

# The contribution of dispositional optimism to understanding insomnia symptomatology: Findings from a cross-sectional population study in Austria

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## Summary

Attitudes and expectations of people towards their lives are essential to future health outcomes. Growing evidence has linked dispositional optimism to beneficial health outcomes, such as exceptional longevity, healthy aging and better sleep quality. We describe the association between dispositional optimism and chronic insomnia, considering potential mediators, in the Austrian Sleep Survey ( $N = 1,004$ ), a population-based cross-sectional study conducted in 2017. Optimism was measured using the validated Life Orientation Test-Revised, and four different definitions were used to assess chronic insomnia. Three definitions were based on the criteria of chronic insomnia according to the International Classification of Sleep Disorders (3rd edn). Age- and multivariable-adjusted logistic regression models were used to calculate odds ratios (OR) and 95% confidence intervals (CIs). Among Austrians who were more optimistic, chronic insomnia risk was lower compared with those less optimistic (middle versus bottom tertile of optimism score: OR = 0.39, 95% CI, 0.22–0.70; and top versus bottom tertile: OR = 0.28, 95% CI, 0.14–0.54;  $p$ -trend < .001). Results were similar for all four definitions of insomnia, and differed slightly between men and women. Happiness, depression and health status confounded the association, whereas lifestyle did not. Promoting dispositional optimism could represent a simple and accessible strategy to improve sleep quality and lower insomnia risk, with downstream beneficial health effects. Further research is needed to clarify the prevention potential of interventions targeting this mental trait.

## KEYWORDS

happiness, insomnia symptoms, optimism, population-representative health survey, positive affect, sleep complaints

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## 1 | INTRODUCTION

The attitude and expectations of people towards their lives are essential for future health outcomes. Growing evidence has linked dispositional optimism to better health (Lee et al., 2019) and a lower risk of chronic disease outcomes, especially cardiovascular disease (Rozanski, Bavishi, Kubzansky, & Cohen, 2019). Dispositional optimism, i.e. high expectancies for positive outcomes in the future and low expectancies for negative events (Sohl, Moyer, Lukin, & Knapp-Oliver, 2011), is considered a continuous trait where optimism and pessimism represent opposite poles (Mavioğlu, Boomsma, & Bartels, 2015). Moderate to high test–retest correlations (0.58–0.79) of validated measures of dispositional optimism were found for time periods of up to 10 years (Carver, Scheier, & Segerstrom, 2010). Yet, recent evidence indicates that dispositional optimism can be promoted through training. A meta-analytic review of 29 studies concluded that psychological interventions can increase dispositional optimism, and that the strongest effect was achieved when applying the Best Possible Self method (Malouff & Schutte, 2017).

Optimists have been shown to maintain a healthier lifestyle (Boehm et al., 2018), have lower cortisol levels when experiencing high levels of stress (Jobin, Wrosch, & Scheier, 2014), in general have lower levels of other inflammatory biomarkers (Roy et al., 2010), and apply more effective coping strategies (Chiang et al., 2019). This evidence supports a potential effect of dispositional optimism also on sleep quality and insomnia susceptibility through factors such as improved coping. In previous research, dispositional optimism was associated with better sleep quality (Hernandez et al., 2019; Uchino et al., 2018), as well as fewer insomnia symptoms in adults (Lemola, Räikkönen, Gomez, & Allemand, 2013). In children, shorter sleep latency was associated with higher optimism (Lemola et al., 2011).

In longitudinal observational studies, path analysis revealed depressive mood, stress symptoms and anxiety as possible mediators of the relationship of dispositional optimism and subjective sleep quality (Hernandez et al., 2019; Lau, Harry Hui, Cheung, & Lam, 2015; Lau, Hui, Lam, & Cheung, 2017). Anxiety and stress symptoms mediated the influence of dispositional optimism on sleep quality, while depressive mood partially explained the effect of worse sleep quality on dispositional optimism (Lau et al., 2015, 2017). Other physical and psychological states and a healthy lifestyle could additionally mediate the relationship (Hernandez et al., 2019; Lau et al., 2015). Promoting dispositional optimism might improve sleep quality and reduce insomnia symptoms, and vice versa. Both factors are independently associated with better health, but joint effects are expected. Consequently, this makes both optimism and insomnia symptoms suitable targets for disease prevention. Previous studies investigated the relationship of optimism with insomnia symptoms (Hernandez et al., 2019; Lemola et al., 2013) and sleep quality (Lau et al., 2015, 2017), but so far no study focused on optimism and chronic insomnia.

In the present analysis, we describe the correlation of dispositional optimism and chronic insomnia and potential mediators in an

Austrian population-based cross-sectional study. We hypothesize that dispositional optimism is associated with a lower insomnia risk.

