Sex differences in the severity and number of common cold symptoms

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Introduction

Probably everyone has experienced the sensations of a runny nose, a scratchy or painful throat, fullness in the ears, headache, fever, cough or tiredness once in a while. These sensations are all symptoms of an upper respiratory infection called a common cold (American College of Nurse-Midwives, 2019). While a common cold is generally not a very severe illness, it does affect people on a wide scale and comes with specific discomfort (Allan & Arroll, 2014). Besides disturbing symptoms, a cold can cause people to be less productive at work or cause accidents while driving (Smith & Jamson, 2012; Smith, Thomas & Whitney, 2000). Moreover, it has an impact on society and healthcare. It is, for instance, a well-known cause of increased doctor visits and absenteeism for jobs and schools (Dicpinigaitis, Eccles, Blaiss, & Wingertzahn, 2015; Sauro, Barone, Blasio, Russo, & Santillo, 2006). However, some people suffer more from illness symptoms than others.

It is commonly believed that men tend to exaggerate the severity of their illness when infected with a respiratory virus. It is so common that the word "Man flu" can even be found in the Oxford dictionary (n.d). It is explained as "A cold or similar minor ailment as experienced by a man who is regarded as exaggerating the severity of the symptoms". On the contrary, in literature on health, it seems that in general women are the ones who are "sicker". Women are more susceptible to upper respiratory tract infections (Falagas, Mourtzoukou, & Vardakas, 2007), experience more morbidity in general (McDonough & Walters, 2001), and are known to report more symptoms and a higher symptom severity on several physical and mental illnesses (McLean, Asnaani, Litz, & Hofmann, 2011; Nolen-Hoeksema, Larson & Grayson, 1999; Van Wijk, Huisman, & Kolk, 1999; Williams & Wiebe, 2000).

Studying reasons why there are differences between men and women in health is not a simple as it might seem. Explanations have evolved over the past couple of decades. While early health research explained differences between men and women mostly from a biological perspective of sex, today's research recognizes that health is also socially constructed by gender (Annandale, 2013). The concept of "sex" relates to biological attributes like genes and hormones, while the concept of "gender" captures the social construction of norms, roles, behaviours and expressions of identities (West & Zimmerman, 1987). Gender is not something we have; it is something we do. This sex/gender distinction in health research was brought more to the attention by feminist movements in the 1960s and 1970s (Annandale, 2013; Miller et al., 2013).

One widely discussed topic illustrating this importance of recognizing social construction of health is the male-female health-survival paradox (Annandale & Hunt 1990; Verbrugge, 1985). This paradox refers to the phenomenon that women tend to live longer than men do in almost every country, but consistently report worse self-rated health. The life-expectancy gap varies across time and countries. Therefore, it cannot be merely the result of differences in biology (Schünemann, Strulik & Trimborn, 2017). Factors such as men engaging in more risk-taking behaviours (Mahalik, Lagan & Morrison, 2006), carrying out more dangerous jobs (Bureau of Labour Statistics, 2018) or going to the doctor less often (Mansfield, Addis, & Mahalik, 2003) could explain these variations. Moreover, the gap in self-reported health outcomes (e.g. women reporting worse health than men) exists across various illnesses and diseases (Schünemann et al., 2017). These worse self-reported health outcomes for women might have to do with stress resulting from existing social norms, roles, expectations and obligations for women (Courtenay, 2000; Klonoff & Landrine, 1992; Matud, 2004; Nathanson, 1975). Stress is known to have an impact on immune system functioning and causes people to report worse illness symptoms (Cohen, Tyrrell & Smith, 1993; Goldman, Kraemer & Salovey, 1996; Mayor, 2015).

This previous illustration of the health-survival paradox shows that biological sex differences are not enough to explain differences between men and women in health outcomes. It shows why it is important to study differences between men and women from the perspective of social sciences. In addition, understanding differences between men and women in health, helps health professionals and policymakers to design interventions that tackle gender-based inequities in health. While for numerous illnesses or diseases, sex and/or gender differences are studied, few pay attention to the common cold. Although we know that women generally tend to report worse health, the direction and magnitude of differences between men and women might vary according to the particular symptom or condition studied (Macintyre, Hunt & Sweeting, 1996). Most studies on symptom reports have focused on mental diseases or somatic complaints (Macintyre et al., 1996; Nolen-Hoeksema, 2001). There are also studies on daily minor symptom reports (Van Wijk et al., 1999). However, whether men or women tend to over-report minor health problems is still debated (Caroli & Weber-Baghdiguian, 2016). As mentioned earlier, the common cold is a minor illness, but it affects people on a very wide scale and has implications for society as a whole. In addition, there are only a few researches focusing specifically on sex/gender differences in symptoms of the common cold and they present results that contradict the idea that women are generally "sicker" (Macintyre, 1993; Macintyre et al., 1996; Sue, 2017).

In sum, differences between men and women in symptoms of the common cold deserves more attention in research, building from a sociological perspective of gender. Therefore, this study gives an answer to the questions:

1) *Is there a difference between men and women in the self-reported symptom severity of the common cold?*
2) *Is there a difference between men and women in the number of self-reported symptoms of the common cold?*
3) *Could these effects be mediated by stress?*

Hypothesis will be derived from a sociological perspective of gender differences in health.

Theory

Social construction of health

According to social constructionist theory, thoughts and behaviours that affect health are socially constructed by the environment that we live in. Social interactions shape the ways that people "do gender" and also "do health" in a way that society considers appropriate for men and women (Courtenay, 2000). For example, concepts of femininity or masculinity, sex/gender roles, norms, expectations and obligations within a culture, influence certain thoughts and behaviours that come into existence.

