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The impact of a living wage on subjective social status and self-rated health: a quasi-experimental study in the Dominican Republic

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By

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Professor S. Leonard Syme
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Abstract

The impact of a living wage on subjective social status and self-rated health: a quasi-experimental study in the Dominican Republic

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Subjective social status (SSS) and individuals' self-rated health are strongly associated with health. We studied the differences in SSS and self-rated health associated with a 350% increase in wages of apparel workers in the Dominican Republic in order to better understand how this change in income may affect the long-term health of the participants.

We examine the differences in four measures of subjective social status and two measures of self-rated health. Data were collected via in-person interviews 15-16 months following the initiation of the higher wage. We perform multivariate linear regressions and mediation tests, controlling for age, height, highest level of education, and years of work experience.

We found that the wage intervention was associated with significantly higher scores for women on four measures of SSS (community, national, children's wealth, and children's future). For men, there were effects only for the national ladder. Workers at the intervention factory tended to rate their health as better than those at the comparison factory, and subjective social status was a significant mediator of this association.

Our results suggest that subjective social status is substantially affected by income, and thus is not actually entirely subjective. Given the evidence that these measures are associated with future health outcomes, wage interventions may be useful tools for improving public health as well as the economic development.

Dedicated to Rachel

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Literature Review

Introduction:

Reducing health inequity has long been a global health priority.(League of Nations, 1931) Research over the past fifty years has confirmed what to many people now seems incontrovertibly true –socioeconomic status (SES) and health share a strong positive correlation. Internationally, health inequities often coexist with wealth disparities. For instance, in Iceland, the infant mortality rate is 2 in 1000 live births, while in Mozambique, the rate is 60 times higher, at 120 in 1000 live births.(Marmot, Friel, Bell, Houweling, Taylor, Commission on Social Determinants of Health, 2008b) Gaps in life expectancy between low- and high-income countries can exceed 35 years.(Marmot, Shipley, & Rose, 1984) Similarly, two other common measures of socioeconomic status, education and occupational status, also show gradients with health between nations.

More recently, global health researchers and advocates have begun to focus on *relative* income and health inequity (i.e., *within* as well as *across* countries).(Braveman & Tarimo, 2002; Economic Policy Research Institute, 2004; Marmot, Rose, Shipley, & Hamilton, 1978) This growing interest stems from evidence that just as health inequity between developed and developing countries is predictable, health inequity between the best and worst off residents (whether measured by income, education level, or occupational status) within a single country is consistent, regardless of the overall status of that country's gross domestic product (GDP). (Black, Morris, Smith, & Townsend, 1980; Gwatkin et al., 2007; Marmot, Friel, Bell, Houweling, Taylor, Commission on Social Determinants of Health, 2008b)

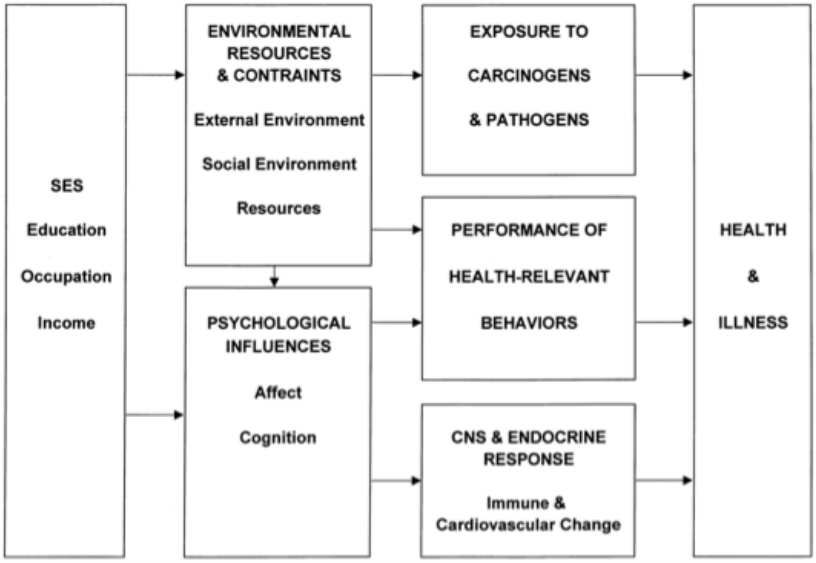
The relationship between health and income is bi-directional. On the one hand, poor individuals (and nations) have reduced access to goods and services that can either treat or prevent poor health, such as health care, healthy food, and adequate clothing and shelter. Perpetuating this cycle, unhealthy individuals (and nations) are less effective at climbing the economic ladder due to catastrophic medical bills, missed school, and lost jobs. In addition to each of these measures (health and income) being outcomes, which can indirectly influence each other, mounting evidence suggests that social stratification itself directly affects health. (Adler & Stewart, 2010; Marmot, Friel, Bell, Houweling, Taylor, Commission on Social Determinants of Health, 2008b; Marmot, Ryff, Bumpass, Shipley, & Marks, 1997b)

Although various measures of SES (income, education, occupation) all show gradients with health status, evidence from the seminal Whitehall I and II studies in the United Kingdom suggest that the traditional risk factors that might have been influenced by these SES measures can account for only 40% of the differences in health outcomes seen across the SES hierarchy.(Marmot et al., 1984) As a result, investigators and public health advocates have focused on social (rather than economic/resource-based) determinants of health to explain the difference.

(Marmot & Kogevinas, 1987; Syme, 2008) One promising proposed mechanism involves the biochemical internalization of stressors from the environment.

This epidemiological data suggesting that stressors might drive the observed SES/health gradient is supported by robust neuroscience research on the processes by which our body responds to environmental treats, whether perceived or real. (Beckie, 2012; Juster, McEwan, & Lupien, 2010; McEwen & Tucker, 2011) Scientists now have a basic understanding of the complex interplay of physiologic regulatory systems which, when driven to dysregulation by stressors, have a significant impact on health outcomes.(McEwen & Gianaros, 2010)

The myriad ways by which SES may affect health can be visualized in a causal pathway similar to the one below, borrowed from Adler and Ostrove's 1999 review of the evidence on the SES/health gradient.(Adler & Ostrove, 1999)



In this paper I will discuss the evidence for such a conceptual framework. I will first explore the social influences of health, and the varied ways societal influences and status can protect or threaten individual health outcomes. I will then discuss ways in which previous interventions have attempted to improve health and socioeconomic status. In this section, I will explore the ways investigators have measured aspects of the SES/health gradient, and I will focus on the emergence of a relatively new measure; *subjective social status.* Subjective social status is a measure of an individuals perception of his or her status (which can be defined by a number of metrics) in a community or country. Lastly, I will discuss the particular intervention with which my research is concerned – a living wage campaign among apparel factory workers in the Dominican Republic through which we assessed the influence of the campaign on perceived social status of these workers.

Chapter 1

The relationship between socioeconomic status and health outcomes has been observed in censuses and described in the medical literature for at least a century. In 1928, T.H.C. Stevenson, an Irish statistician, wrote for the Royal Statistical Society of the decline in life expectancy and increase in infant mortality among members of lower social classes. In this, however, Stevenson went further, positing that wealth alone is not a protective factor, and that "the power of culture, even in the complete absence of wealth, is well illustrated by the case of the clergy."(Stevenson, 1928) He described how members of religious orders, when compared with similarly compensated members of other professions, experienced lower mortality rates. Stevenson's attribute of this variation to 'the power of culture' presaged the work of investigators in the latter half of the 20th century that attempted to further explain the socioeconomic status – health gradient.

In 1975, S. Leonard Syme and colleagues published a series of papers describing the results of the NiHonSan Study of Japanese men living in Japan, Hawaii, and California.(Marmot et al., 1975; Nichaman et al., 1975; Syme, Marmot, Kagan, Kato, & Rhoads, 1975; Winkelstein, Kagan, Kato, & Sacks, 1975; Worth, Kato, Rhoads, Kagan, & Syme, 1975) Their analyses compared rates of coronary heart disease and stroke in three cohorts of men aged 45-64. The total study sample included 11,989 participants (2,141 in Japan, 8,006 in Hawaii, and 1,842 in California). In the decades preceding the study, evidence had shown that mortality from coronary heart disease varied greatly between American Caucasian and Japanese men: While the American Caucasians typically experienced a coronary heart disease mortality rate of 8-10 deaths per 1000 men, Japanese experienced a mortality rate closer to 1 death per 1000 men.(Gordon, 1957) Whether this variation was due to genetics, diet, other health-related behaviors, or some other unknown factors remained unclear. The NiHonSan investigators, however, found that the rates of coronary heart disease for Japanese men rose depending on *where* they lived. In California, the incidence of coronary heart disease was 5 deaths per 1000 men, in Hawaii the rate was 4.5 deaths per 1000 men, and in mainland Japan the rate was 2 cases per 1000 men. The prevalence of coronary heart disease, angina pectoris, and possible myocardial infarction followed similar trends, with Japanese men in California experiencing the highest prevalence of each outcome. These trends of increasing CHD risk run counter to evidence from the cohorts suggesting that Japanese men in America experienced *lower* overall and stroke-related mortality. Given the rapidity with which these diversions in health outcomes developed (the vast majority of Japanese migration to California and the US occurred from 1880-1924), the investigators concluded that environmental factors (rather than genetic) were to blame.

Perhaps the most important study of the NiHonSan data was Michael Marmot's and Len Syme's 1976 study of the affect of 'acculturation' on the coronary heart disease of Japanese Americans.(Marmot & Syme, 1976) The goal of the study was to further examine the determinants of poor coronary health, as the previous work had found

that traditional risk factors (serum cholesterol, blood pressure, and smoking) failed to account for the disparities in coronary heart disease among men of Japanese descent in Japan, Hawaii, and California. The authors used the broad term of 'acculturation' to refer to cultural and social assimilation that occurs as individuals adapt to new settings, and they predicted that those Japanese men who were most 'acculturated' to a Western way of life would have higher rates of coronary heart disease. An important consideration in this analysis was variation in diet, because Westernized diets had been associated with increased risk for coronary heart disease (due to increased fat consumption). Within sites, however, Marmot and Syme were not able to explain the relatively wide variation in coronary heart disease by the relatively narrow variation in dietary preferences. After controlling for dietary preferences, the investigators still found that coronary heart disease risk was strongly associated with acculturation, suggesting that culture might be an insidious factor not traditionally considered in assessing risk for coronary heart disease.

