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The association of daily physical symptoms with future health

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ABSTRACT

Rationale: Daily physical symptoms play a critical role in health and illness experiences. Despite their daily prevalence, the ability of these symptoms to predict future health status is debated.
Objective: The current study examined whether physical symptom reports predict future health outcomes independent of trait measures of emotion.
Methods: Participants ($N = 1189$) who completed both Midlife in the United States (MIDUS) Surveys I and II as well as the National Study of Daily Experiences (NSDE) reported their daily physical symptoms at baseline and number of reported chronic conditions and functional disability nearly 10 years later.
Results: Physical symptoms at baseline significantly predicted the occurrence of chronic conditions and functional impairment at long-term follow-up, even after adjusting for self-reported affect, self-reported health, and previous health status.
Conclusion: Findings suggest that daily physical symptoms are unique indicators of future health status.

Physical health symptoms such as headaches and indigestion shape our health behaviors, interfere with our daily routines, and contribute greatly to our perceived sense of health and well-being (Charles and Almeida, 2006). Despite their importance for the quality of daily life, it is unclear how such symptoms predict future physical health status. Some researchers claim that symptom reports and health complaints are not reliable indicators of physical health because they are largely manifestations of affective states. This view states that because positive and negative emotions are related to future health processes (see reviews by Friedman and Booth-Kewley, 1987 and Pressman and Cohen, 2005), physical symptom reports simply reflect these relationships and have no predictive merit on their own. In contrast, other researchers believe that non-specific daily symptoms predict physical future health outcomes (Creed et al., 2012). The view that people's own health assessments reliably predict later health is bolstered by findings showing self-reported health predicts survival better than medical record information (see review by Idler and Benyamini, 1997). The current study examines how well daily physical symptoms uniquely predict three different health-related outcomes among adults nearly 10 years later: self-reported chronic conditions, basic activities of daily living, and instrumental activities of daily living, after adjusting for affect and baseline self-reported health.

1. The importance of physical symptoms

The physical symptoms described in this paper refer to sensations such as back pain, fatigue, headache, and other discomforts that are often perceived by people as worrisome or a change from normal health (Kroenke, 2003; Zijlema et al., 2013). Classic studies note their importance and impact on daily life (e.g., Aneshensel et al., 1984; Verbrugge, 1985). They are the leading reason people seek medical care (Kroenke, 2001), interfere with work and daily routines, and can be detrimental to an individual's ability to function (Matalon et al., 2011). A question receiving less attention is whether such symptoms relate to future physical health and illness.

2. The relationship between symptoms and affect

Despite the prevalence and importance of daily symptoms,

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researchers disagree as to whether they actually reflect physical health status. The Symptom Perception Hypothesis (Watson and Pennebaker, 1989) argues that rather than being signs of physical health problems, non-specific symptoms reflect high levels of negative affect. According to this view, people with high levels of negative affect are more likely to engage in somatosensory amplification, defined as being highly attuned to bodily sensations that are reported as physical symptoms. People with high levels of negative affect also have a tendency to interpret benign bodily sensations as physical symptoms demanding attention (Brown et al., 2012; Hansell and Mechanic, 1985; McAndrew et al., 2014). Consistent with this view, studies have found that trait negative affect, a disposition associated with higher levels of experiencing anger, contempt, and disgust, is associated with a greater degree of physical symptom reporting (Van Diest et al., 2005).

Across a large number of studies and a variety of measures, higher levels of negative affect are consistently associated with increased physical symptom reporting (Brown and Moskowitz, 1997; Feldman et al., 1999; Mora et al., 2002; Verbrugge, 1985; Williams and Wiebe, 2000). In addition, higher levels of neuroticism, a personality trait related to experiencing negative, distressing emotions, are associated a wide range of physical symptoms and conditions (Costa and McCrae, 1987; McNiel and Fleeson, 2006; Ramirez-Maestre et al., 2004), even those unrelated to objective health status (Costa and McCrae, 1980). These associations are often bidirectional, with studies documenting that high negative mood and affect leads to increases in symptom reporting, and that a greater number of symptoms lead to higher negative affect (e.g., Charles and Almeida, 2006; Aneshensel et al., 1984).

Symptom reporting is not only associated with higher levels of negative affect and neuroticism, but also with lower levels of positive affect. Early studies found little association between positive affect and symptom reporting in healthy populations (Watson and Pennebaker, 1989), but more recent studies find that in patient samples, individuals with high levels of positive affect report fewer and less severe symptoms even after adjusting for objective measures of disease (Cohen et al., 2003). In non-patient samples, both state and trait positive affect have been associated with fewer symptom reports (Røysamb et al., 2003; Benyamini et al., 2000).

