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Mapping speech pathology services to developmentally vulnerable and at risk communities
using the Australian Early Development Census

Jane McCormack and Sarah Verdon

Charles Sturt University

Correspondence:

Jane McCormack

Email: jmccormack@csu.edu.au

ABSTRACT

Purpose: The Australian Early Development Census (AEDC) is a population-based measure of children's development across 5 domains in the first year of formal schooling. In this study, the AEDC data from 2 domains (Language and Cognitive Skills, and Communication Skills and General Knowledge) were used to explore the extent and distribution of vulnerability in communication skills among children in Australian communities. Speech Pathology Australia membership data was then used to explore the accessibility of services within those communities. .

Method: The 2012 AEDC data were accessed for 289,973 children, living in 577 communities across Australia. The number of children identified as "at risk" (10-25th percentile) or developmentally "vulnerable" (<10th percentile) in each of the domains was calculated, then the location of communities with high proportions (>20%) of these children was determined. These data were mapped against the location of paediatric speech-language pathologists (SLPs) to identify the number of communities with little to no access to speech-language pathology services.

Result: Across Australia, there were 47,636 children (17.4%) identified as developmentally vulnerable/at risk in Language and Cognitive Skills and 69,153 children (25.3%) in Communication Skills and General Knowledge. There were 27 communities with >20% of children identified as developmentally vulnerable/at risk in Language and Cognition. Of those, none had access to speech-language pathology services, according to current membership data. There were also 27 LGAs with >20% of children identified as developmentally vulnerable/at risk in the Communication Skills and General Knowledge domain. Of these, three had access to SLP(s), and these were in regional/metropolitan areas.

Conclusion: The AEDC provides a means of identifying communities where children are performing well and communities which may benefit from population-based prevention or intervention. Given the number of communities within Australia without access to SLPs, there is a need to reconsider how such population-based services could be delivered, particularly in the communities with higher levels of vulnerability in communication development.

INTRODUCTION

The early childhood years are a critical period, during which time the foundations for later academic, social-emotional and physical development are put in place, and skills for future life success are acquired. The role of the early years in ensuring later positive outcomes has led communities and governments to recognise the need for children's development during this time to be supported. For example, in Australia, policies now exist requiring universal provision of preschool education (15 hours per week) for all children. Furthermore, the *Early Years Learning Framework* (EYLF, DEEWR, 2009), implemented in 2010 to guide curriculum in preschool settings, highlights key developmental areas to be supported. One of the five learning outcomes articulated in this document is that children will learn to be "effective communicators", signalling the importance of speech and language development during the early years.

Communication development and impairment in childhood

Children may experience difficulties in achieving communicative competence regardless of the language(s) they speak. Communication impairment is a high prevalence condition in childhood (Law, Boyle, Harris, Harkness, & Nye, 2000), and may continue to be experienced into adolescence and adulthood (Felsenfeld, Broen, & McGue, 1992). In a study of teachers of 14,500 primary and secondary students in Sydney, communication disorder (such as speech and /or language difficulties) was identified as the second most common learning need, affecting 13% of the children taught (McLeod & McKinnon, 2007). This was more prevalent than intellectual impairment, hearing and vision difficulties, or behavioural problems.

In a nationally representative study of 4,329 Australian children, those with a history of communication concerns in preschool reported more bullying, poorer peer relationships, and less enjoyment of school than did their peers at age 8-9 years (McCormack, Harrison,

McLeod, & McAllister, 2011). In addition, parents and teachers reported that children with a history of communication concerns demonstrated slower progression in reading, writing, and overall school achievement than their typically developing peers. The development of speech and language skills is “intimately related to all aspects of educational and social development” (Law, Boyle, Harris, Harkness, & Nye, 1998, p. 2). Consequently, impairment of speech and language skills may affect a child’s education and social development, which may have lifelong impacts on their employment (Ruben, 2000), or vocational choices in adulthood (Felsenfeld, Broen & McGue, 1994).

Such findings demonstrate the need for early identification and intervention addressing the speech and language needs of these children, but also provide strong evidence of the need to ensure intervention is maintained for as long as required.

Early speech-language pathology intervention is effective at minimising the lifelong impact of speech and language difficulties in children if provided at an appropriate point in time, and for an appropriate duration, depending on the child’s needs (e.g., Almost & Rosenbaum, 1998; Gallagher & Chiat, 2009). Thus, there is a need to identify the communities where services are needed and to ensure services are available and accessible to the children and families who live there.

Population-based measures of development

In order to enable appropriate prioritisation of resources and access to services for all children, especially those at risk of poorer outcomes, there is a need to understand strengths and challenges at a community or population level, and to recognise longitudinal and geographical trends that need to be addressed. Hertzman and Williams (2009) suggested one approach to gathering such data is through the use of indirect assessments such as population-based surveys. Such surveys require individual data collection for all children in a given location, but enable aggregation of data to examine development (and factors impacting

development) at a community level. The Australian Early Development Index (AEDI; based on the Early Development Instrument used in Canada) is one example of such a population-based tool.

