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Title	Can population-level variation in early childhood development be measured in a manner that supports service planning and intervention?
Authors	Curtin, Margaret
Publication date	2014
Original Citation	Curtin, M. 2014 Can population-level variation in early childhood development be measured in a manner that supports service planning and intervention? PhD Thesis, University College Cork.
Type of publication	Doctoral thesis
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Download date	2026-11-03 12:59:56
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Can population-level variation in Early Childhood Development be measured in a manner that supports service planning and intervention?

A thesis submitted to the National University of Ireland, Cork for the degree of Doctor of Philosophy in the Department of Epidemiology and Public Health, School of Medicine.

December 2013

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Table of Contents

List of Tables vi
List of Figures viii
Glossary iix
Declaration x
Declaration of Authorship xi
Acknowledgements xii
Thesis Abstract xiii
CHAPTER 1: BACKGROUND 1
1.1 Early childhood development 2
1.2 Why is early childhood development important? 3
1.3 Perspectives on child development 3
1.4 Ecology of early childhood development 4
1.4.1 Microsystems 5
1.4.2 Mesosystems 6
1.4.3 Exosystems 6
1.4.4 Macrosystems 7
1.4.5 Chronosystems 7
1.5 Life course theory 7
1.5.1 Resilience and vulnerability 8
1.6 Population health 8
1.7 Measurement of early childhood development 9
1.8 Early childhood development in Ireland 11
1.8.1 Cork City 13
1.9 Aims and objectives 15
CHAPTER 2: LITERATURE REVIEW 18
2.1 Introduction 19
2.2 Search strategy 19
2.2.1 Inclusion criteria 20
2.2.2 Exclusion criteria 20
2.3 Background to the EDI 20
2.3.1 Vulnerability 22

2.4 Findings from literature review 22
2.5 Psychometric properties of the EDI 25
2.5.1 Psychometric theory 25
2.5.2 Psychometric analysis of the EDI using traditional approaches 29
2.5.3 New psychometric methods 32
2.5.4 Rasch analysis of the EDI 34
2.6 Implementation of the EDI 35
2.6.1 Populations at risk of poor developmental outcomes 36
2.6.2 Spatial variation 37
2.6.3 Neighbourhood-level variation 37
2.6.4 Family context 39
2.6.5 Children with special educational needs 40
2.6.6 Economic effects of developmental vulnerability 40
2.6.7 Evaluation studies 41
2.7 Summary and gaps in the literature 55
CHAPTER 3: DETERMINANTS OF VULNERABILITY IN EARLY CHILDHOOD DEVELOPMENT IN IRELAND – A CROSS-SECTIONAL STUDY 57
3.0 Abstract 58
3.1 Background 59
3.2 Methods 60
3.2.1 Measurement of child development - the EDI 61
3.2.2 Parental Questionnaire 63
3.2.3 Data collection 63
3.2.4 Developmental scoring 64
3.2.5 Explanatory variables 65
3.2.6 Data analysis 65
3.3 Results 66
3.3.1 Distribution of domain scores (mean and standard error) 68
3.3.2 Factors associated with vulnerability 70
3.3.3 Logistic regression 71
3.3.4 Population attributable fraction 72
3.4 Discussion 72
3.4.1 Limitations 74
3.4.2 Policy Implications 74

CHAPTER 4: PROVIDING POPULATION-LEVEL DATA TO SUPPORT POLICY AND PRACTICE FOR HEALTHY CHILD DEVELOPMENT – THE ROLE OF THE EARLY DEVELOPMENT INSTRUMENT 77
4.0 Abstract 78
4.1 Background 79
4.2 Methods 80
4.2.1 Measurement of child development - the EDI 80
4.2.2 Data collection 81
4.2.3 Developmental scoring 81
4.2.4 Explanatory variables 82
4.2.4.1 Area-level disadvantage 82
4.2.4.2 School level disadvantage 82
4.2.5 Data analysis 83
4.3 Results 84
4.3.1 Vulnerability 84
4.3.2 Univariate analysis 85
4.3.3 Logistic regression 87
4.3.4 Multi-level model 89
4.3.5 Population attributable fraction (PAF) 89
4.4 Discussion 92
4.4.1 Limitation 94
4.4.2 Conclusion 94
CHAPTER 5: ARE THE SPECIAL EDUCATIONAL NEEDS OF CHILDREN IN THEIR FIRST YEAR IN PRIMARY SCHOOL IN IRELAND BEING IDENTIFIED – A CROSS-SECTIONAL STUDY? 96
5.0 Abstract 97
5.1 Background 99
5.1.1 The Early Development Instrument 100
5.2 Methods 101
5.2.1 Data collection 102
5.2.2 Ethics Statement 102
5.2.3 Parental Questionnaire 102
5.2.4 Independent Variables 103
5.2.5 Dependant variables 105
5.2.6 Data analysis 107
5.3 Results 107
5.3.1 Developmental vulnerability 108

5.3.2 Mean scores for each group 108
5.3.3 Impairment (specific problems) 111
5.3.4 Social Gradient 111
5.3.5 Services accessed 113
5.4 Discussion 114
5.4.1 Limitations 116
5.4.2 Conclusion 116
CHAPTER 6: THE EARLY DEVELOPMENT INSTRUMENT: AN EVALUATION OF ITS FIVE DOMAINS USING RASCH ANALYSIS 117
6.0 Abstract 118
6.1 Background 119
6.1.1 The Rasch model 121
6.2 Methods 122
6.2.1 The Early Development Instrument 123
6.2.2 Data collection 124
6.2.3 Scoring methods 124
6.2.4 Data analysis 125
6.2.5 Scale to sample targeting 125
6.2.6 Overall fit to the Rasch model 125
6.2.7 Analysis of individual items 126
6.2.8 Differential item functioning 127
6.3 Results 127
6.3.1 Descriptive statistics 127
6.3.2 Scale to sample targeting 128
6.3.3 Overall fit to the Rasch model 131
6.3.4 Analysis of individual items 133
6.3.5 Differential item functioning 139
6.4 Discussion 147
6.4.1 Physical health and well being 147
6.4.2 Social competence 147
6.4.3 Emotional maturity 148
6.4.4 Language and cognitive development 148
6.4.5 Communication skills and general knowledge 148
6.4.6 Limitations 151
6.4.7 Conclusion 152

CHAPTER 7: DISCUSSION 153
7.1 Summary of main findings 154
7.2 Limitations 159
7.3 Implications for research in early childhood development 160
7.4 Implications for policy and programme development in Ireland 162
7.5 Conclusion 164
REFERENCES 165
Appendix 1: Early Development Instrument teacher-filled questionnaire 177
Appendix 2: Parental Questionnaire 185
Appendix 3: Parental information letter 194
Appendix 4: Participant flow chart for whole study 197
Appendix 5: Ethical approval letter 198
Appendix 6 : Domains, sub-domains and questions on the EDI 199
Appendix 7: Level of vulnerability by area of risk 201
Appendix 8: Research dissemination 203
Appendix 9: School feedback form 205

List of Tables

Table 1: Outline of the papers included in the literature review 42

Table 2: Child development outcomes measured by the EDI 62

Table 3: Comparison between sample for whom parental data was or was not available 68

Table 4: Factors associated with developmental vulnerability 70

Table 5: Logistic Regression predicting odds of vulnerability on EDI Scores 71

Table 6: PAF for vulnerability based on OR adjusted for all other variables 72

Table 7: Mean domain scores at child, school and area level 86

Table 8: Univariate analysis and logistic regression predicting the odds of developmental vulnerability on EDI scores 88

Table 9: Comparison of odds ratios resulting from logistic regression and multi-level model..... 89

Table 10: Population attributable fraction for vulnerability based on OR adjusted for all other variables..... 90

Table 11: Logistic regression to determine the likelihood of vulnerability by each domain of development..... 91

Table 12: Demographic characteristics and mean scores on each EDI domain by Special Needs or Needs Further Assessment..... 108

Table 13: Difference in Mean Scores between Groups 106

Table 14: Type of Impairment among children with Special Needs or Needing Further Assessment 108

Table 15: Services accessed (based on parental reports)..... 109

Table 16: Descriptive statistics for each scale 124

Table 17: Summary of EDI scale fit to the Rasch model 132

Table 18: Ordered item locations, fit residuals and probabilities for the physical health and well-being scale 134

Table 19: Ordered item locations, fit residuals and probabilities for the social competence scale 135

Table 20: Ordered item locations, fit residuals and probabilities for the emotional maturity scale 136

Table 21: Ordered item locations, fit residuals and probabilities for the language and cognitive development domain 137

Table 22: Ordered item locations, fit residuals and probabilities for the communication skills and general knowledge scale 138

List of Figures

Figure 1: Bronfenbrenner's Ecology of Child Development 5
Figure 2 Population health approach 9
Figure 3: Child poverty rates in Ireland before and after taxes and transfers 12
Figure 4: Overview of aims, objectives and chapters 17
Figure 5: Outline of study types included in the literature review 24
Figure 6: Countries throughout the world where the EDI has been implemented . 35
Figure 7: Participant flow chart 67
Figure 8: Distribution of scores across all five domains of development 69
Figure 9: Map of vulnerability in city Electoral Division 95
Figure 10: Special Needs Designation..... 104
Figure 11: Mean domain scores by special needs status 109
Figure 12: Percentage of children requiring further assessment by Deprivation Quintile 111
Figure 13: Person-item threshold distribution for the physical health and well-being scale 128
Figure 14: Person-item threshold distribution for the social competence scale 129
Figure 15: Person-item threshold distribution for the emotional maturity scale...130
Figure 16: Person-item threshold distribution for the language and cognitive development scale 130
Figure 17: Person-item threshold distribution for the communication skills and general knowledge scale 131
Figure 18: Gender DIF for physical health and well-being (item 3 and item 9) 136
Figure 19: Gender DIF for social competence scale (items 4, 7 and 18) 141
Figure 20: Gender DIF for emotional maturity scale (items 1, 5, 6, 10, 12, 15, 17, 18, 20) 143
Figure 21: Gender DIF for language and cognitive development scale 146

Glossary

Abbreviation	Definition
AEDI	Australian Early Development Index
ANOVA	Analysis Of Variance
BC	British Columbia
BMC	BioMed Central
BMJ	British Medical Journal
CCT	Classical Test Theory
CI	Confidence Interval
CICD	Community Index of Childhood Development
CSO	Central Statistics Office
DCYA	Department of Children and Youth Affairs
DEIS	Delivering Equal Opportunity In Schools
DIF	Differential Item Functioning
DOH	Department of Health
ED	Electoral Division
EDI	Early Development Instrument
EPSEN	Education of Persons with Special Educational Needs
ESL	English as a Second Language
FSA	Foundation Skills Assessment
GDP	Gross Domestic Product
HLM	Hierarchical Linear Modelling
ICC	Intra-Class Correlation
ICE	Index of Concentration at the Extremes
ICF	International Classification of Functioning
ID	Identification Number
ISRAD	Index of Relative Socio-economic Advantage and Disadvantage
LSAC	Longitudinal Study of Australian Children
NCSE	National Council for Special Education
OECD	The Organisation for Economic Co-operation and Development
OMCYA	Office of the Minister for Children and Youth Affairs
OR	Odds Ratio
PAF	Population Attributable Fraction
PPVT	Peabody Picture Vocabulary Test
PSI	Person Separation Index
SAHRU Index	National Deprivation Index for Health and Health Service Research
SD	Standard Deviation
SEIFA	Socio-Economic Indicators For Areas
SES	Socio-Economic Circumstances
SII	Slope Index of Inequality
SLAN	Study of Lifestyle, Behaviour and Nutrition in Ireland
SN	Special Needs
UNICEF	United Nations Children's Fund

Declaration

I declare that this thesis has not been submitted as an exercise for a degree at this or any other University. The work, upon which this thesis is based, was carried out in collaboration with a team of researchers and supervisors who are duly acknowledged in the text of the thesis. The library may lend or copy this thesis upon request.

Signed: _____ Date: _____

Declaration of Authorship

The candidate has taken responsibility for all aspects of the work presented in the thesis from its inception. This research was carried out under the direction of the candidate's PhD supervisors Professor Ivan Perry and Professor Anthony Staines. Data collection and entry was conducted by the candidate with assistance from two Masters students.

All data were analysed by the candidate with two exceptions. The Population Attributable Fractions in Chapter 3 were analysed by Jamie Madden of the Department of Epidemiology and Public Health, UCC. Subsequent Population Attributable Fractions were calculated by the candidate. Professor John Brown conducted the RASCH analysis and assisted with the interpretation of the Rasch findings.

Acknowledgements

I would like to sincerely thank my supervisors, Professor Ivan Perry and Professor Anthony Staines for you support and encouragement. Thank you, Ivan for guiding me to a topic that suited me so well and for keeping me on track with your words of wisdom. Thank you Anthony for always steering the work in the right direction and knowing exactly what was needed. It was a privilege to work with you both.

I would also like to thank Professor John Browne for helping and supporting me through the process of Rasch analysis. Thank you to Denise Baker for helping me with data collection and entry; for travelling around the schools with me and for your passion for supporting children with disabilities. Thank you to Magdalena Janus, Eric Duku and all the team at the Offord Centre for making me so welcome and for offering continued support and encouragement.

Thank you to the School Principal and Teachers for engaging in the study with such enthusiasm. Thanks also to Health Intelligence Ireland for allowing me to use the Health Atlas.

Thank you to my colleagues, especially 'our pod' for all your help and support. And Maria, thank for always listening with such patience.

A very special thank you to my wonderful parents and parents-in-law for always being there. Your support and back-up made this possible.

To Lena, Tomàs, Lydia and Maria, thank you for being all a mother could ever ask for.

Finally, to Jim, the love of my life, how can I ever thank you. You believe in me, support me and care for me. You share the bad days and the good days. I could never have done this without you. Thank you.

Thesis Abstract

Background

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

- To conduct a comprehensive literature review of all published studies in which the EDI was used;
- To examine associations between EDI scores and indicators of child well-being at the individual, family, school and area level;
- To assess the potential use of the EDI in informing early childhood support services by identifying areas where additional supports are needed;
- To assess the validity/feasibility of using the EDI as a measure of population-level variation in early childhood development in the Irish context.

Methods

A cross-sectional study was conducted in 42 out of 47 primary schools in a major Irish urban centre (Cork city) and a further five schools in a neighbouring rural area in 2011 using the EDI and a linked parental questionnaire. EDI (teacher completed) scores were calculated for 1,344 children in their first year of full-time education. Those scoring in the lowest 10% of the sample population in one or more domains were deemed to be 'developmentally vulnerable'. Data were also collected on age, gender, language status, pre-school attendance, special needs status and area of residence. Scores were correlated with contextual data from the parental questionnaire and with indicators of area and school-level deprivation. Logistic regression and population attributable fractions were used to identify factors strongly associated with developmental vulnerability. Mean developmental scores of children with special needs and those deemed by the teachers to be in need of

assessment were compared using one-way ANOVA. Rasch analysis was used to determine the validity of the EDI in the Irish population.

Results

Over one quarter (27.5%) of all children in the study were developmentally vulnerable. This was consistent with findings from urban areas in Canada, supporting the transferability of the instrument from the Canadian to the Irish context. Four separate but related papers emerged from the study.

Individual characteristics associated with increased risk of vulnerability were: being male; being under 5 years of age; and having English as a second language. 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.

The geographical distribution of vulnerability scores illustrated the value of a child-specific population-level indicator. Vulnerability did not follow the area-level deprivation gradient as measured by a composite index of material deprivation. Non attendance at pre-school and attending a school with a designated disadvantaged status were both associated with increased risk of vulnerability, which supports current national policy on inclusive education.

Children with special needs had lower mean scores than typically developing children in all five developmental domains. Children considered by the teacher to be in need of assessment also had lower scores, which were not significantly different from those of children with a clinical diagnosis of special needs. This illustrates the value of teacher observation in identifying children in need of additional support, particularly when those children do not have a diagnosable disability.

Finally, the study endorses the overall fit of the EDI to the Rasch model. However, it points to a number of issues which will have to be addressed. If the EDI is to be

implemented at a national level in Ireland, it would benefit from further refinement which could in turn inform the international implementation of the EDI.

Conclusion

This thesis provides a unique snapshot of early childhood development in Ireland. 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.

CHAPTER 1: BACKGROUND

1.1 Early childhood development

Early childhood development refers to the rapid growth and change that takes place during the critical period in human life between conception and age six. During this time the central nervous system is developing and the child is gaining the basic skills and competencies which will be necessary throughout life.[1]

Before birth the child's neurosystem is pre-programmed to develop various skills and neuropathways. During the first six years of life these neurosystems develop in response to external physical and social stimuli.[2] The extent to which healthy development takes place is thereby influenced by the environment to which the child is exposed.[3] Early childhood development is a multi-dimensional construct referring to the physical, social, emotional and cognitive health and well-being of the developing child.

Child development is synonymous with child health.[4] The American National Research Council and Institute of Medicine, finding adult-orientated definitions of health inadequate, proposed the following definition of child health:

"the extent to which individual children or groups of children are able or enabled to (a) develop and realize their potential, (b) satisfy their needs, and (c) develop the capacities that allow them to interact successfully with their biological, physical, and social environments." (pg4, Committee on Evaluation of Children's Health)[5]

This definition moves child health beyond a focus on the presence or absence of disease to a positive focus on supporting children to achieve their full developmental potential and has implications for how we conceptualise and measure child health and well-being.[6]

1.2 Why is early childhood development important?

Worldwide, ten million children under the age of five die annually and a further 200 million children do not achieve their full developmental potential.[7] This is most pronounced in low and middle-income countries. Yet even in high-income countries, despite unprecedented economic growth and technological development in the past fifty years, many children and young people have unacceptably poor health and social outcomes. Keating and Hertzman[8] describe this as 'Modernity's Paradox'. Moreover, the gap between children from lower and upper income families is widening,[9] with children from poorer backgrounds doing less well in school and entering into an inter-generational cycle of reduced employment opportunities, higher fertility and health inequalities.[10]

1.3 Perspectives on child development

Modern research on child development began with the '*baby biographies*' in the 19th century. Charles Darwin among others documented in detail the developmental progress of his own children.[11] These records are criticised as emotional and biased, yet they are recognised for their accuracy in depicting the developing child.[12]

It was only in the 20th century that childhood was recognised as a unique and important stage in human life. Child care, protection, education and health were given attention in the legal and policy domain. Moreover, theories of child development expanded from a variety of disciplines.[13] These included psychology, medicine, education and sociology.

The biological process of child development was first outlined by Gesell in the early part of the 20th century.[14] He systematically documented the various stages of development as linear, pre-determined and progressive. This biological underpinning is still used today to assess the extent to which children are following the expected developmental trajectories. However, this process was understood as

biologically determined and any deviation from the normal developmental trajectory was seen as the result of a deficiency in the individual child's biological make-up.[13]

While Gesell believed strongly that child development was a purely biological process, advocates of the 'behaviourist' approach placed child development in the context of the nurturing environment thus fuelling a nature-nurture debate.[13] It was not until the advent of Piaget's work in the 1950s and 1960s that the inter-related nature of biological and environmental factors in child development was discussed. Piaget's theory of cognitive development put forward the idea that children did indeed develop in particular stages but that these were influenced by the child's interaction with the world around them.

These theories illustrate the complexity of the process of child development. It is now recognised that a complex interplay between genetic makeup and environmental factors influences development in the first five years of life [15] with the early years environment, stimulation and relationships all having a direct impact.[16] Indeed, it is not only brain development that is affected by the early environment but multiple organs, resulting in what is termed as 'biological embedding'[17] which sets conditions for future cardiovascular and metabolic health.[18]

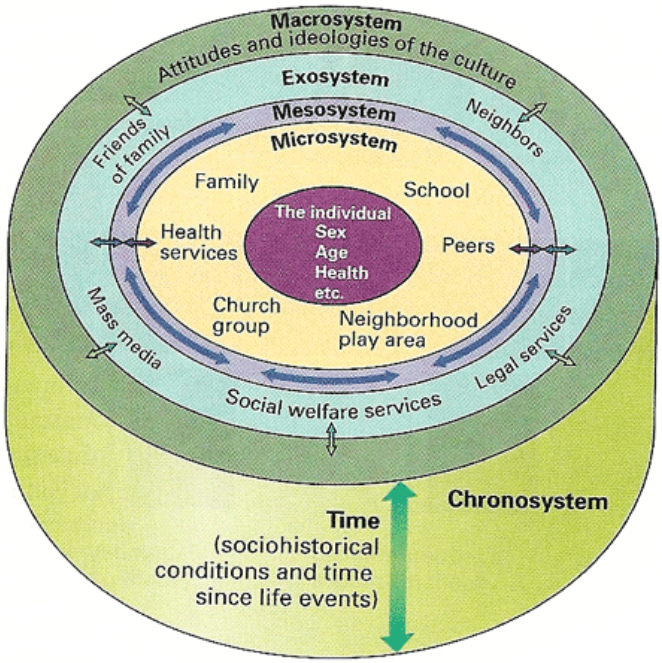
Of particular interest in this study are the factors that impact on early childhood development and the resulting outcomes in terms of life-long health and well-being. From this perspective three key frameworks are relevant to this study namely: ecological theory; the life-course perspective; and population health.

1.4 Ecology of early childhood development

Children's development is strongly influenced by environmental factors. Urie Bronfenbrenner's ecological theory explores the impact of context on child development and outlines the complex interconnectedness between the child's

intimate environments, social relations and the broader social, economic and cultural setting.[19] He describes this environment as consisting of inter-related systems: Microsystems, Mesosystems, Exosystems and Macro-systems.

Figure 1: Bronfenbrenner's ecology of child development



Source: Bronfenbrenner 1979

1.4.1 Microsystems

These are the immediate environments that the child experiences first-hand. They include the physical, social and emotional circumstances that support or impede children in developing their full potential. In the early years, the care-giver/child relationship is a crucial aspect of this environment. Nurturing relationships with family, school and peer-groups all play a role.[19]

Within the microsystem, influences can be viewed in terms of structure and process.[20] Structural influences include the impact of family socio-economic circumstances on child development which in which a social gradient is very evident.[21-23] Other structural effects include parental education[24] and household composition, with children from lone-parent families doing less well.[25-26]

Family processes play a crucial role in mitigating the effects of socio-economic circumstances.[27] In particular, parenting is seen as a key factor[28-30] as is the home learning environment[31-32] and positive parent/child interaction such as storytelling.[33-35] As a result, many early intervention programmes with low-income families focus on parenting.[36]

Other settings which influence child development include childcare and education.[37] These are also seen as opportunities for intervention in promoting healthy development.[38]

1.4.2 Mesosystems

The mesosystems are the links between the various elements of the microsystem. Of particular relevance are the links between the home and school (or childcare) environments.[39] Indeed, a key element in the delivery of quality childcare is the strength of the communication between parents and childcare providers.[40]

1.4.3 Exosystems

The exosystems are outside settings which are not directly related to the child but nonetheless impact on their development (for example, the parents' place of work).

The neighbourhoods into which children are born and/or live are exosystems which have also been researched extensively. Neighbourhood effects literature outlines the characteristics of neighbourhoods which are conducive or otherwise to healthy child development.[41-42] 'Neighbourhood' generally refers to a geographical area with boundaries such as census tracts often used as proxy for neighbourhood boundaries.[30] Jencks and Mayer[43] identified five mechanisms through which neighbourhoods theoretically affect child outcomes namely: neighbourhood resources; collective socialisation; contagion; competition; and relative deprivation. These mechanism are mediated by family characteristics and processes.[44]

1.4.4 Macrosystems

These refer to the overarching socio-cultural systems in which the microsystems, mesosystems, and exosystems are located and which provide the norms and values that inform each of the systems.[45]

1.4.5 Chronosystems

These refer to an additional dimension – the passage of time. This does not just refer to the child's age but also to the time-sensitive effects across all of the other systems and the effects of changes and events in the environment in which the child lives.[46] Indeed, it was the study of the impact of major historical events such as the Great Depression and World War 2 on child outcomes in longitudinal studies that led to life course theories on child development.[47]

1.5 Life course theory

Birth cohort studies implemented in a number of countries have made a major contribution to our understanding of the impact of early childhood development throughout the life span.[48] As a result, it is clearly documented that early childhood environments and experiences have an impact on health throughout life.[49] Loving supportive environments where children can play and learn, speak and listen to others without fear or excessive punishment are crucial for long-term health.[50] Three key pathways or mechanisms by which this impact occurs have been identified:

Latent effects: There are sensitive periods of brain development which, if missed, cannot be easily altered in later life. If circumstances in early life are not conducive to particular aspects of human development taking place, the effects are lifelong, regardless of intermediate life events.

Pathway effects: Events in early life are not discrete but have a knock-on effect on subsequent life experiences leading to a pathway or series of

events. Therefore, early adverse events lead to on-going problems which in turn lead to poorer outcomes and conditions.

Cumulative effects: adverse outcomes are not the result of a discrete event but are due to an accumulation of on-going circumstances which, if taken individually are not that exceptional. However, it is the extent and depth of the experience of early deprivation that has a graded effect on later outcomes.[51]

1.5.1 Resilience and vulnerability

Children adapt to meet the pressures of the early environment. Within a life course perspective, resilience and vulnerability are the opposite poles of a continuum with resilience representing a positive and vulnerability a negative adaptation in response to particular environmental triggers. Vulnerability is often expressed in behavioural and psycho-social responses to the environment.[49]

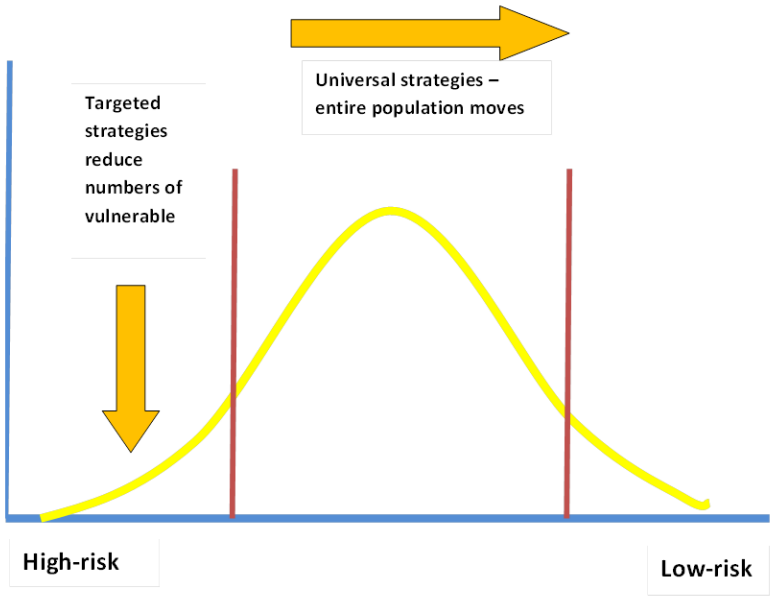
1.6 Population health

Population health is concerned with identifying and addressing the health outcomes of specific population groups. Rose[52] observed that there is a difference between the factors which affect an individual's chances of getting a disease and those which contribute to the incidence of that disease within society. A population health strategy aims to reduce the burden of risk within a society by addressing factors which, though of little immediate benefit to the individual, positively shift the distribution of the health outcome.[53]

Of particular interest to population health is the social gradient. Even in high income countries, society is graded with those on the higher end of the social hierarchy living longer and experiencing better health than those at the lower end. This gradient is persistent despite changes in absolute levels of health.[54]

Child development is both socially determined and a social determinant of health.[55] Early childhood development differs from adult health in the extent and manner in which it is influenced by the environment.[6] The social gradient is also very evident and child development is predictive of later health outcomes. Moreover, the relatively large numbers of children with less-pronounced developmental risk are a potentially greater burden to society than a small number of children at high risk.[56]

Figure 2: Population health approach



1.7 Measurement of early childhood development

If early childhood development is to be seen as a population-level construct, then appropriate epidemiological measures are required to ascertain the level of risk across population groups.[57] However, child development is generally measured as a diagnostic which aims to identify children at greatest risk and provide appropriate individual care. Consequently, there is a dearth of research evidence on which to build population level-strategies.[58]

Child development is also a dynamic process which changes rapidly over time, leading to the need for measurements that are specific to a particular phase of development. As a result, adapting adult level measures is not appropriate.[59]

The majority of measures of child development have been advanced by psychologists and educationalists and are clinically based.[60] Bronfenbrenner describes the perceived over-emphasis on experimental design in psychological experiments as 'the strange behaviour of children with strange adults for the briefest period of time'(pg 513).[45]

Child development, with its emphasis on the multiple facets of physical, social, emotional, and intellectual abilities, is a multi-disciplinary concept.[60] However, child development outcomes have largely been measured in terms of cognitive ability, behavioural difficulties and school test scores. Inadequate attention is paid to the physical, social and emotional development of the child.[61] In line with a broader understanding of child development appropriate tools are needed to accurately capture its multi-faceted nature.[60] In a review of seven commonly used measures of child development, Janus and Offord[62] found that only two placed any emphasis on the child's social and emotional development while none took account of the child's ability to interact appropriately with peers and adults. Moreover, all instruments needed to be administered by a trained professional who would not be familiar with the child's usual behaviour. This also made the cost of administering the tests on a large scale prohibitive.

The Early Development Instrument (EDI) and its Australian adaptation, the Australian Early Development Index (AEDI), are the only instruments specifically designed and psychometrically tested as a population-level measure of child development across five domains of development.[6] The EDI was initially developed as a measure of school readiness[62] but is recognised as a valuable instrument for monitoring the developmental status of populations of children at a neighbourhood, regional and national level, thereby, assessing the effectiveness of

early childhood support at the macro-level.[16] This study is primarily concerned with the utility of the EDI in the Ireland.

1.8 Early childhood development in Ireland

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.[63] There are five major urban centres, namely: Dublin; Cork; Limerick; Galway and Waterford. While all of these centres are comprised of areas of concentrated affluence and disadvantage, they all have similar overall rates of key socio-economic indicators including unemployment, lone-parent families and education.[64]

Ireland has a total population of 421,266 children aged five or under. The child mortality rate in 2011 was 3.4 per 10,000. A minority (1.2%) of Irish children are members of the Traveller Community. Moreover, 18.8% of children are considered at risk of poverty and 9.3% live in consistent poverty.[65]

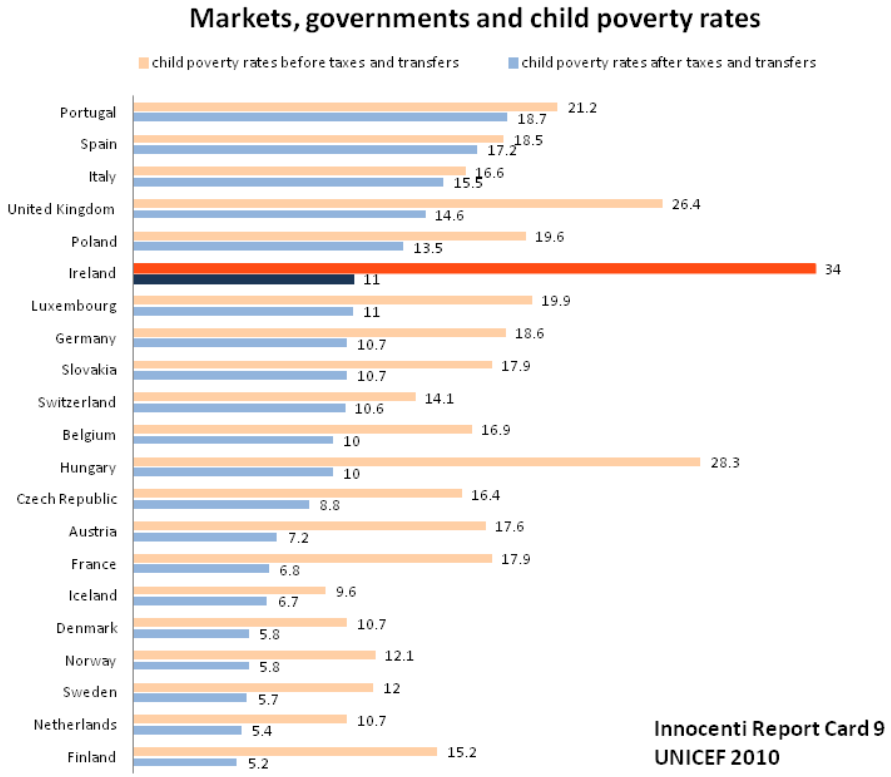
The education system is consistent throughout the country, with all schools adhering to nationally-defined curriculum and standards. Most children in Ireland start school when they are four or five years of age. However, attendance at primary school is not mandatory until a child reaches their sixth birthday. The primary school cycle is eight years' long. The first two years are referred to as 'Junior and Senior Infants'. During these years, children attend school for an hour less than the usual school day.

During the boom years, 1998 to 2007, supports to families with young children were primarily in the form of direct payments. The provision of quality early years services was seen as primarily the remit of the private sector. Indeed in 2008 Ireland ranked lowest in 25 OECD countries in terms of the quality of early years service provision.[66] Moreover, the level of direct provision to families masked an unacceptably high level of child poverty.[67] This is significant as dependence on

social welfare is not conducive to health child development and also in the current financial climate this level of payment is not considered sustainable.

Currently in Ireland there is a policy shift, with regard to the early years, from a reliance on direct payments to parents to an emphasis on providing quality integrated services. Significant investment is being made in developing a high standard of accessible child care. Moreover, the introduction of the free pre-school year in 2011 and a focus on quality curriculum development should enhance child development outcomes. The introduction of a full cabinet-led Department of Children and Youth Affairs in 2011 has formalised the multi-dimensional nature of policy on children by drawing together in one ministry elements of education, justice and health.[68]

Figure 3: Child poverty rates in Ireland before and after taxes and transfers



1.8.1 Cork City

The current study was conducted in Cork city which is situated on the south coast of Ireland. According to the 2011 census the population of Cork is 119,230, a drop of 0.4% since the previous census in 2006. The population of pre-school children (age 0 to 4) is 6,042 or 3% of the total city population.[69]

Cork city is the fifth most disadvantaged local authority area in Ireland. Similarly to other cities in Ireland, Cork is comprised of areas of both relative affluence and deprivation. The most affluent areas are located towards the East and West of the city, while the South, and particularly the North are considerably more disadvantaged. The city is composed of 74 Electoral Districts. Of these, three are categorised as 'extremely disadvantaged', fourteen as 'very disadvantaged' and a further six as 'disadvantaged'.[70]

In total, 12% of households are headed by a lone parent (this is the same as the figure for Ireland as a whole). However, the percentage of lone parent households is significantly higher in areas of greater disadvantage [71]. Of those aged 15 years or older who have ceased full-time education, 18% have primary level education only and 30% had a third level qualification. In the national survey of lifestyle, attitudes and nutrition (Slan), 1% of those surveyed in Cork city reported severe lack of social support and 74% felt that the people in their neighbourhood could be trusted.[72]

A total of 12.7% of the population of Cork city are non-national according to the 2011 census. The majority of these are Polish (3,648) followed by UK nationals (1,984). Twelve percent of the population speak a language other than English. Of children age 0 to 14, 2% are members of the traveller community.[63]

In 2013, there were 247 people seeking asylum in Ireland, resident in the Kinsale Road direct provision centre in Cork. Of these 26 were under four years of age and a further 33 were aged between 5 and 12 years. People seeking asylum in Ireland are accommodated in direct provision centres where they are provided with

accommodation, food and basic supplies. Personal allowances of €19.10 per adult and €9.60 per child are paid. Those seeking asylum are not permitted to work. In total 64% of residents of the Kinsale Road direct provision centre had been living in direct provision for more than three years, of whom 16% had been in direct provision for more than seven years.[73]

The primary education and pre-school system in Cork is consistent with that elsewhere in the country. There are 52 primary schools in the city. The pupil teacher ratio for 2012/13 was 23.4 children per teaching teacher which is comparable to the national average of 24.7. Attendance at primary school is very good with only 10% of children absent for 20 or more days. Almost half (43%) of all children aged between 5 and 12 walk to school. [72]

In Ireland there is no population-level measure of early childhood development to inform planning and to track changes over time. Assumptions are made, based on broad area-level deprivation indices, that children in particular deprived areas are at greater risk. However, this does not allow us to identify areas in which populations of children are most likely to be at risk or to measure the impact of area-based interventions. We do not know what area-level factors enhance or impede early childhood development. Moreover, we do not know which domains of early childhood development are affected.

