Determinants of Vulnerability in Early Childhood Development – a Population Level Study

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Determinants of Vulnerability in Early Childhood Development – a Population Level Study

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ARTICLE SUMMARY

Article focus

- This study demonstrates that significant population level variation exists in healthy child development.
- The Early Development Instrument (EDI) is a unique, well-validated population level instrument which allows us to track all five domains of early development and identify populations of children at risk.
- When used in conjunction with a parental questionnaire factors which impact on child development at the child, family and community level can be identified.

Key Messages

- A direct population level evidence base on normal child development in needed both as an indicator of child health and a predictor of future outcomes.
- Three child-level demographic factors (age, gender and language) accounted for over half of the population level risk of developmental vulnerability, reinforcing the need for universal early childhood programmes which are cognisant of these variations.

Strengths and limitations of the study

- This is the first population level study in Europe assessing child development outcomes across multiple domain using the EDI>
- The study identifies proximal factors associated with child development, yet children and families do not live in a vacuum. Further research is needed to identify associated factors in the broader socio-cultural environment.

Abstract:

Objectives: Early childhood development strongly influences life-long health. The Early Development Instrument (EDI) is a well validated population-level measure of five developmental domains (physical, social, emotional, language and cognitive skills, and general knowledge) at school entry age. The aim of this study was to explore the potential of the EDI as an indicator of early development in Ireland. It is the first population level study in Europe measuring child development across multiple domains using the EDI.

Design: A cross-sectional design was used.

Setting: The study was conducted in 42 out of 47 primary schools in a major Irish urban centre.

Participants: EDI (teacher completed) scores were calculated for 1,243 children in their first year of full-time education. Contextual data from a subset of 865 children was collected using a parental questionnaire.

Primary and secondary outcome measures: Children scoring in the lowest 10% of the population in one or more domains were deemed 'developmentally vulnerable'. Scores were correlated with contextual data from the parental questionnaire.

Results: In the sample population 29% of children were not developmentally ready to engage in school. Factors associated with increased risk of vulnerability were being male OR=2.1 (CI =1.6 to 2.7); under 5 years OR = 1.5 (CI = 1.1 to 2.1); and having English as a second language OR = 3.7 (CI = 2.6 to 5.2). Adjusted for these demographics, low birth weight, poor parent/child interaction and mother's lower level of education showed the most significant odds ratios for developmental vulnerability. Calculating Population Attributable Fractions, the greatest population-level risk factors were being male (35%), mother's education (27%) and having English as a second language (12%).

Conclusion: The EDI and linked parental questionnaires are promising indicators of the extent, distribution and determinants of developmental vulnerability among children in their first year of primary school in Ireland.

BACKGROUND

There is significant epidemiological evidence that early childhood development (from gestation to age six) strongly influences life-long health trajectories [1]. Indeed, major public health problems such as obesity, heart-disease and mental health problems can be seen to have roots in early childhood [2-3]. This results from a complex interplay between genetic makeup, in utero development, and both pre and postnatal environmental factors, all of which influence brain development in the first five years of life [4].

There is also evidence of a social gradient in child development [5], with children from poorer backgrounds doing less well in school and entering into an intergenerational cycle of reduced employment opportunities, higher fertility and health inequalities [6]. The long term social and economic gain of investing in the early years is also recognised [7]. Kershaw estimates that the cost of preventable early vulnerability to the Canadian economy is between $2.2 and $3.4 trillion [8].

The challenge for public health, is to give due consideration to early childhood development both as an indicator of child health and as a predictor of future outcomes. Child development has been recognised as a key social determinant (Furumoto-Dawson et al., 2007, Maggi et al., 2010). Moreover, the relatively large numbers of children with less pronounced development delay are a potentially greater burden than a small number of children at high risk [9] leading to a need for a population health approach [10]. Yet, measurement of child development is usually in the form of a diagnostic which aims to identify children at greatest risk and provide appropriate individual care, leaving a dearth of research evidence on which to build population level strategies (Guhn et al., 2007a, Avan and Kirkwood, 2010). In this context a direct population level evidence base on normal child development is needed.

The Early Development Instrument (EDI) is an internationally accepted, validated tool which has the potential to provide such an evidence base [11]. In Australia the EDI (AEDI) has been used universally as a census of child development and has revealed significant variation across stated and territories [12]. This is the first population level study in Europe assessing child development outcomes across multiple domains, and using the EDI. The overall objective of the study was to ascertain the proportion of children who were developmentally ready for school in a representative sample of schools in a major urban centre in Ireland using the EDI and to examine associated factors. The study also aimed to assess the feasibility of implementing the EDI and its performance in this setting.

METHODS

This observational study of child development was implemented with children in their first year of formal education (i.e. Junior Infants) in 42 of the 47 primary schools in Cork city. Five schools in the city declined to take part. A further four schools agreed to participate in the study but chose not to administer the parental questionnaire as they believed it would put undue pressure on parents with literacy challenges.

All eligible children in the participating schools were included. Eligibility criteria were: being in the first year of formal education, being in the class more than one month and not having left the school.

Measurement of Child Development - The Early Development Instrument

Child development at school entry age was measured using the Early Development Instrument (EDI). This population level measure was designed at the Offord Centre for Child Studies, McMasters University, Hamilton, Ontario in the late 90s to measure the extent to which children have attained the physical, social, emotional and cognitive maturity necessary to engage in school activities [13]. The EDI is a community or population level measure, not an individual screening or diagnostic tool. The underlying focus is that of a population health approach i.e. small modifications of risk for large numbers are more effective at producing change than large modifications for small numbers [10]. It can be retrospective, focusing on early childhood development outcomes; or predictive, informing school and child-health programmes [13]. The instrument consists of five domains, sixteen sub-domains and 104 questions. The domains and sub domains are outlined in Table 1.

The EDI is a well validated instrument which has had extensive psychometric testing done both in Canada and Australia (Janus et al., 2007, Janus and Offord, 2007, D'Angiulli et al., 2009, Brinkman et al., 2007, Janus et al., 2011).

Parental Questionnaire

In 2003 a parental questionnaire was developed and tested by the Offord Centre to complement the results of the EDI and provide a deeper population level context to the lives of children. This questionnaire was adapted to suit the Irish context and consists of seven sections: child health and development; child care; pre-school; school; family; neighbourhood; and background information.

Data collection

The EDI is a teacher completed questionnaire based on five months observation of the children from the date when they start school, and was, therefore, implemented in the latter half of the first year of formal education. Prior to completing the questionnaires, the teachers were given a short training and were each issued with an EDI guide book. Children were not present when the questionnaire was completed and no individual identifiers were recorded. Each child was assigned a form ID which was used on both the EDI and Parental Questionnaire.

The parental questionnaires were administered simultaneously and were distributed in school bags or homework folders. Each parental pack contained a letter of explanation, questionnaire (again with no individual identifier) and a blank envelope in which to return the questionnaire sealed to the school. Parents were reassured that the envelope would not be opened at the school.

Developmental scoring

EDI scores were calculated for each developmental domain i.e. Physical Health and Well-being; Social Competence; Emotional Maturity; Language and Cognitive Development; and Communication Skills and General Knowledge. All questions had a 2 or 3 point Likert type response format (yes, no, don't know; very true, sometimes or somewhat true, never or not true, don't know). All responses had a score of 0 to 10 (2 point answers were scored 0 and 10; 3 point answers were scored 0, 5 and10). 'Don't know' responses were not scored. Domain scores refer to the child's mean score in that domain - ranging between 0 and 10. Higher scores indicate better results.

Children who scored in the lowest 10% of the study population in one or more of the five domains of the EDI were classed as 'vulnerable'. Those scoring in the lowest 10-25% for one or more domains

were deemed 'at risk' and children who scored in the top 75% were 'on track' in that domain. Each domain was scored separately as children who are vulnerable in one area cannot compensate through competence in another. All scores were aggregated to the group level.

Data from the parental questionnaires was linked to the teacher filled questionnaire using the Form ID number and the matching was crosschecked using the recorded date of birth and gender. Questions, again, were constructed in a Likert type response format - yes, no or three to five response options. Demographic questions on child's date of birth and birth weight were also included.

Explanatory variables

The child's age was calculated from their date of birth and the date on which the form was completed and reported in years and months. 'Children for whom English is a second language (ESL)' refers to those reported by the teacher to have a first language other than English. Members of the Travelling Community were children who were known by school to be part of this Irish ethnic minority group.

'Children identified as special needs' refers to those children who had already been identified as needing special assistance in the classroom. In Ireland this is defined as having a 'Special Education Condition' which has been recognised through a standardised assessment process [14].

Parental reported birth weight was used to calculate whether the child had a low birth weight i.e. less than 2.5kgs. Parental report of birth weight is proven to be adequately accurate to be acceptable for research purposes [15].

Parents were asked how much time (to the nearest hour) the child spent either watching television, using the computer or playing video games on a typical school day. This was coded into '1 or less', 'two to three' and '4 or more' hours.

Data analysis

SPSS was used to analyse data. Each child's developmental scores were calculated by the Offord Centre for Child Studies in line with international EDI process. Initial analysis involved a cross-tabulation of potential risk items from the teacher completed EDI questionnaire (i.e gender, age, ESL, pre-school attendance and membership of the Travelling Community) against the child's score in each of the developmental domains.

All further analyses reported here were confined to the sub-group of children for whom parental data was available. Univariate analysis was used to explore factors associated with 'vulnerability' i.e. being in the lowest 10% of the target population in one or more domain. Factors which proved significant ($p<0.05$) were then entered into logistic regression models to predict likelihood of vulnerability on EDI scores. The first model adjusted for age, gender and ESL. The second model adjusted for all other factors.

Population attributable fractions (PAF) were used to calculate the proportion of risk attributed to each of the factors in the final regression [16-17]. This was calculated using the 'punaf' command in STATA 12.

RESULTS

EDI questionnaires were distributed to teachers of 1366 children. A total of 1243 (92%) were returned completed and valid. Of these, 45% (n=563) were girls. The average age at which children in the study started school was 4 years and 9 months. The youngest was 3 years 11 months and the oldest 6 years and 1 month.

There was considerable diversity in first language with 12.9% of the children reported to have English as a Second Language (ESL) and 36 different languages spoken. Three percent of the children in the study were members of the Traveller Community. The majority of children (76%) were known by the teacher to have attended preschool in the year before commencing full-time education.

In total, 6.6% of children had already been identified as having special needs. The study was conducted in mainstream primary schools and this number does not, therefore, include those children in Cork attending Junior Infants equivalent in special schools, who would tend to be more severely disabled. Parental questionnaires were returned and linked to 865 (63%) valid child questionnaires. The characteristics of the study population varied somewhat between the overall study and those who returned the parental questionnaire. In particular, the proportion of children for whom English was a second language fell from 12.7% in the overall group to 9.8% in those returning parental questionnaires; for children reported as having special needs, the proportions were 6.15 and 5.0 % respectively; and for those reported to be members of the Travelling community, 3.1% and 1.7% respectively. The characteristics of the overall population and those who returned the parental questionnaire are outlined in Table 2.

Distribution of domain scores (Mean and standard error)

Mean scores varied across the EDI domains. However, particular groups of children consistently scored below the mean in all domains i.e. boys, children who had English as a second language, members of the Traveller Community, children who had not been to pre-school and those who were under four years 10 months at the time of the study. This is outlined in Figure 1 with the vertical axis representing the mean domain score for the study population.

Vulnerability

The majority of children scored well in each domain, with 71% not showing any vulnerability. However, over one quarter (28.6%) of all children in the study were developmentally vulnerable (i.e. in the lowest 10th percentile for one or more domain). In total 12% were vulnerable in one domain, 6% in 2 and only 3% of children were vulnerable in all 5 domains.

Factors associated with vulnerability

The following analysis is based only the subset of the study population (n=865) on whom parental questionnaires were returned.

Factors associated with developmental vulnerability (outlined in Table 3) were being male (odds ratio [OR] =2.2, 95% confidence interval [CI] = 1.6 – 3.1), ESL (OR = 3.8, CI= 2.4 – 6.1), being under five years of age at the time of the study (OR = 1.6, CI = 1.1 – 2.4) and low birth weight (OR=2.5,

CI=1.4 – 4.5). When compared with children whose mothers had a university education those with only primary education (OR= 2.8, CI = 1.3 - 5.8) or secondary level (OR = 1.7, CI = 1.1 - 2.6) showed higher levels of vulnerability. Children who were never or seldom told stories in the past week and those who spent more than four hours watching television or playing video games also showed significantly increased vulnerability.

Logistic Regression

Regression analysis was then used to assess the impact of each variable on the odds of being vulnerable as outlined in Table 4. The first model controlled for being male, having English as a second language and being under five years of age at the time of EDI completion, the second also controlled for all other factors. Children whose birth weight was less than 2.5kg were over twice as likely to be vulnerable. Mother's education showed a graded effect. When controlled for all other variables, children who had not been told or read stories in the past week were over five times as likely to be vulnerable than those who were told stories every day. In the final model, the amount of time spent watching television became insignificant.

Population Attributable Fraction (PAF)

PAF was used to measure the proportion of vulnerability attributed to each of the factors included in the final regression model (Table 5). Boys were almost three times as likely as girls to be vulnerable and being male accounted for 35% of the overall vulnerability. English as a second language accounted for 12%, and mothers education (primary, secondary or diploma) for 27% of vulnerability. Despite the high risk of vulnerability among children who were not read to (OR 5.3), this only accounted for 1.7% of the overall vulnerability reflecting its low prevalence in this population.

DISCUSSION

This paper explored the extent to which children in a major urban centre in Ireland have attained the level of child development necessary to engage fully in the education process. The majority of children in the study had achieved a level of development appropriate for their age. However, a significant minority of over one quarter (28.6%) were not developmentally ready to engage in, and thereby benefit fully from school. Factors associated with this level of vulnerability at the child level were being male, a younger child, having English as a second language and low birth weight. Key factors at the family level were mothers education, reading stories.

The overall level of developmental vulnerability was consistent with findings from urban areas in Canada where the EDI has been implemented (Carpiano et al., 2009, Kershaw et al., 2010, Janus and Duku, 2007, Kohen et al., 2009). Hertzman describes this as an unacceptable level of difficulty at school entry age. Considering the expected level of biological determined developmental delay is 5 - 8 % of any given population, external factors can be seen to contribute to major disparities[18].

The study had identified key factors that are associated with this developmental delay. In the final model, the strongest predictor of vulnerability on EDI scores was story telling. Children who were never told stories in the past week were over five times as likely to be vulnerable in one or more domain when compared with children who were told stories every day. This supports numerous

studies which show a link between reading stories and literacy development [19]and with broader aspects of development [20].

Three child-level demographics were strongly associated with vulnerability. Boys, children who start school at a younger age and those for whom English is a second language were also more likely to be vulnerable. PAF illustrates that these three factors account for half of all vulnerability. These findings are consistent with international studies (Maggi et al., 2010, Janus and Duku, 2007) and reinforce the need for universal early childhood programmes which are cognisant of these variations.

This paper specifically considers the proximal factors associated with early childhood development. Yet it is clear that children and families do not live in a vacuum. There are multiple factors in the broader economic and socio-cultural environment which must be considered [1].

Epidemiological studies have clearly linked early socio-economic circumstances to later outcomes (Lawlor et al., 2006, Irwin et al., 2007, Ford-Jones et al., 2008). Yet, the specific factors and processes in the early years which contribute to these outcomes have not been adequately explored. The reliance on diagnostic instruments which are professionally administered and measure particular aspects of development has led to gaps in population level studies on early development outcomes [21]. The EDI is a unique, well-validated, population level instrument which allows us to track all five domains of early childhood development. It has the potential to enhance our understanding of the early years environment and identify populations of children at risk of developmental delay. This in turn can inform universal programmes to enhance outcomes for whole populations of children.

Table 1: Child development outcomes measured by the EDI

EDI Domains /Sub-domains	Expected behaviour
PHYSICAL HEALTH & WELL BEING	
Physical readiness for school day	Usually dressed appropriately for school and not tired, late or hungry.
Physical independence	Can look after own personal needs appropriately, established hand preference, well coordinated, and do not suck a thumb/finger.
Gross and fine motor skills	Physically able to participate in school and excellent or good gross and fine motor skills.
SOCIAL COMPETENCE	
Overall social competence	Very good ability to play and get along with various children, usually cooperative and self-confident.
Responsibility and respect	Respect for others, and for property, follow rules and take care of materials, accept responsibility for actions, and show self-control.
Approaches to learning	Can work neatly, independently, and solve problems, follow instructions and class routines, easily adjusts to changes.
Readiness to explore new things	Curious about the surrounding world, and eager to explore new books, toys and games.
EMOTIONAL MATURITY	
Pro-social and helping behaviour	Helping someone hurt, sick or upset, offering to help spontaneously, invite bystanders to join in.
Anxious and fearful behaviour	Seldom or never showing anxious behaviours; happy and able to enjoy school, comfortable being left at school by caregivers.
Aggressive behaviour	Seldom or never showing aggressive behaviours; not using aggression to solve conflict, not having temper tantrums, and not mean to others.
Hyperactivity and inattention	Not showing hyperactive behaviours; able to concentrate, attend to chosen activities, wait their turn, and usually think before doing.
LANGUAGE & COGNITIVE	
Basic literacy skills	Have basic literacy skills: can handle a book, identify some letters and attach sounds to some letters, show awareness of rhyming words, know the writing directions, and write their own name.
Interest literacy/numeracy and memory	Showing interest in books and reading, math and numbers, and no difficulty remembering things.
Advanced literacy skills	Can read simple, complex words or sentences, write voluntarily, write simple words or sentences.
Basic numeracy skills	Can count to 20, recognize shapes and numbers, compare numbers, sort and classify, use one-to-one correspondence, and understand simple time concepts.
COMMUNICATION & GENERAL KNOWLEDGE	
Communication and general knowledge	Can communicate easily and effectively, can participate in story-telling or imaginative play, articulate clearly, show adequate general knowledge, and are proficient in their native language.

Table 2: Demographic Characteristics comparing total EDI sample and those for whom a parental questionnaire was returned

	Total EDI sample		Parental Questionnaire	
	n	%	N	%
Gender				
Female	563	45.3	402	46.5
Male	659	53.0	463	53.5
Missing	21	1.7		
English as a second language (ESL)				
Not ESL	1072	86.2	770	89.0
ESL	158	12.7	85	9.8
Missing	13	1.0	10	1.2
Identified Special Needs				
Not Special Needs	1160	93.3	821	94.9
Identified Special Needs	82	6.6	43	5.0
Missing	1	.1	1	.1
Member of the Travelling Community				
No	1196	96.2	845	97.7
Yes	39	3.1	15	1.7
Missing	8	.7	5	.6

Table 3: Factors associated with developmental vulnerability (Univariate analysis)

	n(%)	% vulnerable	OR	CI
Male	463 (54)	30%	2.2	(1.6 - 3.1)
English as a second language (ESL)	85 (10)	49%	3.8	(2.4 - 6.1)
Age <5 years	146 (17)	31%	1.6	(1.1 - 2.4)
Low birth weight (<2500g)	49 (6)	41%	2.5	(1.4 - 4.5)
Mother primary education only	38 (4)	37%	2.8	(1.3 - 5.8)
Mother secondary education only	297 (34)	27%	1.7	(1.1 - 2.6)
Four or more hours screen-time per day	128 (15)	32%	2.0	(1.2 - 3.4)
Never told stories in the past week	10 (1)	50%	4.2	(1.2 - 14.8)
Told stories once or twice in the past week	82 (9)	32%	1.9	(1.2 - 3.3)
No preschool	44 (5)	43%	2.7	(1.4 - 5.0)

Table 4: Logistic Regression predicting likelihood of vulnerability on EDI Scores

	OR (95% CI)*	OR (95% CI)**
Male	2.5 (1.8 - 3.6)	2.7 (1.8 - 3.9)
ESL	4.3 (2.6 - 6.9)	4.5 (2.6 – 7.8)
Age <5 years	1.4 (0.9 - 2.2)	1.3 (0.8 - 2.0)
Low Birth Weight	2.6 (1.4 - 4.9)	2.6 (1.3 - 5.0)
Mother Education: Primary or less	3.1 (1.4 - 6.7)	2.5 (1.0 - 6.0)
Secondary	2.1 (1.3 - 3.3)	2.1 (1.3 - 3.4)
Diploma	1.5 (0.9 - 2.3)	1.5 (0.9 - 2.4)
Daily Screen time: 2 to 3 hours	1.2 (0.8 - 1.8)	1.0 (0.6 - 1.6)
4 or more hours	1.7 (1.0 - 3.0)	1.2 (0.6 - 2.1)
Stories in the past week: Never	3.9 (1.0 - 14.3)	5.3 (1.3 - 21.1)
Once or twice	1.7 (1.0 - 2.9)	1.4 (0.8 - 2.5)
Many times	1.2 (0.8 - 1.7)	1.1 (0.7 - 1.6)
No Pre-school	1.9 (1.0 - 3.8)	1.5 (0.7 - 3.1)

* Adjusted for Age, gender and ESL
** Adjusted for all other variables

Table 5: PAF for vulnerability based on OR adjusted for all other variables

	N (%)	OR (95% CI)**	PAF (95% CI)
Under five	146 (17)	1.3 (0.8 - 2.0)	3.0 (-2.8 – 8.5)
Male	463 (54)	2.7 (1.8 - 3.9)	34.6 (21.3 – 45.7)
ESL	85 (10)	4.5 (2.6 - 7.8)	12.2 (7.3 – 16.8)
Low Birth Weight	49 (6)	2.6 (1.3 - 5.0)	4.5 (1.0 – 8.0)
Mother Education: Primary or less	38 (4)	2.5 (1.0 - 6.0)	2.8 (-0.2 – 5.7)
Secondary	297 (34)	2.1 (1.3 - 3.4)	16.8(5.9 – 26.5)
Diploma	263 (30)	1.5 (0.9 - 2.4)	7.7(-1.8 – 16.3)
Daily Screen time: 2 to 3 hours	532 (61)	1.0 (0.6 - 1.6)	-0.3 (-21.7 – 17.3)
4 or more hours	128 (15)	1.2 (0.6 - 2.1)	1.6 (-5.2 – 7.9)
Stories in the past week: Never	10 (1)	5.3 (1.3 - 21.1)	1.7 (0.1 – 3.3)
Once or twice	82 (9)	1.4 (0.8 - 2.5)	2.6 (-2.1 – 7.0)
Many times	251 (29)	1.1 (0.7 - 1.6)	1.7 (-6.8 – 9.5)
No Pre-school	44 (5)	1.5 (0.7 - 3.1)	1.8 (-1.6 – 5.1)
Total PAF			**90.7**

** Adjusted for all other variables

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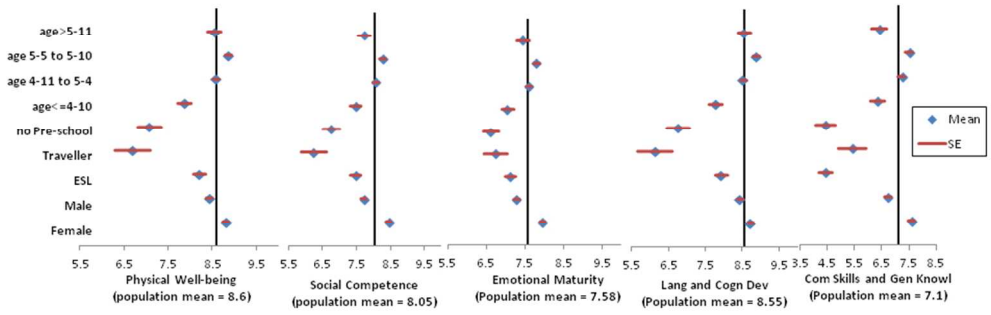
REFERENCES

1. Kershaw P, Forer B. Selection of area-level variables from administrative data: an intersectional approach to the study of place and child development. *Health Place* 2010;16(3):500-11.
2. Marmot M, Allen J, Goldblatt P, Boyce T, et al. 'Fair Society Health Lives', The Marmot Review. Strategic Review of Health Inequalities in England post 2010. London, 2010.
3. Power C, Elliott J. Cohort profile: 1958 British birth cohort (National Child Development Study). *International Journal of Epidemiology* 2006;35(1):34-41.
4. Lemelin J-P, Boivin M, Forget-Dubois N, et al. The Genetic–Environmental Etiology of Cognitive School Readiness and Later Academic Achievement in Early Childhood. *Child Development* 2007;78(6):1855-69.
5. Nicholson JM, Lucas N, Berthelsen D, Wake M. Socioeconomic inequality profiles in physical and developmental health from 0-7 years: Australian National Study. *Journal of Epidemiology & Community Health* 2012;66(1):81-87.
6. Leventhal T, Brooks-Gunn J. The Neighborhoods They Live in: The Effects of Neighborhood Residence on Child and Adolescent Outcomes. *Pshychological Review* 2000;126(2):309-37.
7. Heckman JJ, Masterov DV. The Productivity Argument for Investing in Young Children. *Applied Economic Perspectives and Policy* 2007;29(3):446-93.
8. Kershaw P, Warburton B, Anderson L, et al. The economic costs of early vulnerability in Canada. *Can J Public Health* 2010;101 Suppl 3:S8-12.
9. Guhn M, Janus M, Hertzman C. The Early Development Instrument: Translating school readiness assessment into community actions and policy planning. *Early Education and Development* 2007;18(3):369-74.
10. Rose G. Sick Individuals and Sick Populations. *International Journal of Epidemiology* 1985;14:32 - 38.
11. Janus M, Brinkman S, Duku E. Validity and Psychometric Properties of the Early Development Instrument in Canada, Australia, United States, and Jamaica. *Social Indicators Research* 2011;103(2):283-97.
12. Brinkman SA, Gialamas A, Rahman A, et al. Jurisdictional, socioeconomic and gender inequalities in child health and development: analysis of a national census of 5-year-olds in Australia. *BMJ Open* 2012;2(5).
13. Janus M, Brinkman S, Duku E, et al. The Early Development Instrument: A Population-based Measure for Communities. Hamilton, Ontario: Offord Centre for Child Studies, McMaster University, 2007.
14. Carey DJ. *The Essential Guide to Special Education in Ireland*. Dublin: Primary ABC, 2005.
15. O'Sullivan JJ, Pearce MS, Parker L. Parental recall of birth weight: how accurate is it? *Archives of Disease in Childhood* 2000;82(3):202-03.
16. Hanley JA. A heuristic approach to the formulas for population attributable fraction. *Journal of Epidemiology and Community Health* 2001;55(7):508-14.
17. Miettinen OS. Proportion of disease caused or prevented by a given exposure, trait or intervention. *American Journal of Epidemiology* 1974(99):325 - 32.
18. Hertzman C. The state of child development in Canada: Are we moving toward, or away from, equity from the start? *Paediatr Child Health* 2009;14(10):673-6.