The Australian government has funded the implementation of the Australian Early Development Census (AEDC) since 2009. The AEDC requires teachers to administer the AEDI (note that the AEDI is the tool and the AEDC is the data collection process) to all children in their first year of formal schooling and provides a population-based measure of children's development across five domains (Social competence, Emotional maturity, Physical health and wellbeing, Language and cognitive skills, and Communication skills and general knowledge), which have been linked to positive health, education, and social outcomes in adulthood (Australian Government, 2013). Thus the AEDI is intended as a tool that "informs policy makers and researchers" about community level needs, rather than a "diagnostic instrument for the identification of individual children for therapy or special services" (Brinkman, Sayers, Goldfeld & Kline, 2009, p.420).

Ideally, the identification of areas (suburbs, towns or regions) with high levels of developmental vulnerability, and other factors (including current resources) should enable targeted provision of appropriate resources and services to populations most in need. However, the provision of services firstly requires that the services exist within communities (e.g., availability), and secondly, that children and families are able to utilise them when required and for as long as required (e.g., accessibility). For services such as speech-language pathology, this is not always the case (McAllister, McCormack, McLeod, & Harrison, 2011; McLeod, Press & Phelan, 2010; O'Callaghan, McAllister, & Wilson, 2005; Verdon, Wilson, Smith-Tamaray, & McAllister, 2011; Wilson, Lincoln, & Onslow, 2002).

Speech-language pathology service provision

Currently in Australia, not all children with communication impairment receive speech-language pathology services (McAllister et al., 2011). For some, this is due to services being unavailable in the areas where they live. Verdon et al. (2011) investigated the provision of paediatric speech-language pathology services in non-metropolitan New South Wales and Victoria, the two most populous states in Australia (see Figure 1), and found only 1.7% of locations in the study had speech-language pathology services based in their community or visiting their community as an outreach service. Thus, many children with communication difficulties and their families would need to travel to other locations to receive services. This finding is consistent with earlier research by O’Callaghan et al. (2005), who surveyed families living in rural and remote areas of NSW to determine the barriers affecting utilisation of paediatric speech-language pathology services. They found 86% of respondents who had difficulty accessing services reported this was due to no services being available (O’Callaghan et al., 2005).

While the lack of available services prevents some children from receiving speech-language pathology input, inability to access services, or inadequate access, are barriers for other children. Access to speech-language pathology services for children with communication difficulties is often determined by governmental policies (or interpretations of these). Current Australian government policies do little to acknowledge and support communication impairment of unknown origin, and consequently fail to allocate sufficient resources and funding to those children identified with communication difficulties (McLeod, Press & Phelan, 2010). Thus, the amount and type of intervention received by children with communication impairment is often restricted. This situation contrasts with that in the United States (US) and the United Kingdom (UK), where access to speech-language pathology services is mandated for children with communication impairment (Bercow, 2008; U.S Department of Education, 2004).

Access to services may also be influenced by the locations in which children live. In their study, Verdon and colleagues (2011) reported only 0.75% of communities throughout non-metropolitan NSW and Victoria were serviced at the ideal frequency suggested by participants (weekly or more often), 0.65% were under-serviced (that is, serviced less frequently than suggested), while the vast majority of locations had no services at all. The infrequency of services in many locations is problematic, given that research indicates “low doses” of intervention are often ineffective in bringing about changes to children’s communication skills (Baker, 2012; Glogowska, Campbell, Peters, Roulstone, & Enderby, 2002, p. 520).

When services are not available in their community, children and families are required to travel to other locations. Researchers have suggested the maximum distance that consumers are willing to travel to access services is 50 kilometres for weekly services (Verdon et al., 2011) or 65 kilometres for fortnightly services (Wilson et al., 2002). Over one third of communities in non-metropolitan NSW and Victoria are greater than 50 kilometres from a speech-language pathology service (Verdon, et al., 2011), and thus people living in those communities might be unable/unwilling to access a sufficient amount of speech-language pathology input. This issue is likely to have an equal, if not greater, effect in other states and territories of Australia, where communities are more widely dispersed. O’Callaghan and colleagues (2005) also reported distance to be a barrier, with 76% of those who reported problems accessing SLP services citing “long distances to travel” as a key concern. In rural and remote areas of Australia, travels costs and limited public transport exacerbate the problems associated with distance to services. Other factors that may contribute to poor service access in Australia are: parents’ and educators’ lack of confidence in identifying communication impairment (McAllister et al., 2011), limited knowledge about possible long-term negative outcomes for individuals with communication impairment,

parents' limited awareness of speech-language pathology services (O'Callaghan et al., 2005), and SLPs' cultural competence and confidence in providing services to children from CALD backgrounds (Verdon, McLeod & McDonald, 2014).

