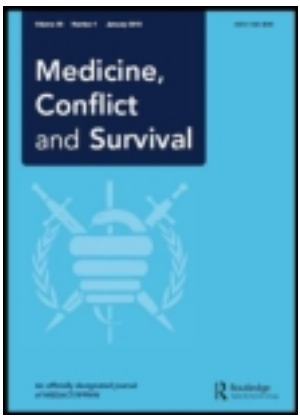

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Environmental characteristics and prevalence of birth defects among children in post-war Iraq: implications for policies on rebuilding the Iraqi education system

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This article explores the relationship between the prevalence of 'birth defects' and environmental characteristics, and considers implications for targeting resources to establish the educational inclusion of children affected. A household survey in four governorates across Iraq in 2010, conducted under the auspices of CARA, achieved interviews with 6032 households and collected data on more than 10,000 children and young people. Analyses suggested an association between reported presence of potential sources of contamination in local environments from human and domestic waste, and to some extent from naturally occurring contaminants and the detritus of warfare, with higher numbers of resident children having 'birth defects'. Children living in Basra were found to be most significantly impacted. This finding adds to a growing literature on associations between potential sources of environmental contaminants and impact on the health of children living in affected localities.

Keywords: birth defect; disability; environment; armed conflict; Iraq

Introduction

This national household survey, of four governorates in Iraq in 2010, aimed to support the development of inclusive education, and policy formation on early child development. A UK/Iraq collaboration, facilitated by the Council for Assisting Refugee Academics (CARA), was commissioned by UNICEF with funding from AusAID. CARA coordinated the study, and it was their contacts and deep understanding of the Iraqi context that made this study possible. CARA identified key individuals who managed logistics, negotiated access to research sites through government ministries, and ensured that final reports were translated and delivered.

CARA recruited two UK academic institutions (the University of Manchester and Institute of Education, University College London) to conduct the

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research based on identified researchers' methodological skills, and interest and expertise in disability and early childhood development. Although none of the UK academics had prior experience of Iraq, several had considerable experience of working cross-culturally.

CARA identified two refugee academics to support delivery of the study. The key academic was supported by CARA to study in the UK after fleeing Iraq due to threats on his life. The second was founder of Child and Adolescent Mental Health Services in Iraq, and supported in exile while continuing to work to improve services for this group. The key Iraqi academic identified the Iraqi Council for Transparency and Anti-corruption (ICTAC) as an organisation with some existing research experience and, following consultations with the UK team, its president agreed to lead the research in Iraq. He recruited Iraqi research team leaders (including members of ICTAC) and supported them in creating field teams. Members had backgrounds in teaching, higher education or associated professions. This enabled exiled academics to contribute to the future of Iraq through academic engagement. In addition, it enabled a number of Iraqi academics in post in Iraq to engage with the international academic community. The initiative provided paid employment in academic research, and investment of funds in skill development in disability research locally, while gathering information to support educational developments across the country.

Background

Iraq has been subject to ongoing national and international armed conflicts for more than two decades. This, coupled with international sanctions, deprived citizens of resources which most take for granted; medicines, food, access to information and so on. However, the most enduring impact of conflict and warfare, arguably, is borne by Iraq's children.

Minister Narmin Othman, former Minister for Environment in Baghdad, outlined challenges to citizens' well-being including 'water, air and soil contamination caused mainly by emissions from cars and generators in crowded areas, unplanned use of chemical fertilisers, war remnants and bombing with depleted uranium' (IRIN 2009). Her ministry had identified discarded military vehicles and tanks contaminated with radioactive materials from the 1991 and 2003 wars, but no action had been taken to dispose of them. This, along with waste from heavy industry and hospitals, and raw sewage discharged into the two main rivers (Tigris and Euphrates) was identified as a major health hazard to wide sections of the population (IRIN 2009). The relationship of depleted uranium (DU) to health deficits, and in particular 'birth defects', has been disputed. However a growing research base continues to explore this issue. Studies of the potential effects DU on health have provided evidence that calls into question claims that there is no association between DU and a range of health problems, including impacts on the unborn child (Hindin et al. 2005).

