April 2021

Understanding service use at a local level

Area-level attendance at B4 School Checks

SOCIAL WELLBEING AGENCY | TOI HAU TĀNGATA

New Zealand Government

Author

Nichola Shackleton, Principal Analyst Insights

Acknowledgements

This work was undertaken in partnership with the ‘A Better Start’ National Science challenge big data team. Analyses were undertaken by Sheree Gibb (University of Otago), Eileen Li (University of Auckland) and Barry Milne (University of Auckland). Debra Small (Senior Analyst, Insights) provided valuable feedback and suggestions throughout the project and helped with the QA of the data presented in the DHB reports and Insights report. Michelle Barr (Analyst, Insights) helped to draft the Insights report and helped with the construction of the DHB reports. Lucy McSweeney (Analyst, Insights) also helped with the construction of the DHB reports.

Creative Commons Licence

Liability

Ethical note

Applications for new analyses of the B4 School Checks table in the Integrated Data Infrastructure (IDI) are currently not being approved, until a revision of the consent form and some other actions are complete. Note that this project started before approvals were halted and that this analysis of attendance does not use personal information from the B4 School Check table.

Citation

Social Wellbeing Agency 2021. Understanding service use at a local level: Area-level attendance at B4 School Checks. Wellington, New Zealand.

Disclaimer

Access to the data used in this study was provided by Statistics New Zealand under conditions designed to give effect to the security and confidentiality provisions of the Statistics Act 1975. The results presented in this study are the work of the authors, not Statistics NZ.

The results are based in part on tax data supplied by Inland Revenue to Statistics NZ under the Tax Administration Act 1994. This tax data must be used only for statistical purposes, and no individual information may be published or disclosed in any other form, or provided to Inland Revenue for administrative or regulatory purposes. Any person who has had access to the unit record data has certified that they have been shown, have read, and have understood section 81 of the Tax Administration Act 1994, which relates to secrecy. Any discussion of data limitations or weaknesses is in the context of using the IDI for statistical purposes, and is not related to the data's ability to support Inland Revenue's core operational requirements.

ISBN 978-0-473-56778-1 (online)

Published in March 2021 by
Social Wellbeing Agency
Wellington, New Zealand

Contents

Purpose

Access to services plays a fundamental role in government's ability to improve wellbeing. The Social Wellbeing Agency is interested in understanding service provision and use at a more granular geographic level. This project was intended to be our first exploration of the value of local area level analyses, and how the local experience may differ from nationally reported figures.

We focused on uptake of B4 School Checks, as national level analysis had already been undertaken as part of the Better Start research programme[1] and we could readily build on this work. This project provided an opportunity to describe the children and their families missing out on this important universal health and development screen at a local area level. For this project we created DHB specific reports describing attendance at B4 School Checks at the level of territorial authority/local board (TALB) area. We also considered the sociodemographic and health factors associated with differences in B4 School Check attendance. This report presents the high-level findings from the analysis. The DHB specific reports were shared with the Ministry of Health.

This work provides useful information for those looking at improving attendance at B4 School Checks and supports the Ministry of Health in their review of Well Child Tamariki Ora[2]. Specifically, this work supports the part of the review focussed on equity by delivering evidence and insights on current access inequities to the final Well Child Tamariki Ora check. This project demonstrates there is value in undertaking these more granular local area-level analyses.

Context

The B4 School Check (B4SC) is a free health and development screen that occurs at age four. It aims to identify and address any health or developmental concerns which could affect a child's ability to get the most benefit from school. If a child is enrolled with a Primary Healthcare Organisation (PHO), a letter or email will be sent to parents inviting them to bring the child along for a B4SC. Parents can also request a check by approaching a general practitioner (GP) or other B4SC provider.

The B4SC consists of a series of checks. For the purposes of this report we have collapsed these checks into three components. These components were developed in consultation with the Ministry of Health and reflect the way in which the checks are typically completed. The components are:

- VHT: Vision and hearing tests. These are usually completed together by vision and hearing technicians.
- Nurse: These include assessments of growth, dental, immunisation, Parental Evaluation of Developmental Status (PEDS) - a questionnaire for parents to detect developmental and behavioural problems in children; as well as the Strengths and Difficulties questionnaire (SDQ) – a tool for assessing emotional and behavioural development - completed by the child's main caregiver.