## 2 | MATERIALS AND METHODS

### 2.1 | Study design and setting

In September 2017, we conducted an online survey assessing sleep, daily routines and lifestyle characteristics among 1,004 Austrians selected to represent the age (18–65 years), sex and county distribution of Austria's general population. The survey was implemented by Interrogare GmbH – a market research institute based in Germany. It included 63 questions and took approximately 30 minutes to complete. A central aspect of the survey was to elicit detailed information on sleep habits and work hours, although employment was not a prerequisite for participation. In addition to lifestyle variables, the Life Orientation Test-Revised (LOT-R; Scheier, Carver, & Bridges, 1994) and the Subjective Happiness Scale (Lyubomirsky & Lepper, 1999) were implemented as part of the survey. Participation was voluntary and anonymous, and informed consent was implied through participation.

### 2.2 | Variables

Dispositional optimism was assessed using the LOT-R, a shorter, revised version of the original LOT (Molina et al., 2013), with responses on a five-point Likert scale (0–4). The LOT-R renders a dispositional optimism scale from 0 to 24, with higher scores indicating higher optimism. The exposure variable was then defined in three categories (least optimistic, intermediate and most optimistic) based on tertiles of the dispositional optimism scale distribution.

Chronic insomnia was defined by four criteria, established by the International Classification of Sleep Disorders, 3rd edn (American Academy of Sleep Medicine, 2014), as follows. (a) Patient reports difficulty initiating sleep and/or difficulty maintaining sleep and/or waking up earlier than desired. (b) Sleep disturbance and associated daytime symptoms occur at least three times per week. (c) Symptoms have been present for at least 3 months. (d) Patient reports daytime impairment related to night-time sleep difficulties: fatigue/malaise and/or attention, concentration or memory impairment and/or impaired social, family, occupational or academic performance and/or mood disturbance/irritability and/or daytime sleepiness and/or behavioural problems (e.g. hyperactivity, impulsivity, aggression) and/or reduced motivation/energy/initiative and/or proneness for errors/accidents and/or concerns about or dissatisfaction with sleep. Because most of the aforementioned impairments in criteria "d" were not assessed in the survey, we used the extent (not at all, a little, somewhat, much or very much) to which the daily functioning was affected by not being well rested as a proxy. The following survey question was used: "On average, to what extent is your daily functioning (e.g. fatigue, mood, ability to

work, concentration, memory) affected by not being well rested?". Criteria "a,b and c" were assessed in the survey using the following questions: (a) "Did you have trouble falling asleep/did you wake up several times a night/did you wake up earlier than planned/did you have trouble getting back to sleep after you woke up earlier than planned in the last 4 weeks?"; (b) "How often per week did each problem occur?" (assessed separately for each problem) (less than once per week; 1–2 times per week; 3–4 times per week; more than 4 times per week); (c) "If you have a sleep problem how long have you been experiencing it?" (less than 3 months; more than 3 months).

In the exact definition, insomnia was present if criteria "a, b and c" applied, and if the daily functioning was affected much or very much (criteria "d"). In the broad definition, insomnia was defined using the same aforementioned criteria, but allowing criteria "d" to apply also if the daily functioning was affected "somewhat" (in addition to much, or very much). Diagnosed insomnia was defined as a self-report of having been diagnosed with insomnia by a physician. For the fourth outcome measure, "insomnia exact or diagnosed insomnia", insomnia was present if participants had ever been diagnosed with insomnia by a physician or if the exact definition applied.

Health status, depression, happiness, lifestyle (physical activity, alcohol consumption and smoking), stress symptoms (unobserved) and anxiety (unobserved) were considered potential mediators of the association of optimism and insomnia. Current health status (very good; good; fair; bad; very bad), depression in the last 12 months (Yes; No), moderate physical activity in the last week (Yes; No), alcohol consumption (binary: Yes; No; continuous: standard glasses per week) and smoking status (never; former smoker; current smoker) were self-reported. Current happiness was assessed with the Subjective Happiness Scale (Lyubomirsky & Lepper, 1999) ranging from 0 to 20 points, the higher the happier. As potential confounders we considered *a priori* age (continuous), socioeconomic status (unobserved), education [elementary or high school; qualification for university entrance (Matura); university degree], work status [(self-)employed, full time; (self-)employed, part time; retired; unemployed; disabled; household; other (student, further training, unpaid work experience, compulsory military or community service)] and sex (male; female) [directed acyclic graph (DAG) in Figure S1]. Further, chronotype, night shift work in lifetime defined as a schedule of at least 3 hr of work between 00:00 hours and 06:00 hours at least three times per week (never; ever), and the prevalence of chronic bronchitis, chronic obstructive pulmonary disease (COPD) or emphysema were self-reported. Chronotype was assessed with the following question: "It is said that there are 'morning' and 'evening' types of people. Which one of these types do you consider yourself to be?" and possible answers (early; rather early; rather late; late).

