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Review article

Explaining Physical Health Disparities and Inequalities Over the First Half of the Life Course: An Integrative Review of Add Health Studies

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A B S T R A C T

This integrative review of research utilizing the National Longitudinal Study of Adolescent to Adult Health draws on previous research detailing pathways linking early socioeconomic adversity in childhood and adolescence (Wave 1 in 1995 and prior) to physical health outcomes in young adulthood (Wave 5 in 2015). Health outcomes considered included specific diseases, disease risk, and morbidity as prospectively measured by parent-reported and self-reported health outcomes as well as clinical biomarkers. A heuristic research framework was developed from the comprehensive review focused on 4 study designs and identifying total associations, physiological pathways, stress pathways, and resources pathways linking early socioeconomic adversity to physical health outcomes for young adults, as well as potential modifiers of these pathways. The appropriateness of different analytical strategies used in these research studies including approaches for analysis of change in health are discussed. Taken together, review findings suggest the merit of an integrated perspective taking a long view over early life course to explain cumulative physical health risk over the first half of the life course by assessing multiple pathways simultaneously. Looking forward, the review findings also emphasize the need for the investigation of the continuity and change in these pathways over the second half of the life course.

IMPLICATIONS AND CONTRIBUTION

The nature of the Add Health dataset affords a detailed look at change over time. A long view of childhood development shows clear pathways linking socioeconomic adversity in childhood to physeical health outcomes in young adulthood.

This integrative review draws from research conducted with The National Longitudinal Study of Adolescent to Adult Health (Add Health) to provide an overall state of the science on the development of physical health disparities and inequalities over the first half of life course. In this article, we review selected Add Health studies with life course hypotheses rooted in stress process, social ecological, and biopsychosocial theoretical perspectives. The findings emphasize the importance of situating research on physical health outcomes within a "long view" while considering the broader social and ecological context (e.g., community, school, family) and taking individual characteristics (e.g., race/ethnic disadvantage, personality) and life course experiences (e.g., life events and transitions) into account. Adolescence is conceptualized as ages 13–19 (Wave 1, 1995 and Wave 2, 1996); the transition from adolescence to young adulthood, or emerging adulthood, is conceptualized as ages 20–25 (Wave 3, 2001); and young and early middle adulthood is defined as ages 26–40 (Wave 4, 2008 and Wave 5, 2015).

The Add Health study design allows researchers to incorporate temporal, multilevel, and intra-race considerations in their

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research using a nationally representative sample. The *temporal* dimension is captured in the longitudinal, prospective study design from adolescence to early midlife. With data on schools, neighborhoods, parents, siblings, friends, and romantic relationship partners, the study's *multilevel* design enables researchers to consider nested hierarchies and social ecological contexts surrounding individuals. The oversampling of racial/ethnic minorities allows for research with a *racial/ethnic minority focus* (intragroup investigations). As a result of these features in the Add Health study design, findings from Add Health studies have advanced understanding of physical health disparities over the first half of the life course.

The current study is not a systematic review rather a thematic review of 25 years of Add Health research of physical health across the life course. We followed the priorities laid out by the editors for the focus of this review of Add Health findings. These priorities included the following: (1) the role of social context in research designs and/or findings, (2) research that integrates biological and/or genetic factors/data, (3) disparities (e.g., recognizing that race/ethnicity represents a social context of racism and race/ethnic disparities in America [1]), and (4) the longitudinal/developmental information yielded by Add Health analyses.

Based on these priorities and the selected research fitting with these priorities, we developed the integrated review framework presented in Figure 1. Thus, this framework incorporates the following: (1) longitudinal studies, (2) examinations of multilevel data, (3) biosocial designs that naturally lend themselves to the study of physical health, and (4) disparities connected to individual characteristics and ecological context. In addition to summarizing findings from Add Health studies on this topic, the current paper describes the analytic and methodological approaches utilized in these studies to provide a holistic understanding of the associations and explanatory pathways of influence. This combination of understanding previous findings coupled with analytic and methodological approaches is key to further advancing longitudinal research understanding physical health across the life course.