Three years after the first NiHonSan results, in 1978, Marmot and colleagues in the United Kingdom began publishing the results of their studies of the Whitehall cohort.(Marmot et al., 1978) The Whitehall cohort consisted of 17,530 male civil servants in London. The prevalence of cardiorespiratory disease and diabetes in this sample had previously been studied by Reid and colleagues, but did not look at within-group variation for these outcomes.(Reid et al., 1974) Marmot's team, however, considered *employment grade* as a predictor for health outcomes, specifically coronary artery disease. They stratified the sample into occupational groups including administrative, professional, executive, clerical, and 'other' grades. The 'other' grades were the lowest in status, and included unskilled manual laborers. The researchers tracked this cohort over seven and a half years, and found that within each age group, coronary heart disease mortality followed a stepwise progression between groups; participants in the lowest grade experienced 3.6 times the coronary heart disease mortality than did those in the highest grade. Participants in lower grades also fared worse than their higher-grade counterparts in coronary heart disease risk factors such as systolic blood pressure and smoking, but they tended to have lower levels of plasma cholesterol and comparable Body Mass Indexes. Risk factors such as these were only able to account for 40% of the variation in mortality among the sample, however. (Marmot et al., 1984; Marmot & Kogevinas, 1987) Employment grade was the single strongest predictor (more than any of the traditional risk factors, such as smoking, age, systolic blood pressure, and cholesterol levels) for coronary heart disease mortality, and even after controlling for these other risk factors, the lowest occupational grade experienced a relative risk of 2.1 for coronary artery disease mortality compared to the highest occupational grade. Most importantly, the authors found that even between the two highest employment grades, with seemingly minimal differences in income or access to health care resources, a slightly lower grade was associated with increased risk of adverse health outcomes. These results suggested that there was something intrinsic to a lower employment grade, unaccounted for by measures of compensation or access to health care, that is a risk factor for health. Marmot

suggested that psychosocial factors associated with the workplace could be a factor in driving the gradient seen in these workers.(Marmot & Theorell, 1988)

Two years after the publication of this initial Whitehall paper, an expert committee chaired by Sir Douglas Black (a driving force behind the formation of the United Kingdom's National Health Service) released a report on health inequality.(Black et al., 1980) The Black Report assessed the status of health inequities in the UK during the late 1970s and provided the government with a list of recommendations on how to address the challenges. In assessing the status of health inequities, they considered mortality rates across occupational grades throughout the country. Their findings corroborated Marmot's; for all ages and both sexes, mortality rates were higher at each step lower on the occupational gradient. The report also described that over the 1960s and early 1970s, when mortality rates were dropping among the highest occupational grades, mortality rates held constant or rose among the lowest grades. The Black Report interpreted this stratification to be primarily a reflection of "specific features of the socio-economic environment features (such as work accidents, overcrowding, cigarette smoking) which are strongly class-related in Britain and also have clear causal significance." Yet, they maintained that the mortality outcomes had multifarious etiologies, and that much of the pathway connecting socioeconomic status and mortality remained unclear. The Black Report also included a series of recommendations about how government could address some of the systemic deficiencies contributing to the health outcomes disparities. The government of Prime Minister Margaret Thatcher, which decided not to officially publish and distribute the report, vehemently opposed these recommendations.(Richmond, 2002) Eventually the Black Report was published, and it has been ensconced as a seminal work in the socioeconomic status – health gradient literature.

The National Health Service (NHS) was founded in 1948 as a part of post-World War II welfare reform programs, with the explicit goal of reducing inequalities in health.(*The NHS in England*, n.d.) By the time Sir Black drafted his report the NHS had been providing cost-free, high quality health care to every British citizen for over three decades.(Delamothe, 2008) A major finding of the Black Report, however, was that in spite of this expansion of access, inequalities in health outcomes persisted. When considering why people of lower socioeconomic status experience worse outcomes, it appeared that more was going on than access to quality care.

A natural response to the demonstration of the socioeconomic status – health gradient described in the Black Report, one that Sir Black acknowledged, is to explain the relationship as causal, but not in the sense that health status, or eugenic predispositions to health outcomes, naturally stratify individuals into higher or lower classes. A number of studies in the 1980s and 1990s explored these ideas, including the British Office of Populations Censuses and Surveys Longitudinal Study and the British birth cohort studies.(Davey Smith et al., 1998; Fox et al., 1985) They argued that social mobility due to health was not a strong contributor to variation in mortality between social classes, and that a more useful approach to thinking about

the socioeconomic status – health gradient would be to consider health as an output affected by social class.

Subsequent studies in the UK similar to the Black Report have corroborated its findings. In 1998, the Report of the Independent Inquiry into Inequalities in Health (known as the Acheson Report, after the committee chair Sir Donald Acheson, former Chief Medical Officer of the UK) published an analysis of the determinants of health, using an approach known as the 'layers of influence' model described by Dahlgren and Whitehead in 1991.(Dahlgren & Whitehead, 1991; Singh-Manoux, 2004) The Acheson Report primarily interpreted the SES – health gradient to be a result of the differences in conditions imbued by social stratification. Additionally, it demonstrated that although the British population experienced an overall decline in mortality from 1970-1990, the slope of this decline depended on the particular social class considered. Upper classes experienced a steeper decline in mortality, whereas lower classes experienced a more gradual decline.

At this point, the SES-health gradient had been described in detail, and it's persistence in the UK in spite of universal access to health care services suggested that inability to afford treatment was not a plausible explanation. Syme's and Marmot's work on the NiHonSan sample had identified 'western acculturation' as a potentiator of poor health outcomes, and the Whitehall I papers had demonstrated that disparities in health persisted between strata even at the upper echelons of SES. A model was needed that could explain the SES/health gradient in the context of these results.

Beginning in 1991, Michael Marmot and colleagues published the results of Whitehall II, a follow-up to their seminal 1971 cohort studies. The goal of this study was to attempt to further elucidate the determinants of health and disease, beyond the known risk factors measured in the Whitehall I study. A sample of 6900 male British civil servants between the ages of 35 and 55 in London was included in final analyses. Marmot and colleagues found that employment grade was strongly and positively correlated with work control, varied work (used to approximate decision latitude afforded workers), and a fast work pace (used to approximate the demands of a job). (Marmot et al., 1991; North et al., 1996) They also found that the prevalence of ischemia, angina, and chronic bronchitis in a given employment category did not improve over the 20 years between Whitehall I and II, a surprising finding, which implied that none of the efforts to improve health related behaviors or health care delivery had resulted in measurable impact.

The investigators did find that BMI, amount of exercise, diet, and rates of smoking were significantly and inversely associated with job status, and the risk factor for coronary artery disease that varied the most across employment grades was smoking. At face value, the fact that workers at lower strata were more overweight, worked out less, ate worse, and smoked more would explain the health disparities. But, Marmot and colleagues also further analyzed coronary heart disease incidence rates, one of the major measures in the Whitehall I study, with the Whitehall II data

to elucidate the proportion of these disease rates that can be attributed to the psychosocial work environments, social support, coronary risk factors, and height (used to reflect factors in early life that can affect long-term health outcomes). (Bosma et al., 1997; Marmot et al., 1997a) The single strongest contribution to the socioeconomic – health gradient in coronary artery disease was a low degree of control in the workplace. Height and standard coronary risk factors, two established predictors of coronary artery disease, made smaller contributions to the gradient.

In 1984, a prospective cohort study named the Coronary Artery Risk Development In Young Adults (CARDIA) study was initiated, and scores of analyses of the study data have been published over the subsequent three decades. The CARDIA sample includes 5,116 black and white men and women recruited from four major urban areas: Birmingham, Minneapolis, Oakland, and Chicago.(Friedman et al., 1988) Studies with the CARDIA data reflect a trend toward focus on biochemical mechanisms in SES-health gradient research, one born of a desire to explain the physiology behind the epidemiological trends described above.

In 2006, Cohen and colleagues looked at the association between socioeconomic status, race, and dysregulation of cortisol diurnal rhythm.(Cohen et al., 2006) Cortisol, the body's primary corticosteroid hormone and a biomarker for stress and the sympathetic response, typically peaks upon waking in the morning, and steadily declines over the course of the day. (De Lacerda, Kowarski, & Migeon, 1973; Weitzman et al., 1971) Cohen and colleagues found that two variables, SES and race, were independently associated with a flatter decline in cortisol over the course of the day, resulting in relatively higher cortisol in the evening, suggesting that these two variables somehow affect the regulation of the body's primary stress hormone.

In 2009, Gruenewald and colleagues considered the association between SES, race, and the inflammatory biomarkers C-Reactive Protein (CRP) and Interleukin-6 (IL-6).(Gruenewald, Cohen, Matthews, Tracy, & Seeman, 2009) These proteins are elevated in inflammatory disease processes, including diabetes and coronary artery disease. The authors found that CRP and IL-6 levels were inversely associated with education and income levels in both white males and females. In black females, IL-6 was inversely associated with education and income levels, and CRP was inversely associated with education (but not income level). In black males, the only significant association was an inverse association between IL-6 and income. These results suggest that race and gender are important considerations when determining the association between SES indicators and inflammatory health mediators. A question remained, however, about whether race and gender were unique, or whether other potential stressors, such as unemployment and income instability, might influence health mediators in a similar way.

Denise Janicki-Deverts and colleagues also studied SES measures and inflammation.(Janicki-Deverts, Cohen, Matthews, & Cullen, 2008) They considered the association between a history of unemployment and CRP levels, and they found that a previous history of unemployment, even after controlling for age, race, BMI,

previous CRP levels, current employment status, and income, was associated with elevated current CRP levels. They concluded that a history of unemployment, even years in the past, is associated with long-term effects on inflammation, even after an individual has obtained steady work.

Numerous other studies using CARDIA data have also considered the associations between various predictor states and urinary catecholamines, pulmonary function, and hypertension, and have consistently found inverse relationships between these states and these health outcomes/indicators.(Janicki-Deverts et al., 2007; Lehman, Taylor, Kiefe, & Seeman, 2009; Sloan et al., 2008; Vijayaraghavan et al., 2012; Yan et al., 2003) The common thread uniting these predictor states, whether they be race, gender, SES, or employment status, is that they expose individuals to states of chronic stress. Thus, the narrative emerging from the CARDIA studies has helped investigators identify a biochemical mechanism to explain the population trends observed of a SES/health gradient. Such a pathway would help us better understand the CNS/Endocrine response to SES, which is postulated by the conceptual framework offered by Adler and Ostrove on page 4 of this paper. This mechanism, the dysregulation of bodily systems due to stress, will be to focus of the next chapter.

The importance of childhood SES:
Investigators have noted that the relationship between SES and health seems to change depending on the age of the individuals. The relationship seems strongest in adulthood (but becomes less strong in old age). In 1991, Ben-Shlomo and Davey Smith correlated infant mortality rates from 1895-1908 with cause-specific adult mortality from 1969-1973, with and without adjustment for social deprivation and social class.(Ben-Shlomo & Smith, 1991) They found that while simple correlations between infant and adult mortality exist, they disappear when accounting for present-day socioeconomic status. Seven years later, in 1998, Davey Smith and colleagues found complementary results in a prospective observational study.(Davey Smith et al., 1998) They compared level of education in childhood with current occupational status to see which was a stronger predictor of adverse adult health outcomes. The authors interpreted this to be evidence that childhood predictors of adverse health outcomes are not as powerful as more proximal indicators, such as contemporary socioeconomic status.