19. Bus AG, Van Ijzendoorn MH. Mothers Reading to Their 3-Year-Olds: The Role of Mother-Child Attachment Security in Becoming Literate. *Reading Research Quarterly* 1995;30(4):998-1015.
20. Fletcher KL, Reese E. Picture book reading with young children: A conceptual framework. *Developmental Review* 2005;25(1):64-103.
21. Janus M, Offord DR. Development and Psychometric Properties of the Early Development Instrument (EDI): A Measure of Children's School Readiness. *Canadian Journal of Behavioural Science-Revue Canadienne Des Sciences Du Comportement* 2007;39(1):1-22.

Figure 1: Distribution of scores across all five domains of development



*Each vertical axis represents the population mean for that domain

254x119mm (96 x 96 DPI)

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	1
Objectives	3	State specific objectives, including any prespecified hypotheses	1
Methods			
Study design	4	Present key elements of study design early in the paper	2
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	1
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	2
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	2 – 3
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	2 -3
Bias	9	Describe any efforts to address potential sources of bias	*3-4*
Study size	10	Explain how the study size was arrived at	2
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	3
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	3
		(*b*) Describe any methods used to examine subgroups and interactions	3-4
		(*c*) Explain how missing data were addressed	3
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	n/a
		(*e*) Describe any sensitivity analyses	n/a
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	1-2
		(b) Give reasons for non-participation at each stage	2
		(c) Consider use of a flow diagram	n/a
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	2
		(b) Indicate number of participants with missing data for each variable of interest	Tables
Outcome data	15*	Report numbers of outcome events or summary measures	3-4
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	4 and tables
		(*b*) Report category boundaries when continuous variables were categorized	3 and tables
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	4-5
Discussion			
Key results	18	Summarise key results with reference to study objectives	5-6
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	5-6
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	6
Generalisability	21	Discuss the generalisability (external validity) of the study results	6
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	1

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Determinants of Vulnerability in Early Childhood Development in Ireland – a Population Level Study

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Determinants of Vulnerability in Early Childhood Development in Ireland – a Population Level Study

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Word Count: 3998

ARTICLE SUMMARY

Article focus

- This study demonstrates that significant population level variation exists in healthy child development in Ireland.
- The Early Development Instrument (EDI) is a unique, well-validated population level instrument which allows us to track all five domains of early development and identify populations of children at risk.
- When used in conjunction with a parental questionnaire factors which impact on child development at the child and family level can be identified.

Key Messages

- A direct population level evidence base on normal child development in needed both as an indicator of child health and a predictor of future outcomes.
- Three child-level demographic factors (age, gender and language) accounted for over half of the population level risk of developmental vulnerability, reinforcing the need for universal early childhood programmes which are cognisant of these variations.

Strengths and limitations of the study

- This is the first population level study in Europe assessing child development outcomes across multiple domain using the EDI>
- The study identifies proximal factors associated with child development, yet children and families do not live in a vacuum. Further research is needed to identify associated factors in the broader socio-cultural environment.

BACKGROUND

There is significant epidemiological evidence that early childhood development (from gestation to age six) strongly influences life-long health trajectories [1]. Indeed, major public health problems such as obesity, heart-disease and mental health problems can be seen to have roots in early childhood [2-3]. This results from a complex interplay between genetic makeup, in utero development, and both pre and postnatal environmental factors, all of which influence brain development in the first five years of life [4].

There is also evidence of a social gradient in child development [5], with children from poorer backgrounds doing less well in school and entering into an intergenerational cycle of reduced employment opportunities, higher fertility and health inequalities [6]. The long term social and economic gain of investing in the early years is also recognised [7]. Kershaw estimates that the cost of preventable early childhood vulnerability to the Canadian economy is between $2.2 and $3.4 trillion [8].

The challenge for public health, is to give due consideration to early childhood development both as an indicator of child health and as a predictor of future outcomes. Child development has been recognised as a key social determinant (Furumoto-Dawson et al., 2007, Maggi et al., 2010). Moreover, the relatively large numbers of children with less pronounced development delay are a potentially greater burden than a small number of children at high risk [9] leading to a need for a population health approach [10]. Yet, measurement of child development is usually in the form of a diagnostic which aims to identify children at greatest risk and provide appropriate individual care, leaving a dearth of research evidence on which to build population level strategies (Guhn et al., 2007a, Avan and Kirkwood, 2010). In this context a direct population level evidence base on normal child development is needed.

The Early Development Instrument (EDI) is an internationally accepted, validated tool which has the potential to provide such an evidence base [11]. In Australia the EDI (AEDI) has been used universally as a census of child development and has revealed significant variation across states and territories [12]. This is the first population level study in Europe assessing child development outcomes across multiple domains, and using the EDI and linked parental questionnaire. The overall objective of the study was to ascertain the proportion of children who were developmentally ready for school in a representative sample of schools in a major urban centre in Ireland using the EDI and to examine associated factors. The study also aimed to assess the feasibility of implementing the EDI and its performance in this setting.

Ireland is a largely homogenous country with 85.8% of the population ethnically White Irish and a further 9.3% of other white ethnic background, primarily British [13]. Cork is one of five major urban centres. While all of these centres are comprised of areas of concentrated affluence and disadvantage, there are similar overall rates of key socio-economic indicators including unemployment, lone-parent families and education [14]. There is a total population of 64,937 five year olds.A minority (1.1%) of Irish children are members of the Traveller Community. Moreover, 19.5% are considered at risk of poverty and 8% live in consistent poverty [15]. The education system is static throughout the country.

METHODS

This observational study of child development was implemented with children in their first year of formal education (in Ireland this is referred to as 'Junior Infants') in 42 of the 47 primary schools in Cork city. Five schools in the city declined to take part. These declining schools were representative of a cross-section of schools in Cork - one boys school, one girls school, one large mixed, middle income school, one designated disadvantaged school and one Irish speaking school – and their omission would not have affected the demographic composition of the study. A further four schools agreed to participate in the study but chose not to administer the parental questionnaire as they believed it would put undue pressure on parents with literacy challenges. These were all designated disadvantaged schools and this has contributed to the under-representation of the most vulnerable children in the parental study.

All eligible children in the participating schools were invited to be included in the study.. Eligibility criteria were: being in the latter half of the first year of formal education (i.e. having completed A minimum of 4 to 5 months of education), being known by the teacher for more than one month and not having left the school.

Measurement of Child Development - The Early Development Instrument

Child development at school entry age was measured using the Early Development Instrument (EDI). This population level measure was designed at the Offord Centre for Child Studies, McMaster University, Hamilton, Ontario in the late 90s to measure the extent to which children have attained the physical, social, emotional and cognitive maturity necessary to engage in school activities [16]. The EDI is a community or population level measure, not an individual screening or diagnostic tool. The underlying focus is that of a population health approach i.e. small modifications of risk for large numbers are more effective at producing change than large modifications for small numbers [10]. It can be retrospective, focusing on early childhood development outcomes; or predictive, informing school and child-health programmes [16]. The instrument consists of five domains, sixteen sub-domains and 104 questions. The domains and sub domains are outlined in Table 1.

The EDI is a well validated instrument which has had extensive psychometric testing done both in Canada and Australia [11 16-19]. It has also been proven valid for use in minority populations [20]. In this Irish study, the EDI had good internally consistency with Cronbach alphas of between 0.8 and 0.96.

Parental Questionnaire

In 2003 a parental questionnaire was developed and tested by the Offord Centre to complement the results of the EDI and provide a deeper population level context to the lives of children [16]. This questionnaire was adapted to suit the Irish context incorporating validated questions from the Growing Up in Ireland Study [21] and the SLAN Survey of Lifestyles, Behaviour and Nutrition in Ireland [22]. It consists of seven sections: child health and development; child care; pre-school; school; family; neighbourhood; and background information.

Data collection

The EDI is a teacher completed questionnaire based on five months observation of the children from the date when they start school, and was, therefore, implemented in the latter half of the first year of formal education. Prior to completing the questionnaires, the teachers were given a short training and were each issued with an EDI guide book. Children were not present when the

questionnaire was completed and no individual identifiers were recorded. Each child was assigned a form ID which was used on both the EDI and Parental Questionnaire.

Passive consent was used in line with previous EDI studies in Canada. An information letter was distributed to all parents by the class teacher two weeks before commencing the study. Parents were given detailed information on the study and asked to contact the school if they did not want their child included. A total of seven parents opted not to participate. Ethical approval was granted by the Clinical Research Ethics Committee of the Cork Teaching Hospitals.

The parental questionnaires were distributed in school bags or homework folders. Each parental pack contained a letter of explanation, questionnaire (again with no individual identifier) and a blank envelope in which to return the questionnaire sealed to the school. Parents were reassured that the envelope would not be opened at the school.

Developmental scoring

EDI scores were calculated for each developmental domain i.e. Physical Health and Well-being; Social Competence; Emotional Maturity; Language and Cognitive Development; and Communication Skills and General Knowledge. All questions had a 2 or 3 point Likert type response format (yes, no, don't know; very true, sometimes or somewhat true, never or not true, don't know). All responses had a score of 0 to 10 (2 point answers were scored 0 and 10; 3 point answers were scored 0, 5 and10). 'Don't know' responses were not scored. Domain scores refer to the child's mean score in that domain - ranging between 0 and 10. Higher scores indicate better results.

Children who scored in the lowest 10% of the study population in one or more of the five domains of the EDI were classed as 'vulnerable'. The 10% cut off is recommended because it is higher than typical clinical cut-off's and should therefore include children who may be more difficult to diagnose [23]. Those scoring in the lowest 10-25% for one or more domains were deemed 'at risk' and children who scored in the top 75% were 'on track' in that domain. Each domain was scored separately as children who are vulnerable in one area cannot compensate through competence in another. All scores were aggregated to the group level. In the absence of an Irish normative sample, to ensure the validity of the cut-off points, data was also scored against Canadian normative data. There was a 99% correlation between 'vulnerability' using the Irish and Canadian cut-off points. In four of the five domains there was 100% correlation between vulnerability using the Irish and Canadian cut-off points.

Data from the parental questionnaires was linked to the teacher filled questionnaire using the Form ID number and the matching was crosschecked using the recorded date of birth and gender. Questions, again, were constructed in a Likert type response format - yes, no or three to five response options. Demographic questions on child's date of birth and birth weight were also included.

Explanatory variables

The child's age was calculated from their date of birth and the date on which the form was completed and reported in years and months. 'Children for whom English is a second language (ESL)' refers to those reported by the teacher to have a first language other than English. Members

of the Travelling Community were children who were known by school to be part of this Irish ethnic minority group.

'Children identified as special needs' refers to those children who had already been identified as needing special assistance in the classroom. In Ireland this is defined as having a 'Special Education Condition' which has been recognised through a standardised assessment process [24].

Parental reported birth weight was used to calculate whether the child had a low birth weight i.e. less than 2.5kgs. Parental report of birth weight has been proven to be adequately accurate to be acceptable for research purposes [25].

Parents were asked how much time (to the nearest hour) the child spent either watching television, using the computer or playing video games on a typical school day. This was coded into '1 or less', 'two to three' and '4 or more' hours.

Data analysis

SPSS was used to analyse data. Each child's EDI scores were calculated by the Offord Centre for Child Studies in line with international EDI process. Initial analysis involved a cross-tabulation of potential risk items from the teacher completed EDI questionnaire (i.e. gender, age, ESL, pre-school attendance and membership of the Travelling Community) against the child's score in each of the developmental domains.

All further analyses reported here were confined to the sub-group of children for whom parental data was available. Univariate analysis was used to explore factors associated with 'vulnerability' i.e. being in the lowest 10% of the target population in one or more domain. Factors which proved significant ($p<0.05$) were then entered into logistic regression models to predict likelihood of vulnerability on EDI scores. The first model adjusted for age, gender and ESL. The second model adjusted for all other factors.

Population attributable fractions (PAF) were used to calculate the proportion of risk attributed to each of the factors in the final regression [26-27]. This was calculated using the 'punaf' command in STATA 12 which calculates confidence intervals for PAF, and also for scenario means and their ratio, known as the population unattributable fraction. Punaf uses the method for estimating PAFs recommended by Greenland and Drescher (1993) for cohort and cross-sectional studies[28].

RESULTS

EDI questionnaires were distributed to teachers of 1366 children. A total of 1243 (92%) were returned completed and valid. Of these, 45% (n=563) were girls. The average age at which children in the study started school was 4 years and 9 months. The youngest was 3 years 11 months and the oldest 6 years and 1 month.

There was considerable diversity in first language with 12.9% of the children reported to have English as a Second Language (ESL) and 36 different languages spoken. Three percent of the children in the study were members of the Traveller Community. The majority of children (76%) were known by the teacher to have attended preschool in the year before commencing full-time education.

In total, 6.6% of children had already been identified as having special needs. The study was conducted in mainstream primary schools and this number does not, therefore, include those children in Cork attending Junior Infants equivalent in special schools, who would tend to be more severely disabled.

Parental questionnaires were returned and linked to 865 (63%) valid child questionnaires. The characteristics of the study population varied somewhat between the overall study and those who returned the parental questionnaire. In particular, the proportion of children for whom English was a second language fell from 12.7% in the overall group to 9.8% in those returning parental questionnaires; for children reported as having special needs, the proportions were 6.15 and 5.0 % respectively; and for those reported to be members of the Travelling community, 3.1% and 1.7% respectively. The characteristics of the population who returned the parental questionnaire and those who did not are compared in Table 2.

Distribution of domain scores (Mean and standard error)

Mean scores varied across the EDI domains. However, particular groups of children consistently scored below the mean in all domains i.e. boys, children who had English as a second language, members of the Traveller Community, children who had not been to pre-school and those who were under four years 10 months at the time of the study. This is outlined in Figure 1 with the vertical axis representing the mean domain score for the study population.

Factors associated with vulnerability

Over one quarter (28.6%) of children in the study were developmentally vulnerable (i.e. in the lowest 10th percentile for one or more domains). In total 12% were vulnerable in only one domain, 6% in 2 domains, 5% in 3 domains, 3% in 4 domains and 3% were vulnerable in all 5 domains.

The following analysis is based only the subset of the study population (n=865) on whom parental questionnaires were returned.

Factors associated with developmental vulnerability (outlined in Table 3) were being male (odds ratio [OR] =2.2, 95% confidence interval [CI] = 1.6 – 3.1), ESL (OR = 3.8, CI= 2.4 – 6.1), being under five years of age at the time of the study (OR = 1.6, CI = 1.1 – 2.4) and low birth weight (OR=2.5, CI=1.4 – 4.5). When compared with children whose mothers had a university education those with only primary education (OR= 2.8, CI = 1.3 - 5.8) or secondary level (OR = 1.7, CI = 1.1 - 2.6) showed higher levels of vulnerability. Children who were never or seldom told stories in the past week and those who spent more than four hours watching television or playing video games also showed significantly increased vulnerability.

Logistic Regression

Regression analysis was then used to assess the impact of each variable on the odds of being vulnerable as outlined in Table 4. The first model controlled for being male, having English as a second language and being under five years of age at the time of EDI completion, the second also controlled for all other factors. Children whose birth weight was less than 2.5kg were over twice as

likely to be vulnerable. Mother's education showed a graded effect. When controlled for all other variables, children who had not been told or read stories in the past week were over five times as likely to be vulnerable than those who were told stories every day. In the final model, the amount of time spent watching television became insignificant.

Population Attributable Fraction (PAF)

PAF was used to measure the proportion of vulnerability attributed to each of the factors included in the final regression model (Table 5). Boys were almost three times as likely as girls to be vulnerable and being male accounted for 35% of the overall vulnerability. English as a second language accounted for 12%, and mothers education (primary, secondary or diploma) for 27% of vulnerability. Despite the high risk of vulnerability among children who were not read to (OR 5.3), this only accounted for 1.7% of the overall vulnerability reflecting its low prevalence in this population.

DISCUSSION

This paper explored the extent to which children in a major urban centre in Ireland have attained the level of child development necessary to engage fully in the education process. The findings suggest that, as expected, a significant minority of over one quarter (28.6%) of children in the study were not developmentally ready to engage in, and thereby benefit fully from school. Clearly these findings should be interpreted cautiously in light of the current level of development of the EDI in Ireland, in particular, the lack of data on predictive validity for the EDI in the Irish population. At the same time, the fundamental issue is not the absolute scores but the unacceptable variation in scores related to socio-economic, environmental and ecological circumstances.

The overall level of developmental vulnerability was consistent with findings from urban areas in Canada where the EDI has been implemented [1 29-31] (Carpiano et al., 2009, Kershaw et al., 2010, Janus and Duku, 2007, Kohen et al., 2009). Indeed mean scores across all domains in the Irish sample were similar to those in the Canadian normative sample. Factors associated with increased risk of vulnerability at the child level were being male, a younger child, having English as a second language and low birth weight. Key factors at the family level were mothers education and reading stories. In the final model, the strongest predictor of vulnerability on EDI scores was story telling. Children who were never told stories in the past week were over five times as likely to be vulnerable compared with children who were told stories every day. This supports numerous studies which show a link between reading stories and literacy development [32]and with broader aspects of development [33] These are again consistent with findings from Canada, further supporting the transferability of the instrument between the two jurisdictions [34]

The mean scores across all five domains varied between sub-groups of the population. The impact of age is very clear. Younger children, aged less than 4 years and 10 months scored on average less well across all the domains. Children who had not attended pre-school also showed below average scores. However, non- attendance at pre-school can result from a variety of underlying reasons. Therefore, these scores cannot be attributed solely to the lack of pre-school education. Children from the Traveller Community also showed lower mean scores across all domains. Traveller children face a variety of challenges including accommodation in poorly serviced communal sites, greater risk of low birth weight, ill-health and hospitalisation [35].

Three child-level demographics were strongly associated with vulnerability. Boys, children who start school at a younger age and those for whom English is a second language were more likely to be vulnerable. PAF illustrates that these three factors account for half of all vulnerability. These findings are consistent with international studies [30 36]

Hertzman describes vulnerability levels of above 15%as an unacceptable level of difficulty at school entry age[37]. There is considerable debate regarding the expected level of biologically determined disability. OECD country estimated range between 1.8% and 10.4%[38]. Considering these expected levels of biological determined developmental delay external factors can be seen to contribute to major disparities. .

Limitations

The overall study was representative of children in their first year in formal education in Cork city. However, there was a 63% return rate on the parental questionnaire. While this compares favourably to other jurisdictions where this method has been used [34], there are significant differences between those for whom parental data were available and those for whom it was not. It is clear that the most vulnerable children were underrepresented in the parental sample.

This was the first study using the EDI in Ireland. Therefore, there was limited scope for validity testing. Comparisons with Canadian normative data, internal validity testing and qualitative work with teachers indicate that the EDI functions well in the Irish context. Future research will consider Rasch modelling and examining issues of predictive validity.

Policy Implications

Epidemiological studies have clearly linked early socio-economic circumstances to later outcomes [39-41]. Yet, the specific factors and processes in the early years which contribute to these outcomes have not been adequately explored. The reliance on diagnostic instruments which are professionally administered and measure particular aspects of development has led to gaps in population level studies on early development outcomes [17]. The EDI is a unique, well-validated, population level instrument which allows us to track all five domains of early childhood development. It has the potential to enhance our understanding of the early years environment and identify populations of children at risk of developmental delay. This in turn can inform universal programmes to enhance outcomes for whole populations of children. National policy which focuses on the early years is essential with investment in peri-natal care, quality support to families and provision of pre-school care by highly skilled practitioners[2]. In Ireland, significant investment is being made in developing a high standard of accessible child care including a free pre-school year and a focus on quality curriculum development. This study was implemented in the year prior to the introduction throughout Ireland of the universally accessible free pre-school year and related investment in skills-enhancement for pre-school staff.

From and Irish perspective, the study raises important questions regarding support to families where English is a second language. ESL was associated with lower mean scores across all domains. The

pace of immigration to Ireland increased rapidly between 1990 and 2008 in response to employment opportunities which have since diminished. There is evidence of communities of immigrant populations living in areas of newly emerging disadvantage which lack the support structures associated with established communities. Indeed this study has identified such communities in which there were vulnerability rates of close to 50%. Particular attention also needs to be focused on the implications of the findings in relation to age. Attendance at school is not mandatory until children are six years old but they may start once they are four, leading to classes with mixed age groups. Moreover, attendance by children under six in not officially monitored.

Poverty and inequality affect up to one quarter of Irish children. Throughout the boom years Irish policy in tackling child poverty consisted almost uniquely of direct payments to families, a practice which is now under threat. Moreover, little consideration was given to creating structures and policies to support and protect families. Tackling child poverty through a strategy of area-based prevention and early intervention features highly on the agenda of the current government [42]. This focus on both universal and targeted interventions has the potential to contribute to breaking this cycle of poverty. However, effective targeting in the context of early childhood development is problematic, with many instruments providing poor predictive reiability[43]. There is a need for longitudinal and population-level data which can be linked to administrative sources to provide a holistic basis for effective programming[44] In Australia and Canada the EDI is providing just such data on early childhood development.

Early childhood development is a key public health issue that needs to be addressed through a comprehensive programme of targeted and universal approaches, supported by high quality research. The EDI can play a critical role in informing policy and practice at a local and national level, and allowing for internationally comparable studies on early childhood development.

Table 1: Child development outcomes measured by the EDI

EDI Domains /Sub-domains	Expected behaviour
PHYSICAL HEALTH & WELL BEING	
Physical readiness for school day	Usually dressed appropriately for school and not tired, late or hungry.
Physical independence	Can look after own personal needs appropriately, established hand preference, well coordinated, and do not suck a thumb/finger.
Gross and fine motor skills	Physically able to participate in school and excellent or good gross and fine motor skills.
SOCIAL COMPETENCE	
Overall social competence	Very good ability to play and get along with various children, usually cooperative and self-confident.
Responsibility and respect	Respect for others and for property, follow rules and take care of materials, accept responsibility for actions, and show self-control.
Approaches to learning	Can work neatly, independently, and solve problems, follow instructions and class routines, easily adjust to changes.
Readiness to explore new things	Curious about the surrounding world, and eager to explore new books, toys and games.
EMOTIONAL MATURITY	
Pro-social and helping behaviour	Helping someone hurt, sick or upset, offering to help spontaneously, invite bystanders to join in.
Anxious and fearful behaviour	Seldom or never showing anxious behaviours; happy and able to enjoy school, comfortable being left at school by caregivers.
Aggressive behaviour	Seldom or never showing aggressive behaviours; not using aggression to solve conflict, not having temper tantrums, and not mean to others.
Hyperactivity and inattention	Not showing hyperactive behaviours; able to concentrate, attend to chosen activities, wait their turn, and usually think before doing.
LANGUAGE & COGNITIVE	
Basic literacy skills	Have basic literacy skills: can handle a book, identify some letters and attach sounds to some letters, show awareness of rhyming words, know the writing directions, and write their own name.
Interest literacy/numeracy and memory	Showing interest in books and reading, math and numbers, and no difficulty remembering things.
Advanced literacy skills	Can read simple, complex words or sentences, write voluntarily, write simple words or sentences.
Basic numeracy skills	Can count to 20, recognize shapes and numbers, compare numbers, sort and classify, use one-to-one correspondence, and understand simple time concepts.
COMMUNICATION & GENERAL KNOWLEDGE	
Communication and general knowledge	Can communicate easily and effectively, can participate in story-telling or imaginative play, articulate clearly, show adequate general knowledge, and are proficient in their native language.