The research to date provides some understanding of the service delivery gaps that exist for children with communication difficulties; however, the focus of this research has been on specific states (e.g., VIC/NSW) rather than at a population level. Larger scale studies, such as those involving population level surveys, reduce the possible impact of methodological issues common to smaller studies, such as recruitment bias and sampling. In recognition of the importance of communication skills for children, but challenges experienced by many children and families in accessing services to support communication development, the Australian Government launched a Senate Inquiry into the prevalence of different types of speech, language, and communication disorders and speech-language pathology services in Australia in 2014. The findings of the Inquiry highlighted the need to identify where services are most needed in order to inform policy and funding decisions to ensure provisions are allocated according to need. Recommendation 3 in the final report of the Inquiry called for “a project that maps language support services across Australia against the Australian Early Development Index information about vulnerable communities” (Commonwealth of Australia, 2014, xii). The current study addresses this recommendation by mapping AEDC data against the location of speech-language pathology services available for children in Australia according to the membership records of Speech Pathology Australia. The use of a mapping system to analyse the data was selected to address the recommendations made by the Australian Government Senate Inquiry and because of its previous use in identifying areas of speech-language pathology service provision and unmet need for other populations including those in rural and remote areas, and those from CALD backgrounds (see Verdon et al., 2011; Verdon et al., 2014).

Research aims

The current research aims to use data from the AEDC and Speech Pathology Australia to:

1. Explore the extent and distribution of communication difficulties among children in their first year of school within Australian communities; and
2. Map the availability of speech-language pathology services for communities with high proportions of children identified as having communication difficulties.

Findings from the data are used to inform a discussion about the factors that need to be considered in the identification of need and subsequent community/government responses.

METHOD

Participants

The participants in this study were drawn from two different datasets: (1) 289,973 children whose teachers completed the AEDC in 2012 and (2) 3,181 SLPs who were registered with Speech Pathology Australia in 2014 and who provided services to children. Each participant group is described in detail below.

Children

There were 289,973 children aged 5-6 years (mean 5;7 years) whose teachers (n=16,425) completed the AEDC in 2012. This represented 96.5 per cent of the children enrolled in their first year of formal full-time school. Children came from 7,417 government, Catholic and independent schools across all Australian states and territories, with the largest numbers of children coming from NSW, Victoria, and Queensland, reflecting the population of those states (see Figure 1 for a map of Australia including state boundaries and capital

cities). Tables 3 provides the total number of children from each state/territory assessed on the two domains which are the focus of this research. In most states, the highest proportion of children lived in major cities; however, in Tasmania, the majority were from regional areas, and in the Northern Territory, most were from regional or remote areas, which reflects the population distribution in those places.

There were 55,489 (19.1%) children identified as being from a language background other than English (LBOTE), with 305 languages other than English spoken at home. The most common languages other than English spoken by the children were Arabic (12.8% of children from LBOTE), Vietnamese (6.8%) and Mandarin (6.0%). In addition, there were 15,490 (5.3%) children who were identified as being from an Aboriginal or Torres Strait Islander background, with 109 different traditional languages reported as being spoken by the children.

The majority of children ($n=249,273$, 94.8%) were reported to have attended non-parental care and/or educational programs in the year prior to school. A small proportion ($n=14,173$, 4.9%) of children were reported to have chronic physical, intellectual, and/or medical needs, and 10.3% ($n=29,628$) were identified as needing further assessment. See the AEDC national report (Australian Government, 2013) for more information.

Communities

Data were collected from children in 577 local government areas (LGAs) across Australia; however, data for some of these LGAs were suppressed to maintain confidentiality due to the small number of children assessed in those locations. In total, data from children living in 493 LGAs across Australia were included in the analysis. LGAs are geographical regions, which vary in size according to population (i.e., an LGA in a sparsely populated region, such as the Northern Territory, may take up a large geographical area, whereas an LGA in a major city, such as Sydney, may occupy only a small geographical region) (see

Australian Bureau of Statistics (2012) for further information). This is an important consideration when interpreting the maps in this study. In the context of this research, LGAs are the reference point whenever “community” level data are reported.

Speech-language pathologists (SLPs)

SLPs were identified in this study using 2014 membership data obtained from the national professional body, Speech Pathology Australia (SPA). According to SPA (personal communication, January, 2015), approximately 80% of SLPs working in Australia are members of the association. There were 3,181 SLPs listed in this database as registered practicing members with SPA, who reported servicing a paediatric population (children 0-5 years and/or 5-12 years). Of these, 170 did not provide details of their location (state/territory and/or postcode) so their data were removed from further analysis. It was not possible to include their data in the maps, but their presence has been acknowledged in the discussion of areas of need, and in the limitations of the study. The SLPs represented all Australian states and territories, as shown in Table 1. The majority of SLPs reported working in the public sector; however private SLPs and those working in non-government organisations were also present.

Measure

Australian Early Development Index (AEDI)

The AEDI is adapted from the EDI tool that has been used to collect large scale data about children in a number of countries including Canada and the United States (McMaster Children’s Hospital, 2004). The AEDI is a teacher-completed checklist comprising five domains that provides information about children’s development during their first year of formal schooling (see Table 2). Each domain receives a score from 0 to 10 (where 0 is the lowest score and 10 is the highest score). Children are classified as “on track” when they

perform at the 25th percentile or above for a given domain, “at risk” when they perform between the 10th and 25th percentile, and “vulnerable” when they perform below the 10th percentile. The cut-off scores for each of these groups were created on the basis of scores received by all children who participated in the AEDC in 2009 (during the first national data collection).

