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A Multimethod Approach Examining the Relative Contributions of Optimism and Pessimism to Cardiovascular Disease Risk Markers

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Abstract

Although dispositional optimism and pessimism are associated with cardiovascular disease (CVD), their relative independence and unique contributions to CVD risk are unclear. This study addressed these issues by using multiple indicators of optimism and pessimism and linking them to objective risk factors for CVD. A diverse sample of adults (N = 300) completed baseline assessments (including global reports of optimism and pessimism), a 2-day/1-night EMA protocol with ambulatory blood pressure (BP) at 45-minute intervals, and had inflammatory markers and carotid intima media imaging collected. EMA reports of momentary positive and negative expectations were averaged to form intraindividual (person) means of optimism and pessimism, respectively. Optimism and pessimism were only modestly correlated between- and within-assessment methods. Higher pessimism, regardless of assessment method, predicted both lower odds of whether BP dipping occurred and a smaller degree of dipping, but was unrelated to other biomarkers. Optimism was not uniquely predictive of CVD risk factors. Pessimism thus appears to exhibit stronger relative contribution to risk indicators of CVD than optimism.

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Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent: Informed consent was obtained from all individual participants included in the study.

Conflict of Interest: The authors declare that they have no conflict of interest.

Keywords

Optimism; pessimism; ecological momentary assessment; inflammatory markers; carotid artery stenosis; ambulatory blood pressure

Positive and protective factors that facilitate resiliency and promote cardiovascular health have recently become of interest (Boehm & Kubzansky, 2012; Crum, Salovey, & Achor, 2013; Felix et al., 2019; Pincus & Metten, 2010; Seery, 2011; Tsai, Harpaz-Rotem, Pietrzak, & Southwick, 2014; Walker, Pfingst, Carnevali, Sgoifo, & Nalivaiko, 2017). Optimism is one such positive and protective factor that has received attention (Boehm & Kubzansky, 2012; Rasmussen, Scheier, & Greenhouse, 2009; Michael F. Scheier & Carver, 2018). Several studies suggest that optimism promotes cardiovascular health in healthy individuals (Boehm et al., 2018; Giltay, Geleijnse, Zitman, Hoekstra, & Schouten, 2004; Michael F. Scheier & Carver, 2018) and is associated with fewer negative cardiac outcomes in clinical patients (Kim, Park, & Peterson, 2011). Some recent work, however, proposes that low pessimism, rather than high optimism, may be what is protective against the development of cardiovascular disease (CVD) (Michael F. Scheier & Carver, 2018; Serlachius et al., 2015). These divergent findings may, at least in part, emerge as a result of optimism and pessimism's treatment as opposite ends of a continuum.

Dispositional optimism and pessimism reflect a person's general tendencies toward expecting positive and negative outcomes, respectively, for what will occur in their day-to-day lives (M. F. Scheier & Carver, 1985; Michael F. Scheier & Carver, 2018). These positive and negative expectations exert their effect on cardiovascular health through indirect behavioral and direct physiologic pathways. Optimists are more likely to engage in cardiac-related health behaviors that slow progression or prevent CVD, including exercising more frequently, eating healthier, and smoking less(A Rozanski, Bavishi, Kubzanksy, & Cohen, n.d.; Alan Rozanski, 2014; Michael F. Scheier & Carver, 2018). Optimists are also more likely than pessimists to respond to adverse events in a more psychologically beneficial way, which directly affects physiologic processes. For instance, higher levels of optimism (and lower pessimism) have been associated with slower development of atherosclerosis (i.e., plaque forming on the arteries) (Matthews, Raikkonen, Sutton-Tyrrell, & Kuller, 2004) and lower blood pressure and inflammatory responses to stressors (Brydon, Walker, Wawrzyniak, Chart, & Steptoe, 2009; La Marca et al., 2017; Roy et al., 2010). The development of atherosclerosis, higher ambulatory blood pressure, and higher levels of inflammatory markers (e.g., CRP, TNF-α, and IL-6) are all prospectively associated with incident of CVD (Frishman, 1998; Soeki & Sata, 2016; Verdecchia et al., 1994). These findings suggest that optimism may directly promote (and pessimism directly harm) cardiovascular health.

Dispositional optimism and pessimism are typically measured via the Life Orientation Test-Revised (LOT-R) (Michael F. Scheier, Carver, & Bridges, 1994). The LOT-R is a retrospective self-report measure that taps into participants' perceptions about their general tendencies toward positive (i.e., optimistic) and negative (i.e., pessimistic) expectations. Traditionally, the LOT-R is scored as a unidimensional construct yielding a single total

score, where higher scores reflect more optimism and lower scores reflect more pessimism (Michael F. Scheier et al., 1994; Segerstrom, Evans, & Eisenlohr-Moul, 2011; Vautler, Raufaste, & Carlou, 2003). Although this conceptualization of optimism and pessimism as opposite ends on a bipolar dimension has an intuitive appeal, it leads to ambiguity about the relative contribution of each. Additionally, treating optimism and pessimism as opposite ends of a continuum implicitly assumes redundancy in measurement, antecedent processes, and/or outcomes, which is not fully supported by findings with the LOT-R (Creed, Patton, & Bartrum, 2002; Segerstrom et al., 2011; Steca, Monzani, Greco, Chiesi, & Primi, 2015; Vautler et al., 2003). To better evaluate their relative contributions, optimism and pessimism may need to be treated as separate, but related dimensions, rather than opposite ends of a continuum.