In 2013 the Department of Health launched a new strategy for improving health and well-being in Ireland. As part of the monitoring framework aimed at providing on-going, timely data the strategy outlined the need to ***'Develop a basic child health dataset'*** (Section 6.7 pg 31, Department of Children).[74] This is to be a cross-sectoral effort in partnership with, among others, the Department of Education and Skills and the Department of Children and Youth Affairs. Moreover, one of the performance indicators for addressing health inequalities is to ***'increase the proportion of children reaching a good level of development at age five'*** (pg 35, Department of Children).[74]

In this context, there is a need for a population-level measure of early childhood development which could be adapted for use in the Irish population, yet have the potential for international comparison. This thesis examined the utility of the EDI for such a purpose.

1.9 Aims and objectives

The overall aim of the study was to explore the potential of the Early Development Instrument as an indicator of early development in Ireland.

Specific objectives in support of this aim were:

- To conduct a comprehensive literature review of all published studies in which the EDI was used;

- To examine associations between EDI scores and indicators of child well-being at the individual, family, school and area level;

- To assess the potential use of the EDI in informing early childhood support services by identifying areas where additional supports are needed;

- To assess the validity/ feasibility of using the EDI as a measure of population-level variation in early childhood development in the Irish context.

The thesis examined these aims through a literature review and four papers, all resulting from a cross-sectional study conducted with 1474 children in 2011 using the EDI and a linked parental questionnaire.

Chapter 2 reviews the literature on the origins and development of the Early Development Instrument. Particular attention is paid to papers outlining the psychometric properties of the EDI using traditional and new psychometric

methods. The international implementation of the EDI is examined, outlining how this has deepened our understanding of variation in child development between populations of children and the interaction between child development outcomes and area-level indicators. Gaps in the literature are identified.

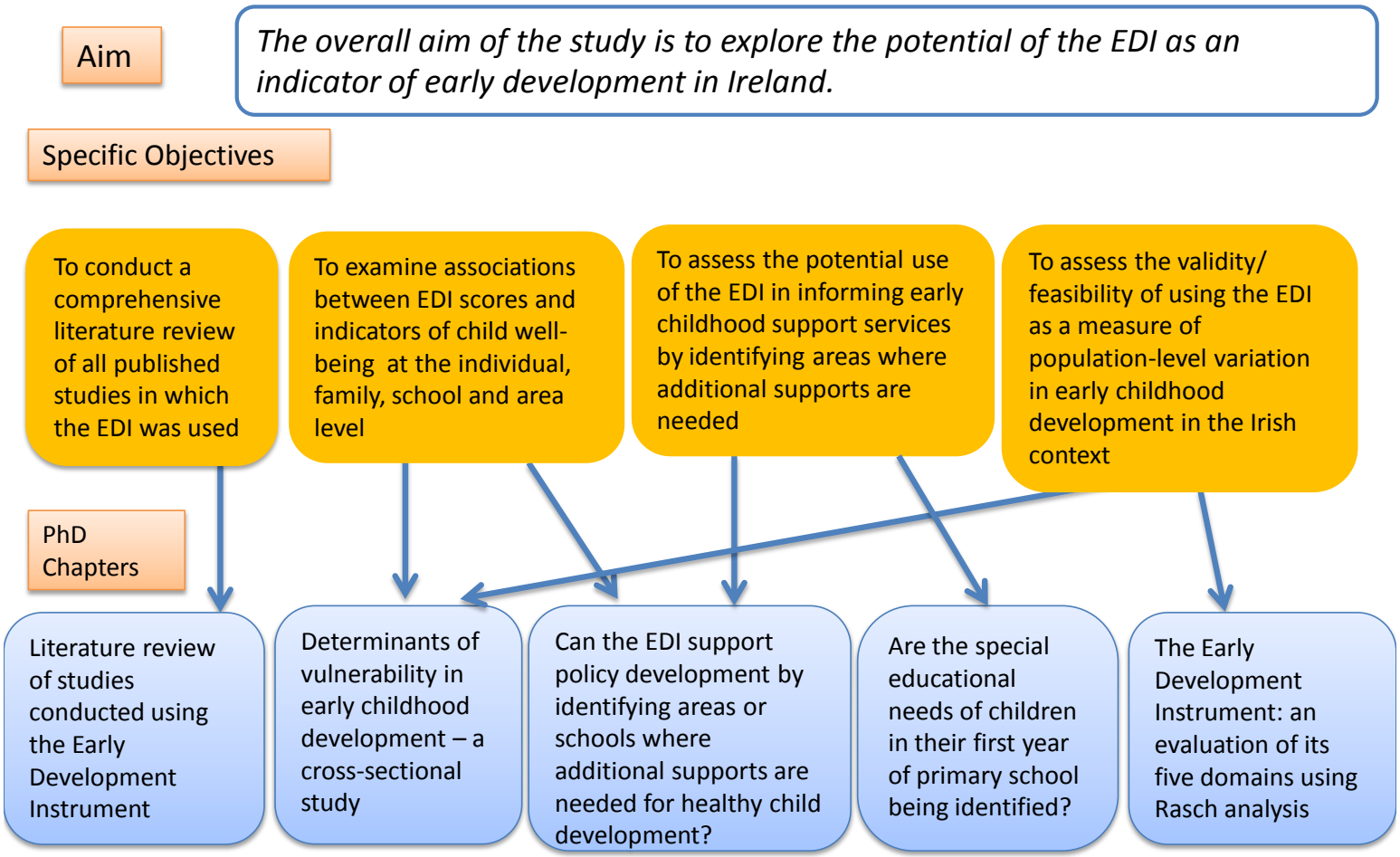
Chapter 3 (Paper 1) explores the determinants of vulnerability in early childhood development in the city population (in order to avoid confounding, data from schools in the rural area were excluded from this paper). The primary aim was to ascertain the proportion of children who were developmentally ready for school in a representative sample of schools in a major urban centre in Ireland using the EDI. The secondary aim was to examine associated factors and population attributable fractions. The study also aimed to assess the feasibility of implementing the EDI and its performance in this setting. This paper was published in the BMJ Open.

Chapter 4 (Paper 2) examines whether the EDI can support policy development by identifying areas or schools where additional supports are needed for healthy child development. The aim of this paper was to explore variation in child development outcomes at school and area level and to examine the implications for policy and practice in early childhood support programmes.

Chapter 5 (Paper 3) examines the situation of children with special educational needs. The aim of this paper was to examine, at a population-level, using EDI data, the extent to which the developmental and special educational needs of children in their first year of formal education have been identified.

Chapter 6 (Paper 4) uses Rasch analysis to build on previous psychometric testing of the EDI. The aim of this paper was to perform a definitive analysis of the psychometric properties of the EDI domains within the Rasch paradigm.

Figure 4: Overview of aims, objectives and chapters



CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The Early Development Instrument (EDI) and its Australian adaptation, the Australian Early Development Index (AEDI), are the only instruments specifically designed and psychometrically tested at an international level as population-level measures of child development across five domains. This review examined all published studies which used either of these instruments. The overall aim of the literature review was to examine the validity and utility of the EDI/AEDI. The specific aims were:

- To access all published, peer-reviewed studies using the EDI or AEDI as an indicator of early childhood development;
- To review the reported psychometric properties of the EDI;
- To examine how and where the EDI has been used internationally and how this has contributed to our understanding of factors which impact on child development at a population level;
- To identify gaps in research using the EDI.

2.2 Search strategy

Using the search terms "Early Development Instrument" and "Australian Early Development Index" the following databases were searched: PubMed; Web of Knowledge; Science Direct; CINAHL; and Psycinfo. The Offord Centre maintains a list of all published studies using the EDI on their web-site and this was also accessed as were the web-sites of both the Human Early Learning Partnership (based in University of British Columbia) and the Australian Early Development Index. This primary search identified 74 articles. These were all read and 38 were included in the review using the following criteria.

2.2.1 Inclusion criteria

Only English-language published (peer reviewed) studies using the Early Development Instrument (full version) or Australian Early Development Index were included.

2.2.2 Exclusion criteria

The following were excluded: review articles; studies using the short version EDI or composite measures not related to validated domains or sub-domains; reports which had not been peer-reviewed; and non-English papers (of which only one was found).

Of those papers excluded, 19 consisted of commentaries, book chapters and opinion papers which, though not directly reviewed, are alluded to and have informed this work.

The 38 papers included in the review are outlined in Table 1 and are numbered 1 to 38 for reference throughout the review.

2.3 Background to the EDI

The EDI was designed at the Offord Centre for Child Studies, McMasters University, Hamilton, Ontario in the late 90s as a population-level measure of early childhood development at school-entry age.[62]

The EDI was initially designed as a measure of school readiness. However, it was based on a broad understanding of the concept of school readiness as a multi-dimensional construct which places emphasis on social, emotional, behavioural and cognitive skills. Specifically, this refers to the child's ability to meet the task demands of school, such as: being comfortable exploring and asking questions; listening to the teacher, playing and working with other children; and remembering and following rules. In essence, it refers to the child's ability to benefit from the educational activities that are provided by the school. Drawing on this concept of

school readiness the EDI measures the extent to which children have attained the developmental maturity necessary to engage in school activities.[75]

Children typically begin school between four and six years of age and this is also the age at which they are emerging from the early development years and entering middle childhood. Therefore, the EDI is a measure of early childhood development outcomes.

The EDI is a community or population-level measure. 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.[53] It can be retrospective, focusing on early childhood development outcomes; or predictive, informing school and child-health programmes.[75]

Extensive piloting and psychometric testing of the instrument was conducted before the instrument was finalised in the 1990s.[76] Questions were refined, some removed and others added until the final version was accepted. The EDI now consists of five domains, sixteen sub-domains and 104 questions. The domains are:

- **Physical health and well-being:** Physical independence; appropriate clothes and nutrition, fine and gross motor skills.
- **Social competence**: Self-confidence; ability to play, get on with others and share.
- **Emotional maturity:** Ability to concentrate; helps others; age appropriate behaviours.
- **Language and cognitive development:** Interest in reading and writing; can count and recognise numbers and shapes.
- **Communication skills and general knowledge:** Can communicate with adults and children; has an appropriate knowledge of the world.

A complete outline of the domains/ sub-domains and related questions is provided in Appendix 6.

The EDI is a teacher-completed questionnaire based on observation of the children over a five to six month period from when they start school to the latter half of their first year of formal education.[75] All children in the school/ area are included. The questionnaire takes approximately 15 minutes per child to complete. There is, therefore, a significant time commitment required from the teacher.

2.3.1 Vulnerability

Children who score below the 10th percentile in any one of the five domains of the EDI are deemed vulnerable. This is because vulnerability in one domain cannot be compensated for by competence in another aspect of development. Moreover, the 10th percentile was chosen because it is above the 3% to 5% cut-off typically used in diagnostic measurement and therefore includes children who may not easily be diagnosed with a particular condition but who nonetheless are experiencing challenges.[77]

2.4 Findings from literature review

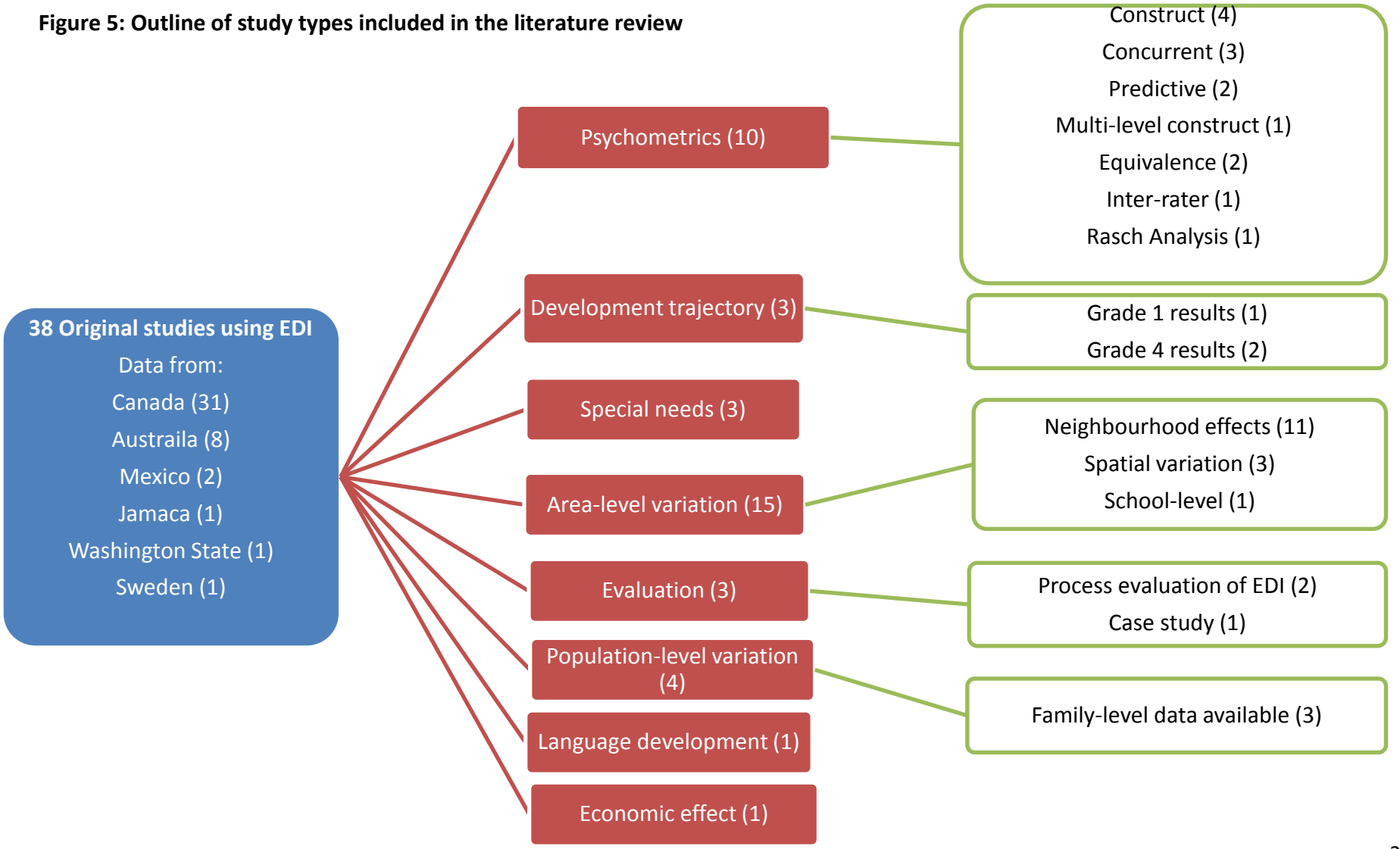
Of the 38 peer-reviewed studies included in the literature review, six used data from Australia only, 28 from Canada only and one from Sweden only. One paper combined data from Canada, Australia and Mexico and another combined data from Canada and Mexico. One paper on the psychometric properties of the EDI combined data from Canada, Australia, Jamaica and Washington State. Of the 28 studies that used Canadian data 18 were from British Columbia and used data collected in various EDI cohorts between 1999 and 2009.

Seven of the studies (1, 9, 12, 17, 21, 26, 38) were published in a special edition of 'Early Education and Development' (Volume 18, Number 3, 2007) on the EDI.[58 78-83] A further four (10, 15, 18, 33) were published in a special edition of 'Social Indicators Research' (Volume 103, Number 2, 2011).[84-87]

A large number of studies (n=15) examined area-level variation in development outcomes. Of those, eleven looked at the effects of neighbourhood-level variables. The other three looked at spatial variation at the level of the school board or state, or used area-level quintiles derived from a composite measure of socio-economic status. A further ten studies examined the psychometric properties of the EDI. Four studies looked at variation between populations of children with three focusing particularly on children with recognised special educational needs. There were three evaluations. One study was concerned with language development and one examined the economic implications of vulnerability on the EDI. The full range of studies included is outlined in Figure 5.

The studies were not uniform in their reporting of EDI outcomes. Some (n=15) reported on mean domain scores while others (n=6) used domain-level vulnerability rates (i.e. children scoring in the lowest 10% in the domain). Only 10 studies examined overall vulnerability rates (i.e. being in the lowest 10% in one or more of the domains of development). Two studies were specifically concerned with the sub-domain level and one study looked at children who scored in the top 10% in two of the five domains. Two studies by the same author used a composite score combining the language and cognitive development and the communication skills and general knowledge domains. Four of the studies on psychometric properties also examined individual items on the EDI questionnaire.

Figure 5: Outline of study types included in the literature review



2.5 Psychometric properties of the EDI

The EDI consists of five domains which are effectively five rating-scales measuring different aspects of developmental health, namely: physical health and well-being; emotional maturity; social competence; language and cognitive development; communication skills and general knowledge. These domains or concepts of developmental health cannot be measured directly and therefore the scales are constructed to measure the manifestations of these 'latent' or hidden traits.

The EDI domains are multiple item scales composed of a mix of dichotomous and polytomous 'items'. Each item or question has two or more responses which are assigned sequential integer scores. The scores from each item are combined to create a score which is a sum of its parts (referred to as the raw score or scaled score). As with all measurement scales the EDI domains seek to place the person on a continuum; in this case, to assess the relative competence of children in each of the five domains of development.

2.5.1 Psychometric theory

Hobart [88] states that if rating scales are to be used as outcome measures they must meet two fundamental requirements:

'evidence that the values produced are actually rigorous measurements and not just numbers; and evidence that the set of items map out the variable they purport to measure' (pg 1094).

These requirements relate to the underlying theory that measurement is achieved by assigning numbers to characteristics or concepts following a set of rules.[89 90] In human terms this refers to attempts to measure aspects of the person. However, certain concepts (e.g. social competence) cannot be measured directly and are

therefore measured indirectly in their imputed effect on actions or behaviours which can be observed (e.g. plays with other children).

Scales should allow for the continuum from less to more of the characteristic being measured and as such allow us to quantify a concept. However, it cannot be assumed that any set of questions can automatically be converted to a scale and thereby a measurement of the underlying concept. In the context of the EDI it is essential to know that the items (questions) chosen do, in fact, provide a balanced measure of each domain. Moreover, while sequential scoring implies that a change in quantity at one end of the scale is the same as a corresponding change at another point in the scale (i.e. a move of one point is the same regardless of its location on the scale) again, this cannot be assumed and is actually unlikely.[91]

The EDI seeks to quantify the concept of healthy child development using five scales and 104 questions. It has been necessary, therefore, to establish the extent to which the questionnaire does meet the requirement of complying with the structure of quantity. To this end, a variety of psychometric tests have been conducted. This review will critically examine the psychometric analysis that has been conducted from the perspective of traditional and new psychometric theory.

Psychometric analysis

Psychometrics emerged as the study of psychological measures but has been more widely applied in a variety of circumstance where rating scales are used. It is generally defined as the analysis of the extent to which quantitative conceptualisation has been operationalised successfully.[92] Whilst there are many methods of psychometric analysis, the most commonly used are traditional methods (which are underpinned by Classical Test Theory) and new methods, (underpinned by latent trait theory, namely, Rasch models and Item Response Theory).[93]

Classical test theory

Classical test theory underpins traditional psychometric methods and is concerned with the way in which errors in measurement can influence scores on rating scales and thereby lead to false deductions.[92] It is based on the idea that there is an observed score (O) which is the summed score on the scale, a true score (T) which is the real score that the person would achieve in the absence of error and the error score.[93] The observed score is the true score plus the error score i.e.

O=T+E

The true score is assumed to be the hypothetical mean score achieved if the test was administered independently and repeatedly to the same person at the same time. The errors are uncorrelated with each other and with the true scores. However, because (T) and (E) are theoretical values and cannot be observed, these key assumptions underpinning the model cannot be tested and are assumed to be true.[92]

Traditional psychometric methods

Traditional psychometric methods are derived from classical test theory and are concerned primarily with evaluating scales in three main properties: reliability, validity and responsiveness. Some traditional methodologies address the cultural and linguistic adaptation of the instrument. Evidence is gathered from correlation and descriptive statistics.[94]

Reliability

Reliability refers to the extent to which the instrument is free from random error. Traditionally this is measured by

- internal consistency - Cronbach's alphas and
- stability - test-retest or inter-rater reliability

Cronbach's alpha is a measure of the extent to which items on a scale measure the same construct. It is calculated from the correlation of the test to itself. The correlation is then squared and subtracted from one to produce an index of measurement error.[95] Test-retest reliability refers to the extent to which the same

results are obtained when the same rater uses the same instrument in the same conditions. Whereas, inter-rater reliability refers to the extent to which two or more raters obtain the same results in the same conditions.

Validity

Validity refers to the extent to which the instrument measures what it is supposed to measure. Reliability can be considered an aspect of validity - an instrument can measure a construct reliably but this is not sufficient if it does not measure what it is supposed to measure. Traditional tests of validity are

- content-related - expert reports on utility and comprehensiveness, and
- construct related – logical relations with other instrument

Responsiveness

Responsiveness is also referred to as sensitivity and refers to the instrument's ability to detect change. Traditional tests of responsiveness include change scores (effect size, or standardised response means). Longitudinal data are used to compare groups which should have changed with those who should not.[94]

Equivalence

Traditional psychometric measures are also concerned with the cross-cultural adaptation of the instrument particularly the conceptual and linguistic equivalence in different cultures and languages.

Limitations

Limitations emerge with traditional psychometrics because the underlying assumptions of classical test theory cannot be tested i.e. true scores and error scores are hypothetical values. There are, however, a number of other limitations. Traditional tests are sample-dependant and describe the data from a single administration. The results would be different for another group of people. As a result, the adequacy of the instrument is dependent on the sample and it is not possible to separate the people from the measures.[92]

Moreover, psychometric tests based on classical test theory treat the ordered scores emerging from rating scales as interval-level measures with the distance between scores being equal across the continuum. However, the relationship between reality and the scores is often non-linear and the assumption of linearity may lead to bias in statistical analysis.[91] In practical terms, when mathematical applications are used where the points on the scale are assumed incorrectly to be equal, results may not be valid and conclusions, therefore, may be misleading.[96]

2.5.2 Psychometric analysis of the EDI using traditional approaches

In total, ten papers have examined the psychometric properties of the EDI. Of these, nine used traditional psychometric approaches.

Results of the earliest psychometric analysis were published by Janus and Offord in 2007. This paper (16) provides background on the rationale for developing the instrument and choosing the domains. It explains the underlying conceptual model which operationalises early development outcomes in terms of school readiness. Based on a review of the literature and discussions with educators and early years specialists, the five domains were selected on the basis that these are key competencies that children need to have if they are to be considered developmentally ready for school. Items were then chosen to populate the domains based on existing questions used in the Canadian National Longitudinal Study of Children and Youth and new questions constructed by the developers. These were tested with teachers and researchers. An initial base of 128 questions was developed and refined through consultation with relevant experts and practitioners. The paper provides a detailed and valuable description of the instrument.[62]

Initial tests to establish the validity and reliability of the EDI outlined in the paper were all based on traditional methods. These include factor analysis and intra-class correlation (ICC) coefficients on a sample of 16,583 children and inter-rater and concurrent reliability tests on a sub-group of 82 children. However, the outcomes

of both the factor analysis and the ICC have been questioned as they are based on the assumption that the EDI scores are continuous and not categorical.[86]

Building on this initial psychometric work, are a number of further studies in Canada, Australia and, to a lesser extent, in Washington State, Jamaica and Sweden.

Reliability

The internal consistency of the EDI has been well documented. Cronbach's alphas calculated on EDI data have been consistent across studies with alphas between 0.84 and 0.96 for the five domains. [62] [84] While this is a strong indicator of the reliability of the instrument care needs to be taken. High alphas, in addition to being a result of homogeneity and unidimensionality, can be as a result of the number of items. Indeed, very high alphas (over .90) may indicate the presence of redundant items.[95] Moreover, Cronbach's alphas are based on the assumption of normal distribution but EDI data are highly skewed.

Further factor analysis was conducted on data from Canada, Australia, Jamaica and Washington State (18) with the same items loading on to the same factor across all countries.[84] In a further study of 26,005 children in British Columbia, confirmatory factor analysis was used to demonstrate the unidimensionality of the domains.[86]

Equivalence

Two papers (12 and 33) examine the performance of the EDI across diverse populations. Muhajarine (33) compared EDI sub-domain scores between aboriginal and non-aboriginal children using correlation co-efficient and logistic regression. While aboriginal children did score lower on all domains, no bias was detected.[85] Guhn (12) examined the individual items for differential item functioning and concluded that the EDI was fair and unbiased across gender, language and aboriginal status.[56]

Validity

In total, seven papers explore different aspects of the validity of the EDI using traditional psychometric measures (1, 7, 9, 10, 15, 16, 18). In Australia, the AEDI was administered alongside the Longitudinal Study of Australian Children (LSAC) providing data on 642 children from a variety of instruments. Strongest correlations were found with other teacher-administered instruments.[78]

Correlations between the EDI language and cognitive development domain and the Peabody Picture Vocabulary test (PPVT) in a study across four countries (18) showed similar levels of correlation across all four countries. However, the results showed that low scores in the language and cognitive domain did not indicate a high probability that a child would have a language problem.[84] A further study, conducted in Canada, comparing the EDI with four directly-administered tests of school readiness (15) found significant correlations at the level of the overall instrument but not at the domain level.[87] However, a small study of 82 children (16) did show strong correlation between EDI domain results and a parental survey.[62]

Two studies (7 and 9) explored the predictive validity of the EDI. Forget-Dubois et al (9) found that the EDI predicted Grade 1 results to the same degree as a range of directly-administered tests.[80] D'Anguilli et al (7) found that vulnerable children were 2-4 times more likely to score below expectations at Grade 4 and that there was a linear increase in risk of scoring below expectations with vulnerability in additional domains.[97]

Tests for reliability and equivalence indicate that the EDI measures are consistent across countries and populations and can be considered free from random errors. In essence, this can be interpreted as supporting the idea that EDI results are consistent and reproducible and therefore, that the instrument is reliable. However, this does not provide evidence that the EDI measures early childhood development outcomes at school entry age.

Results from traditional tests of validity on the EDI are questionable. This is possibly due to the weak theoretical basis of traditional psychometrics (true score and error score calculations) which results in limited options for validity testing and a reliance on correlation with other measures which may not serve the same purpose. In the case of the EDI, the lack of alternative composite measures of child development at school-entry age has resulted in correlation with a range of instruments which have different functions. Hence, validity is assumed, not proven. The EDI, therefore, has not been proven to meet Hobart's stated requirements as outlined above,[88] that is, we have no proof that the values produced by the domain scores are rigorous measurements and we do not have evidence that the individual questions adequately map out the domains. However, the application of new psychometric measures has the potential to address these limitations.

2.5.3 New psychometric methods

New psychometric methods, despite the title, were first developed the 1960s. Two independent theories – Rasch theory and Item Response theory - have emerged. Whilst they have many similarities they are fundamentally different in that item response analysis is concerned with fitting the model to the data and Rasch analysis is concerned with fitting the data to the model. In essence, Item Response analysis is most concerned with the measurement of the person's ability whereas, Rasch analysis is most concerned with how well the instrument operationalises measurement of the underlying trait when tested against the standard set by the Rasch models.[92] As Rasch modelling has been used to assess the EDI this is the method with which this chapter is concerned.

Rasch theory

Rasch theory refers to a group of statistical models and techniques used as a mathematical approach to assessing measurement scales. Like classical test theory it is concerned with the relationship between the person's true measurement and the underlying trait.[98] However, Rasch models are based on the probability of a person's response to items on the scale (i.e. the probability of a person responding

in a certain way to an item is a logistic function of the difference between that person's ability and the individual item's difficulty). The key objective is to measure the ability.[99]

Classical test theory is concerned with the total score and assumes that all items contribute equally to the total score. Rasch theory, however, is based on the assumption that some items are harder and require more of the underlying trait than others and that some people have more of the latent trait than others, thereby, having a greater probability of responding positively to the more difficult item. Furthermore, items conform to a Guttman structure whereby they are ordered in terms of difficulty on a continuum (i.e. if a child had a certain capability then it is assumed that they ought to score positively for all items which demonstrate less difficulty).[100]

A key underlying component of Rasch theory is invariance. This means that the relative location of any two persons on the scale is independent of the items used and conversely the relative location of any two items on the continuum is independent of the person on which they are measured. Unlike classical test theory, the item and person locations are estimated separately but on the same scale. Items are ranked in terms of difficulty. Persons are located on the scale in terms of ability which is defined as the point at which they have a 50% probability of responding positively.[98]

Rasch analysis

Rasch analysis employs statistical techniques to test the quality of the raw score data in terms of their suitability for constructing an interval measurement scale. In particular, the analysis tests for unidimensionality.[92] However, unlike factor analysis which assumes a correlation model for mapping items to the construct, Rasch analysis assumes a hierarchical model (i.e. children with more of the underlying trait will respond positively to progressively more difficult items). Rasch analysis, therefore is well suited to the design of measurements which reflect a wide range of abilities.[101]

Rasch analysis assesses scales in three key areas:

- Targeting – person/item distribution;
- Item measurement – item order/location and fit to the model;
- Person measurement – person separation index.

2.5.4 Rasch analysis of the EDI

Only one published study (14) has used the Rasch model to assess the EDI and this is on a very small sample of 116 children in Sweden.[102] However, an unpublished report outlines a Rasch analysis conducted in Australia in 2004 prior to the adaptation of the EDI to the AEDI.[103] In both studies the person/item distribution was skewed, with more persons located at the upper end of the scale where there were fewer items. This indicates that the EDI is less well able to adequately measure high-achieving individuals. However, as the EDI aims to identify vulnerable children, this is not a problem.

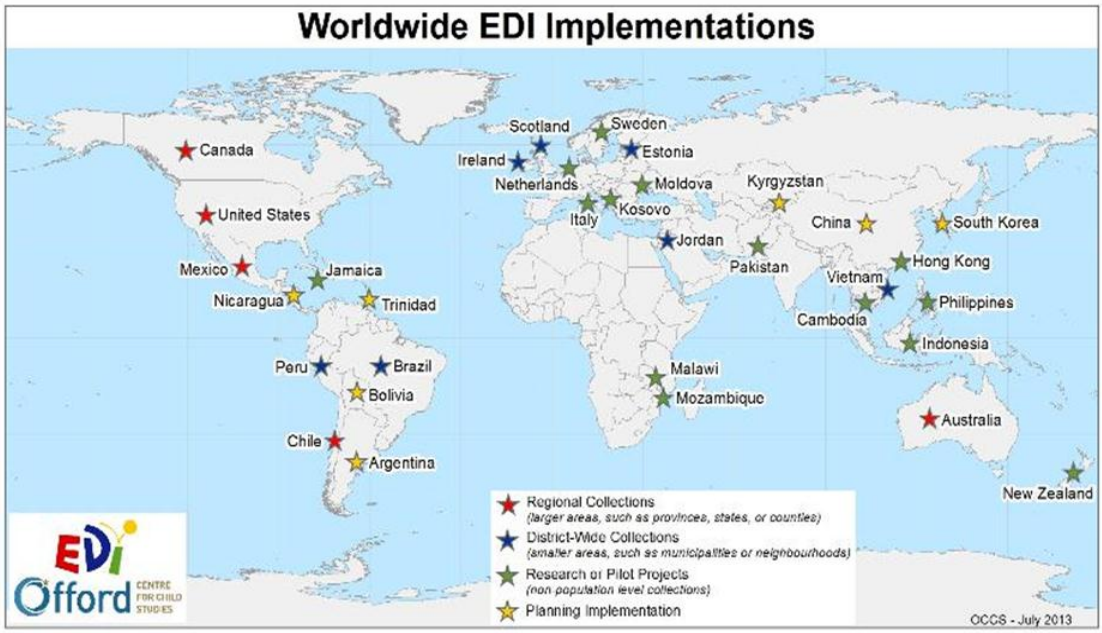
Both studies have identified mis-fitting items and have suggested that this be addressed by removing items. In the case of the Australian study, nine items were removed during the subsequent adaptation of the EDI to the AEDI. Moreover, five-option response items were reduced to three in both the EDI and the AEDI. The Australian and Swedish studies both allude to extreme fit residuals and local response dependency. However, this is not addressed in either study.

The major issue with the one published Rasch analysis is the small number of children in the study. It indicates that the EDI is psychometrically sound. It identifies areas of poor performance but is unable to make recommendations for improvement. The literature indicates that the EDI would benefit from further Rasch analysis on a considerably larger sample.

2.6 Implementation of the EDI

The EDI has been implemented in 24 countries worldwide with full population coverage in Australia and almost full population coverage in Canada. In a further 10 countries it has been used as a population-level measure with regional coverage. [104] Yet, published studies using EDI data do not reflect this international dimension and, as a result, the majority of papers examined in this review reflect the situation regarding early development outcomes in Canada and Australia.

Figure 6: Countries throughout the world where the EDI has been implemented



Source: EDI Newsletter Summer 2013, Offord Centre for Child Studies

At the same time, the published EDI studies have helped to deepen our understanding of variation in child development between populations of children and the interaction between child development outcomes and area-level indicators.[105-108] This is particularly useful when viewed through the lens of population health, typified by Rose's prevention by population strategy.[53]

2.6.1 Populations at risk of poor developmental outcomes

The gender inequality in developmental health is evident across all studies and across the socio-economic spectrum. Girls have higher mean scores in all domains of development. [81] [109-111] Children who have English as a second language and Aboriginal children are also at greater risk.[58] [77] [81] [85] [111-112] However, one Canadian study (13) found evidence of a flatter social gradient in Punjab and Cantonese speaking children than in English speakers. [113]

Child development is an evolving process with differing skills and knowledge emerging over time. The EDI is constructed to measure child development in the latter half of the first year of formal education and therefore cannot be repeated with the same children at a later period. At the same time, it can be used to measure changes in over time in a particular area or population group.[110] It has been linked with Grade one, four and seven results. In fact, in one study (9) the EDI was found to predict Grade 1 results with a similar degree of accuracy to a battery of other professionally administered tests. [80] A further two studies (7, 28) linked individual EDI results with Grade 4 Foundation Skills Assessment (FSA) results. One study (7) demonstrated that children who were vulnerable on the EDI were two to four times more likely to score below expectations on the FSA.[97] The second study (28) explored positive and negative trajectories between EDI and Grade 4 results and found that neighbourhoods with high levels of vulnerability had poorer trajectories. Moreover, these were more likely to be communities with poor high-school completion rates. [114]

The EDI includes a limited range of demographic variables: these are age; gender; language and aboriginal status; and identified special needs status. Further population-level correlation (to examine contextual factors impacting on developmental outcomes) requires the use of alternative sources of data which can be matched to EDI results at the level of the individual or population grouping.

2.6.2 Spatial variation

Three studies (2, 3, 6) examined spatial variation at the state and census tract level.[77 105 115] Complete national coverage was attained in Australia making it was possible to take a whole-population approach.[115] One study using Australian national data (3) demonstrated that considerable socio-economic and demographic inequality exists in child development. In particular, when child and socio-economic variables were controlled for, considerable jurisdictional variation emerged. The authors raise the possibility that this may be linked to policy and services supporting child and family well-being. However, they urged caution in making such inferences without further research. That paper, in particular, points to the utility of the EDI as a census-level indicator of child developmental health. Raos and Janus[105] argued that the most important level of spatial variation to be considered is that of the census tract or neighbourhood as that is the level at which greatest variation exists.

