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A brief observational instrument for the assessment of infant home environment: development and psychometric testing

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Abstract

The present paper reports on the development and the psychometric properties of a brief observational assessment of home environments for use in large-scale investigations with young infants. We generated observational items conceptually relevant for child development by two methods. First, we adapted the Infant Toddler Home Observation for Measurement of the Environment (IT-HOME) inventory for use in an exclusively observational context. Second, we added new observational items following a review of relevant literature and consulting professionals. The quality of the instrument was first evaluated in a pilot study (n = 926). In our study sample of 3406 families and their children (median age = 3.1 months, range = 1.6–6.0), exploratory factor analysis was used to identify latent constructs, Cronbach's alpha was used as a measure of internal consistency, and convergent validity was evaluated against family socio-demographic characteristics. Inter-observer agreement was investigated in a sub-sample of the respondents (n = 124). The results supported good psychometric properties of the instrument based on: (a) exploratory factor analysis yielding three meaningful latent constructs, (b) Cronbach's alphas ranging from $\alpha = 0.66$ to $\alpha = 0.90$, (c) inter-observer agreement ranging from $r = 0.75$ to $r = 0.91$, and (d) associations between the instrument and socio-demographic characteristics in the expected direction [e.g. Odds Ratio for low income = 15.24, 95% confidence interval (11.60, 20.01)].

Introduction

Early environment affects multiple aspects of children's development. Research indicated that a poor early family environment influences the development of behavioural and emotional problems, cognitive and language problems, as well as health problems (Bradley, 1993, 1994; Evans, 2006; Taylor *et al.*, 2004; Totsika and Sylva, 2004). Aspects of early family environment that have emerged as influential include psychosocial characteristics such as the amount of support, responsiveness and stimulation children receive in the home surroundings, as well as physical characteristics such as housing quality and the provision of developmentally stimulating material resources (Bradley, 1993, 1994; Evans, 2006; Taylor *et al.*, 2004; Totsika and Sylva, 2004).

Given these findings, a structured validated assessment of home environments of young children may have potential implications for the early identification of children at risk of impaired development. Previous research investigating children's home environments generally considered the events, objects and social interactions experienced by a child in the family context (Bradley, 1993, 1994). The 45-item Infant Toddler Home Observation for Measurement of the Environment (IT-HOME) inventory (Caldwell and Bradley, 1984) currently distinguishes itself as the most widely used, validated measure of home environments of children from birth to three years of age. The information needed to score the IT-HOME inventory is obtained through observation of the child in the home surroundings but also relies on an interview with the primary caregiver (Caldwell and Bradley, 1984). Interview-based data have been criticized due to their exclusive reliance on participant's reporting, which is liable to distortion (Lytton, 1971). Predominant sources of distortion are social-desirability and inaccuracy of recall (Bailey *et al.*, 2008; Holtgraves, 2004; Lytton, 1971). In contrast, observational measures have the advantage of directly assessing environments, without the interference of participant's subjective reporting (Bailey *et al.*, 2008; Lytton, 1971).

In the current study, we aimed to develop a reliable, valid and brief observational assessment of home environments for use in large-scale investigations with young infants. We generated observational items conceptually relevant for child development by two methods. First, we adapted the IT-HOME inventory for use in an exclusively observational context. Second, we added new observational items following a review of relevant research literature and consulting professionals. This paper describes the development and initial validation of this adapted IT-HOME inventory which was tested in a large population-based study.

Methods

Item generation and item selection

The purpose of this study was to develop a brief observational assessment of infants' home environments, defined as the events, objects and social interactions experienced by a child in the family context. First, we adapted the 45-item IT-HOME inventory (Caldwell and Bradley, 1984) for use in an exclusively observational context. Consequently, we adapted or excluded IT-HOME inventory items that may require supplementary interview data. Second, we added new observational items following a review of relevant research literature and consulting professionals with experience in psychiatry, child psychiatry, epidemiology, or public health. Using these two methods we generated a pool of 48 items from which 25 were guided by the original IT-HOME inventory. In line with the IT-HOME inventory, all items were binary coded.

In order to determine the quality of these 48 items a pilot study was conducted. Trained research nurses observed the home environments of 926 families in the presence of the primary caregiver and the infant. In revising the items, we used the suggestions of the professionals who had contributed to the item generation. After evaluation we revised some items and deleted others because of insufficient variability or insufficient observational feasibility. The resulting revised scale consisted of 35 items that were administered in our total study sample ($n = 3406$).