The call for optimism and pessimism to be treated as a multidimensional construct to evaluate their relative contribution to CVD has been growing. Most notably, Scheier & Carver (2018) state that there is growing evidence that, for some contexts, a multidimensional approach would be beneficial (Michael F. Scheier & Carver, 2018). However, few studies have empirically investigated the relative contribution of optimism and pessimism to cardiovascular health outcomes using the subscales of the LOT-R, but findings suggest differential associations with CVD risk indicators (Michael F. Scheier & Carver, 2018). For example, low pessimism, rather than high optimism, was associated with better cardiovascular health over time in healthy adults (Serlachius et al., 2015). In this study, cardiovascular health was measured by seven ideal cardiovascular health metrics (BMI, diet, physical activity, smoking status, blood pressure, total cholesterol, and plasma glucose). However, both optimism and pessimism were associated with higher or lower concentrations in systemic markers of inflammation (i.e., CRP, IL-6) markers associated with CVD, although these associations were stronger for pessimism (Roy et al., 2010). On the other hand, higher levels of optimism, but not pessimism, were associated with a lower incidence of stroke (a long term consequence of CVD) in older adults (Kim et al., 2011). Although the relative contribution of optimism and pessimism to risk factors of CVD remains unclear, these findings generally provide further evidence consistent with the view that optimism and pessimism, as measured by the LOT-R, may be better conceptualized as distinct, yet overlapping constructs (Michael F. Scheier & Carver, 2018). Taken together, the differential associations suggest that optimism and pessimism may best be reflected as separate but related dimensions, at least for physiologic outcomes.

There is some evidence from psychometric evaluations of the LOT-R that a multidimensional approach would be beneficial. First, Segerstrom et al. (2011) found strong evidence that the LOT-R is “essentially unidimensional” as the intercorrelations of the total score and subscales were not differentially associated with personality measures(26). However, this inquiry did not consider the relative contributions of optimism and pessimism, nor did not account for their shared variance. Additionally, the authors note that these findings are in the context of personality measures and that a multidimensional representation may be warranted in other contexts(26) Second, a meta-analysis from Rasmussen et al (2009) found strong evidence for associations between optimism and physical health outcomes and no significant moderation when incorporating optimism and pessimism as distinct dimensions(9). However, the authors note that average associations

were higher for pessimism across all outcomes and that there were relatively few studies comparing them, suggesting a lack of power to detect effects. As such, Rasmussen et al. note that the question of the dimensionality of optimism and pessimism was still open(9). Additionally, more recent psychometric studies, using confirmatory factor analysis and item response theory methods, have also argued for a multidimensional approach (Creed et al., 2002; Steca et al., 2015). Aside from model fit suggesting the multidimensional model was an adequate representation of the data, the optimism and pessimism subscales were only weakly to moderately negatively correlated across studies ($rs = -0.16$ to -0.60), suggesting distinct, yet overlapping constructs (Creed et al., 2002; Michael F. Scheier & Carver, 2018; Segerstrom et al., 2011; Steca et al., 2015). Taken together, the extant literature underscores the need for more research to examine the relative contribution of optimism and pessimism to risk factors of CVD.

Much of the previous work on optimism and pessimism relies solely on retrospective trait measures such as the LOT-R. Although the LOT-R shows predictive validity for health and disease, global retrospective measures may be in part influenced by individuals' internalized schemas about themselves. As such, the use of global measures could be supplemented by work measuring experiences of optimism and pessimism in everyday life (Michael F. Scheier et al., 1994). Ecological momentary assessment (EMA) is a method in which experiences, contexts, and behaviors are repeatedly assessed in peoples' naturalistic environments (Smyth, Juth, Ma, & Sliwinski, 2017). As such, EMA can serve as a method to sample moments of positivity and negativity in one's current outlook repeatedly in naturalistic settings to repeatedly capture state optimism and pessimism. An empirical average of one's state positive and negative expectations across assessments may then be used to generate a person-specific 'typical' or trait-like score, reflecting individual differences in optimism and pessimism, respectively (Moore, Depp, Wetherell, & Lenze, 2016). Importantly, summaries of momentary assessments might be capturing different aspects of the constructs of interest than global reports (e.g., everyday experiences rather than more global beliefs or schemas), and they have been shown to (at least in some cases) differentially predict outcomes relative to more traditional psychological assessments (Moore et al., 2016). Therefore, the use of repeated assessments from EMA to assess optimism and pessimism may provide additional insight on the independence and relative contribution of these constructs to CVD risk indicators. We are unaware of other research that has computed EMA summaries of momentary optimistic and pessimistic expectations to investigate CVD risk, making this an area ripe for further inquiry.