2.6.3 Neighbourhood-level variation

The EDI has been used to explore the effect of neighbourhood-level context on child development in great depth, particularly in British Columbia. In total, nine studies on neighbourhood-level variation (4, 21, 22, 23, 26, 30, 31, 32, 34) and one on school-level variation (27) were conducted in British Columbia with the remaining two studies (6, 35) conducted in Saskatoon. These studied found that neighbourhood-level, socio-economic indicators were associated with child development outcomes but these associations were not always linear. Moreover, some domains were more affected than others, with studies finding greatest neighbourhood-level effects in the physical health and well-being, language and cognitive development, and communication skills and general knowledge domains. [77-78 111]

One study (32) examined the position of children who were above the 90th percentile and found only weak association with neighbourhood effects.[37] However, these findings should be treated with caution as the EDI has been

developed to identify vulnerable children and does not discriminate well at the upper end of the spectrum.[102-103]

There is clear evidence that vulnerable children are more likely to live in areas experiencing higher levels of disadvantage.[77 106 108 110 115] However, when this is further disaggregated, a significant number of off-diagonal neighbourhoods can be identified. These are neighbourhoods where children's outcomes are not consistent with those expected given the socio-economic profile of the area. This includes areas of disadvantage where children's outcomes are above expectation and areas of affluence where outcomes are below expectation.[116]

Despite agreement that neighbourhood-level variation in early childhood development exists, there is little consensus as to which area-level factors are most significant. Indicators of material wealth including neighbourhood-level occupation, income and education were found to have some significance,[82 110 117] and the effects of this can be seen to last over time.[107] However, conflicting evidence emerged from two papers (4, 30) which examined concentrated affluence and disadvantage. One found that the relationship is non-linear, with affluent neighbourhoods not experiencing the highest mean scores.[108] The other found no relationship between concentrated affluence/ disadvantage and mean scores in a composite indicator formed from the language and cognitive domain and the communication skills and general knowledge domain.[118]

A clear distinction can be made between material and social wealth with the latter playing an important role. Neighbourhood heterogeneity, stability and cultural factors all proved protective,[82 112] while the percentage of single parent families and non-English speaking residents were indicative of poorer child development outcomes.[117]

Kershaw (23) placed neighbourhood-level variation primarily in the domain of macro level policies and processes. In a study of multiple small area census variables he identified the gender and ethnic experience of poverty and inequality

as key determinants and called for macro-level policy to address these issues. Moreover, he associated a lack of improvement in child development outcomes in response to local mobilisation with the concurrent reduction in provincial-level, anti-poverty supports. [83] [106]

2.6.4 Family context

Bronfenbrenner's ecology of human development illustrates that children generally experience the world through the family context.[39] Moreover, studying neighbourhood effects without considering family context can result in an inflation of the importance of neighbourhood-level factors[119]. The same caution has been urged in relation to neighbourhood effects and EDI outcomes.[107] However, only one study (25) involving 2,743 children across Canada examined EDI data at the level of the child, family, school and neighbourhood. This study only considered variation in mean scores in three domains namely emotional maturity, social competence, and language and cognitive development. In all three domains child and family-level variation accounted for 87% of the variation. School-level variation accounted for between 12% and 13% of the variation, with neighbourhood effects accounting for only 1%.[111]

Despite the importance of family influences on child development, there were only three studies (17, 20, 25) concerned with the impact of family-level contextual factors. Two studies (17, 25) used parental interviews while only one book chapter (20) reported on the findings from a parental survey. Gender, health and language status at the level of the child, family socio-economic circumstance, parental education, and parent-child interaction were all important.[81] [111] [120] A parental questionnaire, which was developed in the Offord Centre for Child Studies in 2003, has been used in Canada in conjunction with the EDI. The results emerging from these studies are not available in the published literature but where they are reported in the grey literature, the utility of this questionnaire as a rich source of data to complement the EDI is evident.[121]

2.6.5 Children with special educational needs

As mentioned above, one of the demographic variables included in the EDI questionnaire is whether the child has been identified as having a special educational need. The questionnaire also asks whether the child has an impairment which precludes them from fully engaging in school activities, whether this results in the child needing assessment and whether this assessment has taken place. These additional data, which does not form part of the EDI scoring, are very useful in determining the extent to which educational policy in a particular jurisdiction is supportive of the additional needs of children. The availability of EDI data on whole populations of children allows for the examination of developmental outcomes for children with additional needs within a typically developing population. However, only three studies (11, 19, 29) have used this data to specifically examine the situation of children with special educational needs.[122-124]

In all three studies, children with special needs had significantly lower mean scores on the EDI. In a study spanning Canada, Australia and Mexico (19) children needing assessment were also found to have lower mean scores but not as low as those with an identified special need.[123] However, in British Columbia children with moderate to severe intellectual disability were the most highly vulnerable, whereas children with deafness were more likely to not be vulnerable.[124] Goldfeld[122] found that children in remote areas of Australia were less likely to have had their needs identified.

2.6.6 Economic effects of developmental vulnerability

One study (24) examined the economic effects of a high level of developmental vulnerability. By linking EDI scores to Grade 4 outcomes and estimating the impact of Grade 4 results on Grade 7 results and the impact of Grade 7 results on Grade 12 results, a simulation model was created which estimated the potential impact of reducing the vulnerability rate from 29% to 10%. University eligibility would rise, criminality would fall and GDP would theoretically rise by more than 20%. The study concluded that unnecessary vulnerability costs Canada between $2.21 and $2.4 trillion.[125]

2.6.7 Evaluation studies

Three studies (5, 37, 38) aimed to evaluate aspects of the EDI. Corter et al[126] found the EDI to be a good, formative evidence-base for programme development. Two of the evaluation studies (37, 38) were conducted in Australia as part of the comprehensive preparatory work undertaken to inform the development and national implementation of the AEDI. Sorin[127] conducted interviews and surveys with EDI co-ordinators, principals and teachers and reported a positive response to EDI implementation. Sayer et al[79] found that teachers had a much broader understanding of school readiness than just developmental readiness of the child for school. This encompassed the extent to which the school environment was appropriate for the child's needs.

Table 1: Outline of the papers included in the literature review

	Authors	Type of study	EDI population	Domains	Other data sources	Analysis	Results
1	Brinkman et al 2007[78]	Construct and concurrent validity testing	642 children - sub group of the Longitudinal Study of Australian Children (LSAC)	All mean domain scores and % vulnerability	LSAC parent and teacher reported data	Construct validity - Spearman correlations between each domain and relevant LSAC validated instruments and teacher and parent reports. Concurrent validity - comparison between children 'vulnerable' on AEDI and 'developmentally at risk' on LSAC composite indicator	Physical health and well-being showed low correlation - measuring different things. Other EDI domains showed moderate to high correlations with teacher completed instruments. Generally weak correlation with parental reported measures. Concurrent validity between vulnerability and LSAC negative outcome index Kappa = .51
2	Brinkman et al 2009[77]	Descriptive + area level by quintiles	35,530 collected over 4 years (2004 - 2007) across Australia (SN excluded)	Language and cognitive development and % vulnerability	Census data – Socio-Economic Indices For Areas (SEIFA) measure of disadvantage quintiles	Mean (SD) by quintiles, ESL and English proficiency (no p values)	There is a linear social gradient in results. Proportionally more vulnerable children live in disadvantaged areas. Results differentiated by ESL
3	Brinkman et al 2012[109]	Variation in vulnerability by state and by area level composite indicator of socio-economic disadvantage	26,1147 in 2007 across Australia	% vulnerability in each domain	SEIFA Index of Relative Socio-economic Advantage and Disadvantage (SEIFA IRSAD)	Two nested fixed effects logistic regression models to determine between state variation. Slope Index of Inequality (SII) to measure absolute vulnerability gap between lowest and highest SEIFA IRSAD deciles	There is between state variation in vulnerability when adjusted for ESL, Aboriginal status and SEIFA IRSAD deciles. Levels of inequality vary between states and across all states. Males experience higher inequality and higher levels of vulnerability

	Authors	Type of study	EDI population	Domains	Other data sources	Analysis	Results
4	Carpiano 2009[108]	Neighbourhood effects	37,798 over 3 years 2002 - 2004 British Columbia, Canada (82% urban neighbourhoods)	Mean scores in all domains	Median equivalised disposable income at postal code level as proxy for family SES. Neighbourhood level: Index of Concentration at the extremes (ICE) for income and education, % non-official language, % aboriginal and % moved in last year (2001 Canadian Census data)	Three models using HLM: one way analysis of covariance with random effects	Curvilinear association between EDI scores and concentrated disadvantage/ affluence. Highest EDI scores in heterogeneous neighbourhoods
5	Corter et al 2008[126]	Evaluation, case study	361 in 2003 and 319 in 2005 in Toronto	Mean scores and vulnerability rates in all domains	Mixed method. Qualitative case study to examine use of EDI in informing programme development	Univariate Effect size (Cohen's d) for changes between 2003 and 2005. Case study report	EDI scores improved in social and emotional domains. Case-study showed formative use of EDI as evidence base for programme development
6	Cushon et al 2011[110]	Neighbourhood effects on changes over time	1458 in 2001, 2159 in 2003 and 2218 in 2005 in Saskatoon, Canada	Mean scores in all domains	Neighbourhood level: composite poverty index created from % aboriginal % single parent, % low income families, % moved in last year, % < Grade 9 education, % not owning home, % unemployed (2001 Canadian Census data).	Hierarchical linear regression controlling for child-level characteristics to assess changes over time. Multi-level models for association between these changes and neighbourhood poverty index	Changes over time evident in 2 domains: physical health and well-being and communication and general knowledge. Child-level variables accounted for 15.8% and neighbourhood poverty for 36.8% of the variation in physical health and well-being but were not associated with changes in communication skills and general knowledge

	Authors	Type of study	EDI population	Domains	Other data sources	Analysis	Results
7	D'Angiulli et al 2009[97]	Predictive validity	7910 in 2000 and 2001 in 4 districts in British Columbia	Vulnerability rate in each domain	Foundation Skills Assessment (FSA) at Grade 4 divided into 2 categories: performing below expectations; meeting or performing above expectations	Relative risk to estimate magnitude of association between vulnerability and Grade 4 FSA outcomes	Vulnerable children are 2 -4 times more likely to score below expectation at Grade 4. Strongest association with language and cognitive domain. Linear cumulative risk with increased number of vulnerable domains
8	Fiorentino et al 2004[128]	Association between language, EDI and story telling	25 English-speaking children from low-income backgrounds	Mean scores in all domains	Peabody Picture Vocabulary Test - Revised (PPVT-R), narratives generated from McArthur Story Stem Battery, day-care quality, five family demographic questions	Spearmans correlation	Association between language competence, school readiness and narrative ability (small numbers)
9	Forget-Dubois et al 2007[80]	Predictive validity	EDI for 965 children in Quebec	Mean scores in all domains	Cognitive and school readiness data from the kindergarten-age implementation of the Quebec Longitudinal Study of Child Development, Grade 1 school achievement	Multiple regression models, Cronbachs alpha	EDI scores were predictive of Grade 1 achievement and predicted a similar level of variation to a combination of the direct assessments and explained an additional 5% of the variance

	Authors	Type of study	EDI population	Domains	Other data sources	Analysis	Results
10	Forer et al 2011[86]	Multi level construct validity	264005 between 2005 to 2007 in British Columbia	Overall vulnerability rate and mean domain scores	None	Multi-level factor structure at individual, neighbourhood and class level, ICC for classroom and neighbourhood-level variation. One-way ANOVA for within and between classroom variation. Multi-level analysis for variation between classroom and school district	Individual-level actual scores are valid unidimensional measures for use as explanatory variables in multi-level models. Classroom level variation accounted for up to 25% of individual variation in actual scores, some of which may be due to teacher characteristics. Classroom-level accounted for less variation (7%) in vulnerability. Reliability of class mean vulnerability rates was weaker than class mean actual scores
11	Goldfield et al 2012[122]	Special needs demographics	261,203 in 2009 throughout Australia	Vulnerability rate in each domain	Census data - socio economic indices of areas (SEIFA) measure of disadvantage quintiles	Children identified as special needs, of concern and standard population compared using descriptives and logistic regression	4.4% of children had special health care needs (SN). Children with SN had 81% vulnerability and those of concern had 54% vulnerability. Boys, older children and those living in disadvantaged areas were more likely to have SN. Children in remote areas were more likely to be of concern and less likely to have their needs identified

	Authors	Type of study	EDI population	Domains	Other data sources	Analysis	Results
12	Guhn et al 2007[56]	Validity (item bias)	43,900 children over 5 years 2000 to 2004 in British Columbia, Canada	Functioning of individual questions and domains	None	Ordinal logistic regression to identify the presence of differential item functioning (DIF) with regard to gender, ESL and Aboriginal status	All items displaying DIF were as a result of item impact not item bias. EDI teacher ratings are fair and unbiased in relation to gender, ESL and aboriginal status
13	Guhn et al 2010[113]	Multi-level population based analysis of gender, ESL and area-level socio-economic status	40,772 from 2002 to 2004 in British Columbia, Canada	Mean scores in all domains	Median equivalised disposable income at postal code area as proxy for family socio-economic status	Multi-level model (children nested within schools) to estimate gender, SES and language effects on domain scores	Girls scored better than boys on all domains across socio-economic spectrum. Flatter socio-economic gradient on EDI scores for Punjab and Cantonese speaking children than English speaking children
14	Hagquist and Hellström 2013[102]	Psychometric properties using Rasch analysis	116 in ten pre-schools in two municipalities in Sweden	Individual questions and domains	None	Unidimensional Rasch model	A number of items were identified which did not fit well in each domain. When these were removed the fit improved. Caution is urged because of the small sample size

	Authors	Type of study	EDI population	Domains	Other data sources	Analysis	Results
15	Hymel et al 2011[87]	Convergent and discriminant (construct) Validity	267 from socio-economically and culturally diverse backgrounds in British Columbia	Domain scores and a composite EDI score constructed for this study	Direct (professionally administered) tests of aspects of school readiness: Early Screening Instrument Kindergarten; School Readiness Composite of the Bracken Basic Concepts Scale; Comprehensive Test of Phonological Processing; GSID Relationship Questionnaire	Correlations between scores on EDI and the other direct measures of aspects of school readiness. Linear regression for classroom level variation	All measures significantly correlated with overall EDI scores to a greater extent than to domain scores supporting the convergent validity of the EDI but not that of the domains. The other instruments combined explained 36% of the variation in EDI demonstrating their limited ability to capture the breadth of the EDI. Does not validate the EDI at an individual level
16	Janus and Offord 2007[62]	Psychometric properties and validity	16,074 in Canada	Individual questions within sub-domains and domains	Neighbourhood SES indicators: average family income, unemployment rate and % no high school diploma. Parent EDI rating and survey on 82 children. PPVT scores	Factor structure analysis, ICC, unconditional multi-level models, Cronbach's alphas, Pearson's correlations	EDI psychometric properties are acceptable and comparable to other instruments. Inter-rater reliability, concurrent and convergent reliability, internal consistency all tested and found adequate
17	Janus and Duku 2007[81]	Individual and family level risk factors for early childhood development	2196 sample across 6 sites in Canada (Years not included)	Overall vulnerability rate and mean domain scores	Parental interview	Logistic regression	20% of children were vulnerable. Gender, child health and family SES were the highest predictors. Less significant were age, family status, looking at books and parent smoking

	Authors	Type of study	EDI population	Domains	Other data sources	Analysis	Results
18	Janus et al 2011[84]	Psychometric properties and validity	175,000 in Canada (2005 - 2007), 30,000 in Australia (2004 - 2006), 1200 in Washington State (2004) and 156 in Jamaica	Individual questions within sub-domains and domains	PPVT for comparison on a subset in Canada, Australia and Jamaica	Cronbach alpha, factor structure analysis (exploratory and confirmatory), correlation between vulnerability on the language domain and PPVT scores - 1 SD below mean	High level of consistency in psychometric properties across all four countries. Lower internal consistency on physical health and well-being in Jamaica. Consistent patterns of association with PPVT
19	Janus 2011[123]	Special needs	183,710 in Canada and 31,478 Australia in 2005 - 2007, 168,400 Mexico in 2008	Mean scores in all domains	None	Effect size for difference in EDI outcomes between special needs and typically developing, specific impairments and children needing further assessment	Children with special needs were most vulnerable. Children needing further assessment also were more vulnerable but not to the same extend. Similar patterns emerged across all three countries
20	Janus 2011[120]	Book chapter - not a research paper	2,196 in Canada and 1,672 in Mexico (years not included)	Overall vulnerability rate and mean domain scores	Parental survey	Logistic regression but no tables and only some odds ratios provided	Gender, SES, family status and participation in sessional activities all had an effect on EDI scores. Statistical results not presented
21	Kershaw et al 2007[83]	Neighbourhood effects	43,913 in 469 neighbourhoods in British Columbia	Vulnerability rate in each domain	Census data for 2001 - SES variables	Variable reduction to choose 13 to 24 variables per domain. Logistic regression model for each domain and overall vulnerability with SES variables	Neighbourhood SES indicators explain more variability in physical, cognitive and communication domains. Income, cultural/language status, male involvement in unpaid childcare all important

	Authors	Type of study	EDI population	Domains	Other data sources	Analysis	Results
22	Kershaw et al 2009[116]	Identifying off-diagonal neighbourhoods	82,532 in British Columbia between 2001 and 2007	Overall vulnerability rate and vulnerability in any domain or sub-domain	Census data on SES, family type, mobility, language and ethnicity, Taxfiler data on households, administrative data on childcare services	Multiple regression models using residuals to identify off- and on-diagonal neighbourhoods	Identified 24 off-diagonal low-vulnerability, 24 off-diagonal high vulnerability, 29 on-diagonal low challenge, 13 on-diagonal mid-challenges, 27 on-diagonal high challenge neighbourhoods and 2 regional clusters. These areas were identified as suited for further research on neighbourhood effects
23	Kershaw and Forer 2010[106]	Neighbourhood effects	40,772 in 478 neighbourhoods in British Columbia between 2001 and 2004	Vulnerability rate in each domain	Census, Taxfiler and other administrative combined to provide 1,500 variables	Variable reduction/ principal component analysis to reduce number of variables to 48. Hierarchical stepwise regression - 20 models	Significant effects from income, unemployment, lone parenthood, residential stability with gender and race and policy on welfare and childcare
24	Kershaw et al 2010[125]	Economics	All Canada 2008/09 and British Columbia 2001 to 2009 (exact numbers not stated)	Overall vulnerability rate	FSA in Grade 4 and 7	3 logistic regressions to: 1 - Grade 7 FSA characteristics which predict Grade 12 results and criminality; 2 - Grade 4 results which predict Grade 7 outcomes from model 1; and 3 - linking EDI to Grade 4. Simulation model to estimate changes in trajectory if vulnerability rate reduced from 29% to 10%	Vulnerability rate for Canada in 2009 was 29%. In BC ranged from 26.1% in 2004 to 29.6% in 2007. Simulation model showed that reducing the vulnerability rate would result in university eligible grades rising from 41.5% to 55.6%. GDP would rise by more than 20%. Unnecessary vulnerability costs Canada between $2.21 and $3.4 trillion

	Authors	Type of study	EDI population	Domains	Other data sources	Analysis	Results
25	Kohen et al 2009[111]	Family/ school/ neighbourhood level variation	2,743 across Canada	Mean domain score for emotional maturity, social competence, language and cognitive development	Parental survey, census data on SES, other school readiness test scores	Cross-classified HLM with random intercept	Child/family accounted for 87% of variation and schools for 12 - 13% in all three domains. Neighbourhood accounted for 1% or less but for up to 5% variation on other test scores. Age, gender, ESL, family income and parent education were highly significant
26	Lapointe et al 2007[82]	Neighbourhood effects	53, 059 in British Columbia between 2001 and 2005	Mean scores in all domains	27 neighbourhood predictor variables divided into 10 categories from 2001 Canadian census data.	Three models using HLM linear mixed effects	Neighbourhood level occupation, income, education, language and aboriginal status were all significant. Multiple family households was a positive predictor for emotional maturity
27	Lesaux et al 2009[129]	Link between literacy outcomes and EDI scores at school catchment area level School level analysis	Aggregated results on 478 in British Columbia in 2001-2	Vulnerability rate in each domain	Multiple measures of literacy skills. Census SES data aggregated to school catchment area	Schools classed as low, moderate or high level of literacy risk based on literacy test scores. ANOVAs to compare schools at the three levels of risk with EDI and catchment SES	Links between early literacy and EDI scores. High risk schools had significantly higher rates of vulnerability on physical health, social competence and emotional maturity. No difference in other domains. High risk schools tend to be located in areas with high % of low income families and single parents. No correlation with unemployment, high school completion and home ownership

	Authors	Type of study	EDI population	Domains	Other data sources	Analysis	Results
28	Lloyd and Hertzman 2009[130]	Development trajectories at district level	6,955 in 4 school districts in British Columbia in 2000 and 2001	Vulnerability rate	Grade 4 FSA results for literacy and numeracy. Census data on % adults without high school graduation	EDI and grade 4 results linked at an individual level. Community Index of Childhood Development (CICD) ratio of positive to negative pathways between EDI and Grade 4 FSA results at neighbourhood level	Highest CICDs were in neighbourhoods with lowest vulnerability and highest % completed high-school and lowest in neighbourhoods with higher vulnerability and lower rate of high-school completion. Conflicting evidence of convergence and divergence in trajectories between highly vulnerable neighbourhoods and Grade 4 results
29	Lloyd et al 2009[124]	Linked EDI and Grade 4 outcomes for children with special needs	3,677 children with 12 different categories of special needs in 4 EDI cohorts between 2000 and 2003 in British Columbia	Vulnerability rate	FSA Grade 4 records	Descriptive statistics	58.3% of all children with special needs were not school ready. Highest category was moderate to severe/profound intellectual disability at 95.7%. The majority of children with deafness or gifted were school ready. Similar results are seen on FSA scores. Children who were not school ready on EDI scored 'below expectations' or 'other' on FSA.

	Authors	Type of study	EDI population	Domains	Other data sources	Analysis	Results
30	Lloyd and Hertzman 2010[131]	Cross-sectional and longitudinal EDI and Grade 4 language and cognitive development. Neighbourhood effects	5,022 (635 rural, 4,387 urban) British Columbia 2000 to 2002 - children whose postal code was the same in Kindergarten and Grade 4 selected	Composite score from language and cognitive, and communication and general knowledge	Composite score from Grade 4 assessment of numeracy and reading comprehension. ICE concentration at extremes for income, concentrated immigration, residential stability, proportion of children 0-4, % aboriginal. Median equivalised disposable income at postal code level as proxy for family SES	Individual child EDI score subtracted from Grade 4 score to create difference score. Linear multi-level analysis of covariance with random effects using HLM	ICC - between 4% (rural) and 7% (urban) variation in scores was between neighbourhoods. No correlation between ICE and EDI scores but yes with Grade 4 scores and difference score. Significant difference between rural and urban on EDI language. Increased concentration of immigrants resulted in improved scores
31	Lloyd et al 2010[107]	Neighbourhood effects on long term outcomes - linked EDI and Grade 7 FSA scores	2,648 children in 1999/2000 in British Columbia	Composite score from language and cognitive, and communication and general knowledge	Grade 7 FSA scores for reading and numeracy; composite indicators of neighbourhood disadvantage at kindergarten and Grade 7 from 2001 and 2006 census data	Five cross-classification random effects models controlling for EDI as a child level co-variate.	Literacy outcomes are independently predicted by kindergarten neighbourhood disadvantage. Numeracy outcomes are also predicted by Kindergarten neighbourhood disadvantage but not independently of other variables
32	Maggi et al 2004[132]	Neighbourhood effects EDI and FSA scores from same year - highly competent children	78 schools in Vancouver district in British Columbia in 2000	Language and cognitive development: Highly competent - above 90th percentile	FSA Grade 4 and Grade 7 school level results for 2000. Socioeconomic characteristics of school catchment area. Class composition at Grade 4 and Grade 7	Linear regression	Neighbourhood SES is weakly associated with high competence in Kindergarten but strongly associated with grade 4 and 7 outcomes. Proportion of vulnerable children inversely associates with proportion of Grade 4 and Grade 7 success

	Authors	Type of study	EDI population	Domains	Other data sources	Analysis	Results
33	Muhajarine et al 2011[85]	Equivalence of EDI for Aboriginal and non-Aboriginal children	2,301 in Saskatoon, Canada in 2003	Specifically all sub domains	None	Multiple Challenge Index - challenge cut-off identified for each sub-domain. Children with 9 or more sub-domain challenges were designated as having multiple challenges. Correlation co-efficient and logistic regression	Aboriginal children had lower mean scores on all domains and were more likely to have challenges but the domain clusters in which they are rated as having challenges are the same. Boys, low number of special skills and high number of problems were associated with increased likelihood of low scores in both Aboriginal and non-Aboriginal children. No bias was detected
34	Oliver et al 2007[117]	Neighbourhood effects	3,736 living in Vancouver City British Columbia in 2000. Private and aboriginal reserve schools and children with special needs not included	Mean scores in all domains	Median equivalised disposable income at postal code level as proxy for family SES. Neighbourhood level: % mother tongue English, unemployment rate, no high school certificate, non-movers five years, median family income, lone parent families	Bivariate and 2 multi-level models	Neighbourhood level explains between 4.9% (Social competence) and 15% (communication skills & general knowledge) of the variation. Median income and % lone parent families most strongly associated

	Authors	Type of study	EDI population	Domains	Other data sources	Analysis	Results
35	Puchala et al 2010[112]	Neighbourhood effects on children with English as a second language (ESL)	6144 in Saskatoon, Saskatchewan in 2001, 03 and 05. (127 ESL)	Mean scores in all domains	Seven SES indicators from 2001 census: low income, ethnic diversity, Aboriginal status, education, employment, mobility, lone-parenthood.	Multi-level models to determine the mediating effects of SES indicators on the relationship between EDI scores and ESL	Association between ESL and EDI scores influenced by contextual factors only in communication skills and general knowledge and the emotional maturity domains. Unemployment and transience impacted negatively. Ethnic diversity impacted positively
36	Raos and Janus 2011[105]	Spatial variation at census subdivision and provincial level	152,786 children in British Columbia, Manitoba and Ontario in 2005, 2006 and 2007	Three sub domains of Emotional maturity: hyperactivity, anxiety and aggression	None	Multi-level models to determine variation at each level of aggregation, controlled for age and gender at individual level	Census subdivision accounted for 3.5 to 5.7% of variation. Of this between 3.5 and 16% was accounted for by province level variation therefore census subdivision is more important
37	Sorin 2008[127]	Qualitative-educators views on school readiness.	Qualitative study with educators in area where the AEDI was implemented	n/a	Answers prepared by a panel of 6 educators on how they determined school readiness in the five domains of the AEDI.	Qualitative analysis using emergent coding	Teacher's concepts of school readiness were broader than the five domains of development and encompassed readiness of the school environment for the child
38	Sayers et al 2007[79]	Evaluation of the EDI implementation	n/a	n/a	Survey and interviews with EDI co-ordinators, teachers and school principals	Thematic analysis of surveys and interviews	Pre-implementation engagement was fostered by local leadership, existing services, national support. Teachers could implement AEDI without difficulty. Results were useful for planning, awareness raising an d building relationships

2.7 Summary and gaps in the literature

The EDI is a unique measure of five domains of early childhood development at school entry age based on a broad concept of school readiness. It has been implemented in 24 countries worldwide over more than a decade. However, there are only 38 original published, peer-reviewed studies using EDI data. These most commonly emerge from British Columbia in Canada. It is evident that a very rich source of data on child development outcomes has been under-utilised.

Studies examining the psychometric properties of the EDI were generally positive. It is proven to be reliable and to equivalently measure developmental outcomes in various populations of children. Results correlate well with other teacher-reported measures but not so well with parent-reported measures. It predicts academic outcomes as well as other tests of school readiness. However, the majority of published studies used traditional psychometric measures to assess the EDI. Only one published study used Rasch analysis and this was on a very small group. Further Rasch analysis would allow us to determine the extent to which the questions included in the EDI adequately reflect the developmental domains they propose to measure.

The EDI provides census-type data on early childhood development. It allows for the identification of areas and populations where children are at greatest risk. It can be linked to administrative and other data to provide rich contextual information on children's lives. However, given that the most immediate context in children's lives is the family, there is a notable absence of family-level data in the majority of studies. The grey literature indicates that a parental questionnaire has been administered alongside the EDI in large provincial studies but studies utilising this potentially rich source of contextual data are not published.

Additional data on special needs status, impairment and assessment are also collected on the EDI questionnaires but, apart from three studies, are not reflected in the published literature.

Finally, despite implementation of the EDI in seven European countries (including the current study in Ireland), there is only one published study from Europe. Indeed, even in the grey literature, results from other European studies are not available.

This thesis will add to the evidence base on early childhood development by combining the EDI and a parental questionnaire to examine the impact of proximal, contextual factors. It will examine the psychometric properties of the EDI using Rasch analysis. Data available on special needs will also be analysed and reported. The utility of the EDI as a means of identifying areas where populations of children are at greatest risk will be explored and the implications for policy in early childhood care and education will be outlined.

CHAPTER 3: DETERMINANTS OF VULNERABILITY IN EARLY CHILDHOOD DEVELOPMENT IN IRELAND – A CROSS-SECTIONAL STUDY

Paper published in BMJ Open June 2013

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3.0 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.

3.1 Background

There is significant epidemiological evidence that early childhood development (from gestation to age six) strongly influences life-long health trajectories.[106] Indeed, major public health problems such as obesity, heart-disease and mental health problems can be seen to have roots in early childhood.[133-134] 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.[15]

There is also evidence of a social gradient in child development [23], 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.[10] The long term social and economic gain of investing in the early years is also recognised.[135] Kershaw estimates that the cost of preventable early childhood vulnerability to the Canadian economy is between $2.2 and $3.4 trillion.[125]

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.[136-137] 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, [56] leading to a need for a population health approach.[53] 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.[58 60] 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.[84] In Australia, EDI

(AEDI) has been used universally as a census of child development and has revealed significant variation across states and territories.[115] While 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 EDI and to examine associated factors. The study also aimed to assess the feasibility of implementing 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.[63] 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.[64] 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.[138] The education system is static throughout the country.

3.2 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.

3.2.1 Measurement of child development - the EDI

Child development at school-entry age was measured using 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.[75] 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, that is, small modifications of risk for large numbers are more effective at producing change than large modifications for small numbers.[53] It can be retrospective, focusing on early childhood development outcomes; or predictive, informing school and child-health programmes.[75] The instrument consists of five domains, sixteen sub-domains and 104 questions. The domains and sub domains are outlined in Table 2.

EDI is a well validated instrument which has undergone extensive psychometric testing both in Canada and Australia.[62 75 78 84 97] It has also been proven valid for use in minority populations.[85] In this Irish study, EDI had good internally consistency by domains with Cronbachs alphas of between 0.8 and 0.96.

Table 2: 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 not suck 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 DEVELOPMENT	
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.

3.2.2 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.[75] This questionnaire was adapted to suit the Irish context incorporating validated questions from the Growing Up in Ireland Study [139] and the SLAN Survey of Lifestyles, Behaviour and Nutrition in Ireland.[72] It consists of seven sections: child health and development; child care; pre-school; school; family; neighbourhood; and background information.

3.2.3 Data collection

EDI is a teacher-completed questionnaire based on a 5 month 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.

3.2.4 Developmental scoring

EDI scores were calculated for each developmental domain, that is, Physical Health and Well-being; Social Competence; Emotional Maturity; Language and Cognitive Development; and Communication Skills and General Knowledge. All questions had a two-point or three-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 (two-point answers were scored 0 and 10; three-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-offs and should therefore include children who may be more difficult to diagnose.[77] 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 were linked to the teacher-filled questionnaires using the Form ID number and the matching was crosschecked using the recorded date of birth and gender. Again, questions 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.

3.2.5 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.[140]

Parental reported birth weight was used to calculate whether the child had a low birth weight, that is, less than 2.5kgs. Parental report of birth weight has been proven to be adequately accurate to be acceptable for research purposes.[141]

Parents were asked how much time (to the nearest hour) the child spent 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.

3.2.6 Data analysis

SPSS PASW Statistic 18 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', that is, being in the lowest 10% of the target population in one or more domains. 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 (PAFs) were used to calculate the proportion of risk attributed to each of the factors in the final regression.[142-143] This was calculated using the 'punaf' command in STATA V.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[144] for cohort and cross-sectional studies.

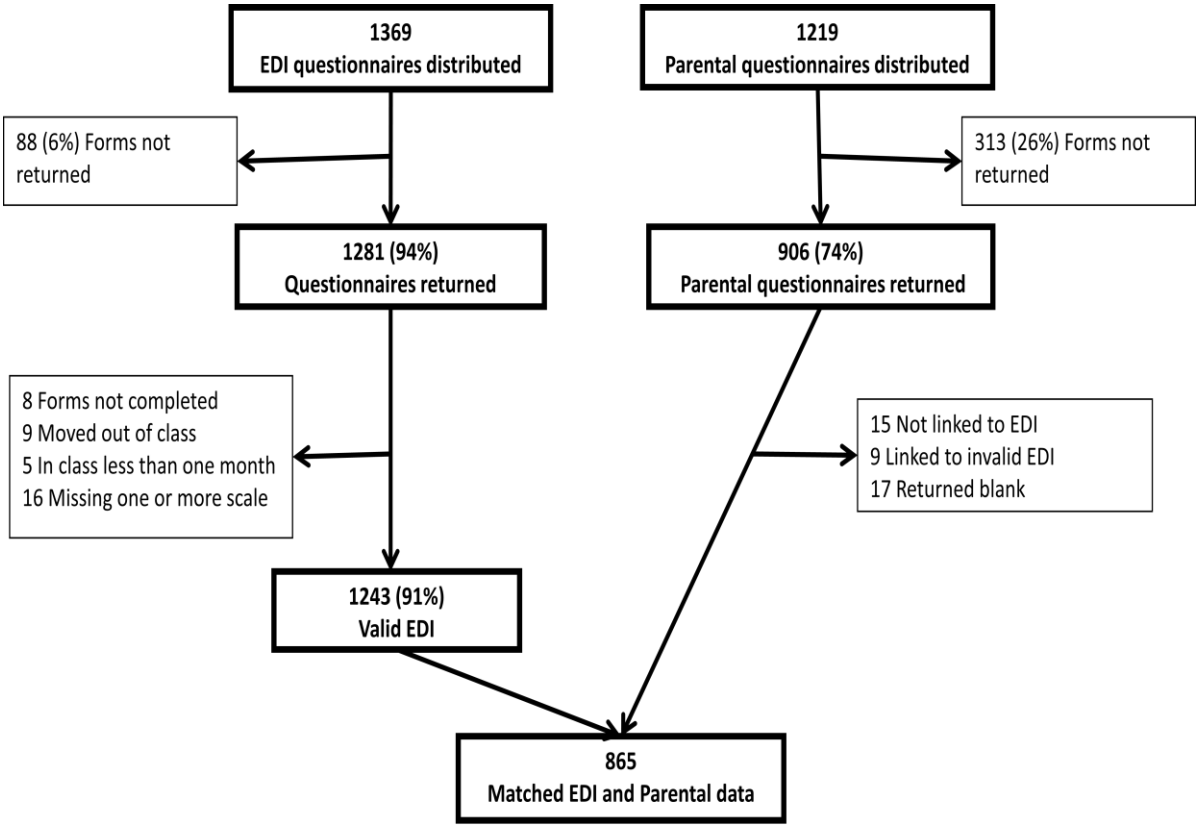
3.3 Results

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. A participant flow-chart is outlined in Figure 7.

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.

Figure 7: Participant flow chart



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 3.

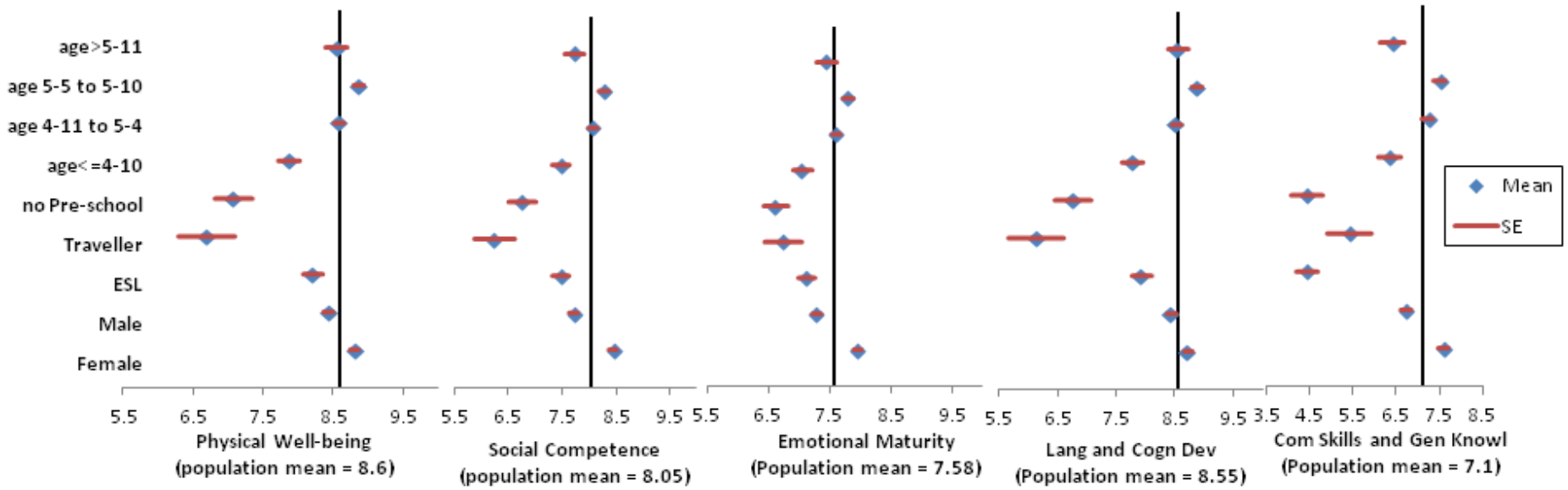
Table 3: Comparison between sample for whom parental data was or was not available

	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

3.3.1 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, that is, 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 the age of 4 years 10 months at the time of the study. This is outlined in Figure 8 with the vertical axis representing the mean domain score for the study population.