DU is a man-made, radioactive heavy metal derived from uranium ore as a by-product of uranium enrichment. Hindin et al. (2005) summarised its nature

and effects. It is a dense metal that reacts with most non-metallic elements and has pyrophoric properties, so may spontaneously ignite at room temperature in air, oxygen and water. It has a number of uses, including in X-ray radiation shielding in hospitals, in powerful projectiles such as bullets and missile nose cones, and as protective armour for tanks. When used as a projectile, a DU penetrator ignites on impact due to the high temperatures produced. This characteristic leads the projectile to sharpen as it melts, making it easier to pierce heavy armour. When piercing armour the projectile leaves behind its DU jacket, dispersing DU dust into the environment. Most of the dust particles are reported to be small enough to be inhaled or ingested by humans and remain windborne for an extended time. When deposited on the ground it settles as partially oxidised DU dust, potentially contaminating ground water. Health effects may arise from either chemical or radiological toxicity. Soluble forms of uranium are associated with toxic effects while insoluble forms are associated with radiological effects. Studies have discovered ingested DU accumulates in bone, kidney, reproductive system, brain and lung, and suggest it may have toxic, mutagenic and carcinogenic effects (Durakovic 2003 cited Hindin et al. 2005). The presence of such a substance close to residential communities is therefore a cause for concern, particularly in relation to the health of unborn and young children.

The United Nations Development Assistance Framework for Iraq 2011–2014 (UNDAF 2010) agreed that Iraq's environment suffered greatly from the impact of poor policies on pollution, resource management, and natural and man-made disasters. Air, water and soil pollution was described as a growing problem (UNDAF 2010). The industrial sector was reported to have generated uncontrolled emissions of hazardous waste from both derelict factories and functioning plants using outdated and environmentally harmful technologies, including rubbish burning in open sites. The agricultural sector used harmful chemicals and pesticides, their environmental impact exacerbated by unregulated irrigation practices. Problems with water supply multiplies these hazards (UNDAF 2010). In addition, man-made disasters named in the UNDAF report included air and surface water contamination from oil spills and fires, and from landmines and other remnants of war. These constitute a health hazard for local communities and take arable land out of production (UNDAF 2010).

Ongoing tensions caused by conflict between sectarian and other groups also impacts on the well-being of local communities in a number of ways. The UN Assistance Mission to Iraq (2011) reported on issues facing Iraqi citizens in 2010, the year in which data was collected for this study. They commented that widespread poverty, environmental degradation and absence of basic services affected large sectors of the population (UNAMI 2011, 3). They detail arbitrary loss of life and injury suffered by civilians, including 194 children who were killed and 232 who were injured in conflict related incidents. The report noted access to education was uneven throughout the country despite the construction of more schools.

UNAMI (2011) recorded 209 attempted assassinations or targeted killings, mostly in Baghdad and Mosul in the Northern region. Among these were 71 assassinated civilians, in the main comprising public officials, community and religious leaders, journalists, and medical and educational professionals. They commented that the distinction between criminal activity and terrorism had become increasingly blurred in 2010 because ideologically or politically driven groups had been turning to crime to fund their activities.

The Kurdish region by comparison was generally improving with very few security incidents or casualties reported. The Kurdish region government had taken steps to improve the protection of children in committing to the construction of schools as well as to shelters for those who were victims of violence (UNAMI 2011). This snapshot of Iraq during 2010 demonstrates ongoing issues which exacerbate the impact of past wars and international sanctions on the infrastructure and well-being of the population.

The ongoing cull of the professional classes, as noted above, has been catastrophic for the rebuilding of Iraq (Baker and Ismael 2010). Many who would otherwise have taken leading roles in establishing a progressive Islamic society have been assassinated or have fled the country, often with their families. Invaluable initiatives, such as those provided by CARA, aim to support professionals to eventually return home to provide their expertise to their country, post-conflict. However, attention also needs to be given to the education of future generations of professional, skilled and unskilled workers, all of whom have a contribution to make to the nation's prosperity and well-being. In rebuilding the educational infrastructure, it is important to provide equality of opportunity for those with impairments or difficulties in physical or psychological functioning so that they may attain their potential and contribute, to the fullest extent possible, as equal citizens in Iraqi society.

Educational facilities, alongside other public services in Iraq, have been decimated by armed conflict over an extended period. The education system caters for a national population of approximately 31.9 million (COSIT 2008), within around 15,000 schools nationally. However, thousands of schools failed to meet minimum health standards at the turn of the millennium, with 80% of school buildings needing significant reconstruction and 1000 requiring a total rebuild (Ministry of Health 2004). By 2007, 70% of school buildings were described as war damaged or neglected (Relief-Web/UCHO 2008), indicating some improvement in the situation over a three-year period.

