Published in final edited form as:

J Dev Behav Pediatr. 2016 April ; 37(3): 213–222. doi:10.1097/DBP.0000000000000282.

Low family income and behavior problems in Norwegian preschoolers: Is child emotionality a marker for sensitivity of influence?

Tormod Bøe^{1,*}, Mari Hysing¹, and Henrik Daae Zachrisson^{2,3}

¹Regional Centre for Child and Youth Mental Health and Child Welfare, Uni Research Health

²Norwegian Institute of Public Health

³The Norwegian Center for Child Behavioral Development

Abstract

Background—Poor children have higher rates of mental health problems compared to more affluent peers, also in progressive welfare states like Norway. Temperamental characteristics may render some children more sensitive to the adverse influence of poor economy.

Objective—The current study examined the direct associations between family income-to-needs and mental health, and assessed moderation by early temperamental characteristics (i.e., emotionality).

Method—Using data from the Norwegian Mother and Child Cohort Study, associations between income-to-needs across children's first three years, and internalizing and externalizing problems when children were five years old were examined. Differential sensitivity to family income-to-needs was assessed by investigating how emotionality, when children were one-and-a-half and three years old, moderated these associations.

Results—Significant main effects of income-to-needs and emotionality, and a significant interaction effect between income-to-needs and emotionality was found for externalizing problems, but not for internalizing problems.

Conclusion—Children in poor families with an emotionally reactive temperament had higher scores on externalizing problems when they were five compared to their less emotionally reactive peers.

Financial adversity is associated with negative socioemotional outcomes in children¹. Children growing up in poor families have, on average, more externalizing problems such as aggression and hyperactivity, and internalizing problems such as anxiety and depression^{2,3}. Experiences of poverty during the first five years of life has been associated with increased likelihood of concurrent and later mental health problems in children⁴. Worse outcomes have been observed for those who experience severe and enduring poverty⁵ and changes in family

*Corresponding author: Tormod Bøe, Regional Centre for Child and Youth Mental Health and Child Welfare, Uni Research Health, PO Box 7801, 5020 Bergen, Norway, Phone: +47 55 58 86 75, Fax: +47 55 58 83 79, tormod.boe@uni.no.

Statement regarding conflict of interest: All of the designated authors contributed to the production of this paper. There are no competing or conflicting interests. The authors will transfer copyright of the paper to the journal on its acceptance and publication.

economy matters more for those who are already poor³. This suggests that family poverty can be viewed as a dynamic, rather than a static and dichotomous construct with a potential of influencing child mental health in both a linearly and/or nonlinearly fashion.

Family poverty influences children's developmental outcomes mostly indirectly, through its effects on the child's physical and psychosocial surroundings⁶. Whereas economists have highlighted the importance of poverty in constraining the resources (such as time and stimulating material) that parents are able to invest in their children⁷, developmental scientist have focused on poverty as causing parent stress which in turn has consequences for parent-child relationships. Specifically, experiences of material hardship and economic pressure increase parent stress which is associated with poorer parental mental health and in turn limits positive parenting behaviours and increase harsh or inconsistent parenting practices⁸. Low family income is often also associated with a cumulation of contextual and structural risk factors, including poor parental mental health, home chaos and unpredictable home environments². Growing up in conditions of low income is associated with several particular risky psychosocial and environmental features⁹, and chaotic living conditions characterized by unpredictability and lack of structure¹⁰ which may relate to emotion dysregulation¹¹ and increased allostatic load¹².

Characteristics of the child may be another important moderator for the impacts of the family's economic circumstances on child development. Temperament studies have demonstrated negative emotionality to be both directly related to internalizing and externalizing problems in children, and to interact with the environment and thereby influence children's adjustment indirectly^{13,14}. In terms of diathesis-stress or transactional/dual-risk models, negative emotionality may render some children more *sensitive* or *vulnerable* to adverse environmental influences^{15,16}. An alternative model; Differential susceptibility, also views some individuals as disproportionately *susceptible* to developmental experiences and environmental exposures¹⁷. Both models predict poorer outcomes for more reactive children under adverse circumstances, while the differential susceptibility model also suggests that the child is more susceptible to the influence of both *positive* and *negative* experiences and exposures¹⁸, and that more reactive children would fare *better* than less reactive children under favourable circumstances, recently conceptualised as *vantage sensitivity*¹⁹.

This interplay between negative emotionality in children and contextual influences has been demonstrated in some areas; i.e. that the influence of stress, parenting and cumulative risk factors are moderated by the child's negative emotionality²⁰. Fewer have investigated to which extent negative emotionality moderate the impact of more distal environmental factors, with some notable exceptions; In one study, impulsivity moderated the influence of neighbourhood socioeconomic status (SES) on delinquency in 13 years old boys: Impulsive boys were at higher risk for delinquency in poor neighbourhoods, whereas there was little relation between impulsivity and delinquency in high-SES neighbourhoods²¹. In another investigation, poor neighbourhood quality was associated with antisocial behaviour in six years olds whom in infancy were characterised by particular temperamental dispositions; either high positive affect *and* low fear, or low positive affect *and* high fear²². The present

study further extends on these previous studies, by investigating how child mental health is influenced by family economy in interaction with temperamental disposition.

The associations between family income and child behavior problems may be confounded by factors associated with both family income and child behavior, including parental education²³, parental mental health²⁴, single parenthood²⁵, low quality housing and lower probability for using quality non-parental child care²⁶, immigrant status²⁷, and premature birth and low birth weight²⁸. Parental mental health²⁴ and parenting practices have an especially prominent role in the association between family economy and child behaviour problems¹. By conditioning our analysis on the abovementioned factors, we aim to investigate the independent associations between family income and child socioemotional and behavioural development, as well as the influence of child emotionality on this association, although we are aware of potential threats from unobserved confounders to any causal interpretation of our findings²⁹.

