Dutch National Institute for Public Health and Environment and data released by the Dutch Health Council (Gezondheidsraad, 2008). It presented factual epidemiological information about the prevalence of HPV and cervical cancer among women and information about the reduction in cervical cancer cases to be expected when all girls would obtain the HPV-vaccination. The latter was based on a study by Cox and colleagues (2010): "when no girl gets the HPV-vaccination, 600 women per year will get cervical cancer. However, when all girls get the HPV-vaccination, 300 women per year (half of 600) will be saved from getting cervical cancer".

*Narrative risk information* (see Appendix C). The narrative message was based on a personal story derived from an Internet health forum of a woman who had found out she had cervical cancer, caused years ago by an HPV-infection. It was reported in the first person, because research has shown this to be more effective in influencing perceived susceptibility than the third person (Nan et al., 2015). We changed the name of the woman into 'Anne', because it is relatively common in The Netherlands, and not specific to individuals with certain backgrounds. She was 30 years old, as it typically takes 10–20 years for an HPV-infection to

develop into cancer (Weinberg, 1999). It was emphasized that she got infected with HPV, despite having had an overall safe sex life (Manhart & Koutsky, 2002; Moscicki, 2005). To ensure mothers that the message concerns their daughters' HPV-vaccination, Anne ended her story by noting: "With the HPV-vaccination that is available now, I sometimes can't help but wonder: 'what if I had gotten myself vaccinated against HPV 18 years ago...'"

The statistical and narrative information were approximately of the same length (i.e.,  $\pm 300$  words).

### Analysis Plan

A two-way analysis of variance (ANOVA) was conducted to examine the impact of the different types of risk information on perceived susceptibility and intention. Mediation and moderation analyses were examined using SPSS PROCESS macro (2.12.1 release), a widely used regression-based approach (Hayes, 2013).

For moderation analysis, the independent variable and the proposed moderator were entered in the model in the first step, followed by the interaction between the independent variable and the moderator in Step 2. The interaction (i.e., moderation) was assumed significant when  $p < .05$ . For mediation analyses, the PROCESS macro first conducted the following hierarchical regressions: the mediators (M) were regressed onto the independent variable (X) and the dependent variable (Y) was regressed onto both the independent variable and the mediator. We assumed mediation when the following conditions were met: (1) X has an effect on M, (2) M has an effect on Y when controlling for X, and (3) the effect of X on Y becomes significantly smaller or non-significant when controlling for M. Then, in order to test the indirect effect for significance, the bootstrapping method was utilized. The indirect effect represents the influence of the mediating variable on the original relation between X and Y. A value of 0 indicates no impact. A bias-corrected 95% bootstrap model with confidence intervals resampled 5,000 times for each analysis was used to judge significance (Shrout & Bolger, 2002); if the bootstrap confidence interval did not include zero, mediation was supported. This method was chosen as it is considered to maximize power and is robust against non-normality (Hayes, 2013).

### Software

The power calculation was conducted with PASS software (Hintze, 2004). The online experiment was developed using TailorBuilder © computer software. Main, moderation, and mediation analyses were conducted using SPSS version 22 (IBM Corp., 2013).

### Ethics

This experiment was part of a larger study, for which ethical approval was obtained from the ethical committee of the VU Medical Center in Amsterdam.

## Results

### Sample Description

Of the invited individuals ( $n = 3,680$ ), 467 initiated the study (13%). Inclusion criteria were that participants had to (1) provide informed consent online (excluded:  $n = 1$ ),

(2) fully complete the questionnaire (excluded:  $n = 72$ ), and (3) be female (excluded:  $n = 19$ ). This resulted in a final sample of 375 (11%) mothers.

The mean age of mothers was 43 years ( $SD = 4.05$ ). Almost all mothers were born in the Netherlands (94%) and almost half of the mothers were high in education (42%). A relatively small percentage was Protestant (16%).

### Univariate Analyses

ANOVA revealed a significant main effect of statistical risk information on mothers' perceived daughters' susceptibility towards HPV ( $F(1, 371) = 7.56, p < .01$ ). Mothers who received statistical information perceived their daughters' susceptibility towards HPV to be higher ( $M = 4.11, SD = .10$ ) than mothers who did not receive statistical information ( $M = 3.73, SD = .09$ ). There was no main effect of narrative risk information on perceived daughters' susceptibility towards HPV ( $F(1, 371) = .00, p = .97$ ), nor was there a significant interaction-effect between statistical and narrative information on perceived daughters' susceptibility towards HPV ( $F(1, 371) = 1.54, p = .22$ ). No significant main or interaction effects were found on mothers' perception of their daughters' susceptibility towards cervical cancer ( $F's < 2.10; p's > .15$ ) or on HPV-vaccination intention ( $F's < .83; p's > .36$ ). See **Tables 1–3** for the mean scores on the outcomes per condition.