[1]Gibb, S, Milne, B. Shackleton, N, Taylor, B, Audas, R. (2019). How Universal are Universal Pre-School Health Checks? An observational study using routine data from New Zealand's B4 School Check. BMJ Open;9:e025535

[2] https://www.health.govt.nz/our-work/life-stages/child-health/well-child-tamariki-ora-services/well-child-tamariki-ora-review

- SDQ-T: SDQ completed by the child's early childhood education (ECE) teacher. Teachers receive the questionnaire directly from the B4SC provider and are responsible for returning it to the provider.

The B4SC is undertaken in a variety of community, health and education settings. The VHT component of the check may happen at a different time to the nurse component of the check.

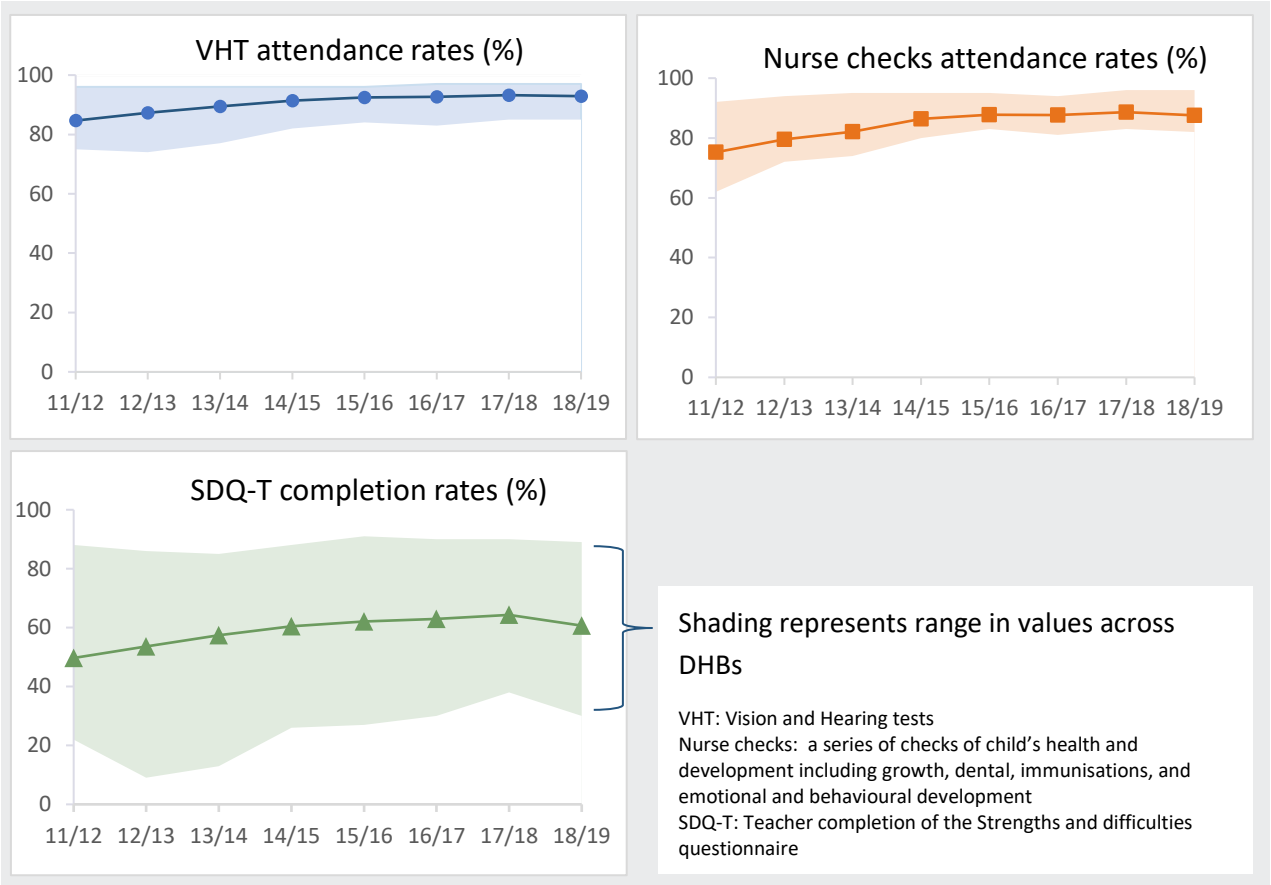
This work updates and extends previous research conducted at the national level which found that children who are most in need of the services offered at the B4 School check may be the least likely to attend. Here we consider a wider range of sociodemographic and health factors and their associations with attendance at B4 School Checks within specific areas. At the time of writing B4SC data were available up to July 2019, making the 2018 fiscal year (1 July 2018 to 30 June 2019) the latest that we were able to include. Attendance rates were measured for each fiscal year from 2011 to 2018.