It is yet to be investigated how low family income in the earliest years of life influences socioemotional and behavioral development in a country with relatively small income inequalities. The Norwegian GINI-index score (a score ranging from no inequality [0] to absolute inequality [1]) is 0.25, compared to an average of 0.32 in the OECD³⁰. This is in part due to a progressive tax system, and in part to a welfare system where economically disadvantaged families are allowed both housing subsidies and means-tested temporary social benefits. Norway also has universally provided free health care and education as well as subsidized Early Childhood Education and Care (ECEC). Child poverty is present also in Norway, at a rate of 6.1%, compared to an average of 15% in the OECD³¹. Importantly, even for poor families in Norway, absolute levels of deprivation where they experience material hardship and are unable to afford basic amenities such as food and housing is uncommon³¹. Nonetheless, higher levels of emotional and behavioral problems among school-age children in low-income families compared to their more affluent peers have been documented^{32,33}.

In the present study, we take advantage of a large, population based cohort study, the Norwegian Mother and Child Cohort Study, and tax records for family income, to investigate 1) the extent to which family income across the first three years of life is associated with internalizing and externalizing problems in 5-year old children, and the shape of this association (i.e. does family income disproportionally affect children from families at the lower end of the income spectrum), 2) whether children with different levels of emotionality are differentially susceptible or vulnerable to the context of low family income, and 3) to examine whether the differential effect of emotionality on the association between family income and behaviour problems is influenced by maternal mental health and parenting.

Method

Participants

The present study uses data from the population-based Norwegian Mother and Child Cohort Study (MoBa³⁴; for a complete description, see www.fhi.no/morogbarn). MoBa is a prospective study including multiple birth cohorts, with data being collected by

questionnaires to prospective mothers during pregnancy at the 17th, 22nd and 30th weeks of gestation and after birth by mail when the child was .5, 1.5, 3, and 5 years of age. All women in Norway giving birth between late 1999 and 2010 at hospitals and maternity units with more than 100 births annually, altogether 52 units, were eligible for the study—there are no exclusion criteria for participation. Women were invited to participate when they attended routine ultrasound examinations offered to all pregnant women in Norway at the 17th week of gestation. By October 2010, 90,725 mothers of 108,639 children had enrolled and completed baseline assessments, which represented 42.1 % of all eligible mothers in Norway. The Norwegian Data Protection Authority and the Regional Ethics Committee South East Norway have approved the study.

Potential self-selection bias in the MoBa was examined by means of differences in prevalence estimates and association measures between MoBa participants and all women giving birth in Norway on demographics, health-related behaviors, and on a number of pregnancy- and birth-related variables³⁵. MoBa participants were on average older, and more likely to be cohabiting (as opposed to having no partner, and thus includes married couples), and had fewer health related risks, and their children had better neonatal health than children of those not participating. However, the relative differences were small (0.3-1.2%).

Retention rates during pregnancy were 91-95%, and 84.8%, 72.4%, 58.5%, and 53.4% when children were 6 months, 1.5, 3, and 5 years old, respectively. The current study is based on version 5 of the data files, including data collected by October 2010. The 5 years questionnaire, from which outcomes for the current study was drawn, was by then only sent to approximately two birth cohorts (participation rate, 2004 cohort = 43.5%; participation rate, 2005 cohort = 42.1%), and the total number of returned questionnaires available was 12,158.

Measures

Behavior problems—Externalizing and internalizing behavior problems at 5 years were measured by selected items (12 items for externalizing problems, 9 items for internalizing problems) from the *Child Behavior Checklist* CBCL;³⁶. Mothers rated each item from “1 – not true” to “3 – very true or often true” as being reflective of their child's behavior within the last two months.

Items measuring externalizing problems were: “Can't concentrate, can't pay attention for long”, “Can't sit still, restless or hyperactive”, “Can't stand waiting, wants everything now”, “Defiant”, “Demands must be met immediately”, “Doesn't seem to feel guilty after misbehaving”, “Gets in many fights”, “Gets into everything”, “Hits others”, “Punishment doesn't change his/her behavior”, “Quickly shifts from one activity to another”, “Poorly coordinated or clumsy”, (Cronbach's $\alpha = .78$). Items measuring internalizing problems were:

“Afraid to try new things”, “Clings to adults or too dependent”, “Disturbed by any change in routine”, “Gets too upset when separated from parents”, “Too fearful or anxious”, “Cries a lot”, “Unhappy, sad, or depressed”, “Fears certain animals, situations, or places”, “Nervous, highstrung or tense”. $\alpha = .68$). In accordance with recommendations by Achenbach³⁷ for

when a selection of items from the CBCL (rather than the complete scale) is used, we report raw scores rather than *T* scores. We use mean scores in our analyses.

Household income-to-needs—For household income, we had access to annual tax records for each participating mother, and from fathers who had agreed to participate in the MoBa (77.6%). In cases where father's income was missing, this was imputed by Expectation Maximization algorithm, including extensive information from the tax records on mother's income, fortune and debt dating back to 1993, as well as all available demographic information including self-reported total family income during pregnancy. We calculated a ratio of family income-to-needs by dividing total annual income by the OECD poverty line for each particular year (50% of the median income, adjusted for family size; OECD, 2011). A family with an income-to-needs ratio of 1 indicates that the family income corresponds to the poverty line for that particular family composition; a lower ratio indicates income below the poverty line, a higher ratio income above the poverty line. Income-to-needs and corresponding annual income for a family of 4 is displayed in Fig 1. Average income-to-needs for the first three years was calculated for each family.