AEDC data were collected in 2012 from teachers of children in their first year of school. Teachers completed the AEDI checklist for each child in their class individually, and data was combined for all children in the LGA to enable calculation of the proportion who were developmentally “on track”, “at risk,” or “vulnerable”. The combined data are publicly available and were accessed as an excel spreadsheet. The spreadsheet listed the 565 local government areas from which data was gathered (only $n = 493$ with accessible data for analysis), and the number of children who had AEDI checklists completed in each LGA. It also listed the number and percentage of children who were reported to be within each of the 3 categories (on track, at risk, and vulnerable) for each of the 5 domains.

For the purposes of this research, results from two domains were considered: Language and Cognitive Skills (which focuses on written communication), and Communication Skills and General Knowledge (which focuses on oral language).

Procedure

Data were analysed in two ways: state-based and community (LGA)-based. Initially, the total number of children identified as on track, at risk or vulnerable in each of the two domains in each state/territory was obtained (see Tables 3 and 4) to determine the proportion of children with potential communication needs in each state/territory. This number was compared to the number of known SLPs in each state/territory to determine the average ratio of SLPs to children with communication needs (see Tables 5 and 6).

The total number of children in each LGA who were identified as on track, at risk, or vulnerable in each of the domains was then obtained. Each LGA was categorised according to whether there was a low (<10%), average (10-20%), or high (>20%) proportion of children identified as at risk or vulnerable for each of the domains. These data were entered into ArcGIS ArcMap, Version 10.1.1 (Esri, 2009) to examine the location of communities with high proportions of children with communication needs. Next, the locations of SLPs (based on postcodes provided in the membership database) were entered into ArcGIS to examine the distribution of speech-language pathology services.

It was not possible to match the location of SLPs directly to communities due to the different geographical boundaries used within both datasets (i.e., postcodes for SLPs and local government areas for communities). Consequently, a decision was made to recognise speech-language pathology service provision within a community when the area represented by the SLP's postcode covered 50% or more of the area represented by the LGA. In order to make this decision, the total area covered by each LGA, and the total area covered by each postcode was calculated, then the percentage of the LGA covered by the postcode was determined. In the following section, communities are recognised as having access to speech-language pathology services when at least one SLP reported a postcode that covered half of the total area of that community.

The ArcGIS mapping program enabled the presentation of results in pictorial form using maps of Australia to aid the clarity of presentation and interpretation of findings.

RESULTS

State-based data

Language and cognitive skills

Across all states/territories, the majority of children were reported to be “on track” in the Language and Cognitive Skills domain of the AEDI (see Table 3). However, the

proportion varied from 87.2% of children in NSW to 62.0% in the Northern Territory. The Northern Territory had the highest proportion of children (38.0%) identified as vulnerable/at risk in this domain, followed by Western Australia (24.2%) and Queensland (21.5%).

Communication and general knowledge

The majority of children were also reported to be “on track” in the Communication Skills and General Knowledge domain of the AEDI (see Table 3). However, the proportion of children identified as vulnerable/at risk was generally higher, compared to the Language and Cognitive Skills domain. The Northern Territory had the highest proportion of children (31.5%) identified as vulnerable/at risk in Communication Skills and General Knowledge, followed by Queensland (28.6%), the Australian Capital Territory (26.6%) and South Australia (26.3%).

Speech-language pathology services

Paediatric SLPs were located in each of the states and territories across Australia, with most located in NSW ($n = 1,216$) and Victoria ($n = 823$), and fewest located in the Northern Territory ($n = 19$) and the Australian Capital Territory ($n = 23$), as is proportionate with the population. Analysis of the AEDC results and the membership data provided by SPA, suggests there is a ratio of one SLP to every 15 children (aged 5-6 years) identified as at risk/vulnerable in Language and Cognitive Skills across Australia, and a ratio of one to every 22 children identified as at risk/vulnerable in Communication Skills and General Knowledge (see Table 3). However, this ratio ranges from 1:9.4 in NSW to 1:62.4 in the Northern Territory (for Language and Cognitive Skills), and from 1:17 in Victoria and 1:64.7 in the Northern Territory (for Communication Skills and General Knowledge). Given that the AEDC data is only collected with 5-6 year old children, and that SLPs typically work with children across multiple age ranges (0-6 years in early intervention, and 5-12 years in

schools), the actual ratio of SLPs to children (0-12 years) in need of services is likely to be significantly fewer than these estimates. This issue is addressed further in the Discussion.

Community-based data

Language and Cognitive Skills Domain

While the majority of children in most LGAs ($n = 493$) were reportedly on track in the Language and Cognitive Skills domain, there were 27 LGAs (5.5% of 493) in which >20% of the children were reported by teachers to be vulnerable (performing below the 10th percentile) (see Table 5). Most of the LGAs were in the Northern Territory, Western Australia, and Queensland. All were in remote or rural areas (see Figure 4). In six of those LGAs, more than 50% of children were identified as vulnerable. There were 47 locations (9.5% of 493) in which >20% of the children were reported to be at risk (performing between the 10-25th percentile). While most of these were also in rural or remote areas, some regional and inner metropolitan areas were represented as well (e.g., see Perth in Figure 3).