3. Symptoms as predictors of future health

The research reviewed above finds strong associations between emotional experience and symptom reports. Yet, other research shows that, nonetheless, people's perceptions of their health status hold some predictive value for their overall health (e.g., Idler and Benyamini, 1997). Self-reported physical symptoms rely on people's appraisals of their health status, and self-reported appraisals of health can reliably predict physical health outcomes. For example, general health appraisals ascertained by asking adults to rate their overall health on a scale from 1 to 5 predicts objective health measures such as chronic conditions, functional status and longevity often better than self-reported lists of medical conditions (Borawski et al., 1996; Linn and Linn, 1980; Kaplan and Kotler, 1985; Idler and Benyamini, 1997; Mossey and Shapiro, 1982). Few prospective studies, however, have examined more proximal reports of health status, such as actual health symptoms and their association with later health-related outcomes.

Among patient samples, self-reported symptoms predict various health-related outcomes (Kaplan and Kotler, 1985; Sha et al., 2005; Creed, 2011; Jackson et al., 2006; Creed et al., 2013). For example, daily disease-specific symptoms (e.g. chest pain) predict mortality among people with ischemic heart disease (Kaplan and Kotler, 1985). In another study, non-specific daily symptoms (such as headache and backache) predict functional impairment in daily activities (Creed, 2011) and health-related quality of life in patients attending neurology, gastroenterology, and cardiology clinics 6 months later (Jackson et al., 2006). Finally, a recent study by Creed et al. (2013) found that the presence of multiple physical symptoms was associated with impaired health status a year later in patients with chronic pain, chronic fatigue, and irritable bowel syndrome.

The research above supports a model where symptom reports are predictors of future health outcomes even after adjusting for the influences of affective states and personality traits. This research suggests that daily symptoms among patient populations may therefore be unique predictors of future health outcomes. Yet, questions remain regarding whether these findings generalize to broader community-based populations. It is possible that symptom reporting in patient populations signals disease-specific change, but that symptoms among community-based populations are unrelated to health-related processes.

4. Present study

The current study examined whether daily symptoms predict future health among a non-patient, community-based sample of men and women. To our knowledge, only one study has addressed this question. In that study, participants reported the physical symptoms they had experienced across the prior six months, as well as their overall health status and symptoms of anxiety and depression (Creed et al., 2012). Higher levels of self-reported physical symptoms predicted overall health status one year later after adjusting for depression and anxiety symptoms. The current study expands upon prior research in several ways. First, we used a daily questionnaire to capture whether symptoms were reported each day as opposed to a retrospective report over a longer time frame. By using a more proximal measure, our goal was to capture daily symptoms the day they were experienced as opposed to general appraisals of health that rely on memory over a longer period of time. We further included self-reported health as a covariate in efforts to distinguish between overall self-reported health appraisals and those specific to self-detected physical symptoms. We did so to minimize any concerns that general self-reports were inflating associations between symptoms and the health-related outcomes. Finally, given concerns that symptoms may just be a proxy for trait characteristics related to affect, we included both trait positive and negative affect in our statistical models.

In the current study, we examined how well daily physical symptoms predict three different health-related outcomes across almost 10 years among a community-based sample: self-reported chronic conditions, basic activities of daily living, and instrumental activities of daily living. By using data from the Midlife in the United States Surveys (MIDUS I and II), we examined this process among a group of men and women who ranged from 25 to 74 years old at the beginning of the study (Midlife in the United States, 2014). We hypothesized that daily symptoms would be related to later health-related outcomes even after adjusting for initial health status, and adjusting for the influences of affect and self-reported health.

5. Methods

5.1. Sample and design

The Midlife in the United States Study (MIDUS I) includes data from telephone interviews and mailed surveys from a national sample of 7108 people, aged 24–74. Original data were collected in 1995–1996. A longitudinal follow-up of the original sample was

conducted approximately 9 years later from 2004 to 2006 (MIDUS II), which included 3990 participants who completed both the self-administered questionnaires and phone interviews at both time points.

The National Study of Daily Experiences (NSDE) consists of a subset ($N = 1500$) of randomly chosen individuals from the MIDUS I sample who completed semi-structured telephone interviews about their daily experiences for eight consecutive days in 1996–1997. Each interview included questions regarding participants' affective state, physical health status, and stressors they encountered. Of the original 1500 NSDE participants, 79% ($N = 1189$) completed MIDUS II. Some sibling pairs ($n = 166$) were included. To check for issues of dependency in the data, analyses were completed both with and including only one sibling. Results were not significantly different when the siblings where excluded, so the current analyses included all 1189 participants. At follow-up, participants (548 men, 641 women) ranged from 35 to 84 years old ($M = 56$) and were predominantly white (91.5%). Almost all participants (93%) reported having at least a high school degree, and 37% had at least a bachelor's degree. Mean household income was $70,000, and men reported higher levels of mean individual income ($M = $55,000) than women ($M = $30,000).