Figure 1 depicts associations and explanatory pathways of influence corresponding to the 3 types of Add Health studies that will be reviewed. Studies of the first type examine the *total association* between different dimensions of early social ecological context and individual context (SEC&IC) and adult physical health outcomes (termed association studies). Studies of the second type incorporate *physiological stress and resource pathways* during adolescence and young and early adulthood that at least partly explain these total associations over the life course using biopsychosocial mechanisms (termed pathway studies). Studies of the third type focus on *moderating influences* of SEC&IC on health outcomes (termed moderation studies). These study types are not mutually exclusive, and this review is not exhaustive; instead, this review provides an illustration of the associations, pathways, and moderating factors involved in explaining physical health disparities and inequalities over the first half of the life course.

We searched the 9,260 Add Health publications listed on the Add Health web site. Of these studies, there were nearly 300

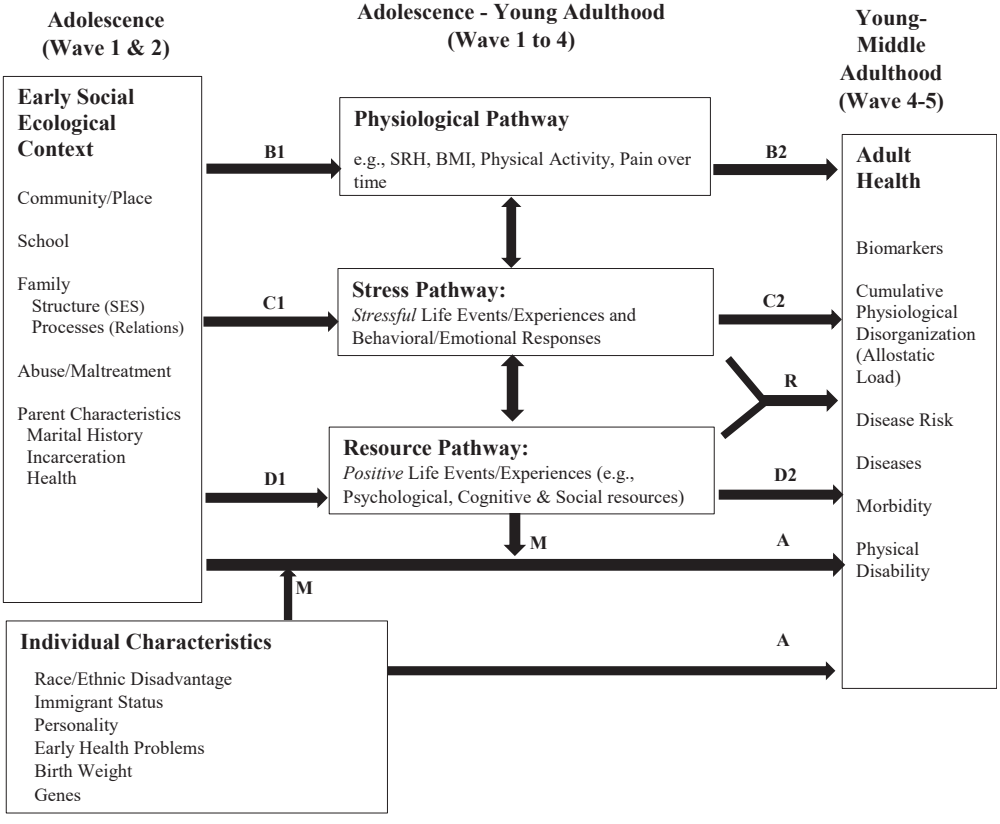

Figure 1. The integrated review framework. A = association studies; B, C, and D = pathway studies; M = moderation studies; R = multiple pathway studies.

articles focused on early SEC&IC and adult physical health outcomes. We narrowed our focus to relevant findings from 44 Add Health studies based on the review framework. Primary search terms included the following: early socioeconomic adversity, stressful life events, puberty, young adult physical health, trajectories, body mass index (BMI), self-reported health (SRH), diseases, allostatic load, mediation, moderation, race, ethnicity, self-control, and mastery.