Although Ben-Shlomo and Davey Smith's work suggests that the health effect of childhood social status is less powerful than the health effect of adult social status, a robust body of work emphasizes that cumulative stress over the life-course is a powerful predictor of ill health. This concept has become known as the 'accumulation hypothesis'. In 2004, Singh-Manoux, and colleagues used data from the Whitehall II cohort to study the concept of accumulation in that sample.(Singh-Manoux, 2004) They estimated SES at three points in the life course: childhood, education, and employment level upon entry into the cohort. The authors found strong evidence for an 'accumulation effect' in which the cumulative advantages or disadvantages experienced by an individual over the life course combine to

significantly effect health outcomes, especially of coronary heart disease. This concept is similar to those of allostasis and allostatic load, and further supports the theory that chronic conditions are multifactorial in origin.

Recently, in a chapter from the 2012 *The Biological Consequences of Socioeconomic Inequalities,* Evans and colleagues analyzed the effects of parents' income on children using 7 predictors of child's health.(Wolfe et al., 2012) Using data from the National Health Interview Surveys, an annual survey from the United States, they looked at the effects of parental income using dummy variables for the 8 predictors of health (including adult supervision, missed school, limited activity due to health, recent hospital stays, recent emergency department visits, recent injury or poisoning, and any previous diagnosis of asthma). They considered the likelihood of experiencing these outcomes across six income brackets. They found significant effects on five of the seven measures, including general health, likelihood of missing school, and hospital and emergency department visits. These effects persisted across all income brackets – as income increased, so did measures of children's health. They also noted that while the direction of the effect was consistent, the magnitude tended to decrease – the greatest improvements in health were seen in increases of income at the lowest socioeconomic level.

The authors conducted similar analyses with adult data, and found a similar stepwise progression of increasingly positive health outcomes with increasing wealth. The strongest and largest effect was seen when comparing adults with incomes below $10000/year and those with incomes above $75000/year; the low-income individuals were 44% more likely to report poor or fair health than the higher income individuals. However, significant differences in health outcomes existed even between adjacent income brackets. The stepwise nature of these income-health gradients observed in this study mirrors that found in Marmot's Whitehall studies, suggesting that perhaps in addition to being a tool for purchasing goods and services that can improve health, income may be a proxy for status.

This theory gained widespread attention in 2000, when Jack Shonkoff, a physician-investigator at Harvard, led the publication of the Institute of Medicine's *From Neurons to Neighborhoods*, a report on the science of early childhood development. The report synthesized decades of research and argued that from birth to age 5 is an incredibly formative age for children. At these ages, they are especially sensitive to environments and experiences that will shape their emotions, resiliency, and behavior for the rest of their lives. These exposures play a central role in brain development, and children's reactions to them, their *feelings*, are integral to the process. Shonkoff and colleagues ended their report with a plea for a renewed focus on providing the resources and support, both material and emotional, to children necessary for healthy childhood development.(Shonkoff & Phillips, 2000)

Moving toward an understanding of the mechanisms of SES-health gradient:
In recent years, investigators have begun exploring more deeply the biological pathways by which poor SES can predispose individuals to disease states.(Adler &

Stewart, 2010) Traditionally, socioeconomic status has been measured by one of three metrics: income, educational status, or occupational status. However, while each of these metrics consistently show similar associations with health, they are relatively different from each other, and provide different types of resources. As previously discussed, the 'resources' measured and controlled for in the Whitehall studies were only able to account for 40% of the variation in health status seen along the SES-health gradient. Additionally, as *From Neurons to Neighborhoods* argued, exposures to deprivation and stressful circumstances have long-term affects on individual development. Perhaps, rather than tangible resources, the common factor of education, income, and employment is a different element: *experiences of stress*. This implies that our interaction with the environment, both in terms of resources and experiences, can have far-reaching physiological and psychological effects. The biological pathways by which experiences of stress affect health will be the topic of the next chapter of this review.

Chapter 2

As established in the previous chapter, socioeconomic status across the life course can predict poor health outcomes, including coronary heart disease. However, traditional risk factors for these outcomes fail to explain the gradient, and other explanations (such as lack of resources) cannot clarify why the gradient persists between groups at the upper strata of socioeconomic status. (Adler et al., 1994; Sapolsky, 2004)

Investigators have begun to hypothesize that *stress* might be a causal agent contributing to the socioeconomic status – health gradient. (Dohrenwend, 2006; Kelly, Hertzman, & Daniels, 1997) Life stress, defined most recently as "real or perceived environmental demands that can be appraised as threatening or benign", has been observed to predict poor health outcomes among vulnerable individuals. (Cohen, Janicki-Deverts, & Miller, 2007; McEwen & Gianaros, 2010) In 2010, in an issue of the Annals of the New York Academy of Sciences devoted to the biology of poor socioeconomic status, Bruce McEwan and Peter Gianaros reviewed the extensive evidence for the role of the brain as a mediator of the socioeconomic status – health gradient.(McEwen & Gianaros, 2010)

In doing so, they focused on the amygdala, hippocampus, and prefrontal cortex, the roles those centers play in local and systemic responses to stress, and the changes in those regions associated with chronic and heavy exposure to stressors. The brain is extremely important in the stress response because it both interprets and assesses threats, and it regulates the body's responses to those threats. In their chapter, McEwen and Gianaros also refer to two key concepts: *allostasis* and *allostatic load*. These concepts were initially introduced nearly two decades earlier by McEwan and Eliot Stellar to describe a possible mechanism by which stress can lead to disease.(McEwan & Stellar, 1993) Allostasis is a normal process, one that involves the maintenance of systemic homeostasis as a result of active adaptation by the body to physical and behavioral stressors. Allostatic load, however, describes the point at which the body accumulates 'wear and tear' from the dynamic responses to multiple instances of stressful events.

McEwen and Gianaros describe how allostatic adaptation depends on many bodily systems, including the hypothalamic-pituitary-adrenal (HPA) axis, the autonomic nervous system, the metabolic system (which includes hormones from the thyroid and pancreas), the immune system, the digestive system, and the renal system. These systems mediate responses via hormones, cytokines, and neurotransmitters that operate in pathways that can down- and up-regulate each other. Stressful experiences, which result not only from low SES but from any other position with relative lack of control or social hierarchy, lead to chronic, frequent, and intense stimulation of these allostatic responses. This can accelerate pathophysiological outcomes associated with these responses.

The cardiovascular (CV) system provides a useful example for understanding how chronic stimulation of the allostatic response to stress can lead to pathophysiology. The CV system is incredibly sensitive to stress, for good reason; if our brain detects a real threat to our wellbeing, an increased heart rate and constricted peripheral vasculature can ensure our ability to 'fight or flee' by perfusing muscles and vital organs with oxygen-rich blood. Key to this process functioning effectively, with no ill effects, is the ability to turn off the response when the threat has abated. Chronic stimulation of this response without termination of it can lead to hypertension, cardiomyopathy, and kidney disease, among other sequelae.

Social stressors are associated with such chronic stimulation. Ferrie and colleagues, using Whitehall II data, found increased job insecurity among British civil servants was associated with increased blood pressure.(Ferrie, Shipley, Stansfeld, & Marmot, 2002) Other studies with Whitehall data, described in the previous chapter, find strong, stepwise associations between socioeconomic status and coronary artery disease.

As mentioned above, the brain structures most central to these systemic responses to stress are the hippocampus, amygdala, and prefrontal cortex. McEwen and Gianaros describe extensive evidence from both animal histology and human imaging to suggest that chronic perceived stress leads to cellular remodeling in these regions. Damage to the hippocampus, some irreversible, can impair an individual's ability to process threats appropriately, and can dysregulate the HPA axis. Damage to the amygdala, an organ associated with aggression and anxiety, can result in an inappropriate response to threats. Damage to the prefrontal cortex leads to impaired regulation of both the HPA axis and the autonomic response.(McEwen & Gianaros, 2010)

As reviewed above, chronic stress can, by exceeding allostatic load, lead to neuropathology. The integral role these damaged brain centers play in many regulatory systems can lead to myriad problems throughout the body. Chronic hypertension, mentioned previously as a sequela of stress-related chronic allostatic stimulation, is a major cause of morbidity and mortality worldwide. (Seeman et al., 1994; Tzourio, Dufouil, Ducimetière, & Alpérovitch, 1999)

Seeman and colleagues, in the same Annals of the New York Academy of Sciences issue on the biology of disadvantage, built on McEwen's and Gianaros's discussion of allostatic load to emphasize that the resulting pathological sequelae reflect the 'sum total' of deranged adaptive responses.(Seeman, Epel, Gruenewald, Karlamangla, & McEwen, 2010) Rather than individual sequelae resulting from a single, identifiable dysregulated pathway, multiple deranged systems compound to lead to disease. Thus, dysregulated HPA, autonomic, metabolic, and immune responses, when multiplied across multiple systems (cardiovascular, pulmonary, renal, etc) can have significant impacts on health. This is true even if the individual effects would be clinically insignificant on their own. Compounded and over time, the perversion of

these allostatic responses can result in vastly increased risk for serious morbidity and mortality.

Seeman et al., in an attempt to develop a method for calculating allostatic load, did so by summing the number of allostatic indicators in which an individual's scores were in the worst quartile. These allostatic indicators included resting blood pressure (systolic and diastolic), waist-hip circumference ratio, total cholesterol, high-density lipoprotein (HDL) cholesterol, glycosylated hemoglobin, urinary free cortisol, norepinephrine, epinephrine, and dehydroepiandrosterone sulfate (DHEA-S). These parameters measured four major allostatic processes (HPA axis, autonomic nervous response, cardiovascular response, and metabolic response).(Seeman, Singer, Rowe, Horwitz, & McEwan, 1997) In doing so, they found that increased allostatic load was significantly associated with increased risks for mortality, incident and recurrent cardiovascular disease, and cognitive and physical decline.

In their review article, Seeman and colleagues also describe how allostatic load accumulates over the life course, and that lower socioeconomic status also contributes to increased allostatic load via social stressors and resource constraints. Gradients in allostatic load associated with the gradient in socioeconomic status develop early; some studies have found it present in children younger than 5 years old.

Although gradients develop at young ages, and these gradients are associated with chronic health conditions that may manifest much later in the life course, Seeman and colleagues describe research suggesting that *mobility* can be a powerful tool for mitigating the effects of elevated allostatic load in youth. Singer and colleagues (1999) found that individuals who experienced increases in SES from childhood to adulthood were found to have allostatic load levels comparable to those individuals of consistently (across the life course) high SES. Similarly, those individuals who experienced a decline in SES from childhood to adulthood were found to have allostatic load levels comparable to individuals of consistently low SES.(Singer & Ryff, 1999)

This evidence that low SES may contribute to allostatic load must be interpreted in the context of the epidemiologic evidence discussed in chapter 1. While it is tempting to understand these relationships as being due to the tangible deprivation of low socioeconomic status, psychosocial factors likely play a much larger role. In Singer's study, it is likely that the experience of moving from low SES to high SES *reduced the experiences of stress*, thus reducing allostatic dysregulation.