Masculinity and Femininity

Masculinity and femininity refer to the traditional behavioural expectations for men and women (Annandale, 2013). The existence of such expectations in society influences behaviours performed by men and women. However, this does not mean that women always act according to feminine stereotypes and men act according to masculine stereotypes. Yet, most people do so. The easiest way to see how concepts of femininity and masculinity are embedded in culture, is through ways that parents treat their children (Courtenay, 2000). Research has shown that parents provide less warmth and nurturance to their sons. Boys are perceived as less fragile and are less encouraged to notice their feelings or interact emotionally than girls. Furthermore, parents are more concerned about their daughters, causing girls to act more dependent and to be more concerned with danger (Courtenay, 2000). This gendered upbringing of children results in men having more masculine characteristics and women having more feminine characteristics. Traditional masculine characteristics are, for example, dominance, independence and aggressiveness. Feminine characteristics are, for instance, dependence, nurturing and emotionality (Courtenay, 2000). Literature shows that identification with traditional masculine characteristics promotes behaviours related to risk taking, reliance and emotional control. This results in practices such as ignoring pain and thoughts of "having to be though" (Mahalik et al., 2006). On the other hand, standards of femininity encourage women to engage in healthy behaviours, like being concerned about nutrition and putting on sunscreen (Courtenay, 2000). However, it is also associated with women reporting poor health (Annandale & Hunt, 1990). For example, femininity is positively related to sickness absence (Evans & Steptoe, 2002). Moreover, women perceive themselves more as being at risk for health problems as compared to men (Courtenay, 2000). For women, it is more allowed to show emotions and they worry more about their health (Courtenay, 2000). In addition, the sick role hypothesis suggests that it is more socially acceptable for women to feel sick and show sickness behaviour than it is for men (Klonoff & Landrine, 1992). This hypothesis is based on traditional feminine roles that come with characteristics such as dependence. On the contrary, for men it is less acceptable to feel sick because they have to be "tough", independent and emotionally stable (Mahalik et al., 2006). The discussed theory and findings above, implicate that women might be less restrained in showing signs of illness and reporting of symptoms of the common cold.

Gender norms

Next to concepts of masculinity and femininity, society constructs social norms. "Social norms are rules and standards that are understood by members of a group, and that guide and/or constrain social behaviour without the force of laws" (Cialdini & Trost, 1999). They affect health reports, thoughts and behaviours. A first example of how these norms affect health reports, is a study from Caroli and Weber-Baghdiguian (2016). They showed that female or male norms in work environments could influence self-assessed health and reports of several illness symptoms (for example, muscular pain, headache or stomach ache). Both sexes reported worse health in female dominated work environments compared to male dominated environments. Second, social norms affect health related thoughts of what is “normal”. For instance, they affect the determination of ideal body weight for women (Gil & Mora, 2011). In addition, when the norm in the reference group prescribes lower weights, people tend to underestimate their actual weight more (Gil & Mora, 2011). Third, gender norms could influence behaviours. For example, smoking (Waldron, 1991) and drinking (Huselid & Cooper, 1992; Suls & Green, 2003). It is considered less appropriate for women to smoke or drink alcohol than it is for men (Alexander, Frohlich, Poland, Haines & Maule, 2010; De Visser & McDonnell, 2012; Landrine, Bardwell & Dean, 1988). In a similar way, gender or sex related norms could influence how men and women report on the severity common cold symptoms. People belonging to a group that holds specific norms that specify the appropriateness of feeling sick, showing illness, adopting a sick role or reporting symptoms, will be likely to act according to these norms. It seems that norms around symptom reporting behaviours are more accepting for women, based on their consistently reported worse self-rated health for several illnesses (Annandale & Hunt 1990). Norms defining what is perceived as feminine behaviour, could initiate that it is more socially acceptable for women to report more and worse symptoms. However, one study from Macintyre (1993) studied gender differences in the perceptions of common cold symptoms and results showed that men were more likely than women to ‘overrate’ their signs and symptoms. This finding might point to a tendency for norms to differ according to the type of illness studied. Sue (2017) adds to this by arguing that men have weaker immune responses to respiratory viruses. Another study from Macintyre et al. (1996) showed that there were no sex differences in reports of “having a cold or a flu”. These few results show that gender differences in common cold symptoms are not sufficiently studied to draw indisputable conclusions from.

Gender roles, traits and stress

Gender roles and traits are constructed by society and they come with specific behavioural expectations for men and women (Courtenay, 2000). As mentioned before, men are expected to be more dominant, independent and emotionally stable, while women are expected to be more dependent, nurturing and emotional (Courtenay, 2000). Socialized roles and traits have an effect on health in different ways.

First, social role obligations differ between men and women and these obligations come with related health risks. For instance, it is still very common for women to have child care responsibilities, while men have full time jobs more often (Dush, Yavorsky & Schoppe-Sullivan, 2018; Thébaud, 2010). Women spending more time with the children is enhancing their risk of upper respiratory infections which are commonly found in children (Falagas et al., 2007).

Second, gender roles could expose people to different demands and obligations in life that affect stress (McDonough & Walters, 2001) and stress could result in more and worse symptom reports (Mayor, 2015). Research has shown that women tend to experience more chronic stress and minor daily stressors than men (Matud, 2004). Stress affects the susceptibility to infectious disease (Cohen et al., 1993). It can increase susceptibility to the common cold, because negative cognitive appraisal, for example negative emotions, has a negative effect on the immune system (Cohen et al., 1993). Furthermore, stress can affect illness symptom reports due to negative emotions resulting from stress. These emotions cause people to report more or more severe symptoms (Goldman et al., 1996).

The difference between men and women in their exposure to stressors can be explained by their social roles. Traditional women's roles are primarily nurturant (or communal) roles such as taking care of the children (Suls & Wallston, 2003). These roles could be more stressful than those of men (Nathanson, 1975). Other research suggests that since women's labour force participation has increased, the double burden of career and family obligations for woman could lead to worse physical and mental health outcomes due to stress (Baum, 2016). For example, one study showed that women having more family obligations in combination with work, results in more sickness absence (Bratberg, Dahl & Risa, 2002). Existing socio-cultural ideas regarding work and family roles can create a conflict, resulting in feelings of guilt or negative evaluations of the "self" as a parent or a spouse (Waldron, Weiss & Hughes, 1998). Stress can result from role conflict or role overload (Waldron et al., 1998). Furthermore, according to the nurturant role hypothesis women could be less willing to fully adopt a sick role (Gove, 1984). Sick role behaviour is referring to behaviours like cutting down on usual activities, self-medication, staying in bed or taking the day of work. Women would not adopt this sick role as easily as men do, because of their traditionally feminine role obligations to household tasks and taking care of their children, spouse and other relatives (Gove, 1984). However, this hypothesis also suggests that this non adaptive behaviour to sickness prevents women from taking care of themselves.

This could result in stress and this stress could lead women to experience more symptoms or more severe symptoms when they are sick in general (Gove, 1984).

Another explanation for why stress levels and symptom perceptions could differ between men and women, comes from symptom perception theory. This theory states that perception of symptoms, (mental and physical) is partly dependent of an individual's cognitions and traits (Van Wijk & Kolk, 1997). Gender traits, such as emotionality, could cause woman to cope with stress and life in a different way. Women tend to use more emotional and avoidance coping styles to deal with stress, which is maladaptive and has a negative effect on health (Matud, 2004).

A final reason why woman could experience more stress follows from gender role stress theory. This theory suggests that people experience stress due to their wish to live up to stereotypical behavioural expectations (Kazmierczak, 2010). Feminine gender role stress relates to issues with not being nurturant, feeling physically unattractive, being exposed to potential harm or violence. Masculine gender role stress relates to issues with expressing tender emotions or experiencing performance failure with regard to work. A study from Kazmierczak (2010) showed that gender role stress is mostly connected to femininity.

