Carer-reported health conditions among seven-year-old children in Northern Ireland in 2011:

A report based on data from the Millennium Cohort Study

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Prepared by: Lorraine Fahy, Prof Kevin P Balanda, and Dr Jude Cosgrove (Institute of Public Health in Ireland).

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Institute of Public Health in Ireland

5th Floor	Forestview
Bishop's Square	Purdy's Lane
Redmond's Hill	Belfast
Dublin 2	BT8 7ZX
Ph: 00 353 1 4786300	0044 28 9064 8494
Fax: 00 353 1 478 6319	0044 28 9069 4409

www.publichealth.ie

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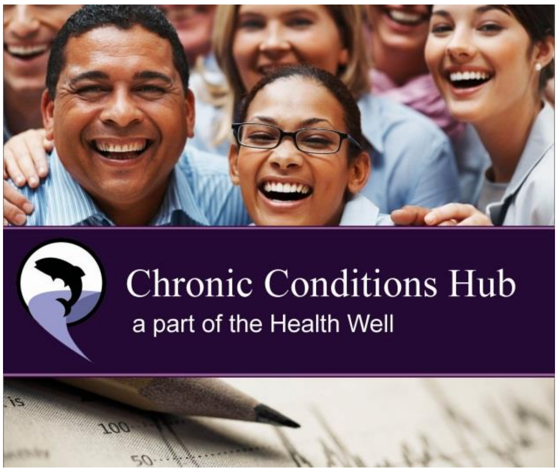
The Institute of Public Health in Ireland (IPH) publishes estimates and forecasts of the prevalence of chronic health conditions for national and subnational areas on the island of Ireland. To date we have published data on the prevalence of chronic airflow obstruction, diabetes, coronary heart disease, hypertension, musculoskeletal conditions, and stroke among adults.

We have extended this work to the prevalence of health conditions among children on the island of Ireland. In 2014 we published national and subnational prevalence estimates for children in the Republic of Ireland (Institute of Public Health in Ireland, 2014). This report provides national and subnational prevalence estimates for children in Northern Ireland.



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The Chronic Conditions Hub includes IPH estimates and forecasts of the number of adults with chronic conditions and children with various health conditions.

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- Detailed national and subnational data that can be downloaded or explored using the Health Well's Data Visualiser tool
- An interactive Chronic Conditions Prevalence Tool that allows you to calculate prevalence estimates for real or hypothetical populations and to explore "What if" scenarios.

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The responsibility of the content of the final version of this report lies solely with IPH.

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1. Introduction

This report examines a range of health conditions in seven-year-old children in Northern Ireland using information collected from children's carers in the Millennium Cohort Study (MCS). We examine prevalence of any longstanding health condition, as well as asthma, eczema, sight and hearing problems. The analyses aim to identify risk factors associated with these conditions, as well as to detect differences in prevalence between regions in Northern Ireland. MCS did not ask about all possible health conditions in children, for example, diabetes, cancers, or kidney disease, so the results are not intended to represent the full burden of disease in children and their families.

1.1 Health conditions in children

Research has shown that a range of health conditions[1] among children can be associated with reduced quality of life for children and their families (Eiser, 1997, Varni et al., 2007b), poorer social and emotional development and behavioural problems (Turkel and Pao, 2007, Hysing et al., 2009) and poorer educational attainment (Layte and McCrory, 2010). Children from lower socioeconomic status (SES) families typically suffer worse health outcomes compared with children from higher SES families (Chen et al., 2002). Health conditions among children can result in substantial financial costs for families and the health and social care system.

The number or per cent of children living with a health condition is known as its population prevalence. Estimates of the population prevalence of health conditions among children vary widely depending on how they are defined and measured and the age group covered (van der Lee et al., 2007). Reliable and valid population prevalence estimates can be used to:

- Describe the pattern of health and ill-health in a population
- Identify determinants of current and future health and wellbeing
- Support evidence-informed policy development and practice
- Support evidence-informed planning of health and social care services.

The Institute of Public Health in Ireland (IPH) publishes estimates and forecasts of the population prevalence of various health conditions among adults at national level and subnational levels on the island of Ireland. To date IPH has published data on the prevalence of diabetes (Balanda et al., 2013, Balanda et al., 2010, Institute of Public Health in Ireland, 2012c, Institute of Public Health in Ireland, 2007, Institute of Public Health in Ireland, 2006), hypertension (Institute of Public Health in Ireland, 2012d), stroke (Institute of Public Health in Ireland, 2012f), coronary heart disease (Institute of Public Health in Ireland, 2012b), chronic airflow obstruction (Institute of Public Health in Ireland, 2012a, Institute of Public Health in Ireland, 2010) and musculoskeletal conditions (Institute of Public Health in Ireland, 2012e) among adults.

IPH extended this work to the prevalence of health conditions among children on the island of Ireland. In 2014 IPH published prevalence estimates for three-year-old children in the Republic of Ireland (RoI) (Institute of Public Health in Ireland, 2014). That report used the Growing Up in Ireland (GUI) survey to

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[1] Including diabetes, gastrointestinal conditions, cardiac conditions, asthma, obesity, kidney disease, psychiatric disorders, cancer, rheumatologic conditions, and neurological conditions.

make these estimates. The present study uses data from the Sweep 4 of the Millennium Cohort Study (MCS4)[2] to estimate prevalence of: *longstanding illnesses, disabilities or infirmities, asthma, eczema, sight and hearing problems* among seven-year-old children in Northern Ireland at two geographical levels – Northern Ireland level and the new 11 Local Government Districts (LGD2014) level.

Direct comparisons of prevalence estimates made on the basis of GUI and MCS should not be made, however, since the ages of respondents, wording and design of questionnaires, and procedures used for sampling and weighting are substantially different across these two studies.

1.2 Context

1.2.1 The importance of early years

There is increasing evidence from life course epidemiology that health experiences in the early years of life are a determinant of later health and wellbeing (Marmot et al., 2010, World Health Organization, 2013). The importance of early years is emphasised in current government policy. *Our Children and Young People – Our Pledge. A Ten Year Strategy for Children and Young People in Northern Ireland 2006 – 2016* (Office of the First Minister and deputy First Minister, 2006) promotes a shift towards early intervention as one of its supporting themes to help deliver improved outcomes for children. *Giving Every Child the Best Start in Life* is the first theme of *Making Life Better: A Whole System Strategic Framework for Public Health 2013-2023* (Department of Health, Social Services and Public Safety, 2014b), highlighting that what happens to children in their earliest years is key to outcomes in adult life. *Delivering Social Change's* programme coordinates government departments' work on priority social policy areas. *Delivering Social Change's Children and Young Persons Early Action Document* (Office of the First Minister and deputy First Minister, 2012) highlights that early intervention provides significant opportunities to improve children's health and wellbeing.

1.2.2 Policy

Our Children and Young People – Our Pledge includes "healthy children" as one of its six outcomes. The strategy monitors progress on its outcomes through indicators relating to mortality, prevalence of longstanding conditions (specifically asthma and Type I diabetes), lifestyle risk factors for poor health, health service use and broader social determinants of health among children.

Following consultation in January 2014 to replace *Our Children and Young People - Our Pledge* which is due to expire in 2016, work has commenced to bring forward the development of a new *Children and Young People's Strategy under* the *Delivering Social Change* programme. The *Early Intervention Transformation Programme*, part of *Delivering Social Change*, aims to improve outcomes for children and young people through early intervention approaches.

Making Life Better aims to achieve better health and wellbeing for everyone. The framework places a strong emphasis on children and young people and supporting their transition into and through adulthood. It includes indicators to monitor progress on infant mortality, smoking during pregnancy, breastfeeding, educational attainment in primary school, childhood obesity, child poverty and long term conditions (the

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[2] The MCS5 dataset was not available at initial planning stage of this work. It was reviewed on release however it was felt that MCS4 contained better risk factor data for the purpose of this study.

number of people with hypertension, and the number of people with a long term condition attending structured patient education/self-management programmes).

Living with Long Term Conditions: A Policy Framework (Department of Health, Social Services and Public Safety, 2012a) sets out how adults living with long term conditions can be supported to maintain and enhance their health and well-being and quality of life. The framework does not include children and young people with long term conditions because they were considered to have very specific needs and beyond the scope of the framework. However, the framework notes that the approach set out for adults may be applicable to young people making the transition to adult services.

There is clear recognition in these policies of the crucial role of parents and carers in promoting and maintaining child health. *Our Children and Young People – Our Pledge* includes a commitment to support parents and carers and enable them to take responsibility for their children. This commitment is supported by the regional family and parenting strategy *Families Matter: Supporting families in Northern Ireland* (Department of Health, Social Services and Public Safety, 2009). *Delivering Social Change* supports parents and families through the development of Family Support Hubs and the provision of positive parenting programmes. *Making Life Better* highlights the importance of good quality parenting and family support and identifies a number of actions to promote and support positive parenting. It also commits to reviewing *Families Matter: Supporting families in Northern Ireland* to ensure that parents continue to receive the information and support they need.

Current policies emphasise the need to take action to reduce health inequalities. *Our Children and Young People – Our Pledge* recognises that targeted interventions are needed for particular groups of children to remove or narrow health inequalities. *Delivering Social Change* aims to help reduce poverty, promote equality and tackle existing patterns of disadvantage. The programme's outcomes include adequate income for families and good educational outcomes for children in poverty. *Making Life Better* is informed by the NI Assembly Committee for Health, Social Services and Public Safety *Review of Health Inequalities Report* (Committee for Health, Social Services & Public Safety, 2013) and explicitly aims to reduce inequalities in health. The strategy adopts a "gradient approach" and, consistent with *Our Children and Young People – Our Pledge*, takes account of the greater need of people with greater social, economic and health disadvantage. *Making Life Better's* review of *Families Matter* will address the barriers that hard to reach families experience in accessing services.

Current policies also highlight the important role of local government and community groups in promoting health and wellbeing, and planning and delivering services based on local need. *Transforming Your Care: A Review of Health and Social Care in Northern Ireland* (Health and Social Care, 2011) sets outs the model for integrated health and social care where most services will be provided locally and will be focused on the needs of the local population. This local model is consistent with *Healthy Child, Healthy Future: A Framework for the Universal Child Health Promotion Programme in Northern Ireland* (Department of Health, Social Services and Public Safety, 2010) which specifies that Health Visitors conducting regular child health reviews should encourage the uptake of local services as appropriate. *Making Life Better* states that action should be focused on individuals, families and communities in their social and economic context. Its themes *Giving Every Child the Best Start* and *Equipped throughout Life* take account of the particular needs across the life course and have been broadened to cover childhood and adulthood. They address the key social determinants at each stage. Particular emphasis is given to children and young people, and to supporting individuals' transitions into and through adulthood and older age.

The other themes of *Creating the Conditions* and *Empowering Communities* aim to address the wider structural, economic, environmental and social conditions impacting on health within local communities. The framework will establish Local Partnerships of key statutory, private, community and voluntary bodies to inform the planning and delivery of services. Specifically the Local Partnerships will focus on: identifying local opportunities for partnership working based on local need; driving local interventions/services to support those most in need; and ensuring that local priorities are fed into strategic processes.

A Strategy for Maternity Care in Northern Ireland 2012-2018 was published in July 2012 (Department of Health, Social Services and Public Safety, 2012b) and sets out standards for maternity care in Northern Ireland. It is outcomes-focused and intended to ensure that every baby has the best start in life. It aims for effective communication and high-quality maternity care; healthier women at the start of pregnancy; effective, locally accessible, antenatal care and a positive experience for prospective parents; safe labour and birth care with improved experiences for mothers and babies; and appropriate advice and support for parents and the baby after birth.

The NI Maternity Strategy explicitly recognises the importance of children's early life experiences and the socioeconomic determinants of health. It notes the importance of good-quality data for monitoring both the quality of care and the health of mothers and babies. For example, the Strategy states that a priority is to agree minimum data sets, definitions and to contribute data to a regional dashboard, NIMATS (Northern Ireland Maternity System) in order to promote quality improvement and influence choice, as well as to continually review and improve NIMATS.

The local data reported here can help local government and community groups in planning and delivering initiatives to address local issues.

1.2.3 Health systems and services

Healthy Child, Healthy Future: A Framework for the Universal Child Health Promotion Programme in Northern Ireland is a public health programme that offers every family with children a programme of screening, immunisations, developmental reviews, and information and guidance to support parenting and healthy choices. The programme includes regular child health reviews (including long term conditions management) throughout primary and post-primary education.

Transforming Your Care: A Review of Health and Social Care in Northern Ireland outlines a number of proposals to improves services to children and families: restructuring existing services to develop an integrated, cross-departmental *Headstart* programme for children aged 0-5 years; review of residential and foster care services; and improvements to child and adolescent mental health services.

Both *Transforming Your Care* and *Making Life Better* highlight the benefits of self-care and self-management for people with long term conditions. Supported self-management can empower people and reduce the number of hospital admissions among people with a long term condition. While, "self-management" has different meaning amongst children, it may place further responsibilities on parents and carers*. Making Life Better* will monitor the number of people with a long term condition attending structured patient education/self-management programmes. Such programmes should also include a component for carers to manage the care of people who are unable to "self-manage."

1.2.4 Research and information

Both *Our Children and Young People – Our Pledge* and *Making Life Better* acknowledge that the availability and use of research and information are vital to achieving the aims of the strategies. Both strategies include a set of indicators linked to their respective outcomes and themes. Baseline data for these indicators have been established and it is intended that progress will be monitored over time. Furthermore, *Our Children and Young People – Our Pledge* established a Research and Information Group consisting of key research and information agencies and individuals. The group advises government on the development of a research programme and reports on the findings of key research which may have implications for government policy and service delivery for children and young people.

There are a number of other research and information initiatives that provide valuable data on young children's health and the factors that influence it. These are described in Box 1 on the next page.

1.2.5 Previous research in Northern Ireland using the Millennium Cohort Study data

There are a large number of publications arising from the Millennium Cohort Study (MCS) data (see http://www.cls.ioe.ac.uk/), but only two include analyses of children's health outcomes specifically for Northern Ireland (Sullivan et al., 2010a, 2010b). Using Sweep 3 of the Millennium Cohort Study (MCS3), Sullivan et al. (2010a) examined a range of outcomes for children in Northern Ireland at age 5 in terms of the conditions and experiences recorded in earlier sweeps of the survey. Cognitive, behavioural, educational and health outcomes were examined. The analyses of health outcomes are of relevance to the present study. Sullivan et al. examined associations between carer-reported child overall health and a range of background measures, including demographic, socioeconomic, home environment, neighbourhood, and other moderating or mediating measures, including health-related behaviours (see Sullivan et al., 2010a, pp. 8-9).

In a multiple regression model of carer-reported child overall health, poorer health outcomes for children in NI were associated with parents not being in work (in both one-parent and two-parent households) and a main carer with a longstanding health condition. Better health outcomes were associated with regular mealtimes, regular bedtime reading by a carer to the child, and formal childcare arrangements. No gender differences in carer-reported child health were evident at age 5. The results confirm the combined influences of socioeconomic characteristics, family characteristics and home environment, though it should be noted that the outcome measure was a subjective rating of overall child health rather than of specific conditions. In their analyses of health outcomes at age 7, Sullivan et al. (2010b) reported that parents' physical and mental health when the child was aged 3 were important predictors of change in overall carer-rated child health between the ages of 5 and 7, and also found that by age 7, girls were significantly more healthy than boys (after adjusting for other background characteristics).

Box 1: Data sources on children's health that include Northern Ireland

Data Source	Type of Data	Description
Personal Child Health Record (PCHR)	Population data, stored on the Northern Ireland Child Health System (CHS)	Records information on demographics, immunisation, screening, development, service use, any specific health problems; also family history of conditions such as childhood deafness, eye problems, reading and spelling difficulties, and asthma, eczema, hayfever or allergies. The steering group responsible for CHS data will not yet approve any access requests until all testing and validation of the data is complete, so CHS cannot be examined at the time of writing (Personal Communication, Honest Broker Services, July 2015)
Quality and Outcomes Framework (QOF) Data	GP practice (primary care) data	QOF is a system to remunerate general medical practices for providing good quality care to their patients, and to help fund work to further improve the quality of health care delivered. QOF measures quality achievements against a range of evidence-based indicators including the following related to children: maintaining a register of patients with specific health conditions; ensuring that child development checks are offered at intervals that are consistent with national and regional guidelines; and ensuring that antenatal care and screening are offered according to current regional guidelines. Of the specific health conditions considered in this report, only asthma is recorded by QOF. http://www.dhsspsni.gov.uk/qof-stats-ni-2013-14.pdf
Northern Ireland Longitudinal Study (NILS)	Linked longitudinal data	NILS links data from Health Card Registrations, Census, Vital Events (births and deaths), Migration, and Property datasets to create a longitudinal dataset that is updated regularly. www.qub.ac.uk/research-centres/NILSResearchSupportUnit/ At present, NILS covers about 500,000 children and adults over a 20-year period. NILS' health measures are limited to the measures that are included in Census data (self-reported limiting long term illness and self-reported general health).
Millennium Cohort Study (MCS)	Longitudinal survey data	The Millennium Cohort Study, upon which this report is based, follows 19,000 children born in the UK (including just under 2,000 children born in Northern Ireland) in 2000-2001 at age nine months, three, five, seven and eleven years, and plans to follow them into adulthood. It collects information on a wide range of child and family characteristics: parenting; childcare; school choice; child behaviour and cognitive development; child and parental health; parents' employment and education; income and poverty; housing, neighbourhood and residential mobility; and social capital and ethnicity. www.cls.ioe.ac.uk The rich contextual data collected in MCS provides a valuable source of information with which to examine children's health outcomes, both cross-sectionally and longitudinally.
Northern Ireland Maternity System (NIMATS)	Regional maternal health service database	NIMAT contains a range of demographic and clinical information on mothers and infants. It captures data relating to the current maternity process, and also contains details about the mother's past medical and obstetric history. It is a key source for data on birth numbers, interventions, maternal risk factors, birth weights, maternal smoking, BMI and breastfeeding at birth and on discharge from hospital. Data from NIMATS is available through the system itself and through the regional honest broker service. The system is currently under on-going development (NI Public Health Agency, Personal Communication, October 22, 2015).
EUROCAT	European surveillance system of congenital abnormalities	EUROCAT is a European network of population-based registries for the epidemiologic surveillance of congenital anomalies. It comprises 23 registries in 43 countries. Amongst other things, EUROCAT can be used to evaluate the effectiveness of primary prevention and assess impact of developments in prenatal screening. http://www.eurocat-network.eu

1.3 Aims

This report describes the burden of various health conditions in seven-year-olds in NI. In doing so, it aims to support the policy direction and prioritisation around child health and wellbeing and provides for some of the information gaps in the prevalence of a range of chronic conditions amongst young children. It provides evidence that some of the risks associated with developing these conditions can be reduced or eliminated with early intervention to support parents in ante-natal and early childhood years.

Specifically, this report provides estimates of population prevalence of health conditions among seven-year-old children in Northern Ireland (NI) in 2011. It:

- Contains national estimates of the prevalence of a “longstanding illness, disability or infirmity”, asthma, eczema, sight problems and hearing problems
- Describes how national population prevalence varies with important characteristics and identifies groups of children and their families who are experiencing a greater burden of these conditions
- Describes how the expected prevalence of these conditions varies across the 11 Local Government Districts (LGD2014) that came into operation on 1 April 2015.

Estimates are based on data from Sweep Four of the Millennium Cohort Study applied to population data from 2011.

This study focuses on one condition at a time and cannot provide estimates of the total burden of disease on children and their families in Northern Ireland. However, future work of the IPH will examine multiple morbidities in children (and their shared risk factors), through more in-depth analysis of all relevant data available through the Millennium Cohort Study.

1.4 Further information on the conditions in this report

Box 2 below provides some additional information on the symptoms, diagnosis, and treatment of the conditions examined in this study, along with links to further information on each.

Box 2: Symptoms, diagnosis, treatment and further information on asthma, eczema, sight and hearing problems

Asthma	Symptoms	Symptoms include wheezing, difficulty breathing, coughing, particularly at night and in the morning, and tightness or soreness in the chest.
	Question used in present study	Has child ever had asthma, OR had four or more attacks of wheezing in the past 12 months, OR has had sleep disturbed once or more a week in the past 12 months due to wheezing OR has severely limited child's speech due to wheezing in the past 12 months?
	Diagnosis	A range of tests can be used to aid diagnosis, including peak expiratory flow, spirometry, and FeNO (fractional exhaled nitric oxide) (administered by GPs or asthma nurses), airways responsiveness (usually carried out in a hospital setting), and allergy tests (carried out by GPs or specialists).
	Treatment	Asthma is usually managed through two inhalers – a short-acting reliever inhaler (bronchodilator) and a longer-acting steroid inhaler. These may be supplemented with other treatments such as leukotriene receptor antagonists (LTRAs), theophylline, long-acting reliever inhalers, or anti-allergy medications.
	Further information in NI	http://www.asthma.org.uk/northern-ireland
Eczema	Symptoms	Eczema is an inflammatory skin disease where the skin becomes red, dry, itchy or scaly and may even weep, bleed or crust over. Atopic eczema is the most common kind, usually appearing during the first two years of life; two other common forms are contact dermatitis and sebhorroeic dermatitis.
	Question used in present study	Has child ever had eczema?
	Diagnosis	Atopic eczema can usually be diagnosed by a GP, who will look for visibly irritated red skin within creases of the skin, a history of skin irritation, generally dry skin in the last 12 months, and a history or family history of asthma or hayfever; he or she may also advise on triggers.
	Treatment	Treatment usually includes application of moisturisers and topical corticosteroids, and, if appropriate, anti-allergy medications.
	Further information in NI	http://www.nhs.uk/Conditions/Eczema-%28atopic%29/Pages/Introduction.aspx
Sight problems	Symptoms	There is a wide range of conditions that may result in sight problems; most commonly these can be near- or far-sightedness, lazy eye (amblyopia), cross-eyedness (strabismus), colour blindness, or conjunctivitis.
	Question used in present study	Has child ever had any problem(s) with his/her eyesight or his/her eyes AND Has child had, or is child due to have, any treatment for this problem?
	Diagnosis	Diagnosis depends on the condition, though is likely to first be identified by a GP and then diagnosed by an eye specialist.
	Treatment	Treatment depends on the condition. Common treatments include eye patches or eye drops and prescription glasses.
	Further information in NI	http://www.nidirect.gov.uk/index/information-and-services/people-with-disabilities/health-and-support/whos-who-in-health-services/sight-care-and-services.htm
Hearing problems	Symptoms	There is a wide range of conditions that may result in sight problems which maybe congenital or acquired, the latter frequently being caused by earwax, middle ear infections or 'glue ear'.
	Question used in present study	Has child ever had any problem(s) with his/her hearing or his/her ears AND Has child had, or is child due to have, any treatment for this problem?
	Diagnosis	Diagnosis and treatment depends on the condition; babies are screened for hearing problems and later problems may be identified by a GP and may be referred to a specialist.
	Treatment	Treatment depends on the condition. Common treatments include hearing aids, grommets, communication aids and, if an infection, antibiotic medication.
	Further information in NI	http://www.nidirect.gov.uk/index/information-and-services/health-and-well-being/health-services/managing-your-healthcare/hearing-and-ear-care.htm

2. Method

The Millennium Cohort Study (MCS) is a longitudinal study of around 19,000 children born in the four countries of the UK between 2000 and 2001. The children and their carers have been involved in five sweeps so far: at 9 months, and ages 3, 5, 7, and 11 years. In NI Sweep 1 of the MCS (MCS1) reached 1,923 families amounting to 1,955 children[3].