Supporting this explanation, researchers have found evidence to suggest that among individuals with lower SES, experiences of psychosocial security such as a 'sense of control' was associated with better health. Similarly, the presence of supportive social ties has been found to associate with improved self-reported psychological well-being among individuals in lower SES. (Lachman & Weaver, 2012; Marmot,

Friel, Bell, Houweling, Taylor, Commission on Social Determinants of Health, 2008b; Ryff & Singer, 2004)

The various hypotheses proposed to explain the demonstrated SES/health gradient can generally be lumped into three categories. First, some hypotheses maintain that poor SES causes poor health outcomes as a result of decreased access to care, stress, poor access to food, etc. Second, some argue that poor health causes poor SES as a result of decreased ability to work, stigma, and increased health-related expenses. Lastly, some hypotheses contend that a common causal factor causes both poor SES and poor health outcomes. None of these proposed mechanisms is mutually exclusive, and most recent analysis suggests that each may play a role.

Chapter 3

The preceding chapters have described the epidemiologic, clinical, and laboratory evidence for the ways in which SES is associated with health outcomes. Naturally, policymakers, NGOs, and other stakeholders have attempted to implement interventions to improve both health and economic stability by improving socioeconomic status. Many approaches have involved the deployment of 'income shocks'. Income shocks are interventions that involve a transfer of wealth (usually cash) to an individual or family. Understanding how these different strategies actually affect SES is vital to predicting their ability to precipitate the longer-term economic, health, and development outcomes that are the goals of their implementation. Three types of 'income shocks' in particular have drawn the most attention from researchers. In the following paragraphs, I will describe these types of interventions, the evidence for their efficacy, and the measurement tools used by investigators to gather this evidence.

a. UCTs

Unconditional cash transfers (UCTs) reflect the type of income shock many in the United States are most familiar with – a welfare scheme that transfers money from an institution (usually a government) to an individual or family, without any conditions other than meeting certain inclusion criteria (e.g., being impoverished, women, children, elderly, etc.). With a handful of exceptions, there have been very few studies of the effects of UCT programs in low and middle income (LAMI) countries. An UCT program in Malawi targeting 'ultra poor' households (defined as being within the lowest economic quintile, having no assets, or consuming only one meal per day) was found to be associated with overall increases in food consumption, particularly proteins (meat, fish, and dairy).(C. M. Miller et al., 2011) The Malawi program also found associated increases in income and money borrowed, which the authors attributed to the anticipation of consistently increased income. In South Africa, two different UCTs, one targeting households with children and the other targeting elders, each demonstrated increased total food expenditures and household savings associated with program participation.(Economic Policy Research Institute, 2004) Studies of UCTs in Zambia and Mozambique have not found significant changes in total food consumed, but have shown that program participation is associated improvements in measures of food security (e.g., number of meals per day). (Datt et al., 1997; Low et al., 2012; Vincent & Cull, 2009)

b. CCTs

In LAMI countries, income shock interventions have increasingly taken the form of conditional cash transfer (CCT) programs. CCTs are similar to UCTs but tie the income increase to participation in a specific required program (such as school enrollment, preventive health services, or nutrition education). The cash transfers typically range from about $6 - $25 per individual per month in Latin American countries, equivalent to between 10%-30% of average household consumption, but depend largely on the goal and budget of the program.(Ranganathan & Lagarde, 2012) Analyses of the effects of these programs on consumption, as defined as the total dollar value of services and goods consumed by a study participant, have

shown a direct relationship between the income shock and increased consumption.(Angelucci, Attanasio, & Di Maro, 2012; Attanasio & Mesnard, 2006) In addition to associated changes in total consumption, research on CCTs in Mexico, Nicaragua, and Colombia have shown that households receiving the transfer direct the majority of their money specifically toward increased food spending, especially on meat and dairy. (Attanasio & Mesnard, 2006; Attanasio, Battistin, & Mesnard, 2012; Hoddinott & Skoufias, 2004; Macours, Schady, & Vakis, 2008; Maluccio, A, Flores, Rafael, 2005) The literature suggests that in some countries CCT programs effect outcomes such as perinatal/neonatal/infant mortality(Barham, 2011; Lim et al., 2010), childhood behavior(Fernald, Gertler, & Neufeld, 2009; Ozer, Fernald, Manley, & Gertler, 2009), childhood salivary cortisol(Fernald, 2009), and food consumption(Hoddinott & Skoufias, 2004; Leroy, Gadsden, Rodríguez-Ramírez, & de Cossío, 2010; Leroy et al., 2008). The literature is more contradictory with regards to CCT effectiveness on other measures, including anthropometric outcomes(Fernald et al., 2009; Gertler, 2004; Maluccio et al., 2005; Perova, 2009) and utilization of vaccines(Barham, 2005; Barham & Maluccio, 2009; Levy, 2007; Maluccio et al., 2005; S. Morris, Flores, Olinto, & Medina, 2004). Some studies found CCTs to have an effect on these outcomes only in certain subgroups, while other studies found no significant association.

The changes in consumption may be seen in relatively unhealthy foods; an analysis of a CCT in Brazil found that participation in the intervention was associated with increased sugar and soda consumption.(de Bem Lignani, Sichieri, Burlandy, & Salles-Costa, 2010) Some studies suggest that some of the behavioral changes resulting from the intervention may lead to increased rates of obesity and hypertension. (Fernald, Gertler, & Hou, 2008a; Leroy, Gadsden, González de Cossío, & Gertler, 2013) Many of these same interventions have found that CCTs improve other components of household economic stability. Similarly, in Mexico, a CCT was found to lead to increased investment, income, and savings, and decreased magnitude and number of loans. (Angelucci et al., 2012; Gertler, Martinez, & Rubio-Codina, 2012)

Some studies have compared CCTs and UCTs, and they tend to indicate that CCTs are more likely to lead to improved behavioral outcomes such as school attendance. A study of the UCT in Malawi found, however, that the initiative there was associated with lower teen pregnancy and marriage rates than similar CCTs, a result likely due to the fact that young women continued to have access to welfare funds regardless of whether they attended school (the 'condition' in that country's scheme).(Baird et al., 2011)

c. Microfinance

Microfinance institutions (MFIs) provide poor individuals with loans to be leveraged into increased productivity and subsequent economic stability. MFIs are different from UCTs and CCTs because they expect the money to be paid back; still, MFIs often lead to an increase in take-home income. (Brau & Woller, 2004; Khandker, Samad, & Khan, 1998; Mosley, 2001) A number of analyses have found MFIs to have mixed effects, sometimes with and other times without improvement of household economic indicators. A study in India found that while a MFI program was

associated with increased numbers of new business ventures and spending on durable goods (e.g., machinery or property), it was also associated with decreased spending on non-durable goods (e.g., food, entertainment, or transportation), no effect on total average monthly spending, and no effect on welfare measures (health, education, or women's decision making).(Banerjee, Duflo, Glennerster, & Kinnan, 2010) Participants in an randomized MFI intervention in rural Morocco were found to decrease total consumption if they were self-employed (to provide savings to expand their business), but to increase total consumption if they were not self-employed.(Crépon, Devoto, Duflo, & Parienté, 2011) A study of the largest MFI in the world, in Thailand, found associated increases in savings, income, and total expenses, but decreases in nondurable asset ownership.(Coleman, 2002) Studies of Bangladeshi MFIs have found associated decreases in poverty and income inequality, and increases in spending. (Khandker, 2005; Mahjabeen, 2008; Schroeder, 2011) MFIs in the Philippines were found to be associated with significant increases in total per capita consumption and per capita food consumption. (Goldberg, 2005; Kondo, Orbeta, Dingcong, & Infantado, 2009)

Measurement

The studies of income shocks described above have focused on objective outcomes such as economic consumption, savings, income, debt, and health measures to gauge the efficacy of the intervention at raising SES. But, as discussed in Chapter 1, these 'objective' components of SES can explain less than half of the variation we see in health outcomes between groups. The sophisticated neuroscience research discussed in Chapter 2 established a framework for explaining how stressors, intangible and subjective measures, may lead to chronic health problems by contributing to allostatic load. Scientists have grappled with how best to measure stress, a variable that is almost by definition subjective. The clues of how to do so lay in the evidence of the Whitehall cohort.

Social groups, from the family level to the national level, can be thought of as existing on a ladder, with the people at the upper rungs more powerful, wealthier, and better educated. Similarly, social groups can be distributed upon a 'health' ladder, where those at the top have a greater life expectancy and lower rates of chronic disease and mental illness. Marmot's observation of a stepwise progression in the SES/health gradient (further supported with additional research by Evans) fits this hierarchical understanding of society, and implies that the two ladders (SES and health) mirror each other. Given hypotheses that low SES exposes individuals to greater experiences of stress, and that greater experiences of stress predict health outcomes, it is clear that a third ladder measuring subjective experiences of stress also exists.

The concept measured by this third ladder, known as *subjective social status*, encapsulates many of the objective indicators, but also captures the subjectivity of a person's experience. As a result, investigators have argued that a measure of subjective social status (SSS) may be more accurate indicators of poor health than objective measures.(Wilkinson, 1999)

Social scientists have attempted to measure SSS for decades, often in pursuit of a more accurate understanding of class. (M. R. Jackman & Jackman, 1973; Kluegel, Royce Singleton, & Starnes, 1977) These investigators utilized simple questionnaires to gauge SSS, asking, for instance, that participants select one of four 'classes' to which they feel they belong. The instruments, while allowing for a greater degree of subjectivity in response, still imposed the author's own assumptions about the existing class structure. There seemed to be room for a more flexible measure to truly grasp perceptions of stratification.

This background helps provide the theory behind the MacArthur Scale of Subjective Social Status, the most established metric today in public health research of gauging the subjective stressors that affect health. Nancy Adler of UCSF led the development of the MacArthur Scale to reflect the stepwise nature of the SES-health gradient. In a straightforward pictorial format (see next page), the tool asks survey participants to mark on the ladder where they believe they stand in response to a variety of questions. Of particular importance, the MacArthur Scale utilizes a 'reference group', which provides context for the respondent when they are answering the question. For instance, in the above image, the Scale asks the respondent to consider where they stand in relation to other people "in their communities". The 'reference group' can vary, based on the particular aspect of SES and SSS the investigator is targeting.

The SSS Ladder has been applied to research for over 15 years. It was included in the Whitehall II questionnaires, the results of which Singh-Manoux and colleagues used to demonstrate that SSS and ill-health are closely correlated, a relationship which couldn't be explained by objective measures of SES alone.(Singh-Manoux, Adler, & Marmot, 2003)

In 2001, Goodman and colleagues attempted to apply the MacArthur Scale to an adolescent patient population, the first time it had been applied to this demographic, and one of the first times it had been used outside of the Whitehall II cohort.(Goodman et al., 2001) They found that the MacArthur Scale was a reliable SSS measure for adolescents, and called for further research to explore how the instrument could be used to enhance scientists' understanding about the relationship between social status and development.

Two years later, Goodman and colleagues built on their previous work and conducted a cross-sectional study of adolescents to ascertain the relationship between SES, SSS, and obesity.(Goodman et al., 2003; Gruenewald et al., 2009) The investigators considered household income, parental education level, and subjective social status (using the MacArthur Scale) as predictors for obesity, finding that all three were associated positively with obesity, with SSS being the strongest predictor.