After the data collection in the study sample was completed, we performed a final evaluation of the items to obtain the present instrument. First, the correlation matrix of the 35 items was inspected for variables that had little in common with other variables and may thus have low communalities (the proportion of the variance in a given observed variable that is explained by all the factors jointly) (Fabrigar *et al.*, 1999). Examination of the correlation matrix of the 35 items resulted in the exclusion of four items that had low correlations with the majority of variables (coefficients < 0.2; e.g. "Brother or sister interferes with the assessment"). Second, when selecting items to include in the analysis, we performed a final evaluation of the face validity of the variables (Fabrigar *et al.*, 1999). Although conceptually relevant in our setting, two items were rated as having a relatively low generalizability to other settings and were therefore excluded: (1) "Parents express interest in the study findings related to their children", and (2) "During the visit, television or radio noise is causing distraction".

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The remaining pool consisted of 29 items and was subjected to exploratory factor analysis (EFA). When conducting EFA, factor loadings (> 0.30) and communalities (> 0.50) were inspected for item inclusion (Fabrigar *et al.*, 1999). We further based item inclusion on theoretical notions. That is, items were included based on existing literature on children's home environments and developmental outcomes.

Exploratory factor analysis (EFA)

We conducted EFA accommodating binary variables as implemented in Mplus version 5 (Muthén and Muthén, 2007). EFA is a common statistical method used to determine the number of latent constructs that are needed to explain the correlations among a set of observed variables (Rabe-Hesketh and Skrondal, 2008). By using EFA, our goal was to understand the structure of correlations among our observed variables (i.e. identifying latent constructs). Reversed adapted IT-HOME items were recoded before analysis.

EFA analysis was conducted with weighted least squares mean- and variance-adjusted (WLSMV) parameter estimates that are appropriate for categorical data (Muthén and Muthén, 2007). We used geomin (oblique) rotation, which is the default rotation in Mplus. Oblique rotations such as geomin permit correlations among factors and estimates of the correlations among factors are provided (Fabrigar *et al.*, 1999).

We decided on how many factors to extract based on the inspection of the eigenvalues and a scree plot (Fabrigar *et al.*, 1999). Because chi-square values are sensitive to the sample size, we used the comparative fit index (CFI), the Tucker–Lewis index (TLI) and the root mean square error of approximation (RMSEA) as our main indices of model fit (Browne and Cudeck, 1993; Hu and Bentler, 1999). For the CFI and TLI, values greater than 0.90 generally indicate reasonably good fit. For the RMSEA, values of 0.05 or lower indicate close fit, the range of 0.05 to 0.08 is interpreted as reasonable fit, the range of 0.08 to 0.10 as marginal fit, and values greater than 0.10 as unacceptable fit.

Items were retained to define the factors for the adapted IT-HOME inventory based on factor loadings (> 0.30), communalities (> 0.50), and theoretical notions. Items that did not meet these criteria were labelled "Other observation items". These items contribute to the total score. See the Achenbach System of Empirically Based Assessment (ASEBA; Achenbach and Rescorla, 2000) for an example of a comparable approach.

Study design and participants

The present study was conducted within Generation R, a population-based cohort from foetal life onwards (Jaddoe *et al.*, 2010). Pregnant women living in the study area in Rotterdam, the Netherlands, with an expected delivery date between April 2002 and January 2006, were approached to participate. Prenatal assessments including foetal ultrasound examinations were planned in early, mid-, and late pregnancy. In the period from birth to the age of four years, data collection in children included a home visit at the age of three months, questionnaires, and routine visits to the child health centres. Currently, at the age of five years, detailed hands on assessments are performed in a dedicated Generation R research centre. These ongoing assessments focus on several developmental outcomes including behaviour, cognition, asthma, and infectious diseases. The study was conducted in accordance with the guidelines proposed in the World Medical Association Declaration of Helsinki, and was approved by the Medical Ethical Committee at Erasmus University Medical Centre Rotterdam. Written informed consent was obtained from all participants.

