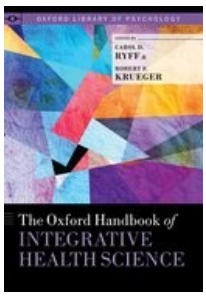

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CHAPTER

15 Psychosocial Resources and Physiological Dysregulation

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Abstract

Psychosocial resources refer to individual personality and social relationship factors that tend to cluster together and contribute to psychological and physical health and well-being. Growing evidence demonstrates robust relations between psychosocial resources and health. Physiological dysregulation represents one key mechanism that may help to explain the link between psychosocial resources and health. The current chapter focuses on the relations of psychosocial resources with physiology, drawing on findings from the Midlife in the United States (MIDUS) study and other large, epidemiological studies. The focus is on the relations of psychosocial resources with allostatic load, a composite index of multisystem physiological dysregulation, while also highlighting select findings for individual biomarkers. The summary of evidence examines psychosocial resources as both a direct and a moderating factor on biological outcomes. The chapter concludes with suggestions for future research.

Keywords: health, well-being, psychosocial resources, physiological dysregulation, physiology, Midlife in the United States, MIDUS, allostatic load, biomarkers

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Introduction

Considerable research has examined factors that promote health and support positive adaptation to stress and adversity. One such set of factors is psychosocial resources (PSRs). Large, prospective epidemiological studies and meta-analyses demonstrated that PSRs such as optimism and social support or relations predict mortality (Engberg et al., 2013; Holt-Lunstad, Smith, & Layton, 2010). Research also has examined whether PSRs are related to more proximal outcomes, such as physiological dysregulation (Wiley, Bei, Bower, & Stanton, 2017). This chapter introduces the construct of PSRs and reviews the evidence for a relation between PSRs and allostatic load (AL), a composite index of multisystem physiological dysregulation.

The chapter consists of four sections. First, we introduce the constructs of PSRs and AL and overview pathways between PSRs and AL. Second, we examine the evidence for a relationship between psychological resources and AL. Third, we review studies on the relations of social relationships and social relational factors, such as social support, size of social network, and low social isolation, with AL. In each section, we discuss both main and moderated effects, particularly considering the potential stress-buffering effects of PSRs for both stressful events and pervasive stressors such as low socioeconomic status (SES). Finally, we conclude with a discussion on what research is needed to address current limitations and advance the science of the relations between PSRs and AL.

What Are Psychosocial Resources?

The PSRs comprise many and heterogeneous specific psychological and social constructs that are unified by their salubrious nature. PSRs have been conceptualized as factors with direct intrinsic value (e.g., self-esteem) or indirect intrinsic value, such as perceived control facilitating lower stress and higher quality of life, which are intrinsically valued (Hobfoll, 2002). PSRs have been defined as ↳ "individual differences and social relationships that have beneficial effects on mental and physical health outcomes" (Taylor & Broffman, 2011, p. 1). In this chapter, we focus on PSRs as resources and AL as an outcome. However, due to their salutogenic nature, depending on the guiding scientific question, PSRs are also examined as outcomes (e.g., purpose in life is studied commonly as a component of psychological well-being; Ryff & Keyes, 1995).

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The broad definition of PSRs, while consistent with the literature, results in many specific constructs qualifying as a PSR. We restrict our focus to personal or psychological resources and social support or social relational resources. Dunkel Schetter and Dolbier (2011) defined a conceptually based taxonomy of resilience resources with six domains: (a) self and ego related; (b) personality and dispositional; (c) interpersonal and social; (d) worldviews and culturally based beliefs and values; (e) behavioral and cognitive skills; and (6) other. Each domain further contains specific resources. PSRs comprise the first three domains primarily and, to a lesser degree, the fourth and fifth domains. PSRs may also be divided broadly as psychological (personal) or social (interpersonal), which we use to organize the presentation of results. The next sections introduce select, commonly studied, psychological and social resources and highlight their relations with health.

Psychological Resources

Control-related resources are some of the most commonly studied, including constructs such as mastery (Pearlin & Schooler, 1978) and self-efficacy (Bandura, 2001). Research showed that mastery is related to better cardiometabolic health (S. K. Roepke & Grant, 2011) and general physical health (T. E. Seeman, 1991). Like mastery, higher self-efficacy is associated with better health, including engaging in health behaviors (D. K. King et al., 2010; Schwarzer & Renner, 2000) and lower psychological symptoms (Brown et al., 2014). The link between self-efficacy and health behaviors also represents a potential mechanism through which psychological resources could influence physiological dysregulation.

Self-esteem comprises stable, favorable self-perceptions and differs from control-related resources in that the favorable self-perceptions are not limited to control or competency. Laboratory research showed that self-esteem moderated the effects of acute stress on heart rate variability and inflammation (O'Donnell, Brydon, Wright, & Steptoe, 2008), although its relation to health behaviors is equivocal (Baumeister, Campbell, Krueger, & Vohs, 2003). Personality measures, including dispositional optimism (Scheier, Carver, & Bridges, 1994); purpose in life (Baumeister, 1991; L. A. King, Hicks, Krull, & Del Gaiso, 2006); hope (Snyder et al., 1991, 1996); conscientious; and to a lesser degree, extraversion (Goldberg, 1990), are examined commonly as psychological resources as well (Boehm & Kubzansky, 2012).

The benefits of optimism are observed in diverse contexts, including during acute and chronic stress (e.g., caregivers) and in medical and academic settings. Indeed, a meta-analysis of optimism and measures of physical health, broadly defined, found an average effect size of .17 between optimism and physical health in more than 80 studies and 30,000 subjects (Rasmussen, Scheier, & Greenhouse, 2009). Research showed purpose in life is related to engaging in better health behaviors, such as the use of preventive health checks (Kim, Strecher, & Ryff, 2014), perceived health (Nygren et al., 2005), and mortality (Hill & Turiano, 2014). Purpose in life also relates to other physical health outcomes (for a review, see A. M. Roepke, Jayawickreme, & Riffle, 2014). There is less convincing evidence for the relation between hope and physical health. However, hope has been associated with markers of physiological function, such as heart rate variability (Schwarz, Schächinger, Adler, & Goetz, 2003).