The right to education for *all* children is enshrined in Article 34 of the Iraq Constitution. Care and rehabilitation of the 'disabled and persons with special needs' is set out in Article 30, while Article 32 establishes the legal right to reintegration into Iraqi society. Article 9 (modified) of the 1976 Mandatory Education Law No.118 addresses provision of primary school special needs classes in standard schools. However, the right to education for disabled children can be overlooked where the task of infrastructure repair and improvement appears overwhelming. Typically, provision is made for those whose

educational and support needs are easily met, while those with more complex needs are left to await specialist provision, which may never materialise. What was significant here was the vision within UNICEF Iraq, in promoting the development of schools designed to include children with 'impairments' who may be disabled within, or excluded from existing or ill-designed school infrastructure (Alborz et al. 2012).

This study was designed to inform the development of inclusive schooling, hence it collected information on the prevalence of 'impairment' among Iraqi children and the characteristics of the households where they resided. The survey targeted households, and not schools, so that children who were not enrolled in school would be included. It is important to acknowledge that, while institutions for children with disabilities were approached, researchers could not screen resident children because access was not always granted. Hence prevalence was calculated for a population of children living in their own communities. Data was gathered on a range of difficulties experienced by children in the households surveyed, including whether the child had been born with a 'birth defect'. While the 'cause' of birth defects is subject to ongoing research, the associations between environmental characteristics and prevalence arguably provide important indicators of potential population need. Such information is therefore potentially a powerful tool for planning.

Methodology

Definition of 'disability'

'Disability' is increasingly regarded as an 'evolving concept', rather than a static characteristic of an individual. It arises from an interaction between a person's impairments and the 'attitudinal and environmental barriers that hinder their full and effective participation in society on an equal basis with others' (UN 2006). It encompasses people with longstanding physical, mental, intellectual or sensory impairments. The study adopted the UN Convention definition above, recognising 'mental illness' alongside 'functional impairments', as defining 'impairment'. 'Functional impairments' were manifest by difficulties in relation to mobility, vision, hearing, self care, communication, cognitive skills or chronic health problems.

The term 'difficulty' was adopted rather than 'impairment' because the latter can be misconstrued to refer only to the most severe difficulties, and is often associated with stigma. While access to support requires the imposition of diagnostic 'labels', parents may be reluctant to stigmatise their child by referring to them as 'impaired'. This was considered a particular issue in Iraq where the translation into Arabic was described as a word akin to the English word 'defective', which was unacceptable. The adopted approach allowed the researchers to focus on 'difficulties' among children as appropriate to the research questions. It acknowledged that 'disability' is an 'active' concept,

individually and contextually defined, and hence difficult to establish conclusively from third party reports. However in relation to the term 'birth *defect*' no similar clear rationale for alternative language was discovered or divined.

Usage of term 'birth defect'

The phenomenon of incomplete or irregular physical development in the womb results in a considerable array of potential outcomes for a child, which are commonly referred to under the generic term 'birth defects'. Having a 'birth defect' does not automatically imply an individual has *any* functional or mental health difficulty. Consequently, while use of the term 'defective' was unacceptable to describe children with functional difficulties, here the language of 'difficulty' was inappropriate. Retaining use of the term 'birth defect', therefore, enabled the phenomenon to remain distinct from 'functional difficulty', it clearly described a gestational developmental outcome, and, because it *is* widely understood, potentially allowed unambiguous messages to reach the widest possible audience.

Sampling

Four governorates, Erbil, Baghdad, Basra and Najaf, were surveyed representing Iraqi communities from the far north to the southern coast. They encompassed rural and urban locations, affluence and poverty, as well as a range of geographical characteristics. Erbil is located in the autonomous Kurdish region, while the other governorates are governed from the national capital, Baghdad. Three governorates (Baghdad, Basra and Erbil) were selected by UNICEF because there was anecdotal evidence they had high numbers of disabled people. The governorates were otherwise considered to represent the diversity of cultures and living conditions across the nation as a whole (Alborz et al. 2011).

The sampling strategy involved consultation with local authorities to identify geographical areas considered to be representative of each governorate as a whole. Areas were divided into localities of 50 to 100 dwellings, up to 50% were then randomly excluded to guard against fieldworker biases in location selection. Data collection began at a randomly chosen point and dwellings were systematically approached to identify 20 households with children who would consent to interview. Once 20 interviews had been achieved, the locality was exited to control for impact of homogeneity of local populations on the integrity of the data (UN 2005). Where random selection generated a locality subject to current conflict, or other risks to researchers or participants, it was replaced with one of a similar nature in a safer location.