**Table 1:** Mean scores ( $SD$ ) on susceptibility towards HPV (1–7;  $N = 375$ ).

	Statistical risk information	No statistical risk information
Narrative information	4.02 (1.28) <sup>ab</sup>	3.82 (1.23) <sup>ab</sup>
No narrative information	4.19 (1.43) <sup>a</sup>	3.65 (1.26) <sup>b</sup>

*Notes:* A higher score represents a higher perceived daughters' susceptibility towards HPV. Values with different superscripts differ significantly ( $p < .05$ ).

**Table 2:** Mean scores ( $SD$ ) on susceptibility towards cervical cancer (1–7;  $N = 375$ ).

	Statistical risk information	No statistical risk information
Narrative information	3.65 (1.18)	3.81 (1.17)
No narrative information	3.79 (1.31)	3.60 (1.08)

*Notes:* A higher score represents a higher perceived daughters' susceptibility towards cervical cancer. Differences between the groups were nonsignificant.

**Table 3:** Mean scores ( $SD$ ) on HPV-vaccination intention (1–7;  $N = 375$ ).

	Statistical risk information	No statistical risk information
Narrative information	6.01 (1.42)	5.92 (1.42)
No narrative information	5.76 (1.62)	5.88 (1.56)

*Notes:* A higher score represents a higher HPV-vaccination intention. Differences between the groups were nonsignificant.

### Moderation and Mediation Analyses

Moderation and mediation analyses were performed using statistical risk information (yes versus no) as the independent variable and mothers' perception of their daughters' susceptibility towards HPV as the dependent variable. No significant interaction effect was found with any of the proposed moderators (comprehensibility, credibility and novelty;  $p$ 's > .05). Also, we didn't find any support for an indirect impact of statistical risk information on mothers' perception of their daughters' susceptibility towards HPV via the proposed mediators (i.e., imaginability, elaboration, perceived personal relevance, defensive avoidance and perceived manipulation). Overall, mean scores on the moderators and mediators were high (except for defensive avoidance and perceived manipulation). Differences between the conditions were small and nonsignificant (See **Table 4**).

### Discussion

This study was an experimental pretest of materials targeting mothers of invited girls developed for a web-based, tailored intervention promoting HPV-vaccination acceptability. We tested the effectiveness of statistical versus narrative risk information on affecting how mothers' perceived their daughters' susceptibility towards HPV and cervical cancer. Results showed that statistical information increased mothers' perceptions of their daughters' susceptibility towards HPV. Such a positive

effect was also found by Mevissen and colleagues (2009), within the context of Chlamydia: participants felt more susceptible to a Chlamydia infection after they read statistical risk information compared to those exposed to narrative or no risk information. These results made us decide to include statistical information as the mode of communication about HPV-related risks in the web-based intervention.

We did not find statistical risk information to affect mothers' perceptions of their daughters' susceptibility towards getting cervical cancer. This might be related to the actual difference in the likelihood of contracting HPV (high probability), relative to contracting cervical cancer (low probability). In the present study, we found that mothers who received no risk information highly overestimated the probability of their daughter contracting cervical cancer when looking at the actual incidence in the Netherlands (Integraal Kankercentrum Nederland, 2013). It seems unlikely that exposure to statistical information – presenting the actual low probability rate – would increase mothers' perceptions of the daughters' susceptibility for contracting cervical cancer.

Mothers who received no risk information perceived the chance of their daughter contracting HPV or cervical cancer to be almost similar, while in fact, the chance of contracting HPV is much higher (Integraal Kankercentrum Nederland, 2013). It seemed that mothers *underestimated* the risk for HPV, and *overestimated* the risk for cervical cancer. The tendency to overestimate small frequencies and underestimate larger ones is well known (Fischhoff, Bostrom & Quadrell, 1993; Lichtenstein et al., 1978). Correcting mothers' misperceptions about the risks of their daughter contracting HPV and cervical cancer, would provide a more realistic and bases for initiating processes of informed decision-making.