Considering the five-factor model of personality, prospective, longitudinal studies showed that childhood conscientiousness predicts engaging in better health behaviors (Hampson, Goldberg, Vogt, & Dubanoski, 2006) and longevity (H. S. Friedman et al., 1993, 1995). Meta-analysis confirmed the relation between conscientiousness and psychological health and health behaviors (Bogg & Roberts, 2004; Kotov, Gamez, Schmidt, & Watson, 2010). In addition to direct relations between conscientiousness and health behaviors, facets of conscientiousness such as self-discipline may be related to experiencing lower levels of stress, and specific facets may moderate the relations between stress and health behaviors (O'Connor, Conner, Jones, McMillan, & Ferguson, 2009). In a study combining data from three epidemiological studies and a meta-analysis, conscientiousness—but not extraversion or other personality dimensions from the five-factor model—was associated with lower levels of the inflammatory markers C-reactive protein and interleukin 6 (Luchetti, Barkley, Stephan, Terracciano, & Sutin, 2014). Despite the lack of evidence that extraversion is related to inflammation, some evidence links higher extraversion to ↳ longevity (Wilson et al., 2005), although not all studies supported this association (Shipley, Weiss, Der, Taylor, & Deary, 2007).

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Social Resources

Dimensions of social resources commonly studied include aspects of social networks or presence of social relationships (e.g., size and diversity of one's social network, the frequency of contact with different network members) and social support. Social support is further subdivided into the type of social support (e.g., emotional, instrumental, informational) and whether it is perceived or received. Although perceived availability of social support and receipt of social support are conceptually related, meta-analysis showed that the two constructs are correlated only .35 on average (Haber, Cohen, Lucas, & Baltes, 2007).

Extensive research exists on social relationships or support and health (e.g., Cohen, Doyle, Skoner, Rabin, & Gwaltney, 1997; DiMatteo, 2004; Holt-Lunstad et al., 2010; Uchino, 2009). Multiple prospective, longitudinal studies demonstrated that social relationships (or the opposite, social isolation) predict mortality (e.g., Berkman & Syme, 1979; House, Landis, & Umberson, 1988). Recent meta-analyses demonstrated a robust relationship between social relationships or isolation and mortality that is comparable to other well-known risk factors, such as smoking (Holt-Lunstad, Smith, Baker, Harris, & Stephenson, 2015; Holt-Lunstad et al., 2010). Social support also is tied to declines in depressive symptoms and distress and improved adjustment in individuals with a chronic disease (e.g., Stanton, Revenson, & Tennen, 2007).

One reason social support may be linked to better health is by buffering against the harmful effects of stress (Cohen & Wills, 1985). Research provides support for both direct and buffering roles of social support with health (Mezuk, Diez Roux, & Seeman, 2010; Mitchell, Evans, Rees, & Hardy, 2014; Taylor & Seeman, 1999). Recent neural evidence suggests that social rejection activates similar neural circuitry as physical pain (Eisenberger, 2012, 2015; Eisenberger, Lieberman, & Williams, 2003), providing potential mechanisms for the observed direct relations between social support and physiology (Uchino, 2006). Finally, although most research has considered social support as a predictor of health or buffer of the effects of stress, longitudinal analyses revealed bidirectional relations between social support and depression symptoms, with depression symptoms predicting declines in social support (Dour et al., 2014).

Allostatic Load

Classically, AL is measured as a composite index of multisystem physiological dysregulation (McEwen & Seeman, 1999; T. E. Seeman, Singer, Rowe, Horwitz, & McEwen, 1997). Research showed that the biomarkers typically included in AL and the overall index predict mortality (Gruenewald, Seeman, Ryff, Karlamangla, & Singer, 2006; Karlamangla, Singer, & Seeman, 2006; Robertson, Beveridge, & Bromley, 2017), and systematic reviews indicated a robust link between AL and health (Beckie, 2012).

The AL indices often include measures of the sympathetic nervous system (e.g., epinephrine, norepinephrine); hypothalamic–pituitary–adrenal axis (e.g., cortisol, dehydroepiandrosterone sulfate); cardiovascular activity (e.g., blood pressure); metabolism (e.g., waist–hip ratio, body mass index); glucose metabolism (e.g., blood sugar, glycosylated hemoglobin); and lipoproteins (T. E. Seeman et al., 1997). Recently, studies (e.g., Gruenewald et al., 2012; T. E. Seeman, Gruenewald, Cohen, Williams, & Matthews, 2014) have also included measures of the immune system, particularly inflammatory markers (e.g., C-reactive protein, interleukin 6) and the parasympathetic nervous system (e.g., heart rate variability). Most research creates an AL index by dichotomizing specific biomarkers based on the upper quartile associated with high risk or clinical thresholds and counting the number of high-risk biomarkers or the number of systems containing a high-risk biomarker (T. E. Seeman et al., 1997). However, alternate methods for including continuous scores are available (McCaffery, Marsland, Strohacker, Muldoon, & Manuck, 2012; T. E. Seeman et al., 2010; Wiley, Gruenewald, Karlamangla, & Seeman, 2016), including ones that incorporate

information about clinically relevant thresholds, such as used in metabolic syndrome (e.g., Wiley & Carrington, 2016).

Researchers have noted that a challenge in the AL literature is the lack of consistency in biomarkers included in the measurement and creation of AL indices (Gallo, Fortmann, & Mattei, 2014). However, recent empirical work using factor analysis suggested that a latent AL factor does not change substantially when removing any one physiological system (Wiley, Gruenewald, et al., 2016). This finding suggests that despite
p. 206 variation in the set of biomarkers included, AL indices may be comparable, although ↳ this remains an area of active debate (Crook & Booth, 2017; Wiley, Gruenewald, Karlamangla, & Seeman, 2017).