This review incorporates studies that examined different kinds of physical health measures available in the Add Health dataset to assess health outcomes, including the following: (1) subjective repeated measures physical health (SRH) (e.g., rating one's own physical health status from poor to excellent) and objective repeated measures of BMI which were largely used to examine trajectories over adolescence-young adulthood labeled as physiological pathway and (2) diagnosed diseases and objective clinical measures reflecting cumulative physical health risk in young adulthood labeled as young adults' health outcomes. These include the following: (1) self-reported physician-diagnosed specific diseases, such as diabetes and hypertension; (2) counts of diseases that reflect morbidity in young adulthood; (3) more objective clinical measures of disease risk known as biomarkers such as systolic blood pressure, diastolic blood pressure, pulse rate, glycohemoglobin (HbA1c), glucose, triglycerides, high-density lipoprotein, low-density lipoprotein, BMI, and C-reactive protein obtained in young adulthood; and (4) computed composite indices using biomarkers to measure cumulative physiological dysregulation in young adulthood or disease/syndrome risk (e.g., cardiovascular disease risk, metabolic disease risk) reflecting overall physiological dysregulation. In the Add Health dataset, longitudinal measures of SRH, BMI, and self-reported physician-diagnosed disease are available at most waves beginning in adolescence, whereas more objective measures, such as biomarkers, are only available at Waves 4 and 5.

Association Studies (Path A)

A substantial number of Add Health studies provide evidence for the total associations between early SEC (e.g., community, school, and family) and IC (e.g., race, personality) on young adults' physical health, without investigating the intervening mechanisms. These association studies have used varying analytical approaches, such as multilevel regression and multiple regression, depending on the level of the predictor variables.

Association studies focusing on early social-ecological context

Multilevel analyses. A substantial number of Add Health studies provide evidence for the total associations between early SEC in one's community or school and young adults' physical health. Consistent with the life course perspective and social-ecological perspective, a stressful community context has adverse health consequences over the life course [2,3]. Early adverse community contexts may adversely influence body systems or biologically program them. Furthermore, chronic exposure to socioeconomic adversity in one's community may lead to physiological dysregulation through neuroendocrine processes, leaving youth vulnerable to chronic health issues that may continue into adulthood. Various dimensions can reflect an adverse community context early in life, including resource deprivation, community poverty, and community disorganization [2]. Furthermore, the school context may also influence youth's physical and mental health outcomes [3]. For example, school racial/ethnic composition (e.g., high concentration of White students in a school) has been shown to be associated with minority students' poor SRH during young adulthood, likely due to their early exposure to racism [3].

Because Add Health respondents are linked to census tracts, in addition to schools, studies have been able to assess the health implications of both school-level and community-level contexts. Add Health studies that use multilevel analyses to investigate the role of SEC have shown significant school-level [3] (e.g., SRH) as well as census tract-level [2] variations in young adult health outcomes (e.g., obesity, hypertension, and diabetes), indicating that both schools and communities are important in investigations of the implications of SECs. Importantly, multilevel Add Health studies have shown that early community and family of origin characteristics are independently associated with young adults' allostatic load as captured by their blood glucose levels, triglycerides, BMI, blood pressure, and the presence of C-reactive protein [4]. These studies have capitalized on the various available indicators of SEC by creating composite indices of cumulative early SEC adversity. These cumulative indices are considered stronger predictors of youth outcomes than individual dimensions of SEC [2]. These measures draw from considerable variety in dimensions of SEC, ranging from parents' marital history to incarceration and child maltreatment [5]. Some studies have addressed the potential heterogeneity in family adversity by examining patterns of early adversity using latent classes defined by multiple markers, such as family poverty and adolescent stressful family experiences [6].

Multiple regression analyses. Using multiple regression analyses, Add Health studies have shown that stressful family contexts, as reflected by dimensions such as poverty [4], mother's marital history [7], parents' poor health [8], parental incarceration [8], and ineffective parental practices [4], can exert a persistent influence on youth's subsequent physical health outcomes (e.g., SRH, multiple diseases and health problems diagnosed by physicians, and sexually transmitted infections), regardless of their social mobility. That is, even when youth overcome these early adversities in some respects (e.g., their own socioeconomic attainment as a young adult), the physical health consequences of early adversity often remain.

Furthermore, family socioeconomic adversity may increase parental emotional problems, thereby exposing youth to more hostile and ineffective parental practices. Moreover, intergenerational continuity of health is also associated with the transmission of resources (or lack thereof) and social interactions across family generations [8].