Stress is a biological as well as a psychological state and this state can result from many stressors, as described above. For this study, I define stress as: "the perception of threat with resulting anxiety, discomfort, emotional tension and difficulty in adjustment" (Fink, 2010), which is a common definition of stress in the behavioral sciences.

Deriving hypotheses

In summary, masculinity is related to better health reports and femininity with worse health reports. Assuming that women behave according to feminine behavioural expectations, they will feel less constrained to report symptoms and report the severity of these symptoms. In addition, social norms could define the appropriateness of poor health reporting behaviours for women and men. Lastly, women's social roles and traits could cause them to report more and worse symptoms. The following hypotheses are formulated:

H_1: Women report a higher severity of common cold symptoms (nasal congestion, sneezing, runny nose, sore throat, cough, headache, chills and malaise) than men.

H_2: Women report more common cold symptoms (nasal congestion, sneezing, runny nose, sore throat, cough, headache, chills and malaise) than men.

Next to that, stress affects biological and psychological processes that could worsen symptom experiences. Differences in stress are a result of socialization processes of gender roles and traits and they could cause woman to experience more stress in general. Stress negatively affects the immune system as well as symptom reports (Cohen et al., 1993; Goldman et al., 1996). Therefore, I assume that stress could be an important mediator for cold symptom reports.
This given, the following hypotheses on are formulated:

H_3: Women experience more stress than men.

H_4: The effect of sex on the severity of common cold symptoms (nasal congestion, sneezing, runny nose, sore throat, cough, headache, chills and malaise), is mediated by stress.

H_5: The effect of sex on the number of common cold symptoms (nasal congestion, sneezing, runny nose, sore throat, cough, headache, chills and malaise), is mediated by stress.

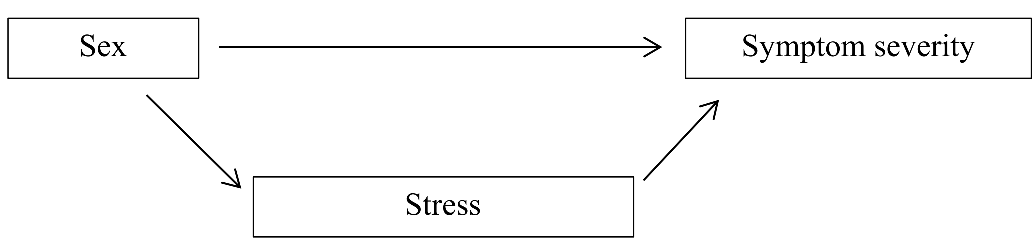

Figure 1. Schematic representation of hypothesis 4.

Methods

To test whether there are any differences between men or women on the amount and severity of self-reported common cold symptoms, and whether this effect was mediated by stress, the aggregated dataset from the Pittsburgh Common Cold Project was used. This dataset holds information on five different prospective viral challenge studies: the British Cold Study (BCS: 1986-1989), the Pittsburgh Cold Studies 1, 2 and 3 (PCS1: 1993-1996, PCS2: 1997-2001, PCS3: 2007-2011) and the Mind Body Center Study (PMBC: 2000-2004). The dataset contained information about biological measures of infection, health behaviours, biomarkers and health outcomes, self-reported health, demographics and psychological and social factors. The total dataset contained 1415 respondents. In all studies, healthy volunteers between 18 and 55 years old were interviewed for 7 or 14 days. After this daily interview period, participants were exposed to a virus. They were administered nasal drops which contained a rhinovirus and they were quarantined for five following days. During the quarantine respondents reported daily on their behaviour and symptoms. Also, they were medically examined, and blood samples were analysed.

Variables

Infection

Respondents were included in this study when they were infected with a rhinovirus (1= yes, 0 = no). Blood samples were taken and analysed. Participants met criteria for infection if their blood values seroconverted (1 = yes) or if there was any virus shedding (1 = yes). Seroconversion means that new antibody titers were found in the blood after the admission of the rhinovirus. If there was no seroconversion and there was no virus shedding, participants did not meet the criteria for infection, and they were excluded from this study.

Female

Respondents reported on their sex: male = 0 and female = 1.

Severity of symptoms

One day before and during the quarantine days, participants reported on the severity of eight cold symptoms including: nasal congestion, sneezing, runny nose, sore throat, cough, headache, chills and malaise. The self-reported symptom severity on the day before the quarantine days served as a baseline measure. Severity was measured as 0 = none to 4 = very severe. Next, the average symptom severity per day, was computed by taking the sum of all daily symptom severity reports, divided by the total days that they were reported (5 days). Third, the averages were adjusted for baseline measures. This controls for the fact that symptom reports could not result directly from having a cold. The Total Adjusted Post Jackson Symptom Score (TAPJSS) was used as a measure for the severity of symptoms. This score was computed by taking the sum of the average adjusted (for baseline) symptom severities for each day. All zero reports on TAPJSS, meaning no average severity, were set to be missing value, because this study focuses only on the symptom severity and not the susceptibility of symptoms. This means that I test "whenever" men and women report symptoms, whether they differ in how they perceive the severity of the symptoms.

Number of symptoms

During the quarantine days, participants reported on eight symptoms: nasal congestion, sneezing, runny nose, sore throat, cough, headache, chills and malaise. The number of symptoms were measured by the Total Jackson Symptoms (TAJS) variable. This measure was computed by counting the daily symptom reports on the severity of symptoms (0 = none to 4 = very severe) that scored above a value of 1. These values were also adjusted for the baseline measure at the day before the quarantine. Zero reports on TJAS, mean that the total number of symptoms, minus the baseline measure, were zero. The zero reports were set to be missing values. This means that I test "whenever" men and women report symptoms, whether they differ in the number of symptoms that they report.

Stress

Stress was measured by a 10-item perceived stress scale. This scale measures the cognitive appraisal that individuals experience when they encounter stressful stimuli. It was measured by taking respondent's mean score on ten questions multiplied by 10. Questions were asked before quarantine. Respondents had to report on at least eight out of the ten questions to be included. Participants were asked to report on a scale from 0 “never” to 4 “very often”. Questions of this scale relate to how unpredictable, uncontrollable and overloaded respondents find their lives. Questions were for example: “In the last month, how often have you felt nervous and stressed?” or “In the last month, how often have you found that you could not cope with all the things that you had to do?”. Some questions were reverse coded so that a high score on the perceived stress scale means that a person experiences high levels of stress (see appendix A for all statements).