6. Measures

6.1. Daily physical symptoms

Daily symptoms were measured in NSDE I using a shortened version of Larsen and Kasimatis' (1991) physical symptom checklist (Charles and Almeida, 2006). Men and women were asked five questions about how much of the time today they had experienced: 1) headaches, backache, or muscle soreness; 2) a cough, sore throat, fever, chills, or other cold and flu symptoms; 3) nausea, diarrhea, poor appetite, or other stomach problems; 4) any chest pain or dizziness; and 5) any other physical symptoms or discomforts. In addition, women were asked 6) whether they had any menstrual-related symptoms such as cramps, bloating, breast tenderness; and 7) hot flashes or flushes. Participants responded to each question using a scale from 1 (all of the time) to 5 (none of the time). A single physical symptom score for each day was calculated for each participant by averaging the scores across each of the questions. Reverse-coding was used so that higher scores indicate longer durations of physical symptoms. The eight daily scores were averaged to create a single mean physical symptom score to reflect an average daily duration of physical symptoms over the 8-day interview period.

6.2. Trait negative affect

Trait negative affect was measured in MIDUS I using the Non-specific Psychological Distress Scale (Kessler et al., 2002). Participants indicated how much of the time over the past 30 days they experienced six emotional descriptors (nervous, restless, hopeless, worthless, everything was an effort, so sad nothing could cheer you up) on a 5-point scale from 1 (all of the time) to 5 (none of the time). Scores were averaged across each set of items for each participant (Cronbach $\alpha = 0.87$). Items were reverse coded so that a higher score was indicative of more trait negative affect.

6.3. Trait positive affect

Trait positive affect was assessed in MIDUS I by asking participants how much of the time over the past 30 days they felt cheerful, in good spirits, extremely happy, calm, satisfied, and full of life. Participants rated each item on a 5-point scale from 1 (all of the time) to 5 (none of the time). Items were averaged together for each participant (Cronbach $\alpha = 0.91$) and reverse coded so higher scores indicate more trait positive affect.

6.4. Body mass index (BMI)

Body mass index was calculated by dividing participants' self-reported weight (converted into kilograms) by height (converted into meters squared).

6.5. Self-rated health

MIDUS I participants rated their physical health on a scale from 1 (poor) to 5 (excellent).

6.6. Exercise

MIDUS I participants reported the frequency in which they completed vigorous physical activities during the summer and winter months. A single physical exercise score was calculated by taking the mean of the summer and winter ratings. These ratings were measured on a scale from 1 (never) to 6 (several times a week).

6.7. History of smoking

Participants indicated whether or not they had ever smoked cigarettes regularly.

6.8. Chronic illness

In both the MIDUS I and II surveys, participants were asked if they have had each of 29 chronic physical conditions in the prior 12 months. Conditions included were asthma, tuberculosis, other lung problems, joint diseases, backache, skin trouble, thyroid disease, hay fever, stomach trouble, urinary/bladder problems, constipation, gall bladder problems, foot trouble, varicose veins, HIV, autoimmune diseases, mouth problems, high blood pressure, emotional disorders, alcohol/drug problems, migraines, diabetes, neurological disorders, stroke, ulcer, hernia, hemorrhoids, and swallowing problems. Participants also reported whether they had ever experienced cancer or heart disease. Chronic conditions were placed into16 chronic condition categories to prevent multiple reports of conditions. Categories included autoimmune disorders, cancer, cardiovascular conditions, diabetes, digestive conditions, foot trouble, hay fever, gall bladder trouble, lung conditions, neurological conditions, pain-related conditions, skin trouble, thyroid disease, mouth/gum trouble, sleep problems, and urinary/bladder problems. Mental health conditions such as anxiety or depression were excluded from the current analyses.

6.9. Functional disability

MIDUS 1 and MIDUS II surveys asked about activities of daily living (ADLs) and instrumental activities of daily living (IADLs) to assess functional disability (Katz et al., 1963; Lawton and Brody, 1969). Items in the ADL category reflect an individual's ability to function at a basic level on her or her own, and include: bathing or dressing oneself, walking one block, and climbing one flight of stairs. Items in the IADL category reflect an individual's ability to engage in everyday activities, including lifting or carrying groceries, climbing several flights of stairs, bending, kneeling, or stooping, walking more than a mile, walking several blocks, vigorous activity, and moderate activity. Participants indicated the extent to which their health limited these activities on a 4-point scale ranging from

1 (a lot) to 4 (not at all), with items averaged together such that higher scores indicated greater functional disability.