Communication Skills and General Knowledge domain

Across the 493 LGAs, there were 27 (5.5% of 493) in which >20% of the children were reported by teachers to be vulnerable in the Communication Skills and General Knowledge domain (see Table 5). In two of those LGAs, half of all assessed children (50%) were identified as vulnerable. Again, most of the LGAs were in the Northern Territory, Western Australia and Queensland. While there were similarities in the LGAs identified across both domains, there were also some differences (see Figure 6). There were 110 LGAs (22.3% of 493) in which >20% of the children were reported to be at risk in the Communication Skills and General Knowledge domain. A combination of regional and inner metropolitan areas as well as rural and remote areas was represented (see Figure 4).

Speech-language pathology services

On Figures 1-4, the known locations of SLPs are represented by patterned (lined) sections. Of the 577 LGAs across Australia, 185 had access to speech-language pathology services (i.e., SLP located in LGA). Of the 493 LGAs with data analysed for this research, 181 (36.7%) had access to speech-language pathology services (i.e., at least one SLP recorded a postcode covering 50% or more of the LGA). This meant that 312 (63.3%) LGAs across Australia had little to no access to speech-language pathology services. Within these LGAs, 7,470 children were identified as vulnerable in Language and Cognitive Skills, and 8,339 children were identified as vulnerable in Communication and General Knowledge (see Table 5).

Of the 27 LGAs with a high proportion (>20%) of children reported to be vulnerable in the Language and Cognition domain, none had access to SLPs. Of the 27 LGAs with a high proportion of children reported to be vulnerable in the Communication Skills and General Knowledge domain, three had access to SLP(s), and these were in regional/metropolitan areas.

DISCUSSION

This study reported on an analysis of data from the 2012 Australian Early Development Census exploring the communication status of children across Australia in the first year of formal schooling. Data from individual children was aggregated to enable identification of communities with high proportions of children at risk/vulnerable in the development of *Language and Cognitive Skills* and *Communication Skills and General Knowledge*. Locations of known paediatric SLPs across Australia were then mapped to the data, to examine the number and distribution of communities with and without access to speech-language pathology services. In the following sections, the findings of the research will be discussed according to the two research aims, and with a reflection on factors that could influence the interpretation of these findings.

The extent and distribution of communication difficulties among children in Australian communities

Within all states and territories of Australia, and within the majority of communities (LGAs), most children's communication skills were at the level expected for their age (i.e., "on track"). This was true for both the AEDC domains analysed for this study, reflecting that oral and written language skills were tracking appropriately for most children during their first year of school, according to the expectations of their teachers. However, there were some communities in which a high (>20%) proportion of children was identified as being "vulnerable" (performing below the 10th percentile) or "at risk" (between the 10th-25th percentile); more so for the Communication Skills and General Knowledge domain than for the Language and Cognitive Skills domain. The greatest proportion of children identified as at risk or vulnerable for both domains was located in rural and remote communities in the Northern Territory, Western Australia, and Queensland. These communities also represent areas of Australia with higher populations of Aboriginal and Torres Strait Islander populations, and the cultural and linguistic diversity that exists there needs to be taken into account when interpreting the significance of these findings.

Cultural and Linguistic Diversity

The existence of language variations and cultural differences has implications for identification of impairment or vulnerability. In the AEDC, teachers were asked to report on children's language and communication skills, and would have done so with reference to skills in Standard Australian English (SAE). As such, the identification of difficulty may not have taken into account the language differences of the populations on whom they were reporting. The identification of vulnerability in language and communication skills using a measure standardised on speakers of SAE is a complex issue in English-dominant nations

such as Australia, where many young children are exposed to multiple languages during the years when communication skills are developing (McLeod, 2011). Multiple researchers have warned against the identification of “delay” or “disorder” when it is in fact a language or dialectal difference that exists (Gould, 2008; McGregor, Williams, Hearst, & Johnson, 1997; Toohill, McLeod, & McCormack, 2010).

In recent years, Australia has seen a growing number of immigrants and refugee families, whose children learn English as a second or other language. Verdon, Mcleod and Winsler (2014) reported that in a nationally representative study of over 5,000 Australian children, 15.3% of Australian children did not speak English as their primary language upon commencing formal schooling. In addition, approximately 3% of the Australian population identify as being Aboriginal or Torres Strait Islander (Australian Bureau of Statistics, 2011). For many young Aboriginal and Torres Strait Islander children, English is one of several languages that they may learn simultaneously (McLeod, Verdon & Bennetts Kneebone, 2014). Aboriginal and Torres Strait Islander children living in remote communities are more likely to speak an Indigenous language (Verdon & McLeod, 2015), and the English that they learn may be a dialect of Standard Australian English, termed Australian Aboriginal English (AAE), which has unique phonetic and linguistic characteristics (Obata & Lee, 2010).