Another limitation of using AL indices in place of individual biomarkers is that they provide less specificity because they aggregate across biomarkers and physiological systems. However, this aggregation also helps to summarize of the overall relations between PSRs and physiological dysregulation when there is no reason to focus on specific biomarkers. Also, the aggregate AL index appears to be useful in providing a stronger prediction of health outcomes than individual biomarkers or other, simpler composites. For example, AL is more predictive of health outcomes than the metabolic syndrome or the Framingham Risk Score, another aggregate index (Karlamangla, Singer, McEwen, Rowe, & Seeman, 2002; Karlamangla et al., 2006). Psychometric evidence supports that AL adds beyond other multisystem measures, such as the metabolic syndrome (McCaffery et al., 2012). Therefore, this chapter focuses on the relations between PSRs and AL to understand the broad relations between resources and physiological function or dysregulation.

Potential Confounds and Mechanisms Between Psychosocial Resources and Physiological Dysregulation

Before examining whether PSRs are related to AL, it is helpful to consider whether plausible mechanisms exist that link PSRs and AL. It is also important to consider whether any apparent relations between PSRs and AL may be spurious, driven by confounding factors or shared origins. Although considerable research has examined the causes or predictors of AL, comparatively limited research has examined the causes or predictors of PSRs. We briefly review research on the causes and predictors of AL, potential confounding factors that may cause or predict both AL and PSRs, and finally possible mechanisms linking PSRs and AL.

The canonical cause of AL is stress. There is a well-characterized stress response, including heightened activity in the amygdala and hypothalamus, increased sympathetic nervous system signaling, and decreased parasympathetic nervous system signaling (McEwen, 2007; McEwen & Seeman, 1999; Ulrich-Lai & Herman, 2009). These neural mechanisms then regulate downstream physiological parameters such as catecholamines, glucocorticoids, and heart rate, which ultimately lead to AL (McEwen & Seeman, 1999). Although the stress response is commonly viewed as an acute response to stress, another recent theory, Generalized Unsafety Theory of Stress (GUTS), argues that the stress response represents a default state that is inhibited under conditions of safety (Brosschot, Verkuil, & Thayer, 2017). The implication from GUTS is that activation of the stress response may occur not only when specific stressors occur but also in the absence of an adequate safety signal being perceived.

The other commonly studied cause of AL is behavioral factors. Considerable evidence relates behavioral factors, such as sleep, physical activity, and diet, to individual components of AL (Kastorini et al., 2011; Shan et al., 2015; Xi, He, Zhang, Xue, & Zhou, 2014; Yamaoka & Tango, 2012). There is less evidence relating health behaviors to indices of AL. However, recent evidence also shows that both mean and night-to-night intraindividual variability in sleep are related to higher AL (Bei, Seeman, Carroll, & Wiley, 2017) and that interventions to improve sleep reduce levels of AL (Carroll et al., 2015). Likewise, higher levels of physical

activity (Gay et al., 2015) and healthier diet (Kusano et al., 2016; Mattei, Bhupathiraju, & Tucker, 2013) are related to lower AL.

One factor that appears to be a common antecedent of both AL and PSRs is SES. Multiple studies demonstrated that adult, child, and neighborhood SES predicts AL (Brody, Lei, Chen, & Miller, 2014; Jiménez, Osypuk, Arevalo, Tucker, & Falcon, 2015; Merkin, Karlamangla, Diez Roux, Shrager, & Seeman, 2014). Although methodological limitations were noted, a recent systematic review found that 23 of 26 studies on socioeconomic position and AL found that lower SES was associated with higher AL (Johsnon, Cavallaro, & Leon, 2017). Studies also showed that higher SES is associated with more PSRs (Boehm, Chen, Williams, Ryff, & Kubzansky, 2015; Gallo et al., 2012; Hostinar, Ross, Chen, & Miller, 2015; Taylor & Seeman, 1999). Although causal evidence is limited, prospective studies do show that the relation between SES and PSRs begins in children, with child poverty predicting self-regulation and the type of coping strategies individuals use (Evans & Kim, 2013). Indeed, one study of older adults showed that their father's SES (education level and occupational prestige) predicted their later life social network size, availability of instrumental support from kin and nonkin, and emotional support from nonkin (Van Groenou & Van Tilburg, 2003).

Genetics are another potential common antecedent of AL and PSRs. One study reported the heritability of AL
p. 207 to be 29.6% (Petrovic et al., 2016). For PSRs, heritability estimates of social support ↳ range from 43% to 75% for different measures of social support (Kendler, 1997) and approximately 25% for optimism (Plomin et al., 1992). Although these studies did not demonstrate that the same genetic factors underlie AL and PSRs, the fact that both demonstrate moderate heritability indicates the possibility that common genetic factors may underlie both.

Many specific potential mechanisms linking PSRs and AL fall under two pathways: neural factors and behavioral factors. Considering neural factors, some research has suggested that PSRs may *prevent* the occurrence of stressors (Aspinwall & Taylor, 1997). Thus, PSRs may be linked to lower AL through the same neural pathways linking stress and AL (McEwen, 2007), although the empirical evidence for this is limited, as it is challenging to capture and study the stress that does not occur due to effective prevention. PSRs also may buffer or moderate the deleterious effects of stress (Cohen & Wills, 1985). First, PSRs may mitigate the severity of a threat (e.g., the threat from the stressor of losing one's job may be less with a large and supportive social network). Second, PSRs may facilitate faster inhibition of the stress response following a stressor (e.g., by providing safety cues).

Behavioral factors are another broad pathway that may link PSRs and AL. As previously covered, there is robust evidence that behavioral factors are related to AL. Further, considerable research demonstrates that PSRs are related to health behaviors. For instance, self-efficacy influences both the initiation and maintenance of behavior change, such as physical activity (Bauman et al., 2012; McAuley & Blissmer, 2000). Self-esteem predicts problem eating (McGee & Williams, 2000), and in the Women's Health Initiative, a large study of women, higher optimism predicted healthier eating at baseline and change over 1 year (Hingle et al., 2014). Meta-analysis showed that social support is associated with higher medication adherence (DiMatteo, 2004), and there is evidence that social support is associated with better self-care behaviors, such as for heart failure (Graven & Grant, 2014). Higher optimism is related to better sleep in both children (Lemola et al., 2011) and adults (Lemola, Räikkönen, Gomez, & Allemand, 2013). In adults, social support also predicts sleep quality in laboratory and naturalistic contexts (Cacioppo et al., 2002). Finally, given the links between stress and both sleep mean and intraindividual variability (Bei, Wiley, Trinder, & Manber, 2016; Slopen, Lewis, & Williams, 2016), PSRs reduce AL through reducing the effects of stress on sleep.