6.10. Statistical analysis

A Poisson regression model with robust error variance evaluated adjusted relative risk ratios (aRR) assessing the likelihood that physical symptoms predict each of the three self-reported health outcomes. This procedure allowed us to correct for the overestimation of the standard error that can occur when using Poisson regressions to estimate relative risk (Zou, 2004). A relative risk of 1 signifies that the variable of interest is not significantly associated with a one unit change in symptom reporting. A relative risk greater than 1 indicates the adjusted increased likelihood of reporting a chronic condition or disability. For these analyses, we categorized each of the health measures into dichotomous variables at both time points. For chronic conditions, participants were categorized as either having [1] or not having [0] any chronic conditions. For both ADLs and IADLs, participants were categorized as either having [1] or not having [0] any functional limitations.

Simple regression analyses examining the ability of physical symptoms to predict each of the self-reported health outcomes were also analyzed using the non-altered, continuous measures. These analyses yielded the identical patterns of results. We chose to report the adjusted risk ratios (and hence analyses using the categorical method) to provide a more accessible interpretation with percentages corresponding to relative risk that are often used in the medical literature. The standardized coefficient betas using continuous variables, however, are available upon request.

All models included trait negative affect, trait positive affect, self-rated health, and baseline health (that matched the outcome variable; e.g., baseline chronic health when predicting follow-up chronic health) as indicators. We also included several covariates that have been previously associated with an increased risk in reporting a chronic condition in the literature: age, race/ethnicity (0 = white; 1 = non-white), gender (0 = female), marital status (0 = non-married), education, BMI, smoking status (0 = smoker) and exercise. In secondary analyses, we only included participants who reported no chronic conditions or limitations in ADLs or IADLs at baseline.

We examined the ability of overall levels of physical symptoms to predict later health status, but we also examined whether the consistency of symptom reports (i.e., symptoms reported over a greater number of days as opposed to symptoms reported at longer duration averaged across the days) predicts these health-related measures. We therefore analyzed the number of days that participants' experienced any physical symptom. A participant was coded as either having [1] or not having [0] a symptom each day if they reported the occurrence of any symptom at least some time during that day. We then calculated the percentage of days that each participant reported at least one symptom. Additionally, we examined the number of continuous days that any symptom was reported. These measures did not predict any of our health-related outcomes at follow-up, and the null effects are available upon request. All analyses were conducted using SAS statistical software, version 9.3 (SAS, Cary, NC).

7. Results

Of the 1189 participants in the sample, five participants were missing scores for one of the affect variables, 10 were missing a score for symptom reports, and 50 were missing data for any of the remaining baseline covariates leaving 1124 participants with complete data. Of these remaining participants (95% of the sample), none were missing scores for the chronic conditions variable at follow-up, but 165 were missing scores for the follow-up ADL variable and 166 were missing scores for the follow-up IADL variable and thus could not be included in analyses predicting these functional outcomes.

Participants reported low levels of overall daily symptoms with an average of 0.52 ($SD = 0.54$) at baseline. Headaches, backaches and muscle soreness were the most common symptoms, reported by 80% of the participants on at least one of eight days. The least common symptoms for both men and women were chest pain and dizziness, reported among 15% of the participants. At baseline, 27% of participants reported no chronic conditions. Across the entire sample including those with and without a chronic condition at baseline, 14% of the entire sample went from having no chronic conditions at baseline to having at least one chronic condition at follow-up. For ADLs, 10% reported an ADL impairment at baseline and 23% did so at follow-up. For IADLS, 63% reported an IADL impairment at baseline and 75% reported some impairment at follow-up.

Consistent with previous findings (Kroenke, 2003) people reporting a higher level of physical symptoms were more likely to be women, $t(1083.7) = 6.48$, $p < 0.001$, and have higher levels of trait negative affect, $r = 0.28$, $p < 0.001$, and lower levels of trait positive affect, $r = -0.22$, $p < 0.001$. People reporting a higher level of physical symptoms were also more likely to be younger, $r = -0.14$, $p < 0.001$, as has been found in prior research (Mallers et al., 2005). Daily symptoms were significantly associated with all health-related outcomes at baseline: more chronic conditions ($r = 0.14$, $p < 0.001$), fewer ADLs ($r = 0.12$, $p < 0.001$) fewer IADLs ($r = 0.19$, $p < 0.001$), and worse self-reported health ($r = -0.18$, $p < 0.001$). Table 1 displays bivariate correlations between all predictor and outcome measures.