The population prevalence estimates generated in this study are based on Sweep 4 of the Millennium Cohort Study (MCS4) when children were 7 years old (University of London Institute of Education: Centre for Longitudinal Studies, 2008). In NI in MCS4, there were 1,395 cohort children in a sample of 1,372 families[4].

Detailed information about MCS can be found at the Centre for Longitudinal Studies website http://www.cls.ioe.ac.uk.

2.1 Carer-reported health conditions included in this report

This report identified five health conditions in MCS4 that were sufficiently common in the data to provide a large enough sample of cases for analysis. These conditions were:

- A "longstanding illness, disability or infirmity" - *longstanding meaning anything that has troubled child for a period of time or is likely to affect child over a period of time*
- Asthma or asthma symptoms
- Eczema ever
- Sight problem ever that required treatment
- Hearing problem ever that required treatment[5].

These conditions, their definitions and the MCS4 survey questions they were based on are shown in Table 1.

Responses to the questions shown in Table 1 are independent of one another. This means that (i) carers who answered *yes* to the question on longstanding illness, disability or infirmity did not necessarily answer *yes* to the other conditions (ie the child could have had a condition *other* than asthma, eczema, sight problems or hearing problems) and (ii) carers could have indicated that their child had one or more of asthma, eczema, sight problems or hearing problems, but not regarded this as a longstanding condition.

Note that the prevalence measure varies according to the condition – some are period prevalence, while others are lifetime prevalence. That is, the question on the presence of a longstanding illness, disability or infirmity refers to *current* prevalence ("Does child have…"), the questions on eczema, sight problems and hearing problems refer to *lifetime* prevalence ("Has child ever had…"), and the questions on asthma cover *both* lifetime presence of asthma as well as prevalence in the past 12 months of asthma symptoms. Furthermore, other than longstanding illness, disability or infirmity, we cannot assess whether the

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[3] In MCS1 there are 1,892 singletons, 30 sets of twins and 1 set of triplets.

[4] In MCS4 there are 1,350 singletons, 21 sets of twins and 1 set of triplets.

[5] Other conditions asked about in MCS which are not included in this study for analysis are epilepsy/seizures, hayfever, ADHD, autistic spectrum disorder, and the occurrence of specific illnesses (measles, chickenpox, whooping cough, tuberculosis).

condition is long-term in nature or not. This applies particularly to eczema, where symptoms appear early (during the first year), and tend to ease or disappear by 7 years of age (eg Gustafsson et al., 2008).

In considering the operational definition of asthma in Table 1, it should be noted that the operational definitions and consequently estimation of the prevalence of asthma or asthma symptoms varies substantially across studies. While the present study defines asthma as lifetime prevalence of diagnosed asthma and/or severe asthma symptoms in the past 12 months, comparisons with other studies are complicated not only by differences in the wording of questions but also due to differences in the manner in which researchers have combined these indicators. For example, Sá-Sousa et al. (2014) have noted that, of 18 published articles which used the International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire, no fewer than eight operational definitions of asthma have been employed.

Table 1: Definition of carer-reported health conditions covered in this report. Source: MCS4

Condition	Definition
Longstanding illness, disability or infirmity	Main respondent answered: YES to: *"Does [child] have any longstanding illness, disability or infirmity[6]? By longstanding I mean anything that has troubled [child] for a period of time or is likely to affect [child] over a period of time."*
Asthma or asthma symptoms	Main respondent answered: YES to: *"Has [child] ever had asthma?"* OR FOUR OR MORE to: *"How many attacks of wheezing has [child] had in the last 12 months?"* OR ONE OR MORE NIGHTS PER WEEK to: *"In the last 12 months, how often on average has [child]'s sleep been disturbed due to wheezing?"* OR YES to: *"In the last 12 months, has wheezing ever been severe enough to limit [child]'s speech to only one or two words at a time between breaths?"* Note: This definition covers both diagnosed and undiagnosed asthma and severe asthma symptoms.

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[6] The term 'infirmity' may be open to interpretation, but MCS did not define this term in its questionnaire; similarly, the length of the period referred to in the question is not defined.

Condition	Definition
Eczema	Main respondent answered: YES to: *"Has [child] ever had eczema?"*
Sight problem that required treatment	Main respondent answered: YES to: *"Has [child] ever had any problem(s) with his/her eyesight or his/her eyes?"* AND YES to: *"Has [child] had, or is [child] due to have, any treatment for this problem?"* (treatment includes a patch, glasses, or waiting for appointment/referral)[7]
Hearing problem that required treatment	Main respondent answered: YES to: *"Has [child] ever had any problem(s) with his/her hearing or his/her ears?"* AND YES to: *"Has [child] had, or is [child] due to have, any treatment for this problem?"* (treatment includes hearing aid(s), grommets, an operation, antibiotics, some other treatment, or waiting for appointment/referral)[8]

Population prevalence estimates for each of these conditions are presented in Section 3, with some comparisons with other studies. However, the validity of these comparisons is very limited, due to differences in:

- Age groups surveyed
- Content and sequencing of survey questions and the manner in which definitions of the conditions are operationalized by the researchers. This includes whether or not the prevalence refers to a period of time (eg had a condition in the past 12 months) or lifetime (ie ever had a condition)
- The quality and representativeness of the samples, and procedures used to adjust for non-response.

Of particular interest are comparisons of the prevalence of health conditions in RoI and NI. Population prevalence estimates for children in RoI were published recently (Institute of Public Health in Ireland, 2014). However, direct comparisons cannot be made between those estimates and the ones in this report due to differences between the surveys on each of the three aspects above.

Comparisons between the survey-based estimates reported here and the NI Child Health System (CHS) are not possible at the time of writing due to data access restrictions.

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[7] The data do not capture which (or how many) children may be classified as blind or severely visually impaired.
[8] The data do not capture which (or how many) children may be classified as deaf or severely hearing impaired.

2.2 Child, carer, family and neighbourhood characteristics

2.2.1 Characteristics included in the MCS4 dataset

Characteristics that influence health operate on a number of interconnected levels. For each condition, from the complete set of child, carer, family and neighbourhood characteristics in the MCS4 questionnaire, those that may be related to that condition according to research literature are referenced in Sections 1 and 3 of this report. This complete set of characteristics is shown in Appendix 1. These characteristics were used in the stepwise regression procedures for each condition. Table 2 lists these sets of characteristics.

2.2.2 Geographical areas used in making subnational prevalence estimates

NI is divided into 11 Local Government Districts (LGD2014s), which came into operation in April 2015, and this report includes estimates of the prevalence of the conditions considered within each of these subnational areas (the method for this is described in Section 2.3.3). The 11 districts (see Appendix 2) come under five regional trusts, which are responsible for the management of staff, health and social care services and have control for their own budgets. The choice of local geography is also constrained by the availability of local area risk factor data.

Table 2: Child, carer, family and neighbourhood characteristics included in tests to detect a significant relationship with each condition, as well as weighted numbers of children in each group. Source: MCS4

Type of characteristic	Millennium Cohort Study (Fourth Sweep)	Characteristic (weighted number of children[9])	Long-standing illness, disability or infirmity	Diagnosed asthma or asthma symptoms	Diagnosed eczema or any kind of skin allergy	Sight problem that required treatment	Hearing problem that required treatment
Child: Biology	MCS4: Family	**Sex** Female (n=659) Male (n=700)	Included	Included	Included	Included	Included
Child: Biology	MCS1 Module C: Pregnancy, Labour and Delivery	**Birthweight**[10] Not low (n=1265) Low (n=90)	Included	Included	Included	Included	Included
Child: Health status	MCS4: Child Health	**Allergy intervention** Child was admitted to hospital for an "allergy (except wheezing, asthma, or eczema)" Or Carer has controlled child's food/drink consumption due to "allergic reactions/food sensitivity" Child did not have an allergy (n=1327) Child had an allergy (n=31)	Included	Included	Included	Not included	Not included
Child: Health status	MCS4: Child Measurement	**Body Mass Index** Calculated from physically measured height and weight Underweight / Normal (n=999) Overweight (n=232) Obese (n=105)	Included	Included	Included	Included	Included

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[9] Numbers may vary due to differences in response rate of individual questions

[10] It may have been desirable to include an indicator of pre-term birth; however, it was not possible to derive this indicator from the MCS data.

Type of characteristic	**Millennium Cohort Study (Fourth Sweep)**	**Characteristic (includes weighted numbers of children)**	**Long-standing illness, disability or infirmity**	**Diagnosed asthma or asthma symptoms**	**Diagnosed eczema or any kind of skin allergy**	**Sight problem that required treatment**	**Hearing problem that required treatment**
Child: Health behaviours	MCS4: Child Health	**Diet** Primary carer has controlled child's food/drink consumption with a "healthy/balanced diet" Carer controlled child's diet (n=515) Carer did not control child's diet (n=843)	Included	Included	Included	Not included	Not included
Child: Educational context	MCS4: Early Education, Schooling and Childcare	**Bullied at school** Never/Once or twice (n=1297) Several/Many times (n=55)	Included	Included	Included	Included	Included
Child: Educational context	MCS4: Early Education, Schooling and Childcare	**Difficulty with schoolwork** Child had "great" difficulty with one or more of reading, writing or maths Child had none/some difficulty (n=1250) Child had great difficulty (n=106)	Included	Included	Included	Included	Included
Child: Educational context	MCS4: Early Education, Schooling and Childcare	**Difficulty with physical education** Child had "great" difficulty with physical education Child had none/some difficulty (n=1347) Child had great difficulty (n=5)	Included	Included	Included	Included	Included
Mother / Primary carer: Health status	MCS4: Parent's health	**Primary carer health status** Primary carer with a longstanding illness, disability or infirmity Carer did not have a condition (n=1052) Carer had a condition (n=306)	Included	Included	Included	Included	Included

Type of characteristic	**Millennium Cohort Study (Fourth Sweep)**	**Characteristic (includes weighted numbers of children)**	**Long-standing illness, disability or infirmity**	**Diagnosed asthma or asthma symptoms**	**Diagnosed eczema or any kind of skin allergy**	**Sight problem that required treatment**	**Hearing problem that required treatment**
Mother / Primary carer: Health behaviours	MCS1 Module G: Parent's Health	**Maternal smoking during pregnancy** Did not smoke (n=761) Smoked (n=594)	Included	Included	Included	Included	Included
Mother / Primary carer: Health behaviours	MCS1 Module G: Parent's Health	**Maternal alcohol consumption during pregnancy** 1-2 times a month or less (n=1265) 1-2 times a week or more (n=90)	Included	Included	Included	Included	Included
Mother / Primary carer: Health behaviours	MCS1 Module C: Pregnancy, Labour and Delivery	**Breastfeeding** Some: 6 months or more (n=127) Some: <6 months (n=490) None (n=738)	Included	Included	Included	Included	Included
Family: Residents	MCS4: Family	**Number of parents in the family** Two parents (n=994) One parent (n=365)	Included	Included	Included	Included	Included
Family: Residents	MCS4: Family	**Other children in the family** No other children (n=170) Other children (n=1189)	Included	Not included	Not included	Not included	Not included
Family: Residents	MCS4: Employment, Income and Education	**Family occupational class** Higher class of primary carer's/partner's current (or last known) occupations I. Managerial and professional (n=442) II. Intermediate (n=188) III. Small employers and self-employed (n=152) IV. Lower supervisors and technical (n=101) V. Semi-routine/routine (n=427)	Included	Included	Included	Included	Included

Type of characteristic	Millennium Cohort Study (Fourth Sweep)	Characteristic (includes weighted numbers of children)	Long-standing illness, disability or infirmity	Diagnosed asthma or asthma symptoms	Diagnosed eczema or any kind of skin allergy	Sight problem that required treatment	Hearing problem that required treatment
Family: Residents	MCS4: Employment, Income and Education	**Family income** Quintiles of income equivalised for family composition 1.Lowest quintile (n=313) 2.Second quintile (n=349) 3.Third quintile (n=282) 4.Fourth quintile (n=243) 5.Highest quintile (n=172	Included	Included	Included	Included	Included
Family: Residents	MCS4: Employment, Income and Education	**Primary carer's education** NVQ Level 5 (n=95) NVQ Level 4 (n=365) NVQ Level 3 (n=204) NVQ Level 2 (n=283) NVQ Level 1 (n=214) None (n=175)	Included	Included	Included	Included	Included
Family: Living conditions	MCS4: Parent's Health	**Exposure to tobacco smoke** People did not smoke in same room as child (n=1166) People smoked in same room as child (n=191)	Included	Included	Included	Included	Included
Family: Living conditions	MCS4: Housing and Local Area	**Damp in the home** No damp/Not much of a problem (n=1284) Some problems/Great problem (n=74)	Included	Included	Included	Not included	Not included
Family: Living conditions	MCS4: Housing and Local Area	**Pets in the home** No furry pets (n=841) Dog, cat or other furry pet (n=517)	Included	Included	Included	Not included	Not included

Type of characteristic	Millennium Cohort Study (Fourth Sweep)	Characteristic (includes weighted numbers of children)	Long-standing illness, disability or infirmity	Diagnosed asthma or asthma symptoms	Diagnosed eczema or any kind of skin allergy	Sight problem that required treatment	Hearing problem that required treatment
Neighbourhood	MSC4: Geographically Linked Data	**Living environment** Quintiles of the Living Environment domain of the Northern Ireland Multiple Deprivation Measure (an indicator of housing quality, access and outdoor physical environment) Quintile 1: Worst (n=302) Quintile 2 (n=244) Quintile 3 (n=354) Quintile 4 (n=242) Quintile 5: Best (n=206)	Included	Included	Included	Included	Included
Neighbourhood	MSC4: Geographically Linked Data	**Rural / Urban** Northern Ireland Urban Rural Status 2005 Urban (n=659) Mixed rural urban (n=164) Rural (n=524)	Included	Included	Included	Not included	Not included

2.3 Statistical procedures

2.3.1 *NI prevalence estimates*

The NI estimate of the per cent of seven-year-olds in 2011 with a condition was based on the per cent of the MCS4 sample in 2008 with that condition. The NI estimate of the number of seven-year-olds in 2011 with a condition was obtained by applying the per cent of the MCS4 sample with a condition to population estimates of the number of seven-year-olds living in NI as recorded in Census 2011.

2.3.2 *How prevalence varies with child, carer, family and neighbourhood characteristics*

A statistical model, originally developed by IPH to estimate various health conditions amongst adults, was used to describe how the condition's prevalence varied with child, carer, family and neighbourhood characteristics (Institute of Public Health in Ireland, 2012g). A stepwise variable selection logistic regression procedure was then applied to the set of characteristics (see Table 2) ensuring that the model for a condition satisfied three statistical criteria (Figure 1, Step 1). The model consisted of the characteristics that had significant ($p<0.05$) independent effects that were not explained by the other characteristics in the model. When the effect of a characteristic appeared to be significantly modified by another characteristic ($p<0.05$), a two-way interaction term was included involving the characteristics in the model.

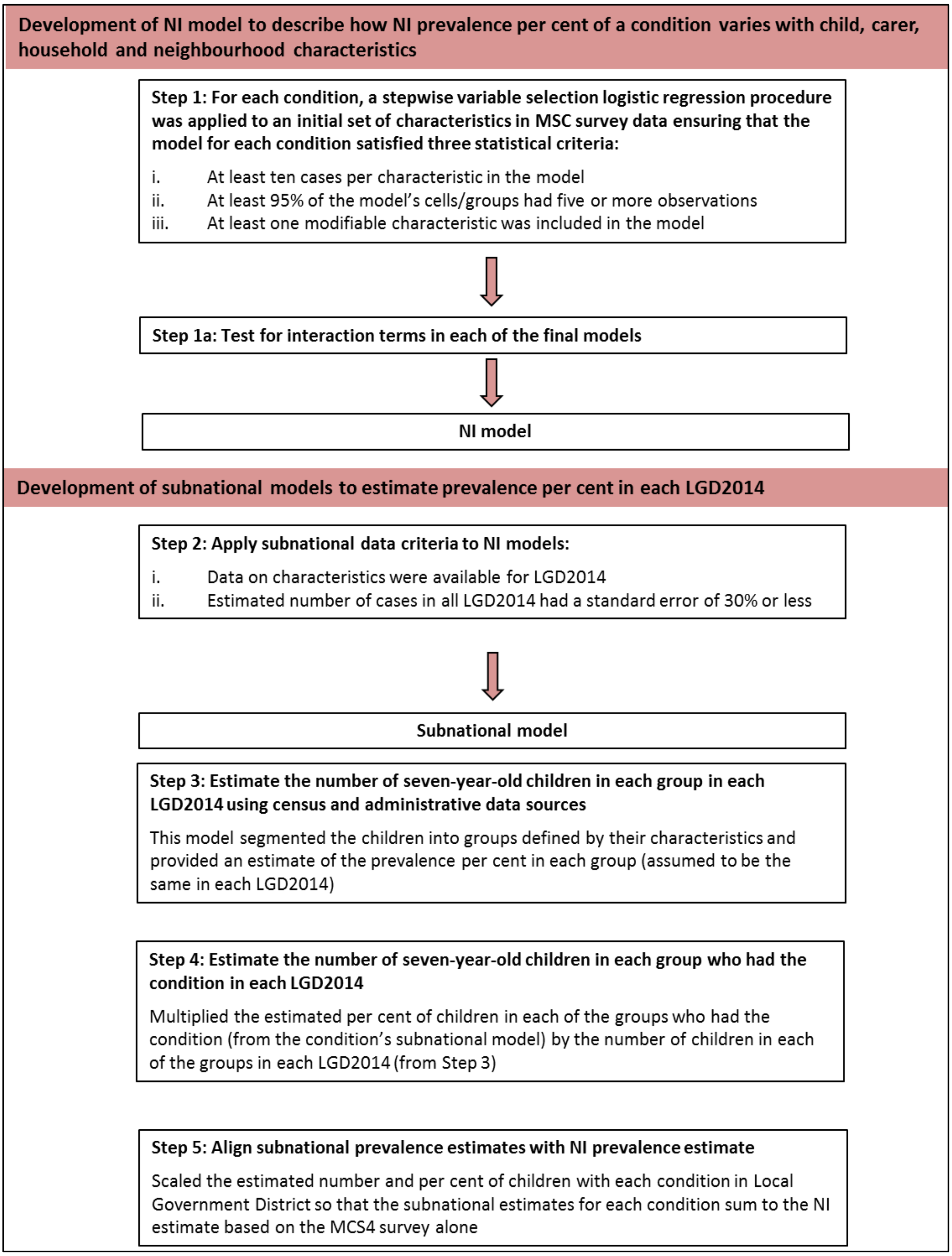
2.3.3 *Subnational prevalence estimates for Local Government Districts*

Unlike the prevalence estimates generated at the national level, the prevalence estimates for the 11 LGD2014 could not be calculated directly from MCS4 because MCS4 does not have adequate sample sizes for all LGD2014s.

The subnational model was derived from the NI model; hence the prevalence estimates for each LGD2014 are "synthetic estimates" that consist of the variables in the NI model for which subnational population data is available. These synthetic estimates represent "expected prevalence" based on the characteristics of the area, rather than actual prevalence.

For some conditions (eg children with longstanding illness, disability or infirmity), there was insufficient subnational-level data about the number of children with some of the characteristics (eg there was no subnational data for the frequency of parental intervention for child's allergy). So such variables were removed and the subnational model was refitted to estimate prevalence in each LGD2014.

