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Health behavior education, e-research and a (H1N1) influenza (Swine Flu): bridging the gap between intentions and health behavior change

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Abstract

This study examined relations between risk perception/self-efficacy and handwashing intentions/behaviors during the A (H1N1) pandemic influenza. Data were collected from a longitudinal sample of Costa Ricans ($N_{T1/T2}$ = 449/97). Results revealed that males and females presented a different social cognitive pattern in reaction to A (H1N1) pandemic. In females, the effects of risk perception/self-efficacy on handwashing behaviors were fully mediated by handwashing intentions. In males, self-efficacy influenced both directly and indirectly on handwashing behaviors, and risk perceptions showed no significant effect on handwashing behaviors. These results suggest that gender oriented protocols should be adopted by public health authorities in order to educate males and females in preventing both A (H1N1) and seasonal influenza.

Keywords: Health behavior education, e-research, A (H1N1) influenza, HAPA-model

1. Introduction

1.1. A (H1N1) Pandemic Influenza and Infection Control

During March 2009, a rapid augment in the number of an acute respiratory infection, combined with severe pneumonia, alerted health authorities in Mexico. The unexpected increase in the new infection was identified by health authorities at the beginning of April 2009 as a new type of influenza: A (H1N1). The general population was alerted by the mass media about the emergence of a new "swine flu" that mortally affected human beings. In the middle of April 2009, Canada and the United States of America (USA) first confirmed positive cases of A (H1N1) influenza. Costa Rica was the second country in Latin America reporting a positive case of A (H1N1). In reaction to global threats of the new influenza, the World Health Organization (WHO) declared the 11th of June of 2009, a pandemic phase six. One month later, more than 160 countries around the globe have reported more than 170,000

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cases of A (H1N1) influenza with over 1,400 mortal cases. In response, local health authorities and mass media published recommendations on clinical management and public health measures. However, the civil population and authorities remained uncertain on the number of vaccine doses necessary to get a satisfactory immune response, as well as the effectiveness of antiviral medication (WHO, 2009).

In the context of vaccine and antiviral medication uncertainty, behavior recommendations about healthcare infection control for influenza type diseases became key factors. Education on hand hygiene (health behavior), the use of protective masks, and the recognition of risk factors (risk perception) and symptoms identification (knowledge) were, among others, fundamental measures in coping with the threats of A (H1N1) influenza. According to Boyce and Pittet (2002), for generations, good hand-hygiene practices and adherence to handwashing recommendations at home, at work and in health care settings were secure practices to prevent acquisition of multiple forms of bacteria and viruses. As a global challenge, the question, however, prevailed on how to motivate people in adopting and maintaining good hand hygiene habits in order to cope with the threat of A (H1N1) influenza.

1.2. Protective Behaviors during Pandemics

Bish and Michie (2010) revised twenty-six studies from The Web of Science and PubMed databases in order to identify predictors of three different protective behaviors (preventive, avoidant, and management of illness) in coping with severe acute respiratory syndrome, avian influenza/flu (H5N1), swine influenza/flu (H1N1), and related pandemics. Studies have been conducted in addressing two types of relations: (a) associations between demographics and protective behaviors, and (b) psychological factors associated with carrying out these behaviors.

Specifically, for the A (H1N1) pandemic influenza, studies have demonstrated that at the beginning of this pandemic, augment in age was linked to higher frequency of handwashing behavior (Jones & Salathe, 2009). As for gender, Rubin, Amlột, Page, and Wessely (2009) found, that women were more likely to adopt recommendations for handwashing and cleaning surfaces facing the A (H1N1) pandemic influenza. In terms of educational levels, studies conducted in Hong Kong (Tang & Wong, 2004), Australia (Barr, Raphael, Taylor, Stevens, Jorm, Giffin, & Lujic 2008), and Korea (Hong & Collins, 2006) revealed that higher educated people were more likely to adopt a set of protective behaviors, such as handwashing, respiratory hygiene, mask wearing, handwashing after touching contaminated surfaces, and the intention to get a vaccine. However, a study conducted in the USA showed that less educated people were more likely (to express the desire) to be vaccinated against the swine flu (Quinn, Kumar, Freimuth, Kidwell, & Musa, 2009). Furthermore, investigations conducted in the United Kindom (Rubin, Amlột, Page, & Wessely, 2009) revealed that unemployed populations, and those with no educational qualifications, were more likely to adopt preventive behaviors.

As for studies conducted in Europe and Asia (e.g., Jones & Salathe, 2009, Brug, Aro, Oenema, de Zwart, Richardus, & Bishop, 2004), emphasizing on psychological factors associated with carrying out preventive behaviors, significant relations have been found between risk perceptions, self-efficacy and preventive behaviors. An online study developed in the first wave of the swine flu showed that higher risk perception to develop swine flu was related to the adoption of more preventive behaviors (Jones & Salathe, 2009). This study also showed that individuals with higher self-confidence, as an ability to avoid swine flu infection, showed higher frequencies in the adoption of avoidant behaviors as to diminish the risk of getting swine flu (Jones & Salathe, 2009).

The majority of revised investigations, nevertheless, lack an explicit theoretic framework, and most designs were cross-sectional and therefore not predictive over time (Bish & Michie, 2010).

A recent study conducted in Germany by Reuter and Renner (2011) evaluated a health behavior model in order to predict which population adopts what kind of precautionary actions facing A (H1N1) pandemic influenza. Specifically, the study examined, how cognitive and affect-related risk perceptions were related to precautionary behavior. Reuter and Renner evaluated three different longitudinal models at three different times (Time 1, T1 = October 2009, Time 2, T2 = December 2009, Time 3, T3 = 1-2 days after T2): The first model predicted the hand sanitary pick-up rate on T3, predictors were cognitive/affective risk perceptions gathered at T2. For the second model, cognitive risk perception on T1 was defined as the predictor of affective risk perception at T2, which in return was defined as the predictor of hand sanitary pick-up rates measured at T3. The third model also predicted the pick-up rate measured at T3, examining whether T1-T2 changes in cognitive risk perceptions were related to T1-T2 changes in affective risk perceptions, and whether former changes predicted hand sanitary pick-up rates measured on T3.