Figure 8 Distribution of scores across all five domains of development



*Each vertical axis represents the population mean for that domain

3.3.2 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 two domains, 5% in three domains, 3% in four domains and 3% were vulnerable in all five 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 4) were being male (odds ratio [OR] 2.2, 95% confidence interval [CI] 1.6 to 3.1), ESL (OR 3.8, CI 2.4 to 6.1), being under 5 years of age at the time of the study (OR 1.6, CI 1.1 to 2.4) and low birth weight (OR 2.5, CI 1.4 to 4.5). When compared with children whose mothers had a university education, those with only primary education (OR 2.8, CI 1.3 to 5.8) or secondary level (OR 1.7, CI 1.1 to 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.

Table 4: 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

3.3.3 Logistic regression

Regression analysis was then used to assess the impact of each variable on the odds of being vulnerable as outlined in Table 5. The first model controlled for being male, having English as a second language and being under 5 years of age at the time of EDI completion, the second controlled for all other factors. Children whose birth weight was less than 2.5kg had over twice the odds of being 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 had over five times the odds of being vulnerable than those who were told stories every day. In the final model, the amount of time spent watching television became insignificant.

Table 5: Logistic regression predicting odds 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

3.3.4 Population attributable fraction

PAF was used to measure the proportion of vulnerability attributed to each of the factors included in the final regression model (Table 6). Boys had almost three times the odds of being vulnerable when compared with girls and being male accounted for 35% of the overall vulnerability. English as a second language accounted for 12%, and mother's 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.

Table 6: 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

3.4 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 EDI in Ireland, in particular, the lack of data on predictive validity for 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.[81 106 108 111] Indeed, the 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 mother's education and reading stories. In the final model, the strongest predictor of vulnerability on EDI scores was storytelling. Children who were never told stories in the past week were over five times more at risk of being vulnerable compared with children who were told stories every day. This supports numerous studies which show a link between reading stories and literacy development[33] and with broader aspects of development.[145] These are again consistent with findings from Canada, further supporting the transferability of the instrument between the two jurisdictions.[120]

The mean scores across all five domains varied between subgroups 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.[146]

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 are at greater risk of vulnerability. PAF illustrates that these three factors account for half of all vulnerability. These findings are consistent with international studies.[51 81]

Hertzman [147] describes vulnerability levels of above 15% as an unacceptable level of difficulty at school entry age. There is considerable debate regarding the expected level of biologically determined developmental vulnerability. OECD country estimates range between 1.8% and 10.4%.[148] Considering these expected levels of biological determined developmental delay external factors can be seen to contribute to major disparities.

3.4.1 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,[120] 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 EDI functions well in the Irish context. Future research will consider Rasch modelling and examining issues of predictive validity.

3.4.2 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.[62] 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 can, in turn, 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 preschool care by highly skilled practitioners.[133] 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 6 years of age, 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.[68] 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 reliability.[149] 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.[57] In Australia and Canada, 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. 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.

CHAPTER 4: PROVIDING POPULATION-LEVEL DATA TO SUPPORT POLICY AND PRACTICE FOR HEALTHY CHILD DEVELOPMENT – THE ROLE OF THE EARLY DEVELOPMENT INSTRUMENT

Paper submitted to the Journal of Epidemiology and Community Health

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4.0 Abstract

Background: 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 variation in child development at both school and area-level using the EDI and to examine the implications for early childhood support programmes.

Methods: This cross-sectional study was conducted in a major Irish urban centre, Cork City, and an adjoining rural area in April 2011. EDI (teacher completed) scores were calculated for 1,344 children in their first year of full-time education. Those scoring in the lowest 10% of the sample population in one or more domains were deemed to be 'developmentally vulnerable'. Data were also collected on age, gender, language status, pre-school attendance and area of residence. Scores were correlated with both area and school-level deprivation using logistic regression.

Results: Over one quarter (27.5%) of children in the study were developmentally vulnerable. When adjusted for individual-level characteristics, the factors most strongly associated with vulnerability were not attending pre-school OR 3.94 (CI 3.42 to 6.43) and being enrolled in a designated disadvantaged school OR 1.66 (CI 1.19 to 2.33). Residence in a deprived area was significant for the 'physical health and well-being' and the 'language and cognitive development' domains but not for overall vulnerability.

Conclusion: This study highlighted the value of universally accessible pre-school education combined with additional supports to schools with highly vulnerable populations. Developmental vulnerability may not follow the area-level deprivation gradients.

4.1 Background

Investment in early childhood development is essential for the attainment of a healthy equitable society.[150-151] Indeed there is a growing consensus that investment in high quality support to children and families through pregnancy, birth and the early years results in improved outcomes later in life.[36] There is also considerable biological evidence that creating supportive environments enhances brain development in the crucial years between the ages of 0 and 6 years.[13]

An evidence-based national policy on early childhood care and education is a fundamental strategy for achieving healthy child development.[7] Yet providing supportive early years environments is not confined to education and health policy. Social supports, family-friendly employment policies and provision of quality child-care are also crucial.[152] These supports should be available to all families regardless of means.

At the same time, there is a social gradient in child development with children who grow up experiencing poverty and disadvantage at greater risk of poor health and social outcomes.[51] There is therefore a need for additional support to families where children are at greater risk.[153]

Investment in early years care and education through a combination of targeted and universal approaches is generally accepted as the optimum approach. Yet many questions remain regarding how best to achieve the balance between targeting and universalism. In many instances, programmes which target specific population groups which are considered to be at greatest risk of poverty are favoured. However, this may be too narrow an approach. Lynch,[149] in an analysis of the Avon Longitudinal Study, illustrated that targeting based on specific family characteristics can exclude children at risk (because they fall outside the proposed target group) and can also lead to stigmatising families based on characteristics (for example being a single, young parent).

In Ireland, there is a dearth of child-level indicators to inform policy on universal and targeted resources.[60] The Early Development Instrument (EDI) is a unique, population-level indicator of early child development.[62] It has the potential to provide census-type data on child development outcomes across five domains of development, thereby, providing a well-validated alternative to adult-level socio-economic indicators. Analysis at the level of the family, community and school can inform targeted and universal strategies.

The aim of this study was to explore variation in child development outcomes at school and area level and examine the implications for policy and practice in early childhood support programmes.

4.2 Methods

This cross-sectional study of child development was implemented with children in their first year of formal education in 42 of the 47 primary schools in Cork City and five schools in an adjoining rural area in 2011.[154] Five schools in the city declined to take part. All eligible children in the participating schools were invited to be included in the study. Eligibility criteria were: having completed a minimum of 4 to 5 months of formal education; being known by the teacher for more than one month; and not having left the school.[154]

4.2.1 Measurement of child development - the EDI

Child development at school entry age was measured using the Early Development Instrument (EDI). Designed at the Offord Centre for Child Studies, McMaster University, Ontario in the late 90s, it measures the extent to which children have attained the physical, social, emotional and cognitive maturity necessary to engage in school activities.[75]

The instrument consists of five domains, namely: **Physical health and well-being** (fine and gross motor skills, physical readiness for the school day and child health); **Social competence** (self-confidence, ability to play, get along with others and share); **Emotional maturity** (ability to concentrate, help others, patient, not aggressive or angry); **Language and cognitive development** (interest in reading and writing, ability to count and recognise numbers and shapes); and **Communication skills and general knowledge** (ability to tell a story, communicate with adults and children, and articulate themselves).[154]

The EDI is a well validated instrument which has had extensive psychometric testing done both in Canada and Australia.[62 75 78 84 97] In this Irish study, the EDI had good internal consistency by domains with Cronbachs alphas of between 0.8 and 0.96.

4.2.2 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.[154]

Passive consent was used in line with previous EDI studies in Canada. A total of seven parents opted not to participate. Ethical approval was granted by the Clinical Research Ethics Committee of the Cork Teaching Hospitals.

4.2.3 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 and 10). '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'. 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.

4.2.4 Explanatory variables

Each child's age was calculated from her/his 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.

4.2.4.1 Area-level disadvantage

The Irish National Deprivation Index for Health and Health Service Research 2013 (SAHRU Index) was used as a measure of area-level disadvantage. The index is based on a score calculated at the level of Electoral Division (there are 3409 EDs in Ireland) using principal components analysis from a weighted combination of four indicators from the 2011 census, namely: unemployment; low social class; local authority housing; and no car.[155] It was developed to specifically reflect material disadvantage and is a relative index. Children were identified as residing in one of three tertiles ranging from most to least deprived based on the position of their ED relative to all other EDs nationally.

4.2.4.2 School level disadvantage

School-level disadvantage was measured by identifying schools in the Irish Department of Education and Skills initiative Delivering Equal Opportunities in Schools (DEIS) which targets resources towards schools with higher concentrations of disadvantage.[156] Schools were designated as 'DEIS Band 1' – highly disadvantaged urban schools, 'DEIS Band 2' – urban schools with a significant but lesser degree of disadvantage and 'DEIS Rural'. DEIS status was allocated based on a survey of enrolment using the following criteria: unemployment; % local authority

accommodation; % lone parenthood; % travellers; % large families (5 or more); and % pupils eligible for free books. Schools continue to receive additional supports based on their DEIS status.[157] There were no schools with 'DEIS rural' designation within the area covered by this study.

In Ireland children living in the same area may attend a variety of schools. Residence in an area of high deprivation does not automatically mean that a child will also attend a designated disadvantaged school.

4.2.5 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.

Univariate analysis was used to explore the impact of individual, school and area-level variables on overall vulnerability (i.e. being in the lowest 10% in at least one domain). These were then entered into logistic regression models to predict likelihood of vulnerability. The first model adjusted for age, gender and ESL. The second model adjusted for all other factors. The second model was also used to predict the likelihood of vulnerability in each of five developmental domains.

In order to examine the effects of school and classroom level variation on the variables of interest a further mixed effects multiple logistic regression model was created. As it was not possible to create this model in SPSS, STATA 12 was used. All factors from the previous logistic regression model were entered as fixed effects and two further variables – school and classroom – were added as random effects.

Population attributable fractions (PAF) were used to estimate the proportion of risk attributed to each of the explanatory factors in the final regression,[142-143] using the method recommended by Greenland and Drescher[144] for cohort and cross-sectional studies.

4.3 Results

EDI questionnaires were distributed to the teachers of 1474 children. A total of 1344 (91%) were returned completed and valid. Of these, 46% (n=615) were for 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 12.4% of the children reported to have English as a Second Language (ESL) and 36 different languages spoken.

The study population lived in 136 different EDs. Over half of all children (58%) lived in electoral districts which were in the most deprived tertile. At the same time, only 27% attended schools which were designated as highly disadvantaged (DEIS band 1) and a further 16% attended schools which were somewhat disadvantaged (DEIS band 2). Almost half (42%) of all children living in the most deprived areas attended schools which were not part of the designated disadvantaged scheme.

4.3.1 Vulnerability

Over one quarter (27.5%) of children in the study were developmentally vulnerable (i.e. in the lowest 10th percentile for one or more domains). In total 11% were vulnerable in only one domain, 6% in two domains, 4% in three domains, 3% in four domains and 3% were vulnerable in all five domains.

Rates of vulnerability were considerably higher among boys (34%), those under five years of age (36%), and children who had English as a second language (53%). Indeed, these groups of children had significantly lower mean scores across all domains of development (see Table 7). Children who had not attended pre-school had particularly high vulnerability rates at 61%.

There was a gradient in vulnerability by type of school attended. Children attending the most disadvantaged schools had a vulnerability rate of 35%, those in schools designated as DEIS Band 2, 31% and those in non disadvantaged schools 23%.

Children living in the most deprived areas had a vulnerability rate of 30% compared to those in the least deprived areas who had a vulnerability rate of 24%. Table 7 outlines vulnerability rates and mean domain scores.

4.3.2 Univariate analysis

Factors strongly associated with developmentally vulnerable at the individual level were: being male (OR 2.17, CI 1.68 to 2.79); being under five years of age at the time of the study (OR 1.64, CI 1.22 to 2.21); and having English as a second language (OR 3.66, CI 2.63 to 5.12). Children who had not attended pre-school showed almost five times the odds of being vulnerable (OR 4.64, CI 2.29 to 7.36).

A significant gradient was evident by the type of school attended with children attending schools designated as having a high level of disadvantage having increased odds of vulnerability (OR 1.82, CI 1.38 to 2.39) when compared with those attending non-disadvantaged schools.

There was no significant difference in the risk of vulnerability between those living in the least deprived and mid-level deprived areas with only a marginal increase among those in the most deprived areas (OR 1.33, CI 1.01 to 1.76).

Table 7: Mean domain scores at child, school and area level

		Vulnerability	Physical Health & Well-being	Social Competence	Emotional Maturity	Language & Cognitive Development	Communication Skills & General Knowledge
	N	%	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Total population	1344	27.5	8.63 (1.59)	8.10 (1.93)	7.63 (1.66)	8.59 (1.87)	7.22 (2.92)
Boys	710	34	8.46 (1.70)	7.75 (2.04)	7.30 (1.76)	8.46 (2.01)	6.81 (3.05)
ESL	166	53	8.22 (1.67)	7.51 (1.92)	7.16 (1.68)	7.94 (2.11)	4.49 (3.10)
Age <5 years	239	36	8.12 (1.74)	7.75 (1.84)	7.32 (1.71)	8.07 (2.03)	6.59 (3.07)
No pre-school	82	61	7.18 (2.20)	6.90 (2.21)	6.74 (1.73)	6.86 (2.68)	4.61 (3.29)
School-level disadvantaged status							
No disadvantage	760	23	8.92 (1.38)	8.30 (1.80)	7.83 (1.53)	8.90 (1.71)	7.55 (2.75)
Moderate	220	31	8.41 (1.66)	7.78 (2.07)	7.21 (1.91)	8.32 (1.95)	6.94 (3.11)
High disadvantage	364	35	8.18 (1.79)	7.86 (2.04)	7.45 (1.72)	8.11 (2.01)	6.70 (3.17)
Area-level deprivation							
Least deprived	384	24	9.13 (1.24)	8.24 (1.89)	7.85 (1.74)	9.13 (1.53)	7.59 (2.84)
Mid deprived	179	26	8.82 (1.39)	8.26 (1.87)	7.59 (1.64)	8.84 (1.63)	7.47 (2.91)
Most deprived	778	30	8.34 (1.71)	7.99 (1.96)	7.52 (1.63)	8.26 (2.00)	6.98 (3.00)

4.3.3 Logistic regression

The findings from the univariate analysis and the logistic regression models are outlined in Table 8. When adjusted for all other variables, the factors most strongly associated with vulnerability were being male, having English as a second language, not attending pre-school and attending a designated disadvantaged school. Area of residence was not a significant factor.

Logistic regression (adjusting for all variables in the model) was also used to determine the odds of vulnerability in each domain of development (see table 11). Children who did not attend pre-school had increased odds of vulnerability across all five domains. Those living in the most deprived tertile showed increased odds of vulnerability in the physical health and well-being domain (OR 2.53, CI 1.48 to 4.33) and the language and cognitive development domain (OR 2.16, CI 1.31 to 3.45). Those attending a designated disadvantaged school showed increased odds of vulnerability in four of the five domains.

Table 8: Univariate analysis and logistic regression predicting the odds of developmental vulnerability on EDI scores

	OR (95% CI)†	OR (95% CI)‡	OR (95% CI)ƀ
Age <5	1.64** (1.22 to 2.21)	1.55** (1.12 to 2.13)	1.38 (0.99 to 1.95)
Male	2.17*** (1.68 to 2.79)	2.40*** (1.84 to 3.14)	2.52*** (1.90 to 3.33)
ESL	3.66*** (2.63 to 5.12)	4.09*** (2.88 to 5.82)	3.61*** (2.49 to 5.25)
Area-level deprivation (ref: least deprived)			
Most deprived	1.33* (1.01 to 1.76)	1.50** (1.11 to 2.03)	1.17 (0.83 to 1.64)
Mid deprived	1.13 (.75 to 1.70)	1.42 (0.92 to 2.19)	1.29 (0.81 to 2.04)
School-level deprivation (ref not disadvantaged)			
High disadvantage	1.82*** (1.38 to 2.39)	1.80*** (1.33 to 2.45)	1.66** (1.19 to 2.33)
Moderate	1.55** (1.11 to 2.16)	1.54* (1.08 to 2.20)	1.39 (0.96 to 2.03)
No Pre-school	4.64*** (2.92 to 7.36)	4.08*** (2.51 to 6.63)	3.94*** (2.42 to 6.43)

*p<0.05, **p<0.01, ***p<0.001. †Univariate analysis. ‡Adjusted for age, gender and ESL (separate tests run for each subsequent variable). ƀAdjusted for all other variables in one model.

4.3.4 Multi-level model

A mixed effects model was used to examine the effects of school and classroom variation on odds of vulnerability previously calculated for the independent variables in the logistic regression model. The model showed significant variation at the level of the classroom (random intercept = 0.678, standard error = 0.15) but not at the level of the school (random intercept = 0.311, standard error = 0.24). However, the addition of these random effects had very limited impact on the odds of vulnerability for the variables of interest (see table xxx).

Table 9: Comparison of odds ratios resulting from logistic regression and multi-level model

	Logistic Regression	Multi-level model
	OR (95% CI)	**OR (95% CI)**
Age <5	1.38 (0.99 to 1.95)	1.30 (0.89 to 1.88)
Male	2.52 (1.90 to 3.33)	2.74 (1.92 to 3.92)
ESL	3.61 (2.49 to 5.25)	4.07 (2.67 to 6.20)
Area-level deprivation (ref: least deprived)		
Most deprived	1.17 (0.83 to 1.64)	1.06 (0.70 to 1.63)
Mid deprived	1.29 (0.81 to 2.04)	1.29 (0.76 to 2.21)
School-level deprivation (ref non-DEIS)		
High disadvantage	1.66 (1.19 to 2.33)	2.03 (1.12 to 3.68)
Moderate	1.39 (0.96 to 2.03)	1.71 (0 .89 to 3.27)
No Pre-school	3.94 (2.42 to 6.43)	4.24 (2.48 to 7.25)

4.3.5 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 10). Being male accounted for 31% of the overall vulnerability. English as a second language accounted for 12%. Attending a school with a designated disadvantaged status accounted for 9%, while non-attendance at pre-school accounted for a total of 7% of the risk in the study population. Collectively, the risk areas outlined accounted for 76% of the risk of vulnerability.

Table 10: Population attributable fraction for vulnerability based on OR adjusted for all other variables

	N (%)	OR (95% CI)	PAF (95% CI)
Age <5	239 (18)	1.38 (0.99 to 1.95)	4.0 (-3.9 to 8.3)
Male	710 (53)	2.52*** (1.90 to 3.33)	31.6 (22.1 to 40.0)
ESL	166 (12)	3.61*** (2.49 to 5.25)	12.0 (8.3 to 15.6)
Area-level deprivation (ref: least deprived)			
Most deprived	778 (58)	1.17 (0.83 to 1.64)	5.9 (-7.5 to 17.6)
Mid deprived	179 (13)	1.29 (0.81 to 2.04)	2.0 (-1.8 to 5.7)
School-level deprivation (ref non-DEIS)			
High disadvantage	364 (27)	1.66** (1.19 to 2.33)	9.3 (2.9 to 15.2)
Moderate	220 (16)	1.39 (0.96 to 2.03)	3.5 (-0.7 to 7.6)
No Pre-school	82 (6)	3.94*** (2.42 to 6.43)	7.1 (4.5 to 9.6)

*p<0.05, **p<0.01, ***p<0.001. Adjusted for all other variables

Table 11: Logistic regression to determine the odds of vulnerability by each domain of development

	Physical health & well-being OR (95% CI)	Social competence OR (95% CI)	Emotional maturity OR (95% CI)	Language & Cognitive Development OR (95% CI)	Communication Skills & General Knowledge OR (95% CI)
Age <5	1.49 (0.98 to 2.29)	1.04 (0.66 to 1.65)	1.21 (0.78 to 1.88)	1.53 (1.00 to 2.33)	1.18 (0.76 to 1.82)
Male	2.08*** (1.43 to 3.04)	2.64*** (1.78 to 3.91)	2.58*** (1.75 to 3.79)	1.75** (1.21 to 2.53)	2.65*** (1.81 to 3.89)
ESL	1.84* (1.13 to 3.00)	1.66* (1.03 to 2.69)	1.49 (0.92 to 2.42)	2.18*** (1.38 to 3.45)	7.47*** (4.9 to 11.38)
Area deprivation (ref: least deprived)					
Most deprived	2.53*** (1.48 to 4.33)	0.84 (0.54 to 1.31)	0.70 (0.45 to 1.10)	2.16** (1.31 to 3.55)	1.51 (0.94 to 2.43)
Mid deprived	2.20* (1.10 to 4.41)	0.95 (0.51 to 1.77)	1.06 (0.59 to 1.92)	1.79 (0.91 to 3.55)	2.08* (1.10 to 3.92)
School level deprivation (ref not disadvantaged)					
High disadvantage	1.76** (1.15 to 2.69)	1.87** (1.19 to 2.94)	2.29*** (1.45 to 3.62)	1.42 (0.92 to 2.18)	2.30*** (1.48 to 3.56)
Moderate	1.29 (0.77 to 2.15)	1.67* (1.03 to 2.73)	2.60*** (1.63 to 4.15)	1.21 (0.74 to 2.00)	1.72* (1.06 to 2.81)
No Pre-school	4.40*** (2.58 to 7.49)	2.86*** (1.66 to 4.94)	1.93* (1.07 to 3.51)	4.92*** (2.97 to 8.15)	4.50*** (2.66 to 7.61)

*p<0.05, **p<0.01, ***p<0.001

4.4 Discussion

In this cross-sectional study conducted in a major Irish urban centre 27.5% of children in their first year of primary school were developmentally vulnerable and, therefore, less ready to begin formal education. This level of vulnerability is comparable to that found in urban areas in Canada and is considered amenable to change through early childhood intervention.[158] At an individual level, being under 5 years of age, being a boy and having English as a second language all led to increased risk of vulnerability.

Children attending designated disadvantaged schools had increased odds of developmental vulnerability. In particular, children attending schools with the greatest level of disadvantage (DEIS Band 1) had almost twice the odds of being vulnerable as those attending non-disadvantaged schools. As the study is concerned with developmental health at school entry, the results are indicative of the intake and not school performance.

At the same time, 47% of children who were vulnerable attended schools where these additional supports were not available. Designated disadvantaged status was conferred on schools based on the demographics make-up of the pupils in 2005.[157] Ireland has changed considerably since then. The economic crisis has impacted on children and families. Some areas have been affected more than others. It may be necessary, therefore, to review the DEIS programme.

Residence in an area in the most deprived tertile (based on being in the most deprived third of Electoral Districts in the whole country) did not emerge as a factor strongly predicting the risk of vulnerability. Some gradient was evident between the most affluent and most deprived tertiles but this was not significantly associated with the odds of vulnerability. The exceptions to this were in the 'physical health and well-being' and in the 'language and cognitive development' domains. Cushon et al[110] found a similar results in Saskatchewan with a significant gradient in only the 'physical health and well-being' domain. At the same time, a

previous publication from this study (Curtin et al)[154] showed a strong social gradient based on family-level characteristics evident in the same study population.

The lack of a clear area-level gradient is consistent with other studies which found that area-level variation in child development is influenced by factors other than standard indicators of material wealth.[37] Community-level processes and implementation of support programmes can result in some neighbourhoods showing better developmental outcomes than would have been predicted based solely on socio-economic indicators. The opposite effect has also been observed in some seemingly affluent neighbourhoods. This results in a complex picture which can only be captured by collecting population-level child development data.[116]

The study found that children who had not attended pre-school were four times more at risk of being developmentally vulnerable than those who had. Indeed, when PAF were calculated non-attendance at pre-school accounted for 7% of the risk of vulnerability in the study population. Moreover, this increased risk was evident across all five domains of development. It is well recognised that accessible, high quality pre-school care enhances children's cognitive and social development particularly among children experiencing disadvantage.[40] Results from the Perry pre-school project show that positive outcomes carry through to adult life.[159] This study was conducted in the year prior to the implementation of a universal free pre-school year in Ireland. It is likely that this initiative will have enhanced child development outcomes.

Vulnerable children were not confined to areas where there are high levels of material deprivation. The PAF demonstrated that living in an area of material deprivation or attending a designated disadvantaged school accounted for only 21.8% of the total population risk of vulnerability. This raises questions as to how best to target initiatives to ensure that all children have the best start in life and has implications for policy on early years' supports. Targeted initiatives alone are not adequate to address inequalities in healthy child development. In line with Rose's population health strategy,[53] a whole population approach is necessary. A system

of 'proportionate universalism' as proposed by the Marmot review[133] would provide services for early childhood care and education to all children but with a concentrated focus on populations of children at greatest risk.

The EDI provides an opportunity to develop a data-base on early childhood development whereby populations of children at risk can be identified and outcomes of both targeted and universal strategies measured. Moreover, the EDI has successfully illustrated variation in vulnerability rates at the level of the Electoral District ranging from 0% to 56% and at the school level varying from 0% to 75%, providing an accurate picture of developmental health.

In Canada, where the EDI has been used extensively over the past decade, it has been possible to map areas of concentrated vulnerability and track changes over time.[158] Some maps have been produced using data from the current Cork study. These have been limited to city Electoral Divisions where there is a population of more than 10 eligible children and where the study included at least 60% of the eligible population. However, the potential exists for effective area level mapping of vulnerability rates in a larger study. A sample map is included in Figure 9.

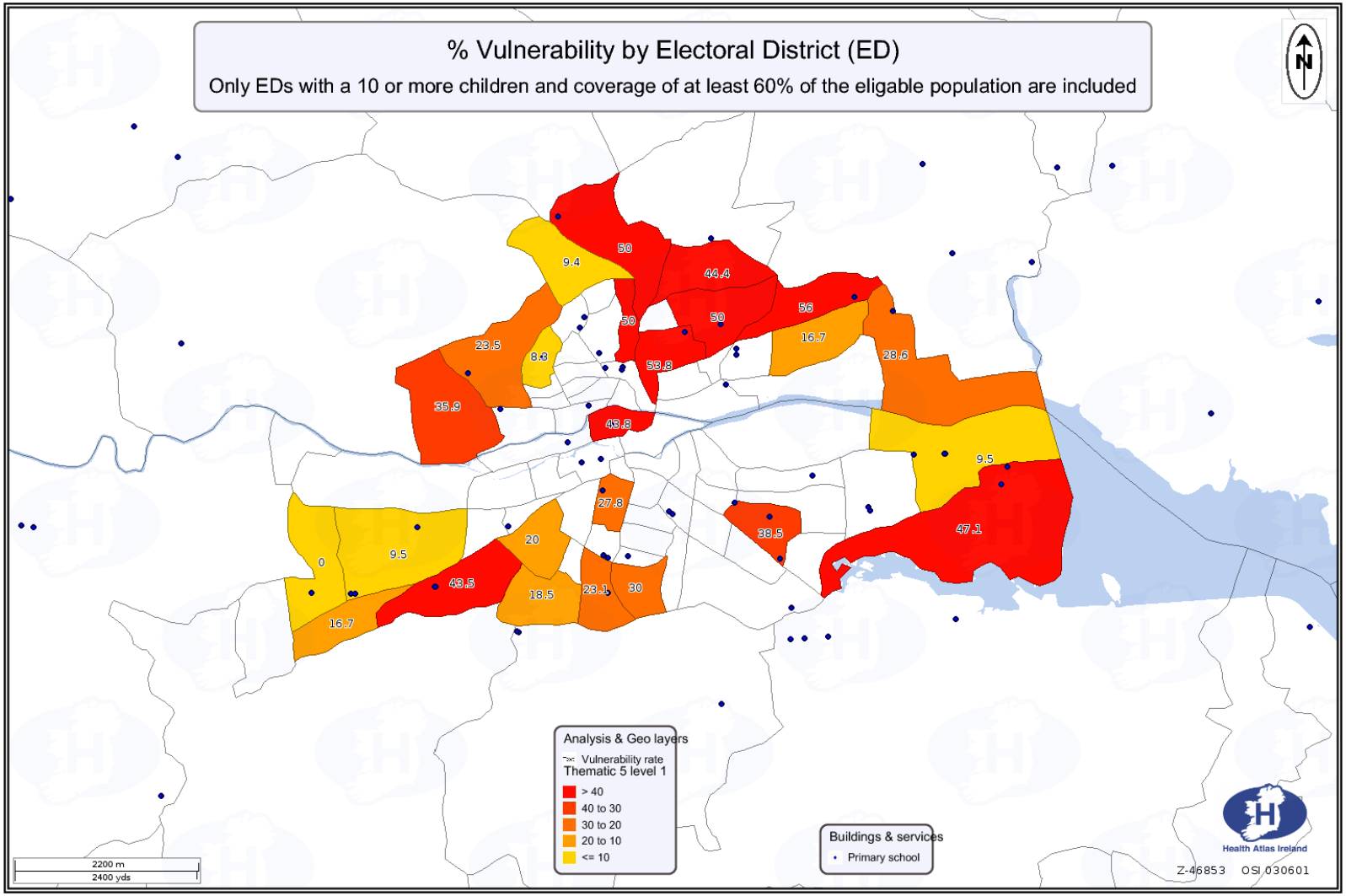
4.4.1 Limitation

The study was confined to one urban and adjoining rural area in Ireland. This limited the number of Electoral Divisions and the social range. However, it is unlikely the results would change significantly if a broader group were included.

4.4.2 Conclusion

This study illustrates the value of universally accessible pre-school education and the provision of additional supports to schools with highly vulnerable populations. Developmental vulnerability does not follow the area-level deprivation gradient as it is also influenced by community processes and social programmes. Population-level data on child development outcomes is essential if support programmes are to target areas with the highest concentrations of vulnerability. The EDI can provide such data.

Figure 9: Map of vulnerability in city Electoral Divisions



CHAPTER 5: ARE THE SPECIAL EDUCATIONAL NEEDS OF CHILDREN IN THEIR FIRST YEAR IN PRIMARY SCHOOL IN IRELAND BEING IDENTIFIED – A CROSS-SECTIONAL STUDY?

Paper published in BMC Pediatrics, February 2014

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5.0 Abstract

Background: If the window of opportunity presented by the early years is missed, it becomes increasingly difficult to create a successful life-course. A biopsychosocial model of special educational need with an emphasis on participation and functioning moves the frame of reference from the clinic to the school and moves the focus from specific conditions to creating supportive environments cognisant of the needs of all children. However, evidence suggests that an emphasis on diagnosed conditions persists and that the needs of children who do not meet these criteria are not identified.

The Early Development Instrument (EDI) is a well-validated, teacher-completed population-level measure of five domains of child development. It is uniquely placed, at the interface between health and education, to explore the developmental status of children with additional challenges within a typically developing population. The aim of this study was to examine the extent to which the special educational needs of children in their first year of formal education have been identified.

Methods: This cross-sectional study was conducted in Ireland in 2011. EDI (teacher completed) scores were calculated for 1,344 children. Data were also collected on special needs status and on children identified by the teacher as needing assessment. Mean developmental scores were compared using one-way ANOVA.

Results: Eighty-three children in the sample population (6.2%) had identified special educational needs. A further 132 children were judged by the teacher as needing assessment. Children with special needs had lower mean scores than typically developing children, in all five developmental domains. Children considered by the teacher to be in need of assessment also had lower scores, which were not significantly different from those of children with special needs. Children needing assessment were more likely to have speech, emotional or behavioural difficulties. There was also a social gradient among this group.

Conclusion: A small but significant number of children have not had their needs adequately assessed. Teacher observation is an effective means of identifying children with a level of impairment which prevents them from fully participating in their educational environment and could be integrated into a multi-disciplinary approach to meeting the needs of all children.

5.1 Background

If the window of opportunity presented by the early years is missed, it becomes increasingly difficult, in terms of both time and resources, to create a successful life course.[16] The foundations for virtually every aspect of human development – physical, intellectual and emotional - are laid in early childhood.[1] What happens in the early years has lifelong effects on health and well-being – from obesity, heart disease and mental health, to educational achievement and economic status - and it is therefore a crucial period for reducing inequalities.[133] Yet for many children developmental delay remains undetected until the formal education years leading to a greater risk of academic failure, behavioural problems and long-term socio-economic disadvantage.[13]

An understanding of child development as a social process of interaction between children and their environment[51] is compatible with a shift from a 'medical' to a 'social' understanding of disability and special educational needs.[160] A biopsychosocial model of child development - with an emphasis on participation, functioning and the child's ability to interact with their environment - underpins the World Health Organisation's International Classification of Functioning (ICF) Disability and Health[161] and has led to a shift from a deficit model of individual disability to a focus on inclusive education and interdisciplinary working between education, health and social services.[162] This moves the frame of reference from the clinic to the school and moves the focus from children identified through a standard, predominantly biomedical, framework to those identified by teachers as requiring additional support.[163]

Children with special educational needs should be identified as early as possible. Appropriate early intervention is effective at providing sustained solutions and, as a direct consequence, children show improved self-esteem and socialisation and enjoy more successful and rewarding participation in their community. Early intervention is vital but to obtain this an early assessment is needed. Ideally

children should be assessed in pre-school, as the earlier the assessment, the greater the chance he or she has of developing coping strategies.[164]

In Ireland, the Education of Persons with Special Educational Needs (EPSEN) Act 2004 provides a legislative underpinning for inclusive education for all children with an identified educational need, not confined to those with an identifiable disability or diagnosis.[165] However, the Irish systems and services have not changed in line with the act resulting in an emphasis on identified medical conditions instead of participation and functioning.[166] Children with less clearly defined needs are therefore less likely to benefit. Moreover, as a result of differing understandings, estimation of the number of children with special educational needs varies resulting in problems with resource allocation.[148]

Distinction is also necessary between assessment for the purpose of identifying children's learning needs and assessment for the purpose of resource allocation. Where this distinction becomes blurred, children are at risk of being prematurely labelled in an attempt to ensure that they qualify for support.[167] Qualitative studies suggest that, in Ireland, this emphasis on diagnosis persists.[148 168-169]

5.1.1 The Early Development Instrument

This study used the Early Development Instrument (EDI) to assess the development status of children in their first year of formal education.[154] The EDI is a well-validated, teacher-completed population level measure of five domains of child development at school entry age designed at the Offord Centre for Child Studies, McMasters University, Hamilton, Ontario in the late 1990s.[84] It is uniquely placed, at the interface between health and education, to explore the developmental status children with additional challenges in the context of a typically developing population. At the same time, the EDI is a population level measure and not a diagnostic tool. It is based on the premise that universal approaches work best in improving long term developmental outcome for all children and provides evidence

to establish the incidence and distribution of developmental delay and to identify populations of children at greater risk.[77]

The instrument consists of five domains and 104 questions. The domains are **Physical health and well-being** (fine an gross motor skills, physical readiness for the school day and child health); **Social competence (**self-confidence, ability to play, get along with others and share); **Emotional maturity** (ability to concentrate, help others, patient, not aggressive or angry); **Language and cognitive development** (interest in reading and writing, ability to count and recognise numbers and shapes); and **Communication skills and general knowledge** (ability to tell a story, communicate with adults and children, articulate themselves).[154]

This study, for the first time, within a typically developing Irish population, quantified the extent to which the special educational needs of children in their first year of formal education are being met. The aim of this study was to examine, at a population level, using EDI data, the extent to which children in their first year of formal education have their developmental and special educational needs identified.

5.2 Methods

This cross-sectional 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 out of 47 primary schools in Cork city in April/May 2011 and a further five schools in an adjoining rural community. Five schools in the city declined to participate. These declining schools were representative of a cross section of schools in the city and would not affect the composition of the study.[154] Parents of all eligible children in the participating schools were informed about the study and invited to have their child included. Eligibility criteria were: being in the latter half of the first year of formal education, being in the class more than one month and not having left the school.

Ireland is a largely homogenous country and Cork City is typical of the Irish urban population. Moreover, the education system is consistent throughout the country, with all schools adhering to nationally defined curriculum and standards. Therefore, the study is representative of the situation of children in Irish schools.

5.2.1 Data collection

The EDI was used to measure child development at school entry age. It 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 each issued with an EDI guide book. Children were not present when the questionnaire was completed and no individual identifiers were recorded. Passive consent was used in line with EDI studies conducted in Canada. The class teacher distributed an information letter to all parents two weeks before the study commenced. This contained detailed information on the study and parents were asked to contact the school if they did not want their child included. A form ID was assigned to each child which was used on both the EDI and Parental Questionnaire.[154]

5.2.2 Ethics Statement

Ethical approval for the study was granted by the Clinical Ethics Committee of the Cork Teaching Hospitals. Passive consent (i.e. parents were given information on the study and asked to contact the school if they did not want their child included) was used as children were not present when the questionnaire was completed and no individual identifiers were provided to the research team. This is in line with international best practice in EDI studies.[75]

5.2.3 Parental Questionnaire

In 2003 the Offord Centre developed and tested a parental questionnaire to complement the results of the EDI and provide a deeper population level context to

the lives of children.[120] We adjusted the questionnaire to suit the Irish context and incorporated questions from the Growing Up in Ireland study[139] and the SLAN Study of Lifestyle, Behaviour and Nutrition in Ireland.[72]

The parental questionnaire provided contextual data on many aspects of the children's lives which have been described elsewhere.[154] However, in this study we were specifically interested in and only used data collected on utilisation of developmental support services.