Emotional reactive temperament—Emotional reactive temperament (“Emotionality”) was measured by maternal reports at 1.5 and 3 years with three selected items from *The Emotionality, Activity and Shyness Temperament Questionnaire* EAS;³⁸. The three items were selected from the full scale in a sample of mothers of 939 1.5 year old children from another Norwegian study³⁹, and correlated 0.95 with the original scale. Each item is rated on a 5-point scale ranging from “1=very typical” to “5=Not at all typical”. The items at both time points were “Your child cries easily”, “Your child gets upset or sad easily”, and “Your child reacts intensely when upset” (Cronbach's $\alpha = .64$ at both time points). The correlation between the measures over time ($r = .48$) were within the ranges usually found in studies of temperament⁴⁰. We calculated mean scores at each time point, and averaged these across 1.5 and 3 years to reflect the child's emotionality across early childhood.

Covariates—Information about maternal education (years) and non-Norwegian family background (“No – 0”, “Yes – 1”) was drawn from the questionnaire at 17th gestational week, while information about maternal employment (“Unemployed – 0”, “Employed – 1”) single parenthood (“No – 0”, “Yes – 1”), and parental –as opposed to non-parental– care (“No – 0”, “Yes – 1”) was drawn from the questionnaire at 3 years. Information about the child's birth weight (“0- $\geq$ 2500 grams”, “1 < 2500 grams”), congenital syndromes (including Down syndrome, cleft lip and palate, and limb malformations; “0 – No”, “1 – Yes”) and gender (“0 – Girl”, “1 – Boy”), was drawn from the Medical Birth Registry. Mothers reported on their psychological distress (anxiety and depression) using the *Hopkins Symptom Checklist* SCL;⁴¹, when their child was 0.5, 1 and 3 years old, and an average of these three time points were used in the analyses. Information about parenting practices were obtained using three items from the parental locus of control scale (PLOC;⁴²; Cronbach's $\alpha = .49$). The PLOC measures the extent to which parents believe that their child's behavior is influenced by their parenting or by other events external to their parenting.

Missing data—There were less than 4% missing items within single scales, and missing items were replaced by scale mean. For the 12,158 children included in our analyses, 0.25% were missing data on behavior problems, 13.9% on family income-to-needs, and 4.3% on emotionality. For the covariates, missing data ranged from 0% (congenital syndromes and birth weight) to 18.42% (maternal employment). Following best practice recommendations for handling moderate to large amounts of missing data, we used multiple imputation (MI;⁴³). We estimated 20 datasets based on all covariates in Table 1, using Stata 12⁴⁴, with fully conditional specification of the multivariate model by a series of conditional linear models, one for each incomplete variable. We estimated all models for participants with complete data (using listwise deletion for all other participants) and with the MI data. Results were substantively identical, and we therefore report results from the MI analyses only.

Statistical analyses

We estimated linear regression models with externalizing- and internalizing behavior problems, respectively, as dependent variables. All models were estimated unconditional, i.e., without covariates, conditional on demographic covariates, and conditional on family-related covariates. In our statistical models, we estimated linear associations with income-to-needs and non-linear associations by using the log of income-to-needs levels i.e., “semi-log” estimates; see e.g.,⁴⁵. While the first assumed a constant strength of association between income-to-needs and behavior problems across all levels of the income-to-needs distribution; specifically, the latter assumed non-linearity with larger effect sizes at lower levels of income-to-needs and decreasingly smaller effect sizes at higher levels of income-to-needs. We compared the non-linear and linear models using seemingly unrelated regression procedures as well as effect size post estimations to determine whether the non-linear models fitted data better than the linear. Note that the use of a log-transformation required that the original metric of the variable was maintained throughout analyses (as changing the mean by standardizing or centering would change the intercept, and thus the coefficient). Thus, we did not center variables before calculating product terms for moderator analyses, but were sensitive to problems of multicollinearity throughout analyses.

Furthermore, as effect size, we report partial correlation (r) which can be calculated from each coefficient's corresponding t-value, using the formula $r = \sqrt{t^2 / (t^2 + df)}$. When testing whether emotionality moderated the association between family income and behavior problems, we followed the recommendations by Roisman et al.⁴⁶ for testing for differential susceptibility and diathesis-stress.

Attrition—We tested for differential attrition at 5 years by comparing those responding to the 5 years questionnaire with all other participants in MoBa. Unfortunately, we could not identify those specifically failing to respond to the questionnaire, and since the 5 years questionnaire was sent to a sub-group, this comparison is not ideal. Yet, we tested differences between respondents and the rest of the MoBa sample by comparing means (t-tests) or proportions (chi-square tests) for the covariates reported in Table 1 at their earliest point of measurement (e.g., parental education at 17th gestational week, income-to-needs at 6 months, emotionality at 18 months). Mothers attending at 5 years were significantly more

likely than the others to have higher income-to-needs (at child's age 6 months), to have higher education (at 17th gestational week), to have lower levels of anxiety and depression (at child's age 6 months), and to be employed (at child's age 36 months), to have immigrant background, and to have children born preterm, being girl, and attending center care. However, effect sizes for the differences were very small, e.g., Cohen's $d < 0.06$.

Results

Means and standard deviations for all variables are presented in Table 1 (percentages for dichotomous variables), along with the percentage of missing data and the range for each variable.

Results for our main analysis investigating the association between income-to-needs and emotionality on externalizing and internalizing problems, as well as interactions with emotionality are reported in Table 2.

In our first set of analyses, displayed in the upper third of Table 2, we examined the crude (unconditional) association between a) our main predictor, family income-to-needs across the child's first three years of life, and b) our moderator (emotionality), and internalizing and externalizing problems at age 5, as well as the interaction of the predictor and the moderator. The unconditional associations serve a dual purpose; they reflect the actual levels of associations before any inferences are made from conditioning on covariates, and they serve as comparisons for the full conditional estimates reflecting the extent to which the initial associations are contingent on covariates included.

For internalizing problems, the unconditional main effect of income-to-needs is a partial r of $-.015$ ($p < .10$). The comparable effect size for externalizing problems is $-.041$ ($p < .001$). These effect sizes show linear associations in that lower income is to some extent associated with higher levels of problems. In the unconditional main-effects models, there is a moderate association between emotionality and both internalizing- ($r = .220$) and externalizing problems ($r = .290$).

