Understanding child disadvantage from a social determinants perspective

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ABSTRACT

Background Child health and developmental inequities exist in all countries. Comprehensive and robust concepts of disadvantage are fundamental to growing an evidence base that can reveal the extent of inequities in childhood, and identify modifiable leverage points for change. We conceptualise and test a multidimensional framework of child disadvantage aligned to a social determinants and bioecological perspective.

Methods The Longitudinal Study of Australian Children is a nationally representative sample of two cohorts of Australian children, including the birth cohort of 5107 infants, which commenced in May 2004. The analysis focused on disadvantage indicators collected at age 4–5 years. Confirmatory factor analysis was used to test a theoretically informed model of disadvantage. Concurrent validity was examined through associations with academic performance at 8–9 years.

Results The model comprising four latent factors of sociodemographic (10 indicators), geographical environments (three indicators), health conditions (three indicators) and risk factors (14 indicators) was found to provide a better fit for the data than alternative models. Each factor was associated with academic performance, providing evidence of concurrent validity.

Conclusion The study provides a theoretically informed and empirically tested framework for operationalising relative child disadvantage. Understanding and addressing inequities will be facilitated by capturing the complexity of children's experiences of disadvantage across the multiple environments in which their development unfolds.

INTRODUCTION

Disadvantage is multifaceted. Philosophical perspectives emphasise disadvantage as limiting opportunity and the capacity for individuals to freely lead lives they have reason to value.[1] In the context of health equity, disadvantage refers to relative position in a social hierarchy determined by wealth, power and prestige.[2] In contrast to concepts of poverty that focus on those who are the most deprived (eg, of money or material possession), socially excluded and/or vulnerable,[3] disadvantage exists on a continuum.

For children, disadvantage manifests as the circumstances in which they live, learn and develop that drive differential health and developmental outcomes.[4] Children experience poorer health and developmental outcomes with successively higher levels of disadvantage, evidencing the significance of relative position on the disadvantage continuum.[5–10] These differential outcomes represent inequities that are unjust, unnecessary and preventable, and due to population differences in social, demographic or economic circumstances.[4 11] Inequities exist in all countries, including Australia, across children's physical health, social-emotional well-being and learning.[4 12]

Exposure to early disadvantage and inequity constitutes a significant and ongoing public health problem with major implications for public policy. The capacity to change developmental trajectories declines with age; therefore, failure to redress early inequities results in increasingly wide disparity gaps in rates of mortality and physical, social and cognitive impairments in adulthood.[13] The WHO Commission on Social Determinants of Health has called for the elimination of inequitable health outcomes within a generation.[4 14] Developing policy to achieve the goal of 'equity from the start' depends on a rigorous understanding of the extent of the problem and identification of the modifiable leverage points for change.[15] The robust conceptualisation and measurement of disadvantage in the child population is fundamental to growing this evidence base.

In operationalising the concept of disadvantage, conventional approaches typically measure children's experiences of disadvantage as socioeconomic status (eg, parental education, occupation and income), but this is inadequate in failing to capture the complex and multifaceted ways in which disadvantage can manifest. The literature on poverty suggests that material and socioeconomic factors alone substantially underestimate the extent of poverty experienced by children in a given population.[3 16–18] In relation to disadvantage, such approaches cannot reveal the full extent of social gradients in children's health and developmental outcomes, and are unable to capture the pathways through which disadvantage shapes children's access to opportunities. This may limit the identification of specific strategies to reduce existing child health and developmental inequities that can help-fully inform policy.[19]