The three models showed evidence of parallel impact (direct effects), time-sequence impact (direct and indirect effects), and dynamic change (direct and indirect effects), respectively. The three models have in common the unique dependent variable hand sanitary pick-up rate, even though model two and three have in common that affective risk perception functions as a mediator of the effects of predictors on the criterion variable. Particularly, results of Model 1 revealed that higher negative affect regarding swine flu at T2 was associated with higher hand sanitary pick-up rate at T3. As for Model 2 and Model 3, results revealed that negative affect-related risk perception at T2 mediated the effects of likelihood, severity and likelihood*severity on hand sanitary pick-up rate at T3. Significant effects emerged from analyses in both, the sequential model and the dynamic change model. Effects remained significant after controlling for age and sex (Reuter & Renner, 2011).

In a similar though different way, the current study aimed to predict, from a social-cognitive viewpoint, the development of protective behaviors during the A (H1N1) pandemic influenza in 2009-2010. Specifically, this study was primarily driven by theoretical assumptions of Health Action Process Approach Model (HAPA-Model), by emphasizing the mediating role of handwashing intentions in the relationship that exists between handwashing self-efficacy beliefs, risk perception of developing swine flu/common influenza, and protective handwashing behaviors during the A (H1N1) pandemic influenza. Next, theoretical basis and study assumptions are described.

1.3. Health Action Process Approach and Infection Control of A (H1N1)

During the last 15 years, attention has been given to applications of the Health Action Process Approach Model (HAPA-Model) in several fields such as physical exercise, breast self-examination, seat belt use, dietary behaviors, and dental flossing (Gutiérrez-Doña, Lippke, Renner, Kwon, & Schwarzer, 2009; Reuter, Ziegelmann, Wiedemann, Geiser, Lippke, Schüz, & Schwarzer, 2010; Renner, Kwon, Yang, Paik, Kim, Roh, Song, & Schwarzer, 2008; Schwarzer, 2008). The current study is the first documented investigation that evaluates selected HAPA-Model assumptions in the context of protective handwashing behaviors during the A (H1N1) pandemic influenza in Spanish speaking populations.

Figure 1 represents causal relations susceptible of empirical analyses by means of structural equation modeling. Specifically, the HAPA-Model postulates that self-efficacy, outcome expectancies, and threats/risks (as function of severity and vulnerability) are the most important predictors of volitional processes (action plans and action control) through the influence on intentions. There are two ways of exploring HAPA-Model relations. One is the stage model approach and the other is the continuum model approach. The first emphasizes on the qualitative stages of behavior change, just as the Transtheoretical Model of Behavior Change (DiClemente & Prochaska, 1982) does, whereas the second stresses the likelihood of behavior change as the Health-Protective-Behavior Model (Weinstein, 2007) does. The HAPA-Model integrates both visions into a unique model which distinguishes between (a) preintentional motivation processes that lead to a behavioral intention, and (b) postintentional volition processes that lead to the actual health behavior (Schwarzer, 2008).

As shown in Figure 1, in the motivational phase, self-efficacy, risk perception and positive outcome expectancies are necessary cognitions in forming intentions to adopt health behaviors. After a person has developed an intention towards precautionary behavior, intentions should be transformed into actions. This process is not the result of a simple intention; it requires complex self-regulatory skills and strategies that can be divided into several proximal predictors that involve maintenance self-efficacy, action planning/coping planning and recovery self-efficacy (Schwarzer, 2008).

It is particularly important to this study to evaluate the role played by handwashing self-efficacy and risk perception of developing swine flu and common influenza as preintentional motivation processes that may lead to a behavioral intention, and subsequently to the actual handwashing behavior. The ultimate goal of this work is to provide health authorities and citizens with educational protocols that are theory driven, in order to support people in coping with future threats of swine flu and common influenza.

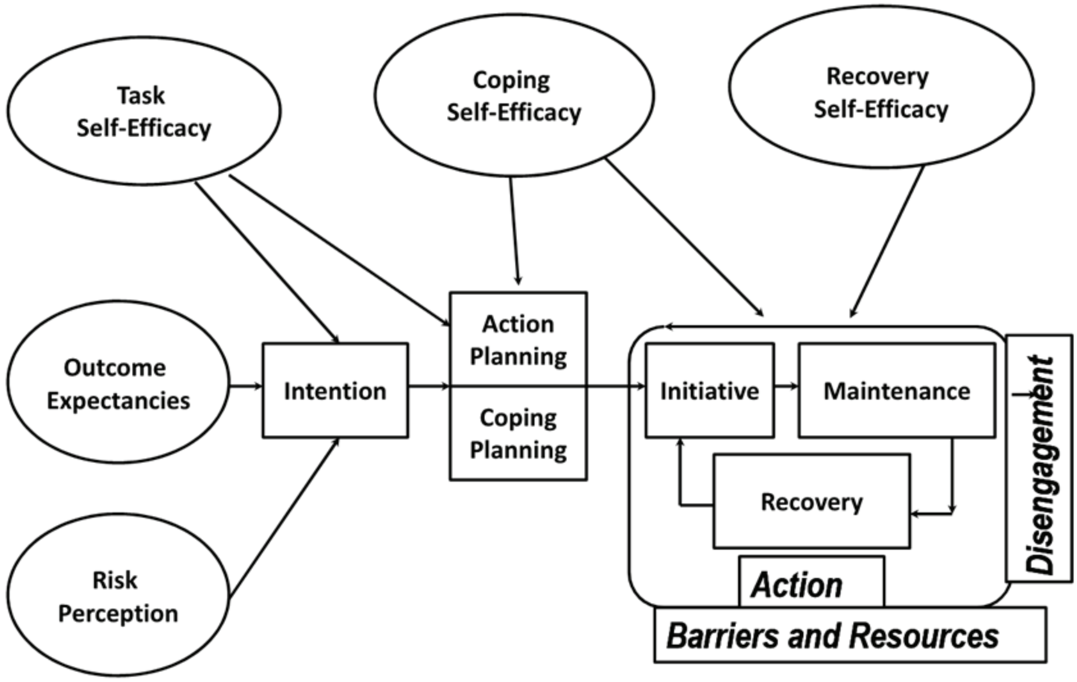

Figure 1. Health Action Process Approach (Schwarzer, 2008).