In 2005, Hu and colleagues applied the MacArthur Scale in a study of Taiwanese elders in which they found SSS to be a powerful predictor of health and functional status, even after controlling for objective SES measures.(Hu, Adler, Goldman, Weinstein, & Seeman, 2005) The fact that SSS remained a predictor of health independent of objective measures suggests that SSS captures some influential component of the social hierarchy not measured by the traditional SES metrics. Many other studies have provided further evidence that SSS is a powerful independent predictor of health. Studies of self-rated health(Franzini & Fernandez-Esquer, 2006), mental health(Singh-Manoux, Marmot, & Adler, 2005), and cortisol levels(Wright & Steptoe, 2005)have all found SSS (as measured by the MacArthur Scale) to be an even *more* powerful predictor of health than objective SES measures.

In the developing-world context, Giatti and colleagues conducted a longitudinal study in Brazil aimed at assessing the reliability of the MacArthur Scale.(Giatti, do Valle Camelo, de Castro Rodrigues, & Barreto, 2012) They found that instrument reliability ranged from moderate to good, depending on the precise variation of the scale, thus suggesting that it may be a valid instrument in developing, low-income settings. Years earlier, Fernald and colleagues used the MacArthur Scale to examine SSS and BMI among low-income Mexican adults.(Fernald, 2007) While objective measures of SES were significantly associated with obesity, SSS was not.

Many other studies have utilized the MacArthur Scale of Subjective Social Status in various settings over the past 15 years, demonstrating its validity and independence as a predictor for health outcomes. (Adler et al., 2008; Cundiff, Smith, Uchino, & Berg, 2013; Demakakos, Nazroo, Breeze, & Marmot, 2008; Kawachi, Adler, & Dow, 2010) Although pioneered in settings in the developed world, it has been used in the developing world, and as interventions such as 'income shocks' become more common, it can be an important tool for gauging these initiatives' effectiveness.

Chapter 4

In the previous chapters of this paper, I have described the epidemiologic, clinical, and laboratory evidence for the socioeconomic status/health gradient. This gradient has persisted across decades and in dozens of nations. However, the objective measures traditionally used to explain variations in chronic disease fail to completely account for the gradient, and a somewhat newer measure, subjective social status, has provided a new way of predicting poor health outcomes. Policymakers and other stakeholders have a number of tested frameworks for interventions to improve health through SES or SSS. Few studies of these interventions have utilized SSS as a tool for gauging the effectiveness of interventions to improve long-term health outcomes. Given the significant power of SSS to predict health, which some studies suggest is greater than objective measures, it would seem that this is a useful tool for studying how health may change in response to an income shock.

In my thesis, which will comprise the second paper of this two-paper series, I will study a population of apparel factory workers who experienced an exogenous income shock in the form of a living wage campaign. My research question for this project is: "What are the differences in the subjective social status of apparel factory workers in the Dominican Republic associated with a 350% exogenous income shock?

Study

Introduction:

Decades of research in the United States and Europe have found that people with higher socioeconomic status (SES) (traditionally measured by income, education, and occupational grade) experience lower rates of morbidity and mortality. (Adler & Newman, 2002; Adler & Rehkopf, 2008; Kitagawa, 1973; Marmot et al., 1978) In the United Kingdom, occupational grade has been found to be an even stronger predictor of death from coronary artery disease than standard risk factors such as smoking, age, systolic blood pressure, and cholesterol levels.(Marmot et al., 1978) While the risk for certain conditions, most notably breast cancer incidence (Kelsey & Bernstein, 1996) and melanoma (Harrison, Haque, Roseman, & Soong, 1998) increase with objective SES, large studies in Europe (Dalstra et al., 2005) and the United States (Minkler, Fuller-Thomson, & Guralnik, 2006) suggest that for most measures of health, the poor are at greatest risk.

Although relying on fewer studies, much of the evidence on the association between objective SES and health in low- and middle-income (LAMI) countries is consistent with that from Europe and the US. One analysis of World Health Organization health surveys found that in LAMI countries, people in the poorest quintile were twice as likely to experience bad health as those in the wealthiest quintile.(Hosseinpoor, Stewart Williams, Itani, & Chatterji, 2012) This study also found that those in the least educated quintile in these countries were three times as likely to experience bad health as those in the best educated quintile.

Other studies from LAMI countries suggest that the gradient of objective SES and health is not always a positive correlated. In Serbia, for example, increased objective SES was correlated with decreased risk for arthritis but with an increased risk for hypertension.(D. Vuković, Bjegović, & Vuković, 2008) In Mexico, a cohort study found that women at the upper end of the income spectrum within a low-income rural population have higher blood pressure than those at the lower end of the income spectrum.(Fernald & Adler, 2008) The results suggest that while increased wealth may provide increased access to health care and sanitation, it might also lead to increased consumption of unhealthy, processed foods. Some have suggested that these seemingly contradictory associations are reflective of the fact that among different populations and for different outcomes, various objective measures of SES affect health via different pathways.(Singh-Manoux et al., 2003)

Socioeconomic status likely influences health via multiple pathways. As outlined in Adler and Ostrove's 1999 review of the evidence, low SES can increase environmental exposure to pathogens or carcinogens and it can affect an individual's health related behaviors.(Adler & Ostrove, 1999) Yet even after controlling for objective measures of SES (income, education, and occupational status), disparities in health persist along the SES-health gradient. Scientists now suspect that the subjective experience of one's position in society may explain some of this discrepancy. (Dohrenwend, 2006; Kelly et al., 1997) In particular, life

stressors have been well established as predictors of ill health, in part through a process called *allostatic load*.(McEwen & Gianaros, 2010) Allostatic load refers to the process by which stressful events chronically stimulate endocrine, metabolic, or neurologic pathways leading to dysregulation of these systems. This dysregulation is associated with increased morbidity and mortality. SES has been found to be a powerful mediator of allostatic responses, providing a pathophysiologic pathway by which subjective experiences of status can lead to disease and death.(Seeman et al., 2010)

As a means of quantifying these subjective experiences, Adler and colleagues developed the MacArthur Scale of Subjective Social Status.(Adler, Epel, Castellazzo, & Ickovics, 2000) For fifteen years, this instrument has been utilized in hundreds of studies around the world, and has consistently been found to be a strong predictor of health outcomes. For certain outcomes, including self-rated health(Franzini & Fernandez-Esquer, 2006), mental health(Singh-Manoux et al., 2005), and salivary cortisol levels(Wright & Steptoe, 2005), subjective social status is an even more powerful predictor than objective measures of SES, because it is effected by both objective and subjective exposures. The differences in the predictive power between these two measures were statistically significant, suggesting that SSS may be a more accurate and comprehensive measure for understanding the health effects of social stratification.

While most of these studies have taken place in the North America and Europe, the MacArthur Scale has been utilized in low- and middle-income countries as well. In Brazil, it was found to be a reliable measure of perceived stratification.(Giatti et al., 2012) Subjective social status (SSS) has been associated with poor mental health outcomes in South Africa.(Hamad, Fernald, Karlan, & Zinman, 2008) In Mexico, however, Fernald and colleagues found that, in contrast to objective measures of SES, subjective social status was not a predictor of obesity.(Fernald, 2007) Also in Mexico, SSS was found to be significantly associated with increased systolic blood pressure.(Fernald & Adler, 2008) In a separate study among a different age group (adolescents) in the same country, subjective social status correlated significantly with increased use of alcohol and tobacco when status was considered relative to the local community, but correlated with decreased use of alcohol and tobacco when status was considered relative to the nation at large.(Ritterman et al., 2009)

The bulk of this evidence suggests that subjective social status may be a useful tool for predicting long-term health outcomes in communities in LAMI countries. In particular, it can be a useful tool to gauge the potential impact of interventions aimed at elevating the socioeconomic status of a group of individuals. Because many health outcomes of interest (obesity, diabetes, cardiovascular disease, cancer, etc.) may not demonstrate a shift in prevalence for years, subjective social status could potentially be used as lens to provide insight into the potential benefits of a SES intervention in a relatively short period following the initiation of an intervention.

Additionally, subjective social status is a composite measure; it is influenced by both objective and subjective exposures. At least in part, what an individual's wages or level of education can influence his or her subjective social status. This multidimensional nature of the measure provides the opportunity for interventions, including wage increases, to improve health by targeting subjective social status.

In this study, we examined the impact of a 3.5 times wage increase (relative to the prevailing minimum wage) on the subjective social status of apparel factory workers in the Dominican Republic. We also considered the degree to which this intervention is associated with changes in self-rated health. These two outcomes are likely interrelated; our conceptual model for associations can be seen in Figure 1. Relationship between site, subjective social status, self-rated health, covariates (education, etc.), and long-term health outcomes.

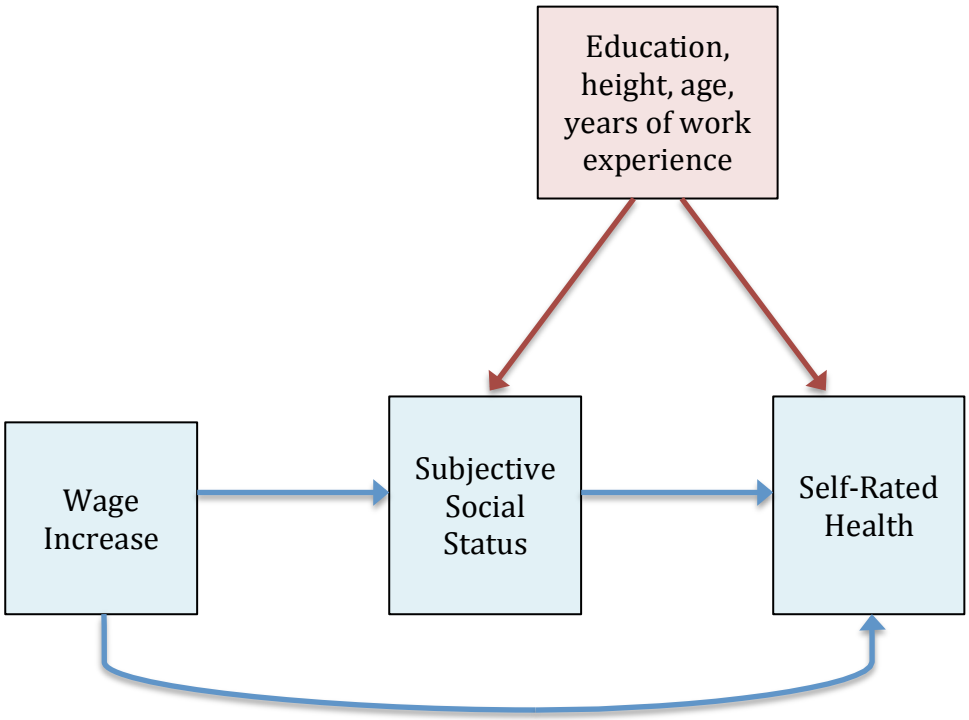


Figure 1 Conceptual Framework

Previous work by our team has demonstrated that the intervention was associated with substantial increases in savings, consumption, and access to credit. These indicators are all believed to play important roles on the pathway to improved chronic health. Our goal in this paper was to assess the impact of the intervention on subjective social status, a well-validated predictor of chronic health outcomes. We hypothesized that the wage intervention would be associated with improved subjective social status and self-rated health, and that subjective social status would be a mediator of the relationship between the wage and self-rated health.