To address these issues, we propose a social determinants approach that also considers the bioecological settings in which child development occurs as a paradigm for understanding and operationalising disadvantage (figure 1). The bioecological perspective suggests that children's biology interacts with
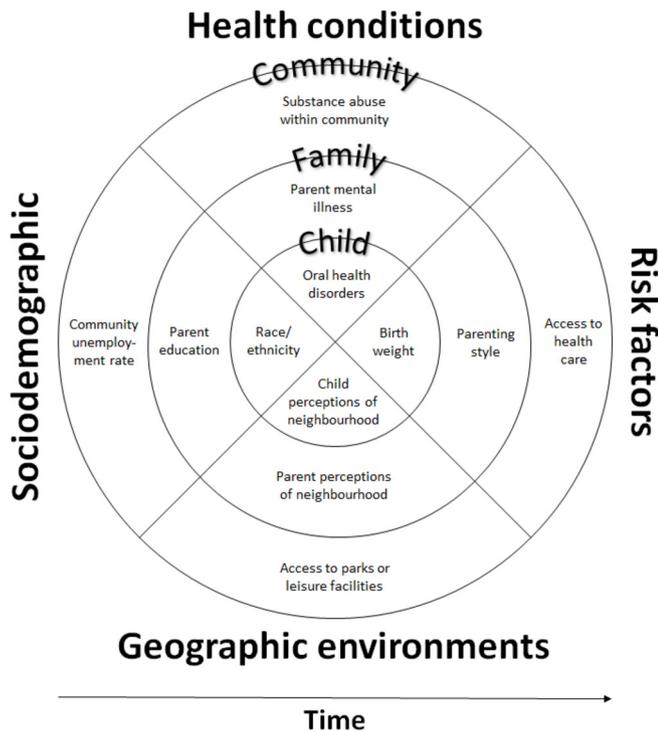
Figure 1 Proposed framework of child disadvantage aligning a social determinants[22] and bioecological[20] perspective. Examples of relevant indicators within each lens (sociodemographic, geographical environments, health conditions and risk factors) and level (child, family and community) are shown. It is expected that disadvantage experienced through each of these lenses will overlap and interact to influence inequities in complex ways.[22]

the multiple nested levels of their surrounding social and physical environments to shape child development.[20] Sources of disadvantage may therefore arise at the individual level (eg, poor nutrition), family level (eg, low parent education) and community level (eg, dangerous neighbourhood).[21]

A social determinants perspective sits comfortably with this developmental paradigm. Social determinants refer to the 'conditions in which people are born, grow, live, work, and age'.[4] Koh et al[22] proposed that social determinants can be viewed through four overlapping 'lenses' or perspectives. The *sociodemographic* lens captures characteristics (eg, ethnicity) that define subpopulation groups that are at risk of poorer outcomes by virtue of their membership in that group. The *geographical environments* lens captures the characteristics of the places in which children live that drive inequities through processes such as socioeconomic segregation and barriers to services. The *health conditions* lens captures diagnosable conditions that drive inequities due to being unevenly distributed across social groups. The *risk factors* lens captures attributes, characteristics and exposures that increase the likelihood of poor child health and developmental outcomes, and are again unevenly distributed across the population. It is expected that disadvantage experienced through each of these lenses will overlap and interact to influence inequities in complex ways,[22] and each of these lenses will manifest across children's ecological settings.

In this study, we empirically test the proposed framework (figure 1) of relative child disadvantage aligned with both bioecological[20] and social determinants[22] perspectives. Disadvantage is measured at 4–5 years as children approach a key transition with the start of formal schooling.[23] We compare different ways

of structuring the data to identify an optimal model. We then examine concurrent validity of the factors derived from this model through associations with academic performance because an established research base suggests that a sound assessment of disadvantage should correlate with this outcome.[12] The aim is to obtain a well-tested child-specific framework for understanding and operationalising disadvantage, which can be used to more accurately quantify the extent of child inequities and reveal policy-sensitive intervention pathways.

METHOD
Data source
Growing Up in Australia: the Longitudinal Study of Australian Children (LSAC) is a nationally representative sample of two cohorts of Australian children—the birth cohort (B-cohort) of 5107 infants on which the current study is focused and the kindergarten cohort (K-cohort) of 4983 children aged 4 years—each of which commenced in May 2004.[24] The LSAC design and sampling methodology is documented elsewhere.[24 25] In short, a complex survey design was used to select a sample that was broadly representative of all Australian children except those living in remote areas.[25] Data are collected on multiple aspects of child development as well as family and community characteristics, and multiple information sources are used, including parent interview, direct child assessments and observational measures, parent and teacher self-report questionnaires, and linkage to administrative datasets.