The parental questionnaires were administered at the same time as the EDI 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. Data from the parental questionnaires was linked to the teacher filled questionnaire using the Form ID number and crosschecked using the recorded date of birth and gender. Questions were constructed in a Likert type response format - yes, no or three to five response options.

5.2.4 Independent Variables

For the purposes of this study three specific groups of children were identified and compared (see figure 10). These were:

1 Children with Special Needs

Children in the 'special needs' group refers to those who had been identified as needing special assistance in the classroom through the nationally recognised assessment process. In Ireland this is defined as having a 'Special Education Condition' which has been recognised through a standardised assessment procedure [140]. In Section 1 of the EDI questionnaire teachers reported on whether the child had a special need identified through the above process. This did not seek

the teachers opinion only information on whether the child had already received this designation.

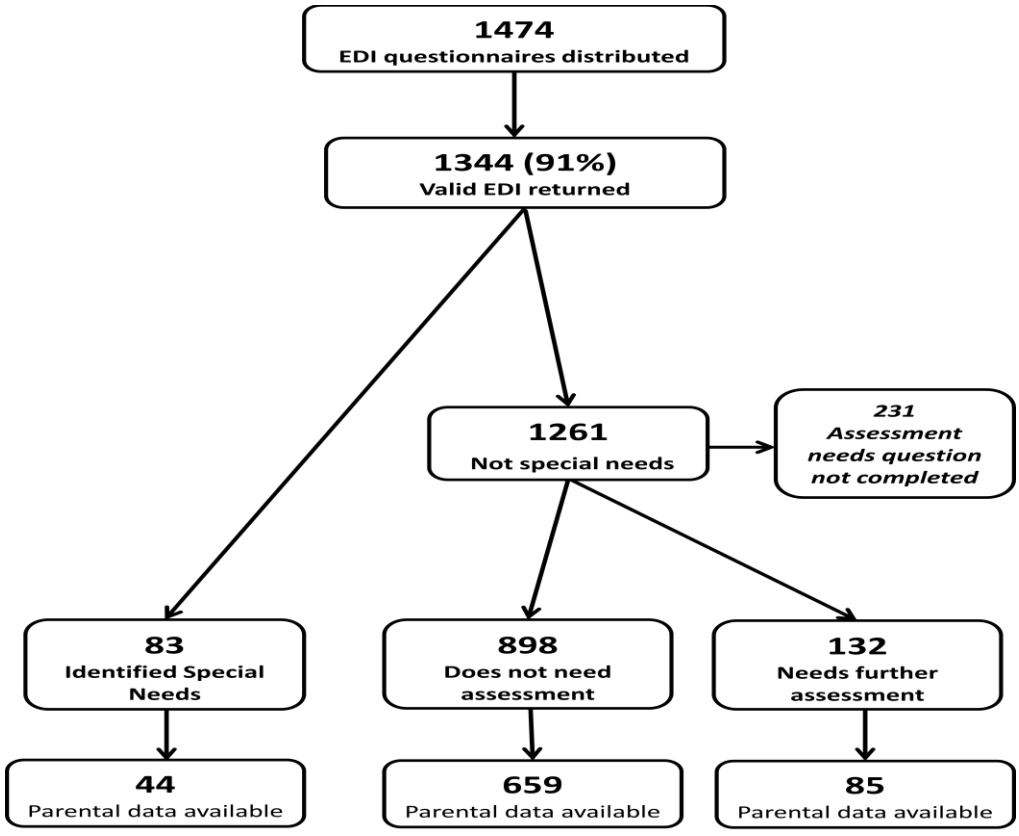
2 Needs further assessment

Children who needed further assessment were those who had not been identified as having a Special Educational Condition through the standardised national assessment process but whom the teacher, based on her observation in the classroom, believed were in need of assessment. As part of the EDI questionnaire the teacher was asked whether, in her opinion, the child needed assessment.

3 Typically developing children

This refers to children who did not have a previously identified special need and who were not deemed by the teacher as needing further assessment.

Figure 10: Special needs designation



5.2.5 Dependant variables

Children in the three groups outlined above were compared using a number of variables. Comparisons were primarily made on EDI mean scores and vulnerability rates but also in relation to type of impairment, services accessed and residence in an area of deprivation/affluence. Data on EDI scores and type of impairment were obtained from the EDI questionnaire. Data on services accessed came from the parental questionnaire and data on area-level deprivation from the Irish National Deprivation Index for Health and Health Service Research 2013 (SAHRU Index). [155]

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

1 EDI scores

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 either a binary or 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. If 30% of questions in any domain were not scored, that domain is not included. If more than one domain was excluded then that child's score was not considered valid and excluded from the study. Domain scores referred to the child's mean score in that domain - ranging between 0 and 10. Higher scores indicated better results.

2 Vulnerability rate

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'[62]. Each domain was scored separately as children who were vulnerable in one area could not compensate through competence in another. Individual vulnerability was not reported rather

vulnerability rates, expressed as percentages are used. 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. Moreover, the EDI is a well validated instrument on which extensive psychometric testing has been conducted in both in Canada and Australia [62 75 78 84 97]. In the current study the EDI had good internal consistency by domains with Cronbach's α of between 0.8 and 0.96.

3 Impairment

In addition to questions aimed at assessing child development a section of the EDI questionnaire focused on special concerns. The teacher was asked whether the child had any impairment which influenced their ability to do regular classroom work and also whether s/he felt that the child needed further assessment.

Impairment referred to seven categories of problems that influenced the child's ability to do school work in a regular classroom. These were listed on the EDI questionnaire, namely: physical impairment, visual impairment, hearing impairment, speech impairment, learning disability, behaviour problem or emotional problem. These were based on difficulties experienced by the child, not diagnosis. If children experience difficulty in more than one category, each was included.

4 Services accessed (parental report)

This information was obtained from the parental questionnaire. Parents were asked if their child had received help from any of a list of seven development support services: speech and language services; blind or low vision services; occupational of physical therapy; hearing services; programmes/ services for behavioural issues; programmes/ services for developmental issues; or mental health programmes/services. Parents were only asked if the child had ever

'received help' from the service and information was not included regarding the nature or extent of the support received from that service.

5 Area-level Deprivation

The Irish National Deprivation Index for Health and Health Service Research 2013 (SAHRU Index) was used as a measure of deprivation. The index is based on a score calculated at the level of Electoral Division (3409 EDs in Ireland) using principal components analysis from a weighted combination of four indicators from the 2011 census, namely unemployment, low social class, local authority housing and no car[155]. Children were identified as residing in one of five quintiles ranging from most to least deprived based on their electoral division.

5.2.6 Data analysis

Data analysis was conducted using SPSS. Children were categorised into three groups, as outlined above. The mean scores in each of the five domains of development measured using the EDI were compared across the three groups of children using analysis of variance (ANOVA). As equality of variance could not be assumed, we used Tamhane's T2 post hoc test to evaluate the mean difference between the groups. Residuals were tested for normal distribution.

5.3 Results

EDI questionnaires were distributed to teachers of 1474 children in their first year of formal education in 47 schools. A total of 1344 (91%) were completed and valid, 52.3% of which related to boys. Of the 1344 children, 83 (6.2%) had previously been identified as having special needs, the majority of whom (68%) were boys. A further 132 children (10%) were judged by the teacher to need further assessment. Again, boys predominated at 66%. There was no significant difference in the mean age between typically developing children, children who had an identified special need and the third group of children who were classed by the teacher as in need of further assessment. Demographic characteristics of the study population are outlined in Table 12.

Table 12: Demographic characteristics and mean scores on each EDI domain by special needs or needs further assessment

	Typically developing	Special needs	Needs further assessment
Number (% total population)	898 (67)	83 (6)	132 (10)
% Boys	53	68	66
Age in years; mean (SD)	5.39 (.40)	5.55 (.52)	5.37 (.43)
% English as a second language	11	17	15
Vulnerable in one or more domain	17%	78%	69%
Domain scores	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**
Physical well-being	8.99 (1.21)	6.48 (2.24)	7.13 (1.92)
Social competence	8.47 (1.66)	5.91 (2.18)	6.37 (2.01)
Emotional maturity	7.98 (1.44)	5.94 (1.82)	6.17 (1.81)
Language and cognitive development	8.96 (1.50)	6.54 (2.68)	7.16 (2.37)
Communication and general knowledge	7.91 (2.53)	3.82 (2.98)	4.54 (2.83)

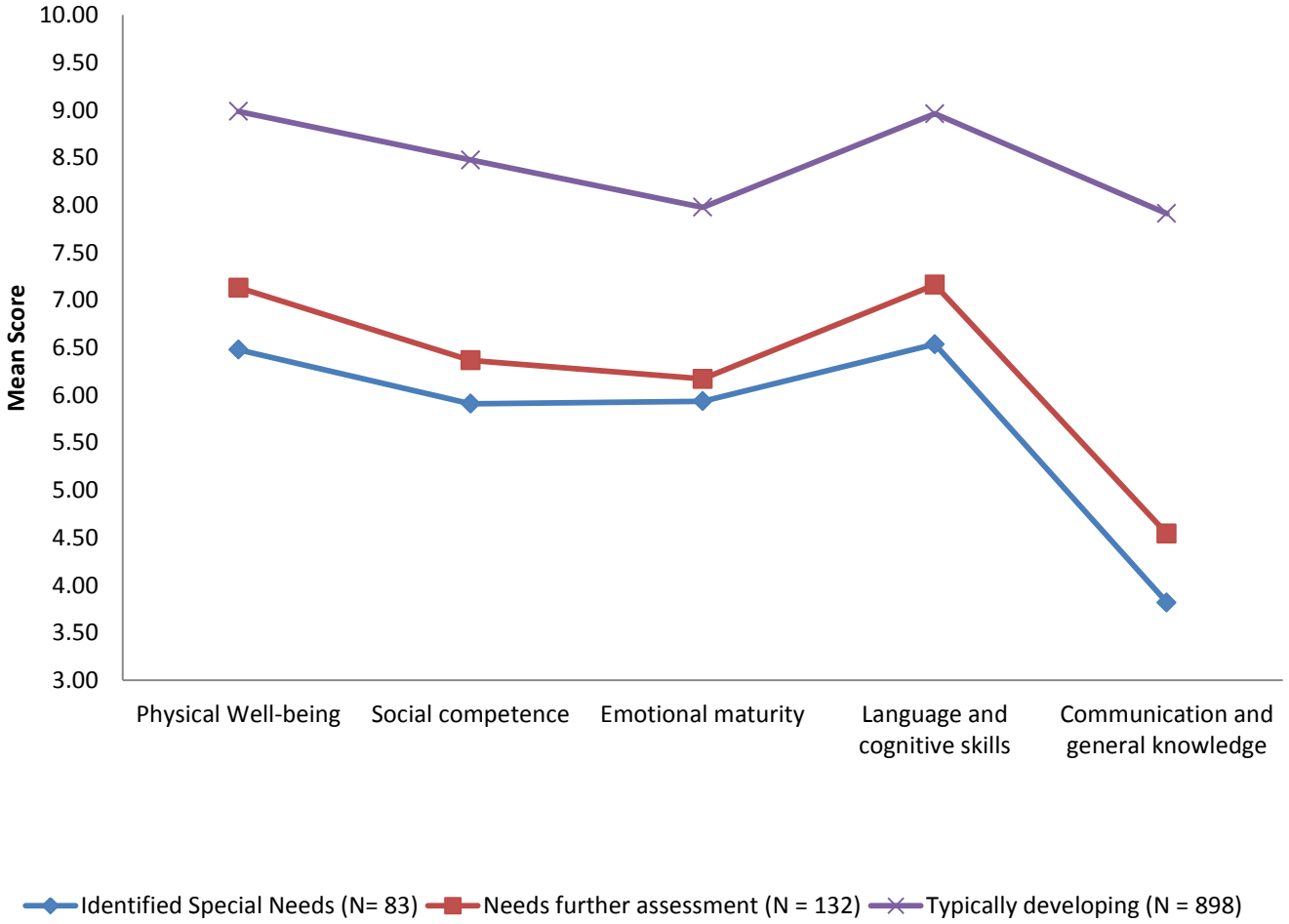
5.3.1 Developmental vulnerability

The study showed that 27% of children in the study population were developmentally vulnerable at school entry age. The vulnerability rate rose to 78% among children with an identified special need and 69% among children who did not have a special need but whom the teachers identified as needing further assessment. There was a strong correlation between vulnerability on the EDI and needing further assessment (correlation coefficient = 0.379, $p < 0.001$).

5.3.2 Mean scores for each group

Typically developing children had high mean scores across all domains (Table 12) and were, therefore, more likely to be developmentally ready to engage in school than those children who were identified with special educational needs or in need of further assessment. Mean scores across all five domains of development for each of the three groups are outlined graphically in Figure 11.

Figure 11: Mean domain scores by special needs status



When the mean scores in each domain were compared across the three groups using ANOVA there was a significant difference between the score of the typically developing group and each of the other two groups. However, there was no significant difference between the children with identified special needs and those needing further assessment (see Table 13). As test showed that equality of variance could not be assumed, Tamhane was used to examine the mean difference. Residuals were tested and shown to be normally distributed.

Table 13: Difference in mean scores between groups

Domain	Groups compared	Mean difference	Sig.	95% CI
Physical well-being	Typically developing vs needs further assessment	-1.86	.000	(-2.28 to -1.43)
	Typically developing vs special needs	-2.51	.000	(-3.13 to -1.88)
	Needs further assessment vs special needs	-.65	.101	(-1.39 to .09)
Social competence	Typically developing vs needs further assessment	-2.11	.000	(-2.55 to -1.67)
	Typically developing vs special needs	-2.57	.000	(-3.16 to -1.97)
	Needs further assessment vs special needs	-.46	.331	(-1.17 to .26)
Emotional maturity	Typically developing vs needs further assessment	-1.81	.000	(-2.2 to -1.41)
	Typically developing vs special needs	-2.04	.000	(-2.54 to -1.54)
	Needs further assessment vs special needs	-.23	.735	(- .85 to .38)
Language and cognitive development	Typically developing vs needs further assessment	-1.80	.000	(-2.31 to -1.29)
	Typically developing vs special needs	-2.42	.000	(-3.15 to -1.70)
	Needs further assessment vs special needs	-.63	.228	(-1.49 to .24)
Communication skills and general knowledge	Typically developing vs needs further assessment	-3.37	.000	(-4.0 to -2.74)
	Typically developing vs special needs	-4.09	.000	(-4.92 to -3.27)
	Needs further assessment vs special needs	-.72	.218	(-1.71 to .26)

**One-way ANOVA*

5.3.3 Impairment (specific problems)

One quarter (25%) of all children with identified special needs had a physical impairment. Almost half (45%) had a speech impairment, 39% a learning disability, 28% emotional and 24% behavioural problems. Relative to children with identified special needs, those designated as needing further assessment were less likely to have physical disability (5%). However, 39% were deemed by the teacher to have difficulties with speech and language, 22% learning difficulties, 19% emotional problems and 21% behavioural problems (Table 14).

5.3.4 Social Gradient

There was also evidence of a social gradient among children needing assessment. Over 15% of children living in the most deprived area quintile were deemed by the teacher as needing further assessment compared to 5.8% of those living in the most affluent quintile.

Figure 12: Percentage of children requiring further assessment by Deprivation Quintile

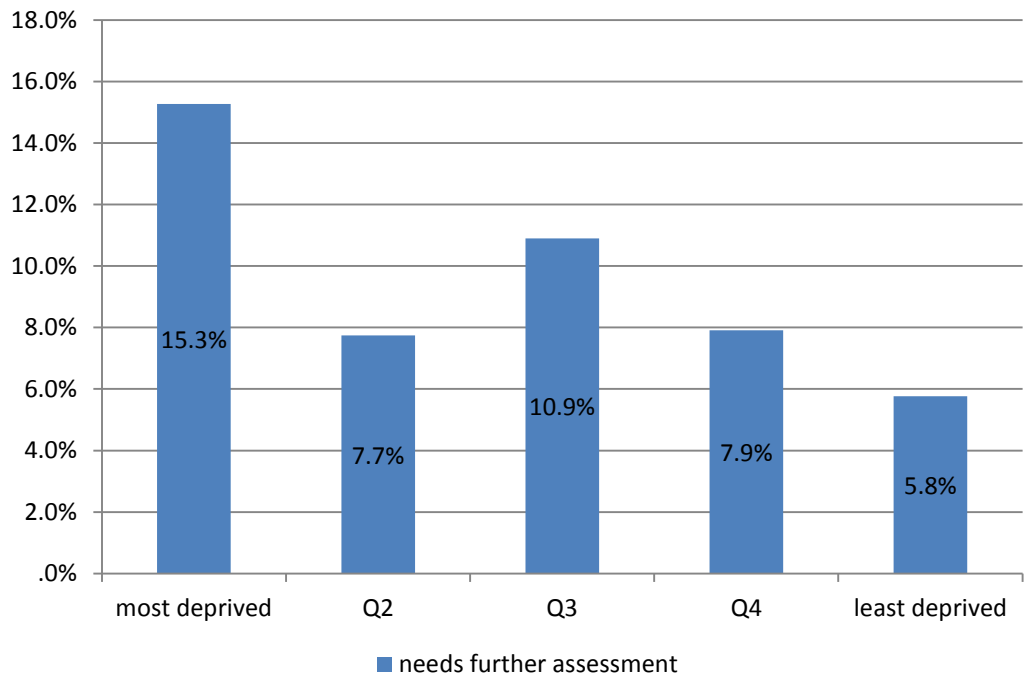


Table 14: Type of impairment among children with special needs or needing further assessment

	Physical Disability %	Visual Impairment %	Hearing Impairment %	Speech Impairment %	Learning Disability %	Emotional Problem %	Behavioural Problem %
Identified special needs	25.3	6.0	6.0	44.6	38.6	27.7	24.1
Needs further assessment	5.3	3.0	1.5	39.4	22.0	18.9	21.2

5.3.5 Services accessed

Information on services with which the children had contact was available on a subset of 963 children on whom parental questionnaires were returned. Of this subset, 44 (4.6%) were identified as special needs and 85 (8.8%) were deemed to need further assessment. Children for whom parental questionnaires were returned also had significantly higher mean scores in all developmental domains and were less likely to be scored as vulnerable on the EDI than those for whom parental data were not available.[154]

The majority of children who had special needs (85%) had accessed at least one support service. However, this was not the case for children who were identified as needing further assessment of whom less than half (48%) had accessed services. The services most commonly utilised by this group were Speech and Language services (36.6%) and Hearing Services (19%). They had very limited access to services for behavioural issues (5.1%), developmental issues (5.2%) or mental health (0). Services utilised are outlined fully in Table 14.

Table 14: Services accessed (based on parental reports)

	Special needs (N=44)* %	Needs further assessment (N=85)* %
Speech and language services	65.9	36.6
Blind or low vision services	9.8	2.5
Occupational or physical therapy	61.0	5.1
Hearing services	29.3	19.0
Services for behavioural issues	27.5	5.1
Services for developmental issues	37.5	5.2
Mental health programmes	5.1	0

*Parental data were available only on a sub-set of 963 children

5.4 Discussion

This paper illustrates that children who have special educational needs are at a greater risk of not being ready to engage in formal education. However, the majority (80%) do have access to support services. Of concern are the 10% of children in the study who were deemed by their teacher to be in need of further assessment. These children showed an equivalent level of vulnerability across all domains of development to the children with special needs but less than half had accessed any services. Learning difficulties, behavioural and emotional problems were prominent among this group. Yet they were more likely to have accessed hearing services than those which deal with their identified problems.

Children with a physical impairment were more likely to have had their special need identified. Only 5% of those who needed further assessment had a physical disability. Similar results from an evaluation of special needs referral in a large Head Start programme showed that children with emotional or behavioural problems were less likely to be referred for assessment.[170] Failure to support children experiencing difficulties in the early years can lead to low self esteem and a sense of worthlessness that can have a profound effect on the mental, social, emotional and cognitive development for the child concerned.

A recent report by the by the National Council for Special Education (NCSE) in Ireland highlighted a number of issues regarding the assessment of special educational needs in Ireland.[167] The assessment process is a continuum from the identification of class room based supports or in-school supports as assessed by teachers (for children with mild challenges) to external assessment of additional support needs where a child is experiencing more profound difficulty. The report raised concerns regarding the link between resource allocation and the diagnosis of a particular category of disability. It appears as imperative that a child has a label prior to any entitlement to additional supports. Some conditions are easier to detect than others, for example severe autism, Down's syndrome, cerebral palsy and other visible conditions. It is the so called 'hidden disabilities' that also need

early detection if the child is to be afforded every chance at a productive life. Indeed the necessity of a definitively diagnosed disability prior to recognition of special needs status is questionable.[171]

In the context of truly inclusive education, a strong focus on participation, functioning and the educational environment as opposed to diagnosis of particular conditions would ensure that the needs of all children are met. [172-173] The NCSE report states that while school principals have responsibility for seeking assessments when they consider it necessary, very often the number of assessments available to schools is limited resulting in long waiting lists and subsequent delays in allocating the required resources to support the child's learning needs. Parents can seek private assessments but these are expensive and therefore not assessable to children in families with limited financial resources. Where parents can afford to pay for private assessment, the child will benefit from more timely allocation of resources and support.[169] The social gradient in the number of children identified as requiring assessment in this study supports the assertion.

The strong link between assessment, identification of a particular 'condition' and allocation of resources may not serve the best interests of the child. The assessment should involve the development of an individual educational plan that builds on the child's strengths and supports their needs.[165] However, in the pressure to provide a diagnosis with resultant resources, the need for a process which is inclusive of the views of teachers and parents with the objective of developing an individually appropriate plan may be overlooked. This study shows that teachers are well placed to correctly identify those children requiring additional support at a very early age.

The study demonstrates that teacher observation is an effective means of identifying children who have a level of impairment which prevents them from fully participating in their educational environment. This is supported by evidence from studies of teacher-completed rating scales.[174] Moreover, a recent qualitative study

conducted in Ireland found that teachers felt that they could play a more active role in the assessment process.[169] A multi-disciplinary approach towards children with special educational needs could integrate teacher observation with other approaches to assessment and support a model of education which would be inclusive of the needs of every child.

5.4.1 Limitations

This study of early development outcomes was conducted with 1344 children in 47 schools and has examined special educational needs in the context of a typically developing population. However, as only 132 children needed further assessment and only 83 were identified as having special educational needs, it was not possible to examine in depth the underlying factors which may determine why some children's support needs are not identified or met. Factors at the individual and family level that may contribute to developmental vulnerability are not explored in this paper but have been previously published.[154]

Parents were asked to recall which of the services their children had attended from a list provided. This may have led to some degree of recall bias. Moreover, parents were not asked if the child received the necessary support from these services therefore we do not know to what extent the needs of the children were addressed by accessing these services.

5.4.2 Conclusion

A small but significant number of children have not had their needs adequately assessed. Teacher observation is an effective means of identifying children with a level of impairment which prevents them from fully participating in their educational environment and could be integrated into a multi-disciplinary approach to meeting the needs of all children.

CHAPTER 6: THE EARLY DEVELOPMENT INSTRUMENT: AN EVALUATION OF ITS FIVE DOMAINS USING RASCH ANALYSIS

Paper submitted to Social Indicators Research

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6.0 Abstract

Background

Early childhood development is a multifaceted construct encompassing physical, social, emotional and intellectual competencies. The Early Development Instrument (EDI) is a population-level measure of five domains of early childhood development (physical health and well-being, emotional maturity, social competence, language and cognitive skills, and communication and general knowledge) on which extensive psychometric testing has been conducted using traditional psychometric methods. This study builds on previous psychometric analysis by providing the first large-scale Rasch analysis of the EDI. The aim of the study was to perform a definitive analysis of the psychometric properties of the EDI domains within the Rasch paradigm.

Methods

Data from a large EDI study conducted in a major Irish urban centre were used for the analysis. The data were analysed with the unidimensional Rasch model which examined whether the EDI scales met the measurement requirements of invariance, allowing responses to be summated across items. Differential item functioning for gender was also analysed.

Results

Data were available for 1344 children. All scales demonstrated at least reasonable fit to the Rasch model with the social competence and emotional maturity scales showing excellent fit. The physical health and well-being scale showed only reasonable fit. All scales had an inadequate number of items for measuring ability at the higher levels with a marked ceiling effect. The DIF for gender was particularly evident in the emotional maturity scale with almost one-third of items (9 out of 30) on this scale biased in favour of girls.

Conclusion

The study endorses the overall fit of the EDI to the Rasch model. However, it points to a number of issues which will have to be addressed. If the EDI is to be implemented at a national level in Ireland, it would benefit from further refinement which could in turn inform the international implementation of the EDI.

6.1 Background

Early childhood development is a key indicator of future health and well-being.[51] It is a multifaceted construct encompassing physical, social, emotional and intellectual competencies. In the early years, child development is synonymous with child health, which can be defined as the extent to which children realise their full developmental potential.[4]

From a population health perspective early childhood development is both an indicator of child health outcomes and a predictor of future health problems.[1] When compared to adult health it is also very susceptible to environmental influences. It is a dynamic process which changes rapidly over time, particularly between gestation and six years of age. As a result, measurement of early childhood development has to be age-specific and multi-dimensional.[6]

The majority of measures of early childhood development have been designed by psychologists or educationalists and are clinically-based diagnostics, with the intention of determining whether an individual child has a disability or underlying condition.[60] At the same time, a potentially greater burden of risk lies with the substantially larger number of children with less pronounced developmental delay.[56] In this context, a population-level approach which can measure the developmental health of children across the spectrum is required.

The Early Development Instrument (EDI) was designed as a population-level measure of five domains of early childhood development. It specifically aims to identify populations or groups of children who are at risk of developmental delay. It is based on a broad conceptualisation of school readiness which goes beyond language and cognitive ability to include the extent to which the child has gained the developmental maturity (physically, socially and emotionally, as well as cognitively) to engage in and benefit from school activities.[62] Children who scored in the lowest 10% of the study population in one or more of the five domains of the EDI are classed as 'vulnerable'. The 10% cut-off is recommended because it is

higher than typical clinical cut-offs and should therefore include children who may be more difficult to diagnose.[77]

The EDI is an internationally recognised measure of early childhood development at school entry age.[154] It has been used in 24 countries worldwide. In Australia, where it is administered as the Australian Early Development Index (AEDI), total population coverage has been achieved. Near-total population coverage has been reached in Canada. Its utility in informing regional and national policy on early childhood care and education and in tracking changes in child development outcomes over time is well recognised.[109]

Extensive psychometric testing has been completed on the EDI in Canada and Australia.[75] It has high internal consistency with Cronbach's alpha coefficients of between 0.84 and 0.96 for the five domains.[62] In the current Cork study the EDI was shown to have similar internal consistency with Cronbach's alpha coefficients of between 0.8 and 0.96.[154]

In Australia, the AEDI was implemented alongside the Longitudinal Study of Australian Children (LSAC) in a subset of the population allowing for correlation with other teacher and parental administered instruments. Results showed strong correlations between the AEDI and other teacher-rated measures. However, correlations with parent-rated measures were weak.[78]

Factor analysis was conducted on data from Canada, Australia, Jamaica and Washington State with items loading on to the correct factors across all countries.[84] In a further study of 26,005 children in British Columbia, confirmatory factor analysis was used to demonstrate the unidimensionality of each domain.[86]

In examining the predictive validity of the EDI to fourth grade, D'Anguilli et al[97] found that children who were vulnerable (i.e. in the lowest 10% of the population in one or more domains of the EDI) in the first year of education were two to four times more likely to score below expectations in Grade 4. There was a linear

increase in the risk of scoring below expectations with vulnerability in additional domains. Two studies examined the performance of the EDI across diverse populations and concluded that the EDI was fair and unbiased across gender, language and aboriginal status.[56 85]

There is also some evidence questioning the validity of the EDI. Although correlations between the EDI language and cognitive development domains and the Peabody Picture Vocabulary Test (PPVT) showed similar levels of correlation across four countries, the results showed that low scores in the this domain did not indicate a high probability that a child would have a language problem.[84] A further study, conducted in Canada, comparing the EDI with four directly administered tests of school readiness found significant correlations at the level of the overall instrument but not at the domain level.[87]

All the psychometric tests outlined above were conducted using traditional psychometric methods based upon Classical Test Theory (CTT). In addition, in 2004 a Rasch analysis of the EDI was conducted prior to its adaptation for use in Australia as the AEDI. That analysis showed the EDI had generally adequate scale properties within the Rasch paradigm but had disordered thresholds on all items with five response options.[103] The EDI was subsequently adjusted to include only two and three item responses. A further Rasch analysis was conducted on a sample of 116 children in Sweden. This study took the approach of removing misfitting items, after which, all scales except physical health and well-being functioned well. However, the study had too low a sample size to perform a definitive analysis and should be considered an exploratory study.[175]

6.1.1 The Rasch model

The Rasch model takes its name from the Danish mathematician Georg Rasch and refers to a group of statistical techniques used as a mathematical approach to assessing measurement scales.[101] The model assumes that the probability of a person responding in a certain way to an item on a psychometric scale is a logistic

function of the difference between that person's ability and the individual item's difficulty.[99]

Rasch theory is based on the assumption that some items are harder and require more of the underlying trait than others and that some people have more of the latent trait than others, thereby, having a greater probability of responding positively to the more difficult item. Furthermore, items conform to a Guttman structure whereby they are ordered in terms of difficulty on a continuum. In other words, if a child has a certain level of developmental ability it is assumed that they ought to score positively for all items which require less difficulty than they possess.[100]

A key underlying component of Rasch theory is invariance.[92] This means that the relative location of any two persons on the scale is independent of the items used and conversely the relative location of any two items on the continuum is independent of the person on which they are measured. The item and person locations are estimated separately but on the same scale. The separation of items and persons is a key advantage of Rasch modelling over CTT as it allows for generalisability across samples and items. Rasch modelling also provides a range of unique tools for testing the extent to which items and persons produce data that fit the Rasch model.[92]

This study builds on previous psychometric analysis by providing the first large-scale Rasch analysis of the EDI. The aim of the study was to perform a definitive analysis of the psychometric properties of the EDI domains within the Rasch paradigm. Data from a large study conducted in a major Irish urban centre were used for the analysis.[154]

6.2 Methods

A cross-sectional study of child development was carried out with children in their first year of formal education in 42 of the 47 primary schools in Cork City and a

further five schools in an adjoining rural area. The five city schools which declined to take part in the study were representative of a cross-section of schools in the study area - 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.

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 minimum of 4 to 5 months of education), being known by the teacher for more than one month and not having left the school.

6.2.1 The Early Development Instrument

The Early Development Instrument (EDI) is a population-level measure designed at the Offord Centre for Child Studies, McMaster University, Hamilton, Ontario to measure the extent to which children have attained the physical, social, emotional and cognitive maturity necessary to engage in school activities.[75] 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.[53] It can be retrospective, focusing on early childhood development outcomes; or predictive, informing school and child-health programmes.[75] The instrument consists of five domains or scales, made up of 104 questions. The domains are:

- **Physical health and well-being.** (13 questions) Physical independence, appropriate clothes and nutrition, fine and gross motor skills
- **Social competence.** (26 questions) Self-confidence, ability to play, get on with others and share
- **Emotional maturity.** (30 questions) Ability to concentrate, help others, age appropriate behaviours

- **Language and cognitive development.** (26 questions) Interest in reading and writing, can count and recognise numbers, shapes
- **Communication skills and general knowledge.** (8 questions) Can communicate with adults and children has an appropriate knowledge of the world

6.2.2 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, administered in the latter half of the first year of formal education. The teachers in this study were given a short period of training on the administration of the EDI 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 unique identifier which was used on the questionnaire.

Passive consent was used in line with previous EDI studies in Canada. A total of seven parents opted not to participate. Ethical approval was granted by the Clinical Research Ethics Committee of the Cork Teaching Hospitals.

6.2.3 Scoring methods

The EDI consists of five scales, each corresponding to a developmental domain. The physical health and well-being scale has 13 items. Seven items have two response options, scored 0 and 1, and six items have three response options, scored 0, 1 and 2. The social competence scale has 26 items, the emotional maturity scale has 30 items and the communication and general knowledge scale has 8 items. All items on these three scales have three response options, scored 0, 1 and 2. The language and cognitive development scale has 26 items all of which have two response options, scored 0 and 1. Lower scores on all items for all scales represent lower levels of the latent trait being measured.

6.2.4 Data analysis

The data were analysed with the unidimensional Rasch model using RUMM2030. The Rasch model was used to examine whether the EDI scales met the measurement requirements of invariance, allowing responses to be summated across items. In order to allow different numbers of categories and different threshold values across items the unconstrained (partial credit) Rasch model was applied.

Three aspects of the EDI were analysed: scale to sample targeting; overall scale fit to the Rasch model; and the extent to which individual items satisfied Rasch criteria.

6.2.5 Scale to sample targeting

Person-item threshold distributions were examined to explore the relationship between the difficulty level of the items in each scale and the ability levels of those taking the test. These histograms, using the convention of Rasch analysis, are always centred at zero logits for the item location scale. Perfect targeting requires the item and person location means to both be zero.

6.2.6 Overall fit to the Rasch model

A number of tests were used to examine the extent to which each scale conformed to the Rasch model. Standardised mean and standard deviation (SD) values for item and person fit residuals are a way of representing the fit of both item and person data to the Rasch model. A mean value of zero with a SD of 1.0 would represent perfect fit (values less than 1.4 are considered acceptable for the SD). A further test examines the extent to which the hierarchical order of difficulty for items varies across class intervals of the measurement continuum. This is examined using a Chi-square statistic. A statistically significant Chi-square value (having performed a Bonferroni adjustment at the 0.05 probability level) indicates a problematic interaction between items and the latent trait being measured. A final test, known as the Person Separation Index (PSI) examines the extent to which the

scale reliably discriminates between persons of different ability. The PSI can be produced with or without extreme values so that the extent of floor and ceiling effects on reliability can be examined. For scales which are intended to be used at the group level, a minimum PSI value of 0.7 is recommended. Rumm2030 also produces a summary of scale fit to the Rasch model, taking into account the various measures of fit. There are five categories used to summarise fit: 'excellent', 'good', 'reasonable', 'low' and 'too low'.

6.2.7 Analysis of individual items

Threshold ordering

One of the requirements of the Rasch model is 'category ordering'. This means that the hierarchical order of response options for particular items should accord with the latent variable in question. In other words, persons with higher levels of overall ability on a particular trait should be more likely than persons with lower ability to endorse item response options that are meant to capture higher levels of ability.

Item location

The location indicates the place on the continuum of difficulty where each item is located. Location is measured on the logit scale and lower scores represent lower levels of difficulty. The fit residuals provide an estimate of the extent to which the variance associated with each item is in accord with the Rasch model. The residuals shown are standardised and values between +/-2.5 demonstrate adequate fit. A test of item-trait interaction is also available. As with the test of overall scale fit, the Chi Square test is used to analyse whether items perform consistently across the continuum of difficulty. The test is Bonferroni adjusted at the $p<0.05$ level and statistically significant values indicate problematic item-trait interaction.

Local response dependency

The Rasch model demands that responses to items on the same scale must be independent, that is, not conditional upon each other. For example, an item about spelling ability would be dependent on an item about ability to read. Response

dependency can be detected by examining the residual correlation between items after extraction of the Rasch model. Inter-item correlations > 0.4 are a strong signal for local response dependency.

6.2.8 Differential item functioning

One of the advantages of Rasch modelling is the possibility of detecting Differential Item Functioning (DIF). DIF occurs when different groups respond differently to an item despite having the same levels of the overall trait being measured. For example, if boys were to consistently score higher than girls on a particular item in an intelligence test, despite there being no gender differences in overall intelligence as measured by the scale, then DIF would be present in that item.

Every item was examined for DIF between male and female children in the sample. DIF was explored in RUMM through an analysis of variance (ANOVA) of the standardized response residuals for each item between genders and across different levels of the trait measured by each scale. A Bonferroni adjusted p-value was then used to determine statistical significance. Item characteristic curves were examined to determine the direction of bias introduced in items where significant DIF was detected.