Association studies focusing on individual characteristics

Multiple regression analyses. A number of Add Health studies using multiple regression analysis have provided evidence for the life course associations of individual characteristics, such as genes, birth weight, infant feeding patterns (e.g., breastfeeding), and early health problems with regard to young adults' physical health [9–12]. Biological and behavioral mechanisms may be responsible for these life course health influences. An increasing number of Add Health studies using polygenetic scores show unique genetic health associations (e.g., gene-obesity) over the life course [10]. Moreover, early health problems, such as

childhood asthma, are associated with numerous health outcomes for young adults, including their SRH, obesity, and physical disability [11]. Moreover, these studies have shown stability in health constructs over time. For instance, adolescent cardiovascular health is associated with cardiovascular health in young adulthood [12].

Adolescent non-normative transitions can be considered another form of individual characteristic related to, but not fully explained by SEC, that may operate as determinants of young adult health outcomes because non-normative transitions can create a stressful life context. For example, earlier puberty [13] and non-normative transitions, such as early marriage or cohabitation [14], are associated with poor SRH and higher BMI in adult males and females. In addition, adolescent behaviors, such as delinquency, contribute to cardiovascular disease risk in young adults [15].

Due to racial/ethnic discrimination, minoritized adolescents may experience greater SEC, including deprivation of necessary material and psychosocial resources, with detrimental consequences for their psychophysiological functioning. The health disadvantages of minority race/ethnic status (e.g., Black, Native Americans) and second-generation immigration status have been documented in Add Health studies [3]. Importantly, darker skin tone, which is an individual characteristic that may be different from one's self-reported racial/ethnic status, was found to be associated with hypertension in young adult siblings after accounting for common family background environments [16].

Methodological concerns. Most Add Health studies that focused on early community and school contexts have used multilevel regression analyses, while studies that focused on individual/family contexts have used traditional regression analyses after accounting for the nested structure of data. Relatively few studies have examined multilevel factors simultaneously, considering communities, school, family, *and* individual characteristics in connection to health outcomes, and even fewer have considered multiplicative influences (i.e., cross-level interactions) [17] between multilevel factors. Such examinations would provide further insight into nonlinear associations.

Although the findings of most association studies are consistent with sensitive period and fetal origin life course hypotheses, omitted variable bias, due to not considering relevant predictors, may be present. However, the design features of the Add Health study, particularly the rich archive of longitudinal prospective data, coupled with appropriate analytic designs enable researchers to mitigate the potential for omitted variable bias. These analytic designs include, for instance, accounting for measurement errors and genetic differences by incorporating school [11], family [11], and sibling fixed-effects [11,15]. Furthermore, the longitudinal design of the Add Health study with retrospective and prospective data has allowed researchers to account for lagged health effects, confounding variables, and young adult socioeconomic status (SES) (a known correlate) in addition to focusing on absolute change over time when predicting health outcomes.

Physiological Pathway Studies (Paths B1 and B2)

The multiple health biomarkers available for young adults in the Add Health data enabled studies addressing the association among early SEC&IC and young adults' allostatic load, cardiometabolic problems, and functional disability using intervening physiological markers, such as SRH [18], physical pain [19], and BMI [20]. This biopsychosocial research has shown that early SEC can influence later physical health through physiological processes that affect immune and stress-related neuroendocrine functioning [21]. Furthermore, this research consistent with the life course perspective emphasizes that physiological status is linked across life stages, forming a pathway that connects early SECs to young adults' physical health outcomes [21]. Using a structural equation modeling (SEM) approach, researchers have evaluated multiple mediating pathways in a single modeling framework [19,20]. Physiological pathway studies have used varying analytical approaches, such as autoregressive (AR) models and latent growth curve models (LGCM), within an SEM framework, depending on the availability of repeated measures and the level of heterogeneity in the data.

AR models are an effective approach for addressing the linkages in physiological status over time when repeated assessments of physiological status are available. For example, Kane et al. [18], capitalizing on the availability of repeated measures, assessed an autoregressed latent construct of poor global physical health (as defined by BMI, SRH, and physical activity) that predicted metabolic problems in young adults. Using SEM, this study also accounted for measurement errors using multiple indicator constructs, reverse causation of social status and health at a point in time, and corrected attenuation of regression parameters.