The current paper draws on data from the B-cohort (51.2% male), focusing on primarily parent-reported data collected at wave 3 when children were aged 4–5 years (school entry). At wave 3, the B-cohort consisted of 4386 children, representing 85.9% of the original sample; this level of attrition compares well with similar cohort studies (eg, ref 26). Missing data within wave 3 were low (average of 5.71% missing in the variables used). To examine concurrent validity, we also drew on children's results from a direct assessment of academic skills at 8–9 years: the National Assessment Program–Literacy and Numeracy (NAPLAN) conducted on all Australian students. NAPLAN was successfully linked for n=3790 (86.4%) of the wave 3 participants.[27]

Measures
Disadvantage indicators at 4–5 years
To operationalise the disadvantage framework illustrated in figure 1, indicators signalling disadvantage across the bioecological levels (individual, family, community) and social determinant lenses (sociodemographic, geographical environments, health conditions and risk factors) were selected if they were (1) available in the LSAC dataset, (2) relevant at the focal time point of 4–5 years and (3) identified in the literature as salient to child developmental outcomes (see online supplementary file for details).

The rich data available in LSAC allowed all four lenses across bioecological settings to be operationalised with some exceptions, mostly at the community level. Where multiple LSAC variables were available to measure the same construct, selection was based on measurement qualities (ie, validity, reliability) and best practice measurement of that construct. Variables contained a mixture of dichotomous and continuous indicators; the full range of scores available for continuous indicators was retained to capture variation across their continuum (eg, from optimal parenting to less effective parenting behaviours).

Because the social determinant lenses overlap, some variables could be aligned with more than one lens. For example, children with a disability were considered a population of children with special needs therefore aligning with the sociodemographic lens, but their disability could alternatively have been qualified in the health conditions lens. Caregiver disability, on the other hand, fits more conventionally in the health conditions lens, rather than considering children to be part of a population who have a parent with a disability. In ambiguous cases, indicators were categorised based on what most closely resembled the original theoretical model presented by Koh et al.[22]

Table 1 provides a summary of the disadvantage indicators analysed at 4–5 years (see refs [28] [29] for further details). Note that indicators were not available for some cells of table 1 due to a lack of suitable measures in the dataset (eg, risk factors at the community level).

Academic performance at 8–9 years

NAPLAN[27] is an Australia-wide direct assessment of academic skills conducted in schools with all children in grades 3, 5, 7 and 9. NAPLAN measures students' skills in reading, writing, spelling, grammar and punctuation, and numeracy, which are mapped onto achievement scales with scores that range from 0 to 1000. Given that the subscales are highly correlated ($r=0.69$ to $r=0.84$), the mean across these subscales was taken for each child as an indicator of general academic performance at 8–9 years.

Analytic approach

Analyses were conducted using Mplus V.7.3. All models were analysed with simultaneous multiple imputation to account for missing data, with five datasets created and pooled estimates reported.

First, we empirically tested the proposed framework of childhood disadvantage as operationalised within LSAC (table 1). Four different ways of structuring the data could be hypothesised from the theoretical framework:

1. A single, global disadvantage factor.
2. A three-factor model representing the bioecological levels of child, family and community.
3. A four-factor model representing the social determinant lenses of sociodemographic, geographical environments, health conditions and risk factors.
4. A twelve-factor model representing the four social determinant lenses interacting with the bioecological levels.

We used confirmatory factor analysis (CFA) to compare these different ways of structuring the data. CFA allows the extent to which a theorised underlying covariance structure fits the observed data to be explicitly tested, and for the fit of different theorised models (comprising different numbers of latent factors) to be statistically compared. Latent factors are not directly measured but are inferred from multiple observed variables that reflect variation in the same underlying construct. The four theorised models were compared according to absolute fit using Bayesian posterior predictive checking (PPC).[30] The optimal model was determined to be that with the PPC estimate closest to zero (ie, the least deviance from data simulated from the theoretical covariance structure) that also did not overlap with the credibility interval of a more parsimonious model. CFA was performed over exploratory factor analysis because CFA is preferred when there is a strong theory underlying the structure of the measurement model, as was the case here.[31]

Table 1 Disadvantage indicators measured in LSAC at 4–5 years according to the four social determinant lenses and bioecological setting