6.3 Results

6.3.1 Descriptive statistics

Data were available for 1344 children. Descriptive statistics for each scale are shown in Table 16. The mean and standard deviation (SD) for each scale is only provided for subjects with complete data on each scale (i.e. there has been no imputation). There was a strong positive skew on all five scales. There was also a marked ceiling effect on some scales with large numbers of children achieving the maximum possible score. This was most apparent for the communication skills and general knowledge scale where 34% of children with complete items achieved the maximum score. The ceiling effect was least apparent for the emotional maturity scale (6% of children with complete items achieved the maximum score).

Table 16: Descriptive statistics for each scale

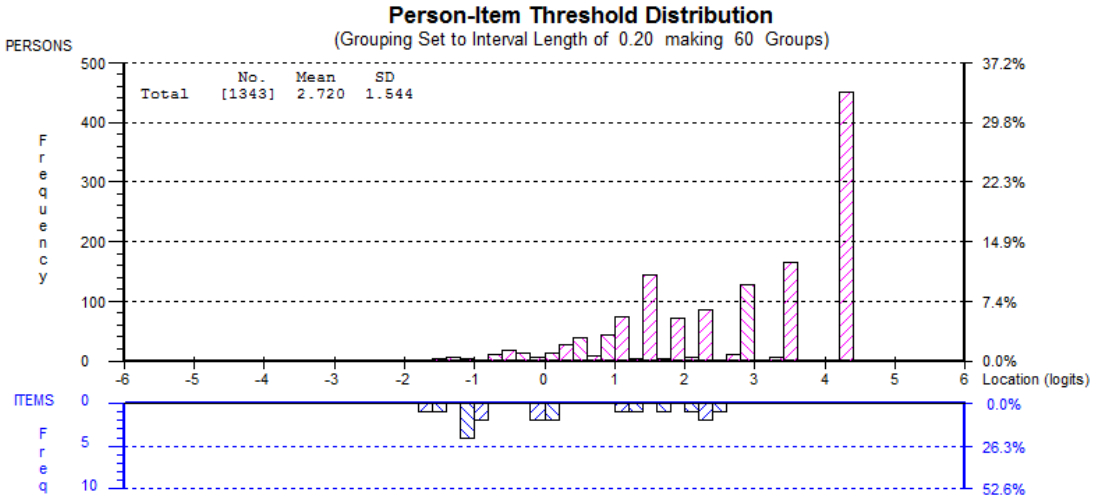
Scale	Theoretical range	Mean (SD)	Min score N*	Max score N*	Items missing N+
Physical health and well-being	0-19	16.3 (3.1)	0	404	223
Social competence	0-52	42.5 (9.8)	0	235	90
Emotional maturity	0-60	45.7 (10.1)	0	68	261
Language & cognitive development	0-26	22.5 (4.7)	1	337	261
Communication & general knowledge	0-16	11.7 (4.7)	13	446	26

* N = number of children, +N = number of items

6.3.2 Scale to sample targeting

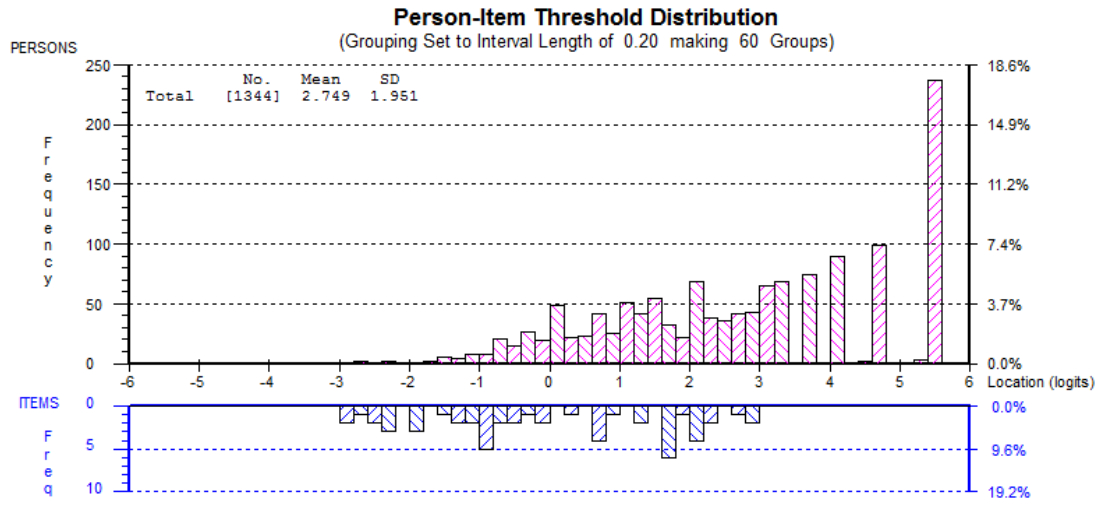
For some scales the person-item histograms demonstrate a poor match between the difficulty levels of the items and the ability levels of those taking the test. In Figure 13, the mean person location is 2.7 (SD = 1.5) for the physical health and well-being scale. The difficulty range for item locations (-1.63 to 1.23) is inconsistent with the ability range observed in the sample (-1.78 to 4.39). This implies that there is higher ability in the sample than the difficulty levels measured by the items on the physical health and well-being scale and suggests that additional items at the higher levels of difficulty are required.

Figure 13: Person-item threshold distribution for the Physical Health and Well-being scale



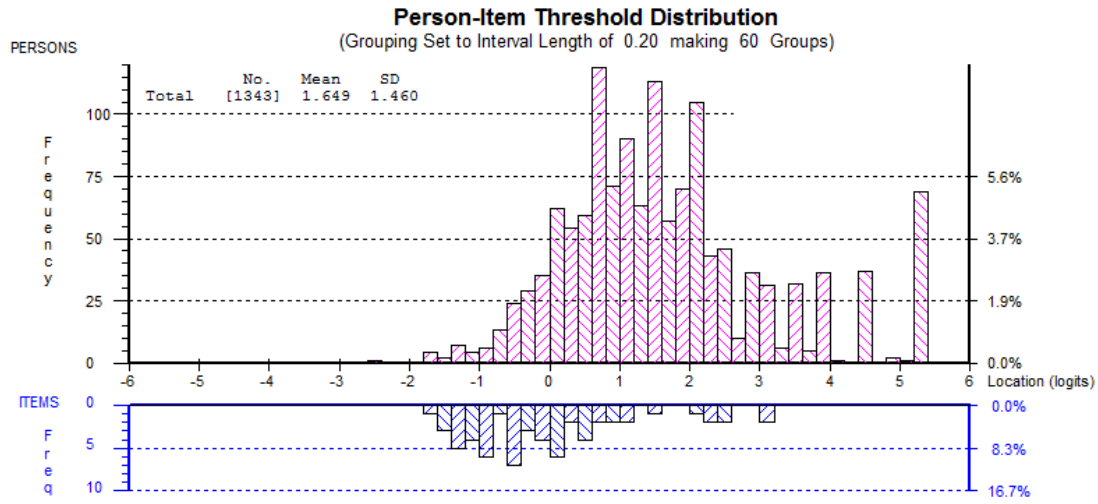
In Figure 14, responses on the social competence scale also demonstrate a mismatch between persons and items. The mean person location on the logit scale is 2.7 (SD = 2.0) and the difficulty range for item locations (-1.50 to 1.26) is inconsistent with the ability range observed in the sample (-3.72 to 5.47). This suggests a need for additional items at both the lower and higher ranges of difficulty.

Figure 14: Person-item threshold distribution for the Social Competence scale.



In Figure 15, the emotional maturity scale demonstrates a better match between sample and items. The highest levels of ability are still not addressed by the item set but this covers a smaller group of children. The mean person location is 1.6 on the logit scale (SD = 1.5) and the difficulty range for item locations (-1.27 to 1.99) is a better match with the ability range observed in the sample (-2.52 to 5.27).

Figure 15: Person-item threshold distribution for the Emotional Maturity scale.



In Figure 16 it can be seen that items on the language and cognitive development scale cover a very wide range of difficulty. The mean person location on the logit scale is 3.3 (SD = 2.1) and the difficulty range for item locations (-3.86 to 4.86) is a good match with the ability range observed in the sample (-4.99 to 5.86) but is still not enough to cover the highest levels of ability in the sample.

Figure 16: Person-item threshold distribution for the language and cognitive development scale.

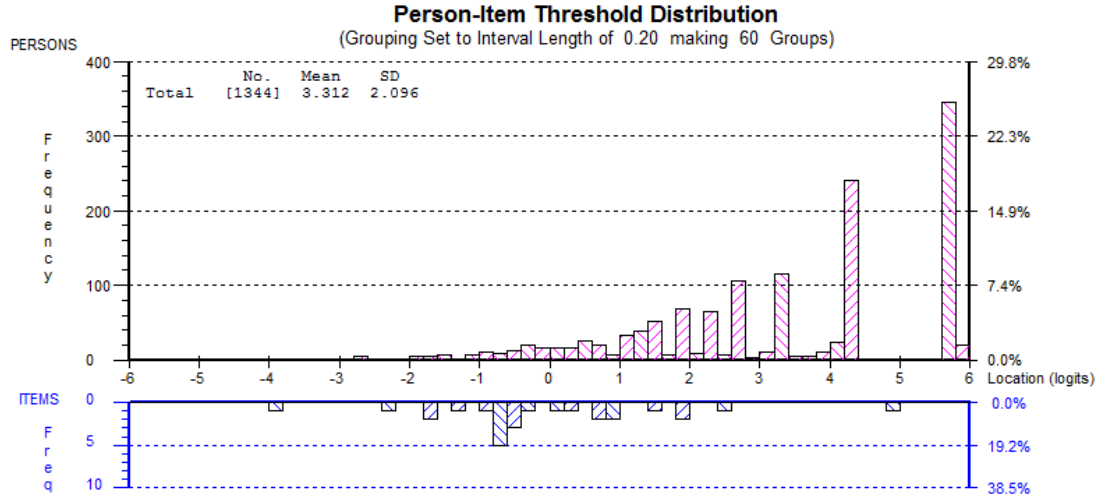
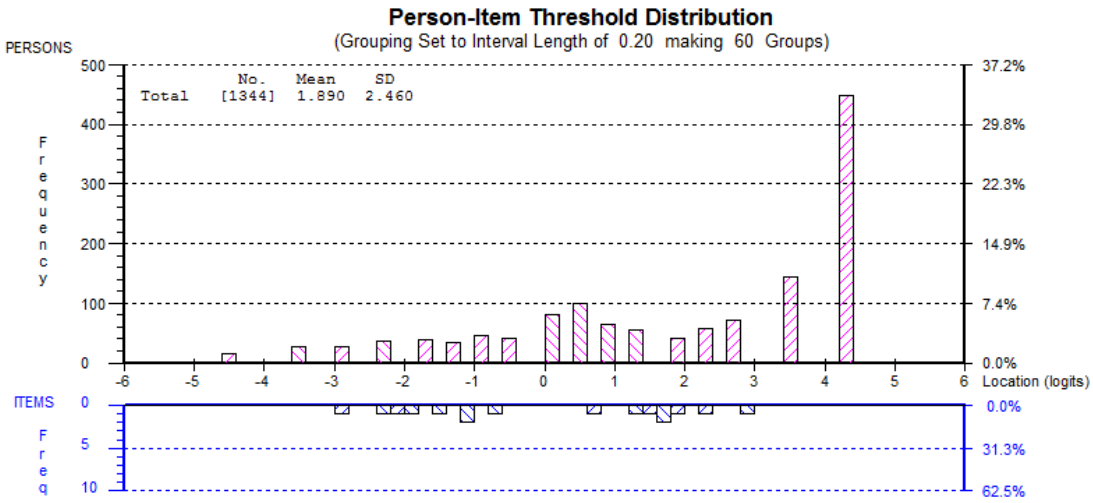


Figure 17 demonstrates a poor match between persons and items on the communication and general knowledge scale. The mean person location on the logit scale is 1.9 (SD = 2.5) and the difficulty range for item locations (-1.11 to 1.03) is a poor match with the ability range observed in the sample (-4.46 to 4.39).

Figure 17: Person-item threshold distribution for the communication skills and general knowledge scale



6.3.3 Overall fit to the Rasch model

Table 17 displays summary Rasch model statistics for the five scales. These give an overall analysis of the extent to which the EDI successfully measures the sample according to the Rasch model paradigm.

All five EDI scales demonstrate at least reasonable fit to the Rasch model and three scales (social competence, emotional maturity and communication and general knowledge) show an excellent fit. Item residuals for all scales apart from emotional maturity are some distance from zero. All scales apart from physical health and well-being demonstrate an ability to reliably discriminate between persons of different ability as measured by the PSI. On the other hand there is evidence of statistically significant item-trait interaction, signalling some room for improvement in the content of each scale.

Table 17: Summary of EDI scale fit to the Rasch model

Scale	Item residual Mean (SD)	Person residual Mean (SD)	Chi square Value	P	PSI with extremes	PSI without extremes	Fit summary
Physical health and well-being	-1.28 (5.51)	-0.39 (1.00)	813.82	<0.001	0.62	0.65	Reasonable
Social competence	-1.46 (3.53)	-0.43 (1.46)	658.53	<0.001	0.87	0.90	Excellent
Emotional maturity	-0.87 (4.19)	-0.43 (1.33)	1,678.47	<0.001	0.88	0.88	Excellent
Language and cognitive development	-1.86 (1.76)	-0.41 (0.57)	382.94	<0.001	0.72	0.78	Good
Communication skills and general knowledge	-1.78 (5.57)	-0.47 (1.31)	372.98	<0.001	0.83	0.85	Excellent

In a separate analysis it is possible to identify the number of persons within the sample who fit the Rasch model. This gives a sense of the extent to which each scale has adequately measured the sample. The physical health and well-being scale performed very poorly on this metric with 452 persons (33.6%) providing extreme standardised person-fit residuals (defined as outside the +/-2.5 range). The social competence scale fared better with 240 persons (17.9%) providing extreme person-fit residuals. The emotional maturity scale had 72 persons (5.4%) with extreme person-fit residuals. A high proportion of the sample (N = 409, 30.4%) had extreme person-fit residuals on the language and cognitive development scale. 464 persons (34.5%) had extreme person-fit residuals on the communication and general knowledge scale, the highest of all five scales.

6.3.4 Analysis of individual items

Threshold ordering

Only one EDI item ('sucks finger' on the physical health and well-being scale) showed threshold disordering indicating that the response options for all but one item are performing as expected.

Item location

Table 18 shows the ordered item locations, fit residuals and probabilities for the physical health and well-being scale. Item 6 ('established hand preference') is the easiest item on the scale and item 11 ('level of energy') is the hardest item. With respect to individual item fit, items 13 through 11 all fail the fit residual test and items 7 through 3 all fail the Chi square test for item-trait interaction (Bonferroni adjusted p values < 0.003846).

Table 18: Ordered item locations, fit residuals and probabilities for the physical health and well-being scale

Item	Item description	Location	SE	Fit residual	Chi square	Probability
6	established hand preference	-1.63	0.16	-1.10	7.74	0.356
5	independent in washroom	-1.57	0.15	-0.08	9.04	0.250
4	hungry	-1.15	0.14	1.61	13.87	0.054
1	over or underdressed	-1.04	0.13	1.09	13.84	0.054
7	well co-ordinated	0.00	0.10	-1.84	***46.23***	***0.000***
2	too tired or sick	0.04	0.10	0.61	***21.73***	***0.003***
13	sucks finger	0.23	0.07	**4.09**	***141.62***	***0.000***
10	climb stairs	0.37	0.07	**-7.26**	***74.23***	***0.000***
12	overall physical development	0.57	0.07	**-8.90**	***89.37***	***0.000***
9	manipulate objects	0.67	0.07	**-8.60**	***77.55***	***0.000***
3	late	1.13	0.08	**11.16**	***292.69***	***0.000***
8	proficiency with pen	1.15	0.06	**-4.66**	15.69	0.028
11	level of energy	1.23	0.06	**-2.83**	10.22	0.176

Table 19 shows the ordered item locations, fit residuals and probabilities for the social competence scale. Item 19 ('play with new toy') is the easiest item on the scale and item 1 ('overall social/emotional development') is the hardest item. Fourteen items (9, 16, 6, 23, 10, 5, 3, 13, 7, 24, 15, 26, 8, 12) demonstrate extreme fit residuals and ten items (19, 9, 16, 6, 5, 18, 3, 13, 26, 8) fail the Chi square test for item-trait interaction (Bonferroni adjusted p values < 0.001923).

Table 19: Ordered item locations, fit residuals and probabilities for the social competence scale

Item	Item description	Location	SE	Fit residual	Chi square	Probability
19	play with new toy	-1.50	0.09	0.55	***27.84***	***0.001***
20	play a new game	-1.29	0.08	-0.90	19.38	0.013
9	respect for adults	-1.08	0.08	**-4.11**	***30.39***	***0.000***
16	takes care of school materials	-0.85	0.08	**-4.63**	***34.62***	***0.000***
6	respects others property	-0.82	0.08	**-3.71**	***25.42***	***0.001***
21	play with new book	-0.82	0.08	0.46	18.29	0.019
23	follow one-step instructions	-0.78	0.07	**-4.11**	23.09	0.003
10	respect for children	-0.72	0.07	**-2.86**	19.03	0.015
5	follow rules and instructions	-0.29	0.07	**-6.36**	***43.16***	***0.000***
18	curious about world	-0.19	0.07	2.35	***25.37***	***0.001***
3	plays and works with other	-0.11	0.07	**-5.33**	***34.16***	***0.000***
25	adjust to change in routines	-0.05	0.07	-0.97	7.80	0.453
13	follows directions	0.05	0.07	**-7.85**	***62.29***	***0.000***
7	self-control	0.11	0.07	**-3.86**	15.66	0.047
4	play with various children	0.34	0.06	0.27	10.90	0.207
24	follow class routines	0.37	0.06	**-3.42**	17.56	0.025
11	responsibility for actions	0.39	0.06	-2.01	10.41	0.237
15	works independently	0.56	0.06	**-3.18**	12.53	0.129
22	solve day-to-day problems	0.59	0.06	-0.77	8.46	0.390
26	tolerance of mistakes	0.60	0.06	**7.63**	***89.84***	***0.000***
8	self-confidence	0.71	0.06	**5.78**	***58.82***	***0.000***
17	works neatly	0.76	0.06	1.48	8.90	0.351
14	completes work on time	0.87	0.06	1.56	12.76	0.121
2	get along with peers	0.92	0.06	-0.69	11.69	0.165
12	listens attentively	0.96	0.06	**-3.71**	22.14	0.005
1	overall social/emotional dev	1.26	0.06	0.43	8.03	0.431

Table 20 shows the ordered item locations, fit residuals and probabilities for the emotional maturity scale. Item 13 ('takes things') is the easiest item on the scale and item 3 ('stop a quarrel') is the hardest item. Sixteen items (12, 19, 26, 18, 27, 21, 22, 9, 20, 15, 16, 23, 1, 30, 8, 4) demonstrate extreme fit residuals and nineteen items (12, 19, 26, 18, 27, 21, 22, 9, 20, 16, 23, 1, 17, 30, 5, 8, 6, 4, 7) fail the Chi square test for item-trait interaction (Bonferroni adjusted p values < 0.001667).

Table 20: Ordered item locations, fit residuals and probabilities for the emotional maturity scale

Item	Item description	Location	SE	Fit residual	Chi square	Probability
13	takes things	-1.27	0.08	-2.35	17.80	0.038
12	kicks bites hits	-1.15	0.07	**-3.42**	***28.64***	***0.001***
24	unhappy, sad, depressed	-1.02	0.07	-0.76	16.38	0.059
14	laughs at discomfort	-0.98	0.07	-0.24	15.98	0.067
10	physical fights	-0.97	0.07	-1.87	19.20	0.024
11	bullies others	-0.96	0.07	-2.46	13.10	0.158
19	temper tantrums	-0.89	0.07	**-4.01**	***37.55***	***0.000***
25	fearful or anxious	-0.80	0.06	0.61	17.29	0.044
29	incapable of making decisions	-0.65	0.06	-0.86	8.45	0.490
26	Worried	-0.64	0.06	**2.89**	***40.12***	***0.000***
18	Disobedient	-0.61	0.06	**-2.97**	***48.74***	***0.000***
27	cries a lot	-0.60	0.06	**2.66**	***33.87***	***0.000***
28	nervous, tense	-0.50	0.06	0.29	15.72	0.073
21	difficulty awaiting turn	-0.41	0.06	**-2.81**	***33.48***	***0.000***
22	can't settle to anything	-0.39	0.06	**-4.40**	***55.02***	***0.000***
9	upset when left	-0.16	0.05	**10.72**	***337.63***	***0.000***
20	Impulsive	-0.04	0.05	**-3.90**	***39.87***	***0.000***
15	Restless	0.05	0.05	**-3.09**	24.28	0.004
16	Distractible	0.23	0.05	**-2.97**	***42.87***	***0.000***
23	is inattentive	0.24	0.05	**-3.14**	***53.95***	***0.000***
1	help someone hurt	0.28	0.05	**-3.52**	***44.51***	***0.000***
17	Fidgets	0.32	0.05	-1.50	***31.07***	***0.000***
30	Shy	0.41	0.05	**15.02**	***507.74***	***0.000***
5	comfort a crying child	1.14	0.05	-2.23	***35.26***	***0.000***
2	clear up a mess	1.23	0.05	-1.43	10.72	0.295
8	help sick children	1.39	0.05	**-2.83**	***33.12***	***0.000***
6	picks up objects	1.39	0.05	0.09	***41.64***	***0.000***
4	help other children	1.47	0.05	**-4.09**	***30.30***	***0.000***
7	invite bystanders to join	1.87	0.05	-1.63	***27.46***	***0.001***
3	stop a quarrel	1.99	0.05	-1.89	16.70	0.054

Table 21 shows the ordered item locations, fit residuals and probabilities for the language and cognitive development scale. Item 1 ('handle a book') is the easiest item on the scale and item 9 ('read complex words') is the hardest item. Nine items (3, 6, 8, 10, 15, 17, 18, 21, 24) demonstrate extreme fit residuals and six items (6, 8, 9, 10, 11, 15) fail the Chi square test for item-trait interaction (Bonferroni adjusted p values < 0.001923).

Table 21: Ordered item locations, fit residuals and probabilities for the language and cognitive development domain

Item	Item description	Location	SE	Fit residual	Chi square	Probability
1	handle a book	-3.86	0.35	-1.34	3.12	0.874
20	sort by common characteristics	-2.25	0.19	-0.40	3.50	0.835
21	use one-to-one correspondence	-1.71	0.16	**-2.53**	9.77	0.202
2	interested in books	-1.64	0.16	-2.29	5.40	0.611
25	recognise shapes	-1.21	0.14	0.54	7.89	0.343
19	interested in number games	-0.81	0.13	-0.34	8.43	0.296
18	interested in maths	-0.78	0.13	**-3.95**	19.67	0.006
5	attach sounds to letters	-0.63	0.12	-1.41	4.35	0.738
4	identify 10 letters	-0.62	0.12	-2.48	7.59	0.370
12	aware of writing direction	-0.62	0.12	-1.30	5.04	0.655
11	experiment with writing	-0.62	0.12	1.23	***34.05***	***0.000***
14	writing his/her name	-0.50	0.12	-1.51	9.32	0.231
3	interested in reading	-0.45	0.12	**-3.29**	9.13	0.243
26	understands time	-0.40	0.12	-0.54	7.14	0.414
24	say which is bigger than 2	-0.39	0.12	**-2.63**	7.65	0.364
7	group reading activities	0.06	0.11	-1.64	15.09	0.035
8	read simple words	0.24	0.10	**-5.14**	***29.66***	***0.000***
17	remember things easily	0.74	0.09	**-2.53**	8.60	0.282
23	recognise 1-10	0.77	0.09	-1.96	13.00	0.072
15	write simple words	0.84	0.09	**-4.97**	***30.98***	***0.000***
6	awareness of rhyming	0.98	0.09	**-3.01**	***23.35***	***0.001***
10	read simple sentences	1.58	0.09	**-5.67**	***38.08***	***0.000***
22	count to 20	1.95	0.08	-0.07	13.50	0.061
13	writing voluntarily	1.97	0.08	-1.02	17.88	0.013
16	write simple sentences	2.51	0.08	-0.09	22.20	0.002
9	read complex words	4.86	0.10	-0.04	***28.56***	***0.000***

Table 22 shows the ordered item locations, fit residuals and probabilities for the communication and general knowledge scale. Item 1 ('handle a book') is the easiest item on the scale and item 9 ('read complex words') is the hardest item. Six items (8, 6, 5, 4, 1, 3) demonstrate extreme fit residuals and fail the Chi square test for item-trait interaction (Bonferroni adjusted p values < 0.006250).

Table 22: Ordered item locations, fit residuals and probabilities for the communication skills and general knowledge scale

Item	Item description	Location	SE	Fit residual	Chi square	Probability
8	knowledge of world	-1.11	0.08	**7.19**	***101.05***	***0.000***
2	ability to listen	-0.47	0.07	-0.16	21.08	0.007
6	understand what is being said	-0.44	0.07	**-5.06**	***46.85***	***0.000***
5	communicate needs	0.09	0.07	**-6.26**	***36.25***	***0.000***
4	imaginative play	0.20	0.07	**5.33**	***53.36***	***0.000***
7	articulate clearly	0.31	0.07	-1.48	8.44	0.391
1	ability to use English	0.37	0.07	**-6.96**	***40.65***	***0.000***
3	ability to tell story	1.03	0.07	**-6.87**	***65.31***	***0.000***

Local response dependency

Only one instance of local response dependency was observed for the physical health and well-being scale, between item 8 ('proficiency with pen') and item 9 ('manipulate objects'). The items are very close conceptually and have an intuitive causal relationship.

Four instances of local response dependency were observed for the social competence scale. These were items 1 and 2 ('overall social/emotional development and 'get along with peers'), items 3 and 4 ('plays and works with others' and 'plays with various children'), items 9 and 10 ('respect for adults' and 'respect for children') and items 14 and 15 ('completes work on time' and 'works independently').

Twenty-three item-pairs demonstrated local response dependency on the emotional maturity scale which suggests a problem with many item relationships. The pairs were: 1-5, 1-8, 2-6, 3-4, 3-5, 3-8, 4-5, 4-8, 5-8, 7-8, 10-12, 11-12, 15-16, 15-17, 15-20, 15-22, 16-17, 16-22, 16-23, 17-23, 22-23, 25-26, 25-28.

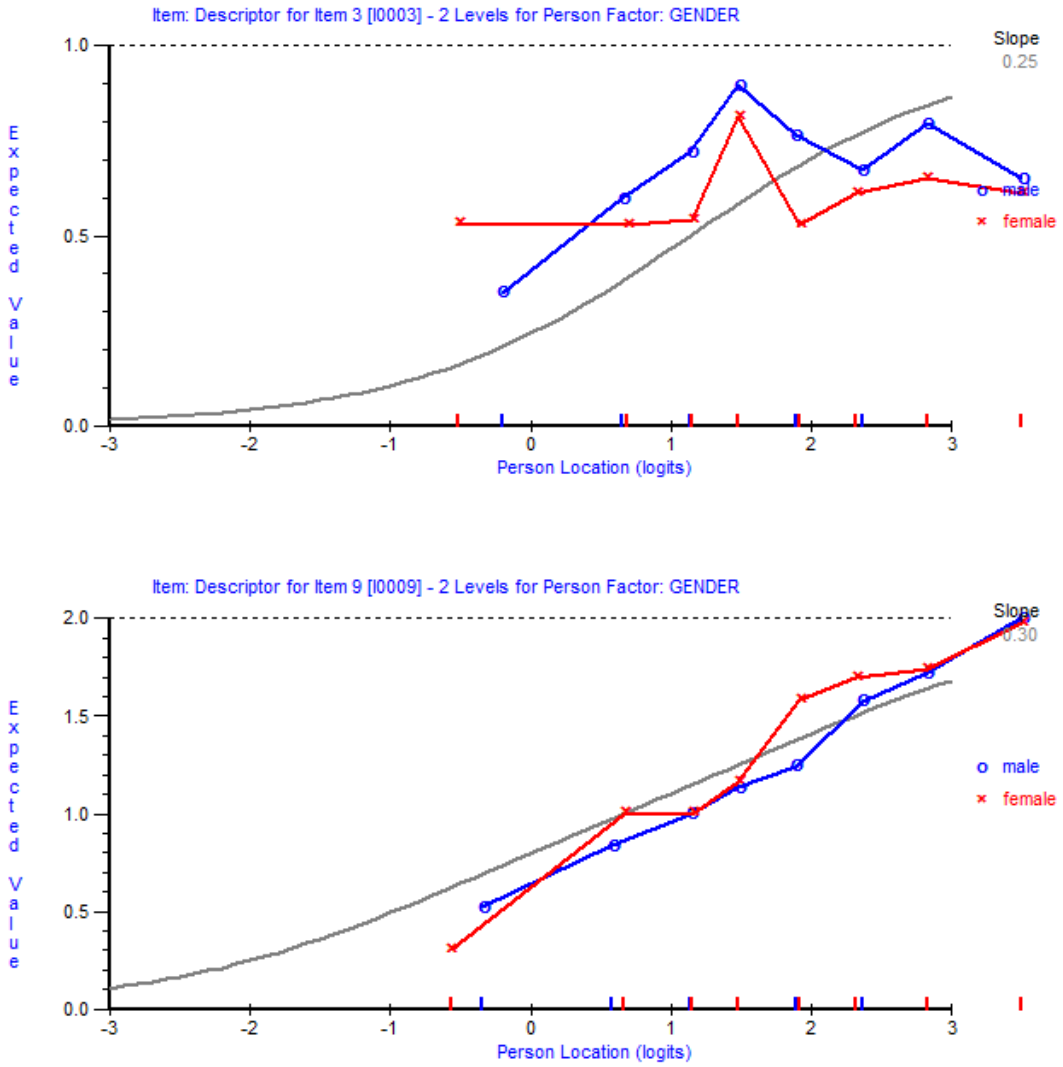
There was only one instance of local response dependency in the language and cognitive development scale. This was between item 2 ('interested in books') and item 3 ('interested in reading'). The items are very close conceptually and have an intuitive

causal relationship. There were no instances of local response dependency on the communication skills and general knowledge scale.

6.3.5 Differential item functioning

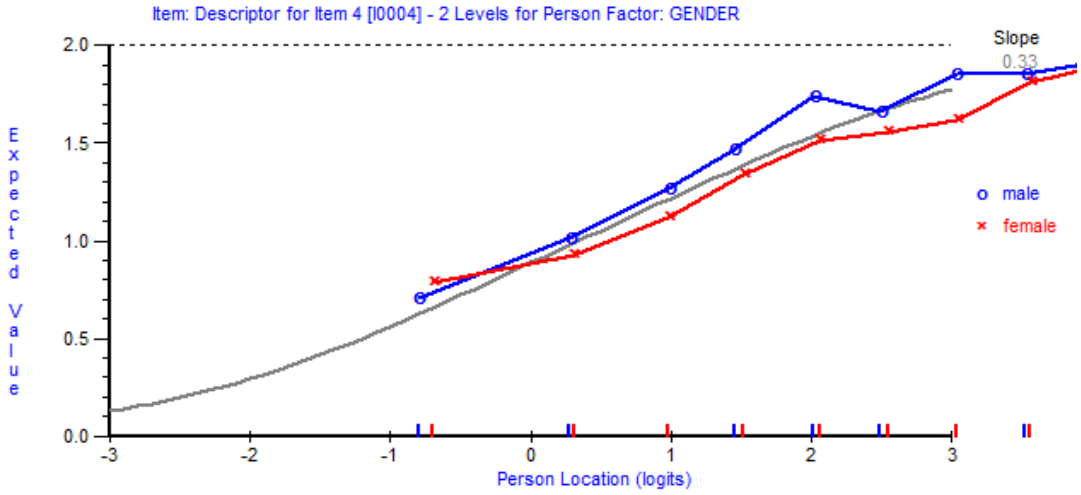
DIF for gender on the physical health and well-being scale is outlined in Figure 18. Item 3 ('late'; F = 18.03) and item 9 ('manipulates objects'; F = 12.28) displayed significant DIF by gender (Bonferroni adjusted p values < 0.001282). Analysis of the item characteristic curves revealed that at equivalent levels of physical health and well-being boys were more likely to be rated positively on item 3 (i.e. to not be late), whereas girls were more likely to be rated positively on item 9 (i.e. to be able to manipulate objects).

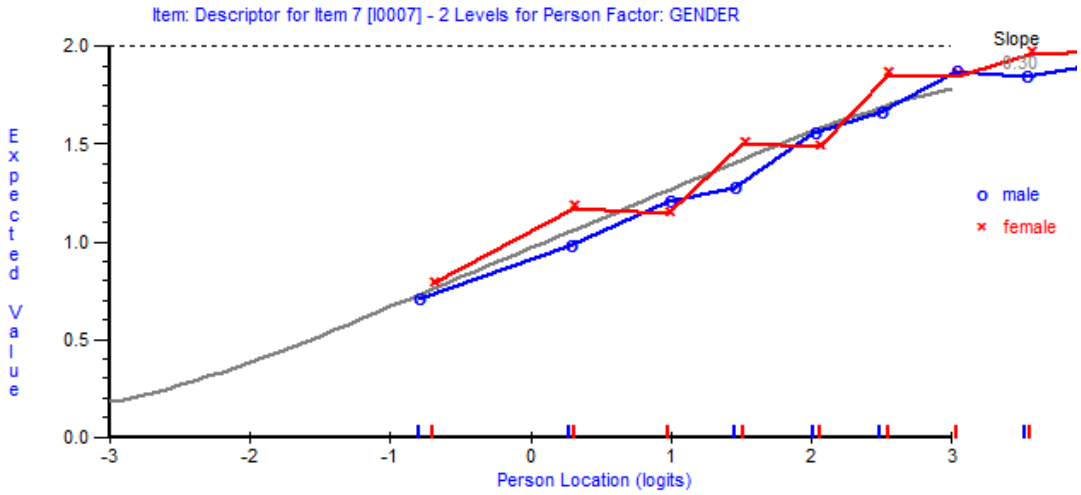
Figure 18: Gender DIF for physical health and well-being (item 3 and item 9)

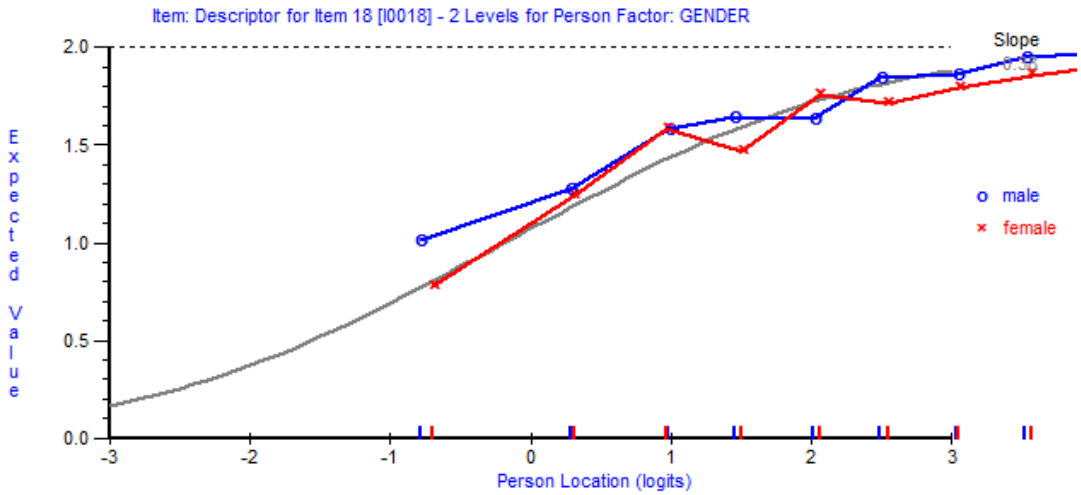


DIF for gender on the social competence scale is outlined in Figure 19. Item 4 ('play with various children'; F = 13.65), item 7 ('self-control; F = 14.17) and item 18 ('curious about world'; F = 16.24) displayed significant DIF by gender (Bonferroni adjusted p values < 0.000641). At equivalent levels of social competence boys were more likely to be rated as able to play with children, girls were more likely to be rated as having self-control, and boys were more likely to be rated as being curious about the world.

Figure 19: Gender DIF for social competence scale (items 4, 7 and 18)







DIF for gender on the emotional maturity scale are outlined in Figure 20. Eleven items on this scale showed significant DIF by gender (Bonferroni adjusted p values < 0.000556). These were item 1 ('help someone hurt'; F = 13.73), item 5 ('comfort a crying child'; F = 15.24), item 6 ('picks up objects'; F = 23.18), item 10 ('physical fights'; F = 16.85), item 12 ('kicks, bites, hits'; F= 17.64), item 15 ('restless'; F = 14.95), item 17 ('fidgets'; F = 13.73), item 18 ('disobedient'; F = 11.97), item 20 ('impulsive'; F = 12.88), item 22 ('can't settle to anything'; F = 13.87) and item 30 ('shy'; F = 58.76). Most of this item bias favoured girls. At equivalent levels of social competence girls were more likely to be rated as likely to help someone hurt, comfort a crying child, avoid physical fights, not kick/bite/hit, not be restless, not fidget, be obedient, not be impulsive, and to be able to settle. On two items (likely to pick up objects and likely to not be shy) the direction of bias favoured boys.