### 2.3 | Statistical methods

The survey sample consisted of 1,004 participants. Confounder-adjusted unconditional logistic regression models were used to estimate odds ratios (ORs) with 95% confidence intervals (CIs) overall

and stratified by sex. We tested for linear trend with orthogonal polynomial contrasts. A DAG was used to identify possible confounders *a priori*. Based on the DAG age, socioeconomic status, education, work status and sex were considered as confounders. Because evidence on confounders of the relationship between optimism and insomnia is scarce, health-depicting variables and ethnicity, citizenship, region of residence, night shift work and self-reported chronotype were investigated as possible confounders based on 10% change of effect estimates (see Appendix S1). This was done separately for all four exposure–outcome pairs. For the relationship between dispositional optimism and diagnosed insomnia, having chronic bronchitis, COPD or an emphysema was identified as a confounder. Additionally, we adjusted the models separately for potential mediators (health status, depression, happiness and lifestyle) to control if each variable altered effect estimates. In sensitivity analyses, we restricted to participants without depression; healthy participants (fair, good or very good health status); people who were never diagnosed by a physician with a sleep disorder other than insomnia (e.g. breathing or sleep movement disorder, hypersomnia, parasomnia or a circadian rhythm sleep disorder); people who never worked night shifts. Finally, we restricted the analysis to participants that reported spending 6 or more hours in bed (based on bedtime and wake up time) on workdays, and thus most likely had an "adequate" opportunity of sleep to control for this additional insomnia criteria established by International Classification of Sleep Disorders, 3rd edn (American Academy of Sleep Medicine, 2014). SAS University Edition was used for analysis.

## 3 | RESULTS

Applying the exact definition of insomnia, 78 participants (7.8%) met the criteria for chronic insomnia [women: 42 (8.3%); men: 36 (7.2%)]. Applying the broad definition, 168 (16.7%) reported insomnia [women: 99 (19.5%); men: 69 (13.9%)]. Fifty-four participants (5.4%) reported being already diagnosed with insomnia by a physician [women: 27 (5.3%); men: 27 (5.4%)], meaning that the "diagnosed" insomnia definition applied. The "exact or diagnosed insomnia" definition applied to 111 (11.1%) participants that reported that they had ever been diagnosed with insomnia by a physician or had insomnia according to the exact definition [women: 58 (11.4%); men: 53 (10.7%)]. Compared with participants who never worked at night, the prevalence for symptoms of chronic insomnia was higher in night workers [exact: Yes: 26 (8.3%), No: 39 (6.3%); broad: Yes: 47 (15.0%), No: 98 (15.7%); diagnosed: Yes: 21 (6.7%), No: 25 (4.0%); exact or diagnosed: Yes: 42 (13.4%), No: 52 (8.4%)]. The variable night shift work had 67 (6.7%) missing values. There were no missing values in other variables.

The median optimism score was 14 (interquartile range [IQR] = 11–17, range = 24). Participants with the highest optimism (top tertile) were older, healthier, happier, exercised more and had a higher educational level compared with participants with intermediate and lower optimism scores (Table 1). Women, participants

**TABLE 1** Population characteristics by optimism in tertiles

	Optimism score			
	Least optimistic N = 366	Intermediate N = 320	Most optimistic N = 318	Total N = 1,004
	N (%)	N (%)	N (%)	N (%)
Optimism score, median (IQR)	10 (8–12)	15 (14–16)	19 (17–21)	14 (11–17)
Women	182 (49.7)	150 (46.8)	175 (55.0)	507 (50.5)
Age, mean (SD)	39.8 (12.8)	42.7 (13.3)	43.7 (12.9)	42.0 (4.5)
Region				
Burgenland	11 (3.0)	22 (6.9)	11 (3.5)	44 (4.4)
Carinthia	20 (5.5)	17 (5.3)	25 (7.9)	62 (6.2)
Lower Austria	80 (21.9)	54 (16.9)	62 (19.5)	196 (19.5)
Salzburg	23 (6.3)	28 (8.8)	17 (5.4)	68 (6.8)
Styria	53 (14.5)	43 (13.4)	49 (15.4)	145 (14.4)
Tyrol	32 (8.7)	25 (7.8)	22 (6.9)	79 (7.9)
Upper Austria	62 (16.9)	43 (13.4)	43 (13.5)	148 (14.7)
Vienna	72 (19.7)	72 (22.5)	79 (24.8)	223 (22.2)
Vorarlberg	13 (3.5)	16 (5.0)	10 (3.1)	39 (3.9)
Highest education				
Elementary or High School	178 (48.6)	131 (40.9)	102 (32.1)	411 (40.9)
Qualification for university entrance (Matura)	112 (30.6)	126 (39.4)	132 (41.5)	370 (36.9)
University degree	76 (20.8)	63 (19.7)	84 (26.4)	223 (22.2)
Current work status				
(Self-)employed, full time	172 (47.0)	180 (56.2)	179 (56.3)	531 (52.8)
(Self-) employed, part time	42 (11.5)	34 (10.6)	34 (10.7)	110 (11.0)
Retired	43 (11.7)	39 (12.2)	44 (13.8)	126 (12.6)
Unemployed	28 (7.6)	22 (6.9)	12 (3.8)	62 (6.2)
Disabled	8 (2.2)	0 (0.0)	0 (0.0)	8 (0.8)
Household	30 (8.2)	12 (3.8)	17 (5.4)	59 (5.9)
Other <sup>a</sup>	43 (11.8)	33 (10.3)	32 (10.0)	108 (10.7)
Night shift work <sup>b</sup>	129 (39.1)	108 (35.2)	77 (25.7)	314 (33.5)
Self-assessed chronotype				
Early or rather early	166 (45.4)	139 (43.4)	171 (53.8)	476 (47.4)
Late or rather late	200 (54.6)	181 (56.6)	147 (46.2)	528 (52.6)
Chronic bronchitis, COPD or emphysema	29 (7.9)	10 (3.1)	7 (2.2)	46 (4.6)
Happiness scale, mean (SD)	11.2 (2.9)	13.9 (2.5)	16.3 (2.2)	13.7 (3.3)
Depression	78 (21.3)	23 (7.2)	14 (4.4)	115 (11.5)
Health status				
Very good	28 (7.6)	48 (15.0)	68 (21.4)	144 (14.3)
Good	174 (47.5)	175 (54.7)	175 (55.0)	524 (52.2)
Fair	118 (32.3)	83 (25.9)	70 (22.0)	271 (27.0)
Bad	38 (10.4)	13 (4.1)	5 (1.6)	56 (5.6)
Very bad	8 (2.2)	1 (0.3)	0 (0)	9 (0.9)
Smoking status				
Never	150 (41.0)	132 (41.2)	148 (46.6)	430 (42.8)
Former smoker	95 (26.0)	95 (29.7)	84 (26.4)	274 (27.3)