Ethical issues of informed consent and researcher risk were of prime importance. Hence fieldworkers were given detailed guidance on the former (overseen by their team leader), worked in pairs, and included a female team

member to ensure data collection from female participants was conducted in accordance with local customs in relation to interaction with non-family members. Teams were also matched to localities in terms of their sectarian characteristics to overcome tensions regarding the motivation for, and legitimacy of the survey. Fieldworkers were provided with letters of permission from local authorities, identity badges and clothing identifying them as working with UNICEF.

Study design

The fully structured survey questionnaire was based on an instrument used in a study of the experiences of families during an epidemiological survey of adults with learning difficulties and challenging behaviour in the UK (Qureshi and Alborz 1993), and adapted to reflect the aims of the current study. It included questions relating to 'difficulties' in six areas of functioning proposed by the Washington Group on Disability Statistics as key to providing standardisation of disability measures across the globe (WGDS undated). A question on chronic health difficulties was added in recognition of its impact on individuals and their access to education (Glendinning et al. 2001). Data was collected from 6032 households, including 10,714 children and young people (55.6% male) aged 0 up to 18 years. In addition to demographic data, descriptive information on school attendance, developmental skills (for those under the age of 8), perceived physical, sensory, cognitive and health difficulties, was collected for each child. A mental health indicator for children aged 4 to 18 years was also completed (Strengths and Difficulties Questionnaire, Goodman 1997). For children perceived to have difficulties, further information was collected on their impact.

The study employed a mixed methodology (Tashakkori and Teddlie 1998). Quantitative data provided descriptive contextual information and addressed prevalence issues. Qualitative interviews enabled stakeholders individually or in groups to both contribute to the development of instruments, and reflect on the impact of 'disability' upon the opportunities for educating disabled children alongside their peers (Alborz et al. 2011). Here quantitative data is interrogated to explore reported environmental characteristics and birth defects.

Fieldwork

Data was collected by seven teams of 10 fieldworkers led by a team leader. Two Kurdish speaking teams undertook all the fieldwork in Erbil. The remaining five Arabic speaking teams completed fieldwork in the three southern governorates. Fieldworkers attended induction training on household survey and qualitative interviewing. They assisted in piloting research instruments in the Erbil governorate. Team leaders were the key contacts for queries and discussion between UK and Iraq research groups, facilitated by CARA. They led the

qualitative individual and group interviews. Iraqi Masters students, who received training at the piloting stage, input the survey data to an SPSS database prepared in the UK. Data were received in batches by UK teams for consolidation, data cleaning and analysis.

The prevalence of functional difficulties among children screened was based on key informant (usually a parent) report. Parents were also asked whether any child had a birth defect and, where appropriate, its nature. Literature on birth defects has queried the reliability of self-report by parents, due to recall biases (Hindin et al. 2005). However, the birth of a child with a birth defect, or subsequent identification, is arguably an unexpected and traumatic event unlikely to be forgotten, or subject to faulty recall by parents. This is not least because of attendant consultations with health professionals, where these are accessible. Hence the parental report of birth defect was accepted as valid. Questions on functional difficulties were based on the respondents' evaluation of the children's abilities in comparison to others of the same chronological age, and so unaffected by potential recall bias.

Research teams also collected information on the characteristics of the surveyed localities. In consultation with local officials and residents, and making observations of environmental features, they catalogued each locality in terms of its geography (urban rural); exposure to recent conflict; natural sources of contamination (e.g., ingress of sea waters into rivers in the south of the country); industrial contamination (e.g., discharge of hazardous waste); contamination from remnants of warfare (e.g., potential sources of DU); and/or other sources of contamination (e.g., hazardous disposal of human or domestic waste). These environmental measures are crude in that they cannot represent the extent of risk to residents from sources identified or, given a risk exists, they do not represent the extent of exposure of individual children or their parents. However, the measures represent a useful indicator which may be used to explore associations with birth defects, or functional difficulties, experienced by children in the four governorates surveyed in 2010.

Findings

Prevalence

Overall prevalence of children with difficulties was 14.2% (Alborz et al. 2011), including children aged 4–18 years with an assessed risk of mental health difficulties (Strengths and Difficulties Questionnaire score in 'abnormal' range, Goodman et al. 2000). Mental health difficulties affected 10.7% of children and young people between the ages of 4 and 18 years. 8.3% of all children were reported to have 'functional' difficulties with mobility, vision, hearing, communication, self-care and/or cognitive skills, compared with children of the same age, and/or had chronic health problems (Alborz et al. 2011).