Figure 20: Gender DIF for emotional maturity scale (items 1, 5, 6, 10, 12, 15, 17, 18, 20)

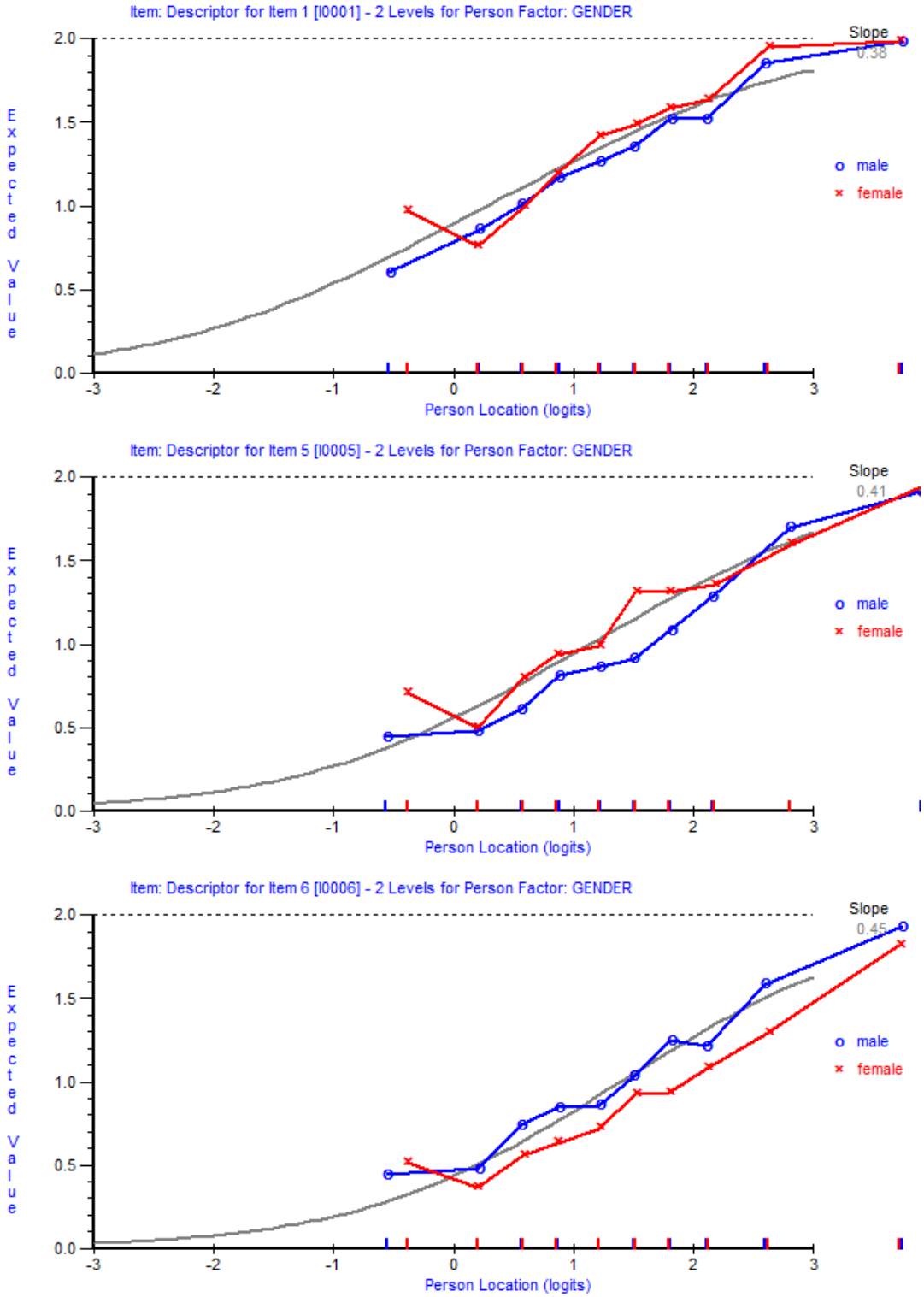
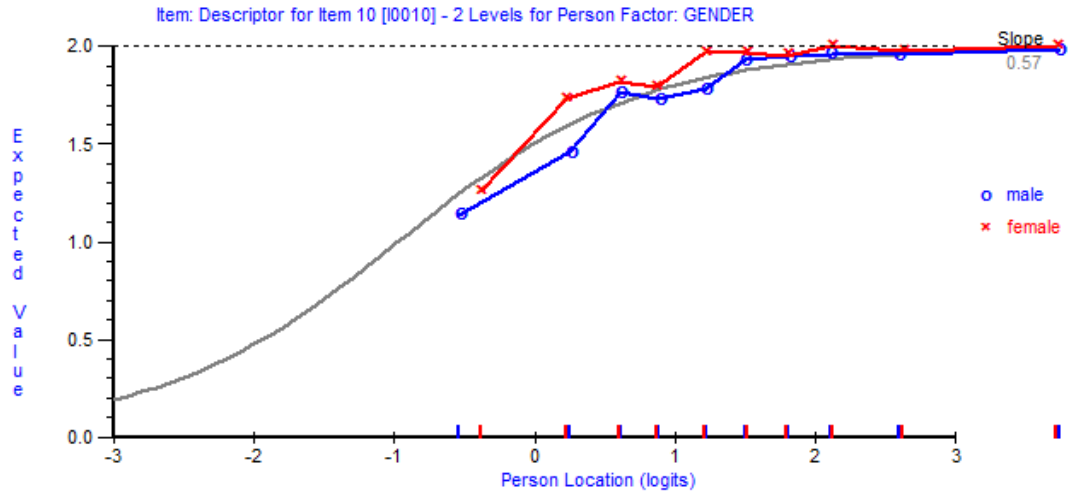
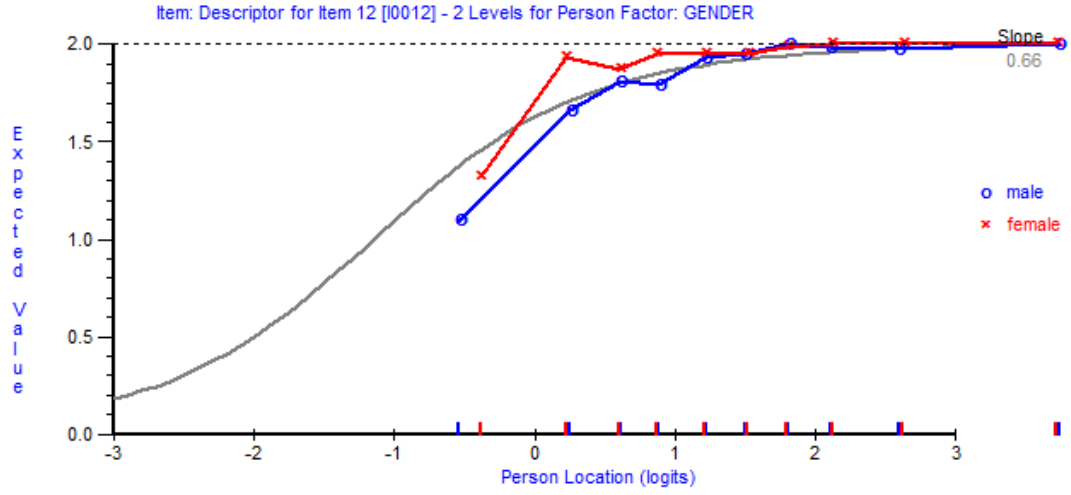


Figure 20: (continued)





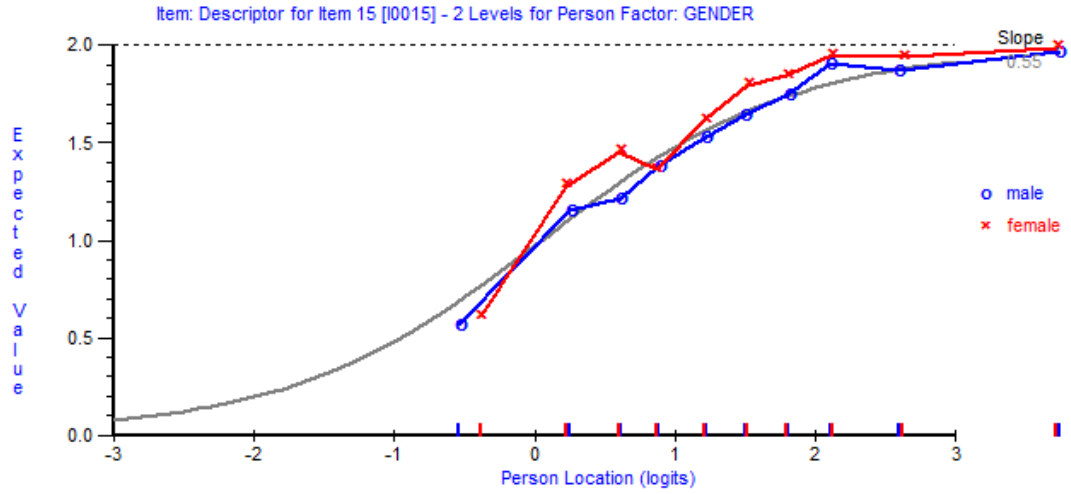
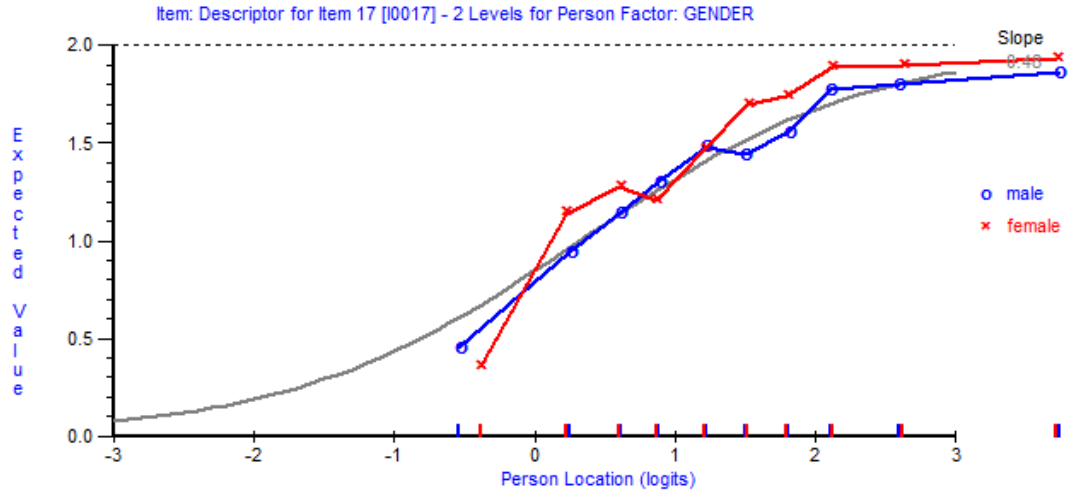
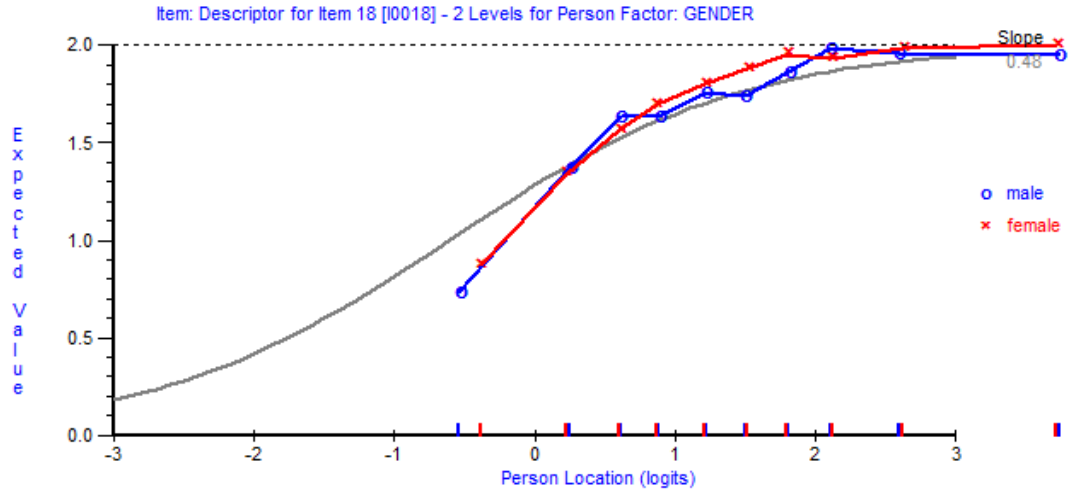
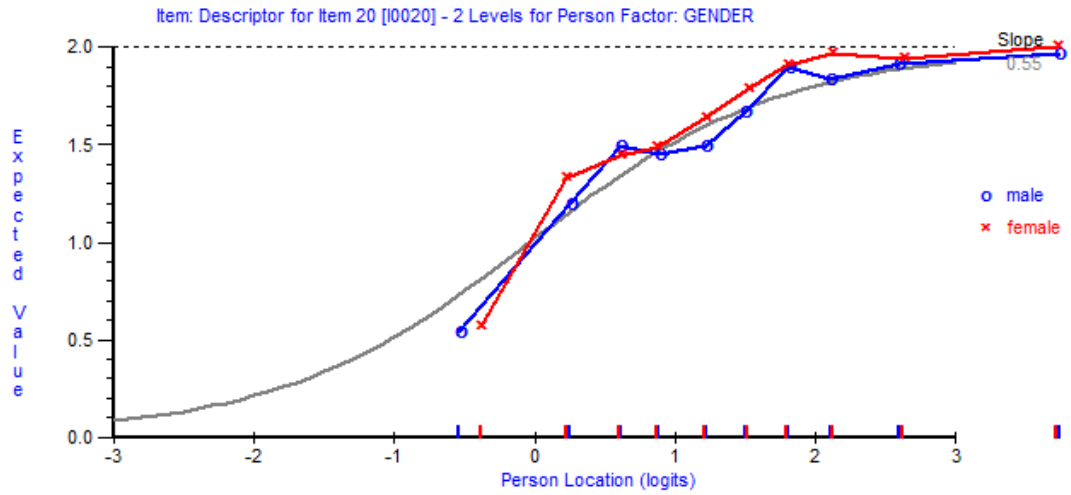


Figure 20: (continued)

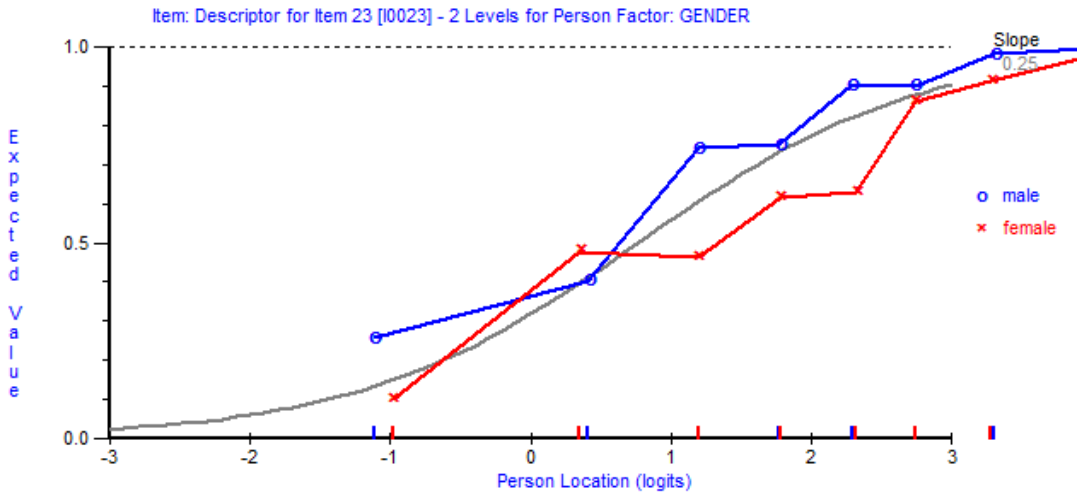






DIF for gender on the language and cognitive scale is outlined in Figure 21. Item 23 ('recognise 1-10'; F = 13.50) showed significant DIF by gender (Bonferroni adjusted p value < 0.000641). At equivalent levels of language and cognitive development boys were more likely to be rated as able to recognise 1-10. No significant DIF by gender was present for any item on the communication skills and general knowledge scale.

Figure 21: Gender DIF for language and cognitive development scale



6.4 Discussion

This paper used Rasch analysis to explore the psychometric properties of the five domains (scales) of the EDI in a sample of 1344 children in Ireland. The aim of the study was to determine the psychometric properties of the EDI within the Rasch paradigm. The findings in relation to each scale can be summarised as follows:

6.4.1 Physical health and well being

The physical health and well-being scale had only reasonable fit to the overall Rasch model. The scale did not discriminate well between children of differing ability and showed evidence of item-trait interaction. In total 33.6% of children showed extreme person fit residuals. There was a mismatch between ability and item difficulty with additional items needed at the upper end of the scale. One item showed disordered thresholds. Seven items had extreme fit residuals and seven showed item-trait interaction. One local response dependency between items was observed. Two items displayed DIF by gender with one showing item bias favouring girls and the other favouring boys.

6.4.2 Social competence

The social competence scale demonstrated excellent fit to the Rasch model and an ability to reliably discriminate between children of different abilities. However, there was evidence of item-trait interaction at the scale level and 17.9% of children showed extreme fit residuals. There were similar levels of person-item mismatch to the physical health and well-being scale. Fourteen items had extreme fit residuals and ten showed item-trait interaction. Four instances of local response dependency between items were observed. Three items displayed DIF by gender with two showing item bias favouring boys and one favouring girls.

6.4.3 Emotional maturity

The emotional maturity scale showed excellent fit to the Rasch model, an ability to discriminate well between children of differing abilities and item residuals close to zero. Only 5.4% of children had extreme fit residuals. This scale had the best match between persons and items. However, sixteen items had extreme fit residuals and nineteen showed item-trait interaction. Twenty-three instances of local response dependency between items were observed. Eleven items showed DIF by gender with nine showing item bias favouring girls and two favouring boys.

6.4.4 Language and cognitive development

The language and cognitive development scale demonstrated good fit to the Rasch model and the ability to reliably discriminate between persons of differing ability but again, there was evidence of item trait interaction and 30.4% of children had extreme fit residuals. This scale covered a wide range of difficulty but still not enough to cover the upper range of ability. Nine items demonstrated extreme fit residuals and six items showed item-trait interaction. One instance of local response dependency between items was observed and one item displayed DIF by gender with the bias favouring boys.

6.4.5 Communication skills and general knowledge

The communication skills and general knowledge scale showed excellent fit to the Rasch model, and the ability to discriminate between children of differing ability, but did show item-trait interaction. The percentage of children with extreme fit residuals was 34.5%. The ceiling effect, which was apparent across all scales, was most marked for this domain. Six items demonstrated extreme fit residuals and six showed item-trait interaction. There was no instance of local response dependency between items and no DIF by gender.

The analysis indicates that the EDI fits the Rasch model at least reasonably on all scales. This lends support to the findings of studies which have used the EDI,[154] while signalling areas where improvements are necessary.

Every scale demonstrated some elements which are of concern. However, the Rasch criteria are very demanding and they have to be taken as a whole.[101] No one criterion is disqualifying.

All scales had an inadequate number of items for measuring ability at the higher levels with a marked ceiling effect. Similar patterns were observed in the Australian and Swedish Rasch analysis of the EDI.[102-103] In the Australian study, Andrich and Styles[103] took the view that, as the instrument was developed for the explicit purpose of identifying children at risk (at the lower end of the spectrum), it was not necessary to discriminate between children who were performing above this level. However, the ceiling effects observed in this study create three important problems that persist regardless of the focus of the instrument. First, it has implications for the use of an arbitrary cut-off point of 10%. If the domain in question has a large ceiling effect it implies that children with high absolute scores may still end up being classified as relatively 'at risk'. In other words, the standard for what constitutes 'at risk' becomes higher and there is the danger that children who would be considered within the normal spectrum of development on other measures are classified as at risk on the EDI. The EDI would eventually become synonymous with over-diagnosis in such a scenario. Second, the ceiling effect is problematic for studies that aim to use the EDI to compare populations as it will lead to an underestimate of the difference between geographical areas with high and low levels of developmental deprivation. Third, the EDI is used extensively to measure changes over time resulting from early childhood interventions. It is essential, therefore, that the full range of possible improvements at the domain level can be detected.

The concept of healthy child development, which underpins the EDI, needs to be fully articulated at all levels of ability. Hobart et al[88] outline the need for a bottom-up approach to instrument development which would begin with a construct theory onto which items would be mapped using both qualitative and quantitative methods. This approach could serve well as a detailed evaluation of the EDI.

The DIF for gender, which is particularly evident in the emotional maturity scale, also needs attention. For the most part, DIF for gender is not unexpected and can achieve a balance between items that favour girls and boys. However, in this instance, almost one-third (9 out of 30) items on this scale are biased in favour of girls meaning that despite equal levels of emotional maturity, girls score better on these items. Gendered differences in emotional and social expression are evident from an early age[176] and need to be addressed in the context of the measurement of early childhood development.

The emotional maturity scale requires attention, particularly at the level of the individual items. It is the longest scale consisting of 30 items. In addition to DIF, twenty-three pairs of local response dependency were observed. Item 5 (comforts a crying child), item 3 (helps someone hurt), item 4 (helps other children) and item 8 (helps sick children) all interact with each other. Moreover, items 3 and 5 showed gender DIF favouring girls. All of these items are indicators of helping behaviour. Another group of items which show a marked degree of response dependency are item 15 (restless), item 16 (distractible), item 17 (fidgets), item 20 (impulsive) and item 22 (can't settle). Again, items 15, 17, 20 and 22 showed DIF favouring girls. These are two instances where the instrument may benefit from qualitative work with teachers and others in the field of education with a view to item reduction.

In order to improve the EDI scales a range of options need to be considered. These include:

(i) qualitative work to attempt to explain some of the flaws - this would be particularly useful in exploring issues such as the high level of DIF displayed by the emotional maturity domain;

(ii) deleting problematic items to determine whether or not that improves fit to the Rasch model;

(iii) adding additional items where there are clear gaps - this would be a strong possibility for the top end of the scales.

The findings highlight the value of Rasch analysis in the psychometric evaluation of rating scales. The EDI had demonstrated sound psychometric properties when evaluated using traditional psychometric tests. However, traditional methods are concerned with total scores on scales. As a result, poorly functioning individual items can remain undetected.[92] This study has allowed a detailed examination of the items which make up the five scales of the EDI.

Rasch analysis, unlike traditional psychometric methods, is not sample dependant.[98] The results from this analysis, therefore, support the validity of the EDI across populations. At the same time, findings from the process of refining the instrument outlined above could inform the adaptation of the EDI on an international level.

6.4.6 Limitations

The Rasch analysis outlined above is the first step in a process of refining the EDI for use in the Irish context. It did not involve any adjustment to the instrument. Further research will be required to test the impact of removing or adding items to the scales.

The authors approached the implementation of the EDI in Ireland from a population-health perspective and the need for an instrument which could identify populations or communities of children at risk, thereby informing policy and services supporting early childhood development. In this context it was essential that we examine the psychometric properties of the EDI. We have identified a number of areas of concern but will not make adjustments to the instrument without detailed consultation with specialists in early education and particularly with Professor Janus of the Offord Centre who developed the instrument and who has been involved with its international adaptation. This level of work was beyond the scope of this study.

6.4.7 Conclusion

The study endorses the overall fit of the EDI to the Rasch model. However, it points to a number of issues which will have to be addressed. If the EDI is to be implemented at a national level in Ireland, it would benefit from further refinement which could in turn inform the international implementation of the EDI.

CHAPTER 7: DISCUSSION

"***The importance of developing measures of early childhood development at a population level should be self evident if we believe that 'what gets counted counts'. With counting comes a focus on issues, public dialogue and resources. Thus monitoring of child development – across a population, over time and with the ability to examine geographic trends – is a key activity in support of the success of a modern developed society***." (Pg 68 Hertzman)[57]

7.1 Summary of main findings

The overall aim of this thesis was to explore the potential of the EDI as a measure of early childhood development in Ireland. It put forward the idea that we need to track in a meaningful way the developmental status of all children in a manner that supports and evaluates public policy. However, the multidimensional nature of early childhood development, along with the fact that children are developing and changing rapidly, particularly in the first six years of life, makes the task of measurement more complex.[6]

At a time when there was an emerging focus on supporting early childhood development in Ireland, we identified the EDI as a unique tool that could provide an accessible, composite means of tracking developmental outcomes across whole populations of children and across all five domains of development.[62] The study demonstrated the utility, feasibility and validity of the EDI as a census of early childhood development. The study also added to the literature on early childhood development by measuring population-level variation using the EDI and identifying associations at the level of the child, family, school and neighbourhood.

Implementing a cross-sectional study in one urban centre and adjoining rural area in Ireland provided a sufficient basis from which to assess the EDI and has demonstrated its ability to detect variations in early childhood development in Ireland at the level of

the family, school and neighbourhood. The validity of the EDI in the Irish population has also been addressed.

The review of the literature revealed that although the EDI has been widely administered, this rich source of data on early childhood development has been underutilised. The majority of published studies were based on Canadian populations, followed by those from Australia. This thesis documented the first published population-level study using the EDI in Europe.[154] Moreover, only three previous studies had linked EDI scores with family-level contextual data. By using an extensive parental questionnaire, this study provided a robust outline of factors associated with early childhood development.

Chapter 3 linked the developmental outcomes as measured by the EDI with data collected using a parental questionnaire to provide contextual data on the lives of the children in the study. The overall level of developmental vulnerability was consistent with that found in other studies using the EDI, supporting the transferability of the instrument from the Canadian to the Irish context.[81 120] The high level of engagement in the study by schools and parents demonstrated its acceptability.

The results showed that certain sub-groups of the population showed consistently lower mean scores across all domains, which raises questions regarding how best to support early childhood development in Ireland. Of particular concern were children from the Traveller Community, those who had English as a second language, and children who started school at a younger age.

Children who were of low birth weight were more than twice as likely to be vulnerable. Longitudinal studies have shown an association between birth weight and cognitive ability independent of socio-economic status.[177] This association is known to continue

into adulthood, mediated by development status at age eight,[178] pointing to the importance of supporting low birth weight children through early intervention.

Mother's education was used as a proxy for socio-economic status. Children whose mothers had primary education only were shown to be at greater risk of developmental vulnerability when compared with those whose mother had university education. This is consistent with findings from studies which show a strong association between mother's education and child development outcomes[81] and behavioural problems.[179] Other factors strongly associated with early development outcomes were indicators of adult involvement in creating supportive environments. This is consistent with findings from studies linking early literacy skills to supportive home environment[27 32] and to story-book reading.[35] A full outline of factors from the parental questionnaire and associated mean scores and vulnerability rates are outlined in Appendix 7.

Chapter 4 moved from the family-level to the area-level to examine associations with early development outcomes and demonstrated the utility of the EDI as a method of accurately identifying geographical populations of children at greater risk. Mean developmental scores across the five domains were analysed at the level of the electoral division (ED) and the school. A composite indicator of neighbourhood economic status (material affluence or deprivation), and school-level designation as disadvantaged or otherwise, were used as population-level indicators. A complex picture emerged. It was clear that schools with designated disadvantaged status have a greater burden of children who are not ready to meet the demands of school, thereby justifying the allocation of additional resources to those schools. However, almost half (47%) of all children who were developmentally vulnerable were not attending designated disadvantaged schools and therefore did not benefit from additional supports.

Some area-level social gradient was evident. However, it was clear that the use of composite indicators of disadvantage as proxy for identifying areas where children are at greatest risk inevitably leads to populations of vulnerable children being overlooked.

One group which emerged as being of particular concern were children who had not attended pre-school. This small group accounted for 7% of the population attributable fraction for risk of vulnerability.

Chapter 5 focused particularly on the extent to which special educational needs are being identified. It demonstrated how teacher observation can contribute to the identification of children in need of additional support, particularly where those children do not have a clinically diagnosable disability. The study found that there was a population of children, identified by teachers as being in need of further assessment, who had mean development scores comparable to those of children with identified special educational needs. It was evident that these children were less likely to have obvious physical conditions and more likely to have social or emotional difficulties which are not as easily labelled or diagnosed.

These children would benefit from a more holistic approach to special educational needs. This chapter advocated a shift from an emphasis on diagnosis to one of creating supportive environments which enhance the participation of all children regardless of needs. This approach would be complementary to a population health approach to early childhood development in that it would enhance the educational experience of all children while particularly benefiting those for whom participation in education is particularly challenging.

The EDI is not an individual diagnostic instrument, none-the-less chapter 5 demonstrates that the availability of population level data can be of benefit in evaluating the extent to which policies aimed at supporting children with additional

needs are in fact reaching their intended beneficiaries within the population as a whole.

Using the EDI, this paper has for the first time been able to identify in a quantitative study the extent to which the Irish approach to special educational needs is failing to reach certain population groups and therefore has implications for national policy. A combination of population-wide and targeted approaches may better serve those children who are currently falling through the gaps.

These three chapters demonstrated the utility of the EDI in identifying populations of children at risk of developmental delay. By linking with a parental questionnaire or with administrative data, the factors which are associated with this increased risk can be examined in detail. The EDI data also provide a robust, timely indicator of the burden of risk which affects neighbourhoods or schools. It allows us to identify populations of children who may not have severe disability but who nonetheless require additional support if they are to achieve their full developmental potential.

The similarity between the findings of the current study and those of studies conducted in Canada provided a strong basis for assuming that the instrument performed well in the Irish context. Extensive testing conducted in Canada and Australia indicated that the instrument was psychometrically sound. However, as it became apparent that the EDI was demonstrating a strong potential for utility for Ireland, it was also evident that the psychometric properties of the instrument needed to be tested. The availability of data on 1,344 children provided a sample on which to test the validity of the instrument.

Chapter 6 built on previous psychometric analysis by providing the first large-scale Rasch analysis of the EDI. Each domain was treated as a separate scale and analysed separately. All domains demonstrated at least reasonable fit to the model with the

social competence and emotional maturity domains showing excellent fit. At the same time, some issues were identified. All scales showed a marked ceiling effect. As a result, the instrument did not discriminate well at the upper levels of ability.

7.2 Limitations

This study only provides a snapshot of developmental health in Ireland. It was confined to one urban and adjoining rural area in Ireland. This limited somewhat the social range. Moreover, the rural population were not chosen as a representative sample but as a means of complementing other studies currently underway in that area. The result cannot, therefore, be extrapolated to represent the general rural population of Ireland which includes pockets of extreme rural isolation not represented in the sample.[155]

The overall study was representative of children in their first year in formal education in the study area. However, there was a 65% return rate on the parental questionnaire. While this compares favourably to other jurisdictions where this method has been used[120] there are significant differences between those for whom parental data were available and those for whom they were not. It is clear that the most vulnerable children were under-represented in the parental sample.

The EDI is not an individual diagnostic instrument nor is it meant to be in any way a reflection on the status of individual children. To protect the children, no names or addresses are included on the questionnaires. In other countries where the EDI has been implemented, postal codes were used as a proxy for neighbourhood-level identifiers. However, in Ireland we do not yet have postal codes. For this reason EDs were used as a proxy for neighbourhoods. This method has limits in that not all EDs correspond to local neighbourhoods.

This was the first study using the EDI in Ireland and was conducted with the expressed purpose of examining the suitability of the EDI in the Irish context. Therefore, there was limited scope for validity testing prior to the implementation of the study. Comparisons with Canadian normative data, internal validity testing and qualitative work with teachers[1] were accepted as indicators that the EDI functioned well in the Irish context. This study provided the data for Rasch analysis (which therefore could not have been completed prior to its implementation due to lack of data). This analysis demonstrated that the instrument would benefit from adjustment to suit the Irish population.

7.3 Implications for research in early childhood development

Despite the acknowledged importance of early childhood development as a key determinant of health, there is very limited consensus as to how best to measure this complex construct. In attempting to track child well-being indicators for country-level comparisons, the OECD found that while there is ample availability of indicators for late childhood ***'there is almost no good data across the breadth of child outcomes during early and middle childhood for a sufficient number of OECD countries.'*** (pg 30, Chapter 2, Doing Better for Children).[180] UNICEF, in response to a similar lack of data on child development, cites the EDI as a potential international indicator.[67] This study has demonstrated that the EDI transfers from the Canadian to the Irish context and therefore has the potential to be transferred to other countries. It adds to the growing volume of work that identifies the EDI as a legitimate, accessible means of collecting data on early childhood development across jurisdictions.

Rasch analysis, unlike traditional psychometric methods, is not sample dependant.[98] The results therefore lend support to the findings of studies which have used the EDI,

[1] A qualitative review of the implementation process and utility of the EDI was conducted with teachers and principals using participatory appraisal techniques and can be made available on request.

while signalling areas where improvements are necessary. A number of possible approaches to refining the instrument have been outlined. These include:

(i) qualitative work to attempt to explain some of the flaws, exploring issues such as the high level of DIF displayed by the emotional maturity domain;

(ii) deleting problematic items to determine whether or not that improves fit to the Rasch model;

(iii) adding additional items where there are clear gaps - this would be a strong possibility for the top end of the scales.

If the EDI is to be implemented at a national level in Ireland, this further refinement will need to be undertaken.

The majority of studies using the EDI have relied on area-level administrative sources for contextual data on child development. Yet, the effect of neighbourhood context on young children is primarily mediated through the family.[119] This study effectively linked the EDI with a parental questionnaire, demonstrating the importance of key family-level factors in child development.

7.4 Implications for policy and programme development in Ireland

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. The study found that children who had not attended pre-school were four times more likely to be developmentally vulnerable than those who had. This increased risk was evident across all five domains of development. This study was conducted in the year prior to the implementation of a universal free pre-school year in Ireland.

From an 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 showed high levels of vulnerability in communities with high concentrations of immigrant families.

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 years old is not officially monitored. The EDI has the potential to inform current debates regarding the introduction of a second free pre-school year (for younger children) and changes to the school-entry age.

Poverty and inequality affect up to one quarter of Irish children. Tackling child poverty through a strategy of area-based prevention and early intervention features highly on the agenda of the current government.[68] However, effective targeting in the context of

early childhood development is problematic.[149] This study demonstrated that vulnerable children were not confined to areas where there are high levels of material deprivation. It illustrated how the EDI can identify areas with high concentrations of vulnerable children with greater accuracy than relying on composite indicators of material deprivation.

Vulnerable children are found in all areas and socio-economic groups. Targeted initiatives alone are therefore not adequate to address inequalities in healthy child development. In line with Rose's population health strategy,[53] a whole population approach is necessary. A system of 'proportionate universalism' as proposed by the Marmot Review[133] would provide services for early childhood care and education to all children but with a concentrated focus on populations of children at greatest risk.

At the same time, population-level preventative programmes have complex outcomes. They aim to reduce the burden of risk across the whole population.[52] In the context of early childhood development success cannot be measured in terms of reduced morbidity or mortality rates. The EDI shifts the focus from only identifying individual children with severe developmental delay to identifying groups or populations with increased risk and thereby supports a population health approach.

7.5 Conclusion

During the first five years of life, human development is highly susceptible to environmental impacts. This results in some children not achieving their full developmental potential. Conversely, it means that appropriate support and intervention in the early years can have a hugely positive effect on future outcomes.[9] It is imperative, therefore that we can effectively identify the populations of children who are most vulnerable and measure trends in developmental outcomes. The EDI can play a critical role in informing policy and practice in support of early childhood development at a local and national level, and allow for internationally comparable studies.

This study demonstrates that it is possible to track early childhood development in Ireland. Implementation of the EDI at a national level would be feasible, affordable and, judging from the level of participation in the current study would have the support of schools and families.

This thesis concludes that population-level variation in early childhood development can be measured in a manner that supports service planning and intervention through the use of the Early Development Instrument.