Methods:

Description of the intervention:

In April 2010, the intervention factory, opened, hiring 130 employees from a small city (total population: ~200,000) in a free trade zone in the Dominican Republic. Free trade zones guarantee special taxes, export regulations, and workplace laws for manufacturers producing goods for export. The factory in this study produces apparel for the international market, primarily in the United States. The wage increase experienced by these workers was exogenous; upon applying for jobs in the factory, workers were not told that wages would differ from the prevailing minimum wage that is standard in free trade zones across the country. After being hired and before beginning work at the factory, the workers were told that their hourly wages would be approximately 3.5 times the prevailing minimum wage. This increased wage was intended to be a 'living wage', which was calculated by an independent labor rights organization at the request of the factory's owners. The calculation employed the validated and widely used 'basket of goods' approach to reflect the financial needs of a family of four according to the local context.(Kline, 2010) The 'basket of goods' approach is similar to the familiar method used to calculate the consumer price index around the globe. The approach involved consultation with local experts as well as a review of the literature on the development of similar wage schemes. In addition to the increase in compensation, the intervention included other changes to the prevailing conditions, including the assertion of a right to a safe workplace and the right of workers to be treated with dignity and respect. The same independent labor rights organization that calculated the 'living wage' also ensured compliance with these standards through periodic site visits and close relationships with the leadership of the Alta Gracia workers' union.

Selection of comparison factory:
A comparison factory was selected to match the intervention factory as closely as possible. Both factories manufactured apparel, were of similar size (X), located in cities with approximately 200,000 residents, and were located within 50 miles of each other, in order to ensure similar environmental, cultural, and political conditions. The comparison factory had a management supportive of the implementation of the study and was in a free trade zone. Ensuring that both factories existed in such zones was vital to our assumption of similar economic climates between the two sites.

Sample:
The main inclusion criteria for participants at the intervention factory were 1) currently employed after having been hired in the initial round of hires (April 2010) and 2) being paid an hourly wage, as opposed to a salary. The primary inclusion criterion at the control factory was being paid an hourly wage. The primary exclusion criterion was being a highly paid managerial, technical, or administrative employee of the factory. Interviewers attempted to contact all eligible intervention factory workers, as well as an equal number of control factory workers.

Data Collection:
Data were collected via in-person interviews in July and August of 2011 (15-16 months after the workers were initially hired at the intervention site). Interviews

lasted approximately 2 hours, and were conducted at the homes of workers on Friday evenings or the weekends (to limit disruption to the work-week). Workers were identified and contacted in collaboration with union representatives and factory managers. A third party survey agency conducted the interviews, and interviewers began each encounter by explaining the purpose of the study and ensuring individuals that participation was both voluntary and confidential. Interviews were conducted in Spanish, and local representatives verified the accuracy of the English translations of the interview questions. The study was approved by Committee for the Protection of Human Subjects at the University of California at Berkeley and signed informed consent was obtained from all participants.

Measures

Subjective Social Status

Subjective social status was measured using the MacArthur Scale of Subjective Social Status, which presents individuals with a pictorial 10-rung ladder.(Fernald & Adler, 2008; *MacArthur Research Network on SES & Health - Community Ladder*, n.d.) Respondents are asked to place themselves on the ladder relative to their community or nation.

Community Ladder

The 'community ladder' asks participants to "define community in whichever way is most meaningful" to them, and to then rank themselves on the ladder relative to community members who are of high or low "standing". This measure is intended to best approximate subjective social status.

National Ladder

The 'national ladder' asks participants to rank themselves on the ladder relative to the rest of their country, explicitly stating that those at the top of the ladder "have the most money, the most education, and the most respected jobs", while those at the bottom of the ladder "have the least money, the least education, and the least respected jobs or no jobs." This measure is linked to the traditional socioeconomic status indicators of income, education, and occupation.

Children's Wealth Ladder

The 'children's wealth ladder' asks participants with children to rank their children's position relative to the wealth of all other children in the Dominican Republic. This instrument is intended to gauge an individual's perception of his or her children's financial well-being.

Children's Future Ladder

The 'children's future ladder' asks participants with children to rank where their children will rank in 20 years relative to other children in the Dominican Republic. This instrument is intended to gauge optimism and sense of security for the future.

Global and comparative self-rated health
We also considered the association between bivariate *community ladder* scores (high/low) and two self-rated health measures. Self-rated health has been well-validated as a measure of current and future health(Idler & Benyamini, 1997; van der Linde et al., 2013; Wannamethee & Shaper, 1991), and has been used elsewhere to gauge the impact of SSS on health. (Adler et al., 2008; Singh-Manoux et al., 2003; 2005) The first asked participants to rate their health on a five-point Likert scale (very bad to excellent). The second asked participants to rate their health relative to peers their same age, also on a five-point Likert scale (much worse to much better).

Covariates
We assumed *a priori* that age, height, education, and years of work experience might independently associate with subjective social status, and also independently associate with self-rated health. We then used t-tests and tests of proportions to assess the group differences in these variables. In order to measure height, the interviewers used the standard approach of taking 2 measurements with a stadiometer.(Cogill, 2003) If the difference between 2 measurements exceeded 0.5cm, a third measurement was taken. The mean of all of the measurements was then entered as the participant's height. Education level was assessed by self-report and was categorized according to the highest level of school completed (secondary school or higher; primary school or lower). Total years of work experience (in any industry) were recorded by self-report as a continuous variable.

Analytical Techniques:
We first compared the two factories by performing tests of means and proportions. Second, we calculated the relative likelihood of participants at each factory scoring a high score (≥6, which represents a midpoint split of the ladder scores). We performed multivariate analyses of the ladder scores as continuous variables, controlling for age, education, height, and years of work experience. Given our *a priori* hypothesis that men and women would respond differently to the income shock, we included a site by gender interaction term. Next, we performed multivariate logistic analyses of the self-rated health outcomes with community ladder score as a predictor variable, controlling for age, height, and weight. Mediation (by subjective social status) of the effect of the wage increase on self-rated health was performed using the Sobel test.(Sobel, 1982) These analyses were performed with and without covariates (age, height, level of education, years of work experience). This approach tests the indirect effect of the mediator by ruling out a significant difference between the cumulative effect and direct effect. We calculated these results using the 'sgmediation' syntax in STATA, with bootstrapping 1000 repetitions. Statistical analyses were conducted using STATA 10.1 (STATA Corporation, College Station, TX).

Results:
105 of 107 eligible workers at the treatment site completed surveys. Of those 105, six were excluded because it was determined they had stopped working at the

factory during the 15-16 month period prior to data collection. 134 workers at the comparison site were eligible to complete the survey (out of a total workforce of 180), using the same eligibility criteria as for the treatment site. Of these 134 workers, 105 completed surveys, 18 were untraceable, 5 were no longer working, 3 were absent on the days surveys were conducted, and 1 declined to participate. The final sample thus consisted of 204 workers, 99 workers from the treatment site and 105 workers from the control site.

Descriptive statistics
Workers in the intervention and comparison factories did not differ in age at follow-up, childhood health and total years of work experience; but workers at the intervention factory were more likely to be women, were taller, were more likely to have completed a secondary level of education, and reported a higher childhood quality of life (Table 1).

Unadjusted Analysis Ladder Scores
Workers from the intervention factory had significantly higher scores than those from the comparison factory on all subjective social status ladders (Figures I-IV): the community ladder, national ladder, children's wealth ladder, and children's future ladder; the differences had a magnitude of 2-3 points (out of 10).(Table 2a)

Relative likelihood of having a low or high ladder score
Workers at the intervention factory were significantly more likely to report a 'high' ladder score (≥6) on the community ladder (42% v. 17% of men, and 75% v. 12% of women). Similarly, the workers at the intervention factory were significantly more likely to report a 'high' score on the national ladder (38% v. 11% of men, and 71% v. 15% of women). On the children's wealth and children's future ladders, we found significant differences for women only: 59% of women at the intervention factory reported a high children's wealth score, compared to 29% of women at the comparison factory. 96% of women at the intervention factory reported a high children's future ladder score, compared to 82% of women at the comparison factory.(Table 2b)

Multivariate Linear Regressions
In women, working at the intervention factory was significantly associated with higher ladder scores for all four ladders, while controlling for covariates (level of education, height, age, and years of work experience). The average adjusted effect of working at the intervention factory was 3 rungs on the community and national ladders. The average adjusted effect on the children's wealth and children's future ladders was 1-2 rungs. In men, the differences were significant only for the national ladder, with a site effect of roughly 1 ladder rung.(Table 3)

Global and comparative self-rated health
A similar number of workers at the intervention factory ranked their health as 'bad' or 'normal' as at the comparison factory.(Table 4) However, workers at the intervention factory were less likely to rate their health as good ($p=0.029$) and more

likely to rate their health as excellent (p=0.007). Workers at the intervention factory were less likely to rank their health as 'the same' as their peers (p=0.001) and more likely to rank their health as 'much better' than their peers (p=0.042).

Mediation analysis
We considered the potential mediation of subjective social status on the relationship between the wage increase and self-rated/comparative self-rated health. There was not a significant relationship between the wage increase and self-rated health (as a 5 point scale) of either gender. We found that for women, subjective social status was a mediator of comparative self-rated health.(Table 5a/b) The indirect effect on comparative self-rated health through SSS was 0.26 for women (95% CI 0.011, 0.52), which represented 92.9% of the overall effect. For men, the indirect effect on comparative self-rated health was -0.0074 (95% CI -0.097, 0.083), and was not statistically significant.

Discussion: This study describes the differences in subjective social status associated with a 350% difference in wages in apparel factory workers in the Dominican Republic. We found that receiving the higher wage was associated with substantially higher social status scores. These scores did not account for all of the differences in self-rated health between the groups, but among the study sample higher social status scores were associated with higher self-rated health. These results suggest that higher wages improve scores on a scale well-validated as a powerful predictor of chronic health outcomes.

The magnitude and statistical significance of the site effects differed by gender. Women, but not men, were found to have significant differences on the 'community ladder', the instrument most sensitive to subjective factors (extending beyond education, income, and occupation). It is possible that the lack of a statistically significant site effect for men could be due to a small sample size, but given the relatively small coefficients seen in these regressions, this is unlikely. Across the factories, the scores for both genders on the 'national ladder' were significantly different, although the magnitude of the effect size was much greater in women.

Low subjective social status is a risk factor for multiple chronic physical and mental health conditions. Given that the incidence and burden of these diseases is rapidly increasing in low- and middle-income countries such as the Dominican Republic(Pan American Health Organization, 2007), these results provide insight into the impact of wage increases on a major emerging public health concern for the region.