1.4. Hypotheses on the Relationship between Demographics, Handwashing Intentions and Handwashing Behaviors at T1 and T2

Considering research results provided by scientific literature and our own study design, the following hypothesis is evaluated here:

Hypothesis 1: It is expected that at T1 and T2, females and elderly people should be more likely to develop handwashing intentions and to adopt handwashing behaviors, as compared to males and younger people.

1.5. Hypotheses on the Mediating Role of Intentions in the Preintentional Motivation -Postintentional Volition Relationship at T1 and T2

Taking into account selected HAPA-Model assumptions regarding (a) preintentional motivation processes that lead to a behavioral intention, and (b) postintentional volition processes that lead to the actual health behavior, the following set of hypotheses are evaluated here:

Hypothesis 2: It is expected that T1 handwashing intentions should be a good mediator of the effects of T1 handwashing self-efficacy and T1 risk perception of developing swine flu and common influenza on T1 handwashing behaviors. Preintentional processes should have direct and indirect effects on actual behavior at T1.

Hypothesis 3: It is expected that a different pattern of causal relations between males and females emerge from analyses of the relationship between T1 handwashing self-efficacy, T1 risk perception of developing swine flu and common influenza and T1 handwashing intentions and T1 handwashing behaviors. In this case, preintentional processes should have a different pattern of direct and indirect effects on actual behavior at T1 as a function of the moderating effect of gender.

Hypothesis 4: After controlling for the effects of T1 handwashing behavior, it is expected that T1 risk perception of developing swine flu and common influenza and T1 handwashing self-efficacy should positively impact T2 handwashing behaviors, both directly and indirectly through the mediation effect of T1 handwashing intentions.

2. Method

2.1. Participants and Procedure

This work was part of the CARE Project, a broader research endeavor on health behaviors and risk perceptions on A (H1N1) influenza led by the University of Konstanz, in Germany, and with the collaboration of the Distance State University of Costa Rica (UNED). UNIPARK, an e-research tool, was used to collect data at two measurement points in time (T1: November 2009; T2: June 2010). Data collection coincides with the first and the second wave of the swine-flu pandemic in Costa Rica. A total of 449 persons responded to the survey invitation sent by e-mail. At T1, N = 428 respondents (65% females, 35% males; M_{age}= 33 years) fully completed the questionnaires, from whom n = 97 (75% females, 25% males; M_{age} = 36 years) filled out the questionnaires at the second measurement point.

Immediately after respondents filled out the T1 questionnaires, online invitations were given to visit and to read the spanish information provided by the WHO at http://www.who.int/csr/disease/swineflu/es/index.html. The website includes a digital poster instructing participants on behavior implementations in accordance with the official WHO protocol on handwashing: http://www.who.int/csr/resources/publications/swineflu/gpsc_5may_How_To_HandWash_Poster_es.pdf. Two further links were provided to all respondents containing official WHO information about antiviral medication and the risk of drug resistance and the status of vaccines for A (H1N1).

2.2. Measures

2.2.1. Risk Perception

In order to assess absolute and relative risk perception of getting A (H1N1) influenza virus infection and seasonal/common influenza, a 6-item scale was used. Items measured absolute risk perception for the peers of getting A (H1N1), absolute risk perception for the peers of getting seasonal flu, absolute risk perception for the self of getting A (H1N1), absolute risk perception for the self of getting seasonal flu, relative risk perception of getting A (H1N1), and relative risk perception of getting seasonal flu. Item examples are: (a) How likely is it that an average person of your sex and age will get A (H1N1) influenza virus this year? Response format was 1 = *very unlikely to* 7 = *very unlikely to*, (b) How likely is it that you will get A (H1N1) influenza virus this year? Response format was 1 = *very unlikely to* 7 = *very unlikely to*, (c) Compared to an average person of my sex and age, my chances of getting A (H1N1) influenza virus this year are? Response format was 1 = *much below average* to 7 = *much above average*. In the Costa Rican sample, Cronbach´s alpha for the 6-item scale was α = .80. Measures were construed by using adaptations of Perloff and Fetzer (1986), Weinstein (1987) and research results derived from Reuter and Renner (2011).

2.2.2. Self-efficacy Beliefs

With the aim of evaluating self-efficacy beliefs for hand hygiene (specifically, hand-washing), a 4-item scale was employed. Items assessed self-efficacy for handwashing before eating, self-efficacy for handwashing after having physical contact with others, self-efficacy for handwashing after using the bathroom, and self-efficacy for handwashing, even under stress or busy. Item example: I am sure I can always wash my hands before eating. Response format ranged from 1 = *not at all true* to 6 = *exactly true*. Cronbach´s alpha for the 4-item scale in the Costa Rican sample reached an $\alpha = .85$. Measures were designed in consistency with the HAPA-Model (Schwarzer, 2008) and research results derived from Reuter and Renner (2011).

2.2.3. Intentions

In order to measure intentions to acquire good habits in hand hygiene (handwashing), a 4-item scale was used. The items measured handwashing intentions before eating, handwashing intentions after having physical contact with others, handwashing intentions after using the bathroom, and handwashing intentions after touching objects contaminated by sick persons. Respondents were asked: Which intentions do you have for the next weeks and months?, with item examples as: I intend to wash my hands before eating, and response formats ranging from 1 = *don't intend at all* to 7 =*strongly intend*. Cronbach´s alpha for the 4-item scale in the Costa Rican sample was $\alpha = .73$. HAPA-Model (Schwarzer, 2008) and findings of Reuter and Renner (2011) were used to design the scale.