For the current study, a total of 6649 caregivers and their infants were eligible for a systematic observation of their home environment. Assessing home environments within the framework of such a large cohort study, we deemed it important to develop a brief and easy to administer instrument. In order to minimize mutual influence of child and environment, the aim was to plan a visit of all eligible families when infants were around three months of age ($\pm$ 1 months) (Bradley, 1994). Our planning of the date for the home visit took into account the expected date of delivery. Because the assessments were conducted during a home visit and visits were frequently rescheduled, it was not logistically possible to visit all children at exactly the same age. We did not exclude children visited after this target age to age six months to minimize selection bias.

In the present study, home visits were scheduled for 45 minutes. During these home visits, additional assessments were performed. Generally, when assessing the home environment of families and their infants exclusively by observation, other activities should be added. Although participants were informed in general terms of measurements of their living conditions during consent, they were blinded to the actual observational assessments.

Of the 6649 eligible caregivers and their infants, 4609 participated in the Generation R home visitation programme (response rate 69%). Of these 4609 observations, 926 were administered in the pilot phase. Non-participation

was due to refusal to participate, administrative problems or change of address. The study version was tested in 3683 infants (4609 – 926). For psychometric reasoning, we excluded infants above the age limit of six months (n = 220) from analyses. We used this age-restriction because the quality of home environments may change as children mature and become more capable of managing their environment (Bradley, 1994). By the age of six months, many infants are already able to provoke encouragement and attention from their parents, suggesting mutual influence (Bradley, 1993, 1994; Zeanah *et al.*, 1997). In order to avoid paired observations, we randomly excluded one twin per pair (n = 33). Home observational data of 24 infants were not included because of missing data on all variables. After excluding these infants, our population for analysis comprised 3406 infants. Table 1 presents the characteristics of our study sample. The measures are described later in this section.

Comparing families in which home observations were performed (the respondents) with families in which no home observations were performed (the non-respondents), we found that the respondents and non-respondents did not differ on prevalence of low income. Non-respondents were more often of Dutch national origin than respondents (59.0% versus 49.9%, $\chi^2 = 47.82$, $p < 0.001$). Non-respondents more often completed higher levels of education than respondents (48.1% versus 45.2%, $\chi^2 = 4.30$, $p = 0.038$).

Table 1. Characteristics of the study population

	Total (n = 3406)
Family net income	
> €2000	60.4
€1200–€2000	19.6
< €1200	20.0
Educational level mother	
High	46.4
Middle	29.9
Low	23.7
Age mother (years)	30.3 (5.2)
Marital status, single	13.3
Age infant at home visit (months)	3.1 (1.6–6.0)
Infant gender, girl	51.1
Infant national origin	
Dutch	49.7
Other-Western	11.5
Non-Western	38.8

Note: Values are means (standard deviations) for continuous normally distributed variables, medians (range) for continuous non-normally distributed variables, and percentages for categorical variables.

Internal consistency

In order to measure the degree to which the items that make up a latent construct are all producing similar scores, Cronbach's alpha coefficients were calculated (Cronbach, 1951). Cronbach's alphas were examined for the total scale and subscales using SPSS version 17.0 for Windows (SPSS Inc., 2009). Generally, a Cronbach's alpha coefficient of 0.70 or higher indicates acceptable internal consistency.

Inter-observer reliability

Consistency of the responses to the scales between observers was assessed in a sub-sample of the respondents. A convenience, non-random sample of 124 families was selected for this purpose. In these families, two research assistants performed a home visit together and independently observed the same home environment. Respective adapted IT-HOME inventory scores were summed to derive scale scores and intra-class correlation coefficients (ICCs) were calculated using SPSS version 17.0 for Windows (SPSS Inc., 2009).

Validation of the adapted IT-HOME inventory

As there was no instrument available that exclusively measures infants' home environments by observation, we subjected the adapted IT-HOME inventory to the following type of validity test. Convergent validity was tested by examining both univariate and multivariate associations between family socio-demographic characteristics and the adapted IT-HOME inventory. Respective adapted IT-HOME inventory scores were summed to derive the total scale. Higher scores on this total scale represented more favourable home environments. Following a suggestion in earlier IT-HOME research (Totsika and Sylva, 2004), we calculated the 25th percentile as a cut-off point. Scores below the cut-off point were considered "less-optimal home environments". Using this dichotomised variable, binary logistic regression analyses were performed using SPSS version 17.0 for Windows (SPSS Inc., 2009). In multivariate analysis, a category missing was added to the categorical socio-demographic variables with missing values, which were infant national origin (7.6%), maternal

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education (10.3%), family income (25.2%), and marital status (10.2%).