(Continues)

TABLE 1 (Continued)

	Optimism score			
	Least optimistic N = 366	Intermediate N = 320	Most optimistic N = 318	Total N = 1,004
	N (%)	N (%)	N (%)	N (%)
Current smoker	121 (33.0)	93 (29.1)	86 (27.0)	300 (29.9)
Alcohol consumption (Yes)	225 (61.5)	232 (72.5)	216 (67.9)	673 (67.0)
Alcohol consumption, standard glasses/week, median (IQR)	1.5 (0–6)	3.0 (0–7.5)	2.0 (0–7.0)	2.0 (0–7.0)
Moderate activity in the last week	212 (57.9)	202 (63.1)	215 (67.6)	629 (62.7)

<sup>a</sup>Student, further training, unpaid work experience, compulsory military or community service.

<sup>b</sup>Currently working night shifts or in the past.

Abbreviations: COPD, chronic obstructive pulmonary disease; IQR, interquartile range.

residing in different provinces of Austria (Carinthia, Styria or Vienna), retired individuals, early chronotypes and people who never worked on nights shifts were more optimistic. Furthermore, the prevalence of unemployment, inability to work, smoking and depressive symptoms were more frequent in the least optimistic individuals. Nevertheless, they consumed less alcohol compared with more optimistic individuals (Table 1).

### 3.1 | Effect of optimism

When applying the exact insomnia definition, intermediate (tertile 2) and most optimistic people (tertile 3) showed a lower insomnia risk (OR = 0.39, 0.22–0.70; OR = 0.28, 0.14–0.54, respectively;  $p$ -trend < .001), compared with the least optimistic participants (tertile 1). The same was observed in women (tertile 2: OR = 0.29, 0.12–0.70; tertile 3: OR = 0.29, 0.12–0.68) and in men (tertile 2: OR = 0.51, 0.22–1.15; tertile 3: OR = 0.24, 0.08–0.72; Table 2). Applying the broad definition for insomnia, all correlations were similar but less pronounced (Table 2).

In participants already diagnosed with insomnia (“diagnosed” insomnia), the overall protective effect of optimism was weaker (tertile 2: OR = 0.49, 0.24–1.02; tertile 3: OR = 0.44, 0.20–0.95;  $p$ -trend = .571), especially in women (tertile 2: OR = 0.76, 0.26–2.57; tertile 3: OR = 0.78, 0.27–2.26; Table 3). Applying the “exact insomnia or diagnosed insomnia” definition led to similar results as for the exact definition (Table 3).

### 3.2 | Effect of potential mediators

Considering happiness in the models led to a strong attenuation (exact insomnia: tertile 2: OR = 0.65, 0.34–1.22; tertile 3: OR = 0.69, 0.31–1.52) of effect estimates (Tables 2 and 3). Adding depression or health status to the models led to less attenuating effects. Lifestyle (smoking, alcohol consumption and moderate physical activity) did not seem to mediate or confound the correlation. After adjustment

for all potential mediators (happiness, health, depression and lifestyle), the association completely disappeared or was considerably attenuated in all definitions and subgroups (Tables 2 and 3), with “being happy” as the primary confounder.

### 3.3 | Sensitivity analysis

Similar risk patterns were found in a subset of individuals without showing symptoms of depression, or when restricting the analysis to individuals with fair, good or very good health; and in participants who were never diagnosed by a physician with a sleep disorder other than insomnia (e.g. sleep apnea, sleep-related movement disorder, hypersomnia, parasomnia or a circadian rhythm sleep disorder; Appendix S1; Tables S1–S3). In participants who never worked night shifts, the protective effect of optimism on insomnia was less pronounced (Appendix S1; Table S4). Excluding participants that indicated to spend less than 6 hr in bed on workdays led to similar results as in the main analysis (Appendix S1; Table S5).