	Child	Family	Community
Sociodemographic	Child speaks language other than English	Main caregiver speaks language other than English	
	Child has medical condition or disability	Main caregiver income	
		Household income	
		Main caregiver level of education	
		Main caregiver occupation	
		Main caregiver financial hardship	
		Parents of child are partners	
		Number of people in household	
Geographical environments		Neighbourhood liveability	Urban versus regional location (L)
			Community socioeconomic status (L)
Health conditions	Child tooth decay	Main caregiver depression	
		Main caregiver medical condition or disability	
Risk factors	Child body mass index (D)	Main caregiver body mass index	
	Child eats high fat foods and high sugar drinks	Main caregiver smoking status	
	Child unmet need for services	Main caregiver binge drinking	
	Child physical inactivity	Main caregiver physical arguments with partner	
		Home education environment	
		Number of homes child lived in	
		Main caregiver argumentative partner relationship	
		Main caregiver angry parenting style	
		Stressful life events within the family	
		Main caregiver unmet need for social support	

All variables are parent reported except where indicated.
D, direct assessment; L, linked data; LSAC, Longitudinal Study of Australian Children.

After identifying the optimal model, continuous scores for each latent factor were generated for each participant, with five plausible values (PVs) imputed. PVs provide an estimate of the plausible range of children's scores on the unobserved latent factors.[32] Five imputed PVs were considered sufficient as no

Table 2 Model fit according to posterior predictive checking (PPC)

Model	Posterior predictive checking (95% CI)
Single, global factor	4658.39 to 5031.41
Three-factor bioecological model	4192.33 to 4577.92
Four-factor lenses model	2979.81 to 3318.19
Twelve-factor bioecological by lenses model	3135.27 to 3480.68

information gain was expected beyond this.[33] Scale reliability was assessed using the intercorrelation of the PVs, that is, the mean of the lower diagonal of the correlation matrix for the five PVs for each factor estimated. Hereafter, PVs are referred to as latent factor scores for simplicity.

In the second step of the analysis, the concurrent validity of the final model was tested. Generalised linear models were used to examine associations between the latent factor scores derived in the first step of the analysis and children's academic performance at 8–9 years. Analyses accounted for clustering and sample weights in the LSAC data to estimate appropriate (robust) standard errors. The sociodemographic lens includes the presence of a medical condition or disability, and n=84 (1.91%) children were reported by parents as having a medical condition or disability associated with 'difficulty learning or understanding things'. To rule out the possibility that learning difficulties were simply predicting learning problems, we performed the analysis on the whole sample (with and without adjusting for learning disability) and also excluding children with learning disability, and results were similar across all approaches.

RESULTS
Testing the hypothesised framework of disadvantage
Using CFA, four different ways of structuring the data were compared (table 2). According to the combined criteria of lower PPC estimates and parsimony, the best fitting model was model 3, structuring the data according to the four lenses of sociodemographic, geographical environments, health conditions and risk factors.

Table 3 presents the final model with standardised factor loadings. Correlations between the four factors (table 4) were relatively low indicating that they were related but unique. Scale reliability was acceptable with α estimates in range 0.63–0.84.

Table 3 Factor loadings for optimal model reflecting the four factors of sociodemographic, geographical environments, health conditions and risk factors

	Factor loadings			
	Sociodemographic	Geographical environments	Health conditions	Risk factors
Child speaks language other than English	0.26	–	–	–
Child has medical condition or disability	0.11	–	–	–
Main caregiver income	0.53	–	–	–
Household income	0.77	–	–	–
Main caregiver speaks language other than English	0.16	–	–	–
Main caregiver level of education	0.43	–	–	–
Main caregiver occupation	0.56	–	–	–
Main caregiver financial hardship	0.55	–	–	–
Parents of child are partners	0.62	–	–	–
Number of people in household	0.14	–	–	–
Neighbourhood liveability	–	0.34	–	–
Community socioeconomic status	–	0.94	–	–
Urban versus regional location	–	0.63	–	–
Child tooth decay	–	–	0.25	–
Main caregiver depression	–	–	0.87	–
Main caregiver medical condition or disability	–	–	0.31	–
Child body mass index	–	–	–	0.14
Main caregiver body mass index	–	–	–	0.19
Child eats high fat foods and high sugar drinks	–	–	–	0.16
Main caregiver smoking status	–	–	–	0.30
Main caregiver binge drinking	–	–	–	0.11
Child unmet need for services	–	–	–	0.28
Main caregiver physical arguments with partner	–	–	–	0.48
Home education environment	–	–	–	0.19
Number of homes child lived in	–	–	–	0.16
Child physical inactivity	–	–	–	0.09
Main caregiver argumentative partner relationship	–	–	–	0.54
Main caregiver angry parenting style	–	–	–	0.37
Stressful life events within the family	–	–	–	0.40
Main caregiver unmet need for social support	–	–	–	0.64