Table 2: Comparison between sample for whom parental data was and was not available

	Parental n= 865	No Parental n=378	Sig
Mean Age - years (SD)	5.38 (.39)	5.36 (0.43)	.405
Female	46%	45%	.719
English as a Second Language	10%	19%	<.001
Identified Special needs	5%	10%	<.001
Member of the Traveller Community	2%	6%	<.001
Mean EDI scores by domain (SD)			
Physical health and wellbeing	8.8 (1.4)	8.1 (2.0)	<.001
Social competence	8.3 (1.8)	7.5 (2.1)	<.001
Emotional maturity	7.7 (1.6)	7.2 (1.7)	<.001
Language and cognitive development	8.8 (1.6)	8.0 (2.4)	<.001
Communication skills and gen knowledge	7.5 (2.8)	6.2 (3.2)	<.001
% Vulnerable in 1 or more domain of EDI	23%	41%	<.001

Table 3: Factors associated with developmental vulnerability (Univariate analysis)

	n(%)	% vulnerable*	OR	CI
Male	463 (54)	30%	2.2	(1.6 - 3.1)
English as a second language (ESL)	85 (10)	49%	3.8	(2.4 - 6.1)
Age <5 years	146 (17)	31%	1.6	(1.1 - 2.4)
Low birth weight (<2500g)	49 (6)	41%	2.5	(1.4 - 4.5)
Mother primary education only	38 (4)	37%	2.8	(1.3 - 5.8)
Mother secondary education only	297 (34)	27%	1.7	(1.1 - 2.6)
Four or more hours screen-time per day	128 (15)	32%	2.0	(1.2 - 3.4)
Never told stories in the past week	10 (1)	50%	4.2	(1.2 - 14.8)
Told stories once or twice in the past week	82 (9)	32%	1.9	(1.2 - 3.3)
No preschool	44 (5)	43%	2.7	(1.4 - 5.0)

*Refers to the % of children vulnerable in one or more of the five domains of the EDI

Table 4: Logistic Regression predicting likelihood of vulnerability on EDI Scores

	OR (95% CI)*	OR (95% CI)**
Male	2.5 (1.8 - 3.6)	2.7 (1.8 - 3.9)
ESL	4.3 (2.6 - 6.9)	4.5 (2.6 – 7.8)
Age <5 years	1.4 (0.9 - 2.2)	1.3 (0.8 - 2.0)
Low Birth Weight	2.6 (1.4 - 4.9)	2.6 (1.3 - 5.0)
Mother Education (ref: University education)		
Primary or less	3.1 (1.4 - 6.7)	2.5 (1.0 - 6.0)
Secondary	2.1 (1.3 - 3.3)	2.1 (1.3 - 3.4)
Diploma	1.5 (0.9 - 2.3)	1.5 (0.9 - 2.4)
Daily Screen time (ref: 1 hour or less)		
2 to 3 hours	1.2 (0.8 - 1.8)	1.0 (0.6 - 1.6)
4 or more hours	1.7 (1.0 - 3.0)	1.2 (0.6 - 2.1)
Stories in the past week (ref: every day)		
: Never	3.9 (1.0 - 14.3)	5.3 (1.3 - 21.1)
Once or twice	1.7 (1.0 - 2.9)	1.4 (0.8 - 2.5)
Many times	1.2 (0.8 - 1.7)	1.1 (0.7 - 1.6)
No Pre-school	1.9 (1.0 - 3.8)	1.5 (0.7 - 3.1)

* Adjusted for Age, gender and ESL (separate tests run for each subsequent variable)
** Adjusted for all other variables in one model

Table 5: PAF for vulnerability based on OR adjusted for all other variables

	N (%)	OR (95% CI)**	PAF (95% CI)
Under five	146 (17)	1.3 (0.8 - 2.0)	3.0 (-2.8 – 8.5)
Male	463 (54)	2.7 (1.8 - 3.9)	34.6 (21.3 – 45.7)
ESL	85 (10)	4.5 (2.6 - 7.8)	12.2 (7.3 – 16.8)
Low Birth Weight	49 (6)	2.6 (1.3 - 5.0)	4.5 (1.0 – 8.0)
Mother Education: Primary or less	38 (4)	2.5 (1.0 - 6.0)	2.8 (-0.2 – 5.7)
Secondary	297 (34)	2.1 (1.3 - 3.4)	16.8(5.9 – 26.5)
Diploma	263 (30)	1.5 (0.9 - 2.4)	7.7(-1.8 – 16.3)
Daily Screen time: 2 to 3 hours	532 (61)	1.0 (0.6 - 1.6)	-0.3 (-21.7 – 17.3)
4 or more hours	128 (15)	1.2 (0.6 - 2.1)	1.6 (-5.2 – 7.9)
Stories in the past week: Never	10 (1)	5.3 (1.3 - 21.1)	1.7 (0.1 – 3.3)
Once or twice	82 (9)	1.4 (0.8 - 2.5)	2.6 (-2.1 – 7.0)
Many times	251 (29)	1.1 (0.7 - 1.6)	1.7 (-6.8 – 9.5)
No Pre-school	44 (5)	1.5 (0.7 - 3.1)	1.8 (-1.6 – 5.1)
Total PAF			**90.7**

** Adjusted for all other variables

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REFERENCES

1. Kershaw P, Forer B. Selection of area-level variables from administrative data: an intersectional approach to the study of place and child development. *Health Place* 2010;16(3):500-11.
2. Marmot M, Allen J, Goldblatt P, Boyce T, McNeish D, Grady M, et al. 'Fair Society Health Lives', The Marmot Review. In: England SRoHIi, editor. London, 2010.
3. Power C, Elliott J. Cohort profile: 1958 British birth cohort (National Child Development Study). *International Journal of Epidemiology* 2006;35(1):34-41.
4. Lemelin J-P, Boivin M, Forget-Dubois N, Dionne G, Brendgen M, Séguin JR, et al. The Genetic–Environmental Etiology of Cognitive School Readiness and Later Academic Achievement in Early Childhood. *Child Development* 2007;78(6):1855-69.
5. Nicholson JM, Lucas N, Berthelsen D, Wake M. Socioeconomic inequality profiles in physical and developmental health from 0-7 years: Australian National Study. *Journal of Epidemiology & Community Health* 2012;66(1):81-87.
6. Leventhal T, Brooks-Gunn J. The Neighborhoods They Live in: The Effects of Neighborhood Residence on Child and Adolescent Outcomes. *Pshychological Review* 2000;126(2):309 - 37.
7. Heckman JJ, Masterov DV. The Productivity Argument for Investing in Young Children. *Applied Economic Perspectives and Policy* 2007;29(3):446-93.
8. Kershaw P, Warburton B, Anderson L, Hertzman C, Irwin LG, Forer B. The economic costs of early vulnerability in Canada. *Can J Public Health* 2010;101 Suppl 3:S8-12.
9. Guhn M, Janus M, Hertzman C. The Early Development Instrument: Translating school readiness assessment into community actions and policy planning. *Early Education and Development* 2007;18(3):369-74.
10. Rose G. Sick Individuals and Sick Populations. *International Journal of Epidemiology* 1985;14:32 - 38.
11. Janus M, Brinkman S, Duku E. Validity and Psychometric Properties of the Early Development Instrument in Canada, Australia, United States, and Jamaica. *Social Indicators Research* 2011;103(2):283-97.
12. Brinkman S, Gialamas A, Rahman A, Mittinty MN, Gregory TA, Silburn S, et al. Jurisdictional, socioeconomic and gender inequalities in child health and development: analysis of a national census of 5-year-olds in Australia. *BMJ Open* 2012;2(5).
13. C.S.O. Profile 7: Religion, Ethnicity and Irish Travellers. Cork: Central Statistics Office, 2012.
14. Haase T, Pratschke J. Deprivation and its Spatial Articulation in the Republic of Ireland. Dublin: Area Development Management, 2005.
15. OMCYA. State of the Nations Children. Dublin: Office of the Minister for Children and Youth Affairs, 2010.
16. Janus M, Brinkman S, Duku E, Hertzman C, Santos R, Sayers M, et al. The Early Development Instrument: A Population-based Measure for Communities. Hamilton, Ontario: Offord Centre for Child Studies, McMaster University, 2007.

17. Janus M, Offord DR. Development and Psychometric Properties of the Early Development Instrument (EDI): A Measure of Children's School Readiness. *Canadian Journal of Behavioural Science-Revue Canadienne Des Sciences Du Comportement* 2007;39(1):1-22.
18. D'Angiulli A, Warburton W, Dahinten S, Hertzman C. Population-level associations between preschool vulnerability and grade-four basic skills. *PLoS One* 2009;4(11):e7692.
19. Brinkman S, Silburn S, Lawrence D, Goldfeld S, Sayers M, Oberklaid F. Investigating the validity of the Australian Early Development Index. *Early Education and Development* 2007;18(3):427-51.
20. Muhajarine N, Puchala C, Janus M. Does the EDI Equivalently Measure Facets of School Readiness for Aboriginal and Non-Aboriginal children? *Social Indicators Research* 2011;103(2):299-314.
21. Williams J, Greene S, Doyle E, Harris E, Layte R, McCoy S, et al. Growing up in Ireland national longitudinal study of children. The lives of 9 year olds: The Stationery Office, 2009.
22. Morgan K, McGee H, Watson D, Perry I, Barry M, Shelley E, et al. SLAN 2007: Survey of Lifestyle, Attitudes & Nutrition in Ireland: Main Report. Dublin: Department of Health and Children, 2008.
23. Brinkman S, Sayers M, Goldfeld S, Kline J. Population monitoring of language and cognitive development in Australia: the Australian Early Development Index. *International Journal of Speech-Language Pathology* 2009;11(5):419-30.
24. Carey DJ. *The Essential Guide to Special Education in Ireland*. Dublin: Primary ABC, 2005.
25. O'Sullivan JJ, Pearce MS, Parker L. Parental recall of birth weight: how accurate is it? *Archives of Disease in Childhood* 2000;82(3):202-03.
26. Hanley JA. A heuristic approach to the formulas for population attributable fraction. *Journal of Epidemiology and Community Health* 2001;55(7):508-14.
27. Miettinen OS. Proportion of disease caused or prevented by a given exposure, trait or intervention. *American Journal of Epidemiology* 1974(99):325 - 32.
28. Greenland S, Drescher K. Maximum likelihood estimation of the attributable fraction from logistic models. *Biometrics* 1993;49:865-72.
29. Carpiano RM, Lloyd JEV, Hertzman C. Concentrated affluence, concentrated disadvantage, and children's readiness for school: A population-based, multi-level investigation. *Social Science & Medicine* 2009;69(3):420-32.
30. Janus M, Duku E. The School Entry Gap: Socioeconomic, Family, and Health Factors Associated With Children's School Readiness to Learn. *Early Education and Development* 2007;18(3):375-403.
31. Kohen D, Oliver L, Pierre F. Examining the effects of schools and neighbourhoods on the outcomes of Kindergarten children in Canada. *International Journal of Speech-Language Pathology* 2009;11(5):404-18.
32. Bus AG, Van Ijzendoorn MH. Mothers Reading to Their 3-Year-Olds: The Role of Mother-Child Attachment Security in Becoming Literate. *Reading Research Quarterly* 1995;30(4):998-1015.
33. Fletcher KL, Reese E. Picture book reading with young children: A conceptual framework. *Developmental Review* 2005;25(1):64-103.
34. Janus M. Transition to school. In: Laverick DM, Jalongo MR, editors. *Transitions to early care and education*: Springer Netherlands, 2011:177 - 87.
35. Abdalla S, Cronin F, Daly L, Drummond A, Fitzpatrick P, Frazier K, et al. Our Geels: All Ireland Traveller Health Study. Dublin, 2010:University College Dublin.
36. Maggi S, Irwin LJ, Siddiqi A, Hertzman C. The social determinants of early child development: an overview. *J Paediatr Child Health* 2010;46(11):627-35.
37. Hertzman C. The state of child development in Canada: Are we moving toward, or away from, equity from the start? *Paediatr Child Health* 2009;14(10):673-6.
38. Banks J, McCoy S. A Study on the Prevalence of Special Educational Needs. Dublin: Economic and Social Research Institute, 2011.

39. Lawlor DA, Ronalds G, Macintyre S, Clark H, Leon DA. Family socioeconomic position at birth and future cardiovascular disease risk: Findings from the Aberdeen children of the 1950s cohort study. *American Journal of Public Health* 2006;96(7):1271-77.
40. Irwin LG, Siddiqi A, Hertzman C. Early Child Development: A Powerful Equaliser: WHO Commission on Social Determinants of Health, 2007.
41. Ford-Jones EL, Williams R, Bertrand J. Social paediatrics and early child development: Part 1. *Paediatr Child Health* 2008;13(9):755-8.
42. Programme for Government 2011 - 2016. In: Expenditure DoP, editor. Dublin, 2011.
43. Lynch JW, Law C, Brinkman S, Chittleborough C, Sawyer M. Inequalities in child healthy development: Some challenges for effective implementation. *Social Science & Medicine* 2010;71(7):1244-48.
44. Hertzman C, Williams R. Making early childhood count. *Canadian Medical Association Journal* 2009;180(1):68-71.

Determinants of Vulnerability in Early Childhood Development in Ireland – a Population Level Study

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ARTICLE SUMMARY

Article focus

- This study demonstrates that significant population level variation exists in healthy child development in Ireland.
- The Early Development Instrument (EDI) is a unique, well-validated population level instrument which allows us to track all five domains of early development and identify populations of children at risk.
- When used in conjunction with a parental questionnaire factors which impact on child development at the child and, family ~~and community~~ level can be identified.

Key Messages

- A direct population level evidence base on normal child development in needed both as an indicator of child health and a predictor of future outcomes.
- Three child-level demographic factors (age, gender and language) accounted for over half of the population level risk of developmental vulnerability, reinforcing the need for universal early childhood programmes which are cognisant of these variations.

Strengths and limitations of the study

- This is the first population level study in Europe assessing child development outcomes across multiple domain using the EDI>
- The study identifies proximal factors associated with child development, yet children and families do not live in a vacuum. Further research is needed to identify associated factors in the broader socio-cultural environment.

BACKGROUND

There is significant epidemiological evidence that early childhood development (from gestation to age six) strongly influences life-long health trajectories [1]. Indeed, major public health problems such as obesity, heart-disease and mental health problems can be seen to have roots in early childhood [2-3]. This results from a complex interplay between genetic makeup, in utero development, and both pre and postnatal environmental factors, all of which influence brain development in the first five years of life [4].

There is also evidence of a social gradient in child development [5], with children from poorer backgrounds doing less well in school and entering into an intergenerational cycle of reduced employment opportunities, higher fertility and health inequalities [6]. The long term social and economic gain of investing in the early years is also recognised [7]. Kershaw estimates that the cost of preventable early childhood vulnerability to the Canadian economy is between $2.2 and $3.4 trillion [8].

The challenge for public health, is to give due consideration to early childhood development both as an indicator of child health and as a predictor of future outcomes. Child development has been recognised as a key social determinant (Furumoto-Dawson et al., 2007, Maggi et al., 2010). Moreover, the relatively large numbers of children with less pronounced development delay are a potentially greater burden than a small number of children at high risk [9] leading to a need for a population health approach [10]. Yet, measurement of child development is usually in the form of a diagnostic which aims to identify children at greatest risk and provide appropriate individual care, leaving a dearth of research evidence on which to build population level strategies (Guhn et al., 2007a, Avan and Kirkwood, 2010). In this context a direct population level evidence base on normal child development is needed.

The Early Development Instrument (EDI) is an internationally accepted, validated tool which has the potential to provide such an evidence base [11]. In Australia the EDI (AEDI) has been used universally as a census of child development and has revealed significant variation across states and territories [12]. This is the first population level study in Europe assessing child development outcomes across multiple domains, and using the EDI and linked parental questionnaire. The overall objective of the study was to ascertain the proportion of children who were developmentally ready for school in a representative sample of schools in a major urban centre in Ireland using the EDI and to examine associated factors. The study also aimed to assess the feasibility of implementing the EDI and its performance in this setting.

Ireland is a largely homogenous country with 85.8% of the population ethnically White Irish and a further 9.3% of other white ethnic background, primarily British [13]. Cork is one of five major urban centres. While all of these centres are comprised of areas of concentrated affluence and disadvantage, there are similar overall rates of key socio-economic indicators including unemployment, lone-parent families and education [14]. There is a total population of 64,937 five year olds.A minority (1.1%) of Irish children are members of the Traveller Community. Moreover, 19.5% are considered at risk of poverty and 8% live in consistent poverty [15]. The education system is static throughout the country.

METHODS

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This observational study of child development was implemented with children in their first year of formal education (~~i.e.~~ in Ireland this is referred to as 'Junior Infants') in 42 of the 47 primary schools in Cork city. Five schools in the city declined to take part. These declining schools were representative of a cross-section of schools in Cork - one boys school, one girls school, one large mixed, middle income school, one designated disadvantaged school and one Irish speaking school – and their omission would not have affected the demographic composition of the study. A further four schools agreed to participate in the study but chose not to administer the parental questionnaire as they believed it would put undue pressure on parents with literacy challenges. These were all designated disadvantaged schools and this has contributed to the under-representation of the most vulnerable children in the parental study.

All eligible children in the participating schools were invited to be included in the study.~~included~~. Eligibility criteria were: being in the latter half of the first year of formal education (i.e. having completed A minimum of 4 to 5 months of education), being ~~in the class~~ known by the teacher for more than one month and not having left the school.

Measurement of Child Development - The Early Development Instrument

Child development at school entry age was measured using the Early Development Instrument (EDI). This population level measure was designed at the Offord Centre for Child Studies, McMaster~~s~~ University, Hamilton, Ontario in the late 90s to measure the extent to which children have attained the physical, social, emotional and cognitive maturity necessary to engage in school activities [16~~13~~]. The EDI is a community or population level measure, not an individual screening or diagnostic tool. The underlying focus is that of a population health approach i.e. small modifications of risk for large numbers are more effective at producing change than large modifications for small numbers [10]. It can be retrospective, focusing on early childhood development outcomes; or predictive, informing school and child-health programmes [16~~13~~]. The instrument consists of five domains, sixteen sub-domains and 104 questions. The domains and sub domains are outlined in Table 1.

The EDI is a well validated instrument which has had extensive psychometric testing done both in Canada and Australia [11 16-19 ~~(Janus et al., 2007, Janus and Offord, 2007, D'Anigulli et al., 2009, Brinkman et al., 2007, Janus et al., 2011)~~]. It has also been proven valid for use in minority populations [20]. In this Irish study, the EDI had good internally consistency with Cronbach alphas of between 0.8 and 0.96.

Parental Questionnaire

In 2003 a parental questionnaire was developed and tested by the Offord Centre to complement the results of the EDI and provide a deeper population level context to the lives of children [16]. This questionnaire was adapted to suit the Irish context incorporating validated questions from the Growing Up in Ireland Study [21] and the SLAN Survey of Lifestyles, Behaviour and Nutrition in Ireland [22]. ~~and~~It consists of seven sections: child health and development; child care; pre-school; school; family; neighbourhood; and background information.

Data collection

The EDI is a teacher completed questionnaire based on five months observation of the children from the date when they start school, and was, therefore, implemented in the latter half of the first year

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of formal education. Prior to completing the questionnaires, the teachers were given a short training and were each issued with an EDI guide book. Children were not present when the questionnaire was completed and no individual identifiers were recorded. Each child was assigned a form ID which was used on both the EDI and Parental Questionnaire.

Passive consent was used in line with previous EDI studies in Canada. An information letter was distributed to all parents by the class teacher two weeks before commencing the study. Parents were given detailed information on the study and asked to contact the school if they did not want their child included. A total of seven parents opted not to participate. Ethical approval was granted by the Clinical Research Ethics Committee of the Cork Teaching Hospitals.

The parental questionnaires ~~were administered simultaneously and~~ were distributed in school bags or homework folders. Each parental pack contained a letter of explanation, questionnaire (again with no individual identifier) and a blank envelope in which to return the questionnaire sealed to the school. Parents were reassured that the envelope would not be opened at the school.

Developmental scoring

EDI scores were calculated for each developmental domain i.e. Physical Health and Well-being; Social Competence; Emotional Maturity; Language and Cognitive Development; and Communication Skills and General Knowledge. All questions had a 2 or 3 point Likert type response format (yes, no, don't know; very true, sometimes or somewhat true, never or not true, don't know). All responses had a score of 0 to 10 (2 point answers were scored 0 and 10; 3 point answers were scored 0, 5 and10). 'Don't know' responses were not scored. Domain scores refer to the child's mean score in that domain - ranging between 0 and 10. Higher scores indicate better results.

Children who scored in the lowest 10% of the study population in one or more of the five domains of the EDI were classed as 'vulnerable'. The 10% cut off is recommended because it is higher than typical clinical cut-off's and should therefore include children who may be more difficult to diagnose [23]. Those scoring in the lowest 10-25% for one or more domains were deemed 'at risk' and children who scored in the top 75% were 'on track' in that domain. Each domain was scored separately as children who are vulnerable in one area cannot compensate through competence in another. All scores were aggregated to the group level. In the absence of an Irish normative sample, to ensure the validity of the cut-off points, data was also scored against Canadian normative data. There was a 99% correlation between 'vulnerability' using the Irish and Canadian cut-off points. In four of the five domains there was 100% correlation between vulnerability using the Irish and Canadian cut-off points.

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Data from the parental questionnaires was linked to the teacher filled questionnaire using the Form ID number and the matching was crosschecked using the recorded date of birth and gender. Questions, again, were constructed in a Likert type response format - yes, no or three to five response options. Demographic questions on child's date of birth and birth weight were also included.

Explanatory variables

The child's age was calculated from their date of birth and the date on which the form was completed and reported in years and months. 'Children for whom English is a second language

(ESL)' refers to those reported by the teacher to have a first language other than English. Members of the Travelling Community were children who were known by school to be part of this Irish ethnic minority group.

'Children identified as special needs' refers to those children who had already been identified as needing special assistance in the classroom. In Ireland this is defined as having a 'Special Education Condition' which has been recognised through a standardised assessment process [24~~14~~].

Parental reported birth weight was used to calculate whether the child had a low birth weight i.e. less than 2.5kgs. Parental report of birth weight ~~is~~has been proven to be adequately accurate to be acceptable for research purposes [25~~15~~].

Parents were asked how much time (to the nearest hour) the child spent either watching television, using the computer or playing video games on a typical school day. This was coded into '1 or less', 'two to three' and '4 or more' hours.

Data analysis

SPSS was used to analyse data. Each child's EDI~~developmental~~ scores were calculated by the Offord Centre for Child Studies in line with international EDI process. Initial analysis involved a cross-tabulation of potential risk items from the teacher completed EDI questionnaire (~~i.e~~i.e. gender, age, ESL, pre-school attendance and membership of the Travelling Community) against the child's score in each of the developmental domains.

All further analyses reported here were confined to the sub-group of children for whom parental data was available. Univariate analysis was used to explore factors associated with 'vulnerability' i.e. being in the lowest 10% of the target population in one or more domain. Factors which proved significant ($p<0.05$) were then entered into logistic regression models to predict likelihood of vulnerability on EDI scores. The first model adjusted for age, gender and ESL. The second model adjusted for all other factors.

Population attributable fractions (PAF) were used to calculate the proportion of risk attributed to each of the factors in the final regression [26-27~~16-17~~]. This was calculated using the 'punaf' command in STATA 12 which calculates confidence intervals for PAF, and also for scenario means and their ratio, known as the population unattributable fraction. Punaf uses the method for estimating PAFs recommended by Greenland and Drescher (1993) for cohort and cross-sectional studies[28].

RESULTS

EDI questionnaires were distributed to teachers of 1366 children. A total of 1243 (92%) were returned completed and valid. Of these, 45% (n=563) were girls. The average age at which children in the study started school was 4 years and 9 months. The youngest was 3 years 11 months and the oldest 6 years and 1 month.

There was considerable diversity in first language with 12.9% of the children reported to have English as a Second Language (ESL) and 36 different languages spoken. Three percent of the children

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in the study were members of the Traveller Community. The majority of children (76%) were known by the teacher to have attended preschool in the year before commencing full-time education.

In total, 6.6% of children had already been identified as having special needs. The study was conducted in mainstream primary schools and this number does not, therefore, include those children in Cork attending Junior Infants equivalent in special schools, who would tend to be more severely disabled.

Parental questionnaires were returned and linked to 865 (63%) valid child questionnaires. The characteristics of the study population varied somewhat between the overall study and those who returned the parental questionnaire. In particular, the proportion of children for whom English was a second language fell from 12.7% in the overall group to 9.8% in those returning parental questionnaires; for children reported as having special needs, the proportions were 6.15 and 5.0 % respectively; and for those reported to be members of the Travelling community, 3.1% and 1.7% respectively. The characteristics of the ~~overall~~ population ~~and those~~ who returned the parental questionnaire and those who did not are compared ~~are outlined~~ in Table 2.

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Distribution of domain scores (Mean and standard error)

Mean scores varied across the EDI domains. However, particular groups of children consistently scored below the mean in all domains i.e. boys, children who had English as a second language, members of the Traveller Community, children who had not been to pre-school and those who were under four years 10 months at the time of the study. This is outlined in Figure 1 with the vertical axis representing the mean domain score for the study population.

~~**Vulnerability**~~

~~The majority of children scored well in each domain, with 71% not showing any vulnerability. However, over one quarter (28.6%) of all children in the study were developmentally vulnerable (i.e. in the lowest 10th percentile for one or more domain). In total 12% were vulnerable in one domain, 6% in 2 and only 3% of children were vulnerable in all 5 domains.~~

Factors associated with vulnerability

Over one quarter (28.6%) of children in the study were developmentally vulnerable (i.e. in the lowest 10th percentile for one or more domains). In total 12% were vulnerable in only one domain, 6% in 2 domains, 5% in 3 domains, 3% in 4 domains and 3% were vulnerable in all 5 domains.

The following analysis is based only the subset of the study population (n=865) on whom parental questionnaires were returned.

Factors associated with developmental vulnerability (outlined in Table 3) were being male (odds ratio [OR] =2.2, 95% confidence interval [CI] = 1.6 – 3.1), ESL (OR = 3.8, CI= 2.4 – 6.1), being under five years of age at the time of the study (OR = 1.6, CI = 1.1 – 2.4) and low birth weight (OR=2.5, CI=1.4 – 4.5). When compared with children whose mothers had a university education those with only primary education (OR= 2.8, CI = 1.3 - 5.8) or secondary level (OR = 1.7, CI = 1.1 - 2.6) showed higher levels of vulnerability. Children who were never or seldom told stories in the past week and

those who spent more than four hours watching television or playing video games also showed significantly increased vulnerability.

Logistic Regression

Regression analysis was then used to assess the impact of each variable on the odds of being vulnerable as outlined in Table 4. The first model controlled for being male, having English as a second language and being under five years of age at the time of EDI completion, the second also controlled for all other factors. Children whose birth weight was less than 2.5kg were over twice as likely to be vulnerable. Mother's education showed a graded effect. When controlled for all other variables, children who had not been told or read stories in the past week were over five times as likely to be vulnerable than those who were told stories every day. In the final model, the amount of time spent watching television became insignificant.

Population Attributable Fraction (PAF)

PAF was used to measure the proportion of vulnerability attributed to each of the factors included in the final regression model (Table 5). Boys were almost three times as likely as girls to be vulnerable and being male accounted for 35% of the overall vulnerability. English as a second language accounted for 12%, and mothers education (primary, secondary or diploma) for 27% of vulnerability. Despite the high risk of vulnerability among children who were not read to (OR 5.3), this only accounted for 1.7% of the overall vulnerability reflecting its low prevalence in this population.

DISCUSSION

This paper explored the extent to which children in a major urban centre in Ireland have attained the level of child development necessary to engage fully in the education process. ~~The majority of children in the study had achieved a level of development appropriate for their age. However,~~ The findings suggest that, as expected, a significant minority of over one quarter (28.6%) of children in the study were not developmentally ready to engage in, and thereby benefit fully from school. Clearly these findings should be interpreted cautiously in light of the current level of development of the EDI in Ireland, in particular, the lack of data on predictive validity for the EDI in the Irish population. At the same time, the fundamental issue is not the absolute scores but the unacceptable variation in scores related to socio-economic, environmental and ecological circumstances.