Environmental characteristics

The environmental profile of governorates surveyed varied. The proportion of the children's living areas potentially contaminated from natural, industrial, warfare or 'other' sources in each governorate comprised Erbil, 31.6%, Baghdad 22.6%, Najaf 16.8% and Basra 80.7%. Unlike other governorates, a substantial minority of children in Basra were living in localities described as located close to three or four potential sources of contamination (36.7%).

The reported environmental characteristics were to some extent correlated with one another. Notable correlations (>.200) were found between reports of contamination from natural sources and from warfare (Spearman's rho = .592, p=.000), and between 'other' sources of contamination, and natural- and warfare-related contamination (Spearman's rho = .660, p=.000; rho=.548, p=.000 respectively). Warfare and 'other' potential contaminants may be associated due to the impact of bombing on infrastructure, damage to drainage, water piping and sewers. Its association with natural contamination may due to Basra's widespread problem of contaminated drinking water caused by the ingress of salt water into rivers.

Descriptive information on the environmental characteristics of localities in each of the four governorates surveyed is presented in Table 1. Households surveyed in Baghdad and Basra were largely urban, and while all governorates were affected by ongoing conflict, greater numbers of children in Baghdad and Basra resided in conflict-ridden localities. At the time of the survey, riots affected Basra City due to civil frustration with lack of public services and poor electricity supply. Other areas were subject to ongoing tensions with neighbouring Iran, with the threat of shootings and kidnappings. The sectarian violence in Baghdad is well documented (UNAMI 2011), and here relatively wealthy residents were at risk of kidnapping. However, Basra was distinct from other governorates surveyed in the numbers of children reported to reside in localities potentially exposed to contamination (Al-Hashemy 2011).

Contamination of the water supply was a particular issue in Basra in 2010 hence potable water was piped or delivered by tankers to householders. In some areas piped water was brown and salt-contaminated, while in poorer areas, affordability of clean water was an issue. Basra was also the site of major industrial activity, particularly oil industries and fertiliser manufacture. Localities were perceived as potentially contaminated due to former damage to, or activities of, local oil refineries. 'Other' types of contamination described as potentially impacting on local environments included poor and damaged drainage systems, open sewers and domestic waste left to rot in the street. Finally, due to its strategic position, Basra had been subject to major military actions. Several areas were described as potentially contaminated by remnants of warfare including DU (post 2003) and/or chemical (early 1990s) weaponry. Buildings and public services in some localities were damaged or destroyed by

Table 1. Locality characteristics by governorate for children screened in the household survey.

	Governorate				
Locality	Erbil	Baghdad	Najaf	Basra	Total
Urban	1823	3297	1027	2370	8517
	79.7%	95.2%	68.4%	90.1%	86.2%
Rural	465	168	474	259	1366
	20.3%	4.8%	31.6%	9.9%	13.8%
Recent conflict					
Yes	699	1853	726	1516	4794
	30.6%	53.5%	47.5%	57.7%	48.4%
No	1589	1612	802	1113	5116
	69.4%	46.5%	52.5%	42.3%	51.6%
Natural contamination					
Yes	0	4	69	1461	1534
	0.0%	0.1%	4.5%	55.6%	15.4%
No	2288	3461	1479	1168	8396
	100.0%	99.9%	95.5%	44.4%	84.6%
Industrial contamination					
Yes	450	401	193	972	2016
	19.7%	11.6%	12.5%	37.0%	20.3%
No	1838	3064	1355	1657	7914
	80.3%	88.4%	87.5%	63.0%	79.7%
Warfare contamination					
Yes	302	0	20	1132	1454
	13.2%	0.0%	1.3%	43.1%	14.6%
No	1986	3465	1528	1497	8476
	86.8%	100.0%	98.7%	56.9%	85.4%
Other contamination					
Yes	0	493	68	1681	2242
	0.0%	14.2%	4.4%	63.9%	22.6%
No	2288	2972	1480	948	7688
	100.0%	85.8%	95.6%	36.1%	77.4%

warfare or recent battles between the government and local militia, and had not been repaired (Al-Hashemy 2011).

Birth defects

Overall, 394 children (3.7%) were reported to have birth defects, with most (n=363, 92.1%) also reported to have functional or health difficulties. In addition, more than 1 in 3 (n=135, 34.3%) were assessed as likely to have mental health difficulties. All the children surveyed were born after the first Gulf War in 1991, hence the survey provides no within-group 'control' samples of children unaffected by the ensuing events. However cross section comparisons may be made between governorates. The age distribution of children with birth defects suggests a peak among children aged 3- to 8-years-old. That is, those

Table 2. Age groupings of children with and without birth defects at time of interview in 2010.