Figure 1: Method for developing NI model to describe national prevalence and subnational models to estimate subnational prevalence



Development of NI model to describe how NI prevalence per cent of a condition varies with child, carer, household and neighbourhood characteristics

Step 1: For each condition, a stepwise variable selection logistic regression procedure was applied to an initial set of characteristics in MSC survey data ensuring that the model for each condition satisfied three statistical criteria:

i. At least ten cases per characteristic in the model
ii. At least 95% of the model's cells/groups had five or more observations
iii. At least one modifiable characteristic was included in the model

Step 1a: Test for interaction terms in each of the final models

NI model

Development of subnational models to estimate prevalence per cent in each LGD2014

Step 2: Apply subnational data criteria to NI models:

i. Data on characteristics were available for LGD2014
ii. Estimated number of cases in all LGD2014 had a standard error of 30% or less

Subnational model

Step 3: Estimate the number of seven-year-old children in each group in each LGD2014 using census and administrative data sources

This model segmented the children into groups defined by their characteristics and provided an estimate of the prevalence per cent in each group (assumed to be the same in each LGD2014)

Step 4: Estimate the number of seven-year-old children in each group who had the condition in each LGD2014

Multiplied the estimated per cent of children in each of the groups who had the condition (from the condition's subnational model) by the number of children in each of the groups in each LGD2014 (from Step 3)

Step 5: Align subnational prevalence estimates with NI prevalence estimate

Scaled the estimated number and per cent of children with each condition in Local Government District so that the subnational estimates for each condition sum to the NI estimate based on the MCS4 survey alone

2.3.4 Aligning subnational prevalence estimates with NI prevalence estimates

The synthetic estimate of the number of children with a condition in each LGD2014 was scaled so that the scaled subnational estimates summed to the national estimate based on the MCS4 survey alone (Figure 1, Step 5)[11]. The prevalence per cent for each LGD2014 was then recalculated based on the rescaled estimated numbers of cases.

2.3.5 Weighting MCS4 to represent the population of seven-year-olds in NI in 2011

The aim of this report was to produce population prevalence estimates for seven-year-old children living in NI in 2011 on the basis of Sweep 4 of MCS in 2008. Weighted estimates were taken from MCS4 and adjusted using data from the 2011 census on the number of 7-year-olds in the population and how these were distributed across demographic measures that were included in both MCS and the 2011 census.

The aim of the MCS design, when first implemented in 2001-2002, was to "ensure a proper representation of the total population, while at the same time having sufficient numbers of key subgroups for analysis"(Centre for Longitudinal Studies, 2000). The target population was defined as all children born between 23 November 2000 and 11 January 2002 living in Northern Ireland at age nine months. The MCS target population at Sweeps 2, 3 and 4 does *not* include families who have moved to Northern Ireland since Sweep 1. This is a limitation of the data for the purposes of the present study ie using later sweeps of a birth cohort longitudinal study to estimate population prevalence.

The MCS used a stratified cluster sample design with oversampling of socioeconomically disadvantaged wards in Northern Ireland. This is the *first* component of the MCS sampling weight. The *second* component of the MCS sampling weight consists of a set of non-response adjustments which are linked across sweeps[12]. In using information from Census 2011, to adjust the MCS4 sampling weights, five characteristics were used, including child's gender, number of carers, child with/without siblings, main carer's education level and presence of a longstanding condition in the main carer.

Appendix 4 shows details of the distribution of children across these characteristics in MCS4 and Census 2011 and Appendix 5 describes how the weight was computed.

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[11] The scaling factor for a particular LGD2014 was calculated as: (NI MCS4 survey prevalence % x NI population of seven-year-olds) / (Sum of the estimated LGD2014 cases).

[12] See Plewis (2007) and Plewis et al. (2006) for information on non-response adjustments for Sweeps 1 and 2, and Ketende (2008) for non-response adjustments for Sweeps 3 and 4.

3. NI findings

3.1 Longstanding illness, disability or infirmity

3.1.1 NI prevalence

It is estimated that more than 4,100 (19.1%; 95% CI = (16.6%, 21.7%)) seven-year-olds in Northern Ireland *currently* (at the time of the survey) had a carer-reported *longstanding illness, disability or infirmity*[13] (longstanding meaning anything that has troubled the child for a period of time or was likely to affect the child for a period of time).

3.1.2 Comparison of prevalence with other studies

Comparisons with other studies are difficult because the prevalence of longstanding illness, disability or infirmity varies according to the definition of the measure used and the ages of the children involved. Prevalence estimates discussed below range from 6% to 19% depending on the age of the cohort, and how conditions were defined.

Using the same question as MCS4, *Growing Up in Scotland* reported that by age six, 19% of children were reported to have a longstanding illness or disability (Bradshaw and Hall, 2013). *Growing Up in Australia* reported that 11.1% of 6-7 year-olds from the child cohort in 2006 had a disability or medical condition (Australian Institute of Family Studies, 2008).

In an analysis of data from Sweep 3 of MCS, when children were aged 5 years, Sullivan et al. (2010) reported that 20.2% of children in NI had a longstanding illness (13.0% described as 'non-limiting' and 7.2% as 'limiting'). Prevalence of longstanding illness did not vary across England, NI, Scotland and Wales in that study.

The *Health Survey for Northern Ireland 2014/15* reported that 16% of children, up to the age of 15 years, had a longstanding illness in the last 12 months (Department of Health, Social Services and Public Safety, 2015). This is a 1% increase from the 2013/14 survey which reported 15% of children having a longstanding illness in the last 12 months (Department of Health, Social Services and Public Safety, 2014a). Results from the 2013 NI *Young Person's Behaviour and Attitudes Survey (YPBAS)* indicated that 12.5% of respondents aged 12-16 years reported currently having one or more physical or mental health conditions, lasting or expected to last 12 months or more (Northern Ireland Statistics and Research Agency, 2013).

In the *Growing Up In Ireland* (GUI) study, parents of 9-year-olds in RoI were asked if their child currently had any ongoing chronic physical or mental health problem, illness or disability. From this data, collected in 2007/08, about 11% were reported as having a chronic illness or disability, and 7% of these (or 0.8% of all children) were described by their parents as being severely hampered in their daily activities because of it. Respiratory conditions were the most common, accounting for 46% of all conditions reported; 19% were mental or behavioural conditions; 4% were skin conditions; and approximately 30% were other conditions (Growing Up in Ireland, 2009). The overall prevalence estimate of 11% of children is lower than the estimate of 19% for the current study of 7-year-olds in

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[13] The term 'infirmity' may be open to interpretation, but MCS did not include a definition in its questionnaire, nor is the period of time defined.

NI. This could be due in part to differences in the wording of the question asked of parents, or other differences in the survey designs of GUI and MCS.

The census in NI in 2011 reported a period prevalence of 14% for "long-term pain or discomfort" among seven-year-olds, which has lasted, or is expected to last, at least 12 months (Census Office for Northern Ireland, 2011b). The question from NI census is not directly comparable to MCS4 since the condition focussed on pain and discomfort rather than illness, disability or infirmity, as asked in MCS4.

The RoI Census in 2011 reported a period prevalence of 6.1% for "long-standing conditions or difficulties" among seven-year-olds (Central Statistics Office, 2011) but the questions from RoI census is not comparable to MCS4 since the response categories focussed more on broad categories of disability and functioning rather than specific longstanding conditions.

3.1.3 Characteristics related to NI prevalence

When the child, carer, family and neighbourhood characteristics detailed in Table 2 were analysed individually the unadjusted population prevalence of a carer-reported longstanding illness, disability or infirmity varied significantly with:

- Child's sex (p=0.0026): prevalence was higher among male children
- Allergy intervention[14] (p<0.0001): prevalence was higher among children who were admitted to hospital for an allergy (except wheezing, asthma, or eczema) or where carer controlled child's food/drink consumption due to "allergic reactions/food sensitivity"
- Schoolwork (p=0.0010): prevalence was higher among children who had great difficulty with schoolwork (ie one or more of reading, writing or maths)
- Physical education (p=0.0001): prevalence was higher among children who had great difficulty with physical education
- Main respondent health status: (p<0.0001): prevalence was higher among children whose primary carer had a longstanding illness, disability or infirmity
- Damp (p=0.0048): prevalence was higher among children whose home had some/great problems of damp
- Neighbourhood (p=0.0456): prevalence was lower among children living in mixed neighbourhoods (rural and urban) compared to either rural or urban neighbourhoods.

The unadjusted population prevalence per cents and 95% confidence intervals for these characteristics are shown in Figure 2.

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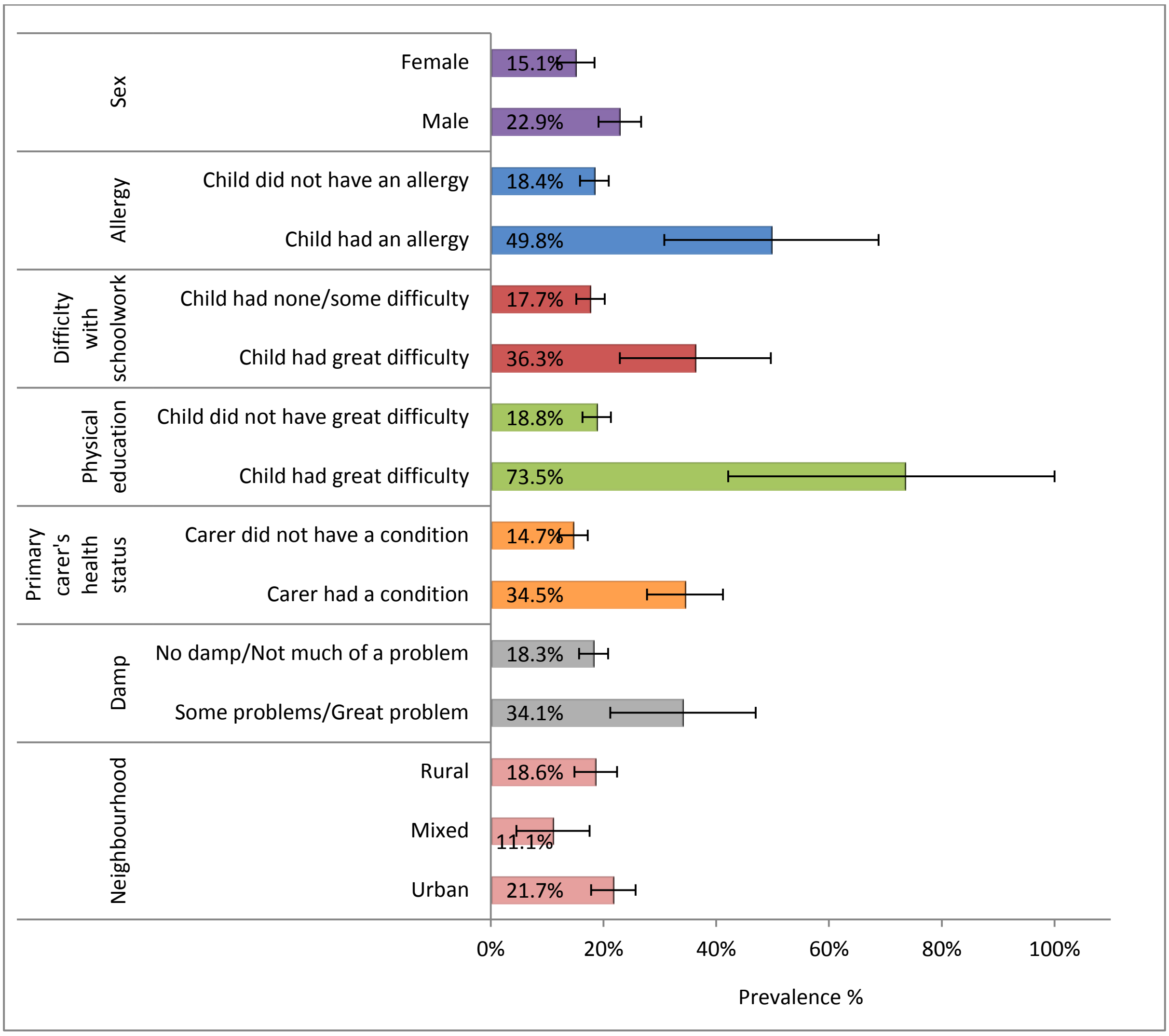
[14] The two questions measuring *allergy intervention* were asked in a separate section to the one about longstanding illness, disability or infirmity.

Figure 2: Estimated unadjusted population prevalence (%) of a “longstanding illness, disability or infirmity” among seven-year-olds by child, carer, family and neighbourhood characteristics that were significantly related to prevalence[15]. Source: MCS4, 2008 & NI Census, 2011



Individual characteristics such as those shown in Figure 2 are often interrelated and combine in complex ways to influence prevalence. To take this into account the NI statistical model was used to identify those characteristics that had a significant relationship with having a longstanding illness, disability or infirmity when the characteristics were analysed together. “Primary carer’s health status” and “allergy intervention” were the only characteristics that had significant independent effects not explained by other characteristics (see Table 3).

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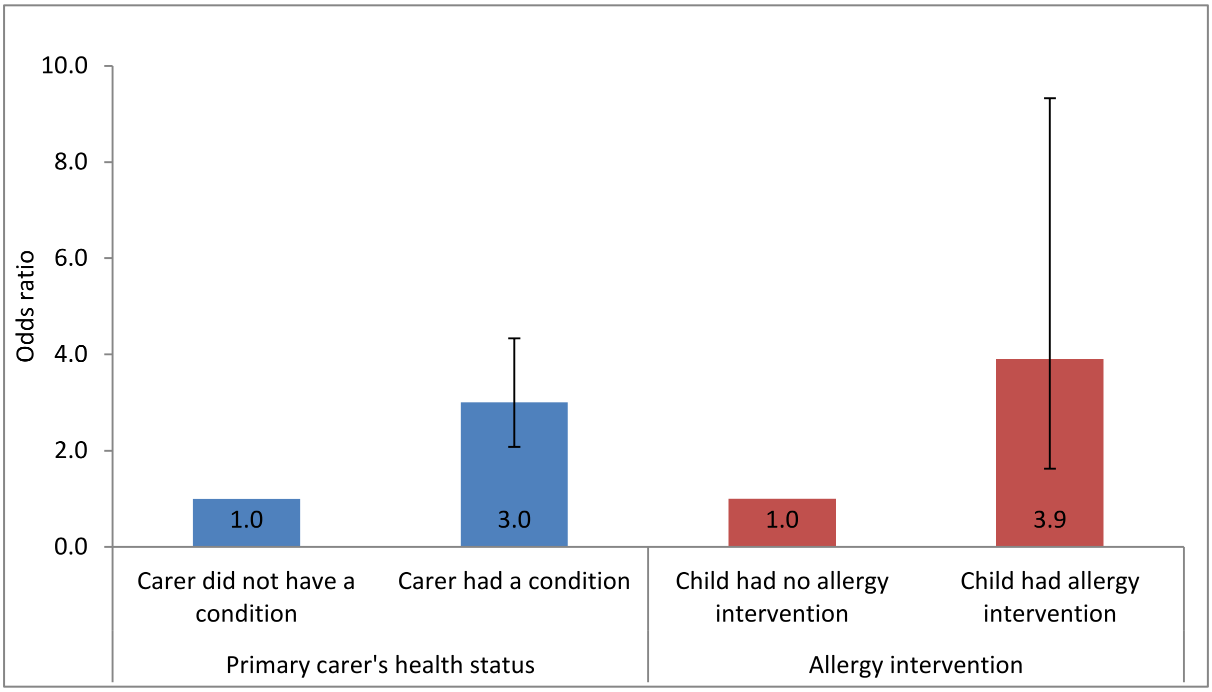
[15] Confidence intervals for categories of some child, carer, family and neighbourhood characteristics overlap. However, the confidence intervals for the difference between categories do not overlap. Therefore there is a significant association between all characteristics in the figure with the condition in question. See Table 2 for the weighted numbers of children in each group.

Table 3: Characteristics that had significant independent effects in the NI statistical model for a "longstanding illness, disability or infirmity". Source: MCS4, 2008 & NI Census, 2011.

Characteristics with significant independent effects after adjusting for the other characteristics	**Effect on the prevalence of a longstanding illness, disability or infirmity**
Primary carer's health status: having a primary carer with a longstanding illness, disability or infirmity	A longstanding illness, disability or infirmity was significantly more likely among children whose primary carer had a longstanding condition. After taking other characteristics into account, children whose primary carer had a longstanding illness, disability or infirmity were three times more likely to have a longstanding illness, disability or infirmity (see Figure 3). Note that the effect of primary carers' health status may be due to the hereditary nature of some conditions, or the shared environmental and economic factors.
Allergy intervention: child admitted to hospital for an allergy (<u>except wheezing, asthma, or eczema</u>) or where carer had controlled child's food/drink consumption due to "allergic reactions/food sensitivity".	A longstanding illness, disability or infirmity was significantly more likely among children with an allergy intervention. Children whose parents had responded yes to an intervention (dietary or hospital) due to the child's allergy were almost four times more likely to have a longstanding illness, condition or disability than children whose parents did not report any intervention (see Figure 3).

Figure 3 shows the adjusted risk ratios and their 95% confidence intervals for these characteristics.

Figure 3: Adjusted OR for a "longstanding illness, disability or infirmity" among seven-year-olds by primary carer's health status and allergy intervention. Source: MCS4, 2008 & NI Census, 2011



3.1.4 National prevalence among different sub-groups of children

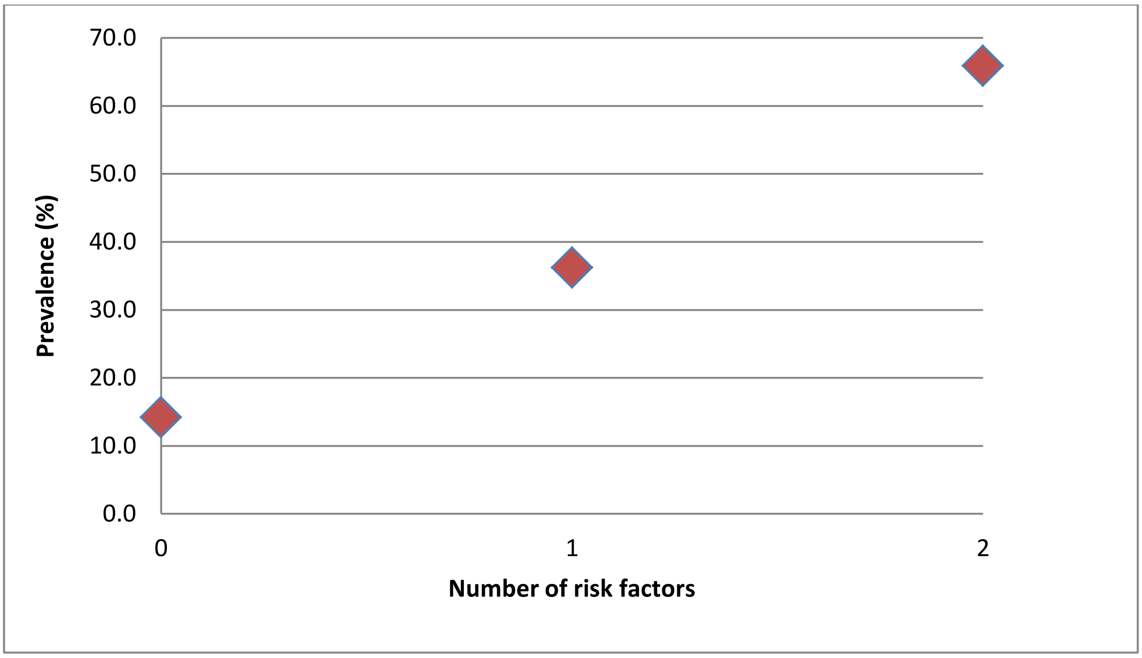
The NI model also provides prevalence estimates among different sub-groups of children. Table 4 shows the prevalence of carer-reported longstanding illness, disability or infirmity for each of these groups. Although the NI population prevalence of these conditions was 19.1%, this varies substantially, from 14.2% (children without an allergy intervention and whose carer did not have a longstanding health condition) to 65.9% (children with an allergy intervention whose carer had a longstanding health condition).

Table 4: Estimated prevalence (%) of a "longstanding illness, disability or infirmity" among seven-year-olds by primary carer's health status and allergy intervention. Source: MCS4, 2008 & NI Census, 2011.

Primary carer's health status	Allergy intervention	% of children in group	No. of risk factors	Prevalence %	95% confidence interval of prevalence
Carer did not have a condition	Child did not have an allergy intervention	74.8%	0	14.2%	(11.9%, 16.9%)
	Child had an allergy intervention	1.3%	1	39.1%	(21.3%, 60.5%)
Carer had a condition	Child did not have an allergy intervention	22.8%	1	33.2%	(26.7%, 40.3%)
	Child had an allergy intervention	1.0%	2	65.9%	(44.4%, 82.4%)

Figure 4 illustrates how the prevalence of longstanding illness, disability or infirmity increases with the number of risk factors shown in Table 4. Children with both risk factors, though just 1% of the sample, have a much higher incidence of a longstanding condition (65.9%) than children with neither risk factor (14.2%). Children with one or other of the two identified risk factors also have a higher incidence of a longstanding condition (33% to 39%) than children with neither risk factor.

Figure 4: Illustration of how prevalence of a longstanding illness, disability or infirmity increases with the number of risk factors identified in the NI joint model. Source: MCS4, 2008 & NI Census, 2011.



3.2 Asthma or asthma symptoms

3.2.1 NI prevalence

It is estimated that just under 5,000 (22.9%; 95% CI = (20.0%, 25.8%)) seven-year-olds in Northern Ireland *ever* had carer-reported asthma/asthma symptoms in 2011, (that is, had a carer who reported that their child had ever had asthma; four or more attacks of wheezing in the past 12 months; sleep disturbance one or more nights per week due to wheezing in the past 12 months; or disruption in speech due to shortness of breath in the past 12 months).

3.2.2 Comparison of prevalence with other studies

Sa-Sousa et al. (2014) have noted that there is a lot of heterogeneity in the way asthma is defined in epidemiological studies. This leads to large variations in estimates of the prevalence of asthma and difficulty in comparing estimates between studies. Some existing prevalence estimates are cited below as examples.

Sullivan et al. (2010) reported the prevalence of both diagnosed asthma (ever) and wheeze (in the past 12 months) among children aged 5 years who took part in Sweep 3 of MCS. They found that 30.3% of children in NI (and 29.6% of children across the UK) had wheeze while 16.7% of children in NI (and 14.6% across the UK) had diagnosed asthma.