The aim of the current paper is to investigate the degree of independence in optimism and pessimism and evaluate their relative contributions to risk indicators of CVD. We used trait assessments and intraindividual means derived from EMA to examine evidence for independence and to test if the associations of optimism and/or pessimism with health indicators varied by assessment method. The following research questions were addressed:

1. How are optimism and pessimism associated with each other?
2. How are optimism and pessimism associated with risk indicators for the development of CVD?

3. Do the associations of optimism and pessimism with risk indicators of CVD vary as a function of how they are measured?

Methods

Participants

This sample includes baseline assessments and wave 1 data from participants recruited for the North Texas Heart (NTH) Study (Ruiz et al., 2017). A community sample of 300 adults (50% women), ages 21 to 70 years (M = 42.44 years, SD = 12.76 years), were enrolled in the study to investigate psychosocial determinants of subclinical atherosclerosis. Informed consent was obtained from all individual participants included in the study. Participants were excluded if they had previous history of myocardial infarction or tertiary cardiac interventions, pregnancy within the last year or anticipated pregnancy during the study period, cognitive impairment, and/or an occupation that required shift work. The sample was stratified by age within gender and race/ethnicity. The diverse sample includes 60% non-Hispanic Whites, 15% non-Hispanic Blacks, and 19% Hispanic/Latino of which 75% self-identified as being of Mexican descent. A majority of participants were married (60%), own a home (63%), and were employed outside the home (79%). Participants represented a broad range of educational backgrounds with more than 86% reporting some college and significant income diversity: 12% reporting a household income less than $20,000, 10% above $150,000, and the modal annual household income reported to be between $75,000 and $150,000. On average, participants were overweight (M_{BMI} = 29.16, SD_{BMI} = 6.37) with elevated average blood pressure (142.20 [1.17]/80.70 [0.67]) and a minority (24%) taking prescribed medications ($n_{BP\ meds}$ = 46, $n_{Lipid\ meds}$ = 41, $n_{Diabetes\ meds}$ = 14, and $n_{other\ cardiac\ meds}$ = 16). Full participant demographics displayed in Table 1.

Procedure

For brevity, we only describe those elements of the protocol pertinent to this study; see Ruiz et al., 2017 (Ruiz et al., 2017) for the full NTH study protocol. All sessions were conducted at a single-site, staffed, vascular medicine clinic located in the community and which functioned as a general clinical research center. All laboratory sessions were conducted on Thursday mornings followed by a 2-day/1-night ambulatory blood pressure (ABP)/EMA study.

A registered nurse evaluated each participant's health at study initiation, rescheduling cases where acute illness/infection was suspected. A fasting blood draw to assess inflammatory marker concentrations was performed. A vascular technologist then performed a complete bilateral ultrasound imaging of the extracranial vasculature including the internal and external carotid arteries and related vasculature for a measure of carotid intima media thickness (cIMT). Finally, participants completed a psychosocial survey which included, among others, measures of dispositional optimism and pessimism.

Prior to leaving the clinic site, all participants were fitted with an ABP cuff and provided a cellular phone for the 2-day/1-night ABP/EMA. The ABP assessments occurred roughly every 45-minutes. Participants were instructed to complete the EMA immediately following

each ABP cuff inflation during waking hours, with a maximum of 35 measurements across the two days.

Measures

Life Orientation Test-Revised.—The LOT-R is a measure of dispositional optimism and pessimism containing 10 items rated on a 5-point Likert-type scale (1 = strongly disagree to 5 = strongly agree) (Michael F. Scheier et al., 1994). Participants are asked to respond to the questions about how they perceive themselves and not about how others would answer. Only six of the items are scored (i.e., four items are fillers and not scored) which includes three positively worded and three negatively worded items. For the LOT-R total score, the pessimism subscale is reverse coded and all items are averaged, where higher scores reflect more optimism and lower scores reflect more pessimism. The optimism subscale is calculated by averaging the positively worded items, where higher scores reflect more optimism (and lower scores less optimism). The pessimism subscale is calculated by averaging the negatively worded items, with higher scores reflecting more pessimism (and lower scores less pessimism). The total score (α = .839), optimism subscale (α = .727), and the pessimism subscale (α = .840) exhibited adequate internal consistency. The LOT-R has been validated and implemented in several diverse samples (Roy et al., 2010; Michael F. Scheier & Carver, 2018; Segerstrom et al., 2011; Steca et al., 2015).

Intraindividual Means of Optimism and Pessimism.—EMA reports of optimism were collected with a single item adapted from the LOT-R to measure positive outlook (i.e., *"I expect good things will happen to me before the next cuff inflation"*). Each assessment reflects a participants state (or momentary) levels of optimistic and pessimistic outlook. An average of 24.74 (*SD* = 7.55) measurements of positive outlook were available for each participant. EMA reports of pessimism were similarly evaluated with a single item adapted from the LOT-R to measure negative outlook (i.e., *"If something can go wrong for me before the next cuff inflation, it will"*). An average of 24.75 (*SD* = 7.55) measurements of negative outlook were available for each participant. Both items were rated on a 7-point Likert-type scale (1 = Strongly disagree to 7 = Strongly agree). Intraindividual means (iMeans) were calculated for both optimism and pessimism by averaging across all moments of positive and negative outlook, respectively, for each individual. As the iMeans are an average of a person's momentary positive and negative outlook, they reflect individual differences in "trait-like" optimism and pessimism.