Control variables

Standard control variables

Differences in age and socioeconomic status could obscure the true effect of sex on the cold symptom reports. First, aging comes with a decline in immune system functioning, which could affect symptom reports for the common cold (Montecino-Rodriguez, Berent-Maoz, & Dorshkind, 2013). However, a study from Thumin and Wims (1975) showed that younger people reported more and more severe physical symptoms when having a cold. Second, increased subjective socioeconomic status is associated with less susceptibility to upper respiratory infection (Cohen et al., 2008). Because age and socioeconomic status have an effect on cold symptoms, they were included as controls.

For this study, age was measured in years. SES was measured by showing the participants a picture of a ladder with 9 steps. Instructions explained that this ladder represented where people stand in the United States. People were asked to place an “X” mark on the rung where they thought they were standing at that point in their life, relative to other people in the United States. The bottom step represented having the least money, least education and the least respected job or having no job (coded as 1). The highest step represented the people who have the most money, most education, and most respected jobs (coded as 9).

Other control variables

Other control variables are body mass, physical activity and employment status. First, body mass is associated with worse course of infections (Falagas, Athanasoulia, Peppas & Karageorgopoulos, 2009). Second, moderate physical activity is associated with lower risk for upper respiratory tract infections and it can alter functions of the immune system (Matthews et al., 2002). Third, problems related to under employment are associated with higher susceptibility to the common cold (Cohen et al., 1993). These three factors can obscure the true effect of sex on symptoms of the common cold and are therefore included in the analysis as control variables. For this study, BMI was measured by taking the weight (in kilogrammes) of the respondent divided by their height in metres squared. Physical activity was measured in times per week. Employment status was measured by asking respondents whether they had any employment part- or fulltime (0 = no, 1 = yes).

Analysis

Two separate analyses were performed. For both analyses I performed two simple regressions and three multiple regressions. I chose to do regression analyses because of this test's power and ability to show a direction of the effect. Hence, a total of ten regressions were performed. The first analysis included five regressions addressing the effect of sex on reports of the *severity* of symptoms. The other analysis addressed the effect of sex on the *number* of reported symptoms (also with five regressions). Variables were centered to their means to be able to interpret the constant.

Exclusion criteria

symptom severity analysis

Respondents were excluded from this study when they had no valid value on the variables that were included in the regression analyses. Also, I chose to exclude people who were not infected with the virus, because this allows to control for part of the possibility that people report symptoms that do not result directly from infection with a cold virus. After exclusion, the final dataset consisted of 438 respondents of which 200 were from PCS2, 144 from PCS3 and 94 from PMBC.

Number of symptoms analysis

The same as for the symptom severity analysis, respondents were excluded from this study when they had no valid value on the variables that were included in the regression analyses, and when they were not infected with the virus. After exclusion, the final dataset consisted of 452 respondents of which 208 were from PCS2, 147 from PCS3 and 97 from PMBC.

Assumptions check symptom severity analysis

I checked for the assumptions that needed to be met to perform a multiple regression analysis. First, I checked for the number of respondents. The number respondents should be 50+ 8(k) to test a full regression model. In this study the regression included 7 predictors. The minimum number of respondents should be 106 (hence, 50+(8x7) =106). Because I also test for the individual predictor "sex", the minimum number of respondents should be 104+k =111. After the exclusions, there were 438 respondents left in the dataset, which exceeds the required minimum.

Second, I checked for the normality assumption. Each continuous variable should be approximately normally distributed. However, this was not the case. I looked at the histograms and the skewness and kurtosis statistic. All continuous variables (e.g. severity of symptoms, stress, age, BMI, SES and physical activity) were not normally distributed. The distributions were positively skewed. However, stress and SES came close to a normal distribution.

Third, I checked for outliers that may influence the final regression. There were some outliers for the total severity score, stress, BMI and SES. However, most were not very dramatic or unrealistic. I chose not to exclude them for the main analyses. Only for physical activity I chose to exclude physical activities above 15 times per week. The values 20 and 28 times per week did not seem very realistic. By doing this, 3 respondents were removed from the analysis. I did check whether excluding these outliers would make any difference in the results. It did not affect the results, only the regression coefficient from physical activity became negative.

Fourth, I checked for multicollinearity. High correlations between predictors could influence the regression results. Tolerances were >.02 and the VIF's did not exceed 10. VIF's were all approximately 1, meaning that there is no multicollinearity and the assumption is met.

Lastly, I checked for the normality, linearity and homoscedasticity of residuals. The P-P plot showed that the standardized residuals of the dependent variable are different from the linear line (see appendix B, figure 1). The points do not cluster tightly along the diagonal line. It looks like an S-shape. This indicates that the residuals are not normally distributed. Furthermore, the scatterplot of the standardized residual and predicted value showed that there is no clear pattern in the spread of points. However, the points cluster on lower y-values and in the middle of the x-axis (see appendix B, figure 2) despite this clustering, the assumptions of normality, linearity and homoscedasticity of residuals have been met because there is no clear pattern.

Assumptions check number of symptoms analysis

I checked for the assumptions for the number of symptoms analysis in the same way that I did for the symptom severity analysis. After the exclusions, there were 452 respondents left in the dataset, which exceeded the required minimum.

All continuous variables (e.g. the number of symptoms, stress, age, BMI, SES and physical activity) were not normally distributed. The distributions were positively skewed. However, stress and SES came close to a normal distribution.

There were some outliers for the number of symptoms, stress, BMI and SES. However, they were not unrealistic. I chose not to exclude them for the main analyses. There were also some outliers for physical activity. I chose to exclude physical activities above 15 times per week. I did check whether excluding some outliers would make any difference in the results. It did not affect the results. Again, only the regression coefficient from physical activity became negative.

Tolerances were >.02 and the VIF's did not exceed 10. VIF's were all approximately 1, meaning that there is no multicollinearity and the assumption is met.

The P-P plot showed that the standardized residuals of the dependent variable are a bit different from the linear line (see appendix B, figure 3). However, the points cluster reasonably tightly along the diagonal line. This indicates that the residuals are more or less normally distributed. The scatterplot of the standardized residual and predicted value showed that there is no clear pattern in the spread of points (see appendix B, figure 4). This means that the assumptions of normality, linearity and homoscedasticity of residuals have been met.