The *International Study of Asthma and Allergies in Childhood* (ISAAC) (Phase Three) reported a prevalence of asthma symptoms of 26.7% amongst 6-7 year olds in RoI and 24.7% of 6-7 year olds in the UK (Asher et al., 2006) where asthma symptoms were defined as wheezing or whistling in the chest in the past 12 months.[16]

Also using the ISAAC questionnaire, Harty et al. (2003) found prevalence rates for wheeze were 17.4% amongst 6-7 year old Irish schoolchildren where ‘wheeze’ was defined as diagnosed asthma, wheeze with exercise, a dry cough not associated with a cold or flu and/or more than four attacks of wheeze in the past year.

The *Health Survey for England* in 2010 found that 20% of 7-9 year old boys and 12% of 7-9 year old girls had self-reported doctor-diagnosed asthma ever (Boodhna and Hall, 2011, Table 4.3). *Growing up in Australia* found that 24% of children aged 6-7 years had been diagnosed with asthma in 2006/07 (Australian Institute of Family Studies, 2008). Note that both of these studies are based on reports of diagnosed asthma excluding asthma symptoms.

Results from the 2013 NI *Young Person’s Behaviour and Attitudes Survey* (YPBAS) indicated that 12.3% of respondents aged 12-16 years reported having asthma during the past 12 months (Northern Ireland Statistics and Research Agency, 2013).

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[16] Note that the definition of asthma used in the present study covers lifetime prevalence, so these results are not easy to compare with one another.

The reliance on parent self-reports also makes comparisons with other studies difficult since the understanding of the term "wheeze" may be open to misinterpretation by parents[17]. Evidence suggests that conceptual understandings of "wheeze" by parents of children who self-reported wheeze are different from epidemiological definitions. In addition, parents' reports of acute wheezing or asthma in children differed to clinicians' findings when the child was brought to a UK paediatric Accident and Emergency department (Cane et al., 2000). Cane et al. (2000) also reviewed a number of UK studies and found wide ranges in prevalence of "current wheeze within the last 12 months" (5.5% to 19.6%); and doctor diagnosed asthma (1.2% to 22.9%).

3.2.3 Characteristics related to national prevalence

When the child, carer, family and neighbourhood characteristics detailed in Table 2 were analysed individually the unadjusted population prevalence of carer-reported diagnosed asthma/asthma symptoms varied significantly with:

- Child's sex (p=0.0026): prevalence was higher among boys
- Primary carer's health status (p=0.0014): prevalence was higher among children whose primary carer had a longstanding illness, disability or infirmity
- Breastfeeding (p=0.0474): prevalence was higher amongst children who had not been breastfed
- Maternal smoking during pregnancy (p=0.0001): prevalence was higher among children whose mother smoked during pregnancy
- Body mass index (p=0.0323): prevalence was higher amongst children classified as obese[18].

The prevalence per cents and 95% confidence intervals for these characteristics are shown in Figure 5.

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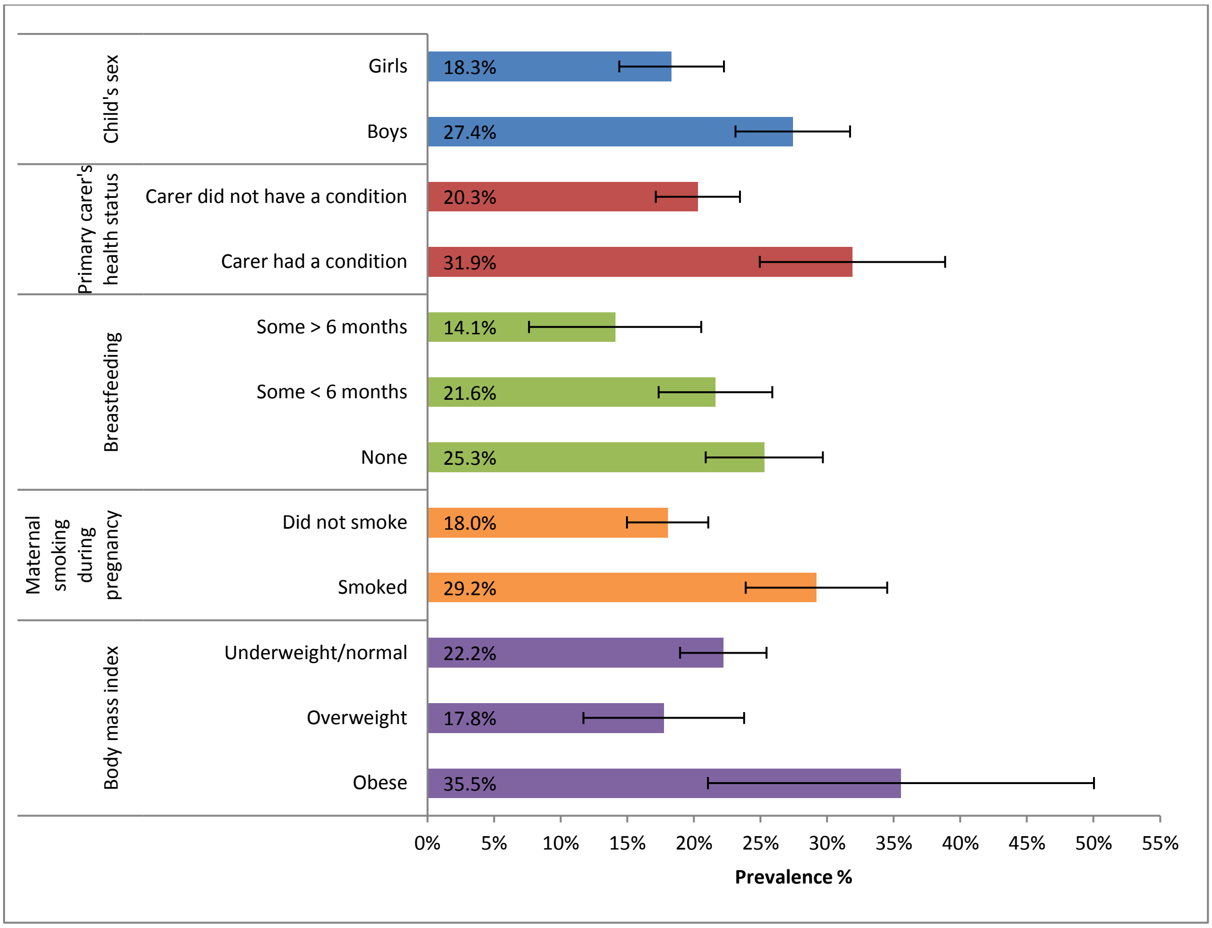
[17] *Wheeze* can be defined as a continuous coarse sound produced by obstruction or narrowing of the respiratory airways due to asthma or other causes (McAvoy et al., 2013).

[18] Ali and Ulrik (2013) conducted a systematic review of studies that have examined the links between obesity and asthma. They concluded that while there is substantial evidence that obesity and asthma are related, they show that the mechanisms by which these are linked are complex, and whether the relationship is causal or due to co-morbidities underlying the two conditions is unclear.

Figure 5: Estimated unadjusted population prevalence (%) of asthma/asthma symptoms among seven-year-olds by child, carer, family and neighbourhood characteristics that were significantly related to prevalence[19]. Source: MCS4, 2008 & NI Census, 2011



Individual characteristics can be interrelated and may combine in complex ways to influence prevalence. Therefore, the NI statistical model was used to identify those characteristics that had a significant relationship with diagnosed asthma/asthma symptoms when the characteristics were analysed together. “Child’s sex”, “Primary carer’s health status”, and “Maternal smoking during pregnancy” were the characteristics that had significant independent effects not explained by other characteristics (see Table 5).

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[19] Confidence intervals for categories of some child, carer, family and neighbourhood characteristics overlap. However, the confidence intervals for the difference between categories do not overlap. Therefore there is a significant association between all characteristics in the figure with the condition in question. See Table 2 for the weighted numbers of children in each group.

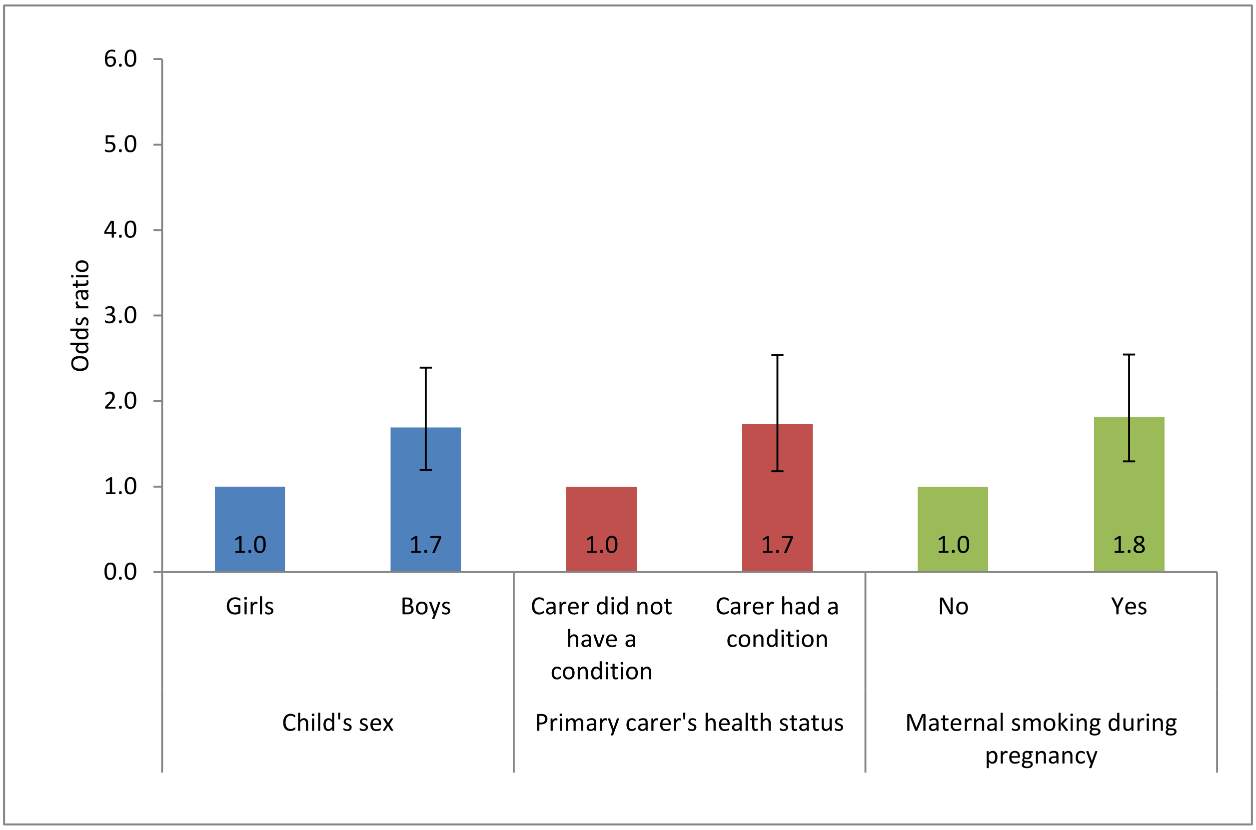
Table 5: Characteristics that had significant independent effects in the NI statistical model for asthma/asthma symptoms. Source: MCS4, 2008 & NI Census, 2011.

Characteristics with significant independent effects after adjusting for the other characteristics	Effect on the prevalence of asthma/asthma symptoms
Child's Sex	Asthma/asthma symptoms were significantly more likely among boys. After taking other characteristics into account, boys were 1.7 times more likely than girls to have asthma/asthma symptoms (Figure 6).
Primary carer's health status: having a primary carer with a longstanding illness, disability or infirmity	Asthma/asthma symptoms were significantly more likely among children whose primary carer had a longstanding condition. After taking other characteristics into account, children whose primary carer had a longstanding illness, disability or infirmity were 1.7 times more likely to have asthma/asthma symptoms (see Figure 6).
Maternal smoking during pregnancy	Asthma/asthma symptoms were significantly more likely among children whose mother smoked during pregnancy. After taking other characteristics into account, children whose mother smoked during pregnancy were 1.8 times more likely to have asthma/asthma symptoms (see Figure 6).

Findings in Table 5 are consistent with previous research. For example, the *Health Survey for England* study, as noted previously, indicated that prevalence of asthma was higher in boys than girls. Evidence from other studies suggests an increased risk of asthma where the mother has smoked during pregnancy (Agabiti et al., 1999, Jaakkola and Gissler, 2004).

Figure 6 shows the adjusted risk ratios and their 95% confidence intervals for these characteristics.

Figure 6: Adjusted risk ratios for asthma/asthma symptoms among seven-year-olds by child's sex, primary carer's health status and maternal smoking during pregnancy. Source: MCS4, 2008 & NI Census, 2011



3.2.4 *National prevalence among different sub-groups of children*

The NI model also provides prevalence estimates among different sub-groups of children. Table 6 shows that the prevalence of carer-reported asthma/asthma symptoms varies by child's sex, carer's health status and maternal smoking during pregnancy. Prevalence was lowest among girls whose carer did not have a longstanding health condition and who did not smoke during pregnancy (12.8%) and highest among boys whose carer had a longstanding health condition and who smoked during pregnancy (43.8%).

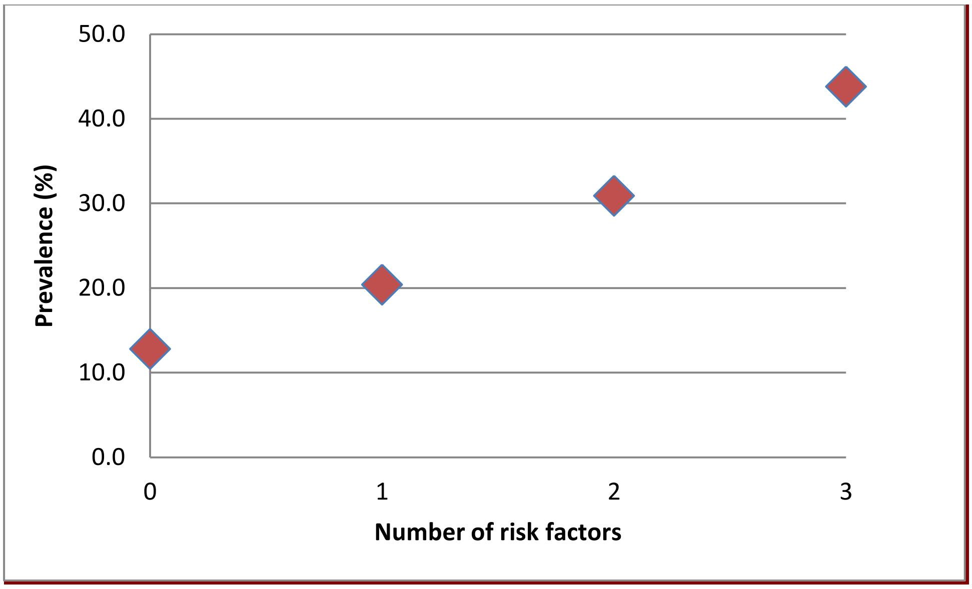
In both boys and girls, as the number of risk factors increased (from none to three), so too did the estimated prevalence. Interestingly, the gradients amongst boys and girls were similar except that prevalence amongst boys with no risk factors was just higher than it was amongst girls with no risk factors.

Table 6: Estimated prevalence (%) of asthma/asthma symptoms among seven-year-olds by child's sex, primary carer's health status and maternal smoking during pregnancy. Source: MCS4, 2008 & NI Census, 2011

Child's Sex	Primary carer's health status	Maternal smoking during pregnancy	% of children in group	No. of risk factors	Prevalence %	95% confidence interval of prevalence
Girls	Carer did not have a condition	Did not smoke	23.9%	0	12.8%	(9.7%, 16.7%)
		Smoked	14.0%	1	21.0%	(15.6%, 27.8%)
	Carer had a condition	Did not smoke	7.2%	1	20.3%	(14.7%, 27.3%)
		Smoked	4.8%	2	31.6%	(23.3%, 41.2%)
Boys	Carer did not have a condition	Did not smoke	23.7%	1	19.9%	(16.0%, 24.5%)
		Smoked	14.6%	2	31.0%	(24.8%, 38.0%)
	Carer had a condition	Did not smoke	6.6%	2	30.0%	(22.4%, 39.0%)
		Smoked	5.2%	3	43.8%	(34.1%, 53.9%)

Figure 7 illustrates how the prevalence of asthma increases with the number of risk factors shown in Table 6. Children with all three factors, comprising about 5% of the sample, have a much higher incidence of asthma (43.8%) than children with no risk factors (12.8%). The prevalence of asthma among children with one of the three risk factors is about 20%, and it is about 30% among children with two of the three risk factors.

Figure 7: Illustration of how prevalence of asthma or asthma symptoms increase with the number of risk factors identified in the NI joint model. Source: MCS4, 2008 & NI Census, 2011.



3.3 Eczema

3.3.1 *NI prevalence*

It is estimated that more than 5,600 (26.1%; 95% CI = (23.3%, 29.0%)) seven-year-olds in Northern Ireland *ever* had carer-reported eczema in 2011 (that is, a carer responding *yes* to the question: has [child] ever had eczema?)[20].

3.3.2 *Comparison of prevalence with other studies*

Evidence suggests that we can expect quite high (lifetime) prevalence estimates for eczema among children. For example, a snapshot survey conducted at the British Association of Dermatologist's AGM in London in 2011 found that nine in ten dermatologists and dermatology nurses see childhood eczema as the biggest problem facing paediatric dermatology, children and their families in the UK (British Skin Foundation, 2012).

Comparisons across survey-based estimates of the prevalence of eczema are greatly hampered by wide variations in the wording of questions (as well as age groups surveyed). For example, 4.0% of 3-year-olds in the *Growing Up in Ireland* (GUI) study had an 'eczema/skin allergy' (Institute of Public Health, 2014). Findings from *Growing up in Scotland* indicated that 28.9% of babies (aged around 10 months) and 23.1% of toddlers (aged around 3 years) were reported to have skin problems that required contact with the National Health Service (Anderson et al., 2007). None of these prevalence estimates is meaningfully comparable with that of the present study due to differences in the content of the questions and ages surveyed. Using data from Sweep 3 of MCS, Sullivan et al. (2010) estimated that 25.3% of 5-year-olds in NI had ever had carer-reported eczema (which is lower than the UK average of 35.3%). The estimates for eczema in NI for Sweep 3 and Sweep 4 are very similar to one another.

A UK cohort study of 593 children in Kent found 25.3% of children had met diagnostic criteria[21] for eczema at least once by the age of eight (Harris et al., 2007). Kay et al. (1994) found the lifetime prevalence of atopic eczema was 20% in children aged 3 to 11 years in a general practice population in England. These studies are reporting lifetime prevalence and are broadly similar to this report's findings for children in NI.

Using the International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire, Harty et al. (2003) found prevalence rate for eczema amongst 6-7 year old Irish schoolchildren in 2000 was 11.2%. This study is older, and research into trends in prevalence over time suggests that the prevalence of eczema is increasing in Western Europe and elsewhere (Deckers et al., 2012).

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[20] Note that we cannot determine how many of these children currently have eczema.

[21] A child was considered to have eczema if they experienced an itchy skin in the past twelve months plus at least three of the following; a history of flexural involvement, history of a generally dry skin, history of allergic disease in parents or siblings and visible dermatitis as per photographic protocol.

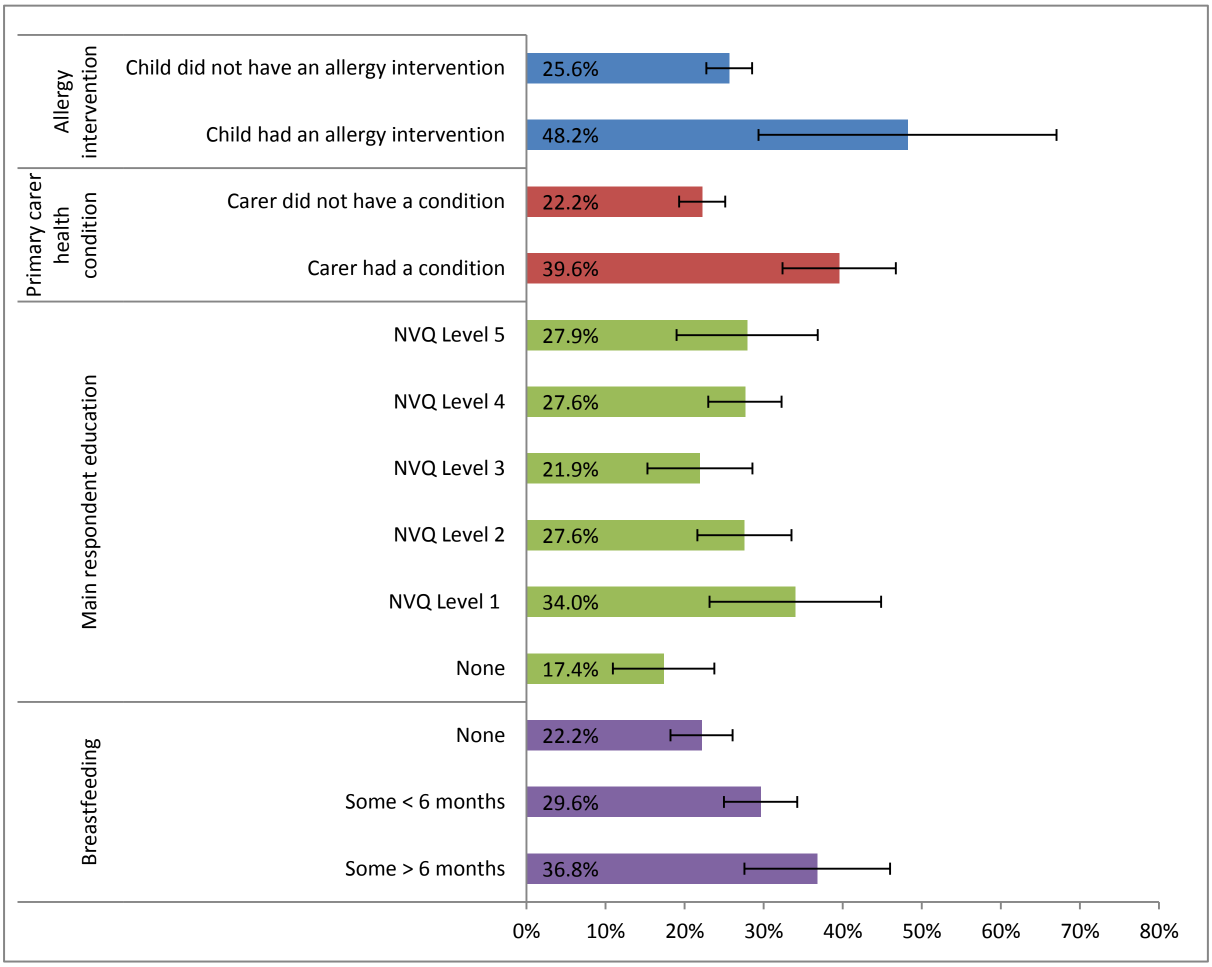
3.3.3 *Characteristics related to national prevalence*

When the child, carer, family and neighbourhood characteristics detailed in Table 2 were analysed individually, the unadjusted population prevalence of carer-reported eczema ever varied significantly with:

- Allergy intervention (p=0.0088): prevalence was higher among children who were admitted to hospital for an allergy (except wheezing, asthma, or eczema) or where carer controlled child's food/drink consumption due to "allergic reactions/food sensitivity"
- Main respondent health status: (p<0.0001): prevalence was higher among children whose primary carer had a longstanding illness, disability or infirmity
- Main respondent education (p=0.0490): prevalence was higher among children where the main respondent had the lowest education qualifications (NVQ Level 1) compared to all other education levels
- Breastfeeding (p=0.0023): prevalence was higher among children who were breastfed (not necessarily exclusively) for six months or more.