Inflammatory Markers.—Fasting blood draws were taken to measure concentrations of the following markers of systemic inflammation: high-sensitivity C-reactive protein (CRP [hs]; ELISA kit BC-1119, Biocheck), tumor necrosis factor-alpha (TNF-α; TNF-α kit KHC3011, Invitrogen), and interleukin-6 (IL-6; ELISA kit KH0061, Biocheck). High accuracy of the assays (*rs* range from 0.990 to 0.998) and coefficients of variation (CVs range from 3.3% to 7.9%) were observed for each analyte.

Ambulatory Blood Pressure.—Participants were fitted with an ambulatory blood pressure monitor (ABP; Oscar II; Suntech, Inc.) and blood pressure (BP) was collected roughly every 45 minutes during both waking hours and during nighttime sleep. BP

measurements were converted to mean arterial pressure (MAP). Additionally, we calculated nocturnal MAP dipping; dipping is considered a restorative physiological process. Greater decreases in MAP during sleep have been associated with better health outcomes and decreased risk for CVD (Rosansky, Menachery, Whittman, & Rosenberg, 1996). We operationalized nocturnal MAP dipping as a ratio of average nighttime MAP and daytime MAP, where nighttime MAP was the average of measurements between 12 AM and 5 AM and daytime MAP was the average of measurement between 7 AM and 10PM. These time frames were used to approximate sleep and wake hours and is a common method of determining nighttime and daytime BP (Yano & Kario, 2012). For nocturnal MAP dipping, a ratio below 1 indicated dipping had occurred. A dichotomous indicator for nocturnal MAP dipping (1 = dipping occurred and 0 = dipping did not occur) and a continuous indicator of the degree/amount of nocturnal MAP dipping ratio were created.

Carotid Intima Media Thickness.—CIMT is a measure of atherosclerosis in the carotid arteries (34). B-model ultrasound was implemented, yielding a two-dimensional image of the carotid vasculature, permitting the measurement of wall thickness (i.e., cIMT). Eighteen images were captured per participant and trained cardiologists coded and scored the cIMT using the Vascular Tools V software (Medical Imaging Applications, Ilc, Coralville, IA). Higher scores reflected higher levels of cIMT. See study protocol for full cIMT details (Ruiz et al., 2017).

Control Variables.—We controlled for the following variables because of their established associations with CVD risk indicators. Self-report measures of age, gender, and ethnicity, and BMI were collected at baseline. Additionally, a variable was created indicating whether participants used any medications that could be associated with BP and immunological markers (i.e., BP medication, lipid medication, diabetes medication, and any other cardiac medication). For models including MAP as an outcome, we created person-mean indicators for activity levels during ABP measurements by averaging across these behaviors for each person in order to control for activity influences on MAP.

Data Analysis Plan

All models were estimated in SAS (v 9.4). All inflammation markers were natural log transformed for normality. The default settings in SAS for proc glm were used for missing data (listwise deletion).For BP assessments, we first removed implausible values according to the manufacturer recommendations. This involved removing systolic BP values below 40 and above 260, and diastolic BP values below 25 and above 200 before converting to MAP and calculating nocturnal dipping and average daytime MAP. In total, 6 (< 0.001 %) BP observations were identified as implausible values and subsequently removed. Correlations were first estimated to evaluate the associations among the indicators of optimism and pessimism. As has been used in previous studies, correlation coefficients below 0.85 were deemed to provide evidence of independence of measures (i.e., divergent validity) (Voorhees, Brady, Calantone, & Ramirez, 2016). Then a series of multiple linear regressions was estimated to evaluate how each operation of optimism and pessimism were associated with markers associated with the development of CVD. A series of multiple logistic regressions was estimated to evaluate whether any of the indicators of optimism and

pessimism were associated with the odds of nocturnal MAP dipping. Optimism and pessimism were included as predictors within the same models using the LOT-R and the iMeans. Alpha levels were set at the nominal .05 for all analyses. Results are presented as standardized slope coefficients (β) with p-values for multiple regressions and odds ratios (OR) with 95% confidence intervals for logistic regressions[1].

Results

Associations of LOT-R and iMeans

Correlations between optimism and pessimism ranged between ±0.272 to ±0.605, suggesting that these two assessment types may be revealing different aspects of these constructs. Correlations were strongest between the optimism and pessimism subscales of the LOT-R ($r = -0.605$, $p < 0.001$) and weakest between the optimism and pessimism iMeans ($r = 0.272$, $p < 0.001$). Correlations between the LOT-R subscales and the iMeans of optimism and pessimism ranged between ±0.309 and ±0.400. Full correlation matrix is displayed in Table 2.