In our second set of analyses, we tested the unconditional interaction of family income-to-needs and emotionality, thus examining whether the association between income-to-needs and internalizing- and externalizing problems, respectively, is different for children with different levels of emotionality. The interaction-term was not significant in the model estimating the association between linear income-to-needs and internalizing problems ($r = -.017$, $p < .10$), but it was significant in the model predicting externalizing problems ($r = -.031$, $p < .01$). Across models, the negative interaction term indicates that the association between income-to-needs and both internalizing- and externalizing problems is less strong for children with lower levels of emotionality. We also ran semi-log models to detect non-linearity in the associations between income-to-needs and internalizing and externalizing problems, respectively, including moderator models. None of these models fit the data significantly better than the linear models. Further details are therefore not reported (but available on request).

Following Roisman et al.'s⁴⁶ recommendations for testing differential susceptibility and diathesis-stress models, we tested for regions of significance, using the online calculator available at www.quantpsy.org⁴⁷. In regions of significance testing, the interaction terms in regression analyses were used to model internalizing and externalizing problems as a function of income-to-needs ratio, the measure of emotionality, and the interaction between these. We calculated regions of significance with respect to income-to-needs ratio (which indicate for which values of income-to-needs the regression of internalizing and externalizing problems on emotionality is significant or not), and with respect to emotionality (which indicate for which values of emotionality the regression of internalizing and externalizing problems on income-to-needs ratio are statistically significant or not). The results indicated that children with higher levels of emotionality have, on average, higher levels of externalizing problems than their peers at the same levels of family income-to-needs but with lower levels of emotionality. As a consequence, the remaining set of recommendations by Roisman et al. (2012) were superfluous, as they refer to further specifications based on the presence of regions of significance.

In our first set of conditional analyses, reported in the middle of Table 2, the findings are fairly similar to the unconditional analyses. In the main effects analyses, when including the covariates listed in Table 1, we found a small association between income-to-needs and internalizing problems ($r = -.021$, $p < .02$), as well as for externalizing problems ($r = -.026$, $p < .004$). For externalizing problems, the main effect for the model was significant ($r = -.036$, $p < .000$), as remained the main effects of emotionality ($r = .125$, $p < .000$), and the interaction-terms ($r = -.030$, $p < .001$). Again, we ran semi-log models, and none of these models fit the data significantly better than the linear models.

Our second set of conditional analyses, reported in the lower section of Table 2, included the family-related covariates (maternal distress, and parental locus of control) as an initial probing of mediator effects. Although the R^2 of the models increased with about 4% across models, the coefficients for the main- and interaction effects were only marginally reduced in these analyses. For instance, the standardized main effect of family income on externalizing problems went from $-.026$ to $-.018$. Given this minor change in coefficients, we concluded that there was little substantive reason to pursue further analyses (e.g. testing for mediation) in these data.

The results from the final, conditional linear model are displayed in Figure 1, showing that for children with low levels of emotionality (one standard deviation below the mean), there is no association between income-to-needs and externalizing problems. For children with high levels of emotionality (one standard deviation above the mean), there is a linear negative association. For children in families at the poverty line, there was about 50% of a standard deviation difference between children with high- and low levels of emotionality. This difference is smaller, but still prominent at higher levels of income-to-needs, at the 97.5th percentile (income-to-needs of 4), there is about 25% of a standard deviation difference in externalizing problems between children with high versus low levels of emotionality.

Although influential temperament theorists have argued that temperament and behaviour problems are related but distinct constructs¹⁴, we ran a series of robustness checks to examine this potential threat to the validity of our findings. First, if emotionality and internalizing problems were overlapping, our interaction effect could be an artefact of comorbid externalizing and internalizing problems being more common among those with internalizing problems and low income. We found evidence of increasing correlations between internalizing and externalizing problems with decreasing income-to-needs ratio. However, had this produced an artificial interaction effect with emotionality, this interaction should have weakened with higher income. As the interaction effect was linear – as opposed to non-linear – higher rates of comorbidity among those with low income is not a likely explanation for the findings.

Second, we included internalizing problems (at 60 months) in the models regressing externalizing problems on emotionality. The coefficients and standard errors barely changed when internalizing problems were included as a covariate in the final conditioned model, and in the final conditioned model including the interaction effect. Finally, we reconstructed the measure of internalizing problems by removing the overlapping items as suggested by¹⁴, and the results from using this new measure of internalizing problems were essentially identical to those from the original analysis (although the new internalizing measure had a slightly lower mean and lower variance). In sum, our robustness checks are not consistent with strong conceptual overlap between emotionality and internalizing problems.

Discussion

One aim of the current study was to investigate the association between income-to-needs and externalizing and internalizing problems in preschool children in a context of a progressive social support system and low income inequality. A second aim was to examine whether the association between income-to-needs and behavioural problems was moderated by emotionality measured when children were one and a half and three years old. The main effect of income-to-needs on externalizing problems was significant in the unconditional analyses; it attenuated after adjusting for demographic and family-related covariates, but remained significant. A significant interaction effect between income-to-needs and emotionality was found, suggesting that children with high levels of emotionality may be more vulnerable to conditions of poor family economy compared to their less emotionally reactive peers. There were no significant main effects of income-to-needs on internalizing problems, except in the model conditioned on demographic variables, and no interaction effect with emotionality was observed.

Income-to-needs as independent predictors of internalizing and externalizing problems

Income-to-needs was, before testing interaction with temperament, found to predict symptoms of externalizing problems in five years old children, in line with findings from previous studies⁴⁸. Previous studies of this association on younger Norwegian children have demonstrated similar associations³, also with effect sizes comparable to studies in the United States, despite the very different macroeconomic and socio-political characteristics of these countries. Norway has low levels of income inequality, and child and family policy supports

are copious. Nonetheless, the social supports in Norway may not be efficient nor timely enough to fully alleviate the consequences of poor family economy, and the stresses related to poor economy may still be relevant for those struggling to make ends meet⁴⁹, although the absolute economic standing may be less important than in countries with more economic disparity. Taken together, these findings demonstrate that poverty still matters in countries and societies with low income inequality and extensive social and economical safety nets.