High-level findings & implications

- At a national level, the rate of reported **teacher completion of the SDQ is much lower than the rate of attendance at VHT or nurse checks**. In 2018 the average national completion of SDQ-T was 61% compared to 93% for VHT and 88% for nurse checks.
- **Across DHBs there is a large variation in the rate of reported teacher completion of SDQ.** In 2018 completion rates ranged between 30-89% across DHBs. This shows that undertaking more granular geographic analysis is useful as national results may mask significant variation in local experiences.
- Whilst the trend for all checks at a national level has been positive or stable for the last few years, **some DHBs have experienced sharp reductions and volatility in SDQ-T reported completion** rates over the last 5 years.
- The **two variables with the strongest and most consistent association with missing the B4 School Checks are 1) whether the child is receiving disability support and 2) whether the child is not enrolled with a GP consistently** (enrolled for 3 or fewer quarters between birth and fourth birthday). These are consistent across all components of the B4 School Checks. This could potentially be because:
  - children receiving disability support may have high levels of interactions already with the health system rendering the B4 School Checks unnecessary or inappropriate (although this assumption needs to be tested) and;
  - children who are not enrolled with a GP may not receive the invites to the B4 School Checks from their PHO.
- **Whilst living in a high deprivation area within a DHB is associated with missing checks, some DHBs with high levels of deprivation have very good levels of attendance – potentially, in part, due to linked funding.**
  - Within each DHB, children living in areas of high deprivation are more likely to miss checks than children living in lower deprivation areas in the same DHB.
  - However, DHBs with a higher proportion of children living in high deprivation areas can have very good attendance rates for VHT and Nurse checks. For example, Tairawhiti has more than twice the national average of children living in a high deprivation area but has higher levels of attendance at all parts of the checks than the national average. This may be because these DHBs have a proportion of their funding linked to achieving a specified coverage level for 'vulnerable groups'.
- Potential next steps for this work include:
  - Putting these data into context through discussions with DHBs and providers, as this may help with appropriate interpretation and lead to more meaningful insights.
  - Undertaking further analysis to focus on policy levers and mechanisms for improving attendance
  - Discussing barriers to attending checks with providers and families to understand the lived experience. This is important for understanding why children receiving disability support have lower levels of B4 School Check attendance.

There is a large range in reported SDQ-T completion rates across DHBS.

Figure 1: B4SC national average attendance rates for each component of the check. Shading represents ranges in attendance rates across DHBs



Between 2011/12 and 2018/19, we estimated a total of 492,096 four-year-olds eligible to take part in the B4 School Checks (approx. 60,000 per year). To determine an 'eligible population' for B4SC attendance each year we included all children who were resident in New Zealand[3] and had turned 4 in the previous year. This allowed each child at least a year after their fourth birthday to get their check completed.

Annual attendance rates for each component of the check are displayed in Figure 1. Shading represents the range in completion rates across DHBs. Further information on the analysis is provided in the 'Analytic Report' in the appendix.

[3] We used the resident population table in the IDI (data.snz_respop) to determine residency. This table includes children in the resident population for a given year if they meet any of the following criteria:
- NZ birth record in the last 5 years
- NZ visa record (excluding visitor or transit visas) in the last 5 years
- Tax, health or education record in the last 2 years

Children who had lived outside NZ for at least 12 of the last 16 months were removed from the resident population.

VHT attendance

Vision and hearing tests (VHT) had the highest average attendance rate of the three components of the check. In 2018, 93% of four-year-olds attended VHTs. VHT attendance rates either increased or remained stable between 2011 and 2018 for all DHBs, apart from Hawke's Bay where attendance rates reduced from 93% in 2011 to 89% in 2018. However, VHT attendance in Hawkes Bay is **underestimated** because some groups in Hawke's Bay have requested VHT data not be entered into the database.