8. Risk of a health-related condition at follow-up

8.1. Chronic conditions

First, we fit a Poisson regression model that included only physical symptom reports and baseline chronic conditions. We included baseline chronic conditions so that any relationship between symptom reports and chronic conditions at follow-up would not be confounded by preexisting conditions. In this model, for every one unit increase symptom reporting, the relative risk of reporting a chronic condition at follow-up increased by 10%. Next, we ran a model with all affect variables and potential covariates (see Table 2). As hypothesized, baseline physical symptom reports predicted risk for future chronic conditions even after adjusting for all potential covariates and baseline chronic condition incidence. Every one unit increase in symptom reporting increased the relative risk of reporting a chronic health condition at follow-up by 12%. In addition, participants who were older, female, had a higher BMI, and had poorer self-rated health at baseline were more likely to report a chronic condition at follow-up.

We next examined whether these effects remained if we only included individuals who reported no chronic conditions at baseline ($N = 307$). Although greatly reducing the sample size, this is arguably the strictest test of the ability of physical symptoms to predict new chronic conditions. Results showed that symptom reports significantly predicted a later chronic condition: for every one unit increase on the physical symptom scale, there was a 40% increase in the risk of reporting a chronic condition at follow-up (see Table 2, model 2).

Finally, to assess whether these findings were driven by the presence of chronic conditions that are most likely to contribute to mortality, we ran separate analyses examining the ability of physical symptoms to predict chronic illnesses that are the main causes

Table 1
Correlation matrix for variables of interest.

	Variable (Mean,SD or %)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	Age (55.21, 12.53)	–																	
2	Gender (46% male)	0.01	–																
3	BMI (26.56, 4.82)	0.13**	0.15**	–															
4	Education (7.21, 2.47)	−0.08*	0.09**	−0.10**	–														
5	Race (91% white)	0.05	0.03	−0.01	0.05	–													
6	Marital Status (72% married)	−0.03	−0.12**	−0.02	−0.02	−0.08*	–												
7	Exercise (4.23, 1.68)	−0.25**	0.21**	−0.08*	0.10**	0.08	−0.04	–											
8	Smoking Status (49% smoker)	−0.11**	−0.11**	0.01	0.16**	−0.05	−0.05	0.05	–										
9	Base Chronic Conditions (26% = 0)	0.19**	−0.06	0.07*	−0.06	0.00	0.01	−0.10**	−0.08*	–									
10	Base ADLs (89% = 0)	0.14**	−0.03	0.15**	−0.09*	−0.10*	0.08*	−0.18**	−0.04	0.13**	–								
11	Base IADLs (36% = 0)	0.28**	−0.11*	0.29**	−0.14**	−0.10*	0.06	−0.36**	−0.04	0.24**	0.68**	–							
12	Base SRH (3.66, 0.90)	−0.12**	0.07	−0.24**	0.22**	0.13**	−0.00	0.27**	0.10**	−0.25**	−0.26**	−0.44**	–						
13	Base TNA (1.52, 0.60)	−0.14**	−0.14**	0.02	−0.10*	−0.05	0.11**	−0.05	−0.07	0.17**	0.16**	0.21**	−0.22**	–					
14	Base TPA (3.42, 0.70)	0.12*	0.11**	−0.01	0.02	−0.03	−0.07	0.12**	0.08*	−0.14**	−0.07	−0.14**	0.23**	−0.63**	–				
15	Base Physical Symptoms (0.51, 0.53)	−0.14**	−0.19**	0.01	−0.07*	−0.00	0.01	−0.04	−0.07	0.14**	0.12**	0.19**	−0.18**	0.28**	−0.22**	–			
16	Follow-up Chronic Conditions (30% = 0)	0.29**	−0.10*	0.14**	−0.03	0.04	0.04	−0.08*	−0.10*	0.28**	0.11*	0.20**	−0.18**	0.05	−0.06	0.12**	–		
17	Follow-up ADL (76% = 0)	0.20**	−0.05	0.28**	−0.18**	−0.02	0.02	−0.18**	−0.10*	0.17**	0.32**	0.46**	−0.27**	0.14**	−0.10*	0.15**	0.18**	–	
18	Follow-up IADL (24% = 0)	0.34**	−0.11*	0.29**	−0.21**	−0.01	0.01	−0.29**	−0.12**	0.25**	0.27**	0.56**	−0.37**	0.15**	−0.16**	0.17**	0.27**	0.75**	–

Note: BMI = Body Mass Index, ADL = Activity of Daily Living, IADL = Instrumental Activity of Daily Living, SRH = Self Rated Health, TNA = Trait Negative Affect, TPA = Trait Positive Affect.
*$p < 0.01$; **$p < 0.001$.

of death in the United States: heart problems, cancer, and stroke. These results were not significant, indicating that the findings may be driven by more minor chronic conditions as opposed to the major contributors to mortality.

