Socioeconomic adversity: which measures to use for child health research?

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The link between socioeconomic deprivation and adverse health outcomes is widely recognised. In the UK, many reports have shown socioeconomic gradients in measures of poor health at birth (such as preterm birth or low birth weight), adverse health outcomes in childhood (such as asthma, obesity or tooth decay), as well as poorer educational and social outcomes.[1,2] Similar patterns are observed in other high income countries. Despite numerous studies linking the socioeconomic circumstances of families and inequalities in child health, evidence is still needed to determine which policies aimed at improving child health should be prioritised, and how to best monitor the effectiveness of policies already introduced. In the current issue of *Acta Paediatrica*, Anand and colleagues present a new measure of socioeconomic deprivation in the population, the Socioeconomic Adversity Index (SAI) which can be used to describe inequalities in child health.[3] What other measures are commonly used for research and how does SAI compare?

National-level measures of poverty

On a national-level, poverty indicators are key for tracking the effects of the policy setting (e.g. welfare and healthcare policies, economic crises and political changes) on the well-being and living standards of children. Relative poverty – defined as the proportion of households with disposable income less than a specified percentage of the national median income – is commonly used by governments and international organisations to inform policy priorities and to monitor their effectiveness. For example, UNICEF reports relative poverty (setting poverty line at 50% of the median national income) as one of the child well-being indicators, along with poverty gap (the difference in median income of poor families and the median national income, indicating the depth of poverty) and the Child Deprivation Index, which measures the proportion of children lacking two or more of 14 items considered normal and necessary for every child. Relative poverty is internationally comparable, enabling comparisons of how differing policy context affects living standards of children, for example in 2009/10, over 20% of children aged 0-17 years old in the US lived in relative poverty, compared to 10% in the UK, 7% in Sweden and approximately 4% in Finland.[4]

The validity and fairness of poverty measures are widely debated both in the media and by policy makers due to the numbers of those classified as being below the poverty line varying according to the applied definition. In England there is currently no official measure of poverty, as the previous measure (setting poverty line at a cut-off of 60% of median national income) was abolished in 2015. In 2018, the Social Metrics Commission proposed a new poverty measure based on a family's disposable income, which accounts for the negative impact of inescapable expenses (such as childcare, mortgage or additional costs associated with a family member's disability) and the positive impact of other non-income assets which can be used immediately in case of an emergency. According to the measure, in 2016/7 there were 14.2 million people in the UK living in relative poverty, and nearly half of those lived in families with a disabled family member. One in three

children lived in poverty, and fewer pensioners lived in poverty than previously expected.[5] This new measure can provide useful insights into the causes of poverty and thereby help inform policy.

Individual-level measures of socioeconomic status

As researchers, we are often more interested in describing the effect of individual's socioeconomic circumstances on their risk of adverse health outcomes, or identifying pathways through which socioeconomic disadvantage contributes to one's health. For that purpose, we commonly use individual-level measures of socioeconomic status (SES) such as education, occupation, income or markers of material circumstances, such as household characteristics (for example, tenure, type of heating, ownership of amenities). Each of these measures reflects a different aspect of SES but they are also strongly correlated – education is a strong determinant of employment opportunities, which in turn can be predictive of expected income.[6] In the absence of individual-level measures, measures of area-level deprivation can be used as proxy for individual's SES, however, any differences according to SES are likely to be attenuated.

In many high income countries, education, occupation or income are routinely collected in administrative datasets, such as the registries of the total population in the Nordic countries, which can be linked to other administrative data sources (birth and death records, hospital admission records) to study socioeconomic inequalities in health across the whole population.[7] Such population-based cohorts developed from administrative linked datasets are commonly used for child health research in the Nordic countries, as well as Australia, Canada, USA and the UK, and can be used for international comparisons of child health outcomes.

Composite indices of socioeconomic status

When multiple, often correlated, measures of SES are available, composite indices can be useful in describing socioeconomic inequality in health, while accounting for multiple dimensions of SES. In the UK, one of the most well-known composite measures of deprivation is the Townsend Deprivation Index, an area-level score used to characterise areas on a continuum from deprived to wealthy. It combines information about unemployment, car and house ownership, and overcrowding for households.[6]

Anand and colleagues propose the use of principal component analysis (PCA) to derive a composite numerical index of socioeconomic adversity, SAI. PCA is a statistical method used to reduce a number of (often correlated) variables into a small number of uncorrelated variables – the principal components.[8] PCA is often used to derive approximate measure of SES in low and middle income country settings, where information about household income or wealth might be unavailable, and instead multiple variables describing living standards are recorded (such as access to utilities and infrastructure, ownership of specific durable assets such as TV, car and housing characteristics).[8] An alternative approach to PCA for deriving a composite indicator of SES is Latent Class Analysis (LCA), a statistical method used to identify unmeasured subgroups within a population according to a set of covariates. Utility of LCA has been illustrated in studies such as *Born in Bradford*, a large multi-ethnic birth cohort in the UK, where LCA was used to determine 5 subgroups based on 19 determinants of SES collected through interviews.[9]

Anand *et al* use data from the CANDLE study (Conditions Affecting Neurocognitive Development and Learning in Early Childhood), which recruited 1,503 pregnant women, without pregnancy complications or chronic illness from Shelby County, (Tennessee, USA) in 2009-2011. SAI was derived from commonly measured SES indicators: type of health insurance, levels of household income, number of household members, marital status, parental education and occupation. Separate scores

were derived during the perinatal period, for the first two years old life (infant/toddler period) and for the preschool period. The score can be used to describe distribution of adversity and characteristics of high-risk populations who might benefit most from targeted, holistic interventions – the most disadvantaged 20% of mothers in the perinatal period (that is mothers with the lowest SAI scores) had household incomes below $25k, nearly 30% did not have a high school degree, 75% were single parents, and all of them had Medicare, Medicaid or no health insurance. In contrast, nearly 90% of mothers in the least deprived 20% had incomes greater than $65k, nearly all had college or professional degree, 97% were married and all had health insurance.

Proposed SAI score and similar composite measures of SES can be used to monitor patterns of socioeconomic adversity and compare populations and trends over time, given that common risk factors are of relevance. For example, lower SAI scores were more common in the population of Shelby County than those for the state of Tennessee or the USA, indicating higher deprivation.[3] However, since one of the components of the score included the type of health insurance, SAI would not be replicable or meaningful in settings where healthcare is universal, such as the Nordic countries or the UK. Instead, and equivalent country-specific SAI score could be calculated by applying the PCA approach to risk factors relevant to and available in datasets a given country.

Which measure to use?

There are a range of measures of socioeconomic disparities that are used for research. National-level measures of poverty or income inequality are a key for monitoring the effects of social and economic policies on the living conditions of the most vulnerable individuals in the population. Individual-level SES indicators are needed to describe socioeconomic inequalities in health and to adjust for confounding when other exposures are the main focus. The SAI index proposed by Anand *et al* can be used for these two purposes and was shown to be useful for characterising the accumulation of socioeconomic adversity in the most deprived mothers, describing changes in the distribution of socioeconomic adversity over the life course and differences across geographic areas. To understand the specific mechanisms and provide evidence for effective interventions to reduce inequalities in health, however, we need more detailed information on risk factors likely to be on the causal pathways between SES and health outcomes, and appropriate statistical methods to indicate causal effects. Such research is key for evidence-based policies to tackle inequalities and improve the health of children.

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