## 4 | DISCUSSION

In this survey, representative of the Austrian general population, higher dispositional optimism correlated with better education, being healthier, a healthier lifestyle, and increasing age. Being more optimistic was associated with lower risk for chronic insomnia independent of known confounders. Previous research found similar associations considering insomnia symptoms (Hernandez et al., 2019; Lemola et al., 2013) and sleep quality (Lau et al., 2015, 2017; Uchino et al., 2018). Happiness, depression and a good health status confounded the effect in our study, with happiness accounting for much of the lower odds of insomnia among highly optimistic individuals.

Optimism most likely acts on insomnia symptoms through a combination of psychological, behavioural and biological pathways. The Broaden-and-Build Theory proposes that positive emotions, which are associated with optimism, enhance physical-, intellectual- and

**TABLE 2** Correlation between optimism and insomnia (exact<sup>a</sup> and broad<sup>b</sup> definition)

Optimism score		Women (N = 507)			Men (N = 497)					
		Least optimistic (N = 318)	Intermediate (N = 320)	Most optimistic (N = 182)	Least optimistic (N = 184)	Intermediate (N = 170)	Most optimistic (N = 143)			
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)			
Insomnia exact <sup>a</sup>	49 (13.4)	17 (5.3)	17 (5.3)	27 (13.7)	7 (4.7)	8 (3.4)	22 (11.9)	10 (5.9)	4 (2.8)	
OR (95% CI) <sup>c</sup>	1	0.36 (0.20–0.64)	0.36 (0.20–0.64)	0.25 (0.13–0.48)	1	0.28 (0.12–0.66)	0.27 (0.12–0.66)	1	0.45 (0.20–0.98)	0.21 (0.07–0.62)
OR (95% CI) <sup>d</sup>	1	0.39 (0.22–0.70)	0.39 (0.22–0.70)	0.28 (0.14–0.54)	1	0.29 (0.12–0.70)	0.29 (0.12–0.68)	1	0.51 (0.22–1.15)	0.24 (0.08–0.72)
+ Happiness <sup>d,e</sup>	1	0.65 (0.34–1.22)	0.65 (0.34–1.22)	0.69 (0.31–1.52)	1	0.48 (0.18–1.28)	0.71 (0.14–2.10)	1	0.89 (0.37–2.12)	0.66 (0.19–2.28)
+ Health status <sup>d,f</sup>	1	0.52 (0.28–0.97)	0.52 (0.28–0.97)	0.43 (0.21–0.88)	1	0.31 (0.12–0.81)	0.41 (0.17–1.02)	1	0.81 (0.33–1.96)	0.42 (0.13–1.40)
+ Depression <sup>d,g</sup>	1	0.54 (0.29–1.00)	0.54 (0.29–1.00)	0.40 (0.20–0.82)	1	0.38 (0.15–0.96)	0.42 (0.17–1.04)	1	0.76 (0.32–1.82)	0.34 (0.11–1.12)
+ Lifestyle <sup>d,h</sup>	1	0.40 (0.22–0.73)	0.40 (0.22–0.73)	0.28 (0.14–0.55)	1	0.28 (0.11–0.69)	0.28 (0.12–0.68)	1	0.50 (0.22–1.13)	0.24 (0.08–0.76)
+ All mediators <sup>d–h</sup>	1	0.83 (0.41–1.64)	0.83 (0.41–1.64)	0.96 (0.39–2.34)	1	0.48 (0.17–1.37)	0.89 (0.27–2.88)	1	1.27 (0.45–3.62)	1.09 (0.24–5.01)
<i>p</i> -trend <sup>d,i</sup>										<i>p</i> = .012
Insomnia broad <sup>b</sup>	83 (22.7)	45 (14.1)	45 (14.1)	48 (26.4)	24 (16.0)	27 (15.4)	35 (19.0)	21 (12.4)	13 (9.1)	
OR (95% CI) <sup>c</sup>	1	0.54 (0.36–0.80)	0.54 (0.36–0.80)	0.47 (0.31–0.71)	1	0.52 (0.30–0.91)	0.49 (0.29–0.84)	1	0.55 (0.31–1.01)	0.40 (0.20–0.78)
OR (95% CI) <sup>d</sup>	1	0.58 (0.38–0.87)	0.58 (0.38–0.87)	0.49 (0.32–0.76)	1	0.54 (0.30–0.94)	0.52 (0.30–0.91)	1	0.59 (0.32–1.09)	0.44 (0.21–0.88)
+ Happiness <sup>d,e</sup>	1	0.78 (0.50–1.22)	0.78 (0.50–1.22)	0.86 (0.50–1.46)	1	0.71 (0.38–1.33)	0.87 (0.43–1.77)	1	0.85 (0.44–1.66)	0.82 (0.36–1.92)
+ Health status <sup>d,f</sup>	1	0.71 (0.46–1.09)	0.71 (0.46–1.09)	0.67 (0.43–1.06)	1	0.58 (0.32–1.04)	0.64 (0.35–1.14)	1	0.81 (0.42–1.58)	0.64 (0.30–1.37)
+ Depression <sup>d,g</sup>	1	0.73 (0.47–1.12)	0.73 (0.47–1.12)	0.65 (0.41–1.02)	1	0.67 (0.37–1.20)	0.69 (0.38–1.23)	1	0.77 (0.40–1.49)	0.57 (0.27–1.21)
+ Lifestyle <sup>d,h</sup>	1	0.58 (0.39–0.89)	0.58 (0.39–0.89)	0.51 (0.33–0.79)	1	0.52 (0.29–0.92)	0.52 (0.30–0.92)	1	0.62 (0.33–1.17)	0.48 (0.23–0.99)
+ All mediators <sup>d–h</sup>	1	0.92 (0.57–1.49)	0.92 (0.57–1.49)	1.01 (0.56–1.79)	1	0.73 (0.38–1.41)	0.95 (0.45–2.01)	1	1.13 (0.53–2.39)	1.11 (0.42–2.91)
<i>p</i> -trend <sup>d,i</sup>										<i>p</i> = .021