	Whether child had a birth defect		
Years of age (inclusive)	Yes	No	Total
0 - 2 yrs	79	1949	2028
	3.9%	96.1%	100.0%
3 - 5 yrs	75	1487	1562
	4.8%	95.2%	100.0%
6 - 8 yrs	67	1180	1247
	5.4%	94.6%	100.0%
9 - 11 yrs	51	2129	2180
	2.3%	97.7%	100.0%
12 - 14 yrs	66	1840	1906
	3.5%	96.5%	100.0%
15 - 17 yrs	56	1582	1638
	3.4%	96.6%	100.0%
Total	394	10,167	10,561
	3.7%	96.3%	100.0%

born between 2002 and 2007 approximately (see Table 2). While most children with birth defects resided in urban households (88.4%), the prevalence was similar within each type of locality (3.9% urban; 3.2% rural). Given the vast majority of children with birth defects experienced functional or chronic health difficulties, characteristics of the localities in which children with birth defects and/or functional difficulties lived were explored (see Table 3).

Analyses suggest an association between the prevalence of birth defects and residence in localities potentially subject to contamination from natural, warfare or other (human or domestic waste) sources. The pattern of associations was similar for children with functional difficulties (who may or may not have birth defects). Here the relationship between residence and 'other' sources of contamination was stronger, while that with contamination from warfare was significant but weaker. However, it was clear that some of these characteristics only affected localities in certain governorates (Table 1).

Table 1 demonstrates that environmental compromise was an issue with greatest potential impact on children living in Basra. Significantly more children in Basra (n=218, 8.2%) were identified by respondents as having birth defects than in other governorates surveyed (Erbil n=33, 1.4%; Baghdad n=89, 2.2%; Najaf n=54, 3.5% – Pearson $Chi^2(3df)$ 208.442, p=0.000). The number of children with birth defects was too small in most governorates for reliable analysis of associations with environmental characteristics. However, the larger number of children with birth defects in Basra enabled further interrogation of potential relationships.

The survey collected information on 2661 children in Basra, of whom 2629 provided data for these analyses (Table 4).

Table 3. Environmental characteristics of localities for children identified with or without birth defects and/or functional difficulties.

Locality		Child has birth defect			Child has functional difficulties		
		Yes	No	Chi^{2*} 1df (significance)	Yes	No	Chi^{2*} 1df (significance)
Natural contamination	Yes	129	1405	101.394***	234	1350	89.417***
		8.4%	91.6%		14.8%	85.2%	
	No	254	8142		637	7856	
		3.0%	97.0%		7.5%	92.5%	
Industrial contamination	Yes	91	1925	1.943	194	1842	2.531
		4.5%	95.5%		9.5%	90.5%	
	No	292	7622		677	7364	
		3.7%	96.3%		8.4%	91.6%	
Warfare Contamination	Yes	105	1349	51.998***	157	1327	8.261**
		7.2%	92.8%		10.6%	89.4%	
	No	278	8198		714	7879	
		3.3%	96.7%		8.3%	91.7%	
Other Contamination	Yes	168	2074	103.259***	349	1956	159.787***
		7.5%	92.5%		15.1%	84.9%	
	No	215	7473		522	7250	
		2.8%	97.2%		6.7%	93.3%	

Note: * Pearsons Chi^2 ** significant beyond p=0.01 level *** significant beyond p=0.001 level.

Table 4. Prevalence of children with birth defects in localities in Basra reported to be subject to natural, industrial, warfare or other source of potential contamination.

Environmental Characteristic	Child has birth defect		Chi^{2*} 1df (significance)
	Yes	No	
Natural contamination	126	1335	1.205
Yes	8.6%	91.4%	
	87	1081	
No	7.4%	92.6%	
Industrial contamination	83	889	.396
Yes	8.5%	91.5%	
	130	1527	
No	7.8%	92.2%	
Warfare Contamination	103	1029	2.654
Yes	9.1%	90.9%	
	110	1387	
No	7.3%	92.7%	
Other Contamination	151	1530	4.858**
Yes	9.0%	91.0%	
	62	886	
No	6.5%	93.5%	

Note: * Pearsons Chi^2 ** significant beyond p=0.05 level

In contrast to overall findings, analysis of the association between environmental characteristics and prevalence of children with birth defects in Basra only demonstrated a significant association with residence close to potential contamination from 'other' sources. That is, hazardous disposal of human and domestic waste. Here, a prevalence of children with birth defects of 9.0% (n=151) was found, compared to a prevalence of 6.5% (n=62) among children living in unaffected localities.