P<0.05 for all loadings.

Table 4 Intercorrelations, reliability and concurrent validity of factors

	Sociodemographic	Geographical environments	Health conditions	Risk factors
Correlations between factors				
Sociodemographic	1			
Geographical environments	0.47	1		
Health conditions	0.21	0.10	1	
Risk factors	0.33	0.18	0.76	1
Reliability (Cronbach's α)				
	0.75	0.84	0.71	0.63
Association with academic performance (concurrent validity)				
β (95% CI)*	−66.89 (−75.08 to −58.70)	−51.70 (−58.48 to −44.91)	−27.03 (−39.29 to −14.77)	−36.85 (−46.26 to −27.43)

P<0.05 for all correlations and coefficients.

*n=84 (1.91%) of children with a learning disability were excluded from this analysis.

Concurrent validity of the disadvantage model

Continuous latent factor scores for sociodemographic, geographical environments, health conditions and risk factors were derived for each participant during the CFA. Associations between these latent factor scores and academic performance at 8–9 years supported the concurrent validity of the optimal model (table 4). Each of the factors had substantial relationships with children's later academic skills, predicting poorer skills as expected.

DISCUSSION

We aimed to rigorously test our framework of child disadvantage (figure 1) at 4–5 years. The findings indicated that a four-factor model representing the social determinant lenses of sociodemographic, geographical environments, health conditions and risk factors was a superior fit for the data compared with alternative models. The model also showed good concurrent validity, with all four factors predicting children's academic performance 3–4 years later. This theoretically informed and empirically tested framework of child disadvantage is well equipped to inform the extent of child health and development inequities and opportunities to intervene.

This study has successfully applied the previously published model proposed by Koh et al[22] of four 'lenses' for viewing the social determinants of health to a child population. The results suggest that it is an empirically valid structure for representing childhood disadvantage. Consistent with current thinking,[1 19] child disadvantage was best measured as a multidimensional construct: the low–moderate intercorrelations between the lenses provide evidence that they represent distinct but related aspects of disadvantage in a child population. Although the model structured according to children's bioecological contexts was not the statistically preferred model, a range of child-level, family-level and community-level indicators loaded meaningfully on each of the lenses. This reinforces the importance of considering children's bioecological contexts when conceptualising and measuring disadvantage.[21]

Compared with traditional socioeconomic indicators, this framework of child disadvantage seems to more adequately capture the 'real-life' experiences of children and the varied influences on their development. There are a number of measures of child poverty that similarly also extend beyond socioeconomic indicators (eg, the UK Poverty and Social Exclusion Survey[34]); however, these measures have been mostly designed to identify and describe the most deprived children. By including variables that ranged across the full disadvantage continuum (from most to least disadvantaged), our approach is well suited to exploring how incremental increases in disadvantage on each lens may be associated with shifts in children's outcomes.

Each of the four lenses showed evidence of concurrent validity. Specifically, each was associated with academic performance at 8–9 years. The well-established association[35] between disadvantage and academic performance is likely due to a range of mechanisms, such as less access to resources that promote learning in the home[36] or to quality early childhood programmes and schools.[37] It may also be due to shared causes like heritability of conditions impacting on both family disadvantage and children's school experience. We explored the association with academic performance as a validity check to ensure the model was operating sensibly in relation to a known correlate of disadvantage, but it is worthy of focused exploration in future work.