~~Factors associated with this level of vulnerability at the child level were being male, a younger child, having English as a second language and low birth weight. Key factors at the family level were mothers education, reading stories.~~

The overall level of developmental vulnerability was consistent with findings from urban areas in Canada where the EDI has been implemented [1 29-31] (Carpiano et al., 2009, Kershaw et al., 2010, Janus and Duku, 2007, Kohen et al., 2009). Indeed mean scores across all domains in the Irish sample were similar to those in the Canadian normative sample. Factors associated with increased risk of vulnerability at the child level were being male, a younger child, having English as a second language and low birth weight. Key factors at the family level were mothers education and reading stories. In the final model, the strongest predictor of vulnerability on EDI scores was story telling.

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Children who were never told stories in the past week were over five times as likely to be vulnerable compared with children who were told stories every day. This supports numerous studies which show a link between reading stories and literacy development [32] and with broader aspects of development [33] These are again consistent with findings from Canada, further supporting the transferability of the instrument between the two jurisdictions [34]

The mean scores across all five domains varied between sub-groups of the population. The impact of age is very clear. Younger children, aged less than 4 years and 10 months scored on average less well across all the domains. Children who had not attended pre-school also showed below average scores. However, non- attendance at pre-school can result from a variety of underlying reasons. Therefore, these scores cannot be attributed solely to the lack of pre-school education. Children from the Traveller Community also showed lower mean scores across all domains. Traveller children face a variety of challenges including accommodation in poorly serviced communal sites, greater risk of low birth weight, ill-health and hospitalisation [35].

Three child-level demographics were strongly associated with vulnerability. Boys, children who start school at a younger age and those for whom English is a second language were more likely to be vulnerable. PAF illustrates that these three factors account for half of all vulnerability. These findings are consistent with international studies [30 36]

Hertzman describes ~~this~~vulnerability levels of above 15% ~~-~~as an unacceptable level of difficulty at school entry age[37]. There is considerable debate regarding the expected level of biologically determined disability. OECD country estimated range between 1.8% and 10.4%[38]. Considering these expected levels of biological determined developmental delay ~~is 5 -8 % of any given population,~~ external factors can be seen to contribute to major disparities[18].

~~The study had identified key factors that are associated with this developmental delay. In the final model, the strongest predictor of vulnerability on EDI scores was story telling. Children who were never told stories in the past week were over five times as likely to be vulnerable in one or more domain when compared with children who were told stories every day. This supports numerous studies which show a link between reading stories and literacy development [19] and with broader aspects of development [20].~~

~~Three child-level demographics were strongly associated with vulnerability. Boys, children who start school at a younger age and those for whom English is a second language were also more likely to be vulnerable. PAF illustrates that these three factors account for half of all vulnerability. These findings are consistent with international studies (Maggi et al., 2010, Janus and Duku, 2007)~~

~~and reinforce the need for universal early childhood programmes which are cognisant of these variations.~~

Limitations

The overall study was representative of children in their first year in formal education in Cork city. However, there was a 63% return rate on the parental questionnaire. While this compares favourably to other jurisdictions where this method has been used [34], there are significant differences between those for whom parental data were available and those for whom it was not. It is clear that the most vulnerable children were underrepresented in the parental sample.

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This was the first study using the EDI in Ireland. Therefore, there was limited scope for validity testing. Comparisons with Canadian normative data, internal validity testing and qualitative work with teachers indicate that the EDI functions well in the Irish context. Future research will consider Rasch modelling and examining issues of predictive validity.

~~This paper specifically considers the proximal factors associated with early childhood development. Yet it is clear that children and families do not live in a vacuum. There are multiple factors in the broader economic and socio-cultural environment which must be considered [‡].~~

Policy Implications

Epidemiological studies have clearly linked early socio-economic circumstances to later outcomes[39-41] ~~(Lawlor et al., 2006, Irwin et al., 2007, Ford Jones et al., 2008)~~. Yet, the specific factors and processes in the early years which contribute to these outcomes have not been adequately explored. The reliance on diagnostic instruments which are professionally administered and measure particular aspects of development has led to gaps in population level studies on early development outcomes[17~~21~~]. The EDI is a unique, well-validated, population level instrument which allows us to track all five domains of early childhood development. It has the potential to enhance our understanding of the early years environment and identify populations of children at risk of developmental delay. This in turn can inform universal programmes to enhance outcomes for whole populations of children.

National policy which focuses on the early years is essential with investment in peri-natal care, quality support to families and provision of pre-school care by highly skilled practitioners[2]. In Ireland, significant investment is being made in developing a high standard of accessible child care including a free pre-school year and a focus on quality curriculum development. This study was implemented in the year prior to the introduction throughout Ireland of the universally accessible free pre-school year and related investment in skills-enhancement for pre-school staff.

From and Irish perspective, the study raises important questions regarding support to families where English is a second language. ESL was associated with lower mean scores across all domains. The pace of immigration to Ireland increased rapidly between 1990 and 2008 in response to employment opportunities which have since diminished. There is evidence of communities of immigrant populations living in areas of newly emerging disadvantage which lack the support structures associated with established communities. Indeed this study has identified such communities in which there were vulnerability rates of close to 50%. Particular attention also needs to be focused on the implications of the findings in relation to age. Attendance at school is not mandatory until children are six years old but they may start once they are four, leading to classes with mixed age groups. Moreover, attendance by children under six in not officially monitored.

Poverty and inequality affect up to one quarter of Irish children. Throughout the boom years Irish policy in tackling child poverty consisted almost uniquely of direct payments to families, a practice which is now under threat. Moreover, little consideration was given to creating structures and policies to support and protect families. Tackling child poverty through a strategy of area-based prevention and early intervention features highly on the agenda of the current government[42]. This focus on both universal and targeted interventions has the potential to

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contribute to breaking this cycle of poverty. However, effective targeting in the context of early childhood development is problematic, with many instruments providing poor predictive reiability[43]. There is a need for longitudinal and population-level data which can be linked to administrative sources to provide a holistic basis for effective programming[44] In Australia and Canada the EDI is providing just such data on early childhood development.

Early childhood development is a key public health issue that needs to be addressed through a comprehensive programme of targeted and universal approaches, supported by high quality research. The EDI can play a critical role in informing policy and practice at a local and national level, and allowing for internationally comparable studies on early childhood development.

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Table 1: Child development outcomes measured by the EDI

EDI Domains /Sub-domains	Expected behaviour
PHYSICAL HEALTH & WELL BEING	
Physical readiness for school day	Usually dressed appropriately for school and not tired, late or hungry.
Physical independence	Can look after own personal needs appropriately, established hand preference, well coordinated, and do not suck a thumb/finger.
Gross and fine motor skills	Physically able to participate in school and excellent or good gross and fine motor skills.
SOCIAL COMPETENCE	
Overall social competence	Very good ability to play and get along with various children, usually cooperative and self-confident.
Responsibility and respect	Respect for ~~others,~~others and for property, follow rules and take care of materials, accept responsibility for actions, and show self-control.
Approaches to learning	Can work neatly, independently, and solve problems, follow instructions and class routines, easily adjust to changes.
Readiness to explore new things	Curious about the surrounding world, and eager to explore new books, toys and games.
EMOTIONAL MATURITY	
Pro-social and helping behaviour	Helping someone hurt, sick or upset, offering to help spontaneously, invite bystanders to join in.
Anxious and fearful behaviour	Seldom or never showing anxious behaviours; happy and able to enjoy school, comfortable being left at school by caregivers.
Aggressive behaviour	Seldom or never showing aggressive behaviours; not using aggression to solve conflict, not having temper tantrums, and not mean to others.
Hyperactivity and inattention	Not showing hyperactive behaviours; able to concentrate, attend to chosen activities, wait their turn, and usually think before doing.
LANGUAGE & COGNITIVE	
Basic literacy skills	Have basic literacy skills: can handle a book, identify some letters and attach sounds to some letters, show awareness of rhyming words, know the writing directions, and write their own name.
Interest literacy/numeracy and memory	Showing interest in books and reading, math and numbers, and no difficulty remembering things.
Advanced literacy skills	Can read simple, complex words or sentences, write voluntarily, write simple words or sentences.
Basic numeracy skills	Can count to 20, recognize shapes and numbers, compare numbers, sort and classify, use one-to-one correspondence, and understand simple time concepts.
COMMUNICATION & GENERAL KNOWLEDGE	
Communication and general knowledge	Can communicate easily and effectively, can participate in story-telling or imaginative play, articulate clearly, show adequate general knowledge, and are proficient in their native language.

Table 2: Demographic Characteristics comparing total EDI sample and those for whom a parental questionnaire was returned

	Total EDI sample		Parental Questionnaire	
	N	%	n	%
Gender				
Female	563	45.3	402	46.5
Male	659	53.0	463	53.5
Missing	21	1.7		
English as a second language (ESL)				
Not ESL	1072	86.2	770	89.0
ESL	158	12.7	85	9.8
Missing	13	1.0	10	1.2
Identified Special Needs				
Not Special Needs	1160	93.3	821	94.9
Identified Special Needs	82	6.6	43	5.0
Missing	1	.1	1	.1
Member of the Travelling Community				
No	1196	96.2	845	97.7
Yes	39	3.1	15	1.7
Missing	8	.7	5	.6

Table 2: Comparison between sample for whom parental data was and was not available

	Parental n= 865	No Parental n=378	Sig
Mean Age - years (SD)	5.38 (.39)	5.36 (0.43)	.405
Female	46%	45%	.719
English as a Second Language	10%	19%	<.001
Identified Special needs	5%	10%	<.001
Member of the Traveller Community	2%	6%	<.001
Mean EDI scores by domain (SD)			
Physical health and wellbeing	8.8 (1.4)	8.1 (2.0)	<.001
Social competence	8.3 (1.8)	7.5 (2.1)	<.001
Emotional maturity	7.7 (1.6)	7.2 (1.7)	<.001
Language and cognitive development	8.8 (1.6)	8.0 (2.4)	<.001
Communication skills and gen knowledge	7.5 (2.8)	6.2 (3.2)	<.001
% Vulnerable in 1 or more domain of EDI	23%	41%	<.001

Table 3: Factors associated with developmental vulnerability (Univariate analysis)

	n(%)	% vulnerable*	OR	CI
Male	463 (54)	30%	2.2	(1.6 - 3.1)
English as a second language (ESL)	85 (10)	49%	3.8	(2.4 - 6.1)
Age <5 years	146 (17)	31%	1.6	(1.1 - 2.4)
Low birth weight (<2500g)	49 (6)	41%	2.5	(1.4 - 4.5)
Mother primary education only	38 (4)	37%	2.8	(1.3 - 5.8)
Mother secondary education only	297 (34)	27%	1.7	(1.1 - 2.6)
Four or more hours screen-time per day	128 (15)	32%	2.0	(1.2 - 3.4)
Never told stories in the past week	10 (1)	50%	4.2	(1.2 - 14.8)
Told stories once or twice in the past week	82 (9)	32%	1.9	(1.2 - 3.3)
No preschool	44 (5)	43%	2.7	(1.4 - 5.0)

*Refers to the % of children vulnerable in one or more of the five domains of the EDI

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Table 4: Logistic Regression predicting likelihood of vulnerability on EDI Scores

	OR (95% CI)*	OR (95% CI)**
Male	2.5 (1.8 - 3.6)	2.7 (1.8 - 3.9)
ESL	4.3 (2.6 - 6.9)	4.5 (2.6 – 7.8)
Age <5 years	1.4 (0.9 - 2.2)	1.3 (0.8 - 2.0)
Low Birth Weight	2.6 (1.4 - 4.9)	2.6 (1.3 - 5.0)
Mother Education (ref: University education)		
~~Mother Education:~~ Primary or less	3.1 (1.4 - 6.7)	2.5 (1.0 - 6.0)
Secondary	2.1 (1.3 - 3.3)	2.1 (1.3 - 3.4)
Diploma	1.5 (0.9 - 2.3)	1.5 (0.9 - 2.4)
Daily Screen time (ref: 1 hour or less)		
~~Daily Screen time:~~ 2 to 3 hours	1.2 (0.8 - 1.8)	1.0 (0.6 - 1.6)
4 or more hours	1.7 (1.0 - 3.0)	1.2 (0.6 - 2.1)
Stories in the past week (ref: every day)		
~~Stories in the past week~~: Never	3.9 (1.0 - 14.3)	5.3 (1.3 - 21.1)
Once or twice	1.7 (1.0 - 2.9)	1.4 (0.8 - 2.5)
Many times	1.2 (0.8 - 1.7)	1.1 (0.7 - 1.6)
No Pre-school	1.9 (1.0 - 3.8)	1.5 (0.7 - 3.1)

* Adjusted for Age, gender and ESL (separate tests run for each subsequent variable)
** Adjusted for all other variables in one model

Table 5: PAF for vulnerability based on OR adjusted for all other variables

	N (%)	OR (95% CI)**	PAF (95% CI)
Under five	146 (17)	1.3 (0.8 - 2.0)	3.0 (-2.8 – 8.5)
Male	463 (54)	2.7 (1.8 - 3.9)	34.6 (21.3 – 45.7)
ESL	85 (10)	4.5 (2.6 - 7.8)	12.2 (7.3 – 16.8)
Low Birth Weight	49 (6)	2.6 (1.3 - 5.0)	4.5 (1.0 – 8.0)
Mother Education: Primary or less	38 (4)	2.5 (1.0 - 6.0)	2.8 (-0.2 – 5.7)
Secondary	297 (34)	2.1 (1.3 - 3.4)	16.8(5.9 – 26.5)
Diploma	263 (30)	1.5 (0.9 - 2.4)	7.7(-1.8 – 16.3)
Daily Screen time: 2 to 3 hours	532 (61)	1.0 (0.6 - 1.6)	-0.3 (-21.7 – 17.3)
4 or more hours	128 (15)	1.2 (0.6 - 2.1)	1.6 (-5.2 – 7.9)
Stories in the past week: Never	10 (1)	5.3 (1.3 - 21.1)	1.7 (0.1 – 3.3)
Once or twice	82 (9)	1.4 (0.8 - 2.5)	2.6 (-2.1 – 7.0)
Many times	251 (29)	1.1 (0.7 - 1.6)	1.7 (-6.8 – 9.5)
No Pre-school	44 (5)	1.5 (0.7 - 3.1)	1.8 (-1.6 – 5.1)
Total PAF			**90.7**

** Adjusted for all other variables

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No competing interests exist

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REFERENCES

1. Kershaw P, Forer B. Selection of area-level variables from administrative data: an intersectional approach to the study of place and child development. *Health Place* 2010;16(3):500-11.
2. Marmot M, Allen J, Goldblatt P, Boyce T, McNeish D, Grady M, et al. 'Fair Society Health Lives', The Marmot Review. In: England SRoHIi, editor. London, 2010.
3. Power C, Elliott J. Cohort profile: 1958 British birth cohort (National Child Development Study). *International Journal of Epidemiology* 2006;35(1):34-41.
4. Lemelin J-P, Boivin M, Forget-Dubois N, Dionne G, Brendgen M, Séguin JR, et al. The Genetic–Environmental Etiology of Cognitive School Readiness and Later Academic Achievement in Early Childhood. *Child Development* 2007;78(6):1855-69.
5. Nicholson JM, Lucas N, Berthelsen D, Wake M. Socioeconomic inequality profiles in physical and developmental health from 0-7 years: Australian National Study. *Journal of Epidemiology & Community Health* 2012;66(1):81-87.
6. Leventhal T, Brooks-Gunn J. The Neighborhoods They Live in: The Effects of Neighborhood Residence on Child and Adolescent Outcomes. *Pshychological Review* 2000;126(2):309 - 37.
7. Heckman JJ, Masterov DV. The Productivity Argument for Investing in Young Children. *Applied Economic Perspectives and Policy* 2007;29(3):446-93.
8. Kershaw P, Warburton B, Anderson L, Hertzman C, Irwin LG, Forer B. The economic costs of early vulnerability in Canada. *Can J Public Health* 2010;101 Suppl 3:S8-12.
9. Guhn M, Janus M, Hertzman C. The Early Development Instrument: Translating school readiness assessment into community actions and policy planning. *Early Education and Development* 2007;18(3):369-74.
10. Rose G. Sick Individuals and Sick Populations. *International Journal of Epidemiology* 1985;14:32 - 38.
11. Janus M, Brinkman S, Duku E. Validity and Psychometric Properties of the Early Development Instrument in Canada, Australia, United States, and Jamaica. *Social Indicators Research* 2011;103(2):283-97.
12. Brinkman S, Gialamas A, Rahman A, Mittinty MN, Gregory TA, Silburn S, et al. Jurisdictional, socioeconomic and gender inequalities in child health and development: analysis of a national census of 5-year-olds in Australia. *BMJ Open* 2012;2(5).
13. C.S.O. Profile 7: Religion, Ethnicity and Irish Travellers. Cork: Central Statistics Office, 2012.
14. Haase T, Pratschke J. Deprivation and its Spatial Articulation in the Republic of Ireland. Dublin: Area Development Management, 2005.
15. OMCYA. State of the Nations Children. Dublin: Office of the Minister for Children and Youth Affairs, 2010.
16. Janus M, Brinkman S, Duku E, Hertzman C, Santos R, Sayers M, et al. The Early Development Instrument: A Population-based Measure for Communities. Hamilton, Ontario: Offord Centre for Child Studies, McMaster University, 2007.

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17. Janus M, Offord DR. Development and Psychometric Properties of the Early Development Instrument (EDI): A Measure of Children's School Readiness. *Canadian Journal of Behavioural Science-Revue Canadienne Des Sciences Du Comportement* 2007;39(1):1-22.
18. D'Angiulli A, Warburton W, Dahinten S, Hertzman C. Population-level associations between preschool vulnerability and grade-four basic skills. *PLoS One* 2009;4(11):e7692.
19. Brinkman S, Silburn S, Lawrence D, Goldfeld S, Sayers M, Oberklaid F. Investigating the validity of the Australian Early Development Index. *Early Education and Development* 2007;18(3):427-51.
20. Muhajarine N, Puchala C, Janus M. Does the EDI Equivalently Measure Facets of School Readiness for Aboriginal and Non-Aboriginal children? *Social Indicators Research* 2011;103(2):299-314.
21. Williams J, Greene S, Doyle E, Harris E, Layte R, McCoy S, et al. Growing up in Ireland national longitudinal study of children. The lives of 9 year olds: The Stationery Office, 2009.
22. Morgan K, McGee H, Watson D, Perry I, Barry M, Shelley E, et al. SLAN 2007: Survey of Lifestyle, Attitudes & Nutrition in Ireland: Main Report. Dublin: Department of Health and Children, 2008.
23. Brinkman S, Sayers M, Goldfeld S, Kline J. Population monitoring of language and cognitive development in Australia: the Australian Early Development Index. *International Journal of Speech-Language Pathology* 2009;11(5):419-30.
24. Carey DJ. *The Essential Guide to Special Education in Ireland*. Dublin: Primary ABC, 2005.
25. O'Sullivan JJ, Pearce MS, Parker L. Parental recall of birth weight: how accurate is it? *Archives of Disease in Childhood* 2000;82(3):202-03.
26. Hanley JA. A heuristic approach to the formulas for population attributable fraction. *Journal of Epidemiology and Community Health* 2001;55(7):508-14.
27. Miettinen OS. Proportion of disease caused or prevented by a given exposure, trait or intervention. *American Journal of Epidemiology* 1974(99):325 - 32.
28. Greenland S, Drescher K. Maximum likelihood estimation of the attributable fraction from logistic models. *Biometrics* 1993;49:865-72.
29. Carpiano RM, Lloyd JEV, Hertzman C. Concentrated affluence, concentrated disadvantage, and children's readiness for school: A population-based, multi-level investigation. *Social Science & Medicine* 2009;69(3):420-32.
30. Janus M, Duku E. The School Entry Gap: Socioeconomic, Family, and Health Factors Associated With Children's School Readiness to Learn. *Early Education and Development* 2007;18(3):375-403.
31. Kohen D, Oliver L, Pierre F. Examining the effects of schools and neighbourhoods on the outcomes of Kindergarten children in Canada. *International Journal of Speech-Language Pathology* 2009;11(5):404-18.
32. Bus AG, Van Ijzendoorn MH. Mothers Reading to Their 3-Year-Olds: The Role of Mother-Child Attachment Security in Becoming Literate. *Reading Research Quarterly* 1995;30(4):998-1015.
33. Fletcher KL, Reese E. Picture book reading with young children: A conceptual framework. *Developmental Review* 2005;25(1):64-103.
34. Janus M. Transition to school. In: Laverick DM, Jalongo MR, editors. *Transitions to early care and education*: Springer Netherlands, 2011:177 - 87.
35. Abdalla S, Cronin F, Daly L, Drummond A, Fitzpatrick P, Frazier K, et al. Our Geels: All Ireland Traveller Health Study. Dublin, 2010:University College Dublin.
36. Maggi S, Irwin LJ, Siddiqi A, Hertzman C. The social determinants of early child development: an overview. *J Paediatr Child Health* 2010;46(11):627-35.
37. Hertzman C. The state of child development in Canada: Are we moving toward, or away from, equity from the start? *Paediatr Child Health* 2009;14(10):673-6.
38. Banks J, McCoy S. A Study on the Prevalence of Special Educational Needs. Dublin: Economic and Social Research Institute, 2011.

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39. Lawlor DA, Ronalds G, Macintyre S, Clark H, Leon DA. Family socioeconomic position at birth and future cardiovascular disease risk: Findings from the Aberdeen children of the 1950s cohort study. *American Journal of Public Health* 2006;96(7):1271-77.
40. Irwin LG, Siddiqi A, Hertzman C. Early Child Development: A Powerful Equaliser: WHO Commission on Social Determinants of Health, 2007.
41. Ford-Jones EL, Williams R, Bertrand J. Social paediatrics and early child development: Part 1. *Paediatr Child Health* 2008;13(9):755-8.
42. Programme for Government 2011 - 2016. In: Expenditure DoP, editor. Dublin, 2011.
43. Lynch JW, Law C, Brinkman S, Chittleborough C, Sawyer M. Inequalities in child healthy development: Some challenges for effective implementation. *Social Science & Medicine* 2010;71(7):1244-48.
44. Hertzman C, Williams R. Making early childhood count. *Canadian Medical Association Journal* 2009;180(1):68-71.

~~1. Kershaw P, Forer B. Selection of area-level variables from administrative data: an intersectional approach to the study of place and child development. *Health Place* 2010;16(3):500-11.~~
~~2. Marmot M, Allen J, Goldblatt P, Boyce T, McNeish D, Grady M, et al. 'Fair Society Health Lives', The Marmot Review. In: England SRoHIi, editor. London, 2010.~~
~~3. Power C, Elliott J. Cohort profile: 1958 British birth cohort (National Child Development Study). *International Journal of Epidemiology* 2006;35(1):34-41.~~
~~4. Lemelin J-P, Boivin M, Forget-Dubois N, Dionne G, Brendgen M, Séguin JR, et al. The Genetic–Environmental Etiology of Cognitive School Readiness and Later Academic Achievement in Early Childhood. *Child Development* 2007;78(6):1855-69.~~
~~5. Nicholson JM, Lucas N, Berthelsen D, Wake M. Socioeconomic inequality profiles in physical and developmental health from 0-7 years: Australian National Study. *Journal of Epidemiology & Community Health* 2012;66(1):81-87.~~
~~6. Leventhal T, Brooks-Gunn J. The Neighborhoods They Live in: The Effects of Neighborhood Residence on Child and Adolescent Outcomes. *Pshychological Review* 2000;126(2):309 - 37.~~
~~7. Heckman JJ, Masterov DV. The Productivity Argument for Investing in Young Children. *Applied Economic Perspectives and Policy* 2007;29(3):446-93.~~
~~8. Kershaw P, Warburton B, Anderson L, Hertzman C, Irwin LG, Forer B. The economic costs of early vulnerability in Canada. *Can J Public Health* 2010;101 Suppl 3:S8-12.~~
~~9. Guhn M, Janus M, Hertzman C. The Early Development Instrument: Translating school readiness assessment into community actions and policy planning. *Early Education and Development* 2007;18(3):369-74.~~
~~10. Rose G. Sick Individuals and Sick Populations. *International Journal of Epidemiology* 1985;14:32-38.~~
~~11. Janus M, Brinkman S, Duku E. Validity and Psychometric Properties of the Early Development Instrument in Canada, Australia, United States, and Jamaica. *Social Indicators Research* 2011;103(2):283-97.~~
~~12. Brinkman S, Gialamas A, Rahman A, Mittinty MN, Gregory TA, Silburn S, et al. Jurisdictional, socioeconomic and gender inequalities in child health and development: analysis of a national census of 5-year-olds in Australia. *BMJ Open* 2012;2(5).~~
~~13. Janus M, Brinkman S, Duku E, Hertzman C, Santos R, Sayers M, et al. The Early Development Instrument: A Population-based Measure for Communities. Hamilton, Ontario: Offord Centre for Child Studies, McMaster University, 2007.~~
~~14. Carey DJ. *The Essential Guide to Special Education in Ireland*. Dublin: Primary ABC, 2005.~~
~~15. O'Sullivan JJ, Pearce MS, Parker L. Parental recall of birth weight: how accurate is it? *Archives of Disease in Childhood* 2000;82(3):202-03.~~
~~16. Hanley JA. A heuristic approach to the formulas for population attributable fraction. *Journal of Epidemiology and Community Health* 2001;55(7):508-14.~~

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17. Miettinen OS. Proportion of disease caused or prevented by a given exposure, trait or intervention. *American Journal of Epidemiology* 1974(99):325 - 32.
18. Hertzman C. The state of child development in Canada: Are we moving toward, or away from, equity from the start? *Paediatr Child Health* 2009;14(10):673-6.
19. Bus AG, Van Ijzendoorn MH. Mothers Reading to Their 3-Year-Olds: The Role of Mother-Child Attachment Security in Becoming Literate. *Reading Research Quarterly* 1995;30(4):998-1015.
20. Fletcher KL, Reese E. Picture book reading with young children: A conceptual framework. *Developmental Review* 2005;25(1):64-103.
21. Janus M, Offord DR. Development and Psychometric Properties of the Early Development Instrument (EDI): A Measure of Children's School Readiness. *Canadian Journal of Behavioural Science-Revue Canadienne Des Sciences Du Comportement* 2007;39(1):1-22.