In order to test consistency, we also performed multivariate analysis with the adapted IT-HOME total score on a dimensional level. The score had a negatively skewed distribution and the reflect and inverse transformation was applied in order to resemble a symmetric distribution (Tabachnick and Fidell, 1996). Using this transformed variable, linear regression analysis was performed. We used the mean substitution method to handle missing data of socio-demographic characteristics.

Socio-demographic characteristics

Information on socio-demographic characteristics was obtained by questionnaire during pregnancy. *Family income*, defined by the total monthly net income of the household was categorized as "< 1200 €" (below social security level), "1200–2000 €" (modal), and "> 2000 €" (more than modal income). *Educational level of mother* was defined by the highest completed educational level and was classified into three categories according to the definition of Statistics Netherlands (2004a): low (lower vocational training or three years general secondary school), intermediate (> three years general secondary school), and high (higher vocational training or higher academic education). *Marital status* was categorized as "married or cohabiting" and "single". *Infant national origin* was classified into three categories in accordance with Statistics Netherlands (2004b): Dutch, other-Western, and non-Western. Child national origin was based on the country of birth of the parents. If both parents were non-Dutch, we used the country of birth of the mother to classify the child's national origin. The group classified as other-Western includes American Western, Asian Western, European, and Australian children. The non-Western group is comprised of children with a Turkish, Moroccan, Surinamese, Cape Verdian, Dutch Antillean, African, American non-Western and Asian non-Western national origin. *Age of infant* was reported during the home visit. *Infant gender* was obtained from midwife and hospital registries at birth.

Results

Exploratory factor analysis (EFA)

An EFA was performed on the full set of 29 observational items. The eigenvalues for the first six factors were, respectively, 10.82, 3.78, 3.26, 1.69, 1.24, and 1.16. The scree plot suggested three factors by showing a last substantial drop in the magnitude of the eigenvalues after the third value. The fit indices for this three factorial solution were acceptable (CFI = 0.96, TLI = 0.97, RMSEA = 0.04). The χ^2 value was significant (987.37, df = 138, $p < 0.001$). Factor determinacies (the proportion of variance in each factor that is explained by the observed variables) were, respectively, 0.98, 0.99, and 0.98. The factor structure for the three-factor model is shown in Table 2. The first factor was characterized by variables such as "The windows or walls are damp inside the residence" and "The kitchen or toilet is unclean". We interpreted this factor as the organization of the physical environment. The second factor included variables such as "Musical toys are available for the infant" and "Muscle activity toys or equipment are available for the infant". We labelled this factor as the provision of appropriate play and learning materials capable of stimulating development. The third factor consisted of items such as "Parent spontaneously vocalizes to infant at least once during visit" and "Parent caresses or kisses infant at least once during visit". We interpreted this factor as the social and emotional responsivity of the parent.

Of these 29 items, six items (see Table 2) did not theoretically correspond to the factor's area of content (e.g. "Paid daily paper is present" loaded on the second factor which encompasses play and learning materials for children). These six items were labelled "Other observation items" and contributed to the total score. A new EFA was conducted for the 23 items that were included in the factor structure. The EFA yielded a similar three-factor model and the estimates presented in Table 2 were derived from this final EFA. Similar to the former EFA, the scree plot of the final EFA suggested three factors (eigenvalues of the first six factors: 9.22, 3.42, 2.88, 1.35, 1.08, 0.87). The fit indices for this three factorial solution were acceptable (CFI = 0.98, TLI = 0.98, RMSEA = 0.04). The χ^2 value was significant (635.63, df = 89, $p < 0.001$). Factor determinacies were, respectively, 0.98, 0.99, and 0.98.

Three of the factor loadings were equal to or larger than one in magnitude (see Table 2). If factors are correlated (oblique), factor loadings are regression coefficients and thus can be larger than one in magnitude (Jöreskog, 1999). In this study, oblique rotations were used and inter-relatedness between factors was shown. Factor correlations were 0.58 for the first and second factor, 0.47 for the first and third factor, and 0.32 for the second and third factor.