<sup>a</sup>Participant reports difficulty initiating sleep and/or difficulty maintaining sleep and/or waking up earlier than desired. Sleep disturbance and associated daytime symptoms occur at least three times per week, and have been present for at least 3 months. Daily functioning is affected much or very much.

<sup>b</sup>Same criteria as for the exact definition apply, but daily functioning is affected somewhat, much or very much; <sup>c</sup>adjusted for age; <sup>d</sup>adjusted for age, sex, education and work status; <sup>e</sup>additionally adjusted for mediator happiness; <sup>f</sup>additionally adjusted for mediator health status; <sup>g</sup>additionally adjusted for mediator depression; <sup>h</sup>additionally adjusted for mediator lifestyle: alcohol consumption, smoking and physical activity; <sup>i</sup>test for linear trend with orthogonal polynomial contrast.

Abbreviations: CI, confidence interval; OR, odds ratio.

TABLE 3 Correlation between optimism and insomnia (diagnosed insomnia<sup>a</sup> and “insomnia exact<sup>b</sup> or diagnosed insomnia<sup>a,h</sup>)

	Optimism score											
	Total (N = 1,004)				Women (N = 507)				Men (N = 497)			
	Least Optimistic (N = 366)	Intermediate (N = 320)	Most optimistic (N = 318)	Least Optimistic (N = 182)	Intermediate (N = 150)	Most optimistic (N = 175)	Least Optimistic (N = 184)	Intermediate (N = 170)	Most optimistic (N = 143)	Least Optimistic (N = 184)	Intermediate (N = 170)	Most optimistic (N = 143)
Diagnosed insomnia <sup>a</sup>	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
	32 (8.7)	12 (3.8)	10 (3.1)	13 (7.1)	7 (4.7)	7 (4.0)	19 (10.3)	5 (2.9)	3 (2.1)			
OR (95% CI) <sup>c</sup>	1	0.38 (0.19–0.75)	0.31 (0.15–0.64)	1	0.56 (0.22–1.47)	0.44 (0.17–1.16)	1	0.25 (0.09–0.70)	0.18 (0.05–0.62)			
OR (95% CI) <sup>d</sup>	1	0.49 (0.24–1.02)	0.44 (0.20–0.95)	1	0.76 (0.26–2.57)	0.78 (0.27–2.26)	1	0.31 (0.11–0.89)	0.21 (0.06–0.77)			
+ Happiness <sup>d,e</sup>	1	0.70 (0.32–1.53)	0.80 (0.31–2.05)	1	0.95 (0.29–3.09)	1.14 (0.30–4.35)	1	0.51 (0.17–1.58)	0.54 (0.12–2.35)			
+ Health status <sup>d,f</sup>	1	0.60 (0.28–1.28)	0.58 (0.26–1.31)	1	0.78 (0.25–2.44)	1.04 (0.33–3.29)	1	0.39 (0.13–1.16)	0.27 (0.07–0.99)			
+ Depression <sup>d,g</sup>	1	0.68 (0.32–1.47)	0.71 (0.31–1.61)	1	1.28 (0.39–4.17)	1.55 (0.47–5.12)	1	0.41 (0.14–1.23)	0.30 (0.08–1.14)			
+ Lifestyle <sup>d,h</sup>	1	0.52 (0.25–1.08)	0.49 (0.22–1.07)	1	0.82 (0.28–2.43)	0.84 (0.28–2.52)	1	0.35 (0.12–1.04)	0.23 (0.06–0.85)			
+ All mediators <sup>d,h</sup>	1	0.88 (0.38–2.05)	1.10 (0.41–3.00)	1	1.29 (0.37–4.43)	1.57 (0.39–6.36)	1	0.70 (0.20–2.38)	0.68 (0.14–3.30)			
p-trend <sup>d,i</sup>												p = .514
Insomnia exact <sup>b</sup> or diagnosed insomnia <sup>a</sup>	67 (18.3)	26 (8.1)	18 (5.7)	33 (18.1)	12 (8.0)	13 (7.4)	34 (18.5)	14 (8.2)	5 (3.5)			
OR (95% CI) <sup>c</sup>	1	0.38 (0.23–0.61)	0.25 (0.15–0.44)	1	0.38 (0.19–0.77)	0.34 (0.17–0.69)	1	0.38 (0.19–0.73)	0.15 (0.06–0.40)			
OR (95% CI) <sup>d</sup>	1	0.46 (0.28–0.77)	0.33 (0.18–0.58)	1	0.44 (0.21–0.91)	0.44 (0.21–0.91)	1	0.49 (0.24–0.98)	0.20 (0.07–0.53)			
+ Happiness <sup>d,e</sup>	1	0.79 (0.46–1.37)	0.86 (0.43–1.71)	1	0.75 (0.33–1.69)	1.15 (0.45–2.94)	1	0.88 (0.41–1.90)	0.55 (0.18–1.68)			
+ Health status <sup>d,f</sup>	1	0.58 (0.34–0.94)	0.46 (0.25–0.84)	1	0.47 (0.21–1.02)	0.58 (0.27–1.24)	1	0.69 (0.33–1.47)	0.29 (0.10–0.82)			
+ Depression <sup>d,g</sup>	1	0.63 (0.37–1.07)	0.48 (0.26–0.88)	1	0.59 (0.27–1.29)	0.66 (0.30–1.45)	1	0.68 (0.32–1.46)	0.26 (0.09–0.76)			
+ Lifestyle <sup>d,h</sup>	1	0.48 (0.28–0.80)	0.34 (0.19–0.61)	1	0.44 (0.21–0.92)	0.45 (0.22–0.94)	1	0.49 (0.24–1.00)	0.20 (0.07–0.55)			
+ All mediators <sup>d,h</sup>	1	0.99 (0.54–1.80)	1.16 (0.54–2.47)	1	0.79 (0.33–1.87)	1.41 (0.52–3.81)	1	1.25 (0.51–3.06)	0.84 (0.23–3.06)			
p-trend <sup>d,i</sup>												p = .001