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Early Development Instrument

A Population-Based Measure for Communities

Cork 2010/2011

School _____

Teachers Name _____

Form Number | | | | | | |

Please fill in the circles like this ● or O NOT O
Please use a blue or black ballpoint pen

1. Child's date of birth
d d / m m / y y

2. Sex: O F O M

3. E. D. Code

4. Class Type:
O J Infants
O J + S Infants
O J + S Infants +1st class
O Other

5. Date of Completion:
d d / m m / y y

6. Identified Special Needs:
O Yes O No

7. Child considered ESL:
O Yes O No

8. Child's first language(s):
O English only
O Other only
O English and other
O & &
Other Other
(Refer to Guide for language codes in 'other' categories. If you do not know the 'other' language code, use '000')

9. Communicates adequately in his/her first language:
O Yes O No O Don't know

10. Member of the Travelling Community:
O Yes O No O Don't know

11. Student Status:
O In class more than 1 month
O In class less than 1 month (see Guide)
O Moved out of class (see Guide)
O Moved out of school (see Guide)
O Other (see Guide)

12. Child is repeating Junior Infants:
O Yes O No

Section A – Physical Well-being

1. About how many regular days (see Guide) has this child been absent since the beginning of school in September? Number of days absent | | |

Since the start of school in September has this child sometimes (more than once) arrived:	yes ^	no ^	don't know ^
2. over- or underdressed for school activities	O	O	O
3. too tired/ sick to do school work	O	O	O
4. late	O	O	O
5. hungry	O	O	O

Would you say that this child:	yes ^	No ^	don't know ^
6. is independent in washroom habits most of the time	O	O	O
7. shows an established hand preference (right vs. left or vice versa)	O	O	O
8. is well co-ordinated (i.e. moves without running into or tripping over things)	O	O	O

How would you rate this child's:	very good /good ^	average ^	poor/ very poor ^	don't know ^
9. proficiency at holding a pen, crayons or a brush	O	O	O	O
10. ability to manipulate objects	O	O	O	O
11. ability to climb stairs	O	O	O	O
12. level of energy throughout the school day	O	O	O	O
13. overall physical development	O	O	O	O

Section B Language and Cognitive Skills

How would you rate this child's:

	very good /good ^	average ^	poor/ very poor ^	don't know ^
1. ability to use language effectively in English	O	O	O	O
2. ability to listen in English	O	O	O	O
3. ability to tell a story	O	O	O	O
4. ability to take part in imaginative play	O	O	O	O
5. ability to communicate own needs in a way understandable to adults and peers	O	O	O	O
6. ability to understand on first try what is being said to him/her	O	O	O	O
7. ability to articulate clearly, without sound substitutions	O	O	O	O

Would you say that this child:

	yes ^	No ^	don't know ^
8. knows how to handle a book (e.g. turn a page)	O	O	O
9. is generally interested in books (pictures and print)	O	O	O
10. is interested in reading (inquisitive/curious about the meaning of printed material)	O	O	O
11. is able to identify at least 10 letters of the alphabet	O	O	O
12. is able to attach sounds to letters	O	O	O
13. is showing awareness of rhyming words	O	O	O
14. is able to participate in group reading activities	O	O	O
15. is able to read simple words	O	O	O
16. is able to read complex words	O	O	O
17. is able to read simple sentences	O	O	O
18. is experimenting with writing tools	O	O	O
19. is aware of writing directions in English (left to right, top to bottom)	O	O	O
20. is interested in writing voluntarily (and not only under the teacher's direction)	O	O	O
21. is able to write his/her own name in English	O	O	O
22. is able to write simple words	O	O	O

Section B Language and Cognitive Skills

Would you say that this child:

	yes	No	don't know
	^	^	^
23. is able to write simple sentences	O	O	O
24. is able to remember things easily	O	O	O
25. is interested in mathematics	O	O	O
26. is interested in games involving numbers	O	O	O
27. is able to sort and classify objects by a common characteristic	O	O	O
28. is able to use one-one correspondence	O	O	O
29. is able to count to 20	O	O	O
30. is able to recognise numbers 1 – 10	O	O	O
31. is able to say which number is bigger than 2	O	O	O
32. is able to recognise geometric shapes (e.g. triangle, circle, square)	O	O	O
33. understands simple time concepts (e.g. today, summer, bedtime)	O	O	O
34. demonstrates special numeracy skills or talents	O	O	O
35. demonstrates special literacy skills or talents	O	O	O
36. demonstrates special skills or talents in arts	O	O	O
37. demonstrates special skills or talents in music	O	O	O
38. demonstrates special skills or talents in athletics/ dance	O	O	O
39. demonstrates special skills or talents in problem solving in a creative way	O	O	O
40. demonstrates special skills or talents in other areas	O	O	O

If yes , please specify: _____

Section C – Social and Emotional Development

How would you rate this child's:

	very good /good	average	poor/ very poor	don't know
	^	^	^	^
1. overall social/ emotional development	O	O	O	O
2. ability to get along with peers	O	O	O	O

Below is a list of statements that describe some of the feelings and behaviours of children. For each statement, please fill in the circle that best describes this child now or within the past six months. Would you say that this child:

	often or very true	sometimes or somewhat true	never or not true	don't know
	^	^	^	^
3. plays and works cooperatively with other children at the level appropriate for his/her age	O	O	O	O
4. is able to play with various children	O	O	O	O
5. follows rules and instructions	O	O	O	O
6. respects the property of others	O	O	O	O
7. demonstrates self-control	O	O	O	O
8. shows self-confidence	O	O	O	O
9. demonstrates respect for adults	O	O	O	O
10. demonstrates respect for other children	O	O	O	O
11. accepts responsibility for actions	O	O	O	O
12. listen attentively	O	O	O	O
13. follows directions	O	O	O	O
14. completes work on time	O	O	O	O
15. works independently	O	O	O	O
16. takes care of school materials	O	O	O	O
17. works neatly and carefully	O	O	O	O
18. is curious about the world	O	O	O	O
19. is eager to play with a new toy	O	O	O	O
20. is eager to play a new game	O	O	O	O
21. is eager to play with/ read a new book	O	O	O	O

Section C – Social and Emotional Development

Would you say that this child:

	often or very true ^	sometimes or somewhat true ^	never or not true ^	don't know ^
22. is able to solve day-to-day problems by himself/ herself	O	O	O	O
23. is able to follow one-step instructions	O	O	O	O
24. is able to follow class routines without reminders	O	O	O	O
25. is able to adjust to changes in routines	O	O	O	O
26. answers questions showing knowledge of the world (e.g. leaves fall in the autumn, apple is a fruit, dogs bark)	O	O	O	O
27. shows tolerance to someone who made a mistake (e.g. when a child gives a wrong answer to a question posed by the teacher)	O	O	O	O
28. will try to help someone who has been hurt	O	O	O	O
29. volunteers to help clear up a mess someone else has made	O	O	O	O
30. if there is a quarrel or dispute will try to stop it	O	O	O	O
31. offers to help other children who have difficulty with a task	O	O	O	O
32. comforts a child who is crying or upset	O	O	O	O
33. spontaneously picks up objects which another child has dropped (e.g. pencils, books)	O	O	O	O
34. will invite bystanders to join in a game	O	O	O	O
35. helps other children who are feeling sick	O	O	O	O
36. is upset when left by parent/ guardian	O	O	O	O
37. gets into physical fights	O	O	O	O
38. bullies or is mean to others	O	O	O	O
39. kicks, bites, hits other children or adults	O	O	O	O
40. takes things that do not belong to him/ her	O	O	O	O
41. laughs at other children's discomfort	O	O	O	O
42. can't sit still, is restless	O	O	O	O
43. is distractible, has trouble sticking to any activity	O	O	O	O
44. fidgets	O	O	O	O
45. is disobedient	O	O	O	O
46. has temper tantrums	O	O	O	O

Section C – Social and Emotional Development

Would you say that this child:

	often or very true ^	sometimes or somewhat true ^	never or not true ^	don't know ^
47. is impulsive, acts without thinking	O	O	O	O
48. has difficulty awaiting turn in games or groups	O	O	O	O
49. cannot settle to anything for more than a few moments	O	O	O	O
50. is inattentive	O	O	O	O
51. seems to be unhappy, sad, or depressed	O	O	O	O
52. appears fearful or anxious	O	O	O	O
53. appears worried	O	O	O	O
54. cries a lot	O	O	O	O
55. is nervous high-strung or tense	O	O	O	O
56. is incapable of making decisions	O	O	O	O
57. is shy	O	O	O	O
58. sucks a thumb/finger	O	O	O	O

Section D – Special Concerns

1. Does the student have a problem that influences his/her ability to do school work in a regular classroom? (based on parent information, medical diagnosis, and/or teacher observation)

O yes O no O don't know (If answered no/don't know go to question 5)

If YES above, please mark all that apply.
Please base your answers on teacher observation or medical diagnosis and/or parent/guardian information.

	YES Observed	YES Parent Info/Medical Diagnosis
2a. physical disability	O	O
b. visual impairment	O	O
c. hearing impairment	O	O
d. speech impairment	O	O
e. learning disability	O	O

	YES Observed	YES Parent Info/Medical Diagnosis
f. emotional problem	O	O
g. behavioural problem	O	O
h. home environment/ problems at home	O	O
i. chronic medical/ health problems	O	O
j. unaddressed dental need	O	O
k. Other (if known print below)	O	O

_____

3. If the child has received a diagnosis or identification by a doctor or psychological professional please indicate (see the Guide for codes) [ ]

Section D – Special Concerns con't

	Yes	no	don't know
	^	^	^
4. Is the child receiving any school based support(s) (e.g. educational assistant, equipment)?	O	O	O
5. a. Is the child currently receiving further assessment?	O	O	O
b. Is the child currently on the waiting list to receive further assessment?	O	O	O
c. Do you feel that this child needs further assessment?	O	O	O

Section E – Additional Questions

To the best of your knowledge, please mark all that apply to this child:	yes	No	don't know
	^	^	^
1. attended an early intervention programme If known, please specify_____	O	O	O
2. attended an organised pre-school	O	O	O

3. If yes, was this
- a. an Early Start pre-school programme O
- b. another pre-school programme based in your school O
- c. another pre-school programme based in a different school O
- d. a pre-school programme based outside of school O
- e. don't know O

	yes	No	don't know
	^	^	^
3. been in non parental care on a regular basis prior to school entry	O	O	O

4. If yes, was this
- a. unpaid care (relative or friend) O
- b. paid care in own home O
- c. paid care in someone's home O
- d. care in centre/ crèche O
- e. don't know O

	full-time	part-time	don't know
	^	^	^
4f. to the best of your knowledge, prior to the child's entry to Junior Infants was this arrangement	O	O	O

If you have any comments about this child and her/his readiness for school, list them below:

_____

_____

_____

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Appendix 2: Parental Questionnaire



Form Number | | | | | | | |

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?	○	○	○	○

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: _____	○	○

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)	○	○	○	○	○

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	○	○	○	○

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 F: 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.	○	○	○

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**
○	○	○	○	○

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**
○	○	○	○	○

SECTIONG: 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?	○	○	○

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?	○	○	○	○	○	

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

Appendix 3: Parental information letter





PARENT

INFORMATION SHEET

Title of Study: Community-Level Measurement of School Readiness-to-Learn for Junior Infants Children

Principal Investigator: Professor Ivan Perry, Department of Epidemiology and Public Health, UCC

Study Coordinator: Margaret Curtin

This information leaflet has been developed by the project team in UCC to provide parents with detailed information on research which is being carried out to help us better understand the factors which support child development across communities in Cork.

Research shows that investing resources and energy into children's early years, when their brains are developing rapidly, will bring life-long benefits to them and to the whole community. The Early Development Instrument (EDI) is a measure of how young children are developing in different communities. This information enables communities and governments to pinpoint the types of services, resources and supports young children and their families need to give children the best possible start in life.

As part of their ongoing commitment to improve the well-being of children, Primary Schools in Cork City are participating in the collection of data on Junior Infants children. Your child's school is participating and all Junior Infants classes in your child's school are taking part in this study. It is your choice whether your child is included in this study and if you chose not to have him/her included, just contact their school.

Why is this research being done?

Children vary a great deal in how ready they are to start school and begin learning. Children who are ready for school from their first day have a greater chance of doing well in school. This research is being done to better understand and measure readiness to learn at school as an outcome of early development.

What is the purpose of the study?
The information that we gather on children as they enter school in Cork will be examined to see if there are factors that may affect a child's development between the ages of 0 to 5.

What will take place?
A questionnaire, called the Early Development Instrument (EDI) which measures children's readiness to learn at school will be completed by the class teacher. This tool was developed in Canada and is used throughout Canada and Australia to track school readiness across communities and populations. It is also being introduced in a number of other countries.

The questionnaire asks questions about five areas of child development: 1) physical health and well-being; 2) social knowledge and competence; 3) emotional health and maturity; 4) language and cognitive development; and 5) general knowledge and communication skills. Under no circumstances and not at any time will your child's name be included. The questionnaire will contain your child's date of birth, gender, and Electoral Area only. This questionnaire will be completed by Junior Infants teachers for all children in their class during June 2012.

Will parents be involved?
To ensure that the views of parents are also taken into account and to allow for a deeper understanding of your child's early years experience, family and neighbourhood, you will be asked to fill out a questionnaire which will be sent to you through the school in the coming weeks. Your name or your child's name will not be included on this form either.

Data will sometimes be linked at group levels (ie., electoral district, city, province, country) with other data about things that may have an effect on how well children are doing to see if there are any trends. For example, the availability of programmes and services for young families, the number of children under 5 in your neighbourhood, or the income level in your Electoral District. This cannot and will not be done for individual children, but only groups of children (the smallest group would be a school or neighbourhood so that no individual child can be identified).

Confidentiality
Results of this study will not be linked to your child. An anonymous ID number will be assigned to your child. This ID number will also appear on the questionnaire you are asked to complete. Your child's name will not be used. Data on gender, date of birth and electoral district will be included.

Results will be examined at Electoral Division or school levels but not on an individual basis. There will be no record kept in your child's academic records. All data collected with the EDI will kept in UCC. Results of the study will be shared with the school (but only at group level and not individual responses). Schools may use these data for future planning in order to meet the needs of children.

All questionnaires will be locked in confidential storage until the end of the study, *when they will be destroyed.* Data will be stored on a password protected computer which only the members of the project team will have access to. Any publications that may result from this research will not identify participants in any way. The study results can be made available to you upon request.

Data will not be examined at any level where there are less than 10 children in a group in order to make it impossible to identify children. If you chose not to have your child included in the study it will have no affect on your child's standing in their classroom or school.

Are there any risks or benefits to you or your child?
There are no risks involved with this study. Although there will be no direct benefit to your child, we feel that this research may answer questions about why children in some areas are doing better or worse than others in terms of their early development which in turn determines their success at school and beyond. We hope that the results of the study will help to bring about changes in communities where there is a need to improve conditions for families with young children.

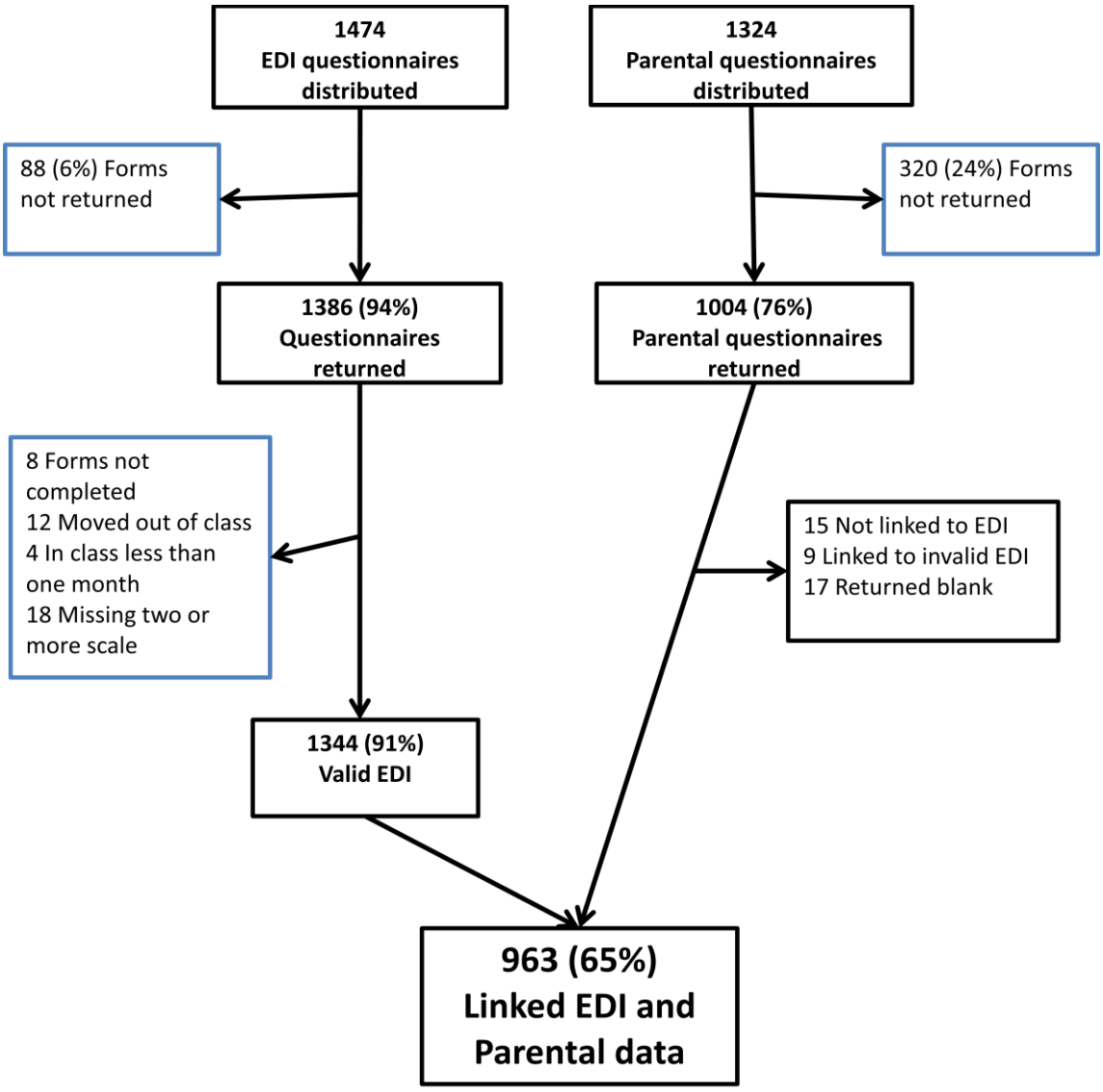
Who do I contact if I have questions or concerns about this study?
If you have questions or concerns you may contact Margaret Curtin who is co-ordinating the study on behalf of UCC on 021 4205529 or 086 3219121.

We will be in contact with you again. Thank you for your co-operation.

Yours sincerely,

Margaret Curtin
On behalf of the UCC project team

Appendix 4: Participant flow chart for whole study



Appendix 5: Ethical approval letter

Tel: + 353-21-490 1901
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Coláiste na hOllscoile Corcaigh, Éire
University College Cork, Ireland

COISTE EITICE UM THAIGHDE CLINICIÚIL
Clinical Research Ethics Committee

Lancaster Hall,
6 Little Hanover Street,
Cork,
Ireland.

Our ref: ECM 4 (h) 07/12/10

3rd November 2010

Professor Ivan Perry
Professor of Epidemiology & Public Health
Floor 2
Brookfield Health Sciences Complex
University College Cork
College Road
Cork

Re: Can geographical variations in early childhood development be measured in a manner that supports service planning and interventions?

Dear Professor Perry

Expedited approval is granted to carry out the above study in:

- Primary Schools in Cork.

The following documents have been approved:

- Application Form
- Study Protocol dated July 2010
- Letter to Schools
- Parent Information Sheet
- Junior Infants Parents Survey
- Early Development Instrument Guide
- Early Development Instrument.

If you feel that any of the above documents are likely to change following the pilot study I would suggest putting a version number or date on the documents prior to use.

We note that the co-investigator involved in this study will be:

- Margaret Curtin.

Yours sincerely

Dr Michael Hyland
Chairman
Clinical Research Ethics Committee
of the Cork Teaching Hospitals

Appendix 6 : Domains, sub-domains and questions on the EDI

EDI Domains Sub-domains	Questions
PHYSICAL HEALTH & WELL-BEING	
Physical readiness for school day	Since the start of school has this child sometimes (more than once) arrived : • over- or underdressed for school-related activities • too tired/sick to do school work • late • hungry
Physical independence	Would you say that this child: • is independent in washroom habits most of the time • shows an established hand preference (right vs. left or vice versa) • is well coordinated (i.e., moves without running into or tripping over things) • sucks a thumb/finger
Gross and fine motor skills	How would you rate this child's: • level of energy throughout the school day • proficiency at holding a pen, crayons, or a brush • ability to manipulate objects • ability to climb stairs • overall physical development
SOCIAL COMPETENCE	
Overall social competence	How would you rate this child's: • overall social/emotional development • ability to get along with peers Would you say that this child: • plays and works cooperatively with other children at the level appropriate for his/her age • is able to play with various children • shows self-confidence
Responsibility and respect	Would you say that this child: • respects the property of others • follows rules and instructions • demonstrates self-control • demonstrates respect for adults • demonstrates respect for other children • accepts responsibility for actions • takes care of school materials • shows tolerance to someone who made a mistake (e.g., when a child gives a wrong answer to a question posed by the teacher)
Approaches to learning	Would you say that this child: • listens attentively • follows directions • completes work on time • works independently • works neatly and carefully • is able to solve day-to-day problems by him/herself • is able to follow one-step instructions • is able to follow class routines without reminders • is able to adjust to changes in routines
Readiness to explore new things	Would you say that this child: • is curious about the world • is eager to play with a new toy • is eager to play a new game • is eager to play with/read a new book
EMOTIONAL MATURITY	
Pro-social and helping behaviour	Would you say that this child: • will try to help someone who has been hurt • volunteers to help clear up a mess someone else has made • if there is a quarrel or dispute will try to stop it • offers to help other children who have difficulty with a task • comforts a child who is crying or upset • spontaneously helps to pick up objects which another child has dropped • will invite bystanders to join in a game • helps other children who are feeling sick

Anxious and fearful behaviour	Would you say that this child: • is upset when left by parent/guardian • seems to be unhappy, sad, or depressed • appears fearful or anxious • appears worried • cries a lot • is nervous, high-strung, or tense • is incapable of making decisions • is shy
Aggressive behaviour	Would you say that this child: • gets into physical fights • bullies or is mean to others • kicks, bites, hits other children or adults • takes things that do not belong to him/her • laughs at other children's discomfort • is disobedient • has temper tantrums
Hyperactivity and inattention	Would you say that this child: • can't sit still, is restless • is distractible, has trouble sticking to any activity • fidgets • is impulsive, acts without thinking • has difficulty awaiting turn in games or groups • cannot settle to anything for more than a few moments • is inattentive
LANGUAGE & COGNITIVE DEVELOPMENT	
Basic literacy skills	Would you say that this child: • knows how to handle a book (e.g., turn a page) • is able to identify at least 10 letters of the alphabet • is able to attach sounds to letters • is showing awareness of rhyming words • is able to participate in group reading activities • is experimenting with writing tools • is aware of writing directions in English (left to right, top to bottom) • is able to write his/her own name in English
Interest literacy/numeracy and memory	Would you say that this child: • is generally interested in books (pictures and print) • is interested in reading (inquisitive/curious about the meaning of print material) • is able to remember things easily • is interested in mathematics • is interested in games involving numbers
Advanced literacy skills	Would you say that this child: • is able to read simple words • is able to read complex words • is able to read simple sentences • is able to write simple words • is able to write simple sentences • is interested in writing voluntarily (and not only under the teacher's direction)
Basic numeracy skills	Would you say that this child: • is able to sort and classify objects by a common characteristic • is able to use one-to-one correspondence • is able to count to 20 • is able to recognize numbers 1 - 10 • is able to say which number is bigger of the two • is able to recognize geometric shapes (e.g., triangle, circle, square) • understands simple time concepts (e.g., today, summer, bedtime)
COMMUNICATION & GENERAL KNOWLEDGE	
Communication and general knowledge	How would you rate this child's: • ability to listen in English • ability to tell a story • ability to take part in imaginative play • ability to communicate own needs in a way understandable to adults and peers • ability to understand on first try what is being said to him/her • ability to articulate clearly, without sound substitutions • ability to use language effectively in English Would you say that this child: • answers questions showing knowledge about the world (e.g. apple is a fruit)

Appendix 7: Level of vulnerability by area of risk

	N	Percent	% Vulnerable
Mothers education (n = 943)			
Primary or less	39	4	36%
Junior or Leaving Cert or equivalent	336	35	26%
Diploma or Certificate	301	31	21%
University graduate	267	28	16%
Home description (n=939)			
Owner occupied	578	60	17%
Local authority	176	18	27%
Private rental and other	185	19	31%
Financial difficulties (n=938)			
No difficulty	661	69	20%
Difficulty	277	29	26%
Intergenerational financial difficulty (n=930)			
No intergenerational difficulty	761	79	21%
Intergenerational difficulty	169	18	26%
Low birth weight (n=926)			
Not low birth weight	872	91	21%
Low birth weight	54	6	37%
Child health (n=955)			
Excellent	467	48	18%
Very good	351	36	24%
Good/fair	137	14	34%
Family type (n=933)			
Single parent or other	162	17	28%
Two parent	771	80	20%
Parent community activity (n=963)			
No community activity	248	26	27%
1 or more community activity	715	74	21%
Parent volunteered in the school (n=945)			
Never	632	66	25%
Once or more	316	33	16%
Care up to 18 months (n=935)			
Parental care only	508	53	25%
Non parental care	427	44	18%
Weekly sports with a trainer (n=944)			
No	454	47	27%
Yes	490	51	18%
Weekly sport without a trainer (n=945)			
No	214	22	28%
Yes	731	76	20%
Visited a Library (n=926)			
Not at all	234	24	27%
Yes	692	72	20%
Participated in music or arts (n=899)			
Not at all	598	62	24%
Yes	301	31	17%
Screen-time (n = 953)			
One hour or less	214	22	18%
2 to 3 hours per day	599	62	22%
4 or more hours per day	140	15	30%
Literacy activity index (n=955)			
Low	224	23	29%
Moderate	528	55	22%
High	203	21	16%
Community safety index (n=940)			
Not safe	189	20	31%
Somewhat safe	281	29	25%
Safe	470	49	17%

Appendix 7 continued: Mean domain score by area of risk

	N	Mean domain scores				
		Physical well-being	Social comp	Emotional maturity	Language and cognitive	Com and gen knowledge
Mothers education (n = 943)						
Primary or less	39	7.57(2.3)	7.35(3.47)	7.14(1.9)	7.50(2.51)	6.27(3.18)
Junior or Leaving Cert or equiv	336	8.53(1.4)	8.24 (1.78)	7.74(1.6)	8.48(1.6)	7.38(2.96)
Diploma or Certificate	301	8.98(1.22)	8.36(1.76)	7.87(1.47)	8.94(1.48)	7.68(2.72)
University graduate	267	9.30(0.92)	8.64(1.63)	7.95(1.65)	9.41(1.04)	8.18(2.31)
Home description (n=939)						
Owner occupied	578	9.07(1.16)	8.58(1.66)	8.02(1.49)	9.10(1.35)	8.03(2.46)
Local authority	176	8.24(1.59)	8.02(1.96)	7.58(1.67)	8.21(1.81)	7.34(2.87)
Private rental and other	185	8.76(1.42)	7.99(1.88)	7.42(1.75)	8.68(1.63)	6.81(3.22)
Financial difficulties (n=938)						
No difficulty	661	8.96(1.21)	8.45(1.77)	7.91(1.59)	8.96(1.41)	7.73(2.86)
Difficulty	277	8.62(1.47)	8.13(1.8)	7.59(1.61)	8.62(1.66)	7.53(2.68)
Intergenerational financial difficulty (n=930)						
No intergenerational difficulty	761	8.94(1.24)	8.40(1.75)	7.85(1.59)	8.94(1.43)	7.71(2.68)
Intergenerational difficulty	169	8.49(1.63)	8.14(1.94)	7.65(1.65)	8.49(1.86)	7.52(2.94)
Low birth weight (n=926)						
Not low birth weight	872	8.88(1.32)	8.39(1.76)	7.83(1.58)	8.87(1.53)	7.72(2.70)
Low birth weight	54	8.26(1.62)	7.78(2.01)	7.30(1.7)	8.34(1.68)	6.59(3.12)
Child health (n=955)						
Excellent	467	9.08(1.17)	8.57(1.68)	8.00(1.53)	9.11(1.35)	8.08(2.48)
Very good	351	8.72(1.45)	8.23(1.91)	7.73(1.67)	8.66(1.7)	7.48(2.84)
Good/fair	137	8.32(1.42)	7.79(1.73)	7.26(1.62)	8.36(1.63)	6.50(3.03)
Family type (n=933)						
Single parent or other	162	8.69(1.28)	8.01(1.82)	7.60(1.74)	8.62(1.54)	7.45(2.74)
Two parent	771	8.91(1.3)	8.44(1.74)	7.87(1.55)	8.92(1.48)	7.71(2.74)
Parent community activity (n=963)						
No community activity	248	8.55(1.49)	8.07(1.89)	7.55(1.63)	8.49(1.74)	7.21(2.91)
1 or more community activity	715	8.93(1.29)	8.42(1.75)	7.87(1.60)	8.94(1.48)	7.77(2.68)
Parent volunteered in the school (n=945)						
Never	632	8.75(1.38)	8.19(1.86)	7.71(1.62)	8.75(1.60)	7.42(2.83)
Once or more	316	9.05(1.19)	8.63(1.58)	7.96(1.57)	9.03(1.37)	8.09(2.47)
Care up to 18 months (n=935)						
Parental care only	508	8.68(1.41)	8.28(1.78)	7.78(1.6)	8.64(1.63)	7.31(2.9)
Non parental care	427	9.1(1.06)	8.47(1.71)	7.88(1.54)	9.16(1.22)	8.11(2.44)
Weekly sports with a trainer (n=944)						
No	454	8.61(1.44)	8.13(1.82)	7.64(1.53)	8.59(1.64)	7.17(2.98)
Yes	490	9.09(1.13)	8.56(1.69)	7.96(1.63)	9.10(1.33)	8.09(2.39)
Weekly sport without a trainer (n=945)						
No	214	8.63(1.39)	8.21(1.77)	7.76(1.63)	8.67(1.49)	7.01(3.0)
Yes	731	8.92(1.27)	8.40(1.76)	7.83(1.58)	8.91(1.51)	7.84(2.61)
Visited a library (n=926)						
Not at all	234	8.65(1.33)	8.20(1.72)	7.69(1.47)	8.58(1.52)	7.03(3.07)
Yes	692	8.93(1.32)	8.40(1.8)	7.85(1.64)	8.95(1.53)	7.87(2.59)
Participated in music or arts (n=899)						
Not at all	598	8.74(1.36)	8.19(1.8)	7.69(1.59)	8.75(1.56)	7.45(2.79)
Yes	301	9.13(1.09)	8.69(1.59)	8.08(1.48)	9.10(1.31)	8.10(2.55)
Screen-time (n = 953)						
One hour or less	214	9.10(1.21)	8.54(1.66)	7.98(1.58)	9.15(1.38)	8.05(2.43)
2 to 3 hours per day	599	8.85(1.29)	8.36(1.77)	7.82(1.58)	8.82(1.54)	7.68(2.76)
4 or more hours per day	140	8.42(1.61)	7.93(2.03)	7.43(1.77)	8.40(1.75)	6.72(3.02)
Literacy activity index (n=955)						
Low	224	8.54(1.60)	7.97(2.0)	7.64(1.65)	8.56(1.78)	7.11(2.97)
Moderate	528	8.90(1.26)	8.35(1.71)	7.76(1.64)	8.89(1.5)	7.67(2.7)
High	203	9.04(1.91)	8.71(1.66)	8.07(1.46)	9.02(1.38)	8.13(2.51)
Community safety index (n=940)						
Not safe	189	8.33(1.59)	7.83(2.01)	7.41(1.69)	8.29(1.87)	6.93(3.18)
Somewhat safe	281	8.85(1.3)	8.30(1.69)	7.76(1.6)	8.85(1.47)	7.43(2.81)
Safe	470	9.03(1.21)	8.57(1.72)	7.99(1.55)	9.04(1.42)	8.06(2.45)

Appendix 8: Research dissemination

1 Peer Review Publication

Curtin M, Madden J, Staines A, Perry IJ. (2013) *Determinants of vulnerability in early childhood development in Ireland: a cross-sectional study.* BMJ Open 3: e002387. doi:10.1136/bmjopen-2012-002387

Curtin M, Baker D, Staines A, Perry IJ. *Are the special educational needs of children in their first year in primary school in Ireland being identified – a cross-sectional study?* Paper submitted to BMC Paediatrics currently under review.

Curtin M, Staines A, Perry IJ. *Providing population-level data to support policy and practice for healthy child development – the role of the Early Development Instrument.* Paper submitted to the Journal of Epidemiology and Community Health

2 Presentations

Curtin M. (2013) *The Early Development Instrument – Cork Project.* Invited presentation, The European Commission Thematic Working Group on Early Childhood Education and Care – Peer Learning Event on Monitoring and Evaluation, Dublin, 29th May 2013

Curtin M. (2012) *Facilitators and Barriers in Applying an International Measure of Child Development: Case Studies from Indonesia, Peru, Brazil, Scotland & Ireland.* Symposium for the International Society for the Study of Behavioral Development 2012 Biennial Meeting, Edmonton, Canada, 8th - 12th July 2012

Curtin M. (2011) *The Early Development Instrument – a potentially promising population level indicator of pre-school care.* Shortlist for the Jacqueline Horan Bronze Medal Prize in Epidemiology, Royal Academy of Medicine in Ireland, 30th November 2011

Curtin M. (2011) *The Early Development Instrument - the Irish Experience*. Seminar presentation to staff of Offord Centre for Child Studies and Hamilton Area Ministry for Health, McMasters University, Hamilton, Ontario, 26th October 2011

Curtin M, Perry IJ. (2011) *The Early Development Instrument - a population- level measure of Early Childhood Development.* Invited presentation to staff of the Department of Children and Youth Affairs, and the Department of Education and Skills, Dublin, 30th September 2011

3 Posters

Curtin M, Perry IJ *Providing population-level data to support policy and practice for healthy child development – the role of the Early Development Instrument,* Institute of Public Health Open Conference, Dublin, 8th October 2013

Curtin M, Staines A, Perry IJ. (2013) *Determinants of vulnerability in early childhood development in Ireland – a population level study.* College of Medicine and Health HRB Clinical Research Facility Conference, UCC, 13th June 2013

Curtin M, Staines A, Perry IJ. (2013) *Determinants of vulnerability in early childhood development in Ireland – a population level study.* Child Health Research the Key to a Healthier European Society, Dublin, 30th - 31st May 2013

Curtin M, Staines A, Perry IJ. (2012) *The Early Development Instrument – a potentially promising population level indicator of pre-school care.* Delivering Better Health Services, Health Services Research Network Symposium, Manchester, 19th – 20th June 2012

4 Reports

Curtin M (2011) Summary Report on the findings of a study on Early Childhood Development in Cork City (Prepared for the Department of Children and Youth Affairs)

Curtin M (2011) Findings from study on Early Childhood Development in Cork City, The Glen and Mayfield (Prepared for the Happy Talk Early Intervention Project)

Curtin M (2011) Findings from study on Early Childhood Development in Cork City, Knocknaheeny and Churchfield (Prepared for the Young Knocknaheeny Prevention and Early Intervention Project)

Curtin M (2012) Findings from the follow-up study on Early Childhood Development in Cork City, The Glen and Mayfield (Prepared for the Happy Talk Early Intervention Project)

Appendix 9: School feedback form

This form was used to provide feedback to schools on their EDI results. Each school was only given their own results and these individual school-level outcomes were not shared with anyone else. The schools could use the results if they wished and some, with poorer outcomes used them to support efforts to retain resources.







Schools Feedback Report
EDI 2011

School Name:

Number of EDI completed		Mean age in years	
Number of Valid EDI		Percentage with English as a Second Language	
Number of Children with Special Needs		Mean days absent	
Number of Children rated as needing further assessment			

School Mean Scores

Higher scores mean better readiness-to-learn skills

	Mean	Cork Mean
Physical Health and Well-being		8.6
Social Competence		8.1
Emotional Maturity		7.6
Language and Cognitive Development		8.6
Communication Skills and General Knowledge		7.2

Number of Children Considered Vulnerable in Each Domain

These are the numbers for your school. If a child is vulnerable in any domain they are classed as vulnerable. A child may be vulnerable in more than one domain

Physical Health and Well-being	
Social Competence	
Emotional Maturity	
Language and Cognitive Development	
Communication Skills and General Knowledge	

Total number of children in this school considered vulnerable:

Percentage of children in this school considered vulnerable:

Percentage of children in all of Cork considered vulnerable: 27%