8.2. Activities of daily living

As with chronic conditions, we first fit a Poisson regression model that included only physical symptom reports and baseline ADLs. In this model, for every one unit increase in symptom reporting, the relative risk of reporting an ADL at follow-up increased by 46%. Next, we ran a model with all affect variables and potential covariates (presented in Table 3). As hypothesized and consistent with the findings for chronic conditions, daily symptom reports at baseline increased the risk of reporting a later ADL limitation even after including all covariates. Specifically, every one unit increase in symptom reporting conveyed a 41% increase in the risk of reporting an ADL impairment at follow-up. Participants who were older, reported an ADL impairment at baseline, scored lower on the positive affect scale, had a higher BMI, had a higher education and reported worse self-rated health at baseline were more likely to report an ADL impairment at follow-up.

As with chronic conditions, we next conducted the stricter test of whether these effects remained if we only included individuals who reported having no ADLs at baseline ($N = 864$). Results were significant and showed that for every one unit increase on the physical symptom scale, there was a 34% increase in the risk of reporting an impairment in ADLs at follow-up (see Table 3, model 2).

8.3. Instrumental activities of daily living

We fit a Poisson regression model that included only physical symptom reports and baseline IADL. In this model, for every one unit increase in symptom reporting, the relative risk of reporting a chronic condition at follow-up increased by 4%. Next, we ran a model with all affect variables and potential covariates (presented in Table 4). Even after adjusting for potential covariates, results remained significant such that every one unit increase in symptom reporting increased the risk of reporting an impairment in IADL at follow-up by 6%. Participants who were older, reported an IADL at baseline, scored lower on the positive affect scale at baseline, and had a higher BMI were more likely to report an IADL impairment at follow-up. When we repeated these analyses on individuals who reported no IADL at Time 1 ($N = 356$), physical symptoms did not significantly increase the risk of reporting an IADL impairment at follow-up (see Table 4, model 2).

9. Discussion

This study examined the ability of daily physical symptom reports to predict future health measures in community-based population. Our findings suggest that physical symptom reports independently predict a variety of future health-related measures above and beyond the influences of affect and overall self-reported health at baseline.

9.1. Relationship between symptoms, affect, and health

We found that higher levels of symptoms are strongly associated with higher levels of trait negative affect and lower levels of trait positive affect, consistent with existing literature (e.g., Watson and Pennebaker, 1989; Cohen et al., 2003). Additionally, both symptom reports and affect are associated with concurrent health-related measures. These findings add to the already large body of

Table 2
Relative risk of reporting a chronic condition at follow-up.

Risk factors	Model 1 risk ratio (95% CI; $n = 1124$)	Model 2 risk ratio (95% CI; $n = 307$)
Baseline Physical Symptoms	**1.12 (1.06–1.18)*****	**1.40 (1.17–1.68)*****
Age	1.01 (1.01–1.02)***	1.03 (1.02–1.03)***
Baseline trait negative affect	0.97 (0.90–1.04)	0.88 (0.65–1.19)
Baseline trait positive affect	0.97 (0.91–1.04)	0.93 (0.76–1.14)
Gender (ref = female)	0.87 (0.81–0.95)**	0.95 (0.74–1.23)
Baseline chronic condition (ref = no)	1.38 (1.22–1.55)***	
Body mass index	1.01 (1.01–1.02)***	1.00 (0.98–1.02)
Education	1.01 (1.00–1.03)	0.98 (0.94–1.03)
Race (ref = non-white)	1.10 (0.96–1.27)	1.47 (0.91–2.37)
Marital status (ref = married)	1.06 (0.98–1.15)	1.12 (0.88–1.42)
Exercise	1.02 (1.00–1.04)	0.99 (0.93–1.06)
Smoking status (ref = smoker)	0.92 (0.86–1.00)*	0.83 (0.66–1.03)
Baseline self-rated health	0.94 (0.91–0.98)**	0.87 (0.75–1.00)

Model 1 includes the full study cohort. Model 2 includes participants with no chronic conditions at baseline.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Table 3
Relative risk of reporting an impairment in Activities of daily living (ADL) at follow-up.