Using the AR approach, other researchers have investigated the *time-sequential process* of physiological status to research how a health construct at one occasion is linked to the same health construct at a subsequent occasion. These AR effects describe the rank-order stability, or individual differences, in health status over time. Furthermore, when coupled with another AR pathway of a time-varying variable (e.g., poor health and human capital) [18], the relative strength (i.e., causal predominance) of the cross-lagged influences of these parallel attributes can be examined. These models are referred to as cross-lagged autoregressive models (CL-AR). When a CL-AR model is based on a strong theory and a proper temporal design (e.g., appropriate time lags between measurement occasions), the model provides important evidence for the causal order of attributes [18]. However, there are several drawbacks to these AR models. First, these models focus on individual differences in rank order (standing) of the attribute examined and are not sensitive to intra- or within-individual (absolute) changes, which may occur between assessments. Second, in these models, predictors explain the residual variance of health outcomes *after controlling* for the lagged health variable. Consequently, if a health construct is highly stable over time, there is no residual change to be predicted by other variables.

Trajectory analyses: latent growth curve models

In mitigating the drawbacks of the AR approach, some Add Health studies [4,21–23] have defined physiological pathways as continuous trajectories over the early life course using latent growth curve models (LGCM) in an SEM framework considering young adult physical health outcomes as the endpoints of these continuous trajectories. The estimation of an LGCM explicitly focuses on intraindividual change by first estimating regression paths involving the initial level (intercept) and intraindividual change (slope) for each individual.

Then, using these intraindividual parameters, latent constructs of initial level and rate of change for the sample are defined with means and interindividual variations. Some Add Health studies utilizing LGCM have shown that trajectories of physiological attributes, such as SRH, may have additional growth factors reflecting nonlinear change [22]. These latent growth factors can be predicted by regressing them on predictors of interest (e.g., SEC&IC).

Using LGCM, a large number of Add Health studies have investigated how early social-ecological adversities, such as disengaged parenting [7], child maltreatment [23], residential mobility [24], family socioeconomic adversity [22], and community socioeconomic adversity [19], influence both the severity (i.e., initial level) and the rate of change (i.e., slope) of physiological attributes (e.g., BMI and SRH trajectories). Specifically, the effect of early SEC&IC on the initial level latent construct reflects the initial inequalities in physiological status [20], while the effect of early SEC&IC on the slope reflects an increasing influence of SEC&IC on the absolute change in physiological status over time [20]. The influence on the slope is consistent with the cumulative disadvantage perspective [25], which posits a compounding effect of early adversity where the effect of adversity continues to "grow" creating further inequality over time. In addition, LGCM allows for the investigation of how distinct courses of health (as evidenced by the level and slope parameters) may uniquely predict distal chronic health outcomes (e.g., metabolic diseases).

Integrating autoregressive and latent growth curve models

Recent Add Health studies have suggested that integrating a trajectory approach (i.e., LGCM) with an AR approach enables a focus on *both* intraindividual absolute change and AR associations (accounting for a lagged effect involving rank order) in the outcome of interest. More specifically, residuals from an LGCM can be used to estimate and incorporate AR effects into the analysis, resulting in a hybrid model, known as an autoregressive latent trajectory (ALT) model. In one Add Health study [26] examining SRH, an ALT model of SRH outperformed both an LGCM and an AR model, revealing both continuous SRH trajectories over time and enduring AR SRH associations. That is, there were multiple aspects of the change in SRH. In addition to the severity (i.e., initial level) and the rate of change (i.e., slope) in the SRH trajectories over time, which were identified by the LGCM portion of the ALT model, rank-order change in SRH was identified by the lagged effect from the AR portion of the model. ALT models can be compared across different groups to examine group variations in trajectories and AR associations within the same analytical framework [26].

Stress Pathway Studies (Paths C1 and C2)

Numerous Add Health studies have illustrated the stress pathway that stems from SEC. The stress pathway is comprised of stressful experiences over the adolescence transition to adulthood that explain the association between SEC and young adults' physical health outcomes. Stress pathway studies have used varying analytical approaches such as path analysis, LGCM, and growth mixture modeling (GMM) within an SEM framework, depending on the availability and the level of heterogeneity of data.