2.2.4 Behaviors

Handwashing behavior was evaluated by using a 4-item self-report measure of hand hygiene. The scale measures the frequency of four types of behaviors, namely handwashing after having contact with others, handwashing after having used the bathroom, handwashing before eating, and handwashing after touching objects contaminated by sick persons. Participants were asked to rate their own frequency of handwashing behavior on a 6-point response format scale ranging from 1 = *never* to 6 = *always*. Item example: I wash my hands before eating. Cronbach´s alpha for the 4-item handwashing scale in the Costa Rican sample was $\alpha = .71$. The scale was construed following results of Reuter and Renner (2011) and the HAPA-Model (Schwarzer, 2008).

2.3. Analytic Strategy

Analyses were implemented in several steps: First, a set of preliminary examinations were conducted to evaluate Hypothesis 1. Basically, the initial task consisted in exploring whether or not differences across time emerged from paired sample t-Tests. Furthermore, significant sex and age group effects where explored by means of analysis of variance (ANOVA) at T1 and T2, separately. Second, research hypotheses concerning the mediating role of intentions in the risk perception/self-efficacy and handwashing behavior relations were investigated at both measurement points. Four models were calculated by means of structural equation models, implemented with LISREL (Jöreskog & Sörbom, 1993, 1996). Selected cutoff criteria for a reasonable fit index were used in arriving to adequate fit index statistics, for example, RMSEA < = 0.8; CFI > = 0.9; and NFI > = 0.95. See Browne and Cudeck (1993), Cheung and Rensvold (2002), Hu and Bentler (1999), and Kenny (2011) for more details.

Model 1 and Model 2 (see Figure 2 and Figure 3) evaluated cross-sectional hypotheses for males and females separately, and Model 3 evaluated multi-sample hypothesis. Model 1 and 2 entailed two exogenous variables, namely ξ_1 (T1 risk perception, operationalized by 6 items), and ξ_2 (T1 self-efficacy, operationalized by 4 items). In addition, two endogenous variables, namely η_1 (T1 intentions, operationalized by 4 items), and η_2 (T1 behaviors, operationalized by 4 items). In Model 3 (multi-sample approach), invariance of causal relations across sexes was evaluated according to the multi-sample strategy recommended for interaction effects by Jaccard and Wand (1996) and Jöreskog and Sörbom (1993, 1996).

In Model 4 (see Figure 4), longitudinal hypotheses were evaluated. This model consisted of three exogenous variables, namely ξ_1 (T1 risk perception, operationalized by 6 items), ξ_2 (T1 self-efficacy, operationalized by 4 items) and ξ_3 (T1 behaviors, operationalized by 4 items). Additionally, it contains two endogenous variables, namely η_1 (T1 intentions, operationalized by 4 items), and η_2 (T2 behaviors, operationalized by 4 items). Figure 4 represents results for the longitudinal sample, controlling for the effects of reported T1 behavior. Model implementation was conducted in coherence with the seminal work of Nesselroade and Baltes (1979), and recent advances in longitudinal health behavior modeling research (Schwarzer, 2008).

3. Results

3.1. Preliminary Analyses

Results of paired-sample t-Tests revealed no significant differences in mean scores for risk perception, self-efficacy, intention, and behavior across the two measurement points in time (see Table 1). Specifically, a non-significant difference between T1 and T2 means score was found for risk perception. Findings suggests that perceived likelihood of getting swine flu and common influenza was moderate ($M_{T1/T2}$ = = 3.96/3.91) and remained stable across the two waves of the A (H1N1) pandemic influenza. In the case of handwashing self-efficacy, a further non-significant difference was found between T1 and T2 mean scores. At both point in time, participants perceived themselves as highly efficacious in adopting handwashing behaviors ($M_{T1/T2}$ = 5.32/5.18). With regard to handwashing intentions, results indicate that participants were strong handwashing intenders at both measurement points ($M_{T1/T2}$ = 6.75/6.75). Also here, no significant differences were identified between T1 and T2. Handwashing behaviors exhibited the same pattern of no change. In general, people reported having washed their hands on a very frequent basis across the two waves of the A (H1N1) pandemic influenza ($M_{T1/T2}$ = 4.98/5.25). No significant differences in the mean scores of handwashing behaviors were found between T1 and T2.

Table 1. Means, Standard Deviations and Paired-sample t-Tests

	Time 1					Time 2					Time 1-Time2	
Preintentional motivation processes	N	Range	*M*	*SD*	*Md*	N	Range	*M*	*SD*	*Md*	M_{T1}-M_{T2}	Sig. (2-tailed)
Risk perception	341	1-7	3.96	1.09	4.00	93	1-7	3.91	0.98	4.00	0.05	*n.s*
Handwashing self-efficacy	305	1-6	5.32	1.07	5.75	93	1-6	5.18	1.20	5.75	0.14	*n.s*
Mediator												
Handwashing intentions	296	1-7	6.45	0.89	6.75	91	1-7	6.41	0.88	6.75	0.03	*n.s*
Postintentional volition processes												
Handwashing behaviors	361	1-6	4.98	0.92	5.25	93	1-6	5.00	0.85	5.25	-0.02	*n.s*

Note: T1 = time 1; T2 = time 2; *n.s.* = non-significant difference.

3.2. Results of Analyses of Variance (ANOVA)

A set of ANOVAs were calculated at T1 and T2 separately, defining sex (male, female) and age (< = 29 years, > = 30 years) as predictors of T1/T2 intentions and T1/T2 behaviors. Educational level was not considered as a predictor because the sample size was insufficient for the group of less formal education. Results of the first set of ANOVA revealed a significant effect of sex on T1 intentions (F [1,294] = 6.240, $p < .01$) and T1 behavior (F [1,359] = 8.790, $p < .01$). In both cases, females presented significantly higher scores as compared to males.