<sup>a</sup>Diagnosed by a physician.<sup>b</sup>Participant reports difficulty initiating sleep and/or difficulty maintaining sleep and/or waking up earlier than desired. Sleep disturbance and associated daytime symptoms occur at least three times per week, and have been present for at least 3 months. Daily functioning is affected much or very much; <sup>c</sup>adjusted for age; <sup>d</sup>adjusted for age, sex, education, work status and chronic bronchitis, COPD or emphysema; <sup>e</sup>additionally adjusted for mediator happiness; <sup>f</sup>additionally adjusted for mediator health status; <sup>g</sup>additionally adjusted for mediator depression; <sup>h</sup>additionally adjusted for mediator lifestyle; alcohol consumption, smoking and physical activity; <sup>i</sup>test for linear trend with orthogonal polynomial contrast.

Abbreviations: CI, confidence interval; OR, odds ratio.

social resources through the broadening of the action-thought repertoire (Fredrickson, 1998, 2004). Examples of such resources include the quality of social ties and resilience, both of which have been suggested to improve sleep quality (Kent, Uchino, Cribbet, Bowen, & Smith, 2015; Li et al., 2019).

It has previously been reported that individuals with a variety of psychological resources such as optimism apply more effective coping strategies (Chiang et al., 2019) and report lower stress levels when experiencing high levels of stress (Jobin et al., 2014). Optimists are more likely to engage in approach- and problem-focused coping, and Solberg Nes and Segerstrom (2006) proposed in their systematic review that they are also more flexible in the application of coping strategies and therefore more successful in dealing with controllable and uncontrollable stressors. Stress leads to the activation of the hypothalamic–pituitary–adrenal (HPA) axis, the most important neuroendocrine mediator of the stress response (Balbo, Leproult, & Van Cauter, 2010), and consequently to the secretion of cortisol (Chiang et al., 2019). Chiang et al. (2019) report that people with more psychological resources did not show a decreased HPA reactivity (worse stress response) related to major negative life events and daily stress, while people with fewer psychological resources did. This implies that psychological resources, such as optimism, seem to protect a functioning stress response. In one study, adolescent girls who developed more adequate coping strategies showed steeper diurnal cortisol slopes, lower total diurnal cortisol output, and lower cortisol awakening responses (Sladek, Doane, & Stroud, 2017). In adults, optimism was associated with lower levels of cortisol secretion during the morning waking response (Endrighi, Hamer, & Steptoe, 2011; Lai et al., 2005). Whereas hyperactivity of the HPA axis resulting in higher cortisol levels may provoke poor sleep and is associated with higher insomnia risk, conversely, insomnia symptoms may increase cortisol levels, triggering a vicious circle (Balbo et al., 2010). We therefore hypothesize that by applying effective coping strategies, optimists maintain a functioning stress response and thus reduce overall cortisol levels, which in turn reduces the risk of poor sleep and insomnia. This notion is supported by previous studies reporting stress symptoms to be important mediators of the association of optimism with good sleep quality (Lau et al., 2015, 2017). Nevertheless, there is also evidence that poor sleep quality can affect optimism (Lau et al., 2015, 2017). Insomnia might predispose individuals to worry, and the repeated failure in trying to sleep could decrease optimism.