Path analyses

Using path analysis, studies have shown that the influences of family SES, parental health, and parental substance use on young adults' health outcomes, such as SRH and cardiovascular disease risk, are mediated by youths' stress experiences. These stress experiences include youths' stressful life events, financial stress, and psychological distress, as well as stress responses, such as psychological and physical behaviors [6,27]. That is, early stress experiences may linger over the life course and influence youths' physical health outcomes through inflammatory and neuroendocrine processes. Consistent with the life course perspective, adolescent stress experiences (both stressful life circumstances and stress responses, such as psychological distress, internalizing and externalizing problem behaviors, and health risk behaviors) are linked to subsequent stress experiences in a successively contingent manner, forming a stress pathway and *proliferating* as a cascading chain of stress experiences or *extending* as a continuous trajectory of stress. These repeated or continuous stressful experiences may erode youths' coping resources, further increasing their health risk.

Trajectory analyses: latent growth curve models

Some stress pathway studies have employed the previously discussed LGCM approach to examine the influence of SEC&IC on cardiovascular disease risk, measured by a composite index of BMI, smoking, systolic blood pressure, diabetes, and antihypertensive medication use in young adulthood [27,28]. LGCM is a variable-centered approach, meaning that an inherent assumption is that all individuals (or trajectories) are drawn from a single population for which a single set of "averaged" parameters can be estimated. However, researchers have realized that this assumption is not always valid because samples can be composed of multiple unknown subpopulations of socially stratified stress trajectories with different patterns (i.e., population heterogeneity).

Growth mixture models

GMM is useful for the identification of subpopulations (i.e., latent classes) of individuals with similar trajectories [29]. Trajectory class membership is inferred from the data with this person-centered analytical approach. Then, predictors and outcomes of the identified subgroups or classes of individuals are examined. Previous Add Health studies using GMM have identified latent trajectory classes of stress experiences, such as depressive symptoms [29] and violent victimization [30], and related them to early antecedents and/or later health outcomes. For example, research identified 4 trajectory classes with distinct patterns of depressive symptoms over time [29]. Compared to the group exhibiting consistently low symptoms, youth in the chronically high, increasing, and decreasing depressive symptom groups averaged greater increases in physical health problems in young adulthood, such as sexually transmitted diseases, asthma, diabetes, SRH, and obesity.

It is also feasible to investigate the comorbidity of stress responses by incorporating comorbid trajectories when identifying classes (e.g., conjoint trajectory classes). For example, research identified 4 distinct conjoint health risk trajectory classes capturing co-occurring trajectories of substance use behaviors, obesogenic-related behaviors, and depressive symptoms [31];

youth exposed to early adverse SECs with overall high-risk conjoint trajectories averaged higher cardiometabolic disease risk, measured by a composite index of systolic blood pressure, diastolic blood pressure, pulse rate, HbA1c, glucose, triglycerides, high-density lipoprotein, low-density lipoprotein, and BMI in young adulthood.

Resource Pathway Studies (Paths D1 and D2)

The findings of Add Health studies suggest that early SEC&IC is related to physical health in young and middle adulthood through the development (or depletion) of psychosocial resources and positive life experiences. Resource pathways occur over the early life course through resource enhancement influenced by early SEC affluence or resource depreciation influenced by early SEC adversity. Resource pathway studies have used varying analytical approaches such as LGCM [32] and path analysis [33,34] within an SEM framework.

Trajectory analyses

Positive school and family relational characteristics during adolescence, such as school connectedness and support from parents, also exert a persistent beneficial influence on youth's behavioral outcomes in terms of healthy behavior trajectories [32]. Furthermore, early SES sets a life course trajectory of socioeconomic well-being and operates through adult SES to influence physical health as adults age [33].

Path analyses

Specifically, previous studies show that early-life SES protects against physiological dysregulation and metabolic disorder over the life course. However, the protective effect of education, an indicator of SES, remained persistent for inflammation markers but declined with age for metabolic disorder. Conversely, early adverse SECs impair the development of youth's psychosocial competencies, such as self-esteem, positive personality, and education attainment, which, in turn, increase young adults' cardiometabolic disease risk [34].