Psychological Resources and Allostatic Load

Main Effects

Several studies have examined whether control-related resources such as mastery, self-control, and self-regulation relate to AL in both adults and children. In children, studies have measured control-related resources based on teacher-rated self-control and competence (Brody et al., 2013) and self-regulation behaviorally based on tasks such as delayed gratification and persistence in solving challenging tasks (Dich, Doan, & Evans, 2015; Evans, 2003; Evans & Fuller-Rowell, 2013). In children, studies have included both cross-sectional and longitudinal (control resources predicting later AL), but of these studies, none found evidence for a main effect of control-related resources on AL.

In the Social Environment and Biomarkers of Aging Study (SEBAS), higher mastery uniquely predicted lower AL approximately 4 years later, controlling for optimism, social resources, and the number of stressors experienced (Glei, Goldman, Chuang, & Weinstein, 2007). Higher mastery was associated with lower AL in SEBAS participants who completed assessments of activities of daily living at a 7-year follow-up (Wu et al., 2015), and adjusting for AL partially explained the relationship between mastery and change in activities of daily living (Wu et al., 2015).

Although not primarily focused on PSRs, a study in the Midlife in the United States (MIDUS) study found no unique relation between mastery or perceived constraints (low mastery) with AL, controlling for SES and other sociodemographic covariates (Gruenewald et al., 2012). However, another study in MIDUS found (controlling for age, race, sex, income, education, and marital status) that although mastery was not associated with AL, a lower level of perceived constraints was associated with lower AL (M. Seeman, Stein Merkin, Karlamangla, Koretz, & Seeman, 2014). Further, a composite index of control in several domains was also associated with lower AL (M. Seeman et al., 2014). Finally, in a smaller study of older adults free of serious illness, mastery was also not associated with AL overall (S. K. Roepke et al., 2011).

In SEBAS, higher optimism was not uniquely related to AL, controlling for mastery, social resources, and the number of stressors (Glei et al., 2007). In a small population-based study of older adults from Illinois
p. 208 (Hawkley, Lavelle, Berntson, & Cacioppo, 2011) and a sample of healthy Japanese adults ↳ (Tanaka et al., 2011), optimism was not significantly related to AL. In a small cross-sectional study of older adults living in nursing homes, hope and optimism were not associated with AL, but given the sample size of just 22 participants, the study was only powered to detect large effects (Meeks et al., 2016). Finally, a longitudinal study of women from the Individual Development and Adaptation (IDA) study showed that grouping women by their career pattern, women in careers groups that tended to be more optimistic also had lower AL (Johansson, Huang, & Lindfors, 2007).

Despite the null findings for a main effect of optimism on AL, there is evidence that optimism is linked to physiological function, such as inflammation. In a large sample of thousands of adults, the Multi-Ethnic Study of Atherosclerosis (MESA), higher optimism and lower pessimism were associated with the inflammatory markers interleukin 6 and C-reactive protein, controlling for sociodemographic factors, depression, and health behaviors (Roy et al., 2010). In addition to the possibility that optimism is related to inflammatory markers but not AL, it is also possible that results in US adults (Roy et al., 2010) do not generalize to other cultures, such as in Taiwan (Glei et al., 2007). The remaining studies had relatively small sample sizes, providing insufficient power to detect small effects (Hawkley et al., 2011; Tanaka et al., 2011).

Other psychological resources have received more limited research. Two studies examined sense of coherence. In a small, cross-sectional sample of healthy Japanese adults, sense of coherence had a small, negative correlation with AL, but was not statistically significant (Tanaka et al., 2011). In contrast, in adult

women from IDA, controlling for baseline levels of sense of coherence, AL predicted lower levels of sense of coherence 6 years later (Lindfors, Lundberg, & Lundberg, 2006). This study provided evidence that although most studies test PSRs predicting AL, there may be bidirectional effects. Also in IDA, grouping women into different career patterns, women in career patterns that tended to have higher psychological well-being (acceptance, positive relations, autonomy, mastery, purpose in life, personal growth) also had lower AL (Johansson et al., 2007). A protective relationship between purpose in life and AL was found in MIDUS. Higher purpose in life predicted lower AL an average of 10 years later, even controlling for sociodemographic factors, negative affect, and positive social relations (Zilioli, Slatcher, Ong, & Gruenewald, 2015). Finally, although its status as psychological resource versus psychological health outcome is equivocal, data from MIDUS found no evidence for a main effect of positive affect on AL after controlling for SES and other sociodemographic factors (Gruenewald et al., 2012).

Moderated Effects

In children, although main effects of mastery were not observed, several moderated effects did emerge. In one study of African American children, higher teacher-rated self-control/competence interacted with SES so that children with low SES backgrounds and high self-control/competence had higher AL at age 19 than children with low SES backgrounds and low self-control/competence (Brody et al., 2013). These results suggest that in adverse environments, maintaining control may come at a physiological cost. Conversely, looking at negative emotionality, self-regulation moderated the effect of negative emotionality on AL so that negative emotionality only predicted higher AL in children with low self-regulation skills, but was not related to AL in children with high self-regulation (Dich et al., 2015). However, negative emotionality also interacted with cumulative risk, such that in children with high cumulative risk, higher negative emotionality was associated with more internalizing or externalizing, but lower AL (Dich, Doan, & Evans, 2017). The relation of negative emotionality with AL was not significant for low cumulative risk, although the trend was that higher negative emotionality was associated with higher AL (Dich et al., 2017). Finally, in the National Longitudinal Study of Adolescent to Adult Health (AddHealth), future orientation—positive future expectancies and hope—in adolescence moderated and mediated the relation between stressful life events and adulthood AL (Wickrama, O'Neal, & Lee, 2016). Specifically, greater future orientation predicted lower AL and also interacted with stressful life events such that stressful life events had a more positive relation with AL in those with higher future orientation (Wickrama et al., 2016).