Risk factors	Model 1 risk ratio (95% CI; $n = 959$)	Model 2 risk ratio (95% CI; $n = 864$)
Baseline Physical Symptoms	**1.41 (1.23–1.63)*****	**1.34 (1.11–1.61)*****
Age	1.03 (1.02–1.04)***	1.03 (1.02–1.04)***
Baseline trait negative affect	0.98 (0.81–1.18)	0.97 (0.74–1.27)
Baseline trait positive affect	0.75 (0.63–0.89)***	0.73 (0.58–0.91)**
Gender (ref = female)	0.85 (0.66–1.09)	0.83 (0.60–1.13)
Baseline activity of daily living (ref = no)	1.90 (1.46–2.47)***	
Body mass index	1.05 (1.04–1.07)***	1.07 (1.04–1.09)***
Education	0.94 (0.89–0.98)**	0.90 (0.85–0.96)**
Race (ref = non-white)	0.84 (0.59–1.21)	0.72 (0.45–1.15)
Marital status (ref = married)	1.08 (0.86–1.37)	1.12 (0.83–1.52)
Exercise	0.99 (0.92–1.05)	1.00 (0.92–1.10)
Smoking status (ref = smoker)	0.84 (0.67–1.07)	0.73 (0.54–0.99)*
Baseline self-rated health	0.82 (0.72–0.94)**	0.76 (0.63–0.90)**

Model 1 includes the full study cohort. Model 2 includes participants with no ADL limitations at baseline.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Table 4
Relative risk of reporting an impairment in instrumental activities of daily living (IADL) at follow-up.

Risk factors	Model 1 risk ratio (95% CI; $n = 958$)	Model 2 risk ratio (95% CI; $n = 356$)
Baseline Physical Symptoms	**1.06 (1.00–1.12)***	**1.16 (0.97–1.38)**
Age	1.01 (1.01–1.01)***	1.02 (1.01–1.03)***
Baseline Trait Negative Affect	0.98 (0.92–1.05)	1.01 (0.80–1.29)
Baseline Trait Positive Affect	0.94 (0.88–0.99)*	0.89 (0.78–1.01)
Gender (ref = female)	1.02 (0.95–1.10)	1.14 (0.92–1.42)
Baseline Instrumental Activity of Daily Living (ref = no)	1.56 (1.40–1.74)***	
Body Mass Index	1.01 (1.00–1.01)	1.02 (0.99–1.04)
Education	0.99 (0.97–1.00)*	1.00 (0.96–1.04)
Race (ref = non-white)	1.01 (0.90–1.12)	1.39 (0.78–2.47)
Marital Status (ref = married)	1.07 (0.99–1.15)	1.21 (0.99–1.49)
Exercise	1.00 (0.98–1.02)	0.98 (0.91–1.05)
Smoking Status (ref = smoker)	0.95 (0.88–1.01)	0.80 (0.65–0.99)*
Baseline Self-rated Health	0.96 (0.93–1.00)	0.92 (0.80–1.04)

Model 1 includes the full study cohort. Model 2 includes participants with no IADL limitations at baseline.
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

literature showing that not only does a relationship exist between symptom reports and affect, but also that these variables are closely tied to concurrent health status (e.g., Pressman and Cohen, 2005). In addition, we found that physical symptom reports at baseline were strongly correlated with all three health-related outcomes nearly a decade later. These outcomes are robust predictors of mortality and are often used in research as summary measures of health status. The fact that these daily physical symptoms predict major health problems in the future illustrates that they provide meaningful information to both the person experiencing these symptoms as well as their health care providers.

We also found that symptom reports did not independently predict the presence of cancer, heart problems, or stroke, the top three causes of death in the United States. Instead, they predicted other chronic conditions that may be less lethal but still influence later health. Unfortunately, the nature of our data did not allow us to ascertain the severity of these conditions (e.g., diabetes controlled by diet or requiring daily insulin injections). Nonetheless, we believe that their ability to predict the risk of developing these chronic conditions signals that our perceptions of minor,

transient symptoms are indicative of more severe, chronic deviations from health in the future.

What is the underlying mechanism that may explain why symptom reports predict health-related outcomes years later? Although not addressed in the current study, one possibility is that these daily physical symptoms are indicative of physiological processes that may lead to worse health later. These daily symptoms may not just be daily annoyances, but may in fact be warning signs of the development of more serious conditions. The finding that symptoms were better predictors of the more debilitating ADLs than IADLs, suggest that this may possibly be the case. Another possibility is that people who report higher levels of physical symptoms have a heightened, more sensitive, physiological response to external environmental influences. For example, it is possible that people who are more physiologically reactive may experience a greater disruption of homeostasis when they encounter external threats. Thus, this heightened physiological reactivity may lead to greater vulnerability to physical health threats in the future, therefore portending worse long-term health (McEwen, 2006). This may also explain why, among the healthy samples, symptoms were not predictive of IADLs, a finding contrary to our hypothesis. One possibility to explain this unexpected finding may be that other factors (life style factors; viruses; genetic endowment) may cause diseases that create limitations, but how the physiological system responds to these illness experiences may make the existing condition worse. Symptoms did predict the onset of ADLs, which may indicate that people who already had functioning limitations had exacerbating problems which transitioned them from a less limited to a more limited level of functioning.