Descriptive statistics - Symptom severity analysis

Table 1. Descriptive statistics for the severity of symptom analysis

	N	Min	Max	Mean	S.D.
Symptom severity	438	.50	104	16.62	15.27
Female sex	438	0	1	.48	.50
Stress	438	0	36	13.97	6.49
Age	438	18	55	30.81	10.71
BMI	438	16.84	52.54	27.09	6.19
SES	438	1	9	4.31	1.87
Employed	438	0	1	.57	.50
Physical activity	438	0	14	3.26	2.21

Table 1 presents the descriptive statistics of all variables included in the regression analyses on symptom severity. The final sample consisted of 438 respondents who were infected with a cold virus. Respondents age was on average 30.81 years old (min = 18, max = 55, SD = 10.71). The dataset consisted of an approximately equal proportion of men (52,1%) and women (47,9%) (min = 0, max = 1, SD = .500). Fifty-seven percent of the respondents was employed (min = 0, max = 1, SD = .50). Respondents mean BMI was relatively high (min = 16.84, max = 52.54, mean = 27.09, SD = 6.19), considered that people with a BMI between 25 and 30 are seen as being overweight. The mean score on the socioeconomic status scale was 4.31. This indicates that respondents had on average a relatively low SES (min = 1, max = 9, SD = 1.87). Respondents average physical exercise was 3.26 times per week (min = 0, max = 14, SD = 2.21). The average symptom severity score was 16.62, while the maximum score was much higher (min = .50, max = 104, SD = 15.27). If there would have been participants who reported the maximum severity for five days on each of the eight symptoms, the maximum total score would have been 160 (hence, a score of 40 per day). A maximum score of 104 means that none of the participants reported such a high severity of symptoms during quarantine. An average score of 16.62 indicates that people, on average, did not report highly severe symptoms. The standard deviation is noteworthy because it 15.27 is almost as high as the mean value. This indicated that there is much variation. Furthermore, people scored low on the stress score (min = 0, max = 36, mean = 13.97, SD = 6.49), considered that a moderate score would be 20 (when a respondent would choose the third option “sometimes (2)”, on each of the ten items on the perceived stress scale) .

Descriptive statistics - Number of symptoms analysis

Table 2. Descriptive statistics for the number of symptoms analysis

	N	Min	Max	Mean	S.D.
Number of symptoms	452	0	35	11.20	7.53
Female sex	452	0	1	.47	.50
Stress	452	0	36	13.98	6.52
Age	452	18	55	30.65	10.62
BMI	452	16.84	52.54	27.12	6.13
SES	452	1	9	4.30	1.87
Employed	452	0	1	.57	.50
Physical activity	452	0	14	3.31	2.20

Table 2 presents the descriptive statistics of all variables included in the regression analyses on the number of symptoms. The final sample consisted of 452 respondents who were infected with a cold virus. Respondents age was on average 30.65 years old (min = 18, max = 55, SD = 10.62). The dataset consisted of an approximately equal proportion of men (53%) and women (47%) (min = 0, max = 1, SD = .50). Fifty-seven percent of the respondents was employed (min = 0, max = 1, SD = .50). Respondents mean BMI was relatively high (min = 16.84, max = 52.54, mean = 27.12, SD = 6.13), considered that people with a BMI between 25 and 30 are seen as being overweight. The mean score on the socioeconomic status scale was 4.30. This indicates that the average person in the dataset has a relatively low SES (min = 1, max = 9, SD = 1.87). Respondents average physical exercise was 3.31 times per week (min = 0, max = 14, SD = 2.20). The average number of symptoms was 11.20 which is relatively low (min = 0, max = 35, SD = 7.53). If there would have been participants who reported on all eight symptoms for five days, the maximum total score would have been 40. An average score of 11.20 indicates that people, on average, did not report many symptoms. Furthermore, people scored low on the stress score (min = 0, max = 36, mean = 13.98, SD = 6.52), considered that a moderate score would be 20 (when a respondent would choose the third option “sometimes (2)”, on each of the ten items on the perceived stress scale) .

Results

Correlations

To perform a multiple regression analysis with a mediator it is necessary to check the correlations table first. I checked the correlations tables for both analyses. Table 3 presents the correlations for the symptom severity analysis. It shows that there was a nonsignificant correlation of -.004 (p = .931) between sex and stress; there was a nonsignificant correlation of .056 (p = .239) between sex and symptom severity and there was a nonsignificant correlation of .089 (p = .064) between stress and symptom severity. Table 4 presents the correlations for the number of symptoms analysis. It shows that there was a nonsignificant correlation of -.001 (p = .980) between sex and stress; there was a nonsignificant correlation of .007 (p = .102) between sex and the number of symptoms and there was a nonsignificant correlation of .068 (p=.150) between stress and the number of symptoms.

Table 3. Pearson correlations (N = 438)

Variables	Sex	Stress
Stress	-.004	
Symptom severity	.056	.089

Note. *p<.01, **p<.001

Table 4. Pearson correlations (N = 452)

Variables	Sex	Stress
Stress	-.001	
Number of symptoms	.077	.068

Note. *p<.01, **p<.001

Normally you would not perform a regression analysis with a mediator, knowing that it is not both correlated with the IV and the DV. However, for this study I will do so, to show that there are indeed no effects.

Regression analyses for symptom severity

Table 5 presents model 1. This model shows the regression parameters for the effect of the independent variable (sex) on the mediator variable (stress). None of the variance in stress is explained by sex ($R^2 = .000$, $F(1, 436) = .007$, $p = .931$). Results show that there is no significant effect for sex on stress ($B = -.057$, $p = .931$). This means that men and women do not differ in perceived stress. The significant intercept ($B = 13.968$, $p < .001$) means that the average stress score is 13.968 for women as well as for men.

Table 6 presents four other models. Model 2 shows the regression parameters for the direct effect of sex on the symptom severity score without taking the control variables into account. This model explains 0.3% of the variance in symptom severity ($R^2 = .003$, $F(1, 436) = 1.392$, $p = .239$). Results show that there is no significant effect of sex on the severity of symptoms ($B = 1.179$, $p = .239$).

Model 3 shows the regression parameters for the multiple regression in which both variables sex and stress are included. This model explains 1.1% of the variance in symptom severity ($R^2 = .011$, $F(2, 435) = 2.433$, $p = .089$). For a full mediation effect to exist, model 1 and 2 have to be significant (which is not the case) and the direct effect of sex on the symptom severity has to become insignificant when the mediator is included in the analysis (or significantly reduced for a partial mediation). However, the results show that the effect of sex remains nonsignificant ($B = 1.730$, $p = .234$) and that there is no significant effect for stress on the severity of symptoms ($B = .208$, $p = .063$).

Model 4 shows the regression parameters for the multiple regression with control variables for predicting the effect of sex on symptom severity. This model explains 3,8% of the variance in symptom severity ($R^2 = .038$, $F(6, 431) = 2.825$, $p < .05$). The significant F value indicates that adding the control variables significantly improved the model’s fit as compared to a model with zero predictor variables. The results show that there is still no effect for sex on the severity of symptoms. However, age did have a significant effect on the severity of symptoms ($B = .229$, $p < .01$). For every year that age increases, the severity of symptom score increases with .229.