In the 2012 AEDC results, teachers reported that out of the 15,490 children identified as being of Aboriginal or Torres Strait Islander background, 3,070 (19.8%) spoke a language other than English at home, with AAE being the most common (n=817, 26.6%) (Australian Government, 2013). In contrast, when drawing on parent report data from the Longitudinal Study of Indigenous Children, 56.4% of parents reported that AAE was spoken at home (Verdon & McLeod, 2015). This discrepancy demonstrates possible implications of using teacher report as opposed to parent report as teachers may come from different cultural and linguistic backgrounds from the children they report on and therefore may not report that

dialect spoken by the children accurately, highlighting the possible cultural insensitivity of the AEDI tool.

In addition to the judgment of teachers completing the checklist, the checklist itself may have influenced the identification of children deemed to be vulnerable/at risk. Debate has occurred throughout the literature regarding the cultural sensitivity of the AEDI as a population measure (see Li, D'Angiulli & Kendall, 2007; Janus, Hertzman, Guhn, Brinkman, & Goldfeld 2009; Li, D'Angiulli & Kendall, 2009). The findings of the EDI in Canada and the AEDI in Australia suggest higher vulnerability in children from CALD backgrounds (e.g. migrant and Indigenous populations) (Li et al., 2007) particularly on the two domains relating to communication: Language and Cognitive Skills and Communication Skills and General Knowledge, suggesting that the tool does not account for language and dialectal differences in the evaluation of children's performance. Counter arguments state that the tool is not intended for use at the individual level to avoid the labelling of children as vulnerable (Janus, et al., 2009). However, community level findings still reflect a bias in communities where children are largely from CALD backgrounds. For example, some children, particularly those from Aboriginal or Torres Strait Islander backgrounds, may have been misidentified with communication impairments due to the checklist lacking cultural sensitivity, and failing to take into account linguistic and cultural differences in ways of communicating. To achieve better sensitivity, it has been recommended that teachers completing the AEDI for Aboriginal or Torres Strait Islander children should do so with the support of an "Indigenous cultural consultant". However, in the 2012 AEDC this was only done with 35.3% of Aboriginal or Torres Strait Islander children (Australian Government, 2013).

Given that most of the locations with high proportions (>20%) of children identified as vulnerable/at risk in Language and Cognitive Skills and Communication Skills and General Knowledge were in areas of Australia with high Aboriginal or Torres Strait Islander

populations, language background and cultural diversity need to be taken into account when determining whether speech-language pathology input or other assistance is actually required. However, the language and communication requirements of the communities in which the children learn and play also need to be considered. At present, SAE is likely to be the language used at school for most children, and proficiency in that language is required to progress through the school curriculum. Thus, identification of children requiring support in their development and use of SAE is warranted. It is important, however, to distinguish between children's need for educational support as learners of English as a second language, and the need for specialist support for vulnerable or impaired language and communication skills.

The availability of speech-language pathology services for Australian communities

Paediatric SLPs are located within all states and territories of Australia, with the majority located in the most populated states. On first reflection, the ratio of SLPs to children in need of services (those identified as vulnerable/at risk) across Australia may present as a manageable figure. However, the states/territories with the highest proportions of children identified as vulnerable/at risk are also those with the fewest SLPs present to service their needs, resulting in a much different ratio of service to need, when individual state data is considered (e.g., Northern Territory). When community level data is considered, the lack of services available to address needs becomes even more apparent. The majority of communities (LGAs) across Australia do not have access to a resident SLP (according to the postcode recorded for the SLPs in the SPA membership database), including those with the highest proportion of children identified as vulnerable or at risk in their language and communication development. When the number of children identified as vulnerable was calculated for each of those LGAs, it was found that between 7000-9000 children might not have access to speech-language pathology services. It is possible that not all of these children

would require speech-language pathology input; however, it is problematic that no services exist for those children who do.

In addition, it must be remembered that children participating in the AEDC are only one age group that paediatric SLPs service. The prevalence of communication concern is often higher among children in the preschool years, and difficulties can continue beyond the early school years, so there would be many more children (both younger and older than the current sample) requiring speech-language pathology services across Australia who have not been considered in the current research. When the potential number of these children is considered, the need for additional services across Australia is clear.

The need for services

While the findings from the AEDC need to be considered in light of other factors that may impact on results, such as linguistic background and cultural sensitivity, the results can still be useful as a broad-brush tool for considering markers of children's early development and wellbeing at the community level and identifying possible areas of need for service planning and provision (Li, D'Angiulli & Kendall, 2007; Sayers, Coutts, Goldfeld, Oberklaid, Brinkman, & Silburn, 2007). The AEDC provides insight into the performance of children on tasks required for successful progression through the current school curriculum. As such, it does provide one means by which to identify children who are not achieving expectations. This is important in order that they may receive appropriate assistance and are not disadvantaged at school or in later education or employment. The benefits of timely and appropriate speech-language pathology intervention far outweigh the cost to individuals, families and society if speech impairment is left untreated (Ruben, 2000).