The unadjusted population prevalence per cents and 95% confidence intervals for these characteristics are shown in Figure 8.

Figure 8: Estimated unadjusted population prevalence (%) of carer-reported eczema ever among seven-year-olds by child, carer, family and neighbourhood characteristics that were significantly related to prevalence[22]. Source: MCS4, 2008 & NI Census, 2011



As noted previously, individual characteristics may be related to one another and can combine in complex ways to influence prevalence. Therefore, the NI statistical model was used to identify those characteristics that had a significant relationship with eczema when the characteristics were analysed together. “Primary carer’s health status” and “Breastfeeding” were the only characteristics that had significant independent effects not explained by other characteristics (see Table 7).

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[22] Confidence intervals for categories of some child, carer, family and neighbourhood characteristics overlap. However, the confidence intervals for the difference between categories do not overlap. Therefore there is a significant association between all characteristics in the figure with the condition in question. See Table 2 for the weighted numbers of children in each group.

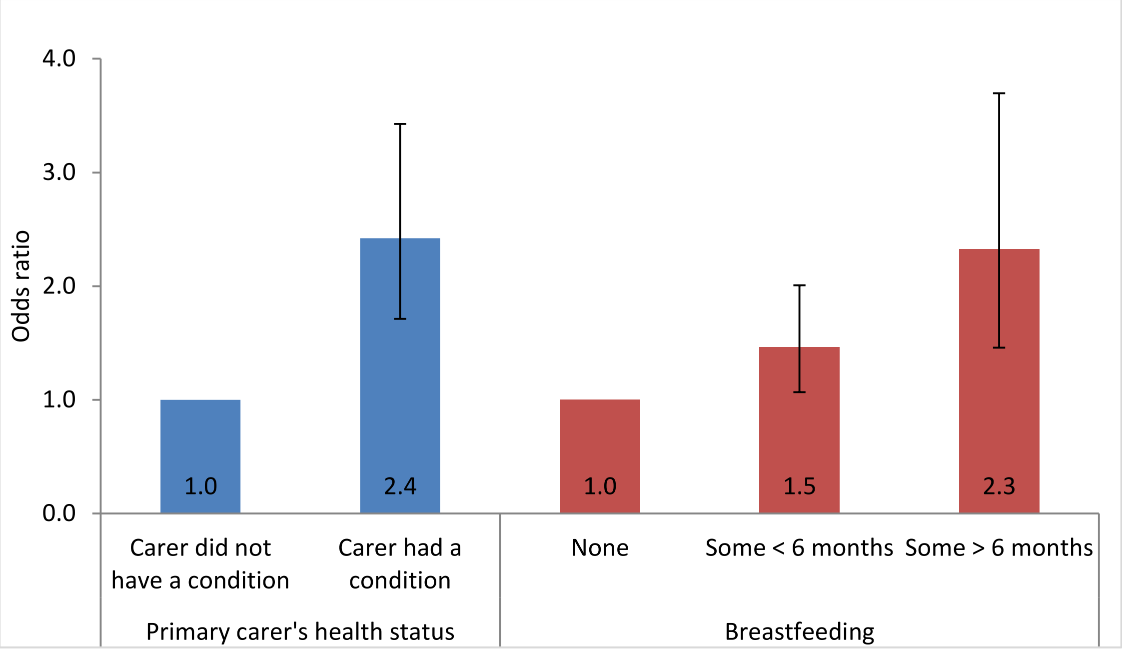
Table 7: Characteristics that had significant independent effects in the NI statistical model for eczema. Source: MCS4, 2008 & NI Census, 2011.

Characteristics with significant independent effects after adjusting for the other characteristics	Effect on the prevalence of eczema
Primary carer’s health status: having a primary carer with a longstanding illness, disability or infirmity	Carer-reported eczema ever was significantly more likely amongst children whose primary carer had a longstanding illness, disability or infirmity. After taking other characteristics into account, children whose primary carer had a longstanding illness, disability or infirmity were almost 2.5 times more likely to have eczema (see Figure 9).
Breastfeeding	Carer-reported eczema ever was significantly more likely amongst children who had some breastfeeding, and for a longer duration. After taking other characteristics into account, children who had some breastfeeding for more than six months were 2.3 times more likely to have eczema (see Figure 9).

It is perhaps unexpected that breastfeeding is associated with a higher likelihood of eczema. However, there is mixed evidence from other studies as to whether breastfeeding is positively or negatively related to eczema and a number of characteristics and processes are likely to mediate this relationship (Flohr et al, 2011; Lien et al, 2011; Kay et al, 1994).

Figure 9 shows the odds ratios and their 95% confidence intervals for these characteristics.

Figure 9: Adjusted OR for carer-reported eczema ever among seven-year-olds by primary carer's health status and breastfeeding. Source: MCS4, 2008 & NI Census, 2011



3.3.4 National prevalence among different sub-groups of children

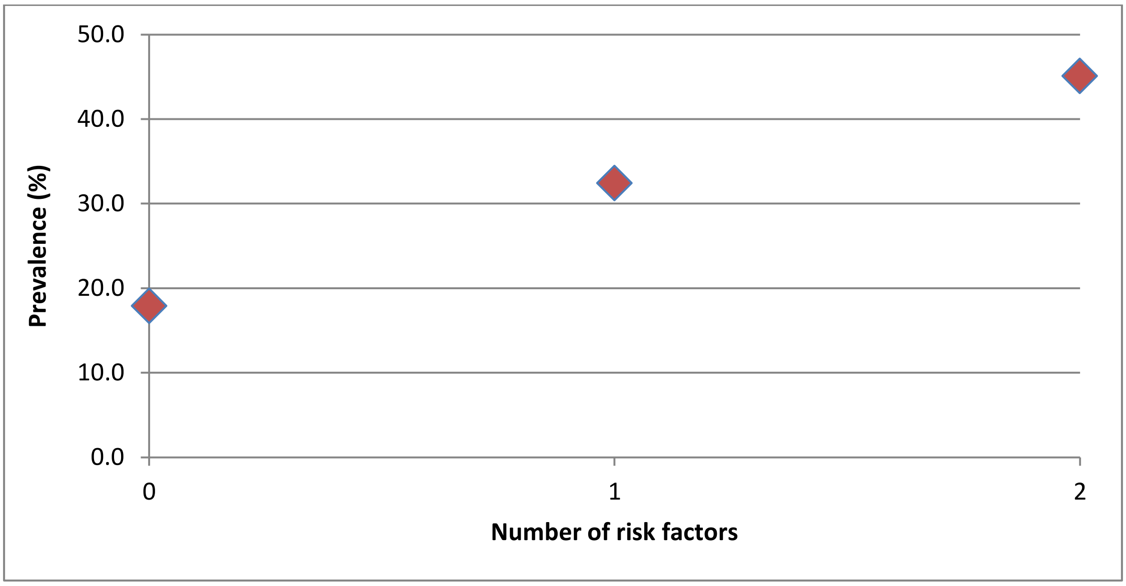
The NI model also provides estimates of the prevalence of carer-reported eczema ever among different sub-groups of children. Table 8 shows the prevalence of carer-reported eczema ever for each of these groups. Although the overall prevalence was 26.1%, the burden was unequally distributed as prevalence ranged from 17.9% to 46.9% across groups of children, depending on carer health status and breastfeeding status. The higher prevalence of eczema associated with breastfeeding, as already noted, should be interpreted with respect to the fact that there is mixed evidence from other studies on this association, and it could also be related to other factors not included in the model.

Table 8: Estimated prevalence (%) of carer-reported eczema ever among seven-year-olds by primary carer's health status and breastfeeding status. Source: MCS4, 2008 & NI Census, 2011.

Primary carer's health status	Breastfeeding	% of children in group	No. of risk factors	Prevalence %	95% confidence interval of prevalence
Carer did not have a condition	None	36.2%	0	17.9%	(14.3%, 22.1%)
	Some (< 6 months)	31.5%	1	25.1%	(20.1%, 30.1%)
	Some (> 6 months)	8.6%	1	35.4%	(26.2%, 45.8%)
Carer had a condition	None	11.9%	1	36.8%	(27.4%, 47.4%)
	Some (< 6 months)	10.4%	2	43.2%	(32.8%, 54.2%)
	Some (> 6 months)	1.5%	2	46.9%	(25.1%, 70.1%)

Figure 10 illustrates how the prevalence of carer-reported eczema ever increases with the number of risk factors shown in Table 8. Children with both risk factors, though just 1.5% of the sample, have a much higher incidence eczema (43% to 47%) than children with neither risk factor (17.9%). Children with one or other of the two identified risk factors also have a higher incidence of eczema (25% to 37%) than children with neither risk factor.

Figure 10: Illustration of how prevalence of carer-reported eczema ever increases with the number of risk factors identified in the NI joint model. Source: MCS4, 2008 & NI Census, 2011.



3.4 Sight problem that required treatment

3.4.1 NI prevalence

It is estimated that just over 3,600 (16.8%; 95% CI = (14.2%, 19.4%)) seven-year-olds in Northern Ireland in 2011 *ever* had a carer-reported sight problem that required treatment (that is, a carer responding *yes* to: Has [child] ever had any problem(s) with his/her eyesight or his/her eyes and *yes* to: Has [child] had, or is [child] due to have, any treatment for this problem?)[23].

3.4.2 Comparison of prevalence with other studies

Sullivan et al. (2010) reported that 13.7% of 5-year-old children in NI (and 10.9% of children across the UK) who took part in Sweep 3 of MCS had ever had a carer-reported sight problem that required treatment. This is marginally lower than the estimate of 16.8% found in this study.

The most recent NI and RoI Censuses both report on more serious sight problems including blindness which may account for the large difference in prevalence. Northern Ireland Census 2011 reported a prevalence of 0.4% for “blindness or partial sight loss” among 5-7 year-olds (Census Office for Northern Ireland, 2011a). Republic of Ireland Census 2011 reported a prevalence of 0.4% for “blindness or a serious vision impairment” among seven-year-olds (Central Statistics Office, 2011).

3.4.3 Characteristics related to national prevalence

When the child, carer, family and neighbourhood characteristics detailed in Table 2 were analysed individually the unadjusted lifetime prevalence of carer-reported sight problems ever that required treatment varied significantly with:

- Schoolwork (p=0.00153): prevalence was higher among children who had great difficulty with schoolwork (ie one or more of reading, writing or maths)
- Number of parents/carers in the family (p=0.0044): prevalence was higher among children in families with one parent/carer
- Siblings (p=0.0155): prevalence was higher amongst children with no siblings
- Family social class (p=0.0118): prevalence was higher among children in families with the lowest social class (compared to all other social classes)
- Primary carers education (p<0.0001): prevalence was higher among children whose primary carer had no education (compared to all other education levels)
- Exposure to tobacco smoke (p=0.0040): prevalence was higher among children whose family members smoked in the same room as them
- Breastfeeding (p=0.0408): prevalence was higher among children who were never breastfed
- Maternal alcohol consumption during pregnancy (p=0.0333): prevalence was higher among children whose mothers consumed alcohol 1-2 times a week or more during pregnancy
- Maternal smoking during pregnancy (p=0.0001): prevalence was higher among children whose mothers smoked during pregnancy.

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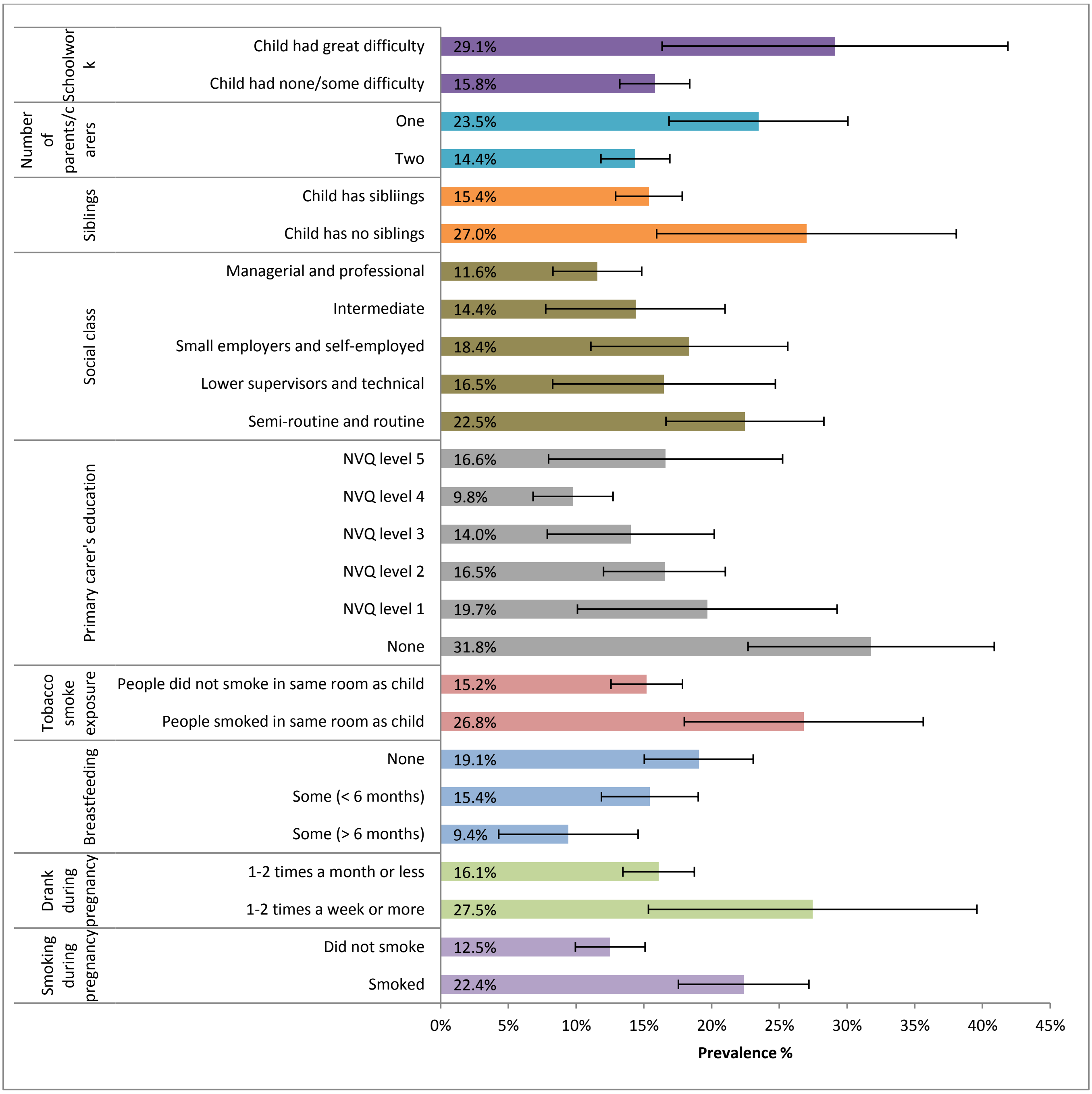
[23] Treatment includes a patch, glasses, or waiting for appointment/referral.

Some of these factors are highly correlated and some of these effects are probably mediated through other characteristics. The unadjusted population prevalence per cents and 95% confidence intervals for these characteristics are shown in Figure 11.

Figure 11: Estimated unadjusted population prevalence (%) of carer-reported sight problems ever that required treatment among seven-year-olds by child, carer, family and neighbourhood characteristics that were significantly related to prevalence[24]. Source: MCS4, 2008 & NI Census, 2011



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[24] Confidence intervals for categories of some child, carer, family and neighbourhood characteristics overlap. However, the confidence intervals for the difference between categories do not overlap. Therefore there is a significant association between all characteristics in the figure with the condition in question. See Table 2 for the weighted numbers of children in each group.

Individual characteristics like those shown in Figure 11 are frequently related to one another, and may operate in combination to influence prevalence. To account for this, the NI statistical model was used to identify those characteristics that had a significant relationship with sight problems when the characteristics were analysed together. “Primary carer’s education” and “maternal smoking during pregnancy” were the only characteristics that had significant independent effects not explained by other characteristics (See Table 9).

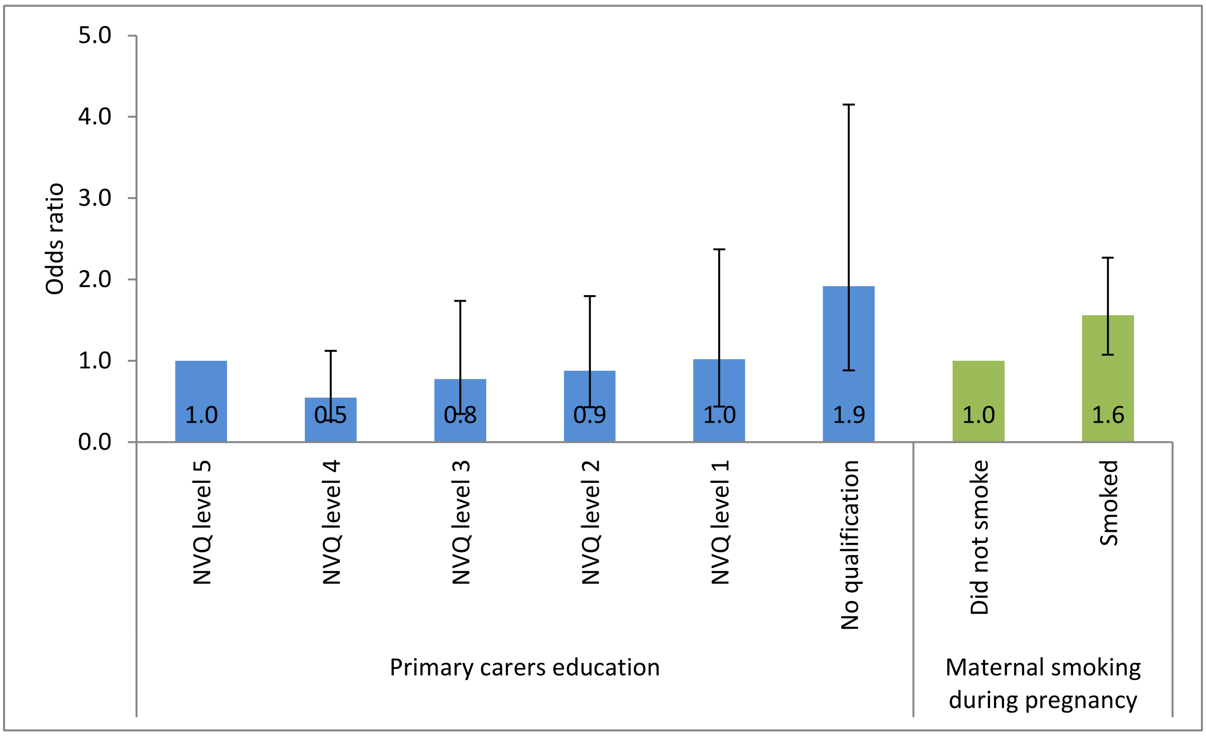
Table 9: Characteristics that had significant independent effects in the NI statistical model for carer-reported sight problems ever that required treatment. Source: MCS4, 2008 & NI Census, 2011.

Characteristics with significant independent effects after adjusting for the other characteristics	Effect on the prevalence of carer-reported sight problems ever that required treatment
Primary carer’s education	There was evidence for an association between primary carer’s education level and sight problems, but the relationship is not linear: • sight problems were significantly less likely among children whose primary carer had attained NVQ Levels 3 or 4 (relative to NVQ Levels 1 and 5) • sight problems were significantly more likely among children whose primary carer had not attained a qualification. After adjusting for other characteristics, the figure shows that children whose primary carer had not attained an educational qualification were about 1.9 times more likely to have sight problems than those whose primary carer had attained NVQ Level 5 (see Figure 12).
Maternal smoking during pregnancy	Sight problems were significantly more likely among children whose mother smoked during pregnancy. After taking other characteristics into account, children whose mother smoked during pregnancy were 1.6 times more likely to have a sight problem that required treatment (see Figure 12).