Multiple Pathway Studies (Path R)

Some previous Add Health studies support this contention by noting multiple pathways responsible for the connection between SEC and physical health outcomes in young adulthood [14,19,28,34]. Compared to focusing on a specific pathway (e.g., stress or resources), studies investigating multiple pathways that correspond to different biopsychobehavioral processes may prove fruitful for better understanding how early SEC&IC comes to impact young adults' physical health outcomes. Moreover, these processes may be comorbid and mutually influence each other over time, forming complex health processes with additive and synergetic influences. These possibilities underscore the need for broadening the previously discussed pathway investigations.

These studies have also used various analytical strategies, such as (1) path analysis models (e.g., incorporating stress, socioeconomic, and behavioral pathways stemming from mothers' marital history and cumulative socioeconomic adversity) [14,34], (2) CL-AR models (e.g., incorporating poor physical health and human capital pathways with cross-lagged influences) [19], and (3) parallel latent growth curve models (e.g., incorporating associated BMI trajectories and depressive symptom trajectories stemming from cumulative family adversity) [28].

Moderation Studies (Path M)

Consistent with the life course social mobility hypothesis, Add Health studies [35,36] have shown that previously discussed associations and pathways connecting early SEC&IC and young adults' physical health outcomes may be moderated by individual characteristics, such as life transitions, psychological resources and vulnerabilities, gender, and race/ethnic disadvantages. In addition to additive influences, psychosocial resources, such as positive effect, may protect youth from the detrimental influence of adverse SECs and the associated physiological effects of adversity. Add Health moderation studies have used varying analytical approaches such as multiple regression or path analysis (using a product term) and multigroup analysis to test moderating effects.

Multiple regression

Using multiple regression analysis, one study has shown the protective role of positive effect in relation to stress and inflammation [35]. Moreover, life transitions, such as military service, may build resiliency by providing educational, social, and psychological advantages and operate as a type of social control to mitigate stress pathways, such as depressive symptoms, leading to poor physical health [36]. Conversely, individual vulnerabilities, such as minority race/ethnic disadvantages and immigrant status, may amplify the detrimental health influence of adverse SECs (e.g., increased physiological dysregulation) [3].

Consistent with the skin-deep resilience hypothesis, using multiple regression and path analysis within an SEM framework, studies [37–40] have shown that socioeconomically or racially/ethnically disadvantaged youth who work hard to succeed in life, as evidenced by their psychological and educational achievements, may pay a cost for their hard work in the form of poor physical health. Striving for educational success [37], college completion [38], and socioeconomic attainment [39] in the context of marginalization and childhood disadvantage, as well as minority race/ethnic disadvantages (non-Hispanic Black and Mexican American), has been shown to contribute to poor physical health outcomes, particularly cardiometabolic disease risk in young adulthood. Similar adverse physiological processes may exist for minority adolescents. For example, high-striving Black adolescents in the most disadvantaged families were more likely to develop type 2 diabetes during young adulthood than high-striving Black adolescents living in more privileged families [40]. By oversampling Black respondents, the Add Health study design has facilitated intragroup studies such as these.

Multigroup analyses

A number of Add Health studies that used multigroup analyses within an SEM framework, provide evidence for this race/ethnicity variation in vulnerability to stressful life experiences. For example, Add Health studies have shown that Black youth are less vulnerable to early cumulative socioeconomic adversity than their White counterparts but are more vulnerable to socioeconomic adversity at a later stage in life, in terms of cardiometabolic risk in young adulthood [41].

These studies have documented that racial/ethnic disparities in health may stem from multiple socioecological levels through different processes. Community/school contexts may initiate disadvantage processes associated with adverse macro-characteristics, such as racial/ethnic segregation, concentration of poverty, and community disorganization. In addition, family contexts may initiate more microlevel disadvantage processes associated with family characteristics, such as family economic pressure, parental health, parental incarnation, and parental marital status. These microlevel processes are nested in macro-level processes producing multilevel influences for minoritized youth.