Moreover, in the second ANOVA was found that age had a significant effect on T1 intentions (F [1,294] = 7.797, $p < .05$) and T1 behavior (F [1,359] = 5.659, $p < .05$). Here, older participants reported higher frequency in the use of handwashing behaviors as compared with younger participants. Results are consistent with literature and confirmed our expectations only for T1.

3.3. Results of Pearson Correlations

Table 2 shows the Product-Moment Correlations (pairwise solutions) between T1/T2 predictors (risk perception, self-efficacy) and T1/T2 criterion variables (intentions, behaviors). At T1 and T2, self-efficacy was positively correlated with intentions and behavior ($p < .05$, $p < .01$, respectively). A similar type of positive correlations emerged from analyses between T1/T2 intentions and T1/T2 behaviors ($p < .01$). Results are consistent with literature and confirmed our expectations for T1 and T2. Correlations were moderated too low and consistent with theoretical assumptions.

Table 2. Means, Standard Deviations and Pairwise Correlation Matrix of Scales

Scale	*N*	*M*	*SD*	1	2	3	4	5	6	7	8
1. T1 RISK	341	3.96	1.09	1.00							
2. T1 SE	305	5.32	1.07	0.05	1.00						
3. T1 INT	296	6.45	0.89	.183**	.358**	1.00					
4. T1 BE	361	4.98	0.92	0.09	.272**	.531**	1.00				
5. T2 RISK	93	3.91	0.98	.591**	-0.13	0.14	0.07	1.00			
6. T2 SE	93	5.18	1.20	-0.02	.362**	0.17	0.10	0.04	1.00		
7. T2 INT	91	6.41	0.88	0.01	0.16	.249*	.276*	.227*	.486**	1.00	
8. T2 BE	93	5.00	0.85	-0.13	0.07	.279*	.580**	-0.02	.246*	.478**	1.00

Note: *$p < 0.05$; ** $p < 0.01$. T1 = time 1; T2 = time 2; RISK = risk perception; SE = self-efficacy; INT = intentions; BE = behavior.

3.4. LISREL-Model 1 (Females)

Figure 2 represents female's standardized solution of predictive relationships (ULS-Parameter) between exogenous and endogenous variables. The model yielded reasonable fit index statistics, which are in accordance with cutoff criteria proposed in literature (Hu & Bentler, 1999; Jöreskog & Sörbom, 1993). Specifically, fit index statistics for the female model were: X^2 (114, n = 196) = 257.29, $p = .00$; X^2/df = 2.26; NFI = 1.00; GFI = 0.95; CFI = 1.00; RMSEA = 0.080, 90% CI for RMSEA (0.067; 0.093).

Results of Gamma-Matrix (effects of T1 risk and T1 self-efficacy on T1 handwashing intention and T1 handwashing behaviors) showed that T1 risk perception has a positive effect on T1 intention (+.24). There was also a positive impact going from T1 self-efficacy to T1 intention (+.45). Nevertheless, there were no significant direct effects on T1 behavior taking originating from self-efficacy and risk perception. In the case of the BETA-Matrix (effects of T1 intentions on T1 behaviors), it can be seen that T1 behavior received a strong and positive impact from T1 intentions, being this effect the strongest of the model (+.63). Analyses of indirect and total effects revealed the presence of two significant mediating effects, one emerging from T1 risk (+.15) and the other coming from T1 self-efficacy (+.28). This model offers evidence suggesting that the effects of T1 risk perception and T1 self-efficacy on T1 handwashing behavior were fully mediated by handwashing intentions in females. The PSI-Matrix (1-PSI), which reveals the proportion of variance accounted for by structural equations, indicated that the female model explained 26% of the variance in T1 handwashing intentions, and about 38% of the variance in T1 handwashing behaviors.

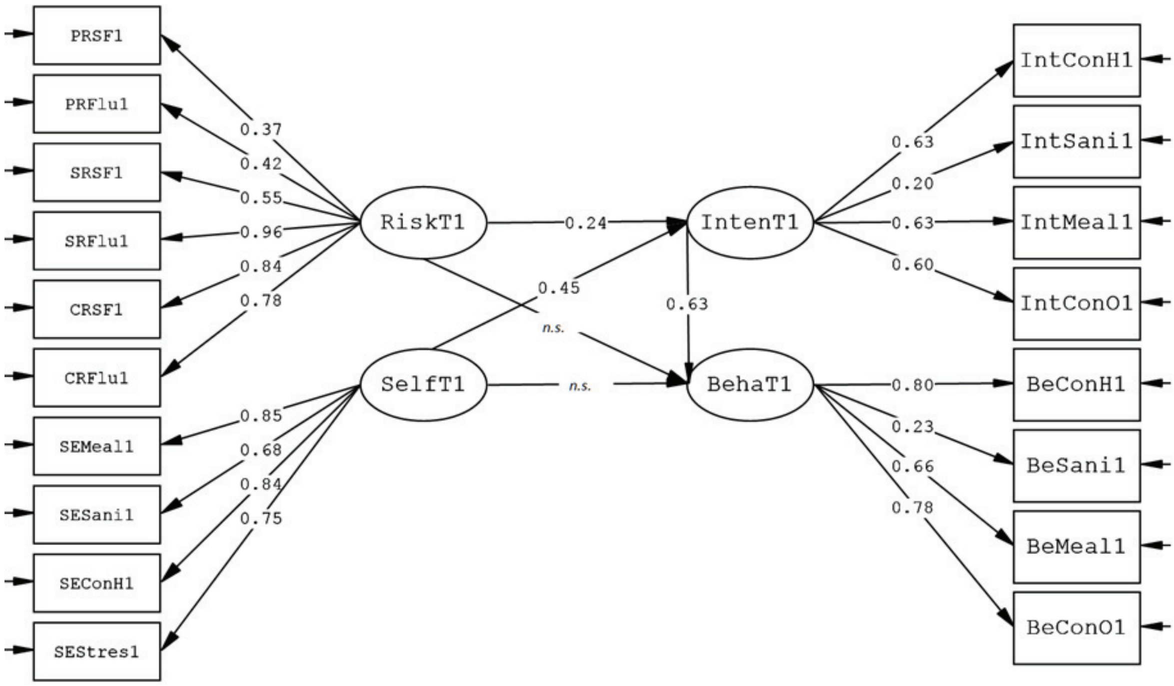

Figure 2. LISREL path diagram[1] of female´s relationships between predictors and criterion at T1 (*n* = 196).