Figure 1: Participant flow chart

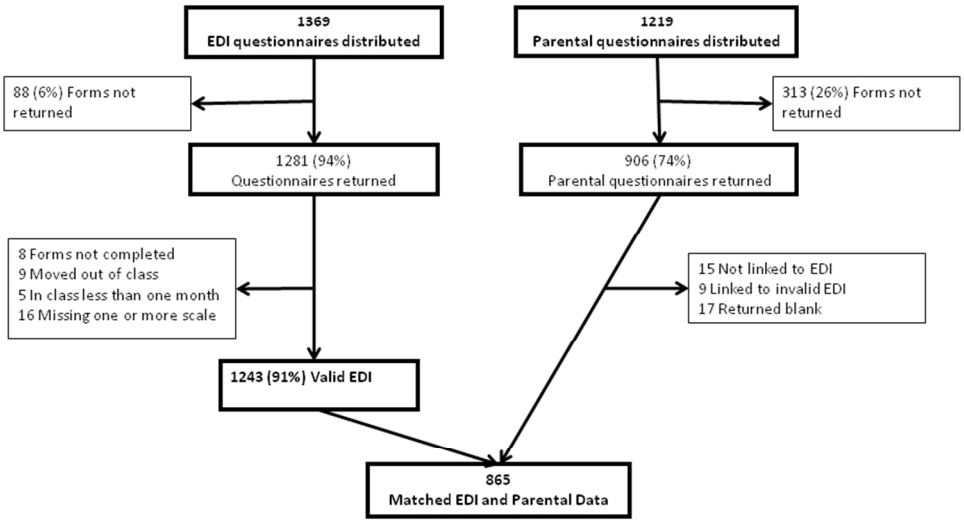

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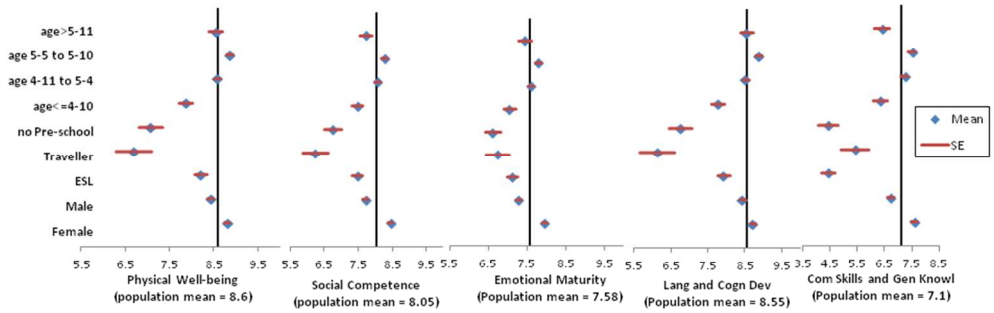
Figure 2: Distribution of scores across all five domains of development



*Each vertical axis represents the population mean for that domain

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Form Number

ucc
Coláiste na hOllscoile Corcaigh, Éire
University College Cork, Ireland

Junior Infants Parent Survey
Cork 2010 - 11

Please fill in the circles like this ● or ⊗. Whenever you are asked about "your child", please answer the question based on your child in Junior Infants.

SECTION A: CHILD HEALTH & DEVELOPMENT

1. Is your child male or female? ○ Male ○ Female

2. When was your child born? _____day _____month _____year

3. What was your child's weight at birth? _____ lbs _____oz or _____ grams

4. Does your family have a regular family doctor or health care provider that you can talk to about your child's health? ○ Yes ○ No

5. In general, would you say your child's health is: ○ Excellent ○ Very Good ○ Good ○ Fair ○ Poor

6. Do you feel your child has a special need that is not yet recognized by the school? ○ Yes ○ No

7. In a typical WEEK, how often does your child	Always	Most of the time	Sometimes	Never
a. Eat breakfast?	○	○	○	○
b. Eat at least 4 servings of vegetables and/or fruits each day?	○	○	○	○
c. Eat or drink 2 servings of milk products *(white or chocolate milk, cheese, yogurt, milk puddings or milk substitutes such as fortified soy beverages)* each day?	○	○	○	○
d. Eat meals together with the family?	○	○	○	○

Please fill in the circles like this ● or ⊗.

SECTION B: EARLY YEARS EXPERIENCES

8. In the years before your child started Junior Infants how often did your child attend:	Once a Week or more	Once a Month	3 or 4 Times a Year	Once a Year	Not at All
a. Play-based children's programmes (e.g. drop-ins, Parent and Toddler Group, Family Centre)	○	○	○	○	○
b. Literacy and family reading programs (e.g. story times, etc)	○	○	○	○	○
c. Children's Club (Beavers, Ladybirds, Boys and Girls Club)	○	○	○	○	○
d. Music, Arts or Dance programmes	○	○	○	○	○
e. Visited a public library	○	○	○	○	○
f. Visited a book shop	○	○	○	○	○
g. Cultural/language/ethnic programmes	○	○	○	○	○

9. In the years before your child started Junior Infants, did your child get help from any of the following services:	Yes	No	On waiting list for assessment	On waiting list for services
a. Speech and Language Services	○	○	○	○
b. Blind or Low Vision Services	○	○	○	○
c. Occupational of Physical Therapy	○	○	○	○
d. Hearing Services	○	○	○	○
e. Programmes / Services for Behavioural Issues	○	○	○	○
f. Programmes / Services for Developmental Issues	○	○	○	○
g. Mental Health Programmes / Services	○	○	○	○
h. Programs / Services for English as a Second Language	○	○	○	○

10. In the years before your child started Junior Infants, were you unable to access services to help your child because of any of the following reasons:	YES	NO
a. Wait list was too long	○	○
b. Cost was too much	○	○
c. Didn't have information about services	○	○
d. Didn't know services were available	○	○
e. No services near where I live	○	○
f. No way to get there (no car, no buses, cost)	○	○
h. Times did not work for me	○	○
i. Services were not available in my language	○	○
j. Other, please tell us: _____	○	○

Please fill in the circles like this ● or ⊗.

SECTION C: CHILD CARE

For the next few questions, we are asking about the MAIN type of child care you used. You may have used more than one type of child care but select the one that you consider to be your main child care provider. Do not include babysitters you used occasionally. Do not include pre-school.

11. For EACH age period, what was your MAIN type of care? Please give one answer for each age. *If your child was NOT in regular child care during a certain age period, please use the answer* ***Parent Care Only.***

Age of Child	Parent Care Only	Unpaid care (eg. relative or friend)	Paid care in your home	Paid care in someone's home	Care in a centre / crèche
0 to 12 months (infant care)	○	○	○	○	○
1 yr up to 1 yr and 6 months (1.5 yrs) (infant care)	○	○	○	○	○
1.5 years up to 2.5 years (toddler care)	○	○	○	○	○
2.5 yrs up to 4 yrs (preschooler care)	○	○	○	○	○
4 yrs up to 6 yrs (school age care)	○	○	○	○	○

12. On average, how many hours per week IN TOTAL did your child spend in your MAIN child care? *If your child was NOT in regular child care during a certain age period, please use the answer* ***None – Parent Care Only.***

Age of Child	None – Parent Care Only	Less than 20 hours per week	20 – 30 hours per week	31 – 40 hours per week	More than 40 hours per week
0 to 12 months (infant care)	○	○	○	○	○
1 yr up to 1 yr and 6 months (1.5 yrs) (infant care)	○	○	○	○	○
1.5 years up to 2.5 years (toddler care)	○	○	○	○	○
2.5 yrs up to 4 yrs (preschooler care)	○	○	○	○	○
4 yrs up to 6 yrs (school age care)	○	○	○	○	○

Please fill in the circles like this ● or ⊗.

SECTION D: PRE-SCHOOL AND SCHOOL

13. In the year before starting school, did your child attend a pre-school?	Yes	No
	○	○

13. a. If yes, where _____

14. We would like to know more about your family's experience with the Junior Infants.	Strongly Disagree	Disagree	Agree	Strongly Agree
a. My child is excited about learning	○	○	○	○
b. As a parent, I feel welcome in my child's school	○	○	○	○
c. My child is able to manage the school day.	○	○	○	○

15. Since the beginning of this school year, have you:	Never	Once or Twice	Three or More Times
a. Attended a parent-teacher meeting?	○	○	○
b. Attended a general school meeting (e.g. open meeting, parents council meeting)	○	○	○
c. Attended a school or class event (e.g. school play or concert)	○	○	○
d. Volunteered in the school? (e.g. helped in the library, helped with a fundraiser or school event)	○	○	○

SECTION E: YOU AND YOUR CHILD

16. In the **PAST 7 DAYS**, have you or someone close to your child done the following things with your child?	Yes, Everyday	Yes, Many Times	Yes, Once or Twice	No
a. Played simple maths games (cards, counting, puzzles, board games)	○	○	○	○
b. Sang songs or said rhymes	○	○	○	○
c. Told or read him/her a story	○	○	○	○
d. Worked on arts, crafts or drawing with him/her	○	○	○	○
e. Worked on the sounds of letters	○	○	○	○
f. Helped with printing letters, numbers or child's name	○	○	○	○
g. Done household chores together like cooking, cleaning, putting away toys, setting the table, caring for pets, gardening	○	○	○	○

Please fill in the circles like this ● or ⊗.

17. Have you ever attended a class, workshop, programme or event meant to help you in your role as a parent?	Yes	No
	○	○

18. In the past 12 months, how often has your child:	Once a Week or more	Once a Month	3 or 4 Times a Year	Once a Year	Not at All
a. Played a sport WITH a coach or instructor, outside of school activities (e.g., swimming lessons, GAA, hockey, etc.)	○	○	○	○	○
b. Played a sport or done physical activities WITHOUT a coach or instructor (e.g.cycling, skate-boarding, etc.)	○	○	○	○	○

19. In a typical school day, how many hours does your child watch TV, use the computer or play video games at home?	5 or more hours per day	4 hours per day	3 hours per day	2 hours per day	One Hour or less
	○	○	○	○	○

20. On a typical school night, how many hours of sleep does your child get?	Less than 8 hours	8 to 10 hours	11 to 12 hours	13 to 14 hours	More than 14 hours
	○	○	○	○	○

SECTION G: YOUR COMMUNITY

21. Please tell us about your neighbourhood.	True	Sometimes True	Not True
a. It is safe to walk alone in my neighbourhood after dark.	○	○	○
b. It is safe for children to play outside during the day in my neighbourhood.	○	○	○
c. There are safe parks, playgrounds and play spaces in my neighbourhood.	○	○	○
d. If there is a problem around here, the neighbours get together and deal with it.	○	○	○
e. There are adults in my neighbourhood that children can look up to.	○	○	○
f. People around here are willing to help their neighbours.	○	○	○
g. You can count on adults in my neighbourhood to watch out that children are safe and don't get into trouble.	○	○	○
h. When I'm away from home, I know that my neighbours will keep their eyes open for possible trouble.	○	○	○

Please fill in the circles like this ● or ⊗.

22. Do you have access to the following places in your community? Access might mean walking, driving your car a short distance or taking the bus.	Yes	No	Don't know
a. Public park or sports grounds	○	○	○
b. Library	○	○	○
c. Shopping centre	○	○	○
d. Community centre	○	○	○
e. School	○	○	○
f. Grocery store	○	○	○

23. Do you regularly join in the activities of any of the following types of organisation?	Yes	No
a. Sports clubs (Parish, GAA, Golf, Other), gym, exercise classes	○	○
b. Political parties, trade unions, environmental groups	○	○
c. Parent-teacher associations, tenants groups, residents groups, neighbourhood watch, youth groups, other community action groups	○	○
d. Church or other religious/parish groups, charitable or voluntary organisations (e.g. collecting for charity, helping the sick, elderly)	○	○
e. Evening classes, arts or music groups, education activities	○	○
f. Social clubs (e.g. mother & toddler group, club, women's groups, elderly group)	○	○
g. Other, please tell us:_____	○	○

24. How many people are so close to you that can count on them if you have serious personal problems?			
None	1 or 2	3 to 5	More than 5
○	○	○	○

25. How much friendly interest do people in your neighbourhood take in what you are doing?				
A lot	Some	Uncertain	Little	None
○	○	○	○	○

26. How easy is it to get practical help from neighbours if you should need it?				
Very easy	Easy	Possible	Difficult	Very Difficult
○	○	○	○	○

Please fill in the circles like this ● or ⊗.

27. Can you to tell me how much you agree or disagree with this statement: "If I was experiencing mental health problems I wouldn't want people knowing about it"				
Agree strongly	**Agree slightly**	**Neither agree nor disagree**	**Disagree slightly**	**Disagree strongly**
○	○	○	○	○

SECTION H: BACKGROUND INFORMATION

To help us understand the families who are participating in this study, we would like to ask a few questions about yourself, your family and your household.

	Mother	**Father**	**Other (please tell us)**
28. Are you the child's:	○$_1$	○$_2$	○$_3$ _____

29. Please tell us if your household has had the following items and if not, is it because you couldn't afford it or for another reason.	**Yes**	**No, Cannot afford**	**No, other reason**
a. Does your household eat meals with meat, chicken, fish (or vegetarian equivalent) at least every second day?	○	○	○
b. Does your household have a roast joint (or its equivalent) at least once a week?	○	○	○
c. Do household members buy new rather than second-hand clothes?	○	○	○
d. Does each household member possess a warm waterproof coat?	○	○	○
e. Does each household member possess two pairs of strong shoes?	○	○	○
f. Does the household replace any worn out furniture?	○	○	○
g. Does the household keep the home adequately warm?	○	○	○
h. Does the household have family or friends for a drink or meal once a month?	○	○	○
i. Does the household buy presents for family or friends at least once a year?	○	○	○

Please fill in the circles like this ● or ⊗.

30. With how much difficulty or ease does your family make ends meet?					
With great difficulty	**With difficulty**	**With some difficulty**	**Fairly easily**	**Easily**	**Very easily**
○	○	○	○	○	○

31. Think back to when you were 16 years old, with how much difficulty or ease did your family at the time make ends meet?					
With great difficulty	**With difficulty**	**With some difficulty**	**Fairly easily**	**Easily**	**Very easily**
○	○	○	○	○	○

32. Do you live in a	
House	○
Apartment/ flat / bedsit	○
Other, tell us_____	○

33. Which of the following best describes your home?	
Owner occupied (with or without a mortgage)	○
Being purchased from a Local Authority under a Tenant Purchase Scheme	○
Rented from a Local Authority	○
Rented from a Voluntary Body	○
Rented from a Private Landlord	○
Living with and paying rent to your or your partner's parent(s)	○
Occupied free of rent with your or your partner's parent(s)	○
Occupied free of rent from your or your partner's job	○

	English	**Irish**	**Polish**	**Latvian**	**Other (please tell us)**
34. What language do YOU speak most often at home?	○	○	○	○	○ _____
35. What language does YOUR CHILD speak most often at home?	○	○	○	○	○ _____

Please fill in the circles like this ● or ⊗.

36. Which of the following best describes your family?	One Parent	Two Parent	Other (please tell us)
	○	○	○ _____

36.(a) What is the child's mothers occupation? _____

(b) How many hours per week does she work? _____

37. (a) What is the child's father's occupation? _____

(b) How many hours per week does he work? _____

38. What is the mother's highest level of education? Please fill in one answer.	
Primary or less	○ 1
Intermediate/ Junior/ Group Certificate or equivalent	○ 2
Leaving Certificate or equivalent	○ 3
Diploma / Certificate	○ 4
University graduate Degree	○ 5

39. What is the father's highest level of education? Please fill in one answer.	
Primary or less	○ 1
Intermediate/ Junior/ Group Certificate or equivalent	○ 2
Leaving Certificate or equivalent	○ 3
Diploma / Certificate	○ 4
University graduate Degree	○ 5

Thank you very much for your participation.

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	1
Objectives	3	State specific objectives, including any prespecified hypotheses	1
Methods			
Study design	4	Present key elements of study design early in the paper	2
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	1
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	2
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	2 – 3
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	2 -3
Bias	9	Describe any efforts to address potential sources of bias	*3-4*
Study size	10	Explain how the study size was arrived at	2
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	3
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	3
		(*b*) Describe any methods used to examine subgroups and interactions	3-4
		(*c*) Explain how missing data were addressed	3
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	n/a
		(*e*) Describe any sensitivity analyses	n/a
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	1-2
		(b) Give reasons for non-participation at each stage	2
		(c) Consider use of a flow diagram	n/a
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	2
		(b) Indicate number of participants with missing data for each variable of interest	Tables
Outcome data	15*	Report numbers of outcome events or summary measures	3-4
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	4 and tables
		(*b*) Report category boundaries when continuous variables were categorized	3 and tables
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	4-5
Discussion			
Key results	18	Summarise key results with reference to study objectives	5-6
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	5-6
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	6
Generalisability	21	Discuss the generalisability (external validity) of the study results	6
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	1

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Determinants of Vulnerability in Early Childhood Development in Ireland – a Population Level Study

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Determinants of Vulnerability in Early Childhood Development in Ireland – a Population Level Study

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ARTICLE SUMMARY

Article focus

- This study demonstrates that significant population level variation exists in healthy child development in Ireland.
- The Early Development Instrument (EDI) is a unique, well-validated population level instrument which allows us to track all five domains of early development and identify populations of children at risk.
- When used in conjunction with a parental questionnaire factors which impact on child development at the child and family level can be identified.

Key Messages

- A direct population level evidence base on normal child development in needed both as an indicator of child health and a predictor of future outcomes.
- Three child-level demographic factors (age, gender and language) accounted for over half of the population level risk of developmental vulnerability, reinforcing the need for universal early childhood programmes which are cognisant of these variations.

Strengths and limitations of the study

- This is the first peer-reviewed population level study published in Europe assessing child development outcomes across multiple domains using the EDI.
- The study identifies proximal factors associated with child development, yet children and families do not live in a vacuum. Further research is needed to identify associated factors in the broader socio-cultural environment.

Abstract:

Objectives: Early childhood development strongly influences life-long health. The Early Development Instrument (EDI) is a well validated population-level measure of five developmental domains (physical health and well-being, social competence, emotional maturity, language and cognitive skills, and communication skills and general knowledge) at school entry age. The aim of this study was to explore the potential of the EDI as an indicator of early development in Ireland.

Design: A cross-sectional design was used.

Setting: The study was conducted in 42 out of 47 primary schools in a major Irish urban centre.

Participants: EDI (teacher completed) scores were calculated for 1,243 children in their first year of full-time education. Contextual data from a subset of 865 children was collected using a parental questionnaire.

Primary and secondary outcome measures: Children scoring in the lowest 10% of the population in one or more domains were deemed 'developmentally vulnerable'. Scores were correlated with contextual data from the parental questionnaire.

Results: In the sample population 29% of children were not developmentally ready to engage in school. Factors associated with increased risk of vulnerability were being male OR=2.1 (CI =1.6 to 2.7); under 5 years OR = 1.5 (CI = 1.1 to 2.1); and having English as a second language OR = 3.7 (CI = 2.6 to 5.2). Adjusted for these demographics, low birth weight, poor parent/child interaction and mother's lower level of education showed the most significant odds ratios for developmental

vulnerability. Calculating Population Attributable Fractions, the greatest population-level risk factors were being male (35%), mother's education (27%) and having English as a second language (12%). Conclusion: The EDI and linked parental questionnaires are promising indicators of the extent, distribution and determinants of developmental vulnerability among children in their first year of primary school in Ireland.

BACKGROUND

There is significant epidemiological evidence that early childhood development (from gestation to age six) strongly influences life-long health trajectories [1]. Indeed, major public health problems such as obesity, heart-disease and mental health problems can be seen to have roots in early childhood [2-3]. This results from a complex interplay between genetic makeup, in utero development, and both pre and postnatal environmental factors, all of which influence brain development in the first five years of life [4].

There is also evidence of a social gradient in child development [5], with children from poorer backgrounds doing less well in school and entering into an intergenerational cycle of reduced employment opportunities, higher fertility and health inequalities [6]. The long term social and economic gain of investing in the early years is also recognised [7]. Kershaw estimates that the cost of preventable early childhood vulnerability to the Canadian economy is between $2.2 and $3.4 trillion [8].

The challenge for public health, is to give due consideration to early childhood development both as an indicator of child health and as a predictor of future outcomes. Child development has been recognised as a key social determinant[9-10]. Moreover, the relatively large numbers of children with less pronounced development delay are a potentially greater burden than a small number of children at high risk [11] leading to a need for a population health approach [12]. Yet, measurement of child development is usually in the form of a diagnostic which aims to identify children at greatest risk and provide appropriate individual care, leaving a dearth of research evidence on which to build population level strategies[13-14]. In this context a direct population level evidence base on normal child development is needed.

The Early Development Instrument (EDI) is an internationally accepted, validated tool which has the potential to provide such an evidence base [15]. In Australia the EDI (AEDI) has been used universally as a census of child development and has revealed significant variation across states and territories [16]. While the EDI has been implemented at a population level in Scotland, Sweden and Kosovo this is the first peer reviewed population-level study published in Europe assessing child development outcomes across multiple domains, and using the EDI and linked parental questionnaire. The overall objective of the study was to ascertain the proportion of children who were developmentally ready for school in a representative sample of schools in a major urban centre in Ireland using the EDI and to examine associated factors. The study also aimed to assess the feasibility of implementing the EDI and its performance in this setting.

Ireland is a largely homogenous country with 85.8% of the population ethnically White Irish and a further 9.3% of other white ethnic background, primarily British [17]. Cork is one of five major urban centres. While all of these centres are comprised of areas of concentrated affluence and disadvantage, there are similar overall rates of key socio-economic indicators including unemployment, lone-parent families and education [18]. There is a total population of 64,937 five year olds. A minority (1.1%) of Irish children are members of the Traveller Community. Moreover, 19.5% are considered at risk of poverty and 8% live in consistent poverty [19]. The education system is static throughout the country.

METHODS

This observational study of child development was implemented with children in their first year of formal education (in Ireland this is referred to as 'Junior Infants') in 42 of the 47 primary schools in Cork city. Five schools in the city declined to take part. These declining schools were representative of a cross-section of schools in Cork - one boys school, one girls school, one large mixed, middle income school, one designated disadvantaged school and one Irish speaking school – and their omission would not have affected the representativeness of the demographic composition of the study. A further four schools agreed to participate in the study but chose not to administer the parental questionnaire as they believed it would put undue pressure on parents with literacy challenges. These were all designated disadvantaged schools and this has contributed to the under-representation of the most vulnerable children in the parental study.

All eligible children in the participating schools were invited to be included in the study.. Eligibility criteria were: being in the latter half of the first year of formal education (i.e. having completed A minimum of 4 to 5 months of education), being known by the teacher for more than one month and not having left the school.

Measurement of Child Development - The Early Development Instrument

Child development at school entry age was measured using the Early Development Instrument (EDI). This population level measure was designed at the Offord Centre for Child Studies, McMaster University, Hamilton, Ontario in the late 90s to measure the extent to which children have attained the physical, social, emotional and cognitive maturity necessary to engage in school activities [20]. The EDI is a community or population level measure, not an individual screening or diagnostic tool. The underlying focus is that of a population health approach i.e. small modifications of risk for large numbers are more effective at producing change than large modifications for small numbers [12]. It can be retrospective, focusing on early childhood development outcomes; or predictive, informing school and child-health programmes [20]. The instrument consists of five domains, sixteen sub-domains and 104 questions. The domains and sub domains are outlined in Table 1.

The EDI is a well validated instrument which has had extensive psychometric testing done both in Canada and Australia [15 20-23]. It has also been proven valid for use in minority populations [24]. In this Irish study, the EDI had good internally consistency by domains with Cronbach alphas of between 0.8 and 0.96.

Parental Questionnaire

In 2003 a parental questionnaire was developed and tested by the Offord Centre to complement the results of the EDI and provide a deeper population level context to the lives of children [20]. This questionnaire was adapted to suit the Irish context incorporating validated questions from the Growing Up in Ireland Study [25] and the SLAN Survey of Lifestyles, Behaviour and Nutrition in Ireland [26]. It consists of seven sections: child health and development; child care; pre-school; school; family; neighbourhood; and background information.

Data collection

The EDI is a teacher completed questionnaire based on five months observation of the children from the date when they start school, and was, therefore, implemented in the latter half of the first year of formal education. Prior to completing the questionnaires, the teachers were given a short

training and were each issued with an EDI guide book. Children were not present when the questionnaire was completed and no individual identifiers were recorded. Each child was assigned a form ID which was used on both the EDI and Parental Questionnaire.

Passive consent was used in line with previous EDI studies in Canada. An information letter was distributed to all parents by the class teacher two weeks before commencing the study. Parents were given detailed information on the study and asked to contact the school if they did not want their child included. A total of seven parents opted not to participate. Ethical approval was granted by the Clinical Research Ethics Committee of the Cork Teaching Hospitals.

The parental questionnaires were distributed in school bags or homework folders. Each parental pack contained a letter of explanation, questionnaire (again with no individual identifier) and a blank envelope in which to return the questionnaire sealed to the school. Parents were reassured that the envelope would not be opened at the school.

Developmental scoring

EDI scores were calculated for each developmental domain i.e. Physical Health and Well-being; Social Competence; Emotional Maturity; Language and Cognitive Development; and Communication Skills and General Knowledge. All questions had a 2 or 3 point Likert type response format (yes, no, don't know; very true, sometimes or somewhat true, never or not true, don't know). All responses had a score of 0 to 10 (2 point answers were scored 0 and 10; 3 point answers were scored 0, 5 and10). 'Don't know' responses were not scored. Domain scores refer to the child's mean score in that domain - ranging between 0 and 10. Higher scores indicate better results.