In adults, moderated effects for control-related resources also emerged. In a study of caregivers (spouses caring for partners with Alzheimer disease) versus noncaregivers, higher mastery was associated with higher AL, but only in caregivers (S. K. Roepke et al., 2011). In SEBAS, a PSR composite comprising six social resource measures, mastery, and optimism moderated the effects of stress on AL, so that for high levels of
p. 209 PSRs, the relation between stress and AL was attenuated (Glei et al., 2007). A study using ↳ MIDUS data found that the combination of a cognitive tendency to positive reappraisal—shift—and persistence interacted to predict lower AL in adults where either parent had less than a high school education, indicative of lower childhood SES (Chen, Miller, Lachman, Gruenewald, & Seeman, 2012). Another study in MIDUS found that in participants caring for children with a developmental disorder and matched controls, positive affect interacted with caregiver status to buffer the stress effects on AL of caring for a child with a developmental disorder (Song et al., 2014). Finally, in the Jackson Heart Study (JHS), adjusting for age, education, and health behaviors, use of approach-oriented coping was not related to AL in men or women. However, use of avoidance-oriented coping was associated with higher AL in women, but not men (Fernandez et al., 2015). In contrast, another study found that several types of approach-oriented coping were associated with lower AL in adults with first episode psychosis, but not in a healthy control comparison (Misiak, Kotowicz, Loska, et al, 2018).

In summary, there is mixed evidence for main effects between psychological resources and AL. The evidence is more consistent when examining moderated effects, particularly for control- or mastery-related resources, which interact with stress or adversity (e.g., low SES) to predict AL. Across studies, the effect sizes were small or moderate at most. Considering the magnitude of effects, studies with less than several hundred participants were likely underpowered. Nevertheless, the results suggest that effects, when present, favor a health-protecting role for psychological resources.

Social Resources and Allostatic Load

Main Effects

In children, only two studies evaluated social resources and AL; both used the same data and focused on emotional support from the primary caregiver and peers in African American children. Overall, there was no relation between emotional support in childhood and AL in adolescence (Brody, Lei, Chae, et al., 2014; Brody, Lei, Chen, et al., 2014).

In adults, several studies have investigated social resources in MIDUS. An overall aggregate of perceived social support from friends, family, and partners was not associated with AL (Brooks et al., 2014; E. M. Friedman, Karlamangla, Gruenewald, Koretz, & Seeman, 2015). However, perceived spouse support alone was related to lower AL (Brooks et al., 2014), although perceived friend or family support alone was not related to AL (Brooks et al., 2014; Gruenewald et al., 2012). Also, more frequent contact with friends was associated with higher AL, but the frequency of contact with family was not associated with AL (Brooks et al., 2014).

In SEBAS, five different measures of social resources centered on social network size and contact (e.g., contact with children, the number of social activities) and emotional support were not uniquely related to AL (Glei et al., 2007). Also in SEBAS, 15 measures of social resources were studied in the near-elderly and elderly (T. E. Seeman et al., 2004). For the near elderly, none of the social resource measures were related to AL. For the elderly, strong ties with relatives were associated with lower AL (T. E. Seeman et al., 2004).

In the Coronary Artery Risk Development in Young Adults (CARDIA) study, more social ties and higher emotional support were both associated with lower AL (T. E. Seeman et al., 2014). In the Boston Puerto Rican Health (BPRH) study, higher scores on a social support composite (comprising social network, average emotional support, average assistance from social network, and the number of social activities) were associated with lower levels of AL (Sotos-Prieto et al., 2015). However, in adult women from the MacArthur Study of Successful Aging (MAC), social integration, emotional support, and instrumental support were not associated with AL (Maselko, Kubzansky, Kawachi, Seeman, & Berkman, 2007).

Finally, in the English Longitudinal Study of Aging (ELSA), one study examined social support measured using a composite of perceived support from partners, children, relatives, and friends and AL (Read & Grundy, 2014). This study was unique in measuring both social support and AL at two time points, 2004–2005 and 2008–2009. At the same time points, social support was not associated with AL. However, social support in 2004–2005 predicted higher AL in 2008–2009, controlling for social support in 2008–2009, AL in 2004–2005, sociodemographic factors, and health behaviors.

In a longitudinal study of abused/neglected and matched nonabused/nonneglected children into adulthood from the United States, higher general social support at age 39 predicted lower AL at age 41 (Horan & Widom, 2015). General social support also mediated the effect of childhood abuse/neglect on adulthood AL (Horan & Widom, 2015). In a small cross-sectional study of older adults living in nursing homes, higher satisfaction with social support was correlated with higher AL (Meeks et al., 2016). In a sample of adults

p. 210 living in Chicago, there were no associations between ↳ loneliness, social support, or network size and AL, although correlations were in the expected direction (higher support or network, lower AL), the effects were small, with correlations less than .10 (Hawkley et al., 2011). In a sample of adults from Canada, perceived social support from supervisors and coworkers was not related to AL (Juster, Moskowitz, Lavoie, & D'Antono, 2013). Another study using a composite social support measure from coworkers and supervisors also found no relationship between social support and AL (Schnorpfeil et al., 2003). Finally, in a small sample of adults living in Taiwan, the number of social activities, social contact, child contact, and co-residing with a child were not significantly related to AL (Weinstein, Goldman, Hedley, Yu-Hsuan, & Seeman, 2003).

Moderated Effects

In children, two studies examined the role of emotional support from the primary caregiver and peers as a potential buffer against the effects of discrimination or low SES in African American children (Brody, Lei, Chae, et al., 2014; Brody, Lei, Chen, et al., 2014). In the first study, perceived discrimination was assessed, and trajectories of discrimination were classified as either low and increasing versus high and stable. For children in the high and stable discrimination trajectory class, higher emotional support was associated with lower AL, but there was no relationship between emotional support and AL in the low and increasing discrimination trajectory class (Brody, Lei, Chae, et al., 2014). Another study using the same data classified neighborhood poverty as either stable low, stable high, worsening, or improving. Emotional support buffered the deleterious effects of being in the worsening neighborhood poverty class, but had no impact in the improving or stable (either high or low neighborhood poverty) classes (Brody, Lei, Chen, et al., 2014).