3.5. LISREL-Model 2 (Males)

Figure 3 represents the standardized solution (ULS-Parameter) for the male sample. This model also showed an acceptable fit and in accordance to parameters defined in the literature (Bentler & Bonnet, 1980; Hu & Bentler, 1999; Jöreskog & Sörbom, 1993). Fit index statistics for the male model were: $X^2(121, n = 85) = 150.41, p = .04$; $X^2/df = 1.24$; NFI = 1.00; GFI = 0.93; CFI = 1.00; RMSEA = 0.054, 90% CI for RMSEA (0.015; 0.080).

Results of GAMMA-Matrix (effects of T1 risk and T1 self-efficacy on T1 handwashing intentions and T1 handwashing behaviors) revealed that T1 risk perceptions had no significant effects on T1 intention and T1 behavior. Conversely, T1 self-efficacy did show a positive effect on both T1 intentions (+.60) and T1 behavior (+.19). This result supported the idea that males did not react to risks of the A (H1N1) pandemic and the threats of seasonal influenza as females did. Actually, T1 male´s intentions and behaviors were exclusively predicted by T1 self-efficacy. As for the BETA-Matrix (effects of T1 intentions on T1 behaviors), results evidenced a further positive and strong effect that goes from T1 intentions to T1 behaviors (+.66). With respect to analyses of indirect and total effects, results showed that T1 intention was an excellent mediator of the indirect effects of T1 self-efficacy (+.40) on T1 behavior. On the whole, T1 self-efficacy had an effect of +.59 on T1 handwashing behaviors. In terms of the proportion of variance accounted for by structural equations (diagonal of the PSI-Matrix, 1-PSI), it was found that the male model explained 37% of the variance in T1 handwashing intentions and 61% of the variance in T1 handwashing behaviors.

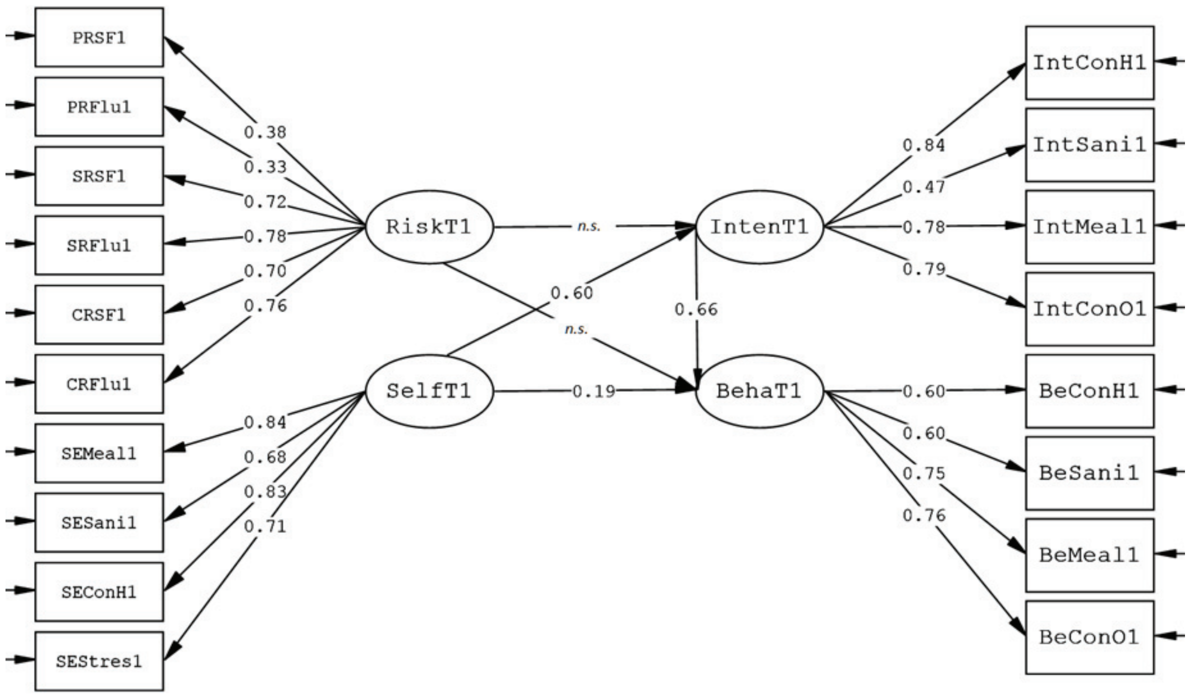

Figure 3. LISREL path diagram[1] of male´s relationships between predictors and criterion at T1 (n = 85).

3.6. LISREL-Model 3 (LISREL Approach on Interaction Effect of Sex)

The next step of analyses consisted in evaluating interaction effects of sex in the relation between predictors and criterion variables. As already shown in sections 3.4. and 3.5., LISREL-Model 1 (females) and LISREL-Model 2 (males) yielded an apparently different pattern of effects in the GAMMA-Matrix. However, this result should be evaluated in terms of whether, effectively, GAMMA-Matrix effects are invariant or not across sexes (females, males). To accomplish this task, a three step approach was implemented:

First, calculating model fit using the multigroup LISREL option (NG = 2) with no across-group constrain. The unrestricted multigroup model yielded the following GLOBAL fit index statistics: X^2 (231) = 322.8, p = .00; X^2/df = 1.40; NFI = 1.00; CFI = 1.00; RMSEA = 0.05, 90% CI for RMSEA (0.039; 0.667); Model AIC = 544.8, Saturated AIC = 684.