Children who scored in the lowest 10% of the study population in one or more of the five domains of the EDI were classed as 'vulnerable'. The 10% cut off is recommended because it is higher than typical clinical cut-off's and should therefore include children who may be more difficult to diagnose [27]. Those scoring in the lowest 10-25% for one or more domains were deemed 'at risk' and children who scored in the top 75% were 'on track' in that domain. Each domain was scored separately as children who are vulnerable in one area cannot compensate through competence in another. All scores were aggregated to the group level. In the absence of an Irish normative sample, to ensure the validity of the cut-off points, data was also scored against Canadian normative data. There was a 99% correlation between 'vulnerability' using the Irish and Canadian cut-off points. In four of the five domains there was 100% correlation between vulnerability using the Irish and Canadian cut-off points.

Data from the parental questionnaires was linked to the teacher filled questionnaire using the Form ID number and the matching was crosschecked using the recorded date of birth and gender. Questions, again, were constructed in a Likert type response format - yes, no or three to five response options. Demographic questions on child's date of birth and birth weight were also included.

Explanatory variables

The child's age was calculated from their date of birth and the date on which the form was completed and reported in years and months. 'Children for whom English is a second language (ESL)' refers to those reported by the teacher to have a first language other than English. Members

of the Travelling Community were children who were known by school to be part of this Irish ethnic minority group.

'Children identified as special needs' refers to those children who had already been identified as needing special assistance in the classroom. In Ireland this is defined as having a 'Special Education Condition' which has been recognised through a standardised assessment process [28].

Parental reported birth weight was used to calculate whether the child had a low birth weight i.e. less than 2.5kgs. Parental report of birth weight has been proven to be adequately accurate to be acceptable for research purposes [29].

Parents were asked how much time (to the nearest hour) the child spent either watching television, using the computer or playing video games on a typical school day. This was coded into '1 or less', 'two to three' and '4 or more' hours.

Data analysis

SPSS was used to analyse data. Each child's EDI scores were calculated by the Offord Centre for Child Studies in line with international EDI process. Initial analysis involved a cross-tabulation of potential risk items from the teacher completed EDI questionnaire (i.e. gender, age, ESL, pre-school attendance and membership of the Travelling Community) against the child's score in each of the developmental domains.

All further analyses reported here were confined to the sub-group of children for whom parental data was available. Univariate analysis was used to explore factors associated with 'vulnerability' i.e. being in the lowest 10% of the target population in one or more domain. Factors which proved significant ($p<0.05$) were then entered into logistic regression models to predict likelihood of vulnerability on EDI scores. The first model adjusted for age, gender and ESL. The second model adjusted for all other factors.

Population attributable fractions (PAF) were used to calculate the proportion of risk attributed to each of the factors in the final regression [30-31]. This was calculated using the 'punaf' command in STATA 12 which calculates confidence intervals for PAF, and also for scenario means and their ratio, known as the population unattributable fraction. Punaf uses the method for estimating PAFs recommended by Greenland and Drescher (1993) for cohort and cross-sectional studies[32].

RESULTS

EDI questionnaires were distributed to teachers of 1366 children. A total of 1243 (92%) were returned completed and valid. Of these, 45% (n=563) were girls. The average age at which children in the study started school was 4 years and 9 months. The youngest was 3 years 11 months and the oldest 6 years and 1 month.

There was considerable diversity in first language with 12.7% of the children reported to have English as a Second Language (ESL) and 36 different languages spoken. Three percent of the children in the study were members of the Traveller Community. The majority of children (76%) were known by the teacher to have attended preschool in the year before commencing full-time education.

In total, 6.6% of children had already been identified as having special needs. The study was conducted in mainstream primary schools and this number does not, therefore, include those children in Cork attending Junior Infants equivalent in special schools, who would tend to be more severely disabled.

Parental questionnaires were returned and linked to 865 (63%) valid child questionnaires. The characteristics of the study population varied somewhat between the overall study and those who returned the parental questionnaire. In particular, the proportion of children for whom English was a second language fell from 12.7% in the overall group to 9.8% in those returning parental questionnaires; for children reported as having special needs, the proportions were 6.6 and 5.0 % respectively; and for those reported to be members of the Travelling community, 3.1% and 1.7% respectively. The characteristics of the population who returned the parental questionnaire and those who did not are compared in Table 2.

Distribution of domain scores (Mean and standard error)

Mean scores varied across the EDI domains. However, particular groups of children consistently scored below the mean in all domains i.e. boys, children who had English as a second language, members of the Traveller Community, children who had not been to pre-school and those who were under four years 10 months at the time of the study. This is outlined in Figure 2 with the vertical axis representing the mean domain score for the study population.

Factors associated with vulnerability

Over one quarter (28.6%) of children in the study were developmentally vulnerable (i.e. in the lowest 10th percentile for one or more domains). In total 12% were vulnerable in only one domain, 6% in 2 domains, 5% in 3 domains, 3% in 4 domains and 3% were vulnerable in all 5 domains.

The following analysis is based only the subset of the study population (n=865) on whom parental questionnaires were returned.

Factors associated with developmental vulnerability (outlined in Table 3) were being male (odds ratio [OR] =2.2, 95% confidence interval [CI] = 1.6 – 3.1), ESL (OR = 3.8, CI= 2.4 – 6.1), being under five years of age at the time of the study (OR = 1.6, CI = 1.1 – 2.4) and low birth weight (OR=2.5, CI=1.4 – 4.5). When compared with children whose mothers had a university education those with only primary education (OR= 2.8, CI = 1.3 - 5.8) or secondary level (OR = 1.7, CI = 1.1 - 2.6) showed higher levels of vulnerability. Children who were never or seldom told stories in the past week and those who spent more than four hours watching television or playing video games also showed significantly increased vulnerability.

Logistic Regression

Regression analysis was then used to assess the impact of each variable on the odds of being vulnerable as outlined in Table 4. The first model controlled for being male, having English as a second language and being under five years of age at the time of EDI completion, the second also controlled for all other factors. Children whose birth weight was less than 2.5kg were over twice as likely to be vulnerable. Mother's education showed a graded effect. When controlled for all other

variables, children who had not been told or read stories in the past week were over five times as likely to be vulnerable than those who were told stories every day. In the final model, the amount of time spent watching television became insignificant.

Population Attributable Fraction (PAF)

PAF was used to measure the proportion of vulnerability attributed to each of the factors included in the final regression model (Table 5). Boys were almost three times as likely as girls to be vulnerable and being male accounted for 35% of the overall vulnerability. English as a second language accounted for 12%, and mothers education (primary, secondary or diploma) for 27% of vulnerability. Despite the high risk of vulnerability among children who were not read to (OR 5.3), this only accounted for 1.7% of the overall vulnerability reflecting its low prevalence in this population.

DISCUSSION

This paper explored the extent to which children in a major urban centre in Ireland have attained the level of child development necessary to engage fully in the education process. The findings suggest that, as expected, a significant minority of over one quarter (28.6%) of children in the study were not developmentally ready to engage in, and thereby benefit fully from school. Clearly these findings should be interpreted cautiously in light of the current level of development of the EDI in Ireland, in particular, the lack of data on predictive validity for the EDI in the Irish population. At the same time, the fundamental issue is not the absolute scores but the unacceptable variation in scores related to socio-economic, environmental and ecological circumstances.

The overall level of developmental vulnerability was consistent with findings from urban areas in Canada where the EDI has been implemented [1 33-35]. Indeed mean scores across all domains in the Irish sample were similar to those in the Canadian normative sample. Factors associated with increased risk of vulnerability at the child level were being male, a younger child, having English as a second language and low birth weight. Key factors at the family level were mothers education and reading stories. In the final model, the strongest predictor of vulnerability on EDI scores was story telling. Children who were never told stories in the past week were over five times as likely to be vulnerable compared with children who were told stories every day. This supports numerous studies which show a link between reading stories and literacy development [36]and with broader aspects of development [37] These are again consistent with findings from Canada, further supporting the transferability of the instrument between the two jurisdictions [38]

The mean scores across all five domains varied between sub-groups of the population. The impact of age is very clear. Younger children, aged less than 4 years and 10 months scored on average less well across all the domains. Children who had not attended pre-school also showed below average scores. However, non- attendance at pre-school can result from a variety of underlying reasons. Therefore, these scores cannot be attributed solely to the lack of pre-school education. Children from the Traveller Community also showed lower mean scores across all domains. Traveller children face a variety of challenges including accommodation in poorly serviced communal sites, greater risk of low birth weight, ill-health and hospitalisation [39].

Three child-level demographics were strongly associated with vulnerability. Boys, children who start school at a younger age and those for whom English is a second language were more likely to be

vulnerable. PAF illustrates that these three factors account for half of all vulnerability. These findings are consistent with international studies [34 40]

Hertzman describes vulnerability levels of above 15%as an unacceptable level of difficulty at school entry age[41]. There is considerable debate regarding the expected level of biologically determined developmental vulnerability. OECD country estimates range between 1.8% and 10.4%[42]. Considering these expected levels of biological determined developmental delay external factors can be seen to contribute to major disparities.

Limitations

The overall study was representative of children in their first year in formal education in Cork city. However, there was a 63% return rate on the parental questionnaire. While this compares favourably to other jurisdictions where this method has been used [38], there are significant differences between those for whom parental data were available and those for whom it was not. It is clear that the most vulnerable children were underrepresented in the parental sample.

This was the first study using the EDI in Ireland. Therefore, there was limited scope for validity testing. Comparisons with Canadian normative data, internal validity testing and qualitative work with teachers indicate that the EDI functions well in the Irish context. Future research will consider Rasch modelling and examining issues of predictive validity.

Policy Implications

Epidemiological studies have clearly linked early socio-economic circumstances to later outcomes [39-41]. Yet, the specific factors and processes in the early years which contribute to these outcomes have not been adequately explored. The reliance on diagnostic instruments which are professionally administered and measure particular aspects of development has led to gaps in population level studies on early development outcomes [21]. The EDI is a unique, well-validated, population level instrument which allows us to track all five domains of early childhood development. It has the potential to enhance our understanding of the early years environment and identify populations of children at risk of developmental delay. This in turn can inform universal programmes to enhance outcomes for whole populations of children. National policy which focuses on the early years is essential with investment in peri-natal care, quality support to families and provision of pre-school care by highly skilled practitioners[2]. In Ireland, significant investment is being made in developing a high standard of accessible child care including a free pre-school year and a focus on quality curriculum development. This study was implemented in the year prior to the introduction throughout Ireland of the universally accessible free pre-school year and related investment in skills-enhancement for pre-school staff.

From and Irish perspective, the study raises important questions regarding support to families where English is a second language. ESL was associated with lower mean scores across all domains. The pace of immigration to Ireland increased rapidly between 1990 and 2008 in response to employment opportunities which have since diminished. There is evidence of communities of immigrant populations living in areas of newly emerging disadvantage which lack the support structures associated with established communities. Indeed this study has identified such communities in which there were vulnerability rates of close to 50%. Particular attention also needs to be focused

on the implications of the findings in relation to age. Attendance at school is not mandatory until children are six years old but they may start once they are four, leading to classes with mixed age groups. Moreover, attendance by children under six in not officially monitored.

Poverty and inequality affect up to one quarter of Irish children. Throughout the boom years Irish policy in tackling child poverty consisted almost uniquely of direct payments to families, a practice which is now under threat. Moreover, little consideration was given to creating structures and policies to support and protect families. Tackling child poverty through a strategy of area-based prevention and early intervention features highly on the agenda of the current government [43]. This focus on both universal and targeted interventions has the potential to contribute to breaking this cycle of poverty. However, effective targeting in the context of early childhood development is problematic, with many instruments providing poor predictive reiability[44]. There is a need for longitudinal and population-level data which can be linked to administrative sources to provide a holistic basis for effective programming[45] In Australia and Canada the EDI is providing just such data on early childhood development.

Early childhood development is a key public health issue that needs to be addressed through a comprehensive programme of targeted and universal approaches, supported by high quality research. The EDI can play a critical role in informing policy and practice at a local and national level, and allowing for internationally comparable studies on early childhood development.

Table 1: Child development outcomes measured by the EDI

EDI Domains /Sub-domains	Expected behaviour
PHYSICAL HEALTH & WELL BEING	
Physical readiness for school day	Usually dressed appropriately for school and not tired, late or hungry.
Physical independence	Can look after own personal needs appropriately, established hand preference, well coordinated, and do not suck a thumb/finger.
Gross and fine motor skills	Physically able to participate in school and excellent or good gross and fine motor skills.
SOCIAL COMPETENCE	
Overall social competence	Very good ability to play and get along with various children, usually cooperative and self-confident.
Responsibility and respect	Respect for others and for property, follow rules and take care of materials, accept responsibility for actions, and show self-control.
Approaches to learning	Can work neatly, independently, and solve problems, follow instructions and class routines, easily adjust to changes.
Readiness to explore new things	Curious about the surrounding world, and eager to explore new books, toys and games.
EMOTIONAL MATURITY	
Pro-social and helping behaviour	Helping someone hurt, sick or upset, offering to help spontaneously, invite bystanders to join in.
Anxious and fearful behaviour	Seldom or never showing anxious behaviours; happy and able to enjoy school, comfortable being left at school by caregivers.
Aggressive behaviour	Seldom or never showing aggressive behaviours; not using aggression to solve conflict, not having temper tantrums, and not mean to others.
Hyperactivity and inattention	Not showing hyperactive behaviours; able to concentrate, attend to chosen activities, wait their turn, and usually think before doing.
LANGUAGE & COGNITIVE	
Basic literacy skills	Have basic literacy skills: can handle a book, identify some letters and attach sounds to some letters, show awareness of rhyming words, know the writing directions, and write their own name.
Interest literacy/numeracy and memory	Showing interest in books and reading, math and numbers, and no difficulty remembering things.
Advanced literacy skills	Can read simple, complex words or sentences, write voluntarily, write simple words or sentences.
Basic numeracy skills	Can count to 20, recognize shapes and numbers, compare numbers, sort and classify, use one-to-one correspondence, and understand simple time concepts.
COMMUNICATION & GENERAL KNOWLEDGE	
Communication and general knowledge	Can communicate easily and effectively, can participate in story-telling or imaginative play, articulate clearly, show adequate general knowledge, and are proficient in their native language.

Table 2: Comparison between sample for whom parental data was and was not available

	Parental n= 865	No Parental n=378	Sig
Mean Age - years (SD)	5.38 (.39)	5.36 (0.43)	.405
Female	46%	45%	.719
English as a Second Language	10%	19%	<.001
Identified Special needs	5%	10%	<.001
Member of the Traveller Community	2%	6%	<.001
Mean EDI scores by domain (SD)			
Physical health and wellbeing	8.8 (1.4)	8.1 (2.0)	<.001
Social competence	8.3 (1.8)	7.5 (2.1)	<.001
Emotional maturity	7.7 (1.6)	7.2 (1.7)	<.001
Language and cognitive development	8.8 (1.6)	8.0 (2.4)	<.001
Communication skills and gen knowledge	7.5 (2.8)	6.2 (3.2)	<.001
% Vulnerable in 1 or more domain of EDI	23%	41%	<.001

Table 3: Factors associated with developmental vulnerability (Univariate analysis)

	n(%)	% vulnerable*	OR	CI
Male	463 (54)	30%	2.2	(1.6 - 3.1)
English as a second language (ESL)	85 (10)	49%	3.8	(2.4 - 6.1)
Age <5 years	146 (17)	31%	1.6	(1.1 - 2.4)
Low birth weight (<2500g)	49 (6)	41%	2.5	(1.4 - 4.5)
Mother primary education only (ref: University ed)	38 (4)	37%	2.8	(1.3 - 5.8)
Mother secondary education only (ref: University ed)	297 (34)	27%	1.7	(1.1 - 2.6)
Four or more hours screen-time per day (ref: 1 hr or less)	128 (15)	32%	2.0	(1.2 - 3.4)
Never told stories in the past week (ref: every day)	10 (1)	50%	4.2	(1.2 - 14.8)
Told stories once or twice in past week (ref: every day)	82 (9)	32%	1.9	(1.2 - 3.3)
No preschool	44 (5)	43%	2.7	(1.4 - 5.0)

*Refers to the % of children vulnerable in one or more of the five domains of the EDI

Table 4: Logistic Regression predicting likelihood of vulnerability on EDI Scores

	OR (95% CI)*	OR (95% CI)**
Male	2.5 (1.8 - 3.6)	2.7 (1.8 - 3.9)
ESL	4.3 (2.6 - 6.9)	4.5 (2.6 – 7.8)
Age <5 years	1.4 (0.9 - 2.2)	1.3 (0.8 - 2.0)
Low Birth Weight	2.6 (1.4 - 4.9)	2.6 (1.3 - 5.0)
Mother Education (ref: University education)		
Primary or less	3.1 (1.4 - 6.7)	2.5 (1.0 - 6.0)
Secondary	2.1 (1.3 - 3.3)	2.1 (1.3 - 3.4)
Diploma	1.5 (0.9 - 2.3)	1.5 (0.9 - 2.4)
Daily Screen time (ref: 1 hour or less)		
2 to 3 hours	1.2 (0.8 - 1.8)	1.0 (0.6 - 1.6)
4 or more hours	1.7 (1.0 - 3.0)	1.2 (0.6 - 2.1)
Stories in the past week (ref: every day)		
Never	3.9 (1.0 - 14.3)	5.3 (1.3 - 21.1)
Once or twice	1.7 (1.0 - 2.9)	1.4 (0.8 - 2.5)
Many times	1.2 (0.8 - 1.7)	1.1 (0.7 - 1.6)
No Pre-school	1.9 (1.0 - 3.8)	1.5 (0.7 - 3.1)

* Adjusted for Age, gender and ESL (separate tests run for each subsequent variable)
** Adjusted for all other variables in one model

Table 5: PAF for vulnerability based on OR adjusted for all other variables

	N (%)	OR (95% CI)**	PAF (95% CI)
Under five	146 (17)	1.3 (0.8 - 2.0)	3.0 (-2.8 – 8.5)
Male	463 (54)	2.7 (1.8 - 3.9)	34.6 (21.3 – 45.7)
ESL	85 (10)	4.5 (2.6 - 7.8)	12.2 (7.3 – 16.8)
Low Birth Weight	49 (6)	2.6 (1.3 - 5.0)	4.5 (1.0 – 8.0)
Mother Education: Primary or less	38 (4)	2.5 (1.0 - 6.0)	2.8 (-0.2 – 5.7)
Secondary	297 (34)	2.1 (1.3 - 3.4)	16.8(5.9 – 26.5)
Diploma	263 (30)	1.5 (0.9 - 2.4)	7.7(-1.8 – 16.3)
Daily Screen time: 2 to 3 hours	532 (61)	1.0 (0.6 - 1.6)	-0.3 (-21.7 – 17.3)
4 or more hours	128 (15)	1.2 (0.6 - 2.1)	1.6 (-5.2 – 7.9)
Stories in the past week: Never	10 (1)	5.3 (1.3 - 21.1)	1.7 (0.1 – 3.3)
Once or twice	82 (9)	1.4 (0.8 - 2.5)	2.6 (-2.1 – 7.0)
Many times	251 (29)	1.1 (0.7 - 1.6)	1.7 (-6.8 – 9.5)
No Pre-school	44 (5)	1.5 (0.7 - 3.1)	1.8 (-1.6 – 5.1)

** Adjusted for all other variables

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REFERENCES

1. Kershaw P, Forer B. Selection of area-level variables from administrative data: an intersectional approach to the study of place and child development. *Health Place* 2010;16(3):500-11.
2. Marmot M, Allen J, Goldblatt P, et al. 'Fair Society Health Lives', The Marmot Review. In: England SRoHIi, editor. London, 2010.
3. Power C, Elliott J. Cohort profile: 1958 British birth cohort (National Child Development Study). *International Journal of Epidemiology* 2006;35(1):34-41.
4. Lemelin J-P, Boivin M, Forget-Dubois N, et al. The Genetic–Environmental Etiology of Cognitive School Readiness and Later Academic Achievement in Early Childhood. *Child Development* 2007;78(6):1855-69.
5. Nicholson JM, Lucas N, Berthelsen D, et al. Socioeconomic inequality profiles in physical and developmental health from 0-7 years: Australian National Study. *Journal of Epidemiology & Community Health* 2012;66(1):81-87.
6. Leventhal T, Brooks-Gunn J. The Neighborhoods They Live in: The Effects of Neighborhood Residence on Child and Adolescent Outcomes. *Pshychological Review* 2000;126(2):309 - 37.
7. Heckman JJ, Masterov DV. The Productivity Argument for Investing in Young Children. *Applied Economic Perspectives and Policy* 2007;29(3):446-93.
8. Kershaw P, Warburton B, Anderson L, et al. The economic costs of early vulnerability in Canada. *Can J Public Health* 2010;101 Suppl 3:S8-12.
9. Maggi S, Roberts W, MacLennan D, et al. Community resilience, quality childcare, and preschoolers' mental health: A three-city comparison. *Social Science & Medicine*;In Press, Accepted Manuscript.
10. Furumoto-Dawson A, Gehlert S, Sohmer D, et al. Early-life conditions and mechanisms of population health vulnerabilities. *Health Aff (Millwood)* 2007;26(5):1238-48.
11. Guhn M, Janus M, Hertzman C. The Early Development Instrument: Translating school readiness assessment into community actions and policy planning. *Early Education and Development* 2007;18(3):369-74.
12. Rose G. Sick Individuals and Sick Populations. *International Journal of Epidemiology* 1985;14:32 - 38.
13. Guhn M, Gadermann A, Zumbo BD. Does the EDI measure school readiness in the same way across different groups of children? *Early Education and Development* 2007;18(3):453-72.
14. Avan BI, Kirkwood B. Review of the theoretical frameworks for the study of child development within public health and epidemiology. *Journal of Epidemiology and Community Health* 2010;64:388 - 93.
15. Janus M, Brinkman S, Duku E. Validity and Psychometric Properties of the Early Development Instrument in Canada, Australia, United States, and Jamaica. *Social Indicators Research* 2011;103(2):283-97.

16. Brinkman S, Gialamas A, Rahman A, et al. Jurisdictional, socioeconomic and gender inequalities in child health and development: analysis of a national census of 5-year-olds in Australia. *BMJ Open* 2012;2(5).
17. C.S.O. Profile 7: Religion, Ethnicity and Irish Travellers. Cork: Central Statistics Office, 2012.
18. Haase T, Pratschke J. Deprivation and its Spatial Articulation in the Republic of Ireland. Dublin: Area Development Management, 2005.
19. OMCYA. State of the Nations Children. Dublin: Office of the Minister for Children and Youth Affairs, 2010.
20. Janus M, Brinkman S, Duku E, et al. The Early Development Instrument: A Population-based Measure for Communities. Hamilton, Ontario: Offord Centre for Child Studies, McMaster University, 2007.
21. Janus M, Offord DR. Development and Psychometric Properties of the Early Development Instrument (EDI): A Measure of Children's School Readiness. *Canadian Journal of Behavioural Science-Revue Canadienne Des Sciences Du Comportement* 2007;39(1):1-22.
22. D'Angiulli A, Warburton W, Dahinten S, et al. Population-level associations between preschool vulnerability and grade-four basic skills. *PLoS One* 2009;4(11):e7692.
23. Brinkman S, Silburn S, Lawrence D, et al. Investigating the validity of the Australian Early Development Index. *Early Education and Development* 2007;18(3):427-51.
24. Muhajarine N, Puchala C, Janus M. Does the EDI Equivalently Measure Facets of School Readiness for Aboriginal and Non-Aboriginal children? *Social Indicators Research* 2011;103(2):299-314.
25. Williams J, Greene S, Doyle E, et al. Growing up in Ireland national longitudinal study of children. The lives of 9 year olds: The Stationery Office, 2009.
26. Morgan K, McGee H, Watson D, et al. SLAN 2007: Survey of Lifestyle, Attitudes & Nutrition in Ireland: Main Report. Dublin: Department of Health and Children, 2008.
27. Brinkman S, Sayers M, Goldfeld S, et al. Population monitoring of language and cognitive development in Australia: the Australian Early Development Index. *International Journal of Speech-Language Pathology* 2009;11(5):419-30.
28. Carey DJ. *The Essential Guide to Special Education in Ireland*. Dublin: Primary ABC, 2005.
29. O'Sullivan JJ, Pearce MS, Parker L. Parental recall of birth weight: how accurate is it? *Archives of Disease in Childhood* 2000;82(3):202-03.
30. Hanley JA. A heuristic approach to the formulas for population attributable fraction. *Journal of Epidemiology and Community Health* 2001;55(7):508-14.
31. Miettinen OS. Proportion of disease caused or prevented by a given exposure, trait or intervention. *American Journal of Epidemiology* 1974(99):325 - 32.
32. Greenland S, Drescher K. Maximum likelihood estimation of the attributable fraction from logistic models. *Biometrics* 1993;49:865-72.
33. Carpiano RM, Lloyd JEV, Hertzman C. Concentrated affluence, concentrated disadvantage, and children's readiness for school: A population-based, multi-level investigation. *Social Science & Medicine* 2009;69(3):420-32.
34. Janus M, Duku E. The School Entry Gap: Socioeconomic, Family, and Health Factors Associated With Children's School Readiness to Learn. *Early Education and Development* 2007;18(3):375-403.
35. Kohen D, Oliver L, Pierre F. Examining the effects of schools and neighbourhoods on the outcomes of Kindergarten children in Canada. *International Journal of Speech-Language Pathology* 2009;11(5):404-18.
36. Bus AG, Van Ijzendoorn MH. Mothers Reading to Their 3-Year-Olds: The Role of Mother-Child Attachment Security in Becoming Literate. *Reading Research Quarterly* 1995;30(4):998-1015.
37. Fletcher KL, Reese E. Picture book reading with young children: A conceptual framework. *Developmental Review* 2005;25(1):64-103.

38. Janus M. Transition to school. In: Laverick DM, Jalongo MR, editors. *Transitions to early care and education*: Springer Netherlands, 2011:177 - 87.
39. Abdalla S, Cronin F, Daly L, et al. Our Geels: All Ireland Traveller Health Study. Dublin, 2010:University College Dublin.
40. Maggi S, Irwin LJ, Siddiqi A, et al. The social determinants of early child development: an overview. *J Paediatr Child Health* 2010;46(11):627-35.
41. Hertzman C. The state of child development in Canada: Are we moving toward, or away from, equity from the start? *Paediatr Child Health* 2009;14(10):673-6.
42. Banks J, McCoy S. A Study on the Prevalence of Special Educational Needs. Dublin: Economic and Social Research Institute, 2011.
43. Programme for Government 2011 - 2016. In: Expenditure DoP, editor. Dublin, 2011.
44. Lynch JW, Law C, Brinkman S, et al. Inequalities in child healthy development: Some challenges for effective implementation. *Social Science & Medicine* 2010;71(7):1244-48.
45. Hertzman C, Williams R. Making early childhood count. *Canadian Medical Association Journal* 2009;180(1):68-71.