In this study, narrative risk information had no effect on how mothers perceived their daughters' susceptibility towards HPV or cervical cancer. We hypothesized narratives to have an effect by increasing the ease of imagination (Kahnemann & Tyversky, 1982). However, secondary analysis indicated that mothers could imagine their daughter contracting both HPV and cervical cancer *less* easily after reading the narrative compared to the statistics. The absence of an effect of narrative information may also have been associated with difficulty for mothers to identify their adolescent daughter with the 30-year-old woman getting cervical cancer. For narrative risk information to be effective, it is important that one can identify him- or herself with the narrative (Cohen, 2001; de Graaf et al., 2012). Difficulties with mothers' identification of their daughter may also have been associated with the relatively young age at which the character had sex for the first time (i.e., 16 years old). In 2017, 28% of Dutch girls aged 15–17 has had sex for the first time, compared to 67% of girls aged 18–20 (De Graaf et al., 2017). Finally, mothers may not have been 'transported' into the narrative enough. Transportation into narrative worlds, or immersion into a story, is a primary mechanism of narrative persuasion (Green & Brock, 2000). Unfortunately, we did not assess the degree of mothers' identification of the

**Table 4:** Mean scores (*SD*) on moderators and mediators of those who did versus those who did not receive statistical risk information ( $N = 375$ ).

	No Statistical Risk Information ( $n = 191$ )	Statistical Risk Information ( $n = 184$ )
<i>Proposed moderators*</i>		
Comprehensibility (1–7)	5.83 (.91)	5.80 (.86)
Credibility (1–7)	5.60 (1.11)	5.58 (.99)
Novelty (1–7)	4.70 (1.40)	4.92 (1.20)
<i>Proposed mediators*</i>		
Imaginability HPV (1–7)	5.76 (.91)	5.74 (.81)
Imaginability cervical cancer (1–7)	5.59 (1.04)	5.63 (.90)
Elaboration (1–7)	5.93 (.97)	5.86 (.84)
Perceived personal relevance (1–7)	5.24 (1.10)	5.42 (1.04)
Defensive avoidance HPV (1–7)	3.65 (2.02)	3.42 (2.00)
Defensive avoidance cervical cancer (1–7)	3.68 (2.06)	3.64 (2.10)
Perceived manipulation (1–7)	3.70 (1.64)	4.09 (1.50)

Notes: \*A higher score represents a higher score on the moderator/mediator. Differences between the groups were nonsignificant.

daughter with the story's character nor did we measure the extent of transportation into the narrative.

Although mothers who received statistical information felt their daughters were more susceptible towards HPV, this did not result in a higher HPV-vaccination intention. An explanation comes from social cognitive models of health behavior (e.g., the Health Belief Model and the Health Action Process Approach; Schwarzer, 2001, 2008) and earlier research (Pot et al., 2017; Van Keulen et al. 2013), which indicate that perceived daughters' susceptibility is not the sole determinant of mothers' intention to have their daughter vaccinated against HPV. Thus, to influence intention, communication should as well target other relevant determinants of HPV-vaccination uptake (e.g., attitudinal beliefs) (Pot et al., 2017; Van Keulen et al., 2013). In the web-based intervention, other relevant determinants of HPV-vaccination uptake were also targeted.

The effect of statistical risk information on mothers' perceptions of their daughters' susceptibility towards HPV was not moderated by message characteristics (i.e., comprehensibility, credibility and novelty), nor was it mediated by factors constituting information processing (i.e., imaginability, elaboration, perceived personal relevance, and defensive reactions). This indicates that, in this study, statistical risk information increased mothers' perceptions of their daughters' susceptibility towards HPV irrespective of the information being believed as more or less comprehensible, credible or novel. Moreover, the increase in mothers' perceptions of their daughters' susceptibility towards HPV could not be explained by how mothers processed the statistical information (e.g., by being perceived as more imaginable). This absence of effects may be related to the fact that we were forced to compute a mean for moderating and mediating factors when mothers received more than one type of information. Thus, for the combination condition, the evaluations of three pieces of risk information (i.e., the general, statistical *and* narrative information) were averaged. Moderation and mediation was tested between the subgroups 'statistical risk information' (i.e., statistical and combination condition) and 'no statistical risk information' (i.e., no risk information and narrative risk information condition). It could well be that actual differences between the statistical versus narrative information were diluted because of this averaging over the separate pieces of risk information. An indication for this comes from secondary analyses, in which we only compared the statistical ( $n = 102$ ) and narrative condition ( $n = 89$ ) (i.e., the general and combination condition were excluded) on the moderator and mediator evaluations of the experimental information only (i.e., the evaluations of the general information was excluded). This way, the scores for moderating and mediating factors did not have to be averaged. Mean scores on moderating and mediating factors differed significantly between the two conditions for the moderator comprehensibility (i.e., mothers understood the narrative better) and for the mediators imaginability (i.e., mothers could imagine their daughter contracting both HPV and cervical cancer better after reading statistics) and personal relevance (i.e., mothers judged the statistics as more relevant). In addition,