In adults, one study in MIDUS found an interaction between age and overall network support (social support from friends, family, and partners) such that higher network support was associated with higher AL in older adults but not in younger adults (Brooks et al., 2014). Examining friend, family, and partner support separately, the effects appeared to be driven by friend support, which showed the same pattern as the composite network support measure, whereas no significant age × support interactions emerged for family or partner support. The frequency of friend and family social contact also did not interact with age (Brooks et al., 2014). Adding to the mixed evidence for an interaction between social resources and age, a study of adults in Canada found no interaction between perceived social support from coworkers and supervisors with either age or occupational status (Juster et al., 2013).

Using SEBAS, one study showed that a composite index of six social and two psychological resources buffered the effect of stress on AL so that the relation between stress and AL was higher in those with higher resources than in those with lower resources (Glei et al., 2007). However, in a sample of German adults, higher levels of social support did not interact with stressful job demands to predict AL (Schnorpfeil et al., 2003). Using longitudinal data from SEBAS, another study examined separate models in the elderly and near elderly. In the near elderly, there were significant two-way interactions between sex and (a) being married at all study waves, (b) low ties with relatives outside immediate family, (c) low emotional support, and (d) low emotional support at any study wave (T. E. Seeman et al., 2004). Although the simple effects in women or men often were not statistically significant, the patterns in women were that (a) not being married at all waves, (b) having low ties with nonimmediate family, (c) low emotional support, and (d) low emotional support at any wave were associated with lower AL, with the opposite directions for men in all cases (T. E. Seeman et al., 2004). In the elderly, there were no significant interactions between any of the social resources and sex (T. E. Seeman et al., 2004). Likewise, in a longitudinal study of abused/neglected and matched nonabused/nonneglected children into adulthood from the United States, stratified by sex, higher general social support in adulthood predicted lower AL 2 years later in women, but higher AL in men (Horan

& Widom, 2015). In MIDUS, there were no interactions between the number of social ties or emotional support with sex or race (M. Seeman et al., 2014).

Another study used data from the Wisconsin Longitudinal Study (WLS) and MAC. In MAC, the study showed that although social integration and emotional support were not related to AL in women, both were associated with lower AL in men (T. E. Seeman, Singer, Ryff, Dienberg Love, & Levy-Storms, 2002). Instrumental support was not related to AL in either men or women (T. E. Seeman et al., 2002). In WLS, greater partner bonding in intellectual and recreational domains but not emotional or sexual domains was associated with lower AL in women (T. E. Seeman et al., 2002). Partner bonding was not significantly related to AL in men. Participants were classified into groups based on their relationship pathways: positive if ↳
p. 211 above the median for either mother or father caring (i.e., early relationships) and for either emotional/sexual or intellectual/recreational adult partner bonding (i.e., later relationships) and negative otherwise. Using these groups, for women, being in a positive pathway was associated with significantly lower levels of AL in adulthood (T. E. Seeman et al., 2002). In men, the difference between the positive and negative relationship pathways did not reach statistical significance, although the direction and magnitude were comparable to the effect in women (T. E. Seeman et al., 2002). Using the same pathways measure, results from WLS demonstrated an interaction with household income. Specifically, being in the positive versus negative relationship pathway was associated with lower rates of high AL in participants with low but not high household income (Singer & Ryff, 2000).

As with psychological resources, the evidence for a relationship between social resources and AL is equivocal. Many of the effects observed included interactions between social resources and other factors, such as age or sex, although not all studies testing sex or age differences found them. Observed effects were small, consistent with other work on social relations and health (Robles, Slatcher, Trombello, & McGinn, 2014). Considering the significant associations that were found, it was not always the case that higher levels of social resources were associated with lower AL. This may be due in part to differences between perceived support, which may be conceptualized as more of an individual difference, and received support, which may be conceptualized as more situationally determined and thus potentially confounded with experience of stressors (Uchino, 2009). Consistent with perceived and received support being distinct, meta-analyses showed only a moderate, positive correlation between the two types of support (Haber et al., 2007).

Overall Summary and Future Directions

Making Sense of the Heterogeneity of Findings Linking PSRs to AL

Considering the overall mixed results, a critical question is, what may explain the observed heterogeneity? Differences in sample characteristics may partially explain mixed findings. Some studies focused on children or adolescents (Brody, Lei, Chae, et al., 2014), others on older adults (e.g., aged 60 or more years; Read & Grundy, 2014), and still others across the adult life span (e.g., aged 34 to 84 years; Brooks et al., 2014). Likewise, although many studies included both sexes, some included only women (Johansson et al., 2007). Heterogeneity also may exist due to differences in country, culture, or race/ethnicity.

In addition to sample differences, studies differed in the specific biomarkers included in AL indices and specific PSRs assessed. If these differences explained the observed heterogeneity, one would expect relatively little heterogeneity when looking at a specific PSR and a specific biomarker. However, a systematic review concluded that there was evidence in support of a relationship between higher social support (a specific PSR) and greater nocturnal blood pressure dipping (a specific biomarker), yet there was considerable heterogeneity, with effect sizes ranging from null to large (Fortmann & Gallo, 2013). Furthermore, the impact of the specific biomarkers included in AL indices appears minimal (Wiley,

Gruenewald, et al., 2016). Indeed, one of the potential strengths of using an aggregate index, like AL, is that in capturing a broader measure of physiological dysregulation, it should be less sensitive to the specific biomarkers included.

If looking at specific PSRs and biomarkers brings little resolution to the apparent heterogeneity, perhaps composite indices would bring more clarity. Several studies have shown stronger and more consistent and larger effect sizes from aggregate indices of AL compared to biomarkers of a single physiological system (Karlamangla et al., 2014; Mori et al., 2014). Perhaps a similar composite index of PSRs would likewise yield more consistent and larger effects.