Model 5 shows the regression parameters for the multiple regression including the control variables, independent variable (sex) and the mediator (stress). The model explains 4,5% of the variance in symptom severity ($R^2 = .045$, $F(7, 430) = 2.862$, $p < .01$). The significant F value indicates that adding the control variables significantly improved the model's fit as compared to a model with zero predictor variables. Again, no significant effect was found for either sex or stress. The results show that age had a significant effect on the severity of symptoms (B = .234, $p < .01$).

The significant intercept in all five models (B = 16.62, $p < .001$) means that the expected average symptom severity score is 16.62 when there is no effect of the predictor variable(s) in the model. This average of symptom severity for both male and female participants is quite low.

In sum, the results do not support the hypotheses (see appendix C for an overview).

Table 5. Model 1 regression analysis for sex predicting perceived stress (N=438)

	B	SE
Constant	13.968***	.310
Female sex	-.053	.621
R^2		.000
F		.007

Note. *p<.01, **p<.001

Table 6. Regression analyses for variables predicting the symptom severity (N=438)

	Model 2		Model 3		Model 4		Model 5	
	B	SE	B	SE	B	SE	B	SE
Constant	16.622***	.728	16.622***	.726	16.627***	.719	16.627***	.718
Female sex	1.179	1.457	1.730	1.453	1.770	1.443	1.774	1.440
Stress			.208	.112			.196	.113
Age					.229**	.071	.234**	.071
BMI					-.110	.125	-.110	.124
SES					-.649	.338	-.523	.394
Employed					2.861	1.471	2.785	1.496
Physical activity					.001	.329	.038	.329
R^2		.003		.011		.038		.045
F		1.392		2.433		2.825*		2.862**

*** p<.001, ** p<.01, * p<.05

Regression analyses for the number of symptoms

Table 7 presents model 1. This model shows the regression parameters for the effect of the independent variable (sex) on the mediator variable (stress). None of the variance in stress is explained by sex (R^2 = .000, F (1, 450) = .000, p = .980). Results show that there is no significant effect for sex on stress (B = -.016, p = .980). This means that men and women do not differ in perceived stress. The significant intercept (B = 13.982, p<.001) means that the average stress score is 13.982 for women as well as for men.

Table 8 presents four other models. Model 2 shows the regression parameters for the direct effect of sex on the number of symptoms without taking the control variables into account. This model explains 0.6% of the variance in the number of symptoms (R^2 = .006, F (1, 450) = 2.683, p = .102). Results show that there is no significant effect of sex on the number of symptoms (B = 1.161, p = .102).

Model 3 shows the regression parameters for the multiple regression in which both variables sex and stress are included. This model explains 1.1% of the variance in symptom severity (R^2 = .011, F (2, 449) = 2.392, p = .093). For a full mediation effect to exist, model 1 and 2 have to be significant (which is not the case) and the direct effect of sex on the number of symptoms has to become insignificant when the mediator is included in the analysis (or significantly reduced for a partial mediation). However, the results show that the effect of sex remains nonsignificant (B = 1.162, p = .101) and that there is no significant effect for stress on the number of symptoms (B = .079, p = .148).

Model 4 shows the regression parameters for the multiple regression with control variables for predicting the effect of sex on the number of symptoms. This model explains 3,8% of the variance in the number of symptoms (R^2 = .038, F (6, 445) = 2.960, p <.01). The significant F value indicates that adding the control variables significantly improved the model's fit as compared to a model with zero predictor variables. The results show that there is still no effect for sex on the number of symptoms. However, age did have a significant effect on the number of symptoms (B = .126, p <.001). For every year that age increases, the number of symptoms increases with .126.

Model 5 shows the regression parameters for the multiple regression including the control variables, independent variable (sex) and the mediator (stress). The model explains 4,3% of the variance in the number of symptoms (R^2 = .043, F (7, 444) = 2.823, p <.01). The significant F value indicates that adding the control variables significantly improved the model's fit as compared to a model with zero predictor variables. Again, no significant effect was found for either sex or stress. The results show that age had a significant effect on the number of symptoms (B = .126, p <.001).

The significant intercept in all five models (B = 11.20, p < .001) means that the expected average number of symptoms is 11.20 when there is no effect of the predictor variable(s) in the model.

In sum, the results do not support the hypotheses (see appendix C for an overview).

Table 7. Model 1 regression analysis for sex predicting perceived stress (N=452)

	B	SE
Constant	13.982***	.307
Female sex	-.016	.615
R^2		.000
F		.001

Note. *p<.01, **p<.001

Table 8. Regression analyses for variables predicting the number of symptoms (N=452)

	Model 2		Model 3		Model 4		Model 5	
	B	SE	B	SE	B	SE	B	SE
Constant	11.198***	.354	11.198***	.354	11,197***	.350	11.197***	.350
Female sex	1.161	.709	1.162	.708	1.189	.703	1.189	.702
Stress			.078	.054			.077	.055
Age					.126***	.035	.126**	.035
BMI					-.070	.061	-.069	.061
SES					-.191	.189	-.143	.192
Employed					.938	.718	.926	.717
Physical activity					.036	.161	.053	.161
R^2		.006		.011		.038		.043
F		2.683		2.392		2.960**		2.823**

*** p<.001, ** p<.01, * p<.05

Discussion

Results from this study show that men and women do not differ in their self-reported severity and number of common cold symptoms. Women do not report more symptoms and they do not perceive their symptoms as more severe. These findings contradict the established idea in the literature that women report worse on physical and mental health outcomes (Annandale, 2013). The results suggest that societal expectations for male and female behaviour do not make it more socially acceptable or more likely that women report bad health outcomes. The idea that it is easier for women to adopt a sick role, that woman express more symptoms because of their emotional traits, or that social norms prescribe other reporting behaviours for men than for women, finds no support.

Although Macintyre (1993) found that men are more likely to overreport on the severity of their cold symptoms. The results do not support Macintyre's (1993) study, by showing no sex differences at all. These divergent results could be due to the different types of symptoms that were examined. Macintyre (1993) took flu related symptoms, such as fever and swollen glands, into account, whereas I examined nasal congestion, sneezing, runny nose, sore throat, cough, headache, chills and malaise.