Type and duration of service provision

There are many available speech and language interventions with high levels of evidence of their effectiveness (Baker & McLeod, 2011; Law, Garrett, & Nye, 2010).

However, in order to be effective, the correct intervention needs to be implemented in accordance with the need identified. Given that the AEDI is a community-level tool for identifying vulnerability, Brinkman et al. (2009) highlight the importance of considering the complexity of patterns of need that may occur within different communities. It is argued that the concentration of need varies within and between communities and therefore approaches taken to meet the needs of children within individual communities also need to vary. For example, in communities where vulnerability is distributed evenly across all children, a universal approach to services may be the best approach to improving children's outcomes. Alternatively, in communities where need is concentrated in a small number of children, a targeted approach to intervention may be the best way to support these children.

In order to be effective, interventions need to be implemented in ways that are supported by evidence. For example, if targeted interventions are selected, sufficient amounts of intervention need to be provided to enable effective change/amelioration of communication difficulties (Law & Conti-Ramsden, 2000). Where current SLP services are limited as a result of limited availability in many rural and remote areas, and the extensive waiting lists in metropolitan areas (Ruggero, McCabe, Ballard, & Munro, 2012), other modes of service delivery, such as telehealth or collaboration/consultation with other professionals (such as early childhood educators and teachers) can be explored to assist in the provision of appropriate services which meet the needs of many children with communication needs and their families.

Limitations

While this study provides a useful exploration of the locations of communities across Australia in which children may require greater access to speech-language pathology services, there are a number of limitations to the findings that need to be considered. In particular, the identification of children who are vulnerable/at risk for language and

communication difficulties is based on an analysis of data from the AEDC, and has not taken into account other factors that may contribute to the identification of communication difficulty (cultural and linguistic background, developmental delay). Additionally, the AEDC does not collect teachers' demographic data, therefore little is known about the cultural and linguistic background of teachers, their confidence in identifying speech, language and communication needs or their years of experience there for its difficult to know whether these factors may have influenced their perceptions of children's performance and their completion of the AEDC.

The identification of speech-language pathology services is based on data from the SPA membership list, which does not take into account speech-language pathologists who are not SPA members. In addition, the data from SPA (collected in 2014) is more recent than the AEDC data (collected in 2012), and there may be some changes in the number and location of communities with high numbers of children identified as vulnerable or at risk, and some SLPs may service multiple LGAs. These factors do impact on the conclusions that can be drawn from the current dataset; however, mapping services and communication status in this way provides a useful first step towards identifying areas of need and may assist in advocating for service provision. Indeed, this study demonstrates how spatial analyses could be used in other countries to produce maps, which identify areas of unmet need to facilitate policy and planning of services.

Conclusion

This research study makes a unique and important contribution to the literature by answering calls to inform policy and decision making with regards to allocation of funding and resources for paediatric speech-language pathology services across Australia. The research draws upon a nationwide large-scale data set to demonstrate the extent of the need and to identify specific areas of need across Australia. The Australian government has identified the

provision of appropriate resources to support health and wellbeing during early childhood as an ongoing investment with long-lasting benefits for the children and the communities in which they live (Centre for Community Child Health, 2009). However, results from the current study indicate that in Australia, at the present time, not all children with communication difficulties have access to necessary speech-language pathology services. This may be due, in part, to government policies within the disability, health, and education departments which fail to allocate sufficient resources and funding to children identified with communication difficulties. It may be exacerbated by government policies in some states of Australia, which do not enable employment of speech-language pathologists within the education system (McLeod et al., 2010). This research provides evidence of the need for collaboration between health, education, and disability sectors to update current service provision policies, and to ensure holistic and appropriate care is available to support all children with communication difficulties, and their families, for as long as required.

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Table I. Location of paediatric speech-language pathologists in Australia who were registered SPA members in 2014

	NSW	Vic	Qld	SA	WA	Tas	ACT	NT	Australia
Total number	1216	823	536	234	278	52	23	19	3181
Missing postcodes*	44 30 private 10 public 2 NGO 2 unknown	43 19 private 17 public 7 unknown	20 6 private 14 public	16 5 private 9 public 1 NGO 1 unknown	20 8 private 11 public 1 unknown	2 1 public 1 unknown	5 4 private 1 public	2 1 private 1 public	170
Mapped									3011

*When SLPs did not provide details of their location (state/territory and/or postcode), their data were removed from further analysis as it was not possible to include their data in the maps (total n=170).