This association between income-to-needs and externalizing problems attenuated somewhat after conditioning the analysis on a rich set of demographic and family-related covariates. The attenuation suggests that the demographic variables do explain some, but not much, of the direct association between externalizing problems and income-to-needs. With regards to the family-related covariates, it has previously been demonstrated that economic pressures increase parental distress and results in less optimal parenting with negative consequences for child mental health^{1,8,49}. The findings from the current study does demonstrate that maternal distress and parenting practices contribute to the pattern of association with externalizing problems, but the reduction in the coefficients observed when including these covariates in the analytic models were minor. It could be that more elaborate parenting measures, for example including positive and negative parenting behaviours as well as inconsistencies and lack of monitoring, would have explained a larger proportion of the variance of these direct associations.

Overall, the results suggest that there are modest, but direct effects of income-to-needs on externalizing problems in children, replicating what has previously been found in a similar sample of younger Norwegian children³. One explanation for the current findings is that the psychosocial and contextual (observed and unobserved) characteristics associated with low income, both independently and in accumulation confer risk, potentially operating also through biological pathways unobserved in the current study⁵⁰.

In contrast to some other studies, we did not find income-to-needs to directly influence internalizing problems, apart from in the model conditioned on demographic variables. In one study, it was for example demonstrated that higher poverty persistence (operationalized as percentage of life living in poverty) was associated with more symptoms of internalizing problems⁵¹. Associations between internalizing problems and income-to-needs has also been found in a previous investigation using data from the MoBa study, although for younger children³, which may suggest that internalizing problems are more responsive to family economy at younger ages, and that the stresses experienced by children in conditions of poverty is more likely to manifest itself as externalizing rather than internalizing behaviours in older children. A different investigation, however, found that the association between persistent poverty and internalizing problems was indirect, and mediated by the quality of the physical home environment i.e., level of cleanliness and safety, and whether the interior was dark or perceptually monotonous;⁵². The sample of low-income families in the current study had a poor economy relative to the rest of our sample. Still, their income level may be sufficient for them to provide an adequate physical home environment for their children, which could prevent them from developing internalizing problems. This may be related to the relatively comprehensive support available for low-income families in Norway, where subsidized ECEC, health, and other services may function to limit the experiences of

material hardship, which could reduce the negative impact of low family income on child behaviour problems⁵³. In fact, one previous investigation using the same dataset at younger ages found ECEC to protect low income children against elevated levels of internalizing, but not externalizing, problems³. The pattern of differences could also be related to parents being better at identifying externalizing (as contrasted with internalizing) problems in pre-schoolers. This could be because these externalizing behaviours are more overt and easily to notice, or that the parents, in conditions of economic stress, becomes particularly sensitive to non-compliant and disruptive behaviours, compared to more subtle indicators of internalizing problems.

Interaction between income-to-needs and emotionality

Emotionality was a risk factor for externalizing problems in the present study. Further, the results suggest that children with high emotionality are more sensitive to low family income as it interacted with income-to-needs producing a multiplicative effect, which was most strongly expressed under conditions of poor family economy. Previous studies have found similar interactive associations between temperamental characteristics and composite measures of SES⁵⁴, and other indicators of socioeconomic status such as neighbourhood quality²². The particular strength of the current study is demonstrating this association with a direct measure of family economic well-being (i.e. income-to-needs ratio) and using recognized measures of child internalizing and externalizing problems and emotionality, while also adjusting for several related co-factors. Together with the findings from the current study, these previous findings are in accordance with the predictions from the transactional/dual-risk models/diathesis-stress perspective¹⁶. The results also align with the predictions from the differential susceptibility perspective for conditions of adversity, however, with regards to vantage sensitivity¹⁹, there were no evidence that economic well being mattered to a larger degree for children high in emotionality. To the contrary, high emotionality, in contrast to low emotionality, was in itself a risk factor for externalizing problems across the whole range of economic conditions, consistent with a vulnerability model, where early temperamental characteristics may contribute to particular developmental processes related to socioemotional development¹⁴.

Limitations

Although, as noted, this study has several strengths, the findings should be interpreted with some limitations in mind. Although income-to-needs is a register-based measure, one limitation is a potential mono informant bias in that a single informant provides both information about childhood mental health problems and early temperamental characteristics. There could also be limits to the external validity of our findings due to a general tendency towards lower participation rates among those with lower SES⁵⁵, although this has probably resulted in an under- rather than overestimation of these associations compared to a fully representative sample. Another potential concern regards the similarity of the items used in the EAS to measure emotionality and some of items measuring internalizing problems in the CBCL¹⁴. Yet, none of our robustness checks addressing this possibility were consistent with a conceptual miss-specification of our models. Finally, the study would have benefited from more information about family stresses, which would have allowed us to further investigate potential mechanisms behind the association between

family economy and externalizing problems. A more detailed investigation into a broader range of parenting behaviours, such as more detailed information about positive and negative parenting behaviours, inconsistencies in parenting and lack of monitoring would also have allowed for a more detailed investigation of the role of these behaviours as potential mediating mechanism of the association between income-to-needs and child behaviour problems. Such data were unfortunately not available.