Notably, racial/ethnic disadvantage entails unique stress exposure and unique resilience/vulnerabilities depending on the individual's life stage and other contextual considerations. For example, family and community resources, such as ethnic density, extended family structure, and supportive and warm parenting may protect minoritized adolescents from the detrimental influence of adverse SECs. However, minoritized young adults often experience age-specific socioeconomic challenges as they are exposed to more social stressors, such as racial discrimination, over time as they develop.

Although null or negative findings are published less frequently, some Add Health studies have also have reported findings counter to theoretical expectations. For example, one study found that family instability during adolescence was associated with either null findings or *better* health outcomes in adulthood [42]. Furthermore, Black and Hispanic young adults who climb the social ladder by rising from a disadvantaged adolescent environment to complete college were found to have *worse* physical health (higher likelihood of metabolic syndrome) than Black and Hispanic young adults who come from disadvantaged backgrounds but do not attend college. In contrast, Whites from disadvantaged backgrounds who complete college were found to have better health [43]. Another study found that the buffering effect of parental closeness on the association between adverse community context on adolescent depressive symptoms dissipates under extreme adverse community context [44].

Future Directions

This review shows that, as a whole, findings from Add Health studies demonstrate convincing evidence of the associations between early SEC&IC and young adults' health outcomes. Using these studies, we developed an integrated review framework rooted in stress process, social-ecological, and biopsychosocial theoretical perspectives along with life course hypotheses. The Add Health studies reviewed explain physical health disparities and inequalities over the first half of life course and identify physiological, stress, and resource pathways as mechanisms that explain these associations as well as the moderating role of individual resources/vulnerabilities as factors that can protect against or amplify health inequalities stemming from SEC&IC. In addition, we discussed the appropriateness of analytical strategies used in Add Health studies of physical health. This integrated framework can be utilized to derive testable models for future research exploring links from early socioeconomic adversity to young adult physical health disparities. This review is also useful to identify appropriate analytical methods for testing hypothesized associations and pathways explaining physical health outcomes. Particularly, the review emphasizes numerous factors that must be taken into consideration when selecting analytical methods, such as understanding the hypothesized type of change (absolute and relative), modeling constructs at the appropriate level (individual or multilevel), accounting for the type and temporal order of variables, utilizing multiple indicators when available, and identifying existing, unobserved, heterogeneity.

This review study also brings to light several important practical implications for interventions targeting early socioeconomic adversity and subsequent health disparity outcomes. First, interventions should aim to target physiological, stress, and resource pathways earlier in the life course to reduce the incidence and severity of health risks in later years. Also, the current review highlights the intervention and prevention opportunities stemming from the psychosocial resources which include self-control, mastery, and self-esteem which appear to be a primary moderator of multiple pathways responsible for the adversity health association.

As the Add Health study continues, with respondents entering midlife (after 40 years of age), a similar ecological framework with a long view can be used to explain health inequalities and disparities in middle adulthood. However, new dimensions of SEC and associated experiences will be important to consider. For instance, salient SEC dimensions in midlife include the family of procreation, marriage, adolescent children, aging parents, and work, which have been shown to be associated with physical health directly and indirectly through life experiences. This means that midlife experiences and adolescent/young adult life experiences (some of which continue into midlife) may have unique additive and multiplicative influences on midlife health. Moreover, midlife research has shown that midlife, as a life stage, is often dense in life events and circumstances (both stressful and positive) with various marriage (e.g., spousal support, divorce), family (e.g., economic events, children leaving home, caring for aging parents), and work (e.g., work dissatisfaction/satisfaction, work-family conflict) characteristics to consider. Chronic stress acquired early in life and carried into midlife may combine with acute stressful life events to influence physical health. Thus, a proper investigation of midlife health disparities and inequalities requires detailed information on midlife positive and negative life events and circumstances in multiple life domains. Similarly, capturing respondents' experiences with recent macro/policy-level changes, such as healthcare/insurance, family leaves, and immigrant and minority policies, may also prove useful for understanding health inequalities and disparities in the middle years in connection to previous life experiences. With regard to health outcomes, it is important to gather information on age-specific (e.g., physical pain, sleep) and gender-specific (e.g., women's health) midlife health outcomes, including relevant biomarkers.

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