All factor loadings exceeded 0.30 except for the loading of one single item (see Table 2: "Parent keeps infant in visual range, looks at often"). Despite its relatively low factor loading, we decided to retain this item as it was obtained from the original IT-HOME inventory which

Table 2. Exploratory factor analysis (EFA) of the adapted IT-HOME inventory

Item	F1	F2	F3	h^2
The exterior of the house is well maintained	1.03			0.82
The living room is tidy	1.02			0.72
The walls inside the house are in good condition	1.00			0.76
The kitchen or toilet is unclean (–)	0.98			0.63
Neglected houses are present in the street (–)	0.94			0.73
The windows or walls are damp inside the residence (–)	0.88			0.56
The street where the family lives looks clean	0.82			0.65
Basic furniture is present	0.64			0.40
Central heating system is present	0.59			0.25
One could smell cigarette smoke in the residence (–)	0.56			0.23
Various toys are available for the infant during home visit[a]		0.97		0.97
Cuddly toys are available for the infant[a]		0.96		0.91
Musical toys are available for the infant[a]		0.87		0.89
Muscle activity toys or equipment are available for the infant[b]		0.86		0.89
Infant has a special place to lay down and play[a]		0.69		0.73
Parent responds verbally to infant's vocalizations or verbalizations[b]			0.91	0.92
Parent expresses positive feelings toward infant[a]			0.89	0.79
Parent spontaneously vocalizes to infant at least once[a]			0.87	0.81
Parent caresses or kisses infant at least once[b]			0.69	0.62
Parent makes eye contact with infant			0.65	0.73
Parent spontaneously praises infant at least twice[b]			0.62	0.57
Parent responds positively to praise of infant offered by visitor[b]			0.38	0.57
Parent keeps infant in visual range, looks at often[b]			0.25	0.25
Factor correlations				
Factor 2	0.58	—		
Factor 3	0.47	0.32	—	
Other observation items				
At least 10 books or CDs are available[a]				
Paid daily paper is present				
Infant is clean				
Infant has clean clothes and bed linen				
Infant's play environment is unsafe (–)[b]				
The television is on in the residence (–)				

Note: Values are factor loadings and communalities (h^2) for EFA using geomin rotations in 3406 families. Factor labels: F1, physical environment; F2, play and learning environment; F3, social-emotional environment; (–) Reversed items were recoded before EFA.
[a]Slightly revised original IT-HOME item.
[b]Original IT-HOME item.

has shown meaningful links to children's health, growth, intelligence, and socio-emotional development (for a review, see Bradley, 1993). Communalities were all 0.5 or higher, except for the item mentioned earlier and three other items (see Table 2: "Basic furniture is present", "Central heating system is present", and "One could smell cigarette smoke in the residence"). Although their communalities were relatively low, we retained these items as they have shown to play a meaningful role in child development. Poor housing conditions may elevate psychological distress in children (for a review, see Evans *et al.*, 2003). Indoor climatic conditions, structural deficiencies and physical shortcomings may be salient aspects of housing quality for psychological health (Evans *et al.*, 2000; Evans *et al.*, 2003). In addition, exposure to secondary tobacco smoke may be a risk factor for children's healthy development (for a review, see Katic *et al.*, 2010).

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Internal consistency and inter-observer agreement

Cronbach's alphas ranged from 0.66 to 0.90 for the three subscales and was 0.82 for the total scale (see Table 3). ICCs for inter-observer agreement ranged from 0.75 to 0.91 for the three subscales and was 0.87 for the total scale (see Table 3).

Convergent validity

In univariate analysis, we found that all socio-demographic characteristics under study except for gender and age of the child were statistically significantly associated with less-optimal home environments as measured by the adapted IT-HOME inventory (see Table 4). All associations were in the expected direction. For instance, a modal family income [Odds Ratio (OR) = 5.62, 95% confidence interval (CI) (4.21, 7.50)] and a low family income [OR = 15.24, 95% CI (11.60, 20.01)] were significantly (all $p < 0.001$) associated with less-optimal home environments. Middle maternal educational level [OR = 3.49, 95% CI (2.72, 4.48)] and low maternal educational level [OR = 9.13, 95% CI (7.15, 11.66)] were significantly (all $p < 0.001$) associated with less-optimal home environments.