Table II. AEDC domains and sub-domains

Domain	Sub-domains	Example checklist items
Physical Health and Wellbeing	Physical readiness for the day Physical independence Gross and fine motor skills	How would you rate this child's proficiency in holding a pen, crayon or brush? (Very good/good, average, poor/very poor, don't know)
Social Competence	Overall social competence Responsibility and respect Approaches to learning Readiness to explore new things	Would you say that this child is able to play with various children? (Often/very true, sometimes/somewhat true, never/not true, don't know)
Emotional Maturity	Pro-social and helping behaviour Anxious and fearful behaviour Aggressive behaviour Hyperactivity and inattention	Would you say this child will try to help someone who is hurt? (Often/very true, sometimes/somewhat true, never/not true, don't know)
Language and Cognitive Skills (school-based)	Basic literacy Interest in literacy, numeracy and memory Advanced literacy Basic literacy	Would you say that this child is able to read simple words? (Yes, no, don't know)
Communication Skills and General Knowledge	Communication skills and general knowledge	How would you rate this child's ability communicate own needs in a way understandable to adults and peers? (Very good/good, average, poor/very poor, don't know)

Table III: Proportion of children within each state/territory evaluated as developmentally vulnerable, at risk or on track in each of the AEDC domains, and ratio of SLPs

State	Total Assessed	Domain	On track		At risk		Vulnerable		At risk/ vulnerable	SLPs	Ratio
			n	%	n	%	n	%	N	n	
NSW	89,450	Language and Cog	78,022	87.2	7,177	8.0	4,251	4.8	11,428	1,216	1:9.4
	89,460	Comm and Knowledge	66,806	74.7	15,064	16.8	7,590	8.5	22654	1,216	1:18.6
VIC	64,195	Language and Cog	53,929	84.0	6,351	9.9	3,915	6.1	10,266	823	1:12.5
	64,038	Comm and Knowledge	49,557	77.4	9,371	14.6	5,110	8.0	14,481	823	1:17.6
QLD	58,122	Language and Cog	45,632	78.5	7,186	12.4	5,304	9.1	12,490	536	1:23.3
	58,203	Comm and Knowledge	41,547	71.4	10,417	17.9	6,239	10.7	16,656	536	1:31.1
SA	17,432	Language and Cog	14,440	82.8	1,804	10.3	1,188	6.8	2,992	234	1:12.8
	17,439	Comm and Knowledge	12,849	73.7	3,038	17.4	1,552	8.9	4,590	234	1:19.6
WA	30,798	Language and Cog	23,346	75.8	4,816	15.6	2,636	8.6	7,452	278	1:26.8
	30,837	Comm and Knowledge	23,643	76.7	4,397	14.3	2,797	9.1	7,194	278	1:25.9
Tas	6,166	Language and Cog	4,966	80.5	761	12.3	439	7.1	1,200	52	1:23.1
	6,114	Comm and Knowledge	4,757	77.8	955	15.6	402	6.6	1,357	52	1:26.1
NT		Language	1,938	62.0	537	17.2	649	20.8	1,186	19	1:62.4

	3,124	and Cog									
	3,142	Comm and Knowledge	2,150	68.4	538	17.1	454	14.4	1,229	19	1:64.7
ACT	4,609	Language and Cog	3,987	86.5	440	9.5	182	3.9	622	23	1:27.0
	4,622	Comm and Knowledge	3,393	73.4	853	18.5	376	8.1	992	23	1:43.1
Australia	273,896	Language and Cog	226,260	82.6	29,072	10.6	18,564	6.8	47,636	3181	1:15*
	273,855	Comm and Knowledge	204,702	74.7	44,633	16.3	24,520	9.0	69153	3181	1:21.7**

* Note: Based on SPA members working with paediatrics (n=3,181). Correspondence with SPA suggests 80% membership, which would suggest total number of SLPs in Australia working with paediatrics would be approximately 3,817. Ratio of SLPs to children would be 1:12.5 based on this estimate.

** Note: Based on SPA members working with paediatrics (n=3,181). Correspondence with SPA suggests 80% membership, which would suggest total number of SLPs in Australia working with paediatrics would be approximately 3,817. Ratio of SLPs to children would be 1:18.1 based on this estimate.

Table 4: Number of LGAs and proportion of children identified as on track, at risk or vulnerable

Proportion of children within LGA	Language and Cognitive Skills			Communication Skills and General Knowledge		
	Vulnerable	At risk	On track	Vulnerable	At risk	On track
<10%	364	207	2	326	77	0
10-20%	102	239	1	140	306	1
>20%	27	47	490	27	110	492

Table 5: Number of SLPs and children assessed in each Local Government Area

Number of SLPs	Number of LGAs	Total number of children assessed on the Language and Cognition domain within those LGAs	Number of children identified as “vulnerable”	Total number of children assessed on the Communication Skills and General Knowledge domain within those LGAs	Number of children identified as “vulnerable”
0	312	93840	7470	93837	8339
1 or more	181	180863	10973	180820	16213

Figure 1: Proportion of children identified as being developmentally vulnerable in the Language and Cognitive Skills domain, and location of SLP services, according to local government areas

Figure 2: Proportion of children identified as being developmentally at risk in the Language and Cognitive Skills domain, and location of SLP services, according to local government areas

Figure 3: Proportion of children identified as being developmentally vulnerable in the Communication Skills and General Knowledge domain, and location of SLP services, according to local government areas

Figure 4: Proportion of children identified as being developmentally at risk in the Communication Skills and General Knowledge domain, and location of SLP services, according to local government areas