Although there were not sufficient studies to evaluate whether a composite PSR index demonstrates stronger effects than individual PSRs, several theories conceptualize PSRs as a constellation or reserve of resources (e.g., Hobfoll, 1989; Taylor & Armor, 1996). Further, PSRs evidence strong intercorrelations. For example, one study found optimism, mastery, and self-esteem correlated .54–.58 (Scheier et al., 1994), and in another study, hope correlated .58–.60 with optimism and self-esteem (Snyder et al., 1991). Furthermore, data from the second wave of MIDUS show eight different measures of PSRs form two higher-order latent factors: psychological and social resources (Figure 15.1), a result replicated across diverse populations in data from our lab including women with breast cancer (Stanton, Thompson, Crespi, Link, & Waisman, 2013) and adults from the University of California Los Angeles (Wiley, Cleary, Karan, & Stanton,
p. 212 2016) and community-dwelling adults (N = 72, unpublished), predominantly ↳ undergraduates from Melbourne, Australia (Figure 15.1).

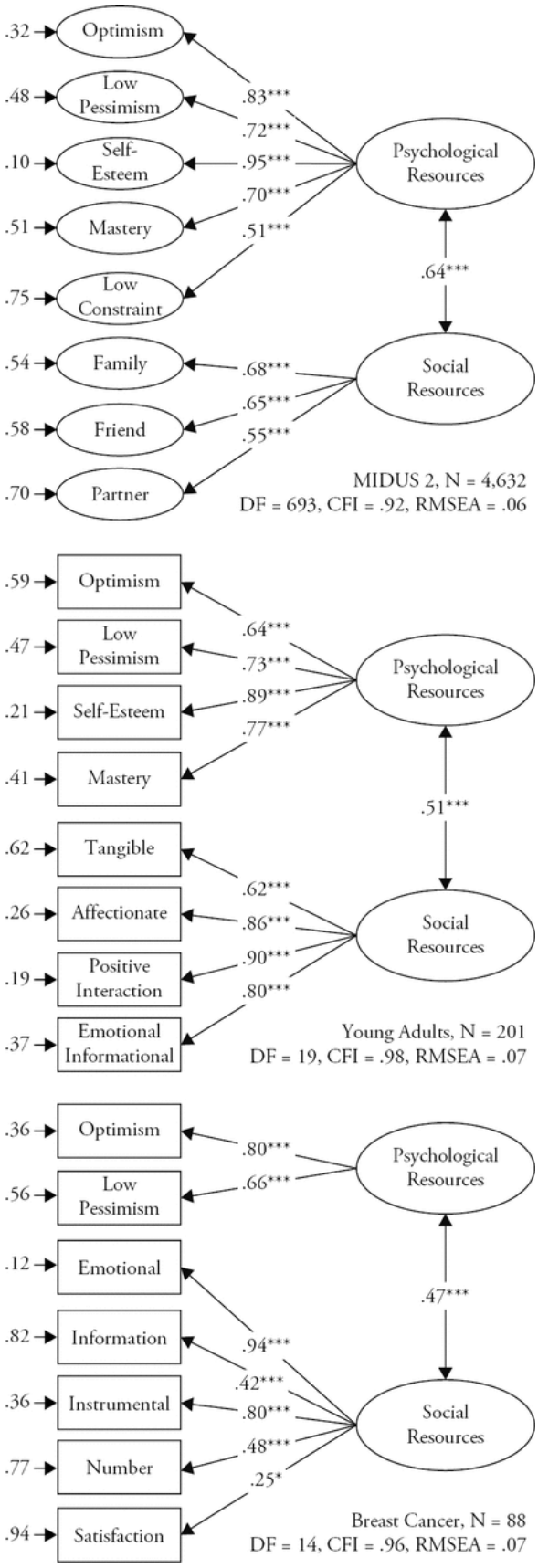

Figure 15.1 Measurement models of psychosocial resources from three unique data sets. Ovals represent latent variables; rectangles represent observed variables. In the Midlife in the United States data, specific resource measures were modeled as latent factors using their individual items. In the remaining samples, individual resource scale scores were calculated due to the

limited sample sizes. CFI = comparative fit index; DF = degrees of freedom; RMSEA = root mean square error of approximation. *** $p < .001$, * $p < .05$.

In MIDUS and the other studies, a single-factor model provided significantly poorer fit than a two-factor model (all $p < .001$), suggesting that at least these PSRs may not be distinct but form two factors. Together, these results suggest that a potential path forward is to consider aggregating PSRs into a psychological resource index and social resource index. Such composite indices may demonstrate larger effects and prove less sensitive to the specific PSR measures, much the same way that AL indices have been shown to have stronger relations with health outcomes than specific physiological systems. Indeed, Elliot and Chapman (2016) found a psychological resource index buffered the relations between low SES and higher pro-inflammatory cytokines (interleukin 6 and C-reactive protein) in men in MIDUS, although they did not test the resource index with other physiological systems.

Stress and the stress response are thought to be one of the main mechanisms that may link PSRs to AL. Variation in whether studies examined the relations between PSRs and AL in the context of stress may help explain some of the heterogeneity. However, it is also important to note that not all stressors are experienced as equally stressful or impact physiology equally. For instance, a meta-analysis found substantial variability in the relation between job strain and ambulatory blood pressure (Landsbergis, Dobson, Koutsouras, & Schnall, 2013). Likewise, a meta-analysis examining the relations between perceived stress and telomere length, a marker of cellular aging, found correlations ranging between -.09 and -.73 (Schutte & Malouff, 2014), despite all studies using identical measures of perceived stress (Cohen, Kamarck, & Mermelstein, 1983). Dimensions of stress such as its domain, duration, severity, and timing (e.g., how long ago the stress occurred) may all influence the potential impact of stress and be relevant when examining the potential buffering effects of PSRs. To date, there is insufficient research to carefully categorize interactions between PSRs and stress varying in each of these dimensions to determine whether such information helps account for the observed heterogeneity.

Need for Better Conceptual Models

Equivocal findings point to the need for conceptual models of PSRs and AL to be refined. Figure 15.2 provides
p. 213 an overview of some of the ↳ relevant mechanisms and individual difference factors identified in the literature that may represent relevant moderators of the relations between PSRs and AL. However, theoretical models are needed that specify under what conditions, when, and for whom PSRs are related to AL. For example, although models such as the Reserve Capacity Model (Gallo & Matthews, 2003; Matthews & Gallo, 2011) posit that PSRs moderate the relations between stress and negative emotions or distress, they do not specify whether the specific domain (e.g., financial, interpersonal); duration (e.g., chronic, acute); or intensity (e.g., daily hassles, severe traumatic events) of stress matters. The reserve capacity model also does not specify for whom (e.g., women, men; younger or older adults) PSRs may be most or least beneficial.