Second, calculating model fit using the multigroup LISREL option (NG = 2) and declaring the GAMMA-Matrix to be equal across both groups with the LISREL command EQ for GA. The resulting GLOBAL fit index statistics for the restricted model were: X^2 (235) = 686.37, p = .00; X^2/df = 2.88; NFI = 1.00; CFI = 1.00; RMSEA = 0.12, 90% CI for RMSEA (0.11; 0.13); Model AIC = 900.37, Saturated AIC = 684.

Third, fit index statistics differences between the constrained solution (EQ GA) and unconstrained solution were compared as follows: [$X^2_{\text{constrained}}$-$X^2_{\text{uncontsrained}}$] = 363.57; [$df_{\text{constrained}}$ – $df_{\text{unconstrained}}$] = 4. Critical value for X^2 with 4 df = 18.47, p < .001. In addition, it can be observed that RMSEA increased to 0.12 point and Model AIC increased to 355.57 points. In accordance to recommendations of Jaccard and Wand (1996) and Jöreskog and Sörbom (1993, 1996), these results indicate that an interaction effect is present, because the distance between the X^2 of the constrained (EQ GA) and the X^2 of the unconstrained solution is statistically significant. Furthermore, there was an increase in the size of RMSEA and also in the Model AIC. Therefore, LISREL approach on interaction effect suggests that sex moderates the effects of GAMMA-matrix. Apart of previous findings, the BETA-Matrix was also analysed in terms of its invariance across sexes. In this case, fit indices were identical for the constrained and the unconstrained model.

In sum, LISREL analyses revealed that males and females seemed to be similar in the pattern of predictive relations between T1 handwashing intentions on T1 handwashing behaviors. However, the pattern of predictive relations (GAMMA-matrix) between T1 predictors (risk perception, self-efficacy) and T1 criterion (handwashing intentions, handwashing behaviors) is completely different for each group. All effects for females and males are represented in figure 2 and figure 3, respectively.

3.7. LISREL-Model 4 (Assessing Longitudinal Relations)

In the last model (figure 4), an effort to predict T2 handwashing behavior from T1 predictors is depicted. The model is conceptually identical to Model 1 and Model 2. However, it is structurally different, because T1 handwashing behavior was introduced in the structural equation to predict the change in T2 handwashing behavior (Nesselroade & Baltes, 1979). Results of the standardized solution (ULS-Parameter) were: X^2 (95, n = 71) = 336, p = .00; X^2/df = 3.54; NFI = GFI = 0.91; CFI = 1.00; RMSEA = 0.10, 90% CI for RMSEA (0.083; 0.12). The evidence provided by the GAMMA-Matrix (effects of exogenous on endogenous variables) revealed that handwashing behavior at T1 had a significant effect on handwashing behavior at T2 (+.47). In addition, it is interesting that the model fairly replicates the female model regarding the influence of T1 risk (+.27) and T1 self-efficacy (+.87) on T1 intention. However, the BETA-Matrix revealed no significant effects on T2 handwashing behavior emerging from T1 handwashing intentions. Therefore, expectations and hypotheses regarding longitudinal relations have to be rejected.

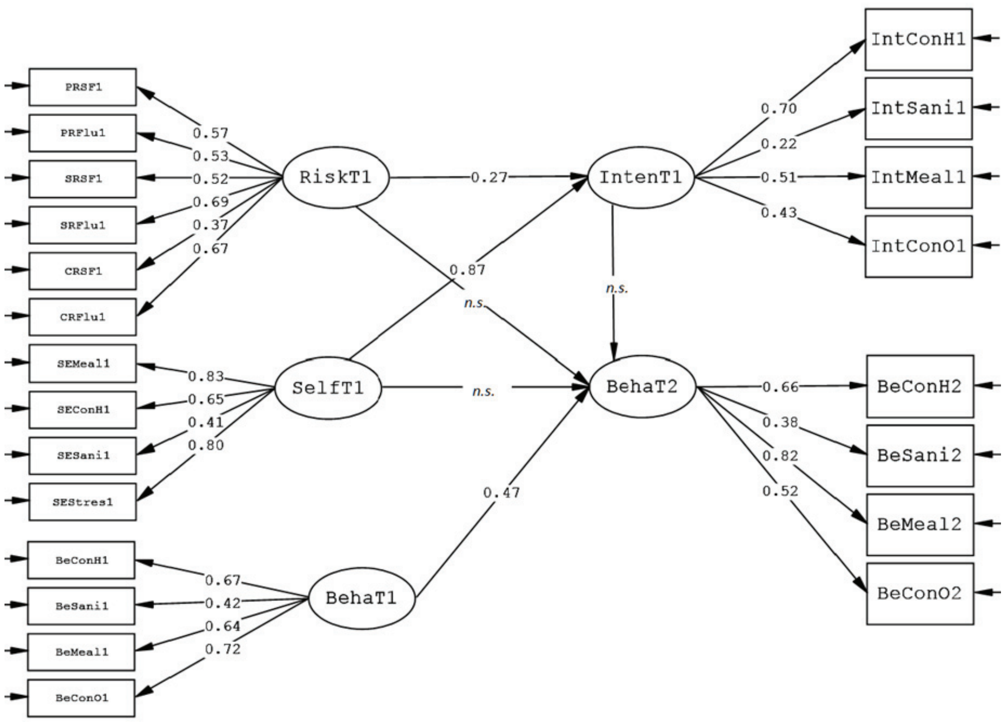

Figure 4. LISREL path diagram[1] for T1-T2 males and females relations (n = 71).

4. Discussion

This study was aimed to offer an initial exploration on the predictive relationship that exists between two relevant social cognitive predictors of health behavior, namely risk perception and self-efficacy and two relevant social cognitive criterion variables, namely intentions and behaviors. Predictive relations were analyzed by means of structural equation modeling on cross-sectional models (including a LISREL approach on interactions effects) and a longitudinal model aiming to predict the change in phenomena (Jaccard & Wan, 1996; Jöreskog & Sörbom, 1993, 1996). Analyses focused on the 2009-2010 A (H1N1) pandemic influenza and models were all theoretically driven by specific postulates of the Health Action Process Approach (Schwarzer, 2008).