Additionally, we considered the association between subjective social status and self-reported health. Some have suggested that the association between subjective social status and self-reported health might be confounded by a characteristic of the individual, such as negative affect. Recent evidence, however, suggests that negative affect is more likely to be a mediator of that association.(Kraus, Adler, & Chen, 2013) Workers at the intervention factory tended to rank their health and their health

relative to their peers higher than workers at the comparison factory. Additionally, for women, subjective social status was found to mediate the relationship between the wage increase in this intervention and comparative self-rated health. The evidence that subjective social status is positively associated with self-rated health provides further evidence that this intervention may contribute to reduced poor health outcomes in the long-term.

The quasi-experimental nature of our study allows us to compare two largely similar populations on the basis of an exogenous income increase. Because of the link between SSS and long-term health outcomes, we are able to get a sense of the likely effects of the intervention in the long run. These significant differences in social status scores did not account for the differences in self-rated health. This suggests that other components of the intervention *not* accounted for by SSS ladders are responsible for the observed differences in self-rated health. However, we were able to establish that in these populations, higher SSS is associated with higher self-reported health, another well-validated predictor of chronic health conditions.

The participants in our study were not randomly assigned to intervention and control groups. Not only would this have violated ethical principles, but the study took place in the context of a pre-existing wage increase initiated by a third-party, private company. As a result, there were some differences in the two populations studied. In addition to selecting a comparison factory that closely approximated the intervention site, we also controlled for these differences in our regressions. In spite of these efforts, it is possible that some differences in the groups persisted. Of note, however, is the fact that we were unable to detect a significant difference between the two populations in self-reported childhood health.

In addition to the 3.5x wage increase experienced by workers at the intervention factory, this intervention was associated with other differences in work environment. Specifically, the management and owners of the intervention factory were committed to creating a high quality and safe work environment, enacting occupational safety measures, and partnering with the local union to provide a voice to workers. Given the subjectivity of the measures assessed in this study, it is possible that these other aspects of the intervention also played a role in the differences seen between the groups.

A second limitation to our study is the fact that our data are cross-sectional. As a consequence, our results only reflect differences between the groups that we can reasonably associate with the intervention, as opposed to changes in the participants over time. However, given our efforts to match our samples and control for persistent differences, we believe that the observed differences in SSS are primarily due to the intervention. Additionally, at no time during the course of follow-up did any economic, political, or social events occur that might have affected only one factory's responses.

A third limitation of our study involves sample size constraints. In spite of the fact that we included all eligible workers at the intervention factory, we did not have large enough samples to perform a multinomial logistic regression, which would have been particularly appropriate for richer understanding of the differences in subjective social status.

Our study is among the first to examine associations between subjective social status of such a large increase in wages in a low- or middle-income country. Previous studies of subjective social status in LAMI countries have focused on income shocks of a much smaller magnitude (e.g. cash transfers typically only increase 5%-25% of the monthly income of the recipients). This intervention involved an income shock 3.5 times the prevailing wage, which allows us to compare differences associated with workers jumping to a much higher income bracket.

The well-established association between subjective social status and chronic health outcomes suggests that this factory intervention will likely reap significant long-term health benefits for the participants, especially women. Researchers in the UK have found that a single-point decline in ladder score is associated with a 0.26% decline in self-reported physical health and 0.36% decline in self-reported mental health for men and a 0.42% decline in self-reported physical health and a 0.38% decline in self-reported mental health in women.(Singh-Manoux et al., 2005) In comparison, among women in our study, we found a single-point increase in community ladder score to be associated with a 0.56% increase in self-rated health and 0.37% increase in comparative self-rated health. We did not find a significant effect for men. Another study in the UK found that even after controlling for objective SES, low SSS ladder scores were associated with a 1.57 times increased risk for diabetes, a 1.14 times increased risk for respiratory disease, a 2.28 times increased risk for low self-reported health, and a 1.48 times increased risk for self-reported depression.(Singh-Manoux et al., 2003) In light of this, the substantial differences in SSS ladder score associated with the intervention may reduce risk of chronic health conditions in the workers.

There are a number of plausible explanations for significant differences in SSS among the women in the sample but not among the men. As mentioned previously, given the small coefficient sizes for the analyses of men, we do not believe that the lack of statistical significance was due to small sample sizes. Previous research by our team found this intervention to be associated with increased spending by women but not men on groceries and school materials and fees. This significant increase in family and household spending may have prompted a greater sense of a shift in social status among women than men.

Given the magnitude of the shift in status (a nearly 30% shift for women), it is important to note the possibility of some other factor amplifying the effect of the wage increase. In addition to providing a wage increase, the factory is a source of much-needed optimism to its community, and the workers are acknowledged and

respected for their participation in this pilot initiative. It is possible that these factors may have contributed in part to the shift in status. However, analyses published elsewhere of the household economic changes associated with this intervention demonstrate widespread increases in spending (especially on food, education, housing, and medical care). While it is plausible that the community's response to the factory affects SSS, we believe that the most significant aspects of the intervention are the wage and work environment, which enable the workers to achieve higher quality of life for themselves and their families.

It is also possible that the observed differences in SSS scores are actually conservative. When asked to place themselves on a ladder *relative to their community*, participants defined their own sense of community, a definition that undoubtedly included colleagues from their respective factories. As a result, the observed effects of the wage increase on SSS may have been diminished by the fact that members of the participants' communities also experienced the intervention.

Further research is needed to better understand the longitudinal association between the wage increase at the intervention factory and subjective social status. Additionally, it is imperative to better understand the association between subjective social status and chronic health outcomes in low- and middle-income countries, so that we can more accurately predict the effects of similar interventions on chronic disease burden.

Decades of research have established that subjective social status is strongly associated with health outcomes. Less evidence exists regarding the effect on subjective social status of increasing wages in a low- or middle-income country like the Dominican Republic. These results, however, suggest that income plays a large role in establishing one's subjective social status. While wage increases have traditionally been considered a tool of economic development, these results suggest that they may also be powerful tools for improving health through subjective social status.

Table 1: Demographics

	Comparison Factory	Intervention Factory	P-value for difference[a]
	n=105	n=99	
Age (mean ± SD)	34.19 ± 8.42	34.95 ± 4.98	0.431
Gender (%)			
Men	46 (43.81%)	24 (24.2%)	0.003
Women	59 (56.19%)	75 (75.8%)	
Height (cm, mean ± SD)			
Men	168 ± 6	171 ± 4	0.028
Women	157 ± 5	159 ± 5	0.019
Highest Level of Education (%)			
Primary or lower	56 (53.33%)	25 (25.3%)	0.000
Secondary or higher	49 (46.67%)	74 (74.7%)	
Childhood Heath (%)			
Fair or poor	33 (31.43%)	39 (39.4%)	0.234
Good or excellent	72 (68.57%)	60 (60.6%)	
Childhood Quality of Life (%)			
Low (neither electricity nor latrine in house)	43 (40.95%)	27 (27.3%)	0.040
High (electricity and/or latrine in house)	62 (59.05%)	72 (72.7%)	
Total years of work experience (mean ± SD)	13.4 ± 7.62	13.2 ± 5.43	0.839

[a] T-tests or tests of proportions were used, as appropriate

Table 2a: Description of subjective social status ladder scores as continuous variables

	Comparison Factory	Intervention Factory	P-value for difference[a]
	Mean score [95% CI]	Mean score [95% CI]	
Community Ladder	4.0 [3.7, 4.4]	6.5 [6.1, 6.9]	<0.001
National Ladder	3.8 [3.4, 4.1]	6.2 [5.7, 6.6]	<0.001
Children's Wealth Ladder	4.6 [4.1, 5.0]	6.0 [5.6, 6.4]	<0.001
Children's Future Ladder	7.6 [7.2, 8.1]	8.8 [8.5, 9.1]	<0.001

[a] T-tests or tests of proportions were used, as appropriate

The community ladder asks participants to rank their status in reference to their peers
The national ladder asks participants to rank their status in reference to everyone in their country
The children's wealth ladder asks parents to rank their children's wealth relative to the children's peers
The children's future ladder asks parents to rank their children's status in 20 years relative their peers

Table 2b: Description of ladder scores as bivariate outcomes (low=5 or below, high=6 or above)

		Comparison Factory	Intervention Factory	P-value for difference
		# in High Category [%]	# in High Category [%]	Fisher's Exact
Community Ladder	Men	8 [17%]	10 [42%]	0.043
	Women	7 [12%]	56 [75%]	<0.001
National Ladder	Men	5 [11%]	9 [38%]	0.012
	Women	9 [15%]	53 [71%]	<0.001
Children's Wealth Ladder	Men	10 [29%]	6 [27%]	1
	Women	15 [29%]	44 [59%]	0.002
Children's Future Ladder	Men	26 [79%]	20 [91%]	0.290
	Women	42 [82%]	71 [96%]	0.015

The community ladder asks participants to rank their status in reference to their peers
The national ladder asks participants to rank their status in reference to everyone in their country
The children's wealth ladder asks parents to rank their children's wealth relative to the children's peers
The children's future ladder asks parents to rank their children's status in 20 years relative their peers

Table 3: Multivariate linear regressions [Ordinary Least Squares] of the association between subjective social status ladder scores and factory site. Covariates include level of education, height, age, and years of work experience.

	Men	Women
	Difference in means [95% CI]	Difference in means [95% CI]
Community Ladder	0.9 [-0.1, 1.8]^	2.9 [2.2, 3.6]**
National Ladder	1.1 [0.1, 2.0]*	2.9 [2.2, 3.5]**
Children's Wealth Ladder	0.5 [-0.7, 1.7]	1.6 [0.8, 2.3]**
Children's Future Ladder	0.7 [-0.3, 1.7]	1.3 [0.7, 2.0]**

^p<0.1; *p<0.05; **p<0.01

The community ladder asks participants to rank their status in reference to their peers
The national ladder asks participants to rank their status in reference to everyone in their country
The children's wealth ladder asks parents to rank their children's wealth relative to the children's peers
The children's future ladder asks parents to rank their children's status in 20 years relative their peers

Table 4: Description self-rated and comparative self-rated health responses by site. Participants were asked to rank their health, both in general and in reference to their peers.