Daily symptoms significantly predicted future health-related outcomes even after adjusting for initial measures of self-rated health. Given that physical symptoms are important factors in determining how we view and report our overall health, one might expect that both measures reflect an evaluation of health that would highly overlap and potentially eliminate any unique variance that each may offer. The current findings that daily physical symptoms predict later health outcomes separately from the perceptions of general health status suggests that symptom reports offer unique information apart from appraisals of self-reported health.

In addition, we found that whereas self-rated health was associated with the risk of developing future chronic conditions in the full sample, there was no significant association in the healthy sample. One possible explanation is that healthy adults who have not experienced any major illnesses are not as good at making judgments about their current health. Findings are consistent with the commonsense model of illness cognition, suggesting that self-rated health is based on knowledge of health conditions that healthy people have not yet acquired (Idler et al., 2004).

9.2. Strengths and limitations

The number of chronic conditions and level of functional impairment were ascertained through self-reported questionnaires. This study did not link self-reports of symptoms with health outcomes that were independent of self-reports, such as a physician's examination. Although we were limited by only self-report measures, other research has found that self-reports of chronic conditions and levels of functional impairment correlate strongly with a diagnosis of illness by a physician (Henderson et al., 2009). In addition, the self-reported outcomes asked about specific diagnoses (chronic conditions) or functional abilities (IADL; ADL) in attempts to ascertain the absence or presence of specific health conditions.

An additional limitation is the restricted scope of the physical symptom checklist used to assess participants' daily levels of physical symptoms. Symptoms were clustered into questions about subgroups, and each evening participants were asked about the duration of their symptoms for each subgroup. As such, analyses on the effects of individual symptoms could not be conducted, limiting variability and specificity in these reports. Additionally, the physical symptoms checklist assessed symptom duration but not severity. Thus, we were unable to examine how symptom severity may interact with symptom duration when predicting future health. Despite of the limited scope of the physical symptom checklist, however, self-reported symptoms still predicted future health-related outcomes. Finally, the majority of the participants was white and had higher socioeconomic status than the national average. Future studies should target minority groups and individuals of lower income levels given the strong associations between health status, minority status and low socio-economic status as well as literature that documents the strong influence of culture on symptom reports (Adler and Ostrove, 1999; Kirmayer and Young, 1998).

9.3. Future directions and conclusion

The current findings suggest that daily physical symptoms predict future health independent of several possible confounding factors. Physical symptom reports are often related to but not solely reflections of emotional states or affective traits. Furthermore, our findings suggest that physical symptom reports may have utility in both clinical and research settings as important indicators of future health status.

Very few studies have examined the ability of daily physical symptoms to predict future health-related outcomes among relatively healthy adults. Our findings in a large national sample and a longitudinal design build upon existing results from studies that examine symptom reporting in predominantly clinical populations (Creed, 2011). Future studies will be able to further build upon our findings by investigating the mechanisms responsible for these longitudinal associations. The progression from subclinical symptoms to diagnosed disease and disability is complex and likely due to the interplay of many factors. Therefore, future studies should examine the potential pathways through which daily physical symptoms can affect multiple aspects of future health including disease onset and progression, disability, and mortality.

Additionally, future studies would benefit from a multi-method approach, using quantitative and qualitative data for a variety of different scales and outcomes and including objective measures of health as outcomes. Symptom experience in the general population is a complex phenomenon. Differences in symptom onset, duration, and severity all contribute to variability in how those symptoms are perceived and handled. Aspects of symptomatology including pain, fatigue, and dizziness have been captured by multi-item scales to assess multiple dimensions of symptom severity, duration, and symptom-related impairment (Kroenke, 2001). In addition, behavioral reports and informant reports further build upon self-reported data from the individual. Future studies should utilize a variety of symptom scales and report sources to increase the robustness of and provide additional support for the relationship between symptom reporting and future health-related outcomes.

Daily physical symptoms are important contributors to perceived health and well-being. They guide health behaviors, influence daily functioning, and are the primary reason why people seek medical care. The findings of this study suggest that daily physical symptoms are valid indicators of long-term health, and that this association exists independently from a variety of psychological factors.

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