Discussion

The overall prevalence of birth defect is a 'blunt tool' in terms of the interests of healthcare professionals, and in comparison to recent studies of the prevalence of specific birth defects (see for example, Parker et al. 2010). Nevertheless, it is a useful indicator of the potential support needs of disabled children in education settings. General prevalence of birth defects in national samples has been recorded as between 3–5% (Robinson and Linden 1993). The overall prevalence rate here was of a similar order (3.7%), but the higher prevalence rate in Basra (8.2%) echoes that found in a prospective study of babies and young children (7%) in a periurban slum community in Lahore, Pakistan (Gustavson 2005). No suggestions regarding possible causes for a higher prevalence were given in that article.

There has been ongoing speculation about the relationship of environmental characteristics, in particular pollutants from industry and warfare, to the health

of local populations. Of particular concern have been perceived links between materials used in armaments, such as DU and lead, and incidence of cancer or birth defects among children born to those potentially affected by this pollution (Wigle et al. 2007). This study suggested a link between prevalence of birth defects and presence of natural, warfare and 'other' sources of contamination. However, analysis of the governorate most affected by these environmental challenges suggested that unsanitary conditions arising from damage to, or poor arrangements for disposal of human and domestic waste was a particularly important factor in the genesis of birth defects and functional difficulties.

Literature on the causes of birth defects and disability among young children notes a number of substances with potential to adversely impact the developing foetus or child (Wigle et al. 2007). Lead (Pb), arsenic (As) and mercury (Hg) are reported to be significant causes of birth defect, chronic health difficulties or disability. For example, chronic ingestion of water containing high levels of arsenic has been associated with miscarriage and risk of skin, liver, lung, kidney and bladder cancers (Tsai et al. 1998, cited Wigle et al. 2007). Transplacental or postnatal methylmercury (MeHg) exposure may also result in a range of physical, cognitive and sensory difficulties (Amin-Zaki et al. 1974 cited Marsh et al. 1980).

The levels of these types of contaminants in Basra is unknown. However, a study by Iraqi and Canadian researchers found moderate to severe pollution from lead and arsenic (among other heavy metals) within several tested locations in marshland areas to the north (Al-Haidarey et al. 2010). While the article does not speculate on the origins of this contamination, the authors note a sampled location had formerly been used for military activities and agriculture while the marshland was dry. Historically, arsenic was used in significant amounts in pesticides, as it kills insects and is an effective fungicide (Loebenstein 1994, cited Bleiwas 2000). This may demonstrate the impact of continued use of hazardous chemicals in agriculture highlighted in the UNDAF report (2010).

The association found in Basra between the prevalence of children with birth defects and functional difficulties, and potential contaminants from human and domestic waste is of concern due to the coincidental difficulties in obtaining clean water supplies (Al-Hashemy 2011). Where infrastructure is damaged by armed conflict there is risk of contaminants entering domestic water supplies to impact on human health. Toxoplasma gondolii is one significant risk arising from faecal contamination from feral or domestic cats. The oocysts within faecal material become infective one to five days after excretion, are spread by surface water and can survive for more than a year (Dubey 1988, cited Cook et al. 2000). Infection is spread therefore by contact with soil or water and not direct contact with cats. Marsh et al. (2000, 143) found a significant infection route, in addition to contact with soil or working with animals, was 'drinking untreated water, or having no piped water, but not with living

on a farm'. Exposure can lead to seizures, and cognitive and severe sensory difficulties (Bale et al. 2003).

Analyses of data at national level revealed associations between three potential contaminants (natural, warfare and 'other' domestic/human sources) and birth defects and functional difficulties. However analysis restricted to Basra, the governorate most severely affected due to an exceptional combination of circumstances, revealed only the association with 'other' human/domestic waste sources remained statistically significant. Arguably the wider analysis allowed for examination of associations within a more typical context. That is, across a nation the number of affected local communities is likely to be small, taking a wider view puts the association with birth defects and functional difficulties into perspective and suggests that each of these potential sources of contamination may have a role in causing birth defects or functional difficulties.