While preliminary analyses demonstrated that predictors and criterion remained stable at both measurement points in time, an interaction effect emerged from structural equation modeling in examining differences in the patterns of predictive relations between males and females during the first wave of the A (H1N1) pandemic influenza. Assumptions regarding differences between males and females where confirmed. As for longitudinal effects, results partially rejected our expectations. T1 intentions, on the one hand, and T1 risk perception/self-efficacy, on the other, did not predict T2 behaviors.

Findings are important not only for health behavior education, but also in terms of the benefits for personal and public health. First of all, health education for A (H1N1) and seasonal influenza should not ignore the social-cognitive differences between males and females when facing the threats of a pandemic.

Based on provided evidence, it seems that Costa Rican males completely ignored their own risks of A (H1N1) and seasonal influenza. It appears that they basically trusted their own capabilities to protect themselves against the virus by handwashing, irrespective of the level of risk. Augments in male self-efficacy were related not only to an increase in handwashing intentions but also in handwashing behaviors. No significant relation was found between risk perception and intention/behavior in males. It is still unclear whether male participants did not trust risk information or whether they just simply perceived themselves as invulnerable.

As for Costa Rican females, it is fundamental to understand that the effects of risk perception and self-efficacy on handwashing behaviors were fully mediated by the development of handwashing intention. Based on provided evidence, it seems that females did not adopt the handwashing behavior without previously having developed an intention to wash their hands. There was no significant effect going from risk perception/self-efficacy to handwashing behavior.

In terms of health education intervention processes, males would need first to reinforce their own capabilities in executing the specific task of washing their hands with water and soap, before they will develop the intention and the behavior of handwashing. This is because they appear to be prone to ignore the risks. Females, on the contrary, have to be educated in both ways, not only in analyzing their own risks, but also in reinforcing their own self-efficacy for hand hygiene. It is our expectancy that former results can be used by health authorities in developing a scientifically-based gender specific protocol to educate males and females in coping with the threats of A (H1N1) influenza and seasonal influenza. Social-cognitive oriented handwashing protocols can protect millions of human beings from acquiring multiple diseases.

As for longitudinal relations, it might result counterproductive to find no significant longitudinal prediction effects from T1 to T2. However it is not. It is also quite relevant to corroborate that previous perceived risks, previous self-efficacy, and previous intentions did not conduce to later health behavior change in Costa Ricans. In the terrain of A (H1N1) pandemic and seasonal influenza, the beneficial effects of social-cognitive variables on health behaviors seem to be wave specific and are not a fixed pattern transmitted from one wave to another. Therefore, people´s motivation to adopt handwashing behaviors has to be reinforced at each wave of A (H1N1) influenza or seasonal influenza. Education authorities and public health authorities cannot assume that previous preventive campaigns will have a long term effect on the memory or motivation of the population. Motivation for handwashing at one step of the road does not necessarily serve the next step.

As for controversies and study limitations, in general terms, several aspects have to be considered in analyzing fit index statistics when calculating structural equations. On the one hand, analysis of change and the introduction of similar constructs (e.g., T1/T2 behaviors) that are highly correlated ($r_{T1\text{-}T2}$ > = .50), and on the other, the use of listwise samples that are smaller in size. Bentler (1990) analyzed the performance of several fit indices at several sample sizes and found that, in the case of small samples a CFI = 1.00 can be considered a reasonable indicator for samples of $n = 50$. There is a debate on whether one should discard a model when some fit indexes do not converge, for example CFI > .95 and RMSEA > .08 (see Jaccard & Wan, 1996). Kenny (2011) adds to the discussion the problem of accomplishing the ratio sample size versus free parameters. Some authors suggest a ratio of 20:1 (Tanaka, 1987), whereas others propose 5:1 (Bentler & Chou, 1987). In our case, LISREL models offered here are conceived to be an initial exploration for a problem that is highly complex, that is, the process of coping with threatening infectious diseases across time.

In considering research questions that are generated by this work, and desirable lines for future research, several specific issues that can be assumed as relevant were recognized: First, the question of whether Model 1, Model 2, Model 3 and Model 4 fit well with german data. Second, and derived from the first point, the question of whether german females and males are different or not in terms of patterns of causal relations between social-cognitive predictors and handwashing intentions/behaviors. Third, the question of cross-cultural invariance/universality of causal relationships remains open. Fourth, the question of whether proximal predictors, such handwashing planning/coping planning at T1 do predict handwashing behaviors at T2. This question has to be evaluated considering HAPA-model assumptions. In sum, more collaborative investigation is needed between and across countries to understand the universality and cultural particularities of pandemics such as the A (H1N1) pandemic influenza from a social-cognitive perspective.

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Notes

1. PRSF = absolute risk perception for the peers of getting A (H1N1); PRFlu = absolute risk perception for the peers of getting seasonal flu; SRSF = absolute risk perception for the self of getting A (H1N1); SRFlu = absolute risk perception for the self of getting seasonal flu; CRSF = relative risk perception of getting A (H1N1); CRFlu = relative risk perception of getting seasonal flu; SEMeal = self-efficacy for handwashing before eating; SEConH = self-efficacy for handwashing after having physical contact with others; SESani = self-efficacy for handwashing after using the bathroom; SEStres= self-efficacy for handwashing, even under stress or busy. IntMeal = handwashing intentions before eating; IntConH = handwashing intentions after having physical contact with others; IntSani = handwashing intentions after using the bathroom; IntConO = handwashing intentions after touching objects contaminated by seek persons; BeConH = frequency of handwashing after having contact with others; BeSani= frequency of handwashing after having using the bathroom; BeMea = frequency of handwashing before eating; BeConO = frequency of handwashing after touching objects contaminated by seek persons. T1 = time 1; T2 = Time 2; Acronym + # = variable name + wave (e.g., CRFS1 = relative risk perception of getting A (H1N1) at Time 1).

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