In multivariate analysis, effect sizes attenuated but remained statistically significant (see Table 4). For instance, a modal family income [OR = 2.49, 95% CI (1.81, 3.42)], a low family income [OR = 3.97, 95% CI (2.87, 5.51)], middle maternal educational level [OR = 1.45, 95% CI (1.09, 1.93)] and low maternal educational level [OR = 2.41, 95% CI (1.80, 3.23)] remained associated with less-optimal home environments. When repeating multivariate analysis with the adapted IT-HOME score on a dimensional level, we found similar results (see Table 4).

Discussion

The objective of this study was to develop a reliable and valid instrument based on the IT-HOME inventory, to assess the home environments of young infants exclusively via observation. Measures of internal consistency and inter-observer agreement supported the reliability of the adapted IT-HOME inventory.

EFA yielded three meaningful constructs that were labelled as "the physical environment", "the play and learning environment" and "the social–emotional environment". These three constructs were all positively correlated. The highest correlation was found for the physical environment and the play and learning environment. The remaining factor inter-correlations were of a moderate magnitude, indicating no substantial overlap in the content domain represented by each factor. Given that environmental factors often co-occur (Bradley, 1993), creating independent subscales would not have been ecologically valid and was therefore not our purpose. The Cronbach's alpha coefficients for these subscales (range = 0.66–0.90), as well as their ICCs for inter-observer agreement (range = 0.75–0.91), were at an acceptable level.

The adapted IT-HOME inventory was statistically significantly related to family socio-demographic variables such as maternal educational level and infant national origin. In particular, a strong association was found between the adapted IT-HOME inventory and family income. All of the associations were in the expected direction. These findings suggest high convergent validity of the adapted IT-HOME inventory. However, an important, but at present an unanswerable question, is whether home observations with the adapted IT-HOME inventory add to screening information based on socio-demographic characteristics.

Elardo and Bradley (1981) noted that the use of social class or socio-economic status (SES) indices in research

Table 3. Internal consistency and inter-observer agreement

	Reliability estimates	
Adapted IT-HOME inventory	Internal consistency (n = 3406)	Inter-observer agreement (n = 124)
Total scale, 29 items	0.82	0.87***
Physical environment subscale, 10 items	0.73	0.75***
Play and learning environment subscale, 5 items	0.90	0.91***
Social-emotional environment subscale, 8 items	0.66	0.79***

Note: Internal consistency was calculated with Cronbach's alpha statistic. Inter-observer agreement was calculated with intra-class correlation coefficient statistic.
***$p < 0.001$.

Table 4. Regression analyses predicting children's home environments from socio-demographic characteristics of the family

	Home environments, less-optimal[a] (categorical)						Home environments, score (continuous)		
	Univariate analysis			Multivariate analysis			Multivariate analysis		
Socio-demographic characteristics	OR	(95% CI)	*p*-value	OR	(95% CI)	*p*-value	β	(95% CI)	*p*-value
Family net income									
> €2000		1.00 (reference)			1.00 (reference)			0.00 (reference)	
€1200–€2000	5.62	(4.21, 7.50)	< 0.001	2.49	(1.81, 3.42)	< 0.001	–0.12	(–0.11, –0.06)	< 0.001
< €1200	15.24	(11.60, 20.01)	< 0.001	3.97	(2.87, 5.51)	< 0.001	–0.16	(–0.14, –0.09)	< 0.001
Educational level									
High		1.00 (reference)			1.00 (reference)			0.00 (reference)	
Middle	3.49	(2.72, 4.48)	< 0.001	1.45	(1.09, 1.93)	0.010	–0.11	(–0.08, –0.04)	< 0.001
Low	9.13	(7.15, 11.66)	< 0.001	2.41	(1.80, 3.23)	< 0.001	–0.17	(–0.13, –0.09)	< 0.001
Age mother (years)	0.88	(0.86, 0.89)	< 0.001	0.94	(0.93, 0.96)	< 0.001	0.14	(0.01, 0.01)	< 0.001
Marital status, single	4.81	(3.86, 6.00)	< 0.001	1.95	(1.51, 2.52)	< 0.001	–0.05	(–0.06, –0.01)	0.003
Age infant (months)	1.05	(0.95, 1.15)	0.388	0.90	(0.81, 1.01)	0.077	0.00	(–0.01, 0.01)	0.832
Infant gender, girl	1.00	(0.86, 1.18)	0.959	1.04	(0.86, 1.25)	0.681	0.00	(–0.01; 0.02)	0.955
Infant national origin									
Dutch		1.00 (reference)			1.00 (reference)			0.00 (reference)	
Other-Western	2.08	(1.50, 2.87)	< 0.001	1.76	(1.24, 2.52)	0.002	–0.06	(–0.07, –0.02)	< 0.001
Non-Western	6.36	(5.17, 7.84)	< 0.001	2.82	(2.22, 3.58)	< 0.001	–0.20	(–0.13, –0.09)	< 0.001