The Basra findings alone arguably demonstrated that, of the three potential sources of contamination associated with impact on child well-being, 'other' human/domestic sources were significantly more likely to be implicated. This finding is not as straightforward as it may appear on the surface. It must be borne in mind that there are significant correlations between the three potential sources of contamination. That is, the presence of 'other' human/domestic waste sources of contamination are likely to exist alongside the presence of remnants from warfare and/or naturally occurring contamination, in this instance salination of rivers. As implied above, warfare may result in detritus including DU or lead from used or abandoned armaments. However, the more widespread and lasting legacy of armed conflict may be the damage to water supplies, drainage and sewers which provide a conduit for the poisoning of local populations. In Basra the situation was further exacerbated by problems in accessing potable water. Further studies are necessary to establish the likely contribution of each of these types of contamination to the difficulties experienced by children.

Conclusion

The discussion above has highlighted the importance of addressing public health issues. While the relationships found are not a 'proven' link, the risks to population health appear significant. Such data should be taken as a warning sign by those responsible for the implementation of public health initiatives, that urgent action is needed to address the issue of disposal of waste in an environmentally sound manner. There is evidence that a plan of action has been devised for the short-, medium- and long-term disposal of domestic waste (Knowles 2009). However data here suggests that domestic waste removal was still problematic in many localities.

Safe removal of human waste and the detritus of armed conflict is a key goal, likely to have been thwarted by ongoing sectarian tensions, and assassi-

nation and exile of the professional classes who would otherwise be involved in strategic planning and delivery of such goals (Baker and Ismael 2010). Nevertheless, whether or not the relationship of DU to population health is confirmed, where there is reasonable doubt, authorities arguably need to act 'as if' this material is a health hazard and take appropriate action.

Given this study, and others (e.g., Marsh et al. 1980), suggest a relationship between the prevalence of birth defects and environmental factors, we must consider the implications for the educational provision of the children affected. Education for *all* children is a Millennium Development Goal (UN 2000) that is particularly challenging to meet in the context of Iraq. While the specific relationship of environmental contaminants to children's health difficulties remains to be uncovered, knowledge about the co-occurrence of elevated prevalence of functional and health difficulties in children residing in areas close to potential contaminants, is arguably an important planning tool for Ministries and Directorates of Education. Where children have particular learning and support needs, enabling them to access their local school requires careful planning to ensure that the facilities, curriculum differentiation and teaching assistance they require is put in place.

Where children have birth defects, they are highly likely to have functional and/or chronic health difficulties. However, their entry into the education system is unlikely to happen for a number of years following identification of any difficulties. During this intervening period, there is an opportunity for teachers to work with health professionals, social services and parents, to define the educational support required by these children. Inter-Ministerial collaboration, to facilitate this co-ordination of services, would provide a clear mandate for the development of this approach (Alborz et al. 2012). Interagency working itself is key in supporting individuals with complex difficulties or chronic health problems, and ensuring smooth transitions at key stages in life (Sloper 2004).

The limitations of this study are twofold. Firstly, lack of access to institutes to screen resident children may mean that prevalence of children with birth defects is an underestimation. Secondly, the research was affected by limited access to certain localities. In the main this stemmed from concerns over personal safety. However, in rare instances, fieldworkers were refused access to localities by security guards protecting wealthy residents, despite official letters of permission. This situation was rare however and so unlikely to have significantly skewed findings within this large national survey.

Recommendations

It is imperative that authorities prioritise public health programmes for the safe disposal of human and domestic waste, and pursue safe removal of remnants of warfare, alongside ensuring access to clean water for residents. Regardless

of the need for further investigation of the impact of potential sources of contamination on child health, there is a moral duty to remove such widespread likely threats to the well-being of future generations in affected localities.

In pursuing inclusive schooling, knowledge of potential sources of contamination in local areas is an important indicator for targeting resources to enable schools to plan to include children with difficulties. Liaison between the Directorates of Health, Labour and Social Affairs, and Education has the potential to establish the profile of support needs for children approaching kindergarten or school age (Alborz et al. 2012). This intelligence can facilitate targeting resources to local schools allowing timely, effective planning to enable inclusion of disabled children.

It is clear that access to schooling is currently not optimal for most children in Iraq (UNAMI 2011). However, in planning the refurbishment of existing, or construction of new educational establishments to meet the aspirations of education for all (UNESCO 2011), an opportunity is afforded to accommodate the needs of disabled children. It is arguably easier to address this issue at the stage of rebuilding Iraq's education system than at an undefined future date when the task at hand may not appear so overwhelming, but many irreversible decisions have been taken (Alborz et al. 2012). It is important, therefore, to grasp the opportunity and envisage effective inclusive schooling at the point of designing infrastructure, so that ultimately all local children may be included. Knowledge of environmental factors potentially impacting on children's learning and support needs provides an insight for planning that should not be overlooked.

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