Clinical and policy implications

The findings from the current study have several clinical implications. Children with a emotionally reactive temperament across ages one to three years had more externalizing and internalizing problems when they were five years old. This suggests that early reports of difficult temperament may warrant extra attention and monitoring of these children during their early years, possibly conducted in well-baby clinics or ECEC. Furthermore, mental health workers who work with young children should be aware of the potential double jeopardy – with regards to externalizing problems – experienced by emotionally reactive children who grow up in conditions of economic deprivation. The demonstration of a direct association between income-to-needs and externalizing problems also has potential implications for policy. Attempts to reduce parental distress or parenting practices in contexts of poverty has proved difficult⁵⁶. In some respects, income is a variable that is more easily targeted by interventions at the policy level, and converging evidence from several experimental and nonexperimental studies have indicate that improved economic conditions may translate into better psychological well-being for children⁵⁷⁻⁵⁹.

Conclusion

Emotionally reactive children were found to have more symptoms of internalizing and externalizing problems later in early childhood. Children who were poor during the three first years of their lives, and who also had an emotionally reactive temperament had higher scores on externalizing problems when they were five, compared to their less emotionally reactive peers.

Acknowledgments

The authors acknowledge the Norwegian Mother and Child Cohort Study, which is supported by the Norwegian Ministry of Health, NIH/NIEHS (grant no N01-ES-85433), NIH/NINDS (grant no.1 U01 NS 047537-01), and the Norwegian Research Council/FUGE (grant no. 151918/S10).

References

1. Dearing E. Psychological costs of growing up poor. *Ann N Y Acad Sci.* 2008; 1136:324–332. [PubMed: 17954672]
2. Evans GW. The environment of childhood poverty. *Am Psychol.* 2004; 59(2):77–92. [PubMed: 14992634]
3. Zachrisson HD, Dearing E. Family income dynamics, early childhood education and care, and early child behavior problems in norway. *Child Dev.* 2015; 86(2):425–440. [PubMed: 25345342]
4. NICHD Early Child Care Research Network. Duration and developmental timing of poverty and children's cognitive and social development from birth through third grade. *Child Development.* 2005; 76(4):795–810. [PubMed: 16026497]

5. Korenman S, Miller JE, Sjaastad JE. Long-term poverty and child development in the united states: Results from the nlsy. *Children and Youth Services Review*. 1995; 17(1–2):127–155.
6. Yeung WJ, Linver MR, Brooks-Gunn J. How money matters for young children's development: Parental investment and family processes. *Child Dev*. 2002; 73(6):1861–1879. [PubMed: 12487499]
7. Foster EM. How economists think about family resources and child development. *Child Dev*. 2002; 73(6):1904–1914. [PubMed: 12487501]
8. Conger RD, Wallace LE, Sun Y, et al. Economic pressure in african american families: A replication and extension of the family stress model. *Dev Psychol*. 2002; 38(2):179–193. [PubMed: 11881755]
9. Repetti RL, Taylor SE, Seeman TE. Risky families: Family social environments and the mental and physical health of offspring. *Psychol Bull*. 2002; 128(2):330–366. [PubMed: 11931522]
10. Evans GW, Gonnella C, Marcynyszyn LA, et al. The role of chaos in poverty and children's socioemotional adjustment. *Psychol Sci*. 2005; 16(7):560–565. [PubMed: 16008790]
11. Kim P, Evans GW, Angstadt M, et al. Effects of childhood poverty and chronic stress on emotion regulatory brain function in adulthood. *Proc Natl Acad Sci U S A*. 2013; 110(46):18442–18447. [PubMed: 24145409]
12. Evans GW, Kim P. Childhood poverty and young adults' allostatic load: The mediating role of childhood cumulative risk exposure. *Psychol Sci*. 2012; 23(9):979–983. [PubMed: 22825357]
13. Rothbart, MK.; Bates, JE. Temperament. In: Eisenberg, N., editor. *Handbook of child psychology*. 5th. Vol. 3. New York: Wiley; 1998. p. 105–176.
14. Rothbart, MK.; Bates, JE. Temperament. In: Eisenberg, N.; Damon, W.; Lerner, RM., editors. *Handbook of child psychology*. 6th. Vol. 3. Hoboken, NJ: Wiley; 2006. p. 99–166.
15. Sameroff, AJ. Developmental systems: Contexts and evolution. In: Mussen, P., editor. *Handbook of child psychology*. Vol. 1. New York, NY: Wiley; 1983. p. 237–294.
16. Zuckerman, M. *Vulnerability to psychopathology: A biosocial model*. Washington, DC: American Psychological Association; 1999.
17. Belsky J, Bakermans-Kranenburg MJ, van IJzendoorn MH. For better and for worse: Differential susceptibility to environmental influences. *Curr Dir Psychol*. 2007; 16(6):300–304.
18. Ellis BJ, Boyce WT, Belsky J, et al. Differential susceptibility to the environment: An evolutionary--neurodevelopmental theory. *Dev Psychopathol*. 2011; 23(1):7–28. [PubMed: 21262036]
19. Pluess M, Belsky J. Vantage sensitivity: Individual differences in response to positive experiences. *Psychol Bull*. 2013; 139(4):901–916. [PubMed: 23025924]
20. Paulussen-Hoogbeem MC, Stams GJ, Hermanns JM, et al. Child negative emotionality and parenting from infancy to preschool: A meta-analytic review. *Dev Psychol*. 2007; 43(2):438–453. [PubMed: 17352551]
21. Lynam DR, Caspi A, Moffit TE, et al. The interaction between impulsivity and neighborhood context on offending: The effects of impulsivity are stronger in poorer neighborhoods. *Journal of Abnormal Psychology*. 2000; 109(4):563–574. [PubMed: 11195980]
22. Colder CR, Lengua LJ, Fite PJ, et al. Temperament in context: Infant temperament moderates the relationship between perceived neighborhood quality and behavior problems. *Journal of applied developmental psychology*. 2006; 27(5):456–467. [PubMed: 25530650]
23. Ford T, Goodman R, Meltzer H. The relative importance of child, family, school and neighbourhood correlates of childhood psychiatric disorder. *Soc Psychiatry Psychiatr Epidemiol*. 2004; 39(6):487–496. [PubMed: 15205734]
24. Beardslee WR, Versage EM, Gladstone TR. Children of affectively ill parents: A review of the past 10 years. *J Am Acad Child Adolesc Psychiatry*. 1998; 37(11):1134–1141. [PubMed: 9808924]
25. Watson T, McLanahan S. Marriage meets the joneses: Relative income, identity, and marital status. *J Hum Resour*. 2011; 46(3):482–517. [PubMed: 24639593]
26. Brooks-Gunn J, Duncan GJ. The effects of poverty on children. *Future Child*. 1997; 7(2):55–71. [PubMed: 9299837]
27. McLeod JD, Owens TJ. Psychological well-being in the early life course: Variations by socioeconomic status, gender, and race/ethnicity. *Soc Psychol Q*. 2004; 67(3):257–278.