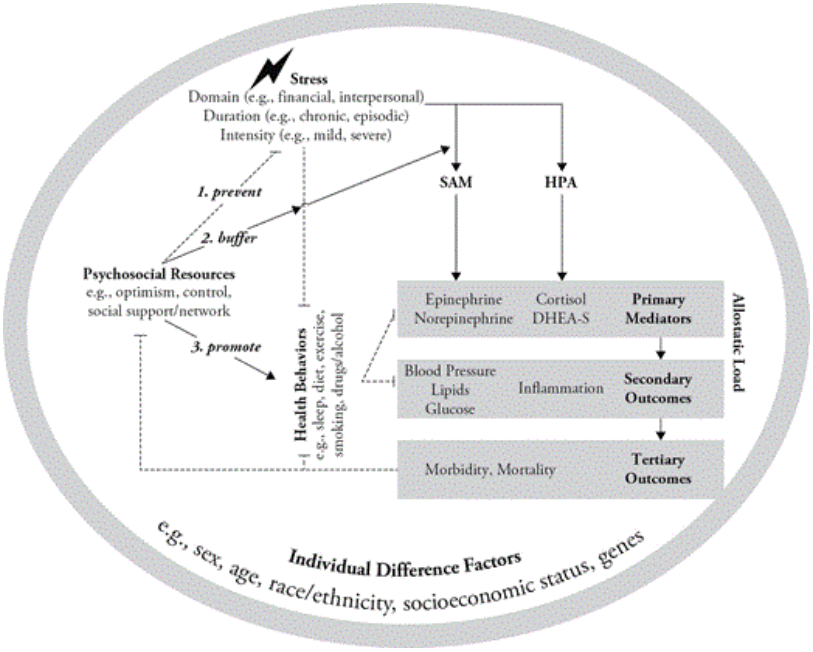

Figure 15.2 Conceptual diagram of potential mechanisms linking psychosocial resources to physiological dysregulation. Specific examples of primary mediators, secondary outcomes, and tertiary outcomes are examples and are not meant to be exhaustive. Solid lines indicate upregulation. Dashed lines indicate inhibition or downregulation. DHEA-S = dehydroepiandrosterone sulfate; HPA = hypothalamic–pituitary–adrenal axis; SAM = sympathetic adrenal medullary axis. Individual difference factors are the context of the person within which the relations between psychosocial resources and allostatic load occur.

To support the development of more sophisticated conceptual models, research on the relations between PSRs and AL must be sharpened. One area that needs further research concerns the nature and timing of measures of stress, PSRs, and AL. Current studies on PSRs and AL are frequently cross-sectional, and even the longitudinal studies rarely include repeated measures of both PSRs and AL. For instance, PSRs may partially buffer the effects of severe, chronic stress on AL initially, but over time chronic stress and a decline in health may deplete PSRs and obscure their initial protective effect. Thus, results may depend on the timing of assessments of stress, PSRs, and AL.

Considering for whom PSRs may be related to AL, several studies reported sex differences (Fernandez et al., 2015; Horan & Widom, 2015; T. E. Seeman et al., 2002). Although not on PSRs, research attempting to distinguish the effects of sex and gender roles showed that the measurement of AL varied somewhat by sex
p. 214 and that gender roles ↳ predicted AL in addition to biological sex (Juster et al., 2016). To date, although studies of PSRs and AL have tested for biological sex differences, they have not distinguished biological sex from gender roles, and conceptual models have not been developed that synthesize and explain the sex differences identified thus far. This is but one example of understanding for whom PSRs may be related to AL. Other moderators identified include age and race/ethnicity or culture, and research systematically testing whether these factors interact or moderate the relations of PSRs and AL will provide the foundation for new conceptual models that acknowledge and provide explanation to the heterogeneity and mixed findings observed.

Another gap in current empirical research is that most studies on PSRs and AL examine direct or moderated effects, without testing likely mechanisms. Health behaviors, when included, are often included as covariates only (e.g., testing whether PSRs are related to AL controlling for smoking status and self-reported alcohol consumption). Also, if PSRs influence AL via health behaviors, sufficient time must pass between the assessment of PSRs and AL for health behaviors to change and to meaningfully influence an

individual's physiology. To our knowledge, studies have yet to be conducted that address or inform answers to these questions. Likewise, few studies include assessments of potential neural mechanisms, particularly not concurrent with the experience of stress when PSRs may exert effects mitigating the neutrally mediated stress response.

Finally, to facilitate translation and impact, research on PSRs and AL needs to move beyond cross-sectional studies or simple longitudinal studies. A focus on examining within-person change or intraindividual variability is increasingly common in studies of psychosocial (Boehm, Winning, Segerstrom, & Kubzansky, 2015; Hardy & Segerstrom, 2016), behavioral (Bei, Wiley, Trinder, et al., 2016), and biological (Wiley, 2016) factors. Longitudinal cohort studies are needed that repeatedly assess both PSRs and AL to establish whether change or intraindividual variability in PSRs predicts change in AL, providing stronger evidence to justify future interventions testing whether enhancing PSRs improves AL, perhaps for specific types of people.

Conclusion

Large epidemiological studies have provided a wealth of data allowing research to integrate rich measures of psychological and social resources with multisystem physiological dysregulation indexed through AL. Empirical and theoretical work remains to be done to clarify the context and populations for which PSRs are related to AL. Nevertheless, research to date has shown some evidence for direct, generally protective, associations between PSRs and AL, as well as for moderated associations with moderators such as sex, age, and stress or adversity. As longitudinal follow-ups of existing epidemiological studies or new longitudinal studies are conducted including assessments of the biomarkers used to assess AL, the evidence base will be enhanced through research examining whether PSRs or their change predict change in AL over time.

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