Determinants of Vulnerability in Early Childhood Development in Ireland – a Population Level Study

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ARTICLE SUMMARY

Article focus

- This study demonstrates that significant population level variation exists in healthy child development in Ireland.
- The Early Development Instrument (EDI) is a unique, well-validated population level instrument which allows us to track all five domains of early development and identify populations of children at risk.
- When used in conjunction with a parental questionnaire factors which impact on child development at the child and family level can be identified.

Key Messages

- A direct population level evidence base on normal child development in needed both as an indicator of child health and a predictor of future outcomes.
- Three child-level demographic factors (age, gender and language) accounted for over half of the population level risk of developmental vulnerability, reinforcing the need for universal early childhood programmes which are cognisant of these variations.

Strengths and limitations of the study

- This is the first peer-reviewed population level study published in Europe assessing child development outcomes across multiple domains using the EDI.
- The study identifies proximal factors associated with child development, yet children and families do not live in a vacuum. Further research is needed to identify associated factors in the broader socio-cultural environment.

BACKGROUND

There is significant epidemiological evidence that early childhood development (from gestation to age six) strongly influences life-long health trajectories [1]. Indeed, major public health problems such as obesity, heart-disease and mental health problems can be seen to have roots in early childhood [2-3]. This results from a complex interplay between genetic makeup, in utero development, and both pre and postnatal environmental factors, all of which influence brain development in the first five years of life [4].

There is also evidence of a social gradient in child development [5], with children from poorer backgrounds doing less well in school and entering into an intergenerational cycle of reduced employment opportunities, higher fertility and health inequalities [6]. The long term social and economic gain of investing in the early years is also recognised [7]. Kershaw estimates that the cost of preventable early childhood vulnerability to the Canadian economy is between $2.2 and $3.4 trillion [8].

The challenge for public health, is to give due consideration to early childhood development both as an indicator of child health and as a predictor of future outcomes. Child development has been recognised as a key social determinant[9-10]. Moreover, the relatively large numbers of children with less pronounced development delay are a potentially greater burden than a small number of children at high risk [11] leading to a need for a population health approach [12]. Yet, measurement of child development is usually in the form of a diagnostic which aims to identify children at greatest risk and provide appropriate individual care, leaving a dearth of research evidence on which to build population level strategies[13-14]. In this context a direct population level evidence base on normal child development is needed.

The Early Development Instrument (EDI) is an internationally accepted, validated tool which has the potential to provide such an evidence base [15]. In Australia the EDI (AEDI) has been used universally as a census of child development and has revealed significant variation across states and territories [16]. While the EDI has been implemented at a population level in Scotland, Sweden and Kosovo ~~T~~this is the first peer reviewed population-level study published in Europe assessing child development outcomes across multiple domains, and using the EDI and linked parental questionnaire. The overall objective of the study was to ascertain the proportion of children who were developmentally ready for school in a representative sample of schools in a major urban centre in Ireland using the EDI and to examine associated factors. The study also aimed to assess the feasibility of implementing the EDI and its performance in this setting.

Ireland is a largely homogenous country with 85.8% of the population ethnically White Irish and a further 9.3% of other white ethnic background, primarily British [17]. Cork is one of five major urban centres. While all of these centres are comprised of areas of concentrated affluence and disadvantage, there are similar overall rates of key socio-economic indicators including unemployment, lone-parent families and education [18]. There is a total population of 64,937 five year olds. A minority (1.1%) of Irish children are members of the Traveller Community. Moreover, 19.5% are considered at risk of poverty and 8% live in consistent poverty [19]. The education system is static throughout the country.

METHODS

This observational study of child development was implemented with children in their first year of formal education (in Ireland this is referred to as 'Junior Infants') in 42 of the 47 primary schools in Cork city. Five schools in the city declined to take part. These declining schools were representative of a cross-section of schools in Cork - one boys school, one girls school, one large mixed, middle income school, one designated disadvantaged school and one Irish speaking school – and their omission would not have affected the representativeness of the demographic composition of the study. A further four schools agreed to participate in the study but chose not to administer the parental questionnaire as they believed it would put undue pressure on parents with literacy challenges. These were all designated disadvantaged schools and this has contributed to the under-representation of the most vulnerable children in the parental study.

All eligible children in the participating schools were invited to be included in the study.. Eligibility criteria were: being in the latter half of the first year of formal education (i.e. having completed A minimum of 4 to 5 months of education), being known by the teacher for more than one month and not having left the school.

Measurement of Child Development - The Early Development Instrument

Child development at school entry age was measured using the Early Development Instrument (EDI). This population level measure was designed at the Offord Centre for Child Studies, McMaster University, Hamilton, Ontario in the late 90s to measure the extent to which children have attained the physical, social, emotional and cognitive maturity necessary to engage in school activities [20]. The EDI is a community or population level measure, not an individual screening or diagnostic tool. The underlying focus is that of a population health approach i.e. small modifications of risk for large numbers are more effective at producing change than large modifications for small numbers [12]. It can be retrospective, focusing on early childhood development outcomes; or predictive, informing school and child-health programmes [20]. The instrument consists of five domains, sixteen sub-domains and 104 questions. The domains and sub domains are outlined in Table 1.

The EDI is a well validated instrument which has had extensive psychometric testing done both in Canada and Australia [15 20-23]. It has also been proven valid for use in minority populations [24]. In this Irish study, the EDI had good internally consistency by domains with Cronbach alphas of between 0.8 and 0.96.

Parental Questionnaire

In 2003 a parental questionnaire was developed and tested by the Offord Centre to complement the results of the EDI and provide a deeper population level context to the lives of children [20]. This questionnaire was adapted to suit the Irish context incorporating validated questions from the Growing Up in Ireland Study [25] and the SLAN Survey of Lifestyles, Behaviour and Nutrition in Ireland [26]. It consists of seven sections: child health and development; child care; pre-school; school; family; neighbourhood; and background information.

Data collection

The EDI is a teacher completed questionnaire based on five months observation of the children from the date when they start school, and was, therefore, implemented in the latter half of the first year of formal education. Prior to completing the questionnaires, the teachers were given a short

training and were each issued with an EDI guide book. Children were not present when the questionnaire was completed and no individual identifiers were recorded. Each child was assigned a form ID which was used on both the EDI and Parental Questionnaire.

Passive consent was used in line with previous EDI studies in Canada. An information letter was distributed to all parents by the class teacher two weeks before commencing the study. Parents were given detailed information on the study and asked to contact the school if they did not want their child included. A total of seven parents opted not to participate. Ethical approval was granted by the Clinical Research Ethics Committee of the Cork Teaching Hospitals.

The parental questionnaires were distributed in school bags or homework folders. Each parental pack contained a letter of explanation, questionnaire (again with no individual identifier) and a blank envelope in which to return the questionnaire sealed to the school. Parents were reassured that the envelope would not be opened at the school.

Developmental scoring

EDI scores were calculated for each developmental domain i.e. Physical Health and Well-being; Social Competence; Emotional Maturity; Language and Cognitive Development; and Communication Skills and General Knowledge. All questions had a 2 or 3 point Likert type response format (yes, no, don't know; very true, sometimes or somewhat true, never or not true, don't know). All responses had a score of 0 to 10 (2 point answers were scored 0 and 10; 3 point answers were scored 0, 5 and10). 'Don't know' responses were not scored. Domain scores refer to the child's mean score in that domain - ranging between 0 and 10. Higher scores indicate better results.

Children who scored in the lowest 10% of the study population in one or more of the five domains of the EDI were classed as 'vulnerable'. The 10% cut off is recommended because it is higher than typical clinical cut-off's and should therefore include children who may be more difficult to diagnose [27]. Those scoring in the lowest 10-25% for one or more domains were deemed 'at risk' and children who scored in the top 75% were 'on track' in that domain. Each domain was scored separately as children who are vulnerable in one area cannot compensate through competence in another. All scores were aggregated to the group level. In the absence of an Irish normative sample, to ensure the validity of the cut-off points, data was also scored against Canadian normative data. There was a 99% correlation between 'vulnerability' using the Irish and Canadian cut-off points. In four of the five domains there was 100% correlation between vulnerability using the Irish and Canadian cut-off points.

Data from the parental questionnaires was linked to the teacher filled questionnaire using the Form ID number and the matching was crosschecked using the recorded date of birth and gender. Questions, again, were constructed in a Likert type response format - yes, no or three to five response options. Demographic questions on child's date of birth and birth weight were also included.

Explanatory variables

The child's age was calculated from their date of birth and the date on which the form was completed and reported in years and months. 'Children for whom English is a second language (ESL)' refers to those reported by the teacher to have a first language other than English. Members

of the Travelling Community were children who were known by school to be part of this Irish ethnic minority group.

'Children identified as special needs' refers to those children who had already been identified as needing special assistance in the classroom. In Ireland this is defined as having a 'Special Education Condition' which has been recognised through a standardised assessment process [28].

Parental reported birth weight was used to calculate whether the child had a low birth weight i.e. less than 2.5kgs. Parental report of birth weight has been proven to be adequately accurate to be acceptable for research purposes [29].

Parents were asked how much time (to the nearest hour) the child spent either watching television, using the computer or playing video games on a typical school day. This was coded into '1 or less', 'two to three' and '4 or more' hours.

Data analysis

SPSS was used to analyse data. Each child's EDI scores were calculated by the Offord Centre for Child Studies in line with international EDI process. Initial analysis involved a cross-tabulation of potential risk items from the teacher completed EDI questionnaire (i.e. gender, age, ESL, pre-school attendance and membership of the Travelling Community) against the child's score in each of the developmental domains.

All further analyses reported here were confined to the sub-group of children for whom parental data was available. Univariate analysis was used to explore factors associated with 'vulnerability' i.e. being in the lowest 10% of the target population in one or more domain. Factors which proved significant ($p<0.05$) were then entered into logistic regression models to predict likelihood of vulnerability on EDI scores. The first model adjusted for age, gender and ESL. The second model adjusted for all other factors.

Population attributable fractions (PAF) were used to calculate the proportion of risk attributed to each of the factors in the final regression [30-31]. This was calculated using the 'punaf' command in STATA 12 which calculates confidence intervals for PAF, and also for scenario means and their ratio, known as the population unattributable fraction. Punaf uses the method for estimating PAFs recommended by Greenland and Drescher (1993) for cohort and cross-sectional studies[32].

RESULTS

EDI questionnaires were distributed to teachers of 1366 children. A total of 1243 (92%) were returned completed and valid. Of these, 45% (n=563) were girls. The average age at which children in the study started school was 4 years and 9 months. The youngest was 3 years 11 months and the oldest 6 years and 1 month.

There was considerable diversity in first language with 12.7% of the children reported to have English as a Second Language (ESL) and 36 different languages spoken. Three percent of the children in the study were members of the Traveller Community. The majority of children (76%) were known by the teacher to have attended preschool in the year before commencing full-time education.

In total, 6.6% of children had already been identified as having special needs. The study was conducted in mainstream primary schools and this number does not, therefore, include those children in Cork attending Junior Infants equivalent in special schools, who would tend to be more severely disabled.

Parental questionnaires were returned and linked to 865 (63%) valid child questionnaires. The characteristics of the study population varied somewhat between the overall study and those who returned the parental questionnaire. In particular, the proportion of children for whom English was a second language fell from 12.7% in the overall group to 9.8% in those returning parental questionnaires; for children reported as having special needs, the proportions were 6.6~~15~~ and 5.0 % respectively; and for those reported to be members of the Travelling community, 3.1% and 1.7% respectively. The characteristics of the population who returned the parental questionnaire and those who did not are compared in Table 2.

Distribution of domain scores (Mean and standard error)

Mean scores varied across the EDI domains. However, particular groups of children consistently scored below the mean in all domains i.e. boys, children who had English as a second language, members of the Traveller Community, children who had not been to pre-school and those who were under four years 10 months at the time of the study. This is outlined in Figure 2~~1~~ with the vertical axis representing the mean domain score for the study population.

Factors associated with vulnerability

Over one quarter (28.6%) of children in the study were developmentally vulnerable (i.e. in the lowest 10th percentile for one or more domains). In total 12% were vulnerable in only one domain, 6% in 2 domains, 5% in 3 domains, 3% in 4 domains and 3% were vulnerable in all 5 domains.

The following analysis is based only the subset of the study population (n=865) on whom parental questionnaires were returned.

Factors associated with developmental vulnerability (outlined in Table 3) were being male (odds ratio [OR] =2.2, 95% confidence interval [CI] = 1.6 – 3.1), ESL (OR = 3.8, CI= 2.4 – 6.1), being under five years of age at the time of the study (OR = 1.6, CI = 1.1 – 2.4) and low birth weight (OR=2.5, CI=1.4 – 4.5). When compared with children whose mothers had a university education those with only primary education (OR= 2.8, CI = 1.3 - 5.8) or secondary level (OR = 1.7, CI = 1.1 - 2.6) showed higher levels of vulnerability. Children who were never or seldom told stories in the past week and those who spent more than four hours watching television or playing video games also showed significantly increased vulnerability.

Logistic Regression

Regression analysis was then used to assess the impact of each variable on the odds of being vulnerable as outlined in Table 4. The first model controlled for being male, having English as a second language and being under five years of age at the time of EDI completion, the second also controlled for all other factors. Children whose birth weight was less than 2.5kg were over twice as likely to be vulnerable. Mother's education showed a graded effect. When controlled for all other

variables, children who had not been told or read stories in the past week were over five times as likely to be vulnerable than those who were told stories every day. In the final model, the amount of time spent watching television became insignificant.

Population Attributable Fraction (PAF)

PAF was used to measure the proportion of vulnerability attributed to each of the factors included in the final regression model (Table 5). Boys were almost three times as likely as girls to be vulnerable and being male accounted for 35% of the overall vulnerability. English as a second language accounted for 12%, and mothers education (primary, secondary or diploma) for 27% of vulnerability. Despite the high risk of vulnerability among children who were not read to (OR 5.3), this only accounted for 1.7% of the overall vulnerability reflecting its low prevalence in this population.

DISCUSSION

This paper explored the extent to which children in a major urban centre in Ireland have attained the level of child development necessary to engage fully in the education process. The findings suggest that, as expected, a significant minority of over one quarter (28.6%) of children in the study were not developmentally ready to engage in, and thereby benefit fully from school. Clearly these findings should be interpreted cautiously in light of the current level of development of the EDI in Ireland, in particular, the lack of data on predictive validity for the EDI in the Irish population. At the same time, the fundamental issue is not the absolute scores but the unacceptable variation in scores related to socio-economic, environmental and ecological circumstances.

The overall level of developmental vulnerability was consistent with findings from urban areas in Canada where the EDI has been implemented [1 33-35] ~~(Carpiano et al., 2009, Kershaw et al., 2010, Janus and Duku, 2007, Kohen et al., 2009)~~. Indeed mean scores across all domains in the Irish sample were similar to those in the Canadian normative sample. Factors associated with increased risk of vulnerability at the child level were being male, a younger child, having English as a second language and low birth weight. Key factors at the family level were mothers education and reading stories. In the final model, the strongest predictor of vulnerability on EDI scores was story telling. Children who were never told stories in the past week were over five times as likely to be vulnerable compared with children who were told stories every day. This supports numerous studies which show a link between reading stories and literacy development [36] and with broader aspects of development [37] These are again consistent with findings from Canada, further supporting the transferability of the instrument between the two jurisdictions [38]

The mean scores across all five domains varied between sub-groups of the population. The impact of age is very clear. Younger children, aged less than 4 years and 10 months scored on average less well across all the domains. Children who had not attended pre-school also showed below average scores. However, non- attendance at pre-school can result from a variety of underlying reasons. Therefore, these scores cannot be attributed solely to the lack of pre-school education. Children from the Traveller Community also showed lower mean scores across all domains. Traveller children face a variety of challenges including accommodation in poorly serviced communal sites, greater risk of low birth weight, ill-health and hospitalisation [39].

Three child-level demographics were strongly associated with vulnerability. Boys, children who start school at a younger age and those for whom English is a second language were more likely to be vulnerable. PAF illustrates that these three factors account for half of all vulnerability. These findings are consistent with international studies [34 40]

Hertzman describes vulnerability levels of above 15%as an unacceptable level of difficulty at school entry age[41]. There is considerable debate regarding the expected level of biologically determined ~~disability~~ developmental vulnerability. OECD country estimates range between 1.8% and 10.4%[42]. Considering these expected levels of biological determined developmental delay external factors can be seen to contribute to major disparities.

Limitations

The overall study was representative of children in their first year in formal education in Cork city. However, there was a 63% return rate on the parental questionnaire. While this compares favourably to other jurisdictions where this method has been used [38], there are significant differences between those for whom parental data were available and those for whom it was not. It is clear that the most vulnerable children were underrepresented in the parental sample.

This was the first study using the EDI in Ireland. Therefore, there was limited scope for validity testing. Comparisons with Canadian normative data, internal validity testing and qualitative work with teachers indicate that the EDI functions well in the Irish context. Future research will consider Rasch modelling and examining issues of predictive validity.

Policy Implications

Epidemiological studies have clearly linked early socio-economic circumstances to later outcomes [39-41]. Yet, the specific factors and processes in the early years which contribute to these outcomes have not been adequately explored. The reliance on diagnostic instruments which are professionally administered and measure particular aspects of development has led to gaps in population level studies on early development outcomes [21]. The EDI is a unique, well-validated, population level instrument which allows us to track all five domains of early childhood development. It has the potential to enhance our understanding of the early years environment and identify populations of children at risk of developmental delay. This in turn can inform universal programmes to enhance outcomes for whole populations of children. National policy which focuses on the early years is essential with investment in peri-natal care, quality support to families and provision of pre-school care by highly skilled practitioners[2]. In Ireland, significant investment is being made in developing a high standard of accessible child care including a free pre-school year and a focus on quality curriculum development. This study was implemented in the year prior to the introduction throughout Ireland of the universally accessible free pre-school year and related investment in skills-enhancement for pre-school staff.

From and Irish perspective, the study raises important questions regarding support to families where English is a second language. ESL was associated with lower mean scores across all domains. The pace of immigration to Ireland increased rapidly between 1990 and 2008 in response to employment opportunities which have since diminished. There is evidence of communities of immigrant populations living in areas of newly emerging disadvantage which lack the support structures

associated with established communities. Indeed this study has identified such communities in which there were vulnerability rates of close to 50%. Particular attention also needs to be focused on the implications of the findings in relation to age. Attendance at school is not mandatory until children are six years old but they may start once they are four, leading to classes with mixed age groups. Moreover, attendance by children under six in not officially monitored.

Poverty and inequality affect up to one quarter of Irish children. Throughout the boom years Irish policy in tackling child poverty consisted almost uniquely of direct payments to families, a practice which is now under threat. Moreover, little consideration was given to creating structures and policies to support and protect families. Tackling child poverty through a strategy of area-based prevention and early intervention features highly on the agenda of the current government [43]. This focus on both universal and targeted interventions has the potential to contribute to breaking this cycle of poverty. However, effective targeting in the context of early childhood development is problematic, with many instruments providing poor predictive reiability[44]. There is a need for longitudinal and population-level data which can be linked to administrative sources to provide a holistic basis for effective programming[45] In Australia and Canada the EDI is providing just such data on early childhood development.

Early childhood development is a key public health issue that needs to be addressed through a comprehensive programme of targeted and universal approaches, supported by high quality research. The EDI can play a critical role in informing policy and practice at a local and national level, and allowing for internationally comparable studies on early childhood development.

Table 1: Child development outcomes measured by the EDI

EDI Domains /Sub-domains	Expected behaviour
PHYSICAL HEALTH & WELL BEING	
Physical readiness for school day	Usually dressed appropriately for school and not tired, late or hungry.
Physical independence	Can look after own personal needs appropriately, established hand preference, well coordinated, and do not suck a thumb/finger.
Gross and fine motor skills	Physically able to participate in school and excellent or good gross and fine motor skills.
SOCIAL COMPETENCE	
Overall social competence	Very good ability to play and get along with various children, usually cooperative and self-confident.
Responsibility and respect	Respect for others and for property, follow rules and take care of materials, accept responsibility for actions, and show self-control.
Approaches to learning	Can work neatly, independently, and solve problems, follow instructions and class routines, easily adjust to changes.
Readiness to explore new things	Curious about the surrounding world, and eager to explore new books, toys and games.
EMOTIONAL MATURITY	
Pro-social and helping behaviour	Helping someone hurt, sick or upset, offering to help spontaneously, invite bystanders to join in.
Anxious and fearful behaviour	Seldom or never showing anxious behaviours; happy and able to enjoy school, comfortable being left at school by caregivers.
Aggressive behaviour	Seldom or never showing aggressive behaviours; not using aggression to solve conflict, not having temper tantrums, and not mean to others.
Hyperactivity and inattention	Not showing hyperactive behaviours; able to concentrate, attend to chosen activities, wait their turn, and usually think before doing.
LANGUAGE & COGNITIVE	
Basic literacy skills	Have basic literacy skills: can handle a book, identify some letters and attach sounds to some letters, show awareness of rhyming words, know the writing directions, and write their own name.
Interest literacy/numeracy and memory	Showing interest in books and reading, math and numbers, and no difficulty remembering things.
Advanced literacy skills	Can read simple, complex words or sentences, write voluntarily, write simple words or sentences.
Basic numeracy skills	Can count to 20, recognize shapes and numbers, compare numbers, sort and classify, use one-to-one correspondence, and understand simple time concepts.
COMMUNICATION & GENERAL KNOWLEDGE	
Communication and general knowledge	Can communicate easily and effectively, can participate in story-telling or imaginative play, articulate clearly, show adequate general knowledge, and are proficient in their native language.

Table 2: Comparison between sample for whom parental data was and was not available

	Parental n= 865	No Parental n=378	Sig
Mean Age - years (SD)	5.38 (.39)	5.36 (0.43)	.405
Female	46%	45%	.719
English as a Second Language	10%	19%	<.001
Identified Special needs	5%	10%	<.001
Member of the Traveller Community	2%	6%	<.001
Mean EDI scores by domain (SD)			
Physical health and wellbeing	8.8 (1.4)	8.1 (2.0)	<.001
Social competence	8.3 (1.8)	7.5 (2.1)	<.001
Emotional maturity	7.7 (1.6)	7.2 (1.7)	<.001
Language and cognitive development	8.8 (1.6)	8.0 (2.4)	<.001
Communication skills and gen knowledge	7.5 (2.8)	6.2 (3.2)	<.001
% Vulnerable in 1 or more domain of EDI	23%	41%	<.001

Table 3: Factors associated with developmental vulnerability (Univariate analysis)

	n(%)	% vulnerable*	OR	CI
Male	463 (54)	30%	2.2	(1.6 - 3.1)
English as a second language (ESL)	85 (10)	49%	3.8	(2.4 - 6.1)
Age <5 years	146 (17)	31%	1.6	(1.1 - 2.4)
Low birth weight (<2500g)	49 (6)	41%	2.5	(1.4 - 4.5)
Mother primary education only (ref: University ed)	38 (4)	37%	2.8	(1.3 - 5.8)
Mother secondary education only (ref: University ed)	297 (34)	27%	1.7	(1.1 - 2.6)
Four or more hours screen-time per day (ref: 1 hr or less)	128 (15)	32%	2.0	(1.2 - 3.4)
Never told stories in the past week (ref: every day)	10 (1)	50%	4.2	(1.2 - 14.8)
Told stories once or twice in past week (ref: every day)	82 (9)	32%	1.9	(1.2 - 3.3)
No preschool	44 (5)	43%	2.7	(1.4 - 5.0)

*Refers to the % of children vulnerable in one or more of the five domains of the EDI

Table 4: Logistic Regression predicting likelihood of vulnerability on EDI Scores

	OR (95% CI)*	OR (95% CI)**
Male	2.5 (1.8 - 3.6)	2.7 (1.8 - 3.9)
ESL	4.3 (2.6 - 6.9)	4.5 (2.6 – 7.8)
Age <5 years	1.4 (0.9 - 2.2)	1.3 (0.8 - 2.0)
Low Birth Weight	2.6 (1.4 - 4.9)	2.6 (1.3 - 5.0)
Mother Education (ref: University education)		
Primary or less	3.1 (1.4 - 6.7)	2.5 (1.0 - 6.0)
Secondary	2.1 (1.3 - 3.3)	2.1 (1.3 - 3.4)
Diploma	1.5 (0.9 - 2.3)	1.5 (0.9 - 2.4)
Daily Screen time (ref: 1 hour or less)		
2 to 3 hours	1.2 (0.8 - 1.8)	1.0 (0.6 - 1.6)
4 or more hours	1.7 (1.0 - 3.0)	1.2 (0.6 - 2.1)
Stories in the past week (ref: every day)		
Never	3.9 (1.0 - 14.3)	5.3 (1.3 - 21.1)
Once or twice	1.7 (1.0 - 2.9)	1.4 (0.8 - 2.5)
Many times	1.2 (0.8 - 1.7)	1.1 (0.7 - 1.6)
No Pre-school	1.9 (1.0 - 3.8)	1.5 (0.7 - 3.1)

* Adjusted for Age, gender and ESL (separate tests run for each subsequent variable)
** Adjusted for all other variables in one model