The *Avon Longitudinal Study of Parents and Children* (ALSPAC) study has shown that seven-year-olds from lower social classes were more likely to have some common visual problems (Williams et al., 2008), which is consistent with our finding that sight problems were most likely among children whose primary carer had not attained an educational qualification.

Figure 12 shows the odds ratios and their 95% confidence intervals for these characteristics.

Figure 12: Adjusted OR carer-reported sight problems ever that required treatment among seven-year-olds by primary carer's education and maternal smoking during pregnancy. Source: MCS4, 2008 & NI Census, 2011



3.4.4 National prevalence among different sub-groups of children

The NI model also provides prevalence estimates among different sub-groups of children. Table 10 shows the prevalence of carer-reported sight problems ever that required treatment for each of these groups. Although the overall prevalence was 16.8%, there was an unequal burden as prevalence ranged from 4.9% to 32.7% across groups of children. The table shows that prevalence tended to be highest among children whose mothers smoked during pregnancy and who had lower levels of educational qualifications. However, since the relationship between prevalence and carer educational attainment is not linear, there is not a clear pattern in the results in Table 10. It is also difficult to assign numbers of risk factors to the results of the model.

Table 10: Estimated prevalence (%) of carer-reported sight problems ever that required treatment among seven-year-olds by primary carers education and maternal smoking during pregnancy. Source: MCS4, 2008 & NI Census, 2011

Primary carer's education	Maternal smoking during pregnancy	% of children in this group	Prevalence %	95% confidence interval of prevalence
NVQ level 5	Did not smoke	6.4%	16.7%	(8.7%, 30.0%)
	Smoked	1.9%	16.4%	(6.1%, 37.1%)
NVQ level 4	Did not smoke	24.7%	9.7%	(6.8%, 13.7%)
	Smoked	6.8%	10.0%	(5.4%, 17.8%)
NVQ level 3	Did not smoke	10.9%	12.8%	(7.9%, 20.3%)
	Smoked	4.8%	16.3%	(6.8%, 34.3%)
NVQ level 2	Did not smoke	13.4%	14.2%	(9.3%, 20.9%)
	Smoked	12.7%	19.0%	(13.0%, 26.9%)
NVQ level 1	Did not smoke	2.4%	4.9%	(1.4%, 16.0%)
	Smoked	4.3%	27.8%	(16.2%, 43.2%)
No qualifications	Did not smoke	4.0%	30.8%	(17.3%, 48.6%)
	Smoked	7.7%	32.7%	(22.7%, 44.7%)

3.5 Hearing problem that required treatment

3.5.1 NI prevalence

It is estimated that just under 1,800 (8.3%; 95% CI = (6.3%, 10.3%)) seven-year-olds in Northern Ireland in 2011 *ever* had a carer-reported hearing problem that required treatment (that is, a carer responding *yes* to: Has [child] ever had any problem(s) with his/her hearing or his/her ears and *yes* to: Has [child] had, or is [child] due to have, any treatment for this problem?)[25].

3.5.2 Comparison of prevalence with other studies

Using data from Sweep 3 of MCS, Sullivan et al. (2010) estimated that 9.7% of children age 5 years in NI (and 12.9% across the UK) ever had a hearing problem that required treatment. This is just marginally higher than our estimate for Sweep 4.

NI Census 2011 reported a prevalence of 0.7% for “deafness or partial hearing loss” among 5-7 year-olds (Census Office for Northern Ireland, 2011a). Republic of Ireland Census 2011 reported a prevalence of 0.4% for “deafness or a serious hearing impairment” among seven-year-olds (Central Statistics Office, 2011).[26]

Growing up in Australia found that 2.8% of non-indigenous children aged 6-7 years had hearing problems and 5% of this cohort had an ear infection (current at the time of the study) (Yiengprugsawan, Hogan & Strazdins, 2013). These estimates are not comparable to findings derived from MCS, since they refer to period rather than lifetime prevalence.

3.5.3 Characteristics related to national prevalence

When the child, carer, family and neighbourhood characteristics detailed in Table 2 were analysed individually the unadjusted population prevalence of carer-reported hearing problems ever that required treatment varied significantly with:

- Bullied at school (p=0.0408): prevalence was higher among children who were bullied Several/Many times[27]
- Number of parents/carers in the family (p=0.0358): prevalence was higher among children in families with one parent/carer
- Siblings (p=0.0307): prevalence was higher amongst children with no siblings.[28]

The unadjusted population prevalence per cents and 95% confidence intervals for these characteristics are shown in Figure 13.

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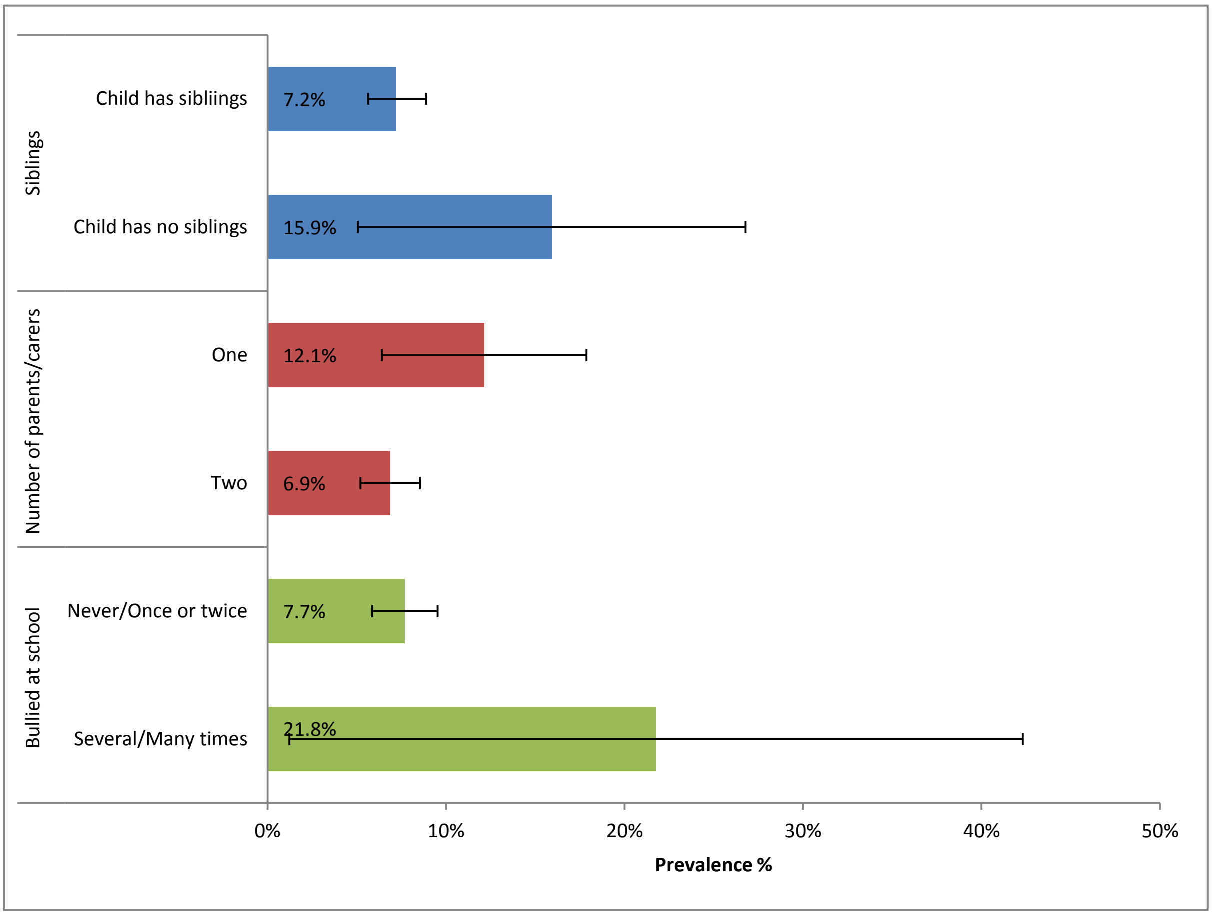
[25] Treatment includes hearing aid(s), grommets, an operation, antibiotics, some other treatment, or waiting for appointment/referral.

[26] Note that the censuses reported more serious hearing problems including deafness which may account for the large difference in prevalence.

[27] Interpret results with caution: due to small sample size, only 7 children in the sample who had a hearing problem were bullied several/many times.

[28] Interpret results with caution: due to small sample size, only 9 children in the sample who had a hearing problem had no siblings.

Figure 13: Estimated unadjusted population prevalence (%) of carer-reported hearing problems ever that required treatment among seven-year-olds by child, carer, family and neighbourhood characteristics that were significantly related to prevalence[29]. Source: MCS4, 2008 & NI Census, 2011



These individual characteristics are often interrelated and can combine in complex ways to influence prevalence. Therefore the NI statistical model was used to identify those characteristics that had a significant relationship with hearing problems when the characteristics were analysed together. “Bullied at school” was the only characteristic that had borderline significant (p=0.0556) independent effects not explained by other characteristics[30] (See Table 11). The data, however, do not indicate why a child was bullied or the severity of its impact.

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[29] Confidence intervals for categories of some child, carer, family and neighbourhood characteristics overlap. However, the confidence intervals for the difference between categories do not overlap. Therefore there is a significant association between all characteristics in the figure with the condition in question. See Table 2 for the weighted numbers of children in each group.

[30] Interpret results with caution: due to small sample size, only 7 children who had a hearing problem were bullied several/many times.

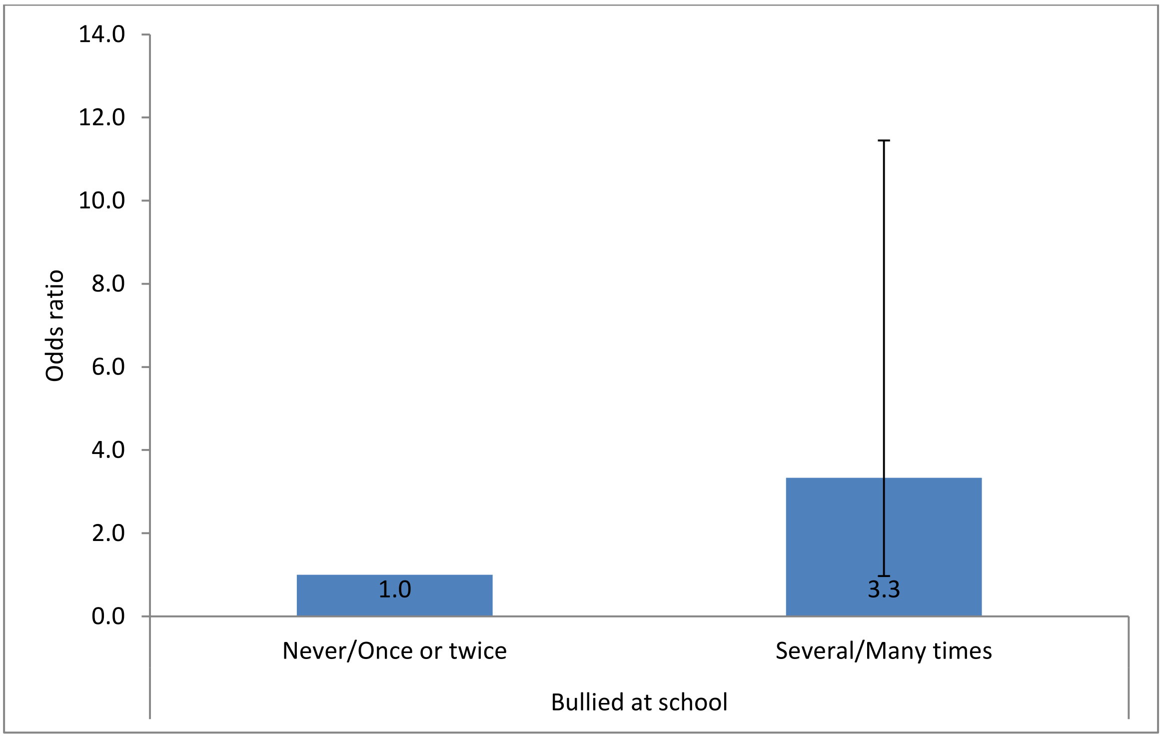
Table 11: Characteristics that had significant independent effects in the NI statistical model for ever had a hearing problem that required treatment. Source: MCS4, 2008 & NI Census, 2011.

Characteristics with significant independent effects after adjusting for the other characteristics	Effect on the prevalence of carer-reported hearing problems ever that required treatment
Bullied at school	There was marginal evidence that ever having a hearing problem that required treatment was significantly more likely amongst children who were bullied at school several/many times. After taking other characteristics into account, children who were bullied at school were 3.3 times more likely to ever have had hearing problems requiring treatment (see Figure 14). There was no evidence that the effect of being bullied at school was modified by the other characteristics.

Consistent with this study's findings, there is evidence from other studies suggests that children with chronic conditions including hearing problems were more likely to be bullied (Nordhagen et al., 2005, Brunnberg et al., 2008, McLaughlin et al., 2010).

Figure 14 shows the odds ratios and their 95% confidence intervals for hearing problems and bullying.

Figure 14: Adjusted OR for carer-reported hearing problems ever that required treatment among seven-year-olds by bullied at school. Source: MCS4, 2008 & NI Census, 2011



3.6 Multiple conditions and multiple risk factors

The aim of this report was to analyse the prevalence of any longstanding illness, disability or infirmity, asthma, eczema, sight problems and hearing problems among seven-year-old children in Northern Ireland in 2011. In doing so, this study does not attempt to measure the total burden of disease among children and their families in NI, since there are many conditions that have not been included in the analysis, due either to insufficient numbers of children with a condition, or to other conditions that may have been present but were not asked about in the MCS carers' questionnaire. Preceding sections examined these conditions one at a time but it is also the case that children can have multiple conditions.

When these conditions were considered jointly, the findings indicate that 46.8% of children had none of these conditions, 27.8% had one, 15.7% had two, and 9.7% had three or more. These estimates appear to be quite high and it should be noted that some of the conditions refer to lifetime prevalence among these children (along with symptoms, in the case of asthma).

The results also show that within each condition examined separately the burden of the condition increases as the number of risk factors (that were identified through multivariate regression analyses) increase. For example, in the case of a longstanding illness, disability or infirmity, the prevalence among children with neither of the two risk factors identified in the model was less than one-quarter (14.2%) of the prevalence among children with both risk factors (65.9%).

The issue of multi-morbidity, including associations with various risk factors and their effects on the burden of disease, will be examined in future IPH research.

4. Subnational findings

Estimates of the prevalence of the five carer-reported health conditions were prepared for the 11 new Local Government Districts (LGD2014) based on subnational statistical models of the prevalence of having the conditions. The subnational models divided the children into groups defined by their child, carer, family and neighbourhood characteristics and provided an estimate of the per cent of children having each condition in each of these groups (See Appendix 3).

For two of the five conditions, no subnational-level data was available for some of the characteristics in the NI model (ie allergy intervention for longstanding illness, disability or infirmity; and bullying for hearing problems requiring treatment). These characteristics had to be removed before forming a subnational model that could be used to estimate prevalence for each LGD2014 (see Method, Section 2.3.3). Note that no subnational model was possible for "hearing problems requiring treatment" since subnational data was not available for "bullying". Table 12 shows the characteristics in the NI model and the characteristics in the subnational model for each condition.

Table 12: Characteristics in the NI model and subnational model for each condition.

Condition	NI model	Subnational model
Longstanding illness, disability or infirmity	Primary carer with longstanding illness	Primary carer with longstanding illness
	Allergy intervention	Allergy intervention*
Asthma/asthma symptoms	Child's sex	Child's sex
	Primary carer with longstanding illness	Primary carer with longstanding illness
	Smoking during pregnancy	Smoking during pregnancy
Eczema	Primary carer with longstanding illness	Primary carer with longstanding illness
	Breastfeeding	Breastfeeding
Sight problem that required treatment	Primary carers education	Primary carers education
	Smoking during pregnancy	Smoking during pregnancy
Hearing problem that required treatment	Bullied	Bullied*
*These characteristics were removed from the subnational model since the data was not available at subnational level.		

Because subnational prevalence estimates are synthetic estimates variation in prevalence per cent across LGD2014s is due to variation in these characteristics. For example, Belfast had a high prevalence estimate for many of the conditions because the area has high prevalence among seven-year-olds of many of the characteristics related to the conditions (such as primary carers with a longstanding condition, female parents with low education levels, and smoking during pregnancy).

Figure 15a-d shows the estimated number of seven-year-olds with each condition in the LGD2014s. Because of substantial differences in population sizes, there was significant variation in the number of seven-year-olds who had these conditions. Although there was some subnational variation in prevalence per cents, comparisons of the 95% confidence intervals revealed no significant variation in the prevalence per cents across LGD2014 areas.

Figure 15 : Estimated prevalence (n) of carer-reported health conditions among seven-year-olds by LGD2014. Source: MCS4, 2008 & NI Census, 2011