Inflammatory Markers and cIMT

None of the measures of optimism and pessimism were associated with any inflammatory markers or cIMT after including control variables (*ps* > .05). Full results are displayed in Tables 3a–3c.

Ambulatory Blood Pressure

Higher average scores on the LOT-R total score (which has typically indicated higher levels of optimism) were associated with higher odds of nocturnal MAP dipping (OR = 1.93, $C.I._{95\%}$: [1.14, 3.26]) and a smaller nocturnal MAP dipping ratio (i.e., ratio further from 1 and a larger amount of dipping; $\beta = -0.14$, $p = .036$). When examining the optimism and pessimism subscales of the LOT-R, only lower scores on the pessimism subscale was associated with the odds of nocturnal MAP dipping (OR = 0.37, $C.I._{95\%}$: [0.20, 0.67]) and a smaller MAP dipping ratio (i.e., ratio further from 1 and a larger amount of dipping; $\beta = 0.23$, $p = 0.005$), whereas scores on the optimism subscale showed no association with dipping ($p > 0.05$). Similarly, lower pessimism iMeans were associated with greater odds of nocturnal MAP dipping (OR = 0.72, $C.I._{95\%}$: [0.54, 0.98]) and a smaller MAP dipping ratio ($b = 0.20$, $p = .003$), whereas the optimism iMeans showed no associations with dipping ($p > 0.05$). None of the measures of optimism or pessimism were associated with average daytime MAP. Full results are displayed in Tables 3a–3c.

Discussion

The purpose of this study was to investigate the degree of independence between optimism and pessimism and evaluate their relative contribution to risk indicators of CVD. Pairing information derived from retrospective, trait-like surveys with individual means from EMA, our findings suggest that optimism and pessimism are distinct, yet overlapping constructs

[1]See Online Supplementary Materials (Tables S1–S3) for additional exploratory results including a composite SES covariate

that were differentially associated with biological risk indicators of CVD. Specifically, the correlations between optimism and pessimism were small to moderate regardless of measurement approach. We found that higher total scores on the LOT-R (where higher scores reflect more optimism) were associated with a larger amount of nocturnal MAP dipping, in accordance with previous studies (Burford, Low, & Matthews, 2013; Fortmann et al., 2012). However, when separating out optimism and pessimism using the LOT-R subscales and the EMA intraindividual means, indicators of lower pessimism, rather than higher optimism, were consistently associated with nocturnal MAP dipping. Contrary to expectations, we found no associations between optimism or pessimism indicators with any inflammatory markers or the average daytime MAP. Taken together, these findings suggest that optimism and pessimism may reflect distinct dimensions and that lower pessimism, rather than higher optimism, may be associated with cardiovascular health as measured by nocturnal MAP dipping.

Although optimism and pessimism are often treated as opposing ends of a bipolar dimension (Michael F. Scheier & Carver, 2018), our findings as well as other recent studies suggest that optimism and pessimism may be best characterized as distinct, yet related constructs (Michael F. Scheier & Carver, 2018; Serlachius et al., 2015). From the current inquiry, two pieces of evidence support this conclusion. First, the correlations of optimism and pessimism, within and between assessment methods, were only moderately correlated (*rs* between ± 0.27 and ± 0.40) and well below guidelines typically used in convergent and divergent validity assessments (Voorhees et al., 2016). Additionally, the LOT-R and the EMA of optimistic and pessimistic expectations are asking participants fundamentally different questions (i.e., “how do you think you typically are” versus “how do you expect the next 45 minutes to go for you”), and may be tapping into different aspects of the same construct. This is supported by the moderate correlations between the LOT-R and iMeans, regardless of whether the same construct was being compared (e.g., LOT-R optimism with iMean optimism). Furthermore, correlations between optimism and pessimism were stronger for the LOT-R than for the iMeans, suggesting that momentary expectations are more distinct from one another than the more schema-based assessments of optimism and pessimism using the LOT-R. It is possible that in the moment, people can experience a mixture of optimistic and pessimistic expectations, especially when multiple events are upcoming. On the other hand, when assessing how one typically is using retrospective trait assessments such as the LOT-R, people may be more likely to endorse primarily optimistic or pessimistic options, which would result in higher correlations between optimism and pessimism. The second set of evidence suggesting optimism and pessimism may be distinct, but overlapping constructs involving the nocturnal blood pressure dipping findings. We found stronger evidence that lower pessimism, rather than higher optimism, was protective (or higher pessimism was harmful). Specifically, people with lower levels of pessimism, but not higher levels of optimism, had greater odds – and a greater degree – of nocturnal MAP dipping. These associations were consistent across assessment methods (i.e., global retrospective assessment and EMA iMeans) that may be taping into different aspects of optimism and pessimsm, providing stronger (multi-method) evidence for the relative independence of optimism and pessimism.