		Comparison factory	Intervention factory	P-value for difference
Self-rated health	Very bad	0 [0%]	0 [0%]	-
	Bad	6 [5.8%]	6 [6.1%]	0.93
	Normal	52 [50.0%]	48 [48.5%]	0.829
	Good	34 [32.7%]	19 [19.2%]	0.029
	Excellent	12 [11.5%]	26 [26.3%]	0.007
	MEAN [out of 5]	3.5 [Normal/Good]	3.7 [Normal/Good]	0.196

		Comparison factory	Intervention factory	P-value for difference
Comparative self-rated health	Much worse	0 [0%]	0 [0%]	-
	Worse	6 [5.7%]	5 [5.1%]	0.834
	The same	45 [42.9%]	20 [20.2%]	0.001
	Better	41 [39.1%]	51 [51.5%]	0.074
	Much Better	13 [12.4%]	23 [23.2%]	0.042
	MEAN [out of 5]	3.5 [The same/Better]	4 [Better]	0.0019

Table 5a: Test of mediation of relationship between wage increase (IV) and self-rated health (DV) by subjective social status (SSS, community ladder score), with and without adjustment for covariates (age, height, level of education, years of work experience)

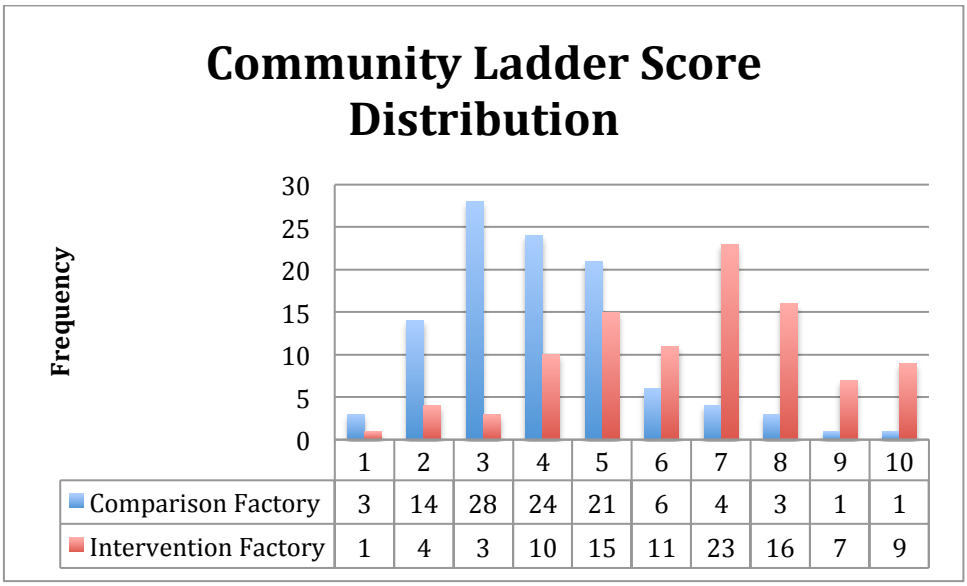
		Unadjusted beta	Adjusted beta
Wage increase on self-rated health, without subjective social status	Men	0.38^ [-0.023, 0.79]	0.38^ [-0.043, 0.81]
	Women	0.22 [-0.065, 0.50]	0.235 [-0.058, 0.53]
Wage increase on self-rated health, adjusted for subjective social status	Men	0.41* [0.042, 0.77]	0.394^ [-0.022, 0.81]
	Women	-0.27 [-0.60, 0.060]	-0.26 [-0.61, 0.082]
Wage increase on subjective social status	Men	1.02* [-0.097, 1.94]	0.89^ [-0.071, 1.84]
	Women	2.94*** [2.31, 3.58]	2.89*** [2.23, 3.55]
Subjective social status on self-rated health	Men	0.025 [-0.056, 0.11]	-0.028 [-0.11, 0.059]
	Women	0.11*** [0.044, 0.17]	0.14*** [0.071, 0.20]
Wage increase on self-rated health, through subjective social status	Men	-0.023 [-0.12, 0.077]	-0.040 [-0.16, 0.082]
	Women	0.49*** [0.21, 0.77]	0.50*** [0.22, 0.78]

Table 5b: Test of mediation of relationship between wage increase (IV) and comparative self-rated health (DV) by subjective social status (SSS, community ladder score), with and without adjustment for covariates (age, height, level of education, years of work experience).

		Unadjusted beta	Adjusted beta
Wage increase on comparative health, without subjective social status	Men	0.51** [0.12, 0.91]	0.45* [0.042, 0.86]
	Women	0.33* [0.058, 0.60]	0.28* [0.0012, 0.50]
Wage increase on comparative health, adjusted for subjective social status	Men	0.51** [0.15, 0.87]	0.51* [0.12, 0.90]
	Women	0.026 [-0.36, 0.41]	-0.012 [-0.43, 0.410]
Wage increase on subjective social status	Men	1.02* [0.097, 1.94]	0.89^ [-0.071, 1.84]
	Women	2.94*** [2.31, 3.58]	2.89*** [2.23, 3.55]
Subjective social status on comparative health	Men	0.025 [-0.056, 0.11]	0.011 [-0.073, 0.096]
	Women	0.11*** [0.044, 0.17]	0.092** [0.025, 0.16]
Wage increase on comparative health, through subjective social status	Men	0.00075 [-0.094, 0.096]	-0.0074 [-0.097, 0.083]
	Women	0.30* [0.036, 0.57]	0.26* [0.011, 0.52]

^p<0.1; *p<0.05; **p<0.01; ***p<0.001

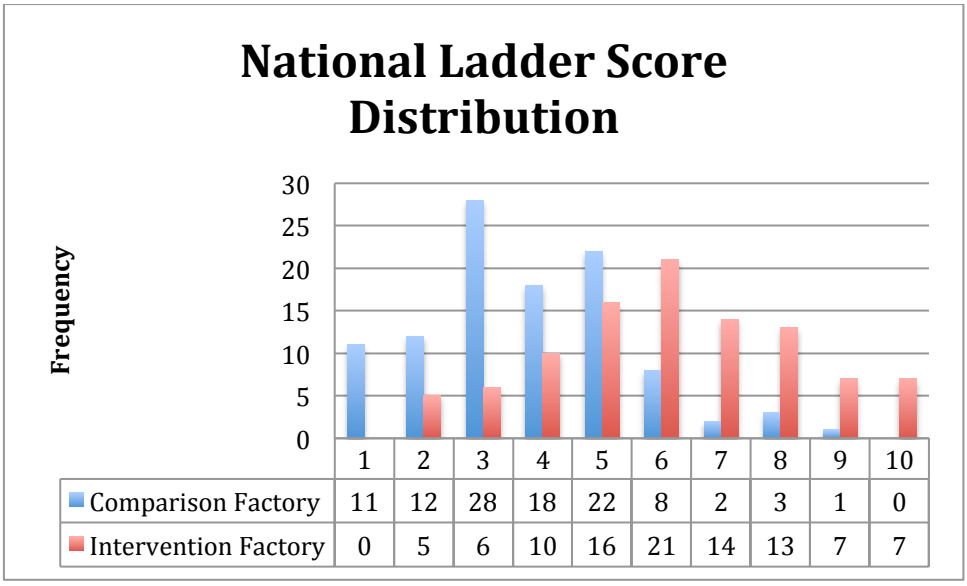
Figure I: Distribution of Community Ladder Scores, by factory site



	1	2	3	4	5	6	7	8	9	10
Comparison Factory	3	14	28	24	21	6	4	3	1	1
Intervention Factory	1	4	3	10	15	11	23	16	7	9

The community ladder asks participants to rank their status in reference to their peers

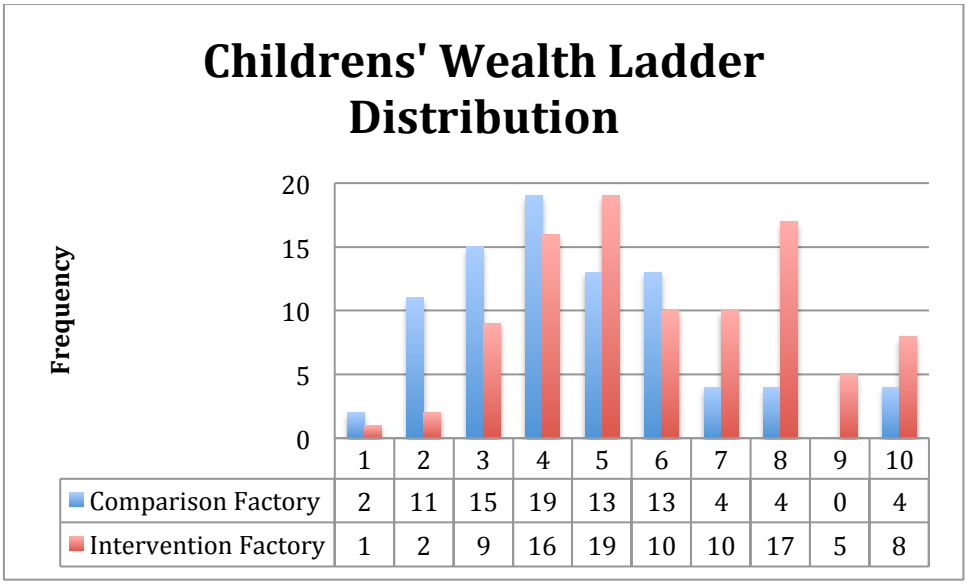
Figure II: Distribution of National Ladder Scores, by factory site



	1	2	3	4	5	6	7	8	9	10
Comparison Factory	11	12	28	18	22	8	2	3	1	0
Intervention Factory	0	5	6	10	16	21	14	13	7	7

The national ladder asks participants to rank their status in reference to everyone in their country

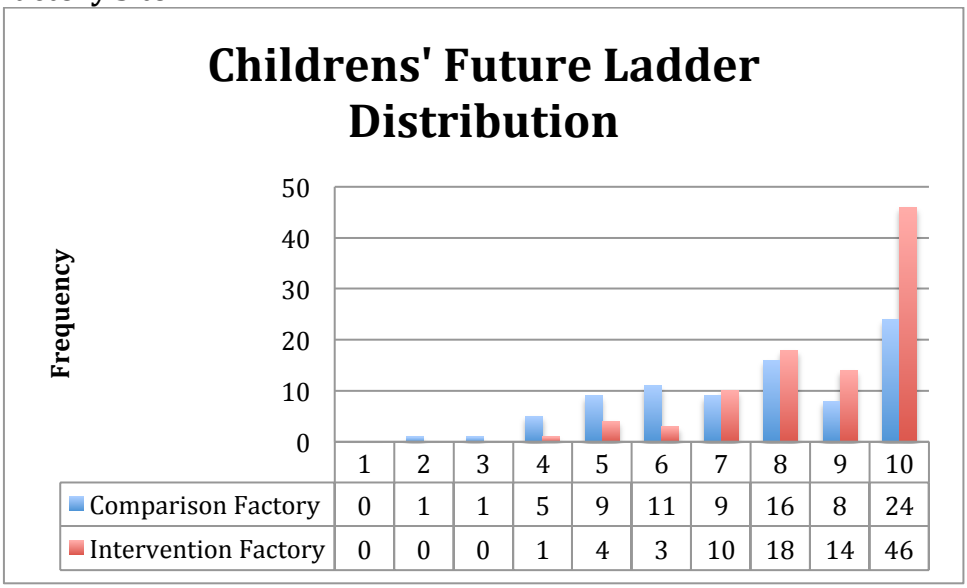
Figure III: Distribution of Parent-assessed Children's Wealth Ladder Scores, by factory site



	1	2	3	4	5	6	7	8	9	10
Comparison Factory	2	11	15	19	13	13	4	4	0	4
Intervention Factory	1	2	9	16	19	10	10	17	5	8

The children's wealth ladder asks parents to rank their children's wealth relative to the children's peers

Figure IV: Distribution of Parent-assessed Children's Future Ladder Scores, by factory site



	1	2	3	4	5	6	7	8	9	10
Comparison Factory	0	1	1	5	9	11	9	16	8	24
Intervention Factory	0	0	0	1	4	3	10	18	14	46

The children's future ladder asks parents to rank their children's status in 20 years

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