In this study, the protective effect of dispositional optimism was slightly different across sex. In men, the protective effect of optimism was stronger compared with women. Sex differences in the use of coping strategies have previously been reported: men tend to use more problem-focused strategies, which are considered to be more effective, while women tend to favour emotion-focused coping styles (Kelly, Tyrka, Price, & Carpenter, 2008). Assuming that dispositional optimism results in effective coping strategies with positive impacts on sleep quality and reducing the risk for chronic insomnia, studies investigating the relationship of optimism and different coping strategies in men and women are warranted.

In this study, happiness, often used interchangeably with joy (Fredrickson, 1998), a positive emotion, seemed to be a major mediator or confounder of the effect of optimism on insomnia risk. McCrae and Costa (1991) proposed that traits like optimism predispose people to feel and consider their emotions, and to seek out situations or activities that foster happiness. However, the relationship between happiness, and more generally positive affect, and sleep quality is still unclear (Ong, Kim, Young, & Steptoe, 2017). Chronic insomnia might also be triggered by depressive symptoms (WHO, 2010), another suggested mediator in this study. Optimism was suggested to reduce depressive symptoms due to lower levels of situation-specific dysfunctional expectations (Kube et al., 2018). Yet, the observed confounding by depression might also be explained by the overlap between insomnia- and depressive symptoms. The overall health status may also mediate the association between optimism and insomnia. Optimism is associated with better overall health (Rozanski et al., 2019), which also positively affects sleep quality (Grandner, 2017). On the other hand, lifestyle (e.g. physical activity, smoking, alcohol consumption) did not seem to mediate the effect of optimism on insomnia risk in our study. However, optimistic individuals were more likely to be physically active and less likely to smoke. Several studies have shown the beneficial effects of physical activity, non-smoking as well as a healthy diet on sleep quality and a lower overall risk of insomnia (Castro-Diehl et al., 2018; Chen, Steptoe, Chen, Ku, & Lin, 2017). To our knowledge, this is the first population-based survey that indicates a protective effect of optimism on insomnia risk, and possible mediation by happiness, health status and depressive symptoms.

However, some limitations need to be considered when interpreting the results. First, we had no information on how physicians diagnosed insomnia, and for the insomnia definitions we used only four out of six criteria suggested by the International Classification of Sleep Disorders (American Academy of Sleep Medicine, 2014). We were unable to examine whether participants reporting insomnia symptoms practiced adequate sleep hygiene or if their sleep/wake difficulties were the consequence of other sleep disorders (e.g. sleep-related breathing disorders). However, the reported correlation did not change materially when analyses were restricted to those participants who had never been diagnosed by a physician with a sleep disorder other than insomnia, or when restricting the analysis to participants reporting to have more than 6 hr between going to bed and waking up on workdays. Second, due to the cross-sectional design, we are unable to comment on the direction of the likely bidirectional relationship between optimism and insomnia. Two previous studies report an effect of sleep quality on optimism; therefore, reverse causality might partly explain our results (Lau et al., 2015, 2017). The effect of possible mediators should be interpreted with caution. Moreover, the questions we used for assessing insomnia, confounders and potential mediators differed in their relation to time. Additionally, two potentially important mediators – stress symptoms and anxiety – were not assessed. In our sample, sex differences in insomnia prevalence were smaller than in other surveys, and the lifetime prevalence for physician-diagnosed



insomnia was comparatively low. Lastly, the number of potential insomnia cases was rather small in certain substrates (e.g. sex), and investigating insomnia subtypes was not possible; however, in our models all correlations remained similar across different insomnia definitions as well as in all sensitivity analyses.

Cognitive behavioural therapy that tackles optimism-related factors such as dysfunctional beliefs is effective in treating chronic insomnia (Trauer et al., 2015) – still, this idea has not received much attention in prevention up to date. Enhancing dispositional optimism or related coping strategies that then translate to better sleep and a lower susceptibility to insomnia symptoms may foster preventive effects. The Best Possible Self intervention, which comprises developing goals for and visualizing a best possible self, can be considered the most effective approach to enhance dispositional optimism thus far (Malouff & Schutte, 2017). However, the intervention's potential to improve sleep is unknown. Future research needs to show in prospective studies that dispositional optimism has positive effects on sleep quality and reduces insomnia risk. Nevertheless, potential mediators such as coping strategies, depressive symptoms, overall health status, happiness, anxiety, stress factors and lifestyle need to be explored. Subtypes of insomnia have to be considered too, as optimism might show different effects on each subtype. Even more important, the following questions have to be addressed: Does dispositional optimism per se, or an optimism-related protective factor, lead to a lower insomnia risk? Does an increase in dispositional optimism through training translate to a lower insomnia risk, and what is its downstream impact? Addressing these questions could clarify the mechanistic underpinning of the relationship between optimism as a protective agent against insomnia and its importance in practice, and it may help to identify additional strategies for intervention. The modifiable nature of optimism makes its study appealing and its potential effect on sleep and long-term health, if confirmed, a promising target for insomnia prevention.

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## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

## AUTHOR CONTRIBUTION

Data collection: ES, SS, GK; study design: JW, ES, KP; data analysis: JW; manuscript draft: JW, CLS. All authors contributed to the revision.

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## SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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