Figure 15a: Longstanding illness, disability or infirmity

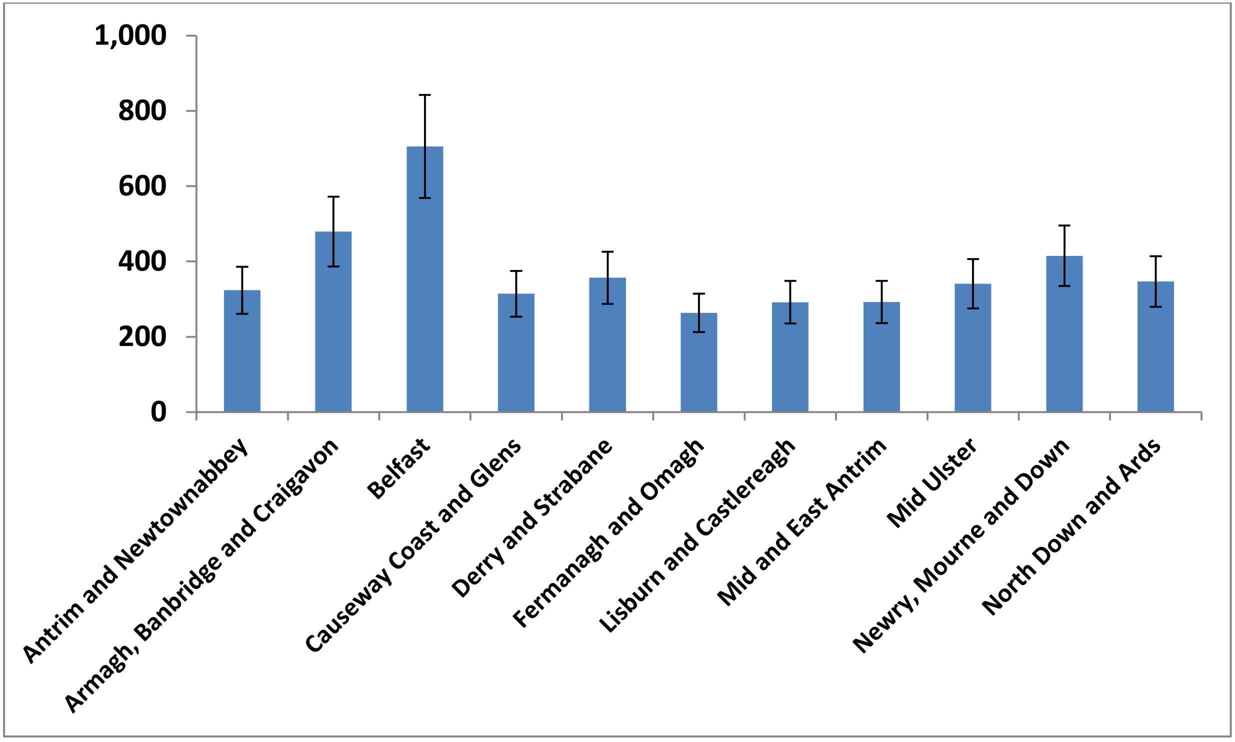


Figure 15b: Asthma or asthma symptoms

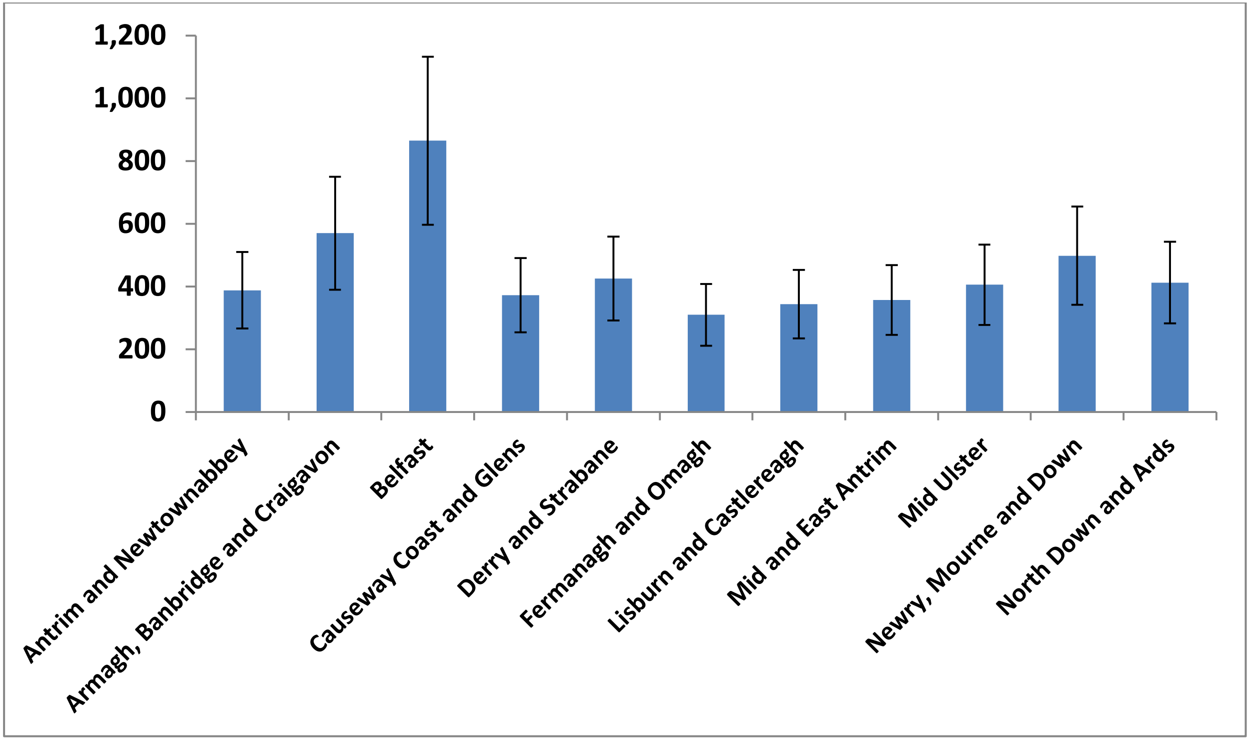


Figure 15c: Eczema

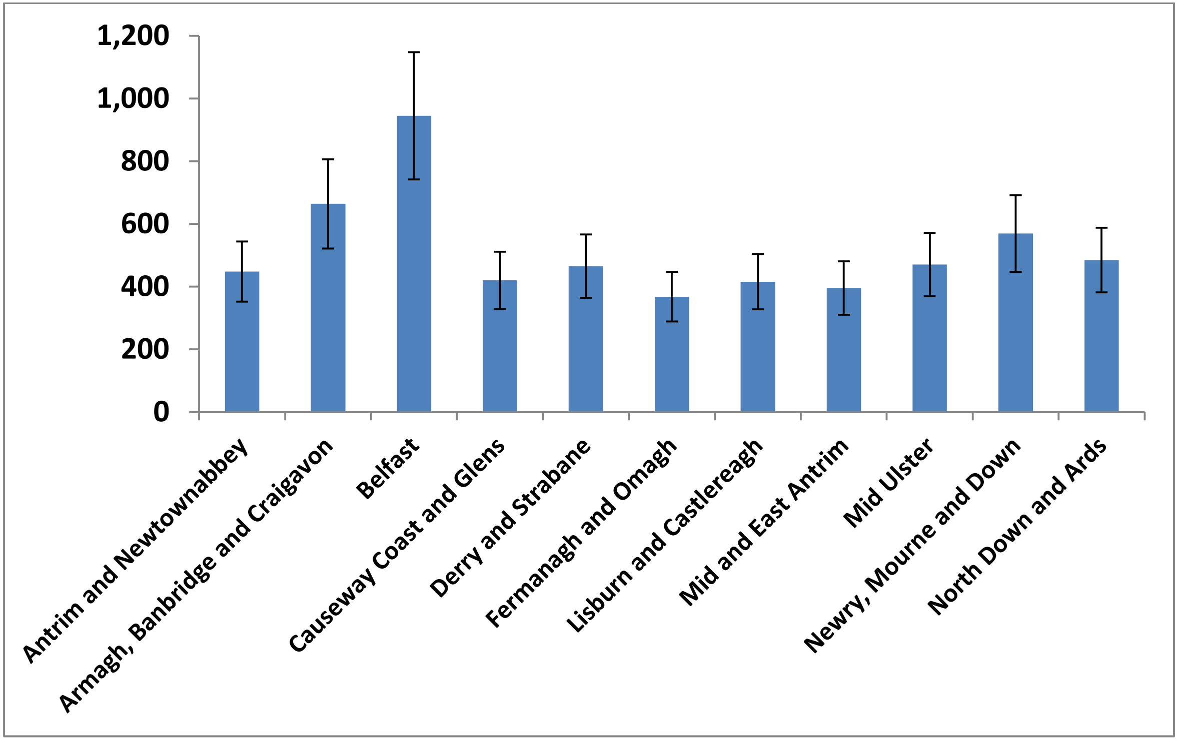
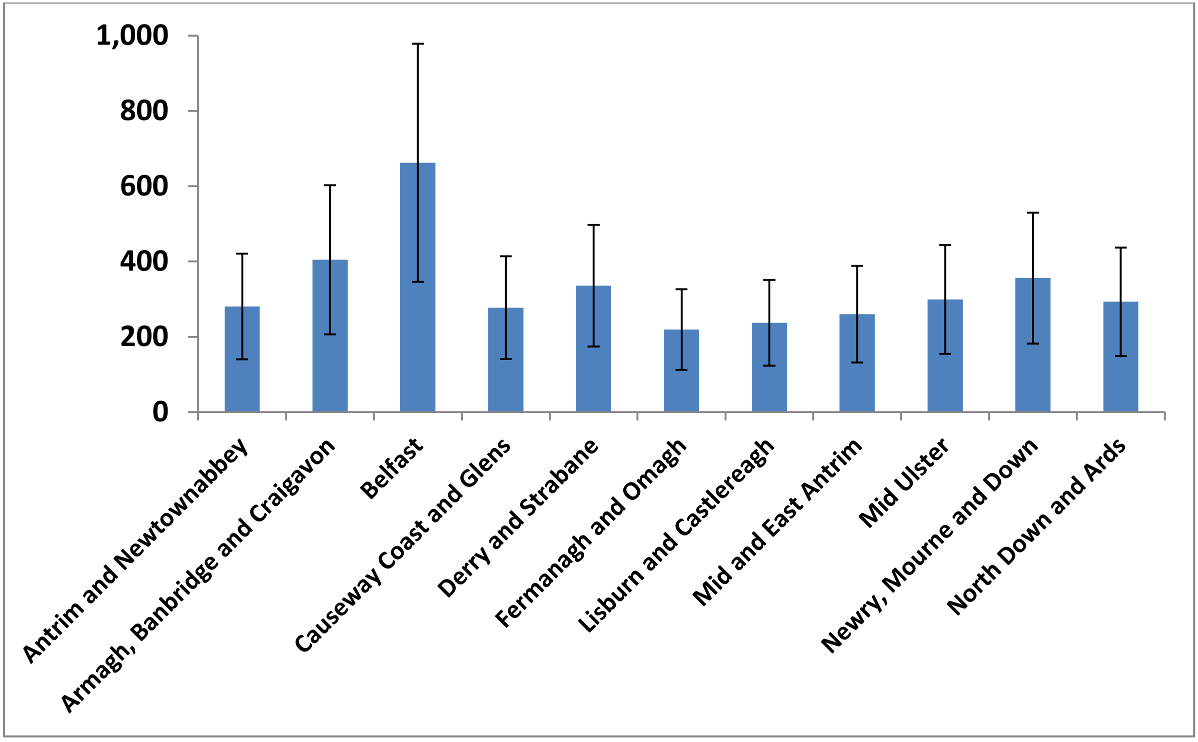


Figure 15d: Sight problem that required treatment



5. Discussion

This report provides population prevalence estimates at national and subnational level of carer-reported health conditions among seven-year-old children in Northern Ireland in 2011. It describes how national prevalence varies with child, carer, family and neighbourhood characteristics, identifies groups of children and their families who were experiencing a greater burden of these conditions, and provides an initial examination of the prevalence of multiple conditions. Since MCS did not ask about all possible health conditions among children this study cannot provide estimates of the full burden of disease on children and their families.

5.1 Summary of findings

5.1.1 NI prevalence

The health conditions examined in this study (any longstanding illness, disability or infirmity; lifetime asthma or asthma symptoms in the past 12 months; lifetime eczema; lifetime sight; and lifetime hearing problems requiring treatment) are common among seven-year-old children in Northern Ireland. It is estimated that 27.8% of children had one condition, 15.7% had two, and 9.7% had three or more, of the conditions examined.

Approximately one in five seven-year-olds (19.1%) had ever had *any* longstanding illness, disability or infirmity in Northern Ireland in 2011.

The lifetime prevalence of asthma/asthma symptoms amongst seven-year-olds in Northern Ireland was estimated at 22.9% (this is a combination of *ever* having asthma and asthma symptoms in the past 12 months). Asthma is one of the most common health conditions in children (Wirl and Puklová, 2007, Lai et al., 2009). ISAAC Phase Three (1999-2004) found that the United Kingdom had one of the highest prevalence of asthma symptoms amongst 6-7 year-olds across 20 European Study centres (Dalbokova et al., 2007).

Lifetime prevalence was also reported for eczema, sight and hearing. Of these three conditions, eczema was most common at 26.1%. Broadly similar prevalence estimates have been reported in other studies as previously outlined (though precise definitions of eczema differ).

Sensory problems were also relatively common among seven-year-olds: 16.8% ever had a sight problem that required treatment and 8.3% ever had a hearing problem that required treatment. It is difficult to interpret how serious these sensory problems are, as the MCS4 questions are based on broad definitions and did not ask about severity, functional capability or limitation associated with sensory impairment.

5.1.2 Comparisons with other studies

Estimates of the population prevalence of various health conditions among children vary widely depending on how the conditions are defined and measured and the age group involved (van der Lee et al., 2007). Many studies of health status among children use different definitions and report prevalence for broader age groups than seven-year-olds, so comparisons must be made with caution. Standardised definitions and methods of measurement of these conditions across surveys would make more meaningful comparisons. Survey-based comparisons between children in NI (using MCS4) and RoI (using GUI) published recently (Institute of Public Health in Ireland, 2014) are not possible due to different age-groups (7 years old in NI and 3 years old in RoI) due to differences in the age cohort, content and sequencing of questions, and weighting and non-response adjustment procedures.

5.1.3 Characteristics that are significantly related to prevalence

A number of the child, carer, family and neighbourhood characteristics considered in this study (see Table 2 in Section 2.2) were significantly related to the prevalence of carer-reported longstanding conditions when the characteristics were analysed individually (see Figures 2, 5, 8, 11, and 13). Significantly higher prevalence was generally found among children whose primary carer had a health condition, children were admitted to hospital or restricted their diet due to allergy and children who had some breastfeeding for more than six months.

Primary carer's health status is linked to a number of these conditions and hence may be regarded as a consistent and significant risk factor, though the measure of primary carer's health status used in the present study does not include information about the precise nature of illness where present.

Since these characteristics are often interrelated and may combine in complex ways to influence prevalence, for each condition, a statistical model was used to identify those characteristics that had, at the national level, significant independent effects that were not explained by other characteristics[31].

Table 13 summarises the characteristics that had significant independent effects that were not explained by other characteristics and places them in context with previous research.

Some of the findings merit specific comment. Firstly, with respect to breastfeeding and eczema, it is perhaps unexpected that breastfeeding for more than six months is associated with a higher risk of eczema in this study. However, the MCS measure of breastfeeding does not distinguish between mothers who breastfed exclusively and mothers who did not. After 6 months, exclusive breastfeeding is not recommended as infants should be moving on to a varied diet of both milk (breast or otherwise) and solids (eg Department of Health, Social Services and Public Safety, 2013).

In a recent analysis of International Study of Asthma and Allergies in Childhood (ISAAC) data, Flohr et al. (2011) found no evidence for a protective effect for breastfeeding on eczema whether breastfeeding was exclusive or not. They commented that more research in this area is needed; for example, including information on time of onset of eczema and the content of the mothers' diets (see Table 13). It may be worth noting that in 2010, Northern Ireland had the lowest prevalence of exclusive breastfeeding at birth (52%) compared to England (71%), Scotland (63%) and Wales (57%) (Department of Health, Social Services and Public Safety, 2013).

Secondly, the link between maternal smoking during pregnancy and asthma found in this study is confirmed by previous research (see Table 13). From the MCS1 data (2001-02), it is estimated that 43% of mothers smoked just before or during pregnancy (including those who gave up during

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[31] It is important to note that the NI models were developed to give the most parsimonious explanation of the variation in the carer-reported prevalence of a condition. The models do not assess the complex causal relationships between characteristics and conditions (see Katz, 2006).

pregnancy and those who smoked for the duration of the pregnancy). These rates are broadly similar to those associated with the Infant Feeding Survey (IFS), conducted in 2000, where 37% of women reported smoking either before or during pregnancy (with 14% giving up and 23% smoking throughout the pregnancy; Hamlyn et al., 2002). More recent trends indicate a reduction in smoking during pregnancy, but a sharp socioeconomic gradient in smoking during pregnancy in NI remains (McAvoy et al., 2013).

Thirdly, the findings did not show any significant associations between children's exposure to smoke in the home and any of the conditions examined in the present study. This is not consistent with other research (eg Purdy et al., 2014; Royal College of Physicians, 2010), and could suggest that the sample size for MCS4 in NI was too small to detect significant effects.

5.1.5 Inequalities

Child, carer, family and neighbourhood characteristics can identify groups of children and their families who are suffering a disproportionate burden of these conditions. For example, although the overall prevalence of a longstanding illness, disability or infirmity was 19.1%, prevalence ranged from 14.2% (among children who did not have an allergy and whose primary carer did not have a longstanding health condition) to 56.5% (among children whose carers had intervened with respect to their child's allergy and whose primary carer had a longstanding health condition) (see Table 4).

Asthma/asthma symptoms also showed quite striking inequality between groups of children. The overall prevalence of asthma/asthma symptoms was 22.9% but prevalence ranged from 12.8% (among girls whose primary carer did not have a longstanding health condition nor who smoked during pregnancy) to 43.8% (among boys whose primary carer had a longstanding health condition and who smoked during pregnancy) (see Table 6).

Table 13: Summary of characteristics that had significant independent effects on the prevalence of carer-reported health conditions that were not explained by other characteristics. Source: MCS4, 2008 & NI Census, 2011.

Type of characteristic	Significant independent effects that were not explained by other characteristics	Comments
Child's biological characteristics	Boys whose primary carer had a longstanding health condition were more likely to have asthma.	Boys have been found to have poorer health than girls in early childhood (Verbrugge, 1982, Sweeting, 1995, Case and Paxson, 2005) and this may be driven by biological or behavioural factors.
Child health status	Children who were admitted to hospital for an allergy (except wheezing, asthma, or eczema) OR a primary carer controlled child's food/drink consumption due to allergic reactions/food sensitivity were more likely to have a longstanding illness, disability or infirmity.	The association between longstanding conditions and allergy intervention should be interpreted with respect to co-morbidities amongst various allergic conditions and symptoms (e.g. Duggan et al., 2012).
Child educational context	Children who were bullied at school were more likely to have a hearing problem that required treatment.	A Swedish study found that young adolescents who were hard of hearing were more likely to be bullied compared to adolescents with no disabilities (Brunnberg et al., 2008). A Nordic study of children aged 2-17 years showed that children with chronic conditions had higher risks for being bullied (Nordhagen et al., 2005). Experience of teasing/bullying was more likely among 11 year olds who had a disability such as a sight, hearing or speech problem, and performed poorly at school (Sweeting and West, 2001).

Type of characteristic	Significant independent effects that were not explained by other characteristics	Comments
Mother / Primary carer: Health status	Primary carer's health status had a consistently strong effect. Children whose primary carer had a longstanding health condition were more likely to have: • A longstanding illness, disability or infirmity. In particular boys whose primary carer had a longstanding health condition were more likely to have asthma compared with girls. • Asthma/asthma symptoms • Eczema	This may be due to the hereditary nature of some conditions, or the shared environmental, behavioural and social factors within families. More information on the specific health conditions in carers and how these are related to children's health is indicated by these findings.
Mother's health behaviours	Children whose mother smoked during pregnancy were more likely to have: • Asthma/asthma symptoms • A sight problem requiring treatment	This may be because smoking during pregnancy can affect in utero development. Agabiti et al. (1999) found that maternal smoking during pregnancy was associated with current asthma and current wheezing in children aged 6-7 years old. A population based study of Finnish children observed that maternal smoking in pregnancy increases the risk of asthma during the first 7 years of life (Jaakkola and Gissler, 2004). Data from the ALSPAC study on seven-year-old children found that children from the lowest occupational social class were almost twice as likely to have some common visual problems (hypermetropic) than children from the highest social class (Williams et al., 2008). In a review of studies on the topic, the Royal College of Physicians (2010, Table 4.2) has found that maternal smoking during pregnancy is associated with an increased risk of asthma among children, with odds ratios ranging from about 1.2 to 1.9.

Type of characteristic	Significant independent effects that were not explained by other characteristics	Comments
	Children who were breastfed were more likely to have eczema.	There is inconclusive evidence on whether or not breastfeeding can have a protective or causative effect for eczema in children (Lien and Goldman, 2011). Results from the KOALA birth cohort study found that infants who were breastfed from birth on had a slight but non-significant increase risk for eczema in the first 3 months of life, compared with infants who were formula fed from birth onwards (Snijders et al., 2007). Kay et al. (1994) found that breastfeeding did not protect against the development of atopic eczema. In a pooled analysis of about 51,000 children aged 8 to 12 years in 21 countries, using data collected from the International Study of Asthma and Allergies in Childhood (ISAAC) Phase Two, Flohr et al. (2011) did not find evidence of a protective effect of breastfeeding for eczema. They found a small increase in the risk of reported 'eczema ever' in association with 'breastfeeding ever' (pooled adjusted odds ratio = 1.11) and breastfeeding for less than 6 months (pooled adjusted odds ratio = 1.10), with no significant association between eczema and breastfeeding for more than 6 months. This pattern of results held whether or not breastfeeding was exclusive of other nutrition. The authors of this study have called for more in-depth research that includes information on time of onset of eczema and the content of the mothers' diets.

5.1.6 Subnational prevalence

Estimates of the prevalence of each of the carer-reported health conditions were prepared for the 11 LGD2014s based on a subnational statistical model for each condition. Although there was some subnational variation in prevalence per cents, comparisons of the 95% confidence intervals revealed no significant variation in the prevalence per cent estimates of the areas but significant variation in prevalence numbers. We did observe significant variation in the numbers of children across LGD2014 which is due to a combination of different population sizes and differences across LGD2014s in the numbers of children or their carers/families with various risk factors.

A lack of significant subnational variation in prevalence percentages may be due to important characteristics that could not be included in the subnational model because there were no subnational data, important characteristics that MCS4 did not measure, or small sample sizes in some of the groups defined by the models.

There may be a number of reasons why we found no statistically significant subnational variation in prevalence across LGD2014s:

- For two of the five conditions there were no subnational data on a characteristic that was related to prevalence in the NI model. Removing these characteristics (see Table 12) meant that the variation that was due to the removed characteristics in the NI model was now included in the subnational estimates as random variation. This was likely to make the estimates more similar and their confidence intervals wider.
- Furthermore, there may be other characteristics that influence the prevalence of these conditions that we did not consider or that were not measured in MCS4. Similar to the previous point, this would be likely to make the subnational estimates more similar and their confidence intervals wider.
- Small sample sizes in some of the groups defined by the models (see Method, Section 2.3.3) would make the NI and subnational confidence intervals wider.

These issues point to the need for better subnational data on the prevalence of health conditions and their risk factors among children in Northern Ireland.

5.2 Limitations

There are a number of methodological limitations with this analysis.

5.2.1 Representativeness of MCS4

There are some sources of bias relating to the representativeness of MCS4 including non-response, population prevalence estimation compared with causal analyses, and projecting the 2008 seven-year-old population to 2011.

Non-response:

Not all the families initially selected to participate in the MCS agreed to do so. In Sweep 1, 2,000 families in NI were targeted and 1,923 families were interviewed when the child was 9 months old.

Children with sample birth dates[32] were eligible for the survey if they were living in one of 63 electoral wards across NI when they were 9 months old. Cohort children were found using Child Benefit records. Sweep 1 of the main stage fieldwork for MCS4 commenced in NI in April 2001. There were 1,372 productive families at Sweep 4 (2008) with an initial response rate of 66%, the lowest across all four UK countries (UK average = 72%). Subsequent sweeps recorded response rates of 71-80% of the initial Sweep 1 respondents (Table 14).

Table 14: Number of respondents and response rates in NI for MCS Sweeps 1-4

Sweep	Productive families (respondents)	Response rate (%)
MCS1	1,923	66.0
MCS2	1,465	76.2
MCS3	1,534	79.8
MCS4	1,372	71.3

Note. Response rates at Sweeps 2, 3 and 4 are expressed as a percentage of respondents at Sweep 1 (N = 1,923).

Population prevalence estimation vs causal analyses

MCS4 was not designed to represent all seven-years-olds living in Northern Ireland, as it does not include seven-year-olds who moved to Northern Ireland after Sweep 1. The “healthy immigrant effect” suggests that these children may have better health than the general population of seven-year-olds. However, Nolan (2012) found limited evidence of this effect among adults in Ireland.

Projecting from 2008 to 2011

In our analysis we aimed to make MCS4 representative of all seven-years-olds living in Northern Ireland in 2011 by creating an additional weight adjustment (see Section 2.3.5).

5.2.2 Changes in the population of Northern Ireland, 2001-2011 – potential impact on prevalence estimates

One issue in the interpretation of the prevalence estimates in this report is the extent to which the profiles or characteristics of 7-year-olds in 2011 are similar to those of the 7-year-olds in the 2008 MCS4 sample which was originally drawn from 9-month-olds in 2001. If changes are associated systematically with characteristics of the population that are in turn related to prevalence estimates, then the analyses risk being biased.

Table 15 suggests that there has been considerable fluctuation in the population of children in NI during the period 2002-2011. While there has been an overall decrease in the number of under-18s in NI during the period, this is not evenly distributed across age groups. There has been an increase in the percentage of 0 to 4 year olds in the population (by about 12%) and a decrease in the percentages of children and young adults aged 5 to 18 years.

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[32] Children born between 23 November 2000 and 11 January 2002.