28. Kelly YJ, Nazroo JY, McMunn A, et al. Birthweight and behavioural problems in children: A modifiable effect? *Int J Epidemiol.* 2001; 30(1):88–94. [PubMed: 11171863]
29. Foster EM. Causal inference and developmental psychology. *Dev Psychol.* 2010; 46(6):1454–1480. [PubMed: 20677855]
30. OECD. Divided we stand. Why inequality keeps rising 2011. <http://www.oecd.org/els/soc/dividedwestandwhyinequalitykeepsrising.htm>
31. UNICEF Innocenti Research Center. Report card 10: Measuring child poverty New league tables of child poverty in the world's richest countries. Florence, It: UNICEF Innocenti Research Center; 2012.
32. Heiervang E, Stormark KM, Lundervold AJ, et al. Psychiatric disorders in norwegian 8- to 10-year-olds: An epidemiological survey of prevalence, risk factors, and service use. *J Am Acad Child Adolesc Psychiatry.* 2007; 46(4):438–447. [PubMed: 17420678]
33. Bøe T, Overland S, Lundervold AJ, et al. Socioeconomic status and children's mental health: Results from the bergen child study. *Soc Psychiatry Psychiatr Epidemiol.* 2012; 47(10):1557–1566. [PubMed: 22183690]
34. Magnus P, Irgens LM, Haug K, et al. Cohort profile: The norwegian mother and child cohort study (moba). *Int J Epidemiol.* 2006; 35(5):1146–1150. [PubMed: 16926217]
35. Nilsen RM, Vollset SE, Gjessing HK, et al. Self-selection and bias in a large prospective pregnancy cohort in norway. *Paediatr Perinat Epidemiol.* 2009; 23(6):597–608. [PubMed: 19840297]
36. Achenbach, TM. Manual for the child behaviour checklist/4-18 and 1991 profile. Burlington, Vt: Dept of Psychiatry, University of Vermont; 1991.
37. Achenbach, TM. Manual for the child behaviour checklist/2-9 and 1992 profile. Burlington, Vt: Dept of Psychiatry, University of Vermont; 1992.
38. Buss, AH.; Plomin, R. Temperament: Early developing personality traits. Hillsdale, NJ: Lawrence Erlbaum; 1984.
39. Mathiesen KS, Tambs K. The eas temperament questionnaire--factor structure, age trends, reliability, and stability in a norwegian sample. *J Child Psychol Psychiatry.* 1999; 40(3):431–439. [PubMed: 10190344]
40. Roberts BW, DelVecchio WF. The rank-order consistency of personality traits from childhood to old age: A quantitative review of longitudinal studies. *Psychol Bull.* 2000; 126(1):3–25. [PubMed: 10668348]
41. Hesbacher PT, Rickels K, Morris RJ, et al. Psychiatric illness in family practice. *J Clin Psychiatry.* 1980; 41(1):6–10. [PubMed: 7351399]
42. Campis L, Lyman R, S P. The parental locus of control scale – development and validation. *Journal of clinical child psychology.* 1986; 15(3):260–267.
43. Graham JW. Missing data analysis: Making it work in the real world. *Annu Rev Psychol.* 2009; 60:549–576. [PubMed: 18652544]
44. Stata/ic [computer program] Version 12.1. Texas: StataCorp LP; 2013.
45. Votruba-Drzal E, Coley RL, Chase-Lansdale PL. Child care and low-income children's development: Direct and moderated effects. *Child Dev.* 2004; 75(1):296–312. [PubMed: 15015691]
46. Roisman GI, Newman DA, Fraley RC, et al. Distinguishing differential susceptibility from diathesis-stress: Recommendations for evaluating interaction effects. *Dev Psychopathol.* 2012; 24(2):389–409. [PubMed: 22559121]
47. Preacher KJ, Curran PJ, Bauer DJ. Computational tools for probing interactions in multiple linear regression, multilevel modeling, and latent curve analysis. *J Educ Behav Stat.* 2006; 31(4):437–448.
48. Davis E, Sawyer MG, Lo SK, et al. Socioeconomic risk factors for mental health problems in 4-5-year-old children: Australian population study. *Acad Pediatr.* 2010; 10(1):41–47. [PubMed: 20129480]
49. Elder GH, Conger RD, Foster EM, et al. Families under economic pressure. *J Fam Issues.* 1992; 13(1):5–37.