My findings support Macintyre et al. (1997) in their statement that "the direction and magnitude of sex differences in health vary according to the particular symptom or condition in question". However, results from this study cannot be used to draw conclusions about the effect of sex on the individual symptoms, because the variables for the severity and number of symptoms were composed by combining scores. The results can only be used to interpret the effect of sex on the combination of symptoms. Moreover, results cannot be used to draw conclusions about sex differences in actions or behaviours in response to symptoms. It may be true that men and women assess the severity and number of the symptoms in the same way, but other factors, such as the extent to which symptoms disrupt one's normal activities, also play a role in guiding behaviour (Jones, Wiese, Moore & Halay, 1981).

Furthermore, stress is not found to be a mediating factor, because there is no main effect of sex on neither the symptom severity nor the number of symptoms. Thus, stress cannot explain the relationship between sex and cold symptoms. However, from theories and hypothesis about gender and stress, one would expect that men and women would at least differ in their perceived stress, with woman reporting the highest stress scores. This study showed that there were no effects of sex on stress. This outcome contradicts the conventional assumption in literature that women experience more stress than men. Also, stress did not have an effect on the severity and the number of symptoms. However, this might have to do with the first limitation of this study.

A first limitation of this study is that the self-reported symptom severities and number of symptoms could be influenced by the experiment. Symptom perception theory states that physical symptom awareness has to do with internal information, bodily sensations and cognitions, as well as with external information in the environment (Van Wijk & Kolk, 1997). In this research the external environment could have affected the results. The participants were put in quarantine. This means they reported on their symptoms while being in an unnatural environment. Participants were not in their normal social, work or living environments that could influence their compliance to existing gender norms, roles and behavioral expectations. Also, daily stressors to which woman are normally exposed to, could affect the perceptions of the severity of the symptoms. For example, if women had been in their natural environment, where they had to work and care for their children at the same time, they could have perceived their symptoms differently. The same is true for men.

A second limitation of this study lies within the analysis of the data. The dependent variables "symptom severity" and "number of symptoms" were highly skewed. This has an impact on the results because normality is one of the main assumptions of a regression analysis. Since the assumption of normality has not been met, the results must be interpreted with caution. However, the explained variances were extremely low, especially the main effects. Sex explained only 0.3% of the variance in the symptom severity and explained only 0.6% of the variance in the number of symptoms. Even when the dependent variables were normally distributed or different data analysis methods were used, the tendency of the results should be similar.

A third limitation is that the measure of stress used in this study, does not necessarily relate to stress that results from gender roles, role conflict, role obligations, gender traits or gender role stress. The 10-item perceived stress scale only asked questions about participant's general cognitive appraisal. So, if there would have been effects, no statements could have been made about the origins of stress. Moreover, perceived stress was measured before the quarantine days. Maybe, the actual stress levels were different when people were in quarantine.

Despite the limitations, this study offers new insights on the topic of sex differences in reports of common cold symptoms and health in general. This study contributes to the literature on sex differences in health by using the Pittsburgh Common Cold Project dataset, which was, according to my knowledge, never used before to address this topic. Besides, I studied not only the severity, but also the number of cold symptoms. Sex differences in the number of cold symptoms were not studied before. I used a combination of eight different cold symptoms and provided arguments for a new explanatory factor (stress), derived from sociological theory.

Conclusion

In this study, I examined the effect of sex on the severity and number of common cold symptoms. Experimental data from the Pittsburgh Common Cold Project was used. Hypotheses were derived from literature building on a social constructionist perspective of gender and health. First, I expected women to report more and more severe symptoms. Second, I expected women to experience more stress than men. Last, I expected stress to explain the relationship between sex and cold symptom reports.

The results show that there are no differences between men and women in their reports on the severity and the number of common cold symptoms. Women do not report more symptoms and they do not report more severe symptoms. No mediation effect of stress is found. This means that all hypotheses were rejected.

My study adds to the discussion about whether men or women tend to over-rate symptoms and severities of minor health problems and it contests the prevalent idea in literature that women are often "sicker" (Annandale, 2013). Although a previous study from Macintyre (1993) indicated that men were more likely to overrate their signs and symptoms, my study included a different combination of symptoms and used a different dataset to address this topic. Results contradicted Macintyre's findings by showing no differences at all.

It is possible that the experimental setting of this research influenced the results. Experiments generally have good qualities by keeping many factors constant, but people behave differently in their natural environments. Especially for doing research from a perspective of gender, future research should consider using different data collection methods. For example, nasal drops can be administered to respondents, but afterwards it would be better to study them within their home environment. Daily in-depth interviews or field observations can yield more information about people’s daily lives and on the role of gender socialization processes in symptom perceptions. It would also be interesting to investigate gender differences in sickness behaviours (like taking medication or cutting down activities) in response to cold symptoms. I also suggest future research to pursue finding explanations for similarities and differences in symptom reports, because is not clear why they occur and why they differ across diseases.

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Appendix A. Perceived stress 10 item scale

pss10tot = mean.8(pss.cntrl, pss.pers_r, pss.way_r, pss.diffs, pss.irrit_r, pss.ontop_r, pss.angr, pss.cope, pss.upset, pss.nervs)*10.	
pss.cntrl	Unable to control important things
pss.pers_r	Confident about ability to handle personal problems (rev)
pss.way_r	Things going your way (rev)
pss.diffs	Difficulties piling up
pss.irrit_r	Control irritations (rev)
pss.ontop_r	On top of things (rev)
pss.angr	Angered b/c things outside of your control
pss.cope	Could not cope
pss.upset	Upset b/c something happened unexpectedly
pss.nervs	Nervous and stressed

Appendix B. Normality, linearity and homoscedasticity of residuals.