Note: Unless otherwise indicated, values are odds ratios (ORs) (95% CI); β is a standardized coefficient and denotes standard deviation change in children's home environments per category or unit change of the socio-demographic characteristics.

[a]Less-optimal home environments are defined by adapted IT-HOME inventory scores below the 25th percentile cut-off ($n = 774$). The remaining scores are considered the reference ($n = 2601$). We excluded 31 children due to missing data: this left 3375 children in the analyses.

on child development has several shortcomings, such as the inability to capture essential differences within SES classes. For example, the finding that low SES is positively related to adverse child development provides us with little information about those home settings in low-SES families which may underlie this relationship (Elardo and Bardley, 1981). Thus, there is a need for measures which could help unravel these environmental processes. Although past research supports the screening efficiency of the original HOME inventory (Bradley and Caldwell, 1977), the usefulness and added value of the adapted IT-HOME inventory as a screening tool remains to be seen.

It may be particularly important for future research to address whether home observations using the adapted IT-HOME inventory are useful to identify at risk families in ethnic minorities or other subgroups. Because of cultural differences, it cannot be assumed that environmental factors have the same meaning and lead to the same developmental outcomes in majority and minority children (Bradley, 1994). Although the IT-HOME inventory has been used in different ethnic groups and few differences in psychometric properties have been reported (Bradley *et al.*, 2001b; Bradley *et al.*, 1996), this may not apply to the present instrument.

The current findings shed light on the development and several psychometric properties of a brief observational assessment of home environments. In comparison with the original IT-HOME inventory, administration time was shortened as the present instrument contains only 29 binary coded items, which do not require a supplementary interview. Our restriction to observational items should minimize distortion by socially desirable response patterns. Importantly, using a large population-based cohort increased the extent to which our results may be generalized.

When interpreting the current results, some methodological considerations should be taken into account. First, an exclusively observational context excludes certain areas of an infant's experience such as out-of-home-activities. Second, our observational assessment of children's home environments may provide only snapshots of a certain time point. For example, the tidiness of the home may fluctuate over time. However, this is inherent to observational assessments that can be applied during short home visits. Finally, the possibility of reactivity should be considered (Lytton, 1971). This denotes changes in the participant's behaviour due to the knowledge that he or she is being observed. For example, parents may act in a socially desirable manner while being observed (Lytton, 1971). In the current study, however, possible reactivity was minimized by blinding our participants to the actual observational assessments.

The adapted IT-HOME inventory was specifically designed as a brief, convenient measure suitable for use in large-scale population-based epidemiological studies. Demonstrating that home environments can be accurately observed with the adapted IT-HOME inventory is but a first step towards a programme of research on young infants' home environments. We know from research that the association between the home environment and children's developmental outcomes may be stronger for certain subgroups of children. For instance, associations between a higher quality physical home environment and lower levels of behaviour problems were observed somewhat more often in poor than in non-poor families (Bradley *et al.*, 2001a). In addition, it has been found that access to stimulating materials in the home mediated the association between SES and child behaviour problems (for a review, see Bradley and Corwyn, 2002). Before passing judgements on the instrument's effectiveness as a screening tool, additional research is required on the relation between the adapted IT-HOME inventory and children's developmental outcomes. A particular focus on moderating or mediating constructs may enhance our understanding of a possible relationship between the adapted IT-HOME inventory and developmental outcomes. In essence, further research is needed to examine whether the adapted IT-HOME inventory is a valuable instrument for population-based investigations examining the impact of infants' home environments on developmental outcomes of the child.

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Declaration of interest statement

The authors have no competing interests.

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