As nocturnal BP dipping is a restorative physiological process that is important for cardiovascular health (Eguchi et al., 2009; Yano & Kario, 2012), these findings suggest that lower levels of pessimism, rather than higher levels of optimism, may promote cardiovascular health. These findings are in line with some recent work suggesting that pessimism is harmful, rather than optimism protective (Roy et al., 2010; Michael F. Scheier & Carver, 2018; Serlachius et al., 2015). One way that pessimism may be harmful is through increased perseverative cognitions (i.e., persistent thoughts about past stressful events or feared future events). People high in pessimism tend to engage in more perseverative cognitions throughout the day (Jones, Lehman, Kirsch, & Hennessy, 2017). Engaging in perseverative cognitions produces sustained physiological arousal that may persist during sleep, disrupting natural restorative processes such as nocturnal BP dipping (Brosschot, Verkuil, & Thayer, 2010). Having lower levels of pessimism then may be beneficial for cardiovascular health by resulting in less engagement in perseverative cognitions. Future work should further explore this potential mechanism to better understand how pessimism is associated with nocturnal BP dipping.

The lack of any observed associations between optimism and pessimism and other biological markers (i.e., inflammatory markers, cIMT, daily average MAP) were not as predicted. However, there are several factors that could potentially explain these discrepancies. First, our work looked at cross-sectional associations with these biomarkers, whereas optimism and pessimism are conceptually linked to the development of CVD longitudinally (Brydon et al., 2009; Roy et al., 2010). Second, the extant literature provides little consensus on how optimism and pessimism are associated with naturally occurring inflammatory markers. Previous work has focused on how optimism and pessimism moderated the relationship between stress and inflammatory markers including CRP and IL-6 (Roy et al., 2010; Michael F. Scheier & Carver, 2018; Segerstrom, 2005). Even these studies came to different conclusions as to whether higher optimism or lower pessimism was protective. Third, significant associations were found in outcomes measured in natural environments (i.e., MAP) and not in outcomes measured in the lab (i.e., systemic inflammatory markers), resulting in a potential location effect. However, findings from the LOT-R (measured in the lab) were significant with nocturnal MAP dipping, suggesting that locations of assessment was less influential in this context. One final limitation in these findings is that daily happenings that may affect momentary expectations (e.g., stressor occurrence, momentary mood, etc) were not controlled for in this study. Future work is necessary to further elucidate these associations using multiple assessment methods (i.e., trait-like and EMA-derived iMeans) of optimism and pessimism and how they are associated with changes in biological markers over time and/or in response to stress.

Conclusion

Using both traditional survey assessments and EMA methods we provide evidence that optimism and pessimism may be distinct, yet overlapping, dimensions with differential associations with risk indicators of CVD. Associations with nocturnal MAP dipping suggest that pessimism may be harmful – rather than optimism protective – for restorative physiological processes associated with the development of CVD.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1:

Participant Demographics and Health Status Separated by Gender

		Men (n = 150)	Women (n = 150)
Age (M±SD)		41 (12.59)	44 (12.79)
Ethnicity (n)	Hispanic	20	37
	Non-Hispanic Black	30	16
	Non-Hispanic White	92	88
	Non-Hispanic Other	6	8
Income ($)	< $20,000	17	18
	$20,000–$75,000	42	72
	$75,001 – $150,000	74	46
	> $150,00	12	7
Marital Status (n married)		100	84
Employment Status	Stay-at-home	0	14
	Full-Time Out of Home	86	105
	Part-Time Out of Home	25	21
	Unemployed	10	11
	Retired	6	11
Highest Education	High School Graduate/GED	13	19
	Some College (Not graduated)	43	38
	College Graduate (AA/BA/BS)	69	59
	Graduate School (Master's/Ph.D)	20	27
	Professional Degree (JD, MD, DDS, Etc)	2	2
Blood Pressure (SBP/DBP)		150/86	141/81
BMI		29.33 (6.11)	29.27 (6.84)
Prescribed Medications (n)	Blood Pressure	25	21
	Lipids	25	16
	Diabetes	5	9
	Other Cardiac	6	10

Note: SBP = Systolic Blood Pressure; DBP = Diastolic Blood Pressure; BMI = Body Mass Index

Table 2:

Zero-Order Pearson Correlations

	1	2	3	4	5	6	7	8	9	10
1. LOT-R Total	1.00									
2. LOT-R Optimism	**0.89**	1.00								
3. LOT-R Pessimism	**−0.90**	**−0.60**	1.00							
4. iMean Optimism	**0.40**	**0.39**	**−0.33**	1.00						
5. iMean Pessimism	**−0.40**	**−0.31**	**0.40**	**−0.27**	1.00					
6. CRP[hs]	0.05	0.02	−0.06	**0.12**	−0.01	1.00				
7. IL-6	0.00	0.00	0.00	0.01	0.08	**0.21**	1.00			
8. TNF-α	0.00	−0.02	−0.02	−0.01	−0.01	**0.12**	**0.26**	1.00		
9. cIMT	0.07	0.04	−0.08	**0.11**	**−0.12**	0.03	0.07	0.07	1.00	
10. Daytime MAP	−0.02	−0.02	0.01	−0.03	−0.03	**0.27**	0.13	−0.03	**0.23**	1.00
11. MAP Dipping	**0.17**	0.07	**−0.22**	**0.13**	−0.18	−0.06	0.03	−0.08	0.04	−0.07
12. MAP Dipping (Yes/No)	**−0.15**	−0.06	**0.21**	**0.21**	0.23	−0.01	−0.05	0.03	−0.07	−0.03
Raw Means	3.79	3.79	2.20	0.02	0.05	−2.74	−86.02	12.10	1.17	104.39
SD or IQR*	0.69	0.74	0.80	1.40	1.09	3.73*	1.26*	8.00*	2.66	14.37