we found personal relevance to mediate the effect of statistical information on mothers' perceived daughters' susceptibility towards HPV: statistical information was judged more personally relevant, which increased mothers' perceptions of their daughters' susceptibility towards HPV. This is in line with the Elaboration Likelihood Model (Petty & Cacioppo, 1986), which suggests that message relevance increases active processing of messages, which in turn enhances message effectiveness if persuasive arguments are perceived as strong. Moreover, this implicates that statistical risk information may be particularly effective for persons who perceive the information as being personally relevant. Hence, statistical messages should be designed in a way that is personally relevant to the message recipient. This can be done, for instance, by tailoring the message to the recipient, as tailored messages have shown to improve personal relevance (Kreuter & Wray, 2003). Finally, this raises the question whether the effects of statistical information would be even stronger in influencing one's own perceived susceptibility instead of someone else's susceptibility. Future studies could include dyads (mother/father-daughter) to examine this.

### **Limitations**

This study had several limitations worth mentioning. First, we did not include identification nor transportation as mediators, which could have helped in disentangling why the narrative used in this study, was not effective since these factors have been shown to be important effect conditions for narratives (Cohen et al., 2001; de Graaf et al., 2017). Second, we cannot exclude that the general information affected mothers' perceived daughters' susceptibility. However, general information is an essential element in communication about the HPV-vaccination, as sufficient knowledge is a prerequisite for an informed decision (Marteau, Dormandy & Michie 2001). Third, the use of single-item measures represents a limitation. These are suggested to be less stable, reliable, and precise compared to multi-item measures (Bowling, 2005). The questionnaire used for this experiment included additional questions about design features of the developed intervention. In order to reduce the time burden for participants, single-items were used. Finally, response rate was low (11%). Although it was higher than found in a previous study which recruited mothers through Praeventis (Van Keulen et al., 2013), the low response rate could be explained by the use of a written invitation letter. Research has shown written invitations to result in lower response rates compared to e-mail invitations in studies using online questionnaires (Manfreda et al., 2008). Due to the low response rate, caution is needed in generalizing the study results.

### **Recommendations for Future Research**

We recommend future research to investigate how to best present statistical risk information to maximize its effectiveness. For instance, Cox and colleagues (2010) found that parents who viewed a graphic presentation of statistical information had a higher HPV-vaccination intention compared to parents who viewed a nongraphic

presentation. Furthermore, we recommend future research to investigate how to make narratives about HPV-related risks more effective, as we still believe narratives to be a promising method in communicating about HPV-related risks (e.g., De Wit et al., 2008; Janssen et al., 2013; Mevissen et al., 2012). To improve effectiveness, future research could use strategies such as multiple narrative messages (Mevissen et al., 2010), self-construed narratives (Mevissen et al., 2012), and tailoring the narrative to the recipients characteristics (Kreuter et al., 2007).

### Take Home Messages

Statistical risk information was most effective in increasing mothers' perceived daughters' susceptibility towards HPV and was therefore implemented in the web-based, tailored intervention promoting HPV-vaccination acceptability. Future research is needed on (a) how to best present statistical risk information and (b) how to make narratives about HPV-related risks more effective.

### Additional Files

The additional files for this article can be found as follows:

- **Appendix A.** General information. DOI: <https://doi.org/10.5334/hpb.7.s1>
- **Appendix B.** Statistical risk information. DOI: <https://doi.org/10.5334/hpb.7.s1>
- **Appendix C.** Narrative risk information. DOI: <https://doi.org/10.5334/hpb.7.s1>

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### Competing Interests

The authors have no competing interests to declare.

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