Figure 1. Symptom severity analysis

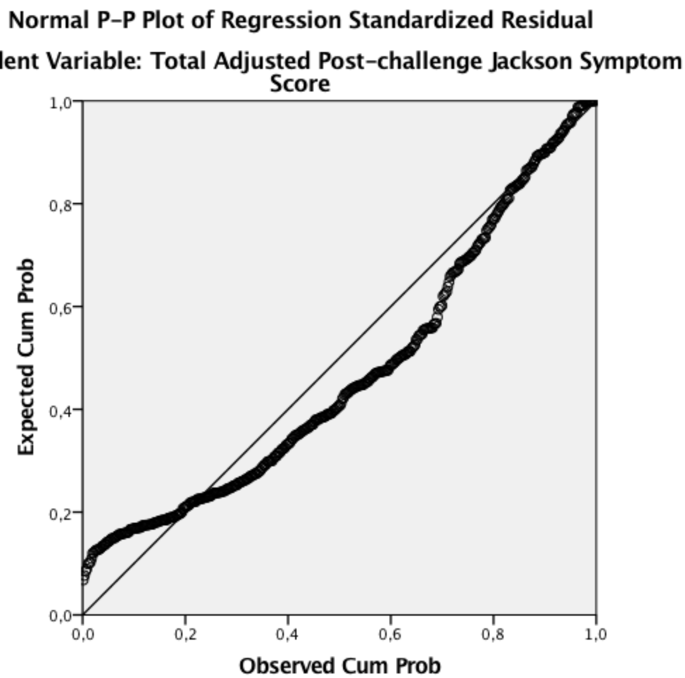


Figure 2. Symptom severity analysis

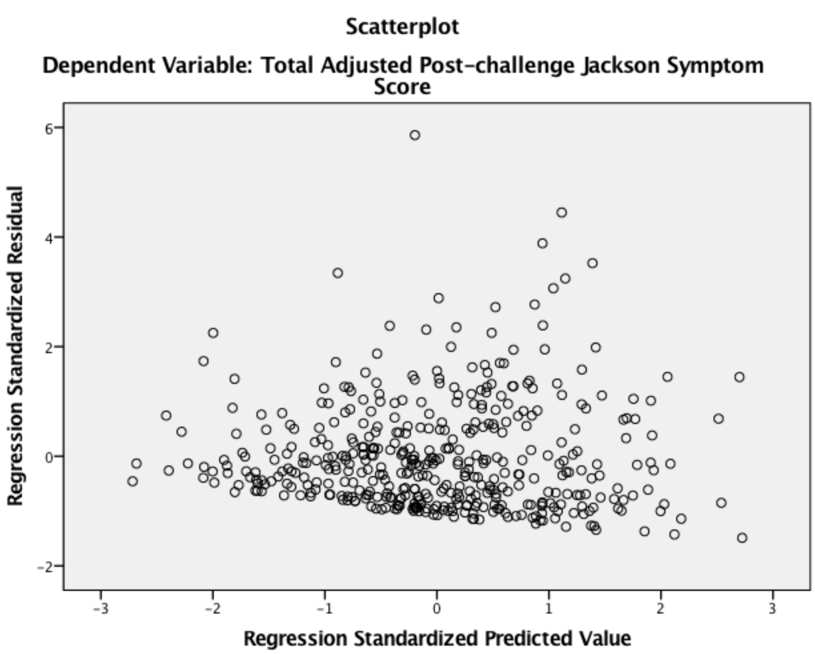


Figure 3. Number of symptoms analysis

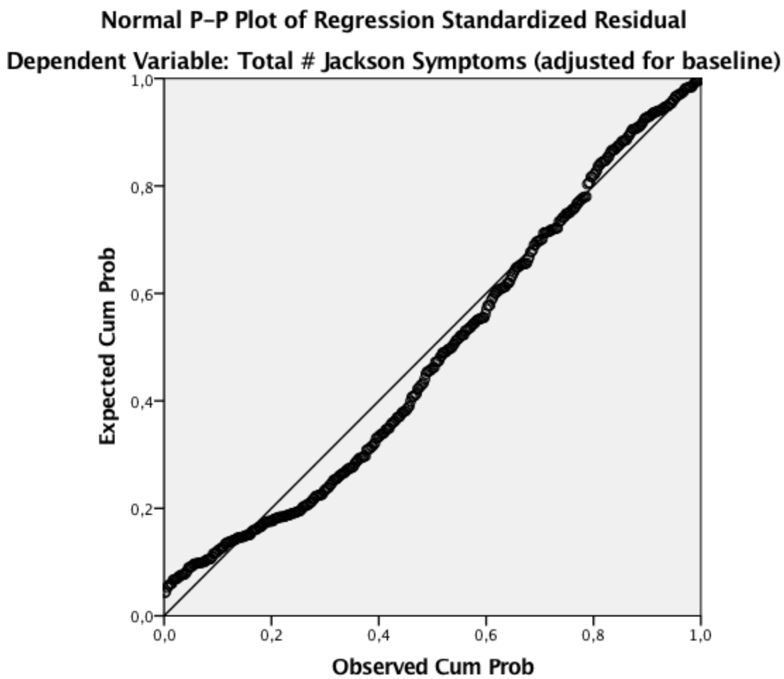
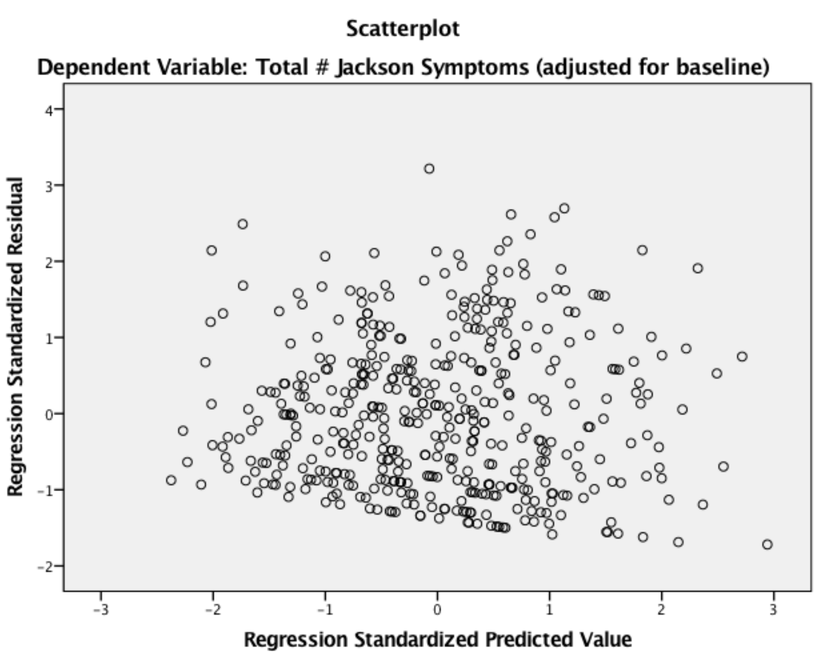


Figure 4. Number of symptoms analysis



Appendix C. Confirmation of hypotheses

Table 9. Confirmation of hypotheses

Hypothesis		Severity analysis Confirmed?	Number analysis Confirmed?
H1	Women report a higher severity of common cold symptoms (nasal congestion, sneezing, runny nose, sore throat, cough, headache, chills and malaise) than men.	No	-
H2	Women report more common cold symptoms (nasal congestion, sneezing, runny nose, sore throat, cough, headache, chills and malaise) than men.	-	No
H3	Women experience more stress than men.	No	No
H4	The effect of sex on the severity of common cold symptoms (nasal congestion, sneezing, runny nose, sore throat, cough, headache, chills and malaise), is mediated by stress.	No	-
H5	The effect of sex on the number of common cold symptoms (nasal congestion, sneezing, runny nose, sore throat, cough, headache, chills and malaise), is mediated by stress.	-	No