Table 15: Changes in population by age, Northern Ireland, 2002-2011

Age group	2002	2011	Change 2002-11	% change
0-4	112,088	126,094	14,006	12.5
5-12	199,160	181,016	-18,144	-9.1
13-15	80,408	73,696	-6,712	-8.3
16-18	80,679	75,448	-5,231	-6.5
Total age 0-18	472,335	456,254	-16,081	-3.4

Source: (CSO/NISRA, 2014, Figure 10)

These quite large fluctuations in patterns of migration and emigration present a potential bias in the estimates associated with the MCS sample. However, as the Northern Ireland Strategic Migration Partnership (NISMP) notes[33]: "It is difficult to accurately measure the migrant population in Northern Ireland since EEA nationals are allowed freedom of movement into and across the UK."

5.2.3 Limitations associated with the MCS data and carer reports

The prevalence estimates (and background characteristics) provided in this report are based on responses from the child's primary carer rather than physical measurements of the child's health. Carer reports have been found to be a reasonably valid method for measuring the health status and health care events of young children (Pless and Pless, 1995, Cooper, 2005, D'Souza-Vazirani et al., 2005, Varni et al., 2007a, Vissing et al., 2012). However, it may also be the case that the measurement of some of the background characteristics may be less reliable than others. For example, the prevalence of hearing problems was associated with carers' reports of their child being bullied at school, and the meaning of bullying may be open to interpretation.

Another limitation of the MCS data is the way questions are worded and how this can impact on the interpretation and use of the generated prevalence estimates. For example the estimates of sight and hearing problems requiring treatment are based on broad definitions and it is hard to distinguish more disabling conditions such as deafness and blindness. The Child (and adult) Disability Living Allowance (DLA) is awarded based on mobility and care needs arising from a disability[34]. Therefore, the prevalence estimates in this report would be more informative in such instances if the original question from MCS was more closely aligned with the categorisations of disabling conditions associated with a child (or adult) DLA claim.

5.2.4 Statistical modelling and sample size

It is important to bear in mind that the sample size in NI for MCS4 is small, amounting to about 1,400 children and their families. This can be put in context by comparing the sample size to that for the infant cohort for the RoI GUI study where close to 10,000 children and their families participated in Wave 2 in 2011 at the age of 3 years. As a consequence of the small sample size, statistical analyses reported here have less power to detect statistically significant differences than if the sample size

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[33] http://www.migrationni.org/demographic-trends

[34] See https://www.gov.uk/dla-disability-living-allowance-benefit/overview

had been larger. Although the models in the present study are technically sound, caution is advised in their interpretation[35].

The NI models which considered each condition in turn with respect to multiple characteristics, consisted of those characteristics that: 1) had the strongest statistical relationships with the conditions and 2) satisfied our statistical modelling criteria. One of our statistical modelling criteria was that the models' group-specific prevalence per cent estimates should be based on adequate numbers of children in the groups in the survey sample[36]. A model with many child, carer, family and neighbourhood characteristics (and therefore many groups defined by combinations of these characteristics) may have very few children in some groups. Due to small MCS4 sample sizes, this study could not include in the NI model all the characteristics which had significant statistical relationships with the conditions.

5.2.5 Subnational data

In addition to the limitations of the survey data, data for some child, carer, family and neighbourhood characteristics in the NI model were not available at a subnational level. LGD2014 data were not available for the characteristics "allergy intervention" and "bullied". This meant that this study could not include these characteristics in subnational models for estimating prevalence of "any longstanding illness, disability or infirmity". In addition, no subnational model could be generated for "hearing problem that required treatment". This introduces bias into subnational prevalence estimates, and variation in these omitted characteristics is included as noise in the estimates. Similar problems arise in estimating adult prevalence (Barron et al., 2014).

5.3 Policy implications

This section considers how the analyses in this report may help to address current policy issues in child health.

This study shows that it is not just the biological or health status characteristics of the child that are important but also broader child, carer and household characteristics. It provides further evidence of the social determinants of health inequalities for example children whose primary carer had lower educational attainment were more likely to have higher prevalence. Although such findings are far from new, it emphasises the need to increase efforts to tackle these inequalities and to give all children a fair chance of health and wellbeing (*Giving Every Child the Best Start* – Theme 1 of *Making Life Better*).

Parents and health professionals should be familiar with the characteristics that place children at higher risk of various health conditions to improve the chances of prevention or early detection and intervention. *Our Children and Young People – Our Pledge* recognises a "Gradual Shift to Preventative and Early Intervention Practice", the aim of which is to improve the quality of life, life

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[35] When characteristics are combined in the models of prevalence, this can result in small cell counts at times; for example in the adjusted model of hearing problems, there were small numbers of children with a hearing problem and reported being bullied.

[36] There should be five or more children in the survey sample in at least 95% of the model's groups (see Method, section 2.3.2).

chances and living for all children and reduce the likelihood of more serious problems developing in the future.

It is important to note that many of the characteristics and risks that influence health conditions can be changed and offer a focus for policy and service interventions to offer "good quality parenting and family support" (*Making Life Better*, Outcome 1), and to ensure "high quality public health and social care services are provided for all children, from ante natal care onwards" (*Making Life Better*, Outcome 2, Action A) such as "support programmes for mothers least likely to breastfeed"; and "additional and tailored support for families with children with a learning or physical disability".

Creating conditions for individuals and families to take greater control over their lives and to enable and support them to lead healthy lives is a key commitment of the Northern Ireland Executive (*Making Life Better*). This study identifies groups of parents and families (such as primary carers with a longstanding condition, parents/carers with lower levels of education) that may have a greater need for support in caring for children with health conditions. An important part of supporting individuals and families is promoting the health and health behaviours of mothers. Primary carer's health status, maternal smoking during pregnancy, and parents/carers education levels were related to higher prevalence of longstanding illness, disability or infirmity among children; addressing these characteristics in the population may reduce the prevalence of such conditions among children. Furthermore, the findings in relation to maternal smoking during pregnancy emphasise that child health promotion starts in the womb. "Smoking during pregnancy" is also one of a number of key indicators from *Making Life Better* to help monitor progress of the framework.

The subnational prevalence estimates highlight LGD2014s where we might expect to see higher prevalence of longstanding conditions based on the characteristics of the area. The estimates can inform local government and community groups and help them to address local health and wellbeing (*Making Life Better*: *Outcome 3 – Children and Young People Skilled for Life; Outcome 4 – Ready for Adult Life*) thus encouraging children to make positive contributions to their local communities and to society generally. Better data sources are needed to provide more detailed and precise subnational estimates for these purposes.

Although this report found that many children have multiple health conditions, this issue requires further examination. Future IPH research is planned that will examine the relationships between multiple conditions and multiple risk factors in order to better understand the patterns of prevalence and to identify those groups of children who are most in need of early, targeted supports.

5.4 Research and information implications

The study contributes to the research and information recommendations identified amongst the aims of a number of key documents. The new *Delivering Social Change for Children and Young People Strategy* which aims to "Ensure that children and young people are central to every policy decision made by Government which could impact on their lives"; a number of the indicators identified in *Our Children and Young People – Our Pledge* under the outcomes "Healthy", and "Living in safety and with stability"; and *Making Life Better* key indicators related to smoking during pregnancy and breastfeeding.

However a number of obstacles and challenges remain in the provision of information. We noted that comparisons of prevalence rates for the various conditions reported here on the basis of the MCS4 survey data with those of other studies are greatly hampered by differences across surveys in the wording and sequencing of questions, and the manner in which researchers operationalise the conditions in data analysis. It is unfortunate that survey-based comparisons of the prevalence of longstanding conditions amongst children cannot be made between NI and RoI.

The relatively small sample size in NI indicates a need for future surveys in this area to increase their sample sizes in order to provide for more robust analyses, particularly where multivariate methods are to be applied.

Data on the prevalence of health conditions among children for LGD2014s support local government and community groups with local data for planning and delivering local initiatives to address local issues and wellbeing (*Making Life Better – Outcome 3 – Children and Young People Skilled for Life*). As noted above, better local data on the characteristics related to prevalence would allow us to produce better local prevalence estimates.

In addition to generating prevalence estimates, the longitudinal nature of the MCS is likely to be a suitable data source to enhance the evidence base by tracking health issues over time and to explore relative contributions of a multitude of factors relating to the child's health and development. This, along with an examination of multiple morbidities and multiple (shared) risk factors, are two areas of study IPH plans to pursue in the future.

5.5 Conclusions

The health conditions that we examined in this study are common among seven-year-old children in Northern Ireland. The burden of these conditions is unequally distributed across the seven-year-old population.

There are a number of characteristics that explain the variation in prevalence of these conditions. The variation in prevalence showed that prevalence increased as children accumulated more of these characteristics. These characteristics can be used to identify groups of children and their families who are experiencing a greater burden of these conditions and who may be in need of greater support.

The majority of the characteristics that influence the prevalence of health conditions can be changed by policies and services that aim to improve health status, health behaviours, socio-economic status and living conditions. They offer a focus for policy and service interventions to improve the lives of children and their families.

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Glossary of terms and abbreviations

CHS

Child Health System.

Confidence interval

Survey questions are usually asked of a portion, or sample group, of the population rather than the full population. Even in the best-designed surveys, there will be random differences between the particular sample group selected and the whole population. Therefore, any statistic taken from the sample group provides an estimate of the true value in the population. A confidence interval is a range of values around an estimate that shows how precise the estimate is. A narrower confidence interval is better because it means that we are confident that the true value in the population falls within a narrower range around the estimate. The estimate and its confidence interval are often written as "12% (95% CI = (10%, 14%))", which means that the estimate from the sample group is 12% and we are 95% confident that the true value in the population is between 10% and 14%.

Effect modification / interaction

Effect modification occurs when the relationship between a characteristic (eg household income) and an outcome (eg asthma) depends on the value of another characteristic (eg sex of the child). In this example, the relationship between household income and asthma is different for boys and girls. This is sometimes called an interaction between household income and sex of child because the characteristic sex modifies the effect of household income on asthma.

IPH

Institute of Public Health in Ireland.

Longstanding illness, disability or infirmity

The Millennium Cohort Study defined longstanding illness, disability or infirmity as anything that has troubled the child over a period of time or that is likely to affect the child over time. We call these "longstanding conditions" in this report.

MCS

The Millennium Cohort Study (MCS) is a longitudinal birth cohort study of around 19,000 children born in the four countries of the UK between 2000 and 2001, and surveyed every two years. The children and their carers have been involved in five 'sweeps' so far: at 9 months, and ages 3, 5, 7, and 11 years.

NINIS

Northern Ireland Neighbourhood Information Service.

NISRA

Northern Ireland Statistics and Research Agency.

Odds ratio (OR)

The odds of an event quantifies how likely it is to happen. The odds is defined as the ratio of the probability of the event happening to the probability of the event not happening. For example, odds of 3:1 for an event means that the event is three times more likely to happen than not happen.

The odds of an event happening in one group can be compared with the odds of the event happening in another group using an odds ratio (ie, the ratio of the odds in the first group to the odds in the second group). For example, an odds ratio can quantify how much more likely a person in one category (eg boys) is to have a particular health condition compared with a person in a reference category (eg girls). The reference category always has an odds ratio of 1.0. Odds ratios that are significantly greater than 1.0 mean that the condition is more likely in that category (male) compared with the reference category (female). Odds ratios that are significantly less than 1.0 mean that the condition is less likely in that category (male) compared with the baseline category (female).

Population prevalence

The population prevalence of a characteristic in a group is the number or per cent of the group who have the characteristic at a specific point in time or during a specific period of time.

Productive families

Families in MCS were treated as 'productive' if they provided the survey with some new information on at least one of five data collection instruments, ie, other than what was carried forward from previous sweeps. The five data collection instruments were: main interview, partner interview, proxy partner interview, cognitive assessments and physical measurements.

Statistical relationship between the prevalence of a condition and characteristics

A statistical relationship between the prevalence of a condition and a characteristic describes how prevalence changes as the characteristic changes. This does not mean that the characteristic causes the condition.

You can describe the relationship between prevalence and one characteristic by analysing characteristics individually. These are sometimes referred to as "unadjusted relationships".

However, individual characteristics are often interrelated and combine in complex ways to influence prevalence. You can describe the relationship between prevalence and a number of characteristics by analysing the characteristics together. A statistical model of prevalence involving several characteristics together estimates the effect of each characteristic on prevalence while taking into account the effects of the other characteristics. The estimate is sometimes called the adjusted or independent effect of a characteristic, in the sense that this effect is not explained by the other characteristics. For example, we developed a statistical model to describe the relationship between the prevalence of a longstanding health condition and two characteristics together (primary carer's health status and child's difficulty with schoolwork) using the MCS data.

Statistical significance

A statistically significant result is one that is unlikely to have occurred by chance alone. For this report, a result is considered statistically significant if the probability of the result occurring by chance alone is less than one in twenty. This is often written as $p<0.05$. If we find a statistically significant result, such as a difference between two groups, we may conclude that there is a true difference between the groups.

Subnational areas

The subnational areas included in this report are the 11 Local Government Districts (LGD2014). These subnational areas are listed in Appendix 2.

Synthetic estimate

Subnational population prevalence estimates for the 11 Local Government Districts (LGD2014) included in this report are synthetic prevalence estimates.

A synthetic estimate for a subnational area combines prevalence at the national level with subnational values of the associated explanatory variables (eg the proportions of primary carers with a longstanding illness). The synthetic estimate generated for each LGD2014 is the expected outcome for that area based on its characteristics as measured by the explanatory variables. Synthetic prevalence estimates can provide a better description of subnational prevalence if there are no prevalence data for subnational areas, or if the national level and subnational distributions of the characteristics related to prevalence are different.

Appendix 1: Child, carer, family and neighbourhood characteristics

The following table shows the child, carer, family and neighbourhood characteristics that were tested for a significant relationship for each condition

Table 16: Child, carer, family and neighbourhood characteristics used in stepwise regression procedures for each condition. Source: MCS4

Child	**Biology**	Sex Birthweight
	Health status	Allergy intervention • Child admitted to hospital for an "allergy (except wheezing, asthma, or eczema)" Or • Primary carer controlled child's food/drink consumption due to "allergic reactions/food sensitivity" Body Mass Index
	Health behaviours	Diet • Primary carer controlled food/drink consumption with a healthy/balanced diet)
	Educational context	Bullied at school Difficulty with schoolwork (ie one or more of reading, writing or maths) Difficulty with physical education
Mother / Primary carer	**Health status**	Primary carer with a long term condition
	Health behaviours	Maternal smoking during pregnancy Maternal alcohol consumption during pregnancy Breastfeeding
Family	**Residents**	Number of parents in the family Other children in the family Family occupational class Income Primary carer's education
	Living conditions	Exposure to tobacco smoke Damp in the home Pets in the home
Neighbourhood		Living environment • One of the seven domains of the NI Multiple Deprivation measure, an indicator of housing quality, access, and outdoor environment Rural / Urban

Appendix 2: Local Government Districts in Northern Ireland as at 1 April 2015

Antrim and Newtownabbey
Belfast
Armagh, Banbridge and Craigavon
Causeway Coast and Glens
Derry and Strabane
Fermanagh and Omagh
Lisburn and Castlereagh
Mid and East Antrim
Mid Ulster
Newry, Mourne and Down
North Down and Ards

Appendix 3: Estimating the number of seven-year-olds with relevant child, carer, family and neighbourhood characteristics at subnational level

Subnational prevalence estimates for 11 LGD2014s are synthetic estimates based on a statistical model of the prevalence of having the condition. The subnational models divided the children into groups defined by their child, carer, family and neighbourhood characteristics and provided an estimate of the per cent of children having each condition in each of these groups. We estimated the number of seven-year-old children in each of these groups in each LGD2014 using data from a number of sources as shown in Table 17.

Table 17: Estimating the number of seven-year-olds with relevant child, carer, family and neighbourhood characteristics in subnational areas

Condition	Characteristics in subnational model	Data used to estimate number of seven-year-olds with these characteristics in LGD2014
Longstanding illness, disability or infirmity	○ Primary carer's health status	Northern Ireland Statistics and Research Agency (NISRA) provided Census 2011 counts of usually resident seven-year-olds in families disaggregated by Primary carer's health status and LGD2014.
Asthma/asthma symptoms	○ Child's sex ○ Primary carer's health status ○ Smoking during pregnancy	NISRA provided Census 2011 counts of usually resident seven-year-olds in families disaggregated by child's sex and female carer with a longstanding condition and LGD2014. Smoking during Pregnancy data disaggregated by LGD2014 for 2011 was obtained from the Child Health System (CHS) via the Northern Ireland Neighbourhood Information service (NINIS) website. We applied this CHS data to the data supplied by NISRA.
Eczema	○ Primary carer's health status ○ Breastfeeding	Northern Ireland Statistics and Research Agency provided Census 2011 counts of usually resident seven-year-olds disaggregated by the two characteristics and LGD2014. Breastfeeding data disaggregated by LGD2014 for 2011 was obtained from the CHS via the NINIS website. Breastfeeding data at national level for 2010 was obtained from the Infant Feeding Survey. CHS data did not report duration of breastfeeding – only breastfeeding rate on discharge. Hence we applied the percentage change in duration of breastfeeding between discharge and 6 months of age from IFS to the proportion of mother's breastfeeding on discharge from CHS in order to obtain breastfeeding duration at LGD2014.
Sight problem that required treatment	○ Highest level of qualification of female parent ○ Smoking during pregnancy	Northern Ireland Statistics and Research Agency provided Census 2011 counts of usually resident seven-year-olds disaggregated by Highest level of qualification of female parent and LGD2014. Smoking during Pregnancy data disaggregated by LGD2014 for 2011 was obtained from CHS via the NINIS website. We applied this CHS data to the data supplied by NISRA.
Hearing problem that required treatment	○ Bullied	Subnational data was not available for bullying hence no subnational prevalence estimates could be generated for "Hearing problem that required treatment".

Appendix 4: Distribution of characteristics common between MCS4 and Census 2011

MCS4 2008			**Census 2011**
	%	**%**	
Sex of child			**Sex of child**
Male	50.0	51.4	Male
Female	50.0	48.6	Female
Main respondent with "any longstanding illness, disability or infirmity". By longstanding I mean anything that has troubled you for a period of time or is likely to affect you for a period of time"			**Female parent with "any of the following conditions which have lasted, or are expected to last, at least 12 months"**
Yes	23.6	22.0	Yes
No	76.4	78.0	No
Number of Parents/carers in family			**Number of Parents/carers in family**
Two parents/carers	78.9	72.3	Two parents/carers
One parent/carer	21.1	27.7	One parent/carer
Other dependent children in family			**Other dependent children in family**
Yes	90.2	85.5	Yes
No	9.8	14.5	No
Main respondent education			**Female parent education**
No qualification	11.8	12.6	No qualification
NVQ level 1	6.6	14.9	NVQ level 1
NVQ level 2	26.0	20.0	NVQ level 2
NVQ level 3	15.8	14.7	NVQ level 3
NVQ level 4+	39.9	32.6	NVQ level 4+

Appendix 5: Weight computation

The distribution of children across the five characteristics that were used to compute the weight to adjust the MCS4 estimates to correspond to the 2011 population (child gender, number of carers, siblings/no siblings), main carer with/without longstanding condition and main carer education level category) is compared with the 2011 census in Table 18. There are 80 possible combinations of the characteristics[37]. In seven of the 80 cells, there are no children in MCS4, (it so happens that there were no children with these particular combinations of characteristics). To address this, the sibling categories were combined for those cells shaded in grey for the purposes of computing adjustments/weights. Further, there are 35 cases in MCS4 which consist of children missing data on parental education and/or main carer with a longstanding condition. In these 35 cases, cells were collapsed further, with weights/adjustments computed on the basis of child sex/number of carers. In a final step to calculating the weights, the computations which were carried out separately for boys and girls were adjusted to correspond to the percentages of male and female children in the population (2011 census).

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[37] In the case of multiple births (in MCS4 there are 1,350 singletons, 21 sets of twins and 1 set of triplets), the second or third of twins or triplets were deleted from MCS4 as part of the analysis; however the Census 2011 tabulation generated by NISRA did not distinguish between twins (or other multiple births). Hence the number of seven-year-olds may be very slightly overrepresented.

Table 18: Numbers of 7-year-old children in each gender, carer, sibling, main carer longstanding condition and main carer education level category: Source: MCS4, 2008 & NI Census, 2011

MCS Data Sweep 4 (2008)									
Main carer long-standing condition		Male				Female			
	Carer	One carer		Two carers		One carer		Two carers	
	Siblings	Yes	No	Yes	No	Yes	No	Yes	No
		N	N	N	N	N	N	N	N
	Main carer education								
Yes	No qualification	15	1	14	0	8	1	15	1
	NVQ level 1	2	0	6	0	2	2	8	1
	NVQ level 2	7	6	32	3	10	1	39	1
	NVQ level 3	8	7	12	0	2	4	19	0
	NVQ level 4+	5	1	45	0	5	2	31	3
No	No qualification	18	3	42	1	18	3	38	1
	NVQ level 1	9	7	28	2	11	1	20	0
	NVQ level 2	26	9	96	4	20	8	81	8
	NVQ level 3	13	4	75	4	12	2	62	2
	NVQ level 4+	13	10	160	12	18	14	151	11
Total					**700**				**636**
NI Census Data (2011)									
Main carer long-standing condition		Male				Female			
	Carer	One carer		Two carers		One carer		Two carers	
	Siblings	Yes	No	Yes	No	Yes	No	Yes	No
		N	N	N	N	N	N	N	N
	Main carer education								
Yes	no qualification	203	71	203	38	184	67	192	33
	NVQ level 1	122	35	241	31	133	47	220	32
	NVQ level 2	147	49	329	30	144	57	280	37
	NVQ level 3	78	30	268	25	86	30	223	28
	NVQ level 4+	69	29	444	41	66	38	440	51
No	no qualification	337	97	474	58	377	84	401	48
	NVQ level 1	319	114	775	84	337	96	745	68
	NVQ level 2	353	140	1,219	106	361	134	1,064	105
	NVQ level 3	212	108	917	84	229	91	856	79
	NVQ level 4+	235	124	2,688	189	170	130	2,508	201
Total					**11118**				**10472**