50. Evans, GW.; Chen, E.; Miller, GE., et al. How poverty gets under the skin: A lifecourse perspective. In: Maholmes, V.; King, R., editors. The oxford handbook of poverty and child development. New York: Oxford University Press; 2012. p. 13-36.
51. Mcleod JD, Shanahan MJ. Poverty, parenting and children's mental health. American sociological review. 1993; 58(3):351–366.
52. Eamon MK. Structural model of the effects of poverty on externalizing and internalizing behaviors of four- to five-year-old children. Soc Work Res. 2000; 24(3):143–154.
53. Gershoff ET, Aber JL, Raver CC, et al. Income is not enough: Incorporating material hardship into models of income associations with parenting and child development. Child Dev. 2007; 78(1):70–95. [PubMed: 17328694]
54. Veenstra R, Lindenberg S, Oldehinkel AJ, et al. Temperament, environment, and antisocial behavior in a population sample of preadolescent boys and girls. International Journal of Behavioral Development. 2006; 30(5):422–432.
55. Lundberg I, Damstrom Thakker K, Hallstrom T, et al. Determinants of non-participation, and the effects of non-participation on potential cause-effect relationships, in the part study on mental disorders. Soc Psychiatry Psychiatr Epidemiol. 2005; 40(6):475–483. [PubMed: 16003597]
56. Kalil, A. Inequality begins at home: The role of parenting in the diverging destinies of rich and poor children. In: Amato, PR.; Booth, A.; McHale, SM.; Van Hook, J., editors. Families in an era of increasing inequality. Switzerland: Springer; 2015.
57. Costello EJ, Compton SN, Keeler G, et al. Relationships between poverty and psychopathology: A natural experiment. JAMA. 2003; 290(15):2023–2029. [PubMed: 14559956]
58. Duncan GJ, Yeung WJ, Brooks-Gunn J, et al. How much does childhood poverty affect the life chances of children? American Sociological Review. 1998; 63(3):406.
59. Dearing E, McCartney K, Taylor BA. Within-child associations between family income and externalizing and internalizing problems. Dev Psychol. 2006; 42(2):237–252. [PubMed: 16569163]

Figure 1.

Externalizing problems in five years old children as a function of the interaction between income-to-needs and average emotionality measured when children were 1.5 and 3. Values on the Y-axis are 1/6 of an SD apart. Error bars represent 95% confidence intervals. Values on the X-axis are income-to-needs ratios, with examples (in brackets) of income in 2006 Norwegian kroner for a family of two adults and two children.

Table 1

Variable	Mean (SD)	Range	Percent Missing
Main variables			
Externalizing problems	1.3 (0.3)	1-3	0.3
Internalizing problems	1.2 (0.2)	1-3	0.3
Income-to-needs averaged	2.2 (0.8)	0.1-10	13.9
Emotionality averaged	3.2 (0.7)	1-5	4.3
Demographic covariates			
Maternal education (in years)	14.8 (2.4)	9-18	2.9
Malformations at birth (%)	5.1		-
Mother employed (%)	80.5		18.4
Non-maternal child-care (%)	4.9		16.9
Non-Norwegian language background (%)	9.1		2.4
Low birth weight (%)	3.8		0.2
Child gender (% male)	50.3		0.1
Family-related covariates			
Maternal psychological distress ^a	1.3 (0.3)	1-4	2.5
Locus of control	2.3 (0.7)	1-5	12.1

^a Average

Table 2

Summary of Income to needs across the child's first three years as predictor of externalizing and internalizing problems. Multiple imputed data (20 imputations) $N=12.153$.

	Unconditional	
	Internalizing problems	Externalizing problems
	<i>b</i> (SE) [Partial <i>r</i>]	<i>b</i> (SE) [Partial <i>r</i>]
Main effects		
Linear ITN	-.005(.003) [-.015]	-.015(.003) *** [-.041]
Emotionality	.073(.003) *** [.220]	.119(.004) *** [.290]
Moderated		
Linear ITN	-.029(.013) * [-.020]	-.067(.015) *** [-.040]
Emotionality	.090(.009) *** [.086]	.154(.011) *** [.130]
Linear ITN × Emotionality	-.008(.004) [-.017]	-.016(.005) ** [-.031]
R^2 (adjusted R^2)	.049 (.049)	.090 (.090)
Conditioned on demographic covariates ^a		
	Internalizing problems	Externalizing problems
	<i>b</i> (SE) [Partial <i>r</i>]	<i>b</i> (SE) [Partial <i>r</i>]
Main effects		
Linear ITN	-.007(.003) * [-.021]	-.011(.004) ** [-.026]
Emotionality	.071(.003) *** [.209]	.116(.004) *** [.286]
R^2 (adjusted R^2)	.065 (.064)	.111 (.112)
Moderated		
Linear ITN	-.031(.013) [-.021]	-.060(.015) ** [-.036]
Emotionality	.086(.009) *** [.082]	.150(.011) *** [.125]
Linear ITN × Emotionality	-.007(.004) [-.016]	-.015(.005) *** [-.030]
R^2 (adjusted R^2)	.065 (.064)	.113 (.113)
Conditioned on demographic and family-related covariates ^b		
	Internalizing problems	Externalizing problems
	<i>b</i> (SE) [Partial <i>r</i>]	<i>b</i> (SE) [Partial <i>r</i>]
Main effects		
Linear ITN	-.004(.003) [-.012]	-.007(.004) * [-.018]
Emotionality	.052(.003) *** [.147]	.091(.004) *** [.222]
R^2 (adjusted R^2)	.100 (.099)	.157 (.156)
Moderated		
Linear ITN	-.024(.013) [-.016]	-.056(.015) *** [-.034]

	Unconditional	
	Internalizing problems	Externalizing problems
	<i>b</i> (SE) [Partial <i>r</i>]	<i>b</i> (SE) [Partial <i>r</i>]
Emotionality	.066(.009) *** [.065]	.120(.011) *** [.102]
Linear ITN x Emotionality	-.006(004) [-.014]	-.015(004) ** [-.028]
<i>R</i> ² (adjusted <i>R</i> ²)	.100 (.099)	.158 (.157)

Note: ITN = Income-to-needs.

^aModels are conditioned on child gender, low birth weight, presence of malformations at birth, non-Norwegian language background, utilization of non-maternal care at 36 months, maternal education, maternal employment, single parenthood at 36 months.

^bFamily-related covariates are: Maternal distress (symptoms of anxiety and depression), Parental locus of control. *R*² for the multiple imputation models were estimated with the command *mibeta* in Stata.

*
p < .05.

**
p < .01.

p < .001.