Strengths and limitations

The breadth and richness of data available within the LSAC allowed us to rigorously test our framework. Nevertheless, some aspects could not be measured due to a lack of available data. Within the LSAC, there will be opportunities to capture more aspects of this framework in the future through data linkage, including features of the built environment (eg, neighbourhood walkability) which are important aspects of the geographical environments lens.[38] To further extend on this work, it will be valuable for future research to replicate the current findings in different cohorts, with different sets of indicators available across the lenses, and validated against different outcomes of interest (eg, employment).

This framework will also need to be tested in populations outside of Australia. The social determinants of health are often context dependent, and differ across countries.[4] The four factors contributing to childhood disadvantage in Australia, and the indicators used to measure them, may or may not be relevant to all countries. International researchers should consider this possibility when applying this framework to their specific population of interest.[39]

In operationalising Koh et al's[22] theoretical model of four social determinants lenses, we needed to consider how to treat the small number of indicators that could conceivably sit in more than one lens. Given that Koh et al[22] did not define what indicators should sit under each lens, we categorised such indicators based on what we deemed most closely resembled the original theoretical model. Researchers applying this framework may choose to categorise such ambiguous indicators differently, as is most relevant to their context and aims.

We included the full variation of continuous indicators (eg, from optimal parenting to less effective parenting behaviours),

but many indicators were geared towards disadvantage (eg, caregivers unmet need for social support). There remain opportunities to further develop the advantage end of such scales to incorporate and measure the full spectrum of experiences from disadvantage to advantage.

Implications and future directions

Given the ubiquity of child inequities,[4 12] and continuing discussion about how adversity impacts development,[40] our framework is likely to be of international interest. The indicators used to populate this framework are commonly collected within population-based cohorts, such as the Millennium Cohort Study (UK) and the Early Childhood Longitudinal Study (USA). Although it is unlikely that all aspects of figure 1 will be perfectly captured in any one study (as was the case here), this framework can guide researchers to better use the data available to them and be more explicit about the data not captured.

As Braveman *et al*[39] have noted, a 'one size fits all' approach to measuring disadvantage can be problematic, and thoughtful consideration is needed in applying this framework depending on the specific research question being explored. Care should be taken in ensuring separation between exposure and outcome. For example, exploring the impact of child disadvantage on obesity would require parsing out child-level disadvantage indicators such as body mass index (risk factors lens). Having an explicit empirically validated framework to support this decision making is highly valuable.

Given that disadvantage can change over time,[41] future work could examine trajectories of disadvantage over childhood using this framework, more comprehensively documenting the nature of disadvantage experienced during other key developmental periods such as adolescence. Another critical area for further exploration is the interaction and contribution of the lenses to children's outcomes across developmental domains (eg, cognitive, social-emotional, physical health). The capacity to capture this interplay is one of the key benefits of applying this more comprehensive framework to future child health and development studies. It will also allow explicit testing of how the current approach compares with narrower socioeconomic measures in explaining children's developmental outcomes; we hypothesise that narrower measures would underestimate the extent of this effect.

With a comprehensive framework of disadvantage, we can identify those policies and interventions capable of attenuating the relationship between disadvantage and children's outcomes. The four lenses of sociodemographic, geographical environments, health conditions and risk factors, which manifest at the child, family and community levels, offer a useful and pragmatic framework for policy-makers to consider social determinants as potentially modifiable opportunities to addressing inequities.[22]

CONCLUSIONS

Child health and developmental inequities are a major public health issue.[2 4 11] Finding new evidence-based ways to improve outcomes for disadvantaged children can generate significant social and economic benefits through savings in health, education and welfare budgets, and improved productivity.[42] Understanding and (importantly) addressing inequities will be facilitated by robust conceptualisation and measurement of disadvantage. This study has generated a framework and approach that can capture the complexity of children's experiences across the multiple environments in which their development unfolds.

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What is already known on this subject

Child development occurs within a complex transactional system where biology interacts with the environment in which children live, learn and grow (social determinants). Measurement of the continuum of child disadvantage based on socioeconomic status alone may substantially underestimate the extent, experience and modifiability of disadvantage in childhood.

What this study adds

This study provides a tested comprehensive framework for understanding and operationalising the continuum of child disadvantage, informed by social determinants and bioecological models of child development. This framework can be used to generate measures that more accurately quantify the extent of child health and developmental inequities and elucidate policy-sensitive intervention pathways.

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