Note: **Bold** indicates statistically significant correlation at α ± = 0.05; LOT-R = Life Orientation Test-Revised; LOT-R Optimism = Optimism Subscale; LOT-R Pessimism = Pessimism Subscale; iMean = Intraindividual means derived from momentary assessments; CRP[hs] = high-sensitivity C-Reactive Protein; IL-6 = Interleukin-6; TNF-α ± = Tumor Necrosis Factor Alpha; cIMT = carotid intima thickness; Daytime MAP = daytime average mean artieral pressure; MAP dipping = ratio of nighttime average MAP and daytime average MAP; MAP dipping (Yes/No) = 1 indicates dipping and 0 indicates no dipping; SD = Standard Deviation; IQR = interquartile range and was used to describe the variance of the raw inflammatory markers only.

Table 3a:

Results for Models with LOT-R Total Score

	CRP [hs] (n = 294)	TNF-α (n = 295)	IL-6 (n = 261)	c-IMT (n = 296)	Daytime MAP (n = 292)	Nocturnal MAP Dipping (n = 248)	Probability of Nocturnal MAP Dipping (n = 248)
	β	β	β	β	β	β	OR
	(p)	(p)	(p)	(p)	(p)	(p)	[95% C.I.]
Model 1							
LOT-R Total Score	0.05	0.03	−0.01	0.01	−0.06	**−0.14**	**1.93**
	(0.34)	(0.55)	(0.81)	(0.90)	(0.28)	(0.036)	[1.14, 3.26]
Age	**0.13**	−0.06	0.13	**0.36**	**0.21**	−0.02	0.99
	(0.023)	(0.31)	(0.06)	(<0.001)	(<0.001)	(0.83)	[0.96, 1.03]
Gender	**0.10**	**−0.29**	**−0.19**	0.09	**0.21**	0.04	0.54
	(0.041)	(<0.001)	(0.002)	(0.12)	(<0.001)	(0.57)	[0.25, 1.18]
Hispanic	0.04	**−0.17**	−0.04	−0.01	−0.10	0.09	0.57
	(0.49)	(0.003)	(0.53)	(0.92)	(0.07)	(0.17)	[0.23, 1.40]
non-Hispanic Black	0.06	**−0.20**	0.06	0.04	0.07	0.06	0.74
	(0.28)	(<0.001)	(0.35)	(0.46)	(0.20)	(0.40)	[0.23, 1.40]
BMI	**0.52**	0.08	**0.30**	−0.05	**0.36**	0.01	0.97
	(<0.001)	(0.14)	(<0.001)	(0.41)	(<0.001)	(0.24)	[0.92, 1.03]
Meds	−0.02	0.04	−0.01	0.10	0.01	−0.08	1.51
	(0.66)	(0.49)	(0.85)	(0.11)	(0.89)	(0.24)	[0.52, 4.34]
Active	-	-	-	-	0.10	0.05	1.10
	-	-	-	-	(0.050)	(0.41)	[0.15, 8.13]

Note: **Bold** indicates statistically significant at a = 0.05. P = Standardized regression coefficient. OR = Odds ratio; 95% C.I. = 95% confidence interval; LOT-R Total = Life Orientation Test Total Score; CRP[hs] = high-sensitivity C-Reactive Protein; TNF-α = Tumor Necrosis Factor- Alpha; IL-6 = Interleukin-6; cIMT = Carotid Intima Media Thickness; MAP = mean arterial pressure. Hispanic and non-Hispanic Black = Indicators for ethnicity with White as reference category; Model 1 = models that use the LOT-R total score as the primary predictor.

Table 3b:

Results for Models with LOT-R Optimism and Pessimism Subscales

	CRP [hs] (n = 294)	TNF-α (n = 295)	IL-6 (n = 261)	c-IMT (n = 296)	Daytime MAP (n = 292)	Nocturnal MAP Dipping (n = 248)	Probability of Nocturnal MAP Dipping (n = 248)
	β	β	β	β	β	β	OR
	(p)	(p)	(p)	(p)	(p)	(p)	[95% C.I.]
Model 2							
LOT-R Optimism	0.01	0.01	0.02	0.02	−0.01	0.08	0.70
	(0.83)	(0.92)	(0.75)	(0.76)	(0.89)	(0.32)	[0.37, 1.33]
LOT-R Pessimism	−0.04	−0.03	0.04	0.01	0.05	**0.23**	**0.37**
	(0.51)	(0.67)	(0.60)	(0.84)	(0.41)	(0.005)	[0.20, 0.67]
Age	**0.13**	−0.07	0.13	**0.36**	**0.21**	−0.00	0.99
	(0.025)	(0.31)	(0.06)	(<0.001)	(<0.001)	(0.99)	[0.96, 1.03]
Gender	**−0.10**	**−0.29**	**−0.19**	0.09	**0.21**	0.04	0.55
	(0.042)	(<0.001)	(0.002)	(0.12)	(<0.001)	(0.57)	[0.25, 1.21]
Hispanic	0.04	**−0.17**	−0.04	−0.01	−0.10	0.08	0.68
	(0.48)	(0.003)	(0.49)	(0.89)	(0.07)	(0.26)	[0.27, 1.73]
Non-Hispanic Black	0.06	**−0.20**	0.05	0.04	0.07	0.04	0.84
	(0.27)	(0.001)	(0.39)	(0.48)	(0.22)	(0.54)	[0.26, 2.78]
BMI	**0.52**	0.08	**0.30**	−0.04	**0.36**)	0.02	0.97
	(0.001)	(0.15)	(<0.001)	(0.42)	(<0.001)	(0.82)	[0.92, 1.03]
Meds	−0.03	0.04	−0.01	0.10	0.01	−0.08	1.44
	(0.65)	(0.50)	(0.87)	(0.10)	(0.86)	(0.27)	[0.49, 4.22]
Active	-	-	-	-	0.10	0.04	1.36
	-	-	-	-	(0.05)	(0.52)	[0.18, 10.63]

Note: **Bold** indicates statistically significant at a = 0.05. P = Standardized regression coefficient. OR = Odds ratio; 95% C.I. = 95% confidence interval; LOT-R Total = Life Orientation Test Total Score; CRP[hs] = high-sensitivity C-Reactive Protein; TNF-α = Tumor Necrosis Factor- Alpha; IL-6 = Interleukin-6; cIMT = Carotid Intima Media Thickness; MAP = mean arterial pressure. Hispanic and non-Hispanic Black = Indicators for ethnicity with White as reference category; Model 2 = Both of the LOT-R subscales were used in the same models together as primary predictors.

Table 3c:

Results for Models with iMeans of Optimism and Pessimism

	CRP [hs] (n = 294)	TNF-α (n = 295)	IL-6 (n = 261)	c-IMT (n = 296)	Daytime MAP (n = 292)	Nocturnal MAP Dipping (n = 248)	Probability of Nocturnal MAP Dipping (n = 248)
	β	β	β	β	β	β	OR
	(p)	(p)	(p)	(p)	(p)	(p)	[95% C.I.]
Model 3							
Mean of Momentary Optimism	0.06	−0.01	−0.03	0.06	−0.08	−0.03	1.25
	(0.22)	(0.86)	(0.63)	(0.27)	(0.15)	(0.64)	[0.96, 1.62]
Mean of Momentary Pessimism	−0.01	−0.00	0.07	−0.05	−0.03	**0.20**	**0.72**
	(0.85)	(0.96)	(0.27)	(0.38)	(0.54)	(0.003)	[0.54, 0.98]
Age	**0.13**	−0.06	**0.14**	**0.34**	**0.21**	−0.01	0.99
	(0.019)	(0.32)	(0.040)	(<0.001)	(<0.001)	(0.89)	[0.96, 1.03]
Gender	**−0.10**	**−0.28**	**−0.19**	0.10	**0.19**	0.03	0.63
	(0.045)	(<0.001)	(0.002)	(0.07)	(<0.001)	(0.68)	[0.29, 1.36]
Hispanic	0.03	**−0.17**	−0.04	−0.00	−0.09	0.08	0.57
	(0.58)	(0.004)	(0.47)	(1.00)	(0.10)	(0.25)	[0.23, 1.42]
Non-Hispanic Black	0.06	**−0.19**	0.05	0.04	0.07	0.03	0.78
	(0.29)	(0.002)	(0.38)	(0.49)	(0.19)	(0.63)	[0.24, 2.57]
BMI	**0.52**	0.08	**0.30**	−0.04	**0.36**	0.03	0.97
	(<0.001)	(0.16)	(<0.001)	(0.48)	(<0.001)	(0.69)	[0.92, 1.02]
Meds	−0.02	0.04	−0.00	0.08	0.02	−0.07	1.27
	(0.68)	(0.55)	(0.88)	(0.20)	(0.76)	(0.36)	[0.46, 3.50]
Active	-	-	-	-	**0.12**	0.06	0.77
	-	-	-	-	(0.024)	(0.39)	[0.11, 5.53]

Note: **Bold** indicates statistically significant at α = 0.05. β = Standardized regression coefficient. OR = Odds ratio; 95% C.I. = 95% confidence interval; LOT-R Total = Life Orientation Test Total Score; CRP[hs] = high-sensitivity C-Reactive Protein; TNF-α = Tumor Necrosis Factor-Alpha; IL-6 = Interleukin-6; cIMT = Carotid Intima Media Thickness; MAP = mean arterial pressure. Hispanic and non-Hispanic Black = Indicators for ethnicity with White as reference category; Model 3 = Both the iMeans were used in the same models together as primary predictors.