Table 5: PAF for vulnerability based on OR adjusted for all other variables

	N (%)	OR (95% CI)**	PAF (95% CI)
Under five	146 (17)	1.3 (0.8 - 2.0)	3.0 (-2.8 – 8.5)
Male	463 (54)	2.7 (1.8 - 3.9)	34.6 (21.3 – 45.7)
ESL	85 (10)	4.5 (2.6 - 7.8)	12.2 (7.3 – 16.8)
Low Birth Weight	49 (6)	2.6 (1.3 - 5.0)	4.5 (1.0 – 8.0)
Mother Education: Primary or less	38 (4)	2.5 (1.0 - 6.0)	2.8 (-0.2 – 5.7)
Secondary	297 (34)	2.1 (1.3 - 3.4)	16.8(5.9 – 26.5)
Diploma	263 (30)	1.5 (0.9 - 2.4)	7.7(-1.8 – 16.3)
Daily Screen time: 2 to 3 hours	532 (61)	1.0 (0.6 - 1.6)	-0.3 (-21.7 – 17.3)
4 or more hours	128 (15)	1.2 (0.6 - 2.1)	1.6 (-5.2 – 7.9)
Stories in the past week: Never	10 (1)	5.3 (1.3 - 21.1)	1.7 (0.1 – 3.3)
Once or twice	82 (9)	1.4 (0.8 - 2.5)	2.6 (-2.1 – 7.0)
Many times	251 (29)	1.1 (0.7 - 1.6)	1.7 (-6.8 – 9.5)
No Pre-school	44 (5)	1.5 (0.7 - 3.1)	1.8 (-1.6 – 5.1)
~~Total PAF~~			~~90.7~~

** Adjusted for all other variables

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No competing interests exist

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REFERENCES

1. Kershaw P, Forer B. Selection of area-level variables from administrative data: an intersectional approach to the study of place and child development. *Health Place* 2010;16(3):500-11.
2. Marmot M, Allen J, Goldblatt P, Boyce T, McNeish D, Grady M, et al. 'Fair Society Health Lives', The Marmot Review. In: England SRoHIi, editor. London, 2010.
3. Power C, Elliott J. Cohort profile: 1958 British birth cohort (National Child Development Study). *International Journal of Epidemiology* 2006;35(1):34-41.
4. Lemelin J-P, Boivin M, Forget-Dubois N, Dionne G, Brendgen M, Séguin JR, et al. The Genetic–Environmental Etiology of Cognitive School Readiness and Later Academic Achievement in Early Childhood. *Child Development* 2007;78(6):1855-69.
5. Nicholson JM, Lucas N, Berthelsen D, Wake M. Socioeconomic inequality profiles in physical and developmental health from 0-7 years: Australian National Study. *Journal of Epidemiology & Community Health* 2012;66(1):81-87.
6. Leventhal T, Brooks-Gunn J. The Neighborhoods They Live in: The Effects of Neighborhood Residence on Child and Adolescent Outcomes. *Pshychological Review* 2000;126(2):309 - 37.
7. Heckman JJ, Masterov DV. The Productivity Argument for Investing in Young Children. *Applied Economic Perspectives and Policy* 2007;29(3):446-93.
8. Kershaw P, Warburton B, Anderson L, Hertzman C, Irwin LG, Forer B. The economic costs of early vulnerability in Canada. *Can J Public Health* 2010;101 Suppl 3:S8-12.
9. Maggi S, Roberts W, MacLennan D, D'Angiulli A. Community resilience, quality childcare, and preschoolers' mental health: A three-city comparison. *Social Science & Medicine*;In Press, Accepted Manuscript.
10. Furumoto-Dawson A, Gehlert S, Sohmer D, Olopade O, Sacks T. Early-life conditions and mechanisms of population health vulnerabilities. *Health Aff (Millwood)* 2007;26(5):1238-48.
11. Guhn M, Janus M, Hertzman C. The Early Development Instrument: Translating school readiness assessment into community actions and policy planning. *Early Education and Development* 2007;18(3):369-74.
12. Rose G. Sick Individuals and Sick Populations. *International Journal of Epidemiology* 1985;14:32 - 38.
13. Guhn M, Gadermann A, Zumbo BD. Does the EDI measure school readiness in the same way across different groups of children? *Early Education and Development* 2007;18(3):453-72.
14. Avan BI, Kirkwood B. Review of the theoretical frameworks for the study of child development within public health and epidemiology. *Journal of Epidemiology and Community Health* 2010;64:388 - 93.
15. Janus M, Brinkman S, Duku E. Validity and Psychometric Properties of the Early Development Instrument in Canada, Australia, United States, and Jamaica. *Social Indicators Research* 2011;103(2):283-97.

16. Brinkman S, Gialamas A, Rahman A, Mittinty MN, Gregory TA, Silburn S, et al. Jurisdictional, socioeconomic and gender inequalities in child health and development: analysis of a national census of 5-year-olds in Australia. *BMJ Open* 2012;2(5).
17. C.S.O. Profile 7: Religion, Ethnicity and Irish Travellers. Cork: Central Statistics Office, 2012.
18. Haase T, Pratschke J. Deprivation and its Spatial Articulation in the Republic of Ireland. Dublin: Area Development Management, 2005.
19. OMCYA. State of the Nations Children. Dublin: Office of the Minister for Children and Youth Affairs, 2010.
20. Janus M, Brinkman S, Duku E, Hertzman C, Santos R, Sayers M, et al. The Early Development Instrument: A Population-based Measure for Communities. Hamilton, Ontario: Offord Centre for Child Studies, McMaster University, 2007.
21. Janus M, Offord DR. Development and Psychometric Properties of the Early Development Instrument (EDI): A Measure of Children's School Readiness. *Canadian Journal of Behavioural Science-Revue Canadienne Des Sciences Du Comportement* 2007;39(1):1-22.
22. D'Angiulli A, Warburton W, Dahinten S, Hertzman C. Population-level associations between preschool vulnerability and grade-four basic skills. *PLoS One* 2009;4(11):e7692.
23. Brinkman S, Silburn S, Lawrence D, Goldfeld S, Sayers M, Oberklaid F. Investigating the validity of the Australian Early Development Index. *Early Education and Development* 2007;18(3):427-51.
24. Muhajarine N, Puchala C, Janus M. Does the EDI Equivalently Measure Facets of School Readiness for Aboriginal and Non-Aboriginal children? *Social Indicators Research* 2011;103(2):299-314.
25. Williams J, Greene S, Doyle E, Harris E, Layte R, McCoy S, et al. Growing up in Ireland national longitudinal study of children. The lives of 9 year olds: The Stationery Office, 2009.
26. Morgan K, McGee H, Watson D, Perry I, Barry M, Shelley E, et al. SLAN 2007: Survey of Lifestyle, Attitudes & Nutrition in Ireland: Main Report. Dublin: Department of Health and Children, 2008.
27. Brinkman S, Sayers M, Goldfeld S, Kline J. Population monitoring of language and cognitive development in Australia: the Australian Early Development Index. *International Journal of Speech-Language Pathology* 2009;11(5):419-30.
28. Carey DJ. *The Essential Guide to Special Education in Ireland*. Dublin: Primary ABC, 2005.
29. O'Sullivan JJ, Pearce MS, Parker L. Parental recall of birth weight: how accurate is it? *Archives of Disease in Childhood* 2000;82(3):202-03.
30. Hanley JA. A heuristic approach to the formulas for population attributable fraction. *Journal of Epidemiology and Community Health* 2001;55(7):508-14.
31. Miettinen OS. Proportion of disease caused or prevented by a given exposure, trait or intervention. *American Journal of Epidemiology* 1974(99):325 - 32.
32. Greenland S, Drescher K. Maximum likelihood estimation of the attributable fraction from logistic models. *Biometrics* 1993;49:865-72.
33. Carpiano RM, Lloyd JEV, Hertzman C. Concentrated affluence, concentrated disadvantage, and children's readiness for school: A population-based, multi-level investigation. *Social Science & Medicine* 2009;69(3):420-32.
34. Janus M, Duku E. The School Entry Gap: Socioeconomic, Family, and Health Factors Associated With Children's School Readiness to Learn. *Early Education and Development* 2007;18(3):375-403.
35. Kohen D, Oliver L, Pierre F. Examining the effects of schools and neighbourhoods on the outcomes of Kindergarten children in Canada. *International Journal of Speech-Language Pathology* 2009;11(5):404-18.
36. Bus AG, Van Ijzendoorn MH. Mothers Reading to Their 3-Year-Olds: The Role of Mother-Child Attachment Security in Becoming Literate. *Reading Research Quarterly* 1995;30(4):998-1015.

37. Fletcher KL, Reese E. Picture book reading with young children: A conceptual framework. *Developmental Review* 2005;25(1):64-103.
38. Janus M. Transition to school. In: Laverick DM, Jalongo MR, editors. *Transitions to early care and education*: Springer Netherlands, 2011:177 - 87.
39. Abdalla S, Cronin F, Daly L, Drummond A, Fitzpatrick P, Frazier K, et al. Our Geels: All Ireland Traveller Health Study. Dublin, 2010:University College Dublin.
40. Maggi S, Irwin LJ, Siddiqi A, Hertzman C. The social determinants of early child development: an overview. *J Paediatr Child Health* 2010;46(11):627-35.
41. Hertzman C. The state of child development in Canada: Are we moving toward, or away from, equity from the start? *Paediatr Child Health* 2009;14(10):673-6.
42. Banks J, McCoy S. A Study on the Prevalence of Special Educational Needs. Dublin: Economic and Social Research Institute, 2011.
43. Programme for Government 2011 - 2016. In: Expenditure DoP, editor. Dublin, 2011.
44. Lynch JW, Law C, Brinkman S, Chittleborough C, Sawyer M. Inequalities in child healthy development: Some challenges for effective implementation. *Social Science & Medicine* 2010;71(7):1244-48.
45. Hertzman C, Williams R. Making early childhood count. *Canadian Medical Association Journal* 2009;180(1):68-71.

Figure 1: Participant flow chart

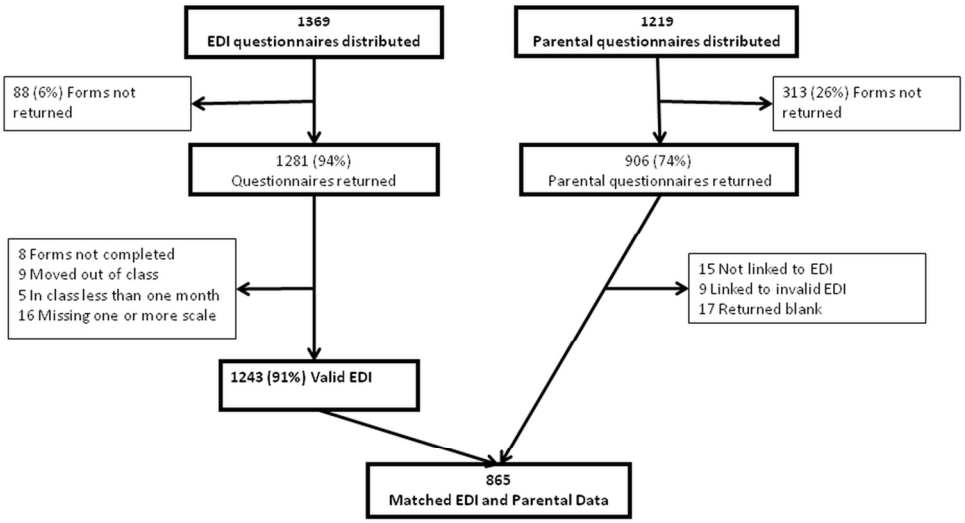

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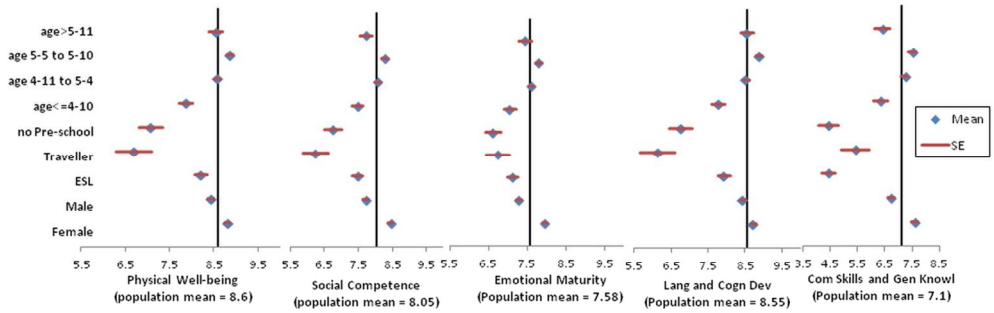
Figure 2: Distribution of scores across all five domains of development



*Each vertical axis represents the population mean for that domain

119x90mm (300 x 300 DPI)

Form Number

ucc

Coláiste na hOllscoile Corcaigh, Éire
University College Cork, Ireland

Junior Infants Parent Survey
Cork 2010 - 11

Please fill in the circles like this ● or ⊗. Whenever you are asked about "your child", please answer the question based on your child in Junior Infants.

SECTION A: CHILD HEALTH & DEVELOPMENT

1. Is your child male or female? ○ Male ○ Female

2. When was your child born? _____day _____month _____year

3. What was your child's weight at birth? _____ lbs _____oz or _____ grams

4. Does your family have a regular family doctor or health care provider that you can talk to about your child's health? ○ Yes ○ No

5. In general, would you say your child's health is: ○ Excellent ○ Very Good ○ Good ○ Fair ○ Poor

6. Do you feel your child has a special need that is not yet recognized by the school? ○ Yes ○ No

7. In a typical WEEK, how often does your child	Always	Most of the time	Sometimes	Never
a. Eat breakfast?	○	○	○	○
b. Eat at least 4 servings of vegetables and/or fruits each day?	○	○	○	○
c. Eat or drink 2 servings of milk products *(white or chocolate milk, cheese, yogurt, milk puddings or milk substitutes such as fortified soy beverages)* each day?	○	○	○	○
d. Eat meals together with the family?	○	○	○	○

Please fill in the circles like this ● or ⊗.

SECTION B: EARLY YEARS EXPERIENCES

8. In the years before your child started Junior Infants how often did your child attend:	Once a Week or more	Once a Month	3 or 4 Times a Year	Once a Year	Not at All
a. Play-based children's programmes (e.g. drop-ins, Parent and Toddler Group, Family Centre)	○	○	○	○	○
b. Literacy and family reading programs (e.g. story times, etc)	○	○	○	○	○
c. Children's Club (Beavers, Ladybirds, Boys and Girls Club)	○	○	○	○	○
d. Music, Arts or Dance programmes	○	○	○	○	○
e. Visited a public library	○	○	○	○	○
f. Visited a book shop	○	○	○	○	○
g. Cultural/language/ethnic programmes	○	○	○	○	○

9. In the years before your child started Junior Infants, did your child get help from any of the following services:	Yes	No	On waiting list for assessment	On waiting list for services
a. Speech and Language Services	○	○	○	○
b. Blind or Low Vision Services	○	○	○	○
c. Occupational of Physical Therapy	○	○	○	○
d. Hearing Services	○	○	○	○
e. Programmes / Services for Behavioural Issues	○	○	○	○
f. Programmes / Services for Developmental Issues	○	○	○	○
g. Mental Health Programmes / Services	○	○	○	○
h. Programs / Services for English as a Second Language	○	○	○	○

10. In the years before your child started Junior Infants, were you unable to access services to help your child because of any of the following reasons:	YES	NO
a. Wait list was too long	○	○
b. Cost was too much	○	○
c. Didn't have information about services	○	○
d. Didn't know services were available	○	○
e. No services near where I live	○	○
f. No way to get there (no car, no buses, cost)	○	○
h. Times did not work for me	○	○
i. Services were not available in my language	○	○
j. Other, please tell us: _____	○	○

Please fill in the circles like this ● or ⊗.

SECTION C: CHILD CARE

For the next few questions, we are asking about the MAIN type of child care you used. You may have used more than one type of child care but select the one that you consider to be your main child care provider. Do not include babysitters you used occasionally. Do not include pre-school.

11. For EACH age period, what was your MAIN type of care? Please give one answer for each age. *If your child was NOT in regular child care during a certain age period, please use the answer* ***Parent Care Only.***

Age of Child	Parent Care Only	Unpaid care (eg. relative or friend)	Paid care in your home	Paid care in someone's home	Care in a centre / crèche
0 to 12 months (infant care)	○	○	○	○	○
1 yr up to 1 yr and 6 months (1.5 yrs) (infant care)	○	○	○	○	○
1.5 years up to 2.5 years (toddler care)	○	○	○	○	○
2.5 yrs up to 4 yrs (preschooler care)	○	○	○	○	○
4 yrs up to 6 yrs (school age care)	○	○	○	○	○

12. On average, how many hours per week IN TOTAL did your child spend in your MAIN child care? *If your child was NOT in regular child care during a certain age period, please use the answer* ***None – Parent Care Only.***

Age of Child	None – Parent Care Only	Less than 20 hours per week	20 – 30 hours per week	31 – 40 hours per week	More than 40 hours per week
0 to 12 months (infant care)	○	○	○	○	○
1 yr up to 1 yr and 6 months (1.5 yrs) (infant care)	○	○	○	○	○
1.5 years up to 2.5 years (toddler care)	○	○	○	○	○
2.5 yrs up to 4 yrs (preschooler care)	○	○	○	○	○
4 yrs up to 6 yrs (school age care)	○	○	○	○	○

Please fill in the circles like this ● or ⊗.

SECTION D: PRE-SCHOOL AND SCHOOL

13. In the year before starting school, did your child attend a pre-school?	Yes	No
	○	○

13. a. If yes, where _____

14. We would like to know more about your family's experience with the Junior Infants.	Strongly Disagree	Disagree	Agree	Strongly Agree
a. My child is excited about learning	○	○	○	○
b. As a parent, I feel welcome in my child's school	○	○	○	○
c. My child is able to manage the school day.	○	○	○	○

15. Since the beginning of this school year, have you:	Never	Once or Twice	Three or More Times
a. Attended a parent-teacher meeting?	○	○	○
b. Attended a general school meeting (e.g. open meeting, parents council meeting)	○	○	○
c. Attended a school or class event (e.g. school play or concert)	○	○	○
d. Volunteered in the school? (e.g. helped in the library, helped with a fundraiser or school event)	○	○	○

SECTION E: YOU AND YOUR CHILD

16. In the **PAST 7 DAYS**, have you or someone close to your child done the following things with your child?	Yes, Everyday	Yes, Many Times	Yes, Once or Twice	No
a. Played simple maths games (cards, counting, puzzles, board games)	○	○	○	○
b. Sang songs or said rhymes	○	○	○	○
c. Told or read him/her a story	○	○	○	○
d. Worked on arts, crafts or drawing with him/her	○	○	○	○
e. Worked on the sounds of letters	○	○	○	○
f. Helped with printing letters, numbers or child's name	○	○	○	○
g. Done household chores together like cooking, cleaning, putting away toys, setting the table, caring for pets, gardening	○	○	○	○

Please fill in the circles like this ● or ⊗.

17. Have you ever attended a class, workshop, programme or event meant to help you in your role as a parent?	Yes	No
	○	○

18. In the past 12 months, how often has your child:	Once a Week or more	Once a Month	3 or 4 Times a Year	Once a Year	Not at All
a. Played a sport WITH a coach or instructor, outside of school activities (e.g., swimming lessons, GAA, hockey, etc.)	○	○	○	○	○
b. Played a sport or done physical activities WITHOUT a coach or instructor (e.g.cycling, skate-boarding, etc.)	○	○	○	○	○

19. In a typical school day, how many hours does your child watch TV, use the computer or play video games at home?	5 or more hours per day	4 hours per day	3 hours per day	2 hours per day	One Hour or less
	○	○	○	○	○

20. On a typical school night, how many hours of sleep does your child get?	Less than 8 hours	8 to 10 hours	11 to 12 hours	13 to 14 hours	More than 14 hours
	○	○	○	○	○

SECTION G: YOUR COMMUNITY

21. Please tell us about your neighbourhood.	True	Sometimes True	Not True
a. It is safe to walk alone in my neighbourhood after dark.	○	○	○
b. It is safe for children to play outside during the day in my neighbourhood.	○	○	○
c. There are safe parks, playgrounds and play spaces in my neighbourhood.	○	○	○
d. If there is a problem around here, the neighbours get together and deal with it.	○	○	○
e. There are adults in my neighbourhood that children can look up to.	○	○	○
f. People around here are willing to help their neighbours.	○	○	○
g. You can count on adults in my neighbourhood to watch out that children are safe and don't get into trouble.	○	○	○
h. When I'm away from home, I know that my neighbours will keep their eyes open for possible trouble.	○	○	○

Please fill in the circles like this ● or ⊗.

22. Do you have access to the following places in your community? Access might mean walking, driving your car a short distance or taking the bus.	Yes	No	Don't know
a. Public park or sports grounds	○	○	○
b. Library	○	○	○
c. Shopping centre	○	○	○
d. Community centre	○	○	○
e. School	○	○	○
f. Grocery store	○	○	○

23. Do you regularly join in the activities of any of the following types of organisation?	Yes	No
a. Sports clubs (Parish, GAA, Golf, Other), gym, exercise classes	○	○
b. Political parties, trade unions, environmental groups	○	○
c. Parent-teacher associations, tenants groups, residents groups, neighbourhood watch, youth groups, other community action groups	○	○
d. Church or other religious/parish groups, charitable or voluntary organisations (e.g. collecting for charity, helping the sick, elderly)	○	○
e. Evening classes, arts or music groups, education activities	○	○
f. Social clubs (e.g. mother & toddler group, club, women's groups, elderly group)	○	○
g. Other, please tell us:_____	○	○

24. How many people are so close to you that can count on them if you have serious personal problems?			
None	1 or 2	3 to 5	More than 5
○	○	○	○

25. How much friendly interest do people in your neighbourhood take in what you are doing?				
A lot	Some	Uncertain	Little	None
○	○	○	○	○

26. How easy is it to get practical help from neighbours if you should need it?				
Very easy	Easy	Possible	Difficult	Very Difficult
○	○	○	○	○

Please fill in the circles like this ● or ⊗.

27. Can you to tell me how much you agree or disagree with this statement: "If I was experiencing mental health problems I wouldn't want people knowing about it"				
Agree strongly	**Agree slightly**	**Neither agree nor disagree**	**Disagree slightly**	**Disagree strongly**
○	○	○	○	○

SECTION H: BACKGROUND INFORMATION

To help us understand the families who are participating in this study, we would like to ask a few questions about yourself, your family and your household.

	Mother	**Father**	**Other (please tell us)**
28. Are you the child's:	○$_1$	○$_2$	○$_3$ _____

29. Please tell us if your household has had the following items and if not, is it because you couldn't afford it or for another reason.	**Yes**	**No, Cannot afford**	**No, other reason**
a. Does your household eat meals with meat, chicken, fish (or vegetarian equivalent) at least every second day?	○	○	○
b. Does your household have a roast joint (or its equivalent) at least once a week?	○	○	○
c. Do household members buy new rather than second-hand clothes?	○	○	○
d. Does each household member possess a warm waterproof coat?	○	○	○
e. Does each household member possess two pairs of strong shoes?	○	○	○
f. Does the household replace any worn out furniture?	○	○	○
g. Does the household keep the home adequately warm?	○	○	○
h. Does the household have family or friends for a drink or meal once a month?	○	○	○
i. Does the household buy presents for family or friends at least once a year?	○	○	○

Please fill in the circles like this ● or ⊗.

30. With how much difficulty or ease does your family make ends meet?					
With great difficulty	**With difficulty**	**With some difficulty**	**Fairly easily**	**Easily**	**Very easily**
○	○	○	○	○	○

31. Think back to when you were 16 years old, with how much difficulty or ease did your family at the time make ends meet?					
With great difficulty	**With difficulty**	**With some difficulty**	**Fairly easily**	**Easily**	**Very easily**
○	○	○	○	○	○

32. Do you live in a	
House	○
Apartment/ flat / bedsit	○
Other, tell us_____	○

33. Which of the following best describes your home?	
Owner occupied (with or without a mortgage)	○
Being purchased from a Local Authority under a Tenant Purchase Scheme	○
Rented from a Local Authority	○
Rented from a Voluntary Body	○
Rented from a Private Landlord	○
Living with and paying rent to your or your partner's parent(s)	○
Occupied free of rent with your or your partner's parent(s)	○
Occupied free of rent from your or your partner's job	○

	English	**Irish**	**Polish**	**Latvian**	**Other (please tell us)**
34. What language do YOU speak most often at home?	○	○	○	○	○ _____
35. What language does YOUR CHILD speak most often at home?	○	○	○	○	○ _____

Please fill in the circles like this ● or ⊗.

36. Which of the following best describes your family?	One Parent	Two Parent	Other (please tell us)
	○	○	○ _____

36.(a) What is the child's mothers occupation? _____

(b) How many hours per week does she work? _____

37. (a) What is the child's father's occupation? _____

(b) How many hours per week does he work? _____

38. What is the mother's highest level of education? Please fill in one answer.	
Primary or less	○ 1
Intermediate/ Junior/ Group Certificate or equivalent	○ 2
Leaving Certificate or equivalent	○ 3
Diploma / Certificate	○ 4
University graduate Degree	○ 5

39. What is the father's highest level of education? Please fill in one answer.	
Primary or less	○ 1
Intermediate/ Junior/ Group Certificate or equivalent	○ 2
Leaving Certificate or equivalent	○ 3
Diploma / Certificate	○ 4
University graduate Degree	○ 5

Thank you very much for your participation.

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	1
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	1
Objectives	3	State specific objectives, including any prespecified hypotheses	1
Methods			
Study design	4	Present key elements of study design early in the paper	2
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	1
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	2
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	2 – 3
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	2 -3
Bias	9	Describe any efforts to address potential sources of bias	*3-4*
Study size	10	Explain how the study size was arrived at	2
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	3
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	3
		(*b*) Describe any methods used to examine subgroups and interactions	3-4
		(*c*) Explain how missing data were addressed	3
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	n/a
		(*e*) Describe any sensitivity analyses	n/a
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	1-2
		(b) Give reasons for non-participation at each stage	2
		(c) Consider use of a flow diagram	n/a
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	2
		(b) Indicate number of participants with missing data for each variable of interest	Tables
Outcome data	15*	Report numbers of outcome events or summary measures	3-4
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	4 and tables
		(*b*) Report category boundaries when continuous variables were categorized	3 and tables
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	4-5
Discussion			
Key results	18	Summarise key results with reference to study objectives	5-6
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	5-6
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	6
Generalisability	21	Discuss the generalisability (external validity) of the study results	6
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	1

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.