VHT attendance was consistently high and had the least variation in attendance rates across DHBs. In 2018 VHT attendance ranged from 85%-97% across DHBs.

Nurse check attendance

Nurse check attendance rates were on average lower than VHT attendance rates but followed similar trends over time. In 2018, 88% of four-year-olds attended a nurse check. Nurse check attendance rates increased or remained stable across all DHBs between 2011 and 2018. In 2018 nurse check attendance ranged from 82%-96% across DHBs.

SDQ-T reported completion

SDQ-T completion rates were on average lower than VHT and nurse check attendance rates. In 2018, the average national completion rate was 61%. However, there was wide variation in SDQ-T completion rates between DHBs. In 2018, SDQ-T completion rates ranged from 30%-89% across DHBs.

On average SDQ-T completion rates increased between 2011 and 2018. However, completion rates in several DHBs declined over time. Within the Auckland DHB, SDQ-T rates reduced from 71% in 2013 to 39% in 2015, before increasing to 45% in 2018. Similarly, completion rates in Northland reduced from 68% in 2013 to 54% in 2018. Decreases in completion rates were also observed in Hawke's Bay, Waitemata, West Coast and Whanganui DHBs in the years to 2018.

We do not know if decreases in recorded SDQ-T completion reflect decreases in teacher completion, or changes in data entry practice over time. An audit of the B4 School Check by Counties Manukau DHB found that SDQ-T forms were not entered in the database when they were returned 'late' (after the child's case has been closed)[4]. But, the number of forms this affected was not quantified – it could be many forms or just a few. SDQ-T completion rates were consistently low in Counties Manukau, but they did increase from 22% in 2011 to 30% in 2018.

Possible explanations for the large range in SDQ-T completion rates across DHBs include differences in the administration of SDQ-T and data entry practices; different local relationships with ECEs; the types of ECEs within the local area; and the perceived acceptability of the SDQ-T assessment. In addition, teachers will only have enough observations to be confident to complete the SDQ-T if children regularly attend the same ECE.

These findings need to be shared with those who undertake the checks and are responsible for reporting so that findings like this can be put into context.

[4] Gray S (2014) Before School Check Audit. Counties Manukau District Health Board. Auckland: Counties Manukau District Health Board

The strongest associations between sociodemographic and health variables with non-attendance

Table 1: The top ten sociodemographic and health variables associated with non-attendance

Rank	VHT	Nurse	SDQ-T
1	Child received disability support	Child received disability support	Child received disability support
2	Enrolled with a GP for 0-3 quarters	Enrolled with a GP for 0-3 quarters	Enrolled with a GP for 0-3 quarters
3	Mother has no formal qualifications	No motor vehicle access	Household contains 8+ people
4	No motor vehicle access	Household contains 8+ people	No motor vehicle access
5	Household contains 8+ people	Mother has no formal qualifications	Living in NZDep Quintile 5 area
6	Mother was aged less than 20 years old at birth	Changed residence 5 or more times	Mother has no formal qualifications
7	Living in NZDep Quintile 5 area	Enrolled with a GP for 4-7 quarters	Mother was aged less than 20 years old at birth
8	Changed residence 5 or more times	Mother was aged less than 20 years old at birth	Changed residence 5 or more times
9	Lives in a rented home	No inpatient hospital visits between birth and age 4	Does not identify as European ethnicity
10	No inpatient hospital visits between birth and age 4	Identifies as Māori ethnicity	No father listed on birth record

We considered the associations between sociodemographic, health and health service use variables and non-attendance at each component of the B4SC for each DHB. Overall, the same characteristics are associated with non-attendance at each of the components of the check within a DHB. However, the strength of the associations is consistently weaker for the SDQ-T component than for the VHT and nurse components. We ranked variables within each DHB based on the strength of the association with non-attendance. Table 1 presents the top ten ranking correlates of attendance on average across DHBs for each component of the B4SC.

The strongest and most consistent correlates of non-attendance across DHBs are whether the child is receiving disability support[5] and not being enrolled with a GP consistently. At the national level children who received a referral to Disability Support Services before their fourth birthday or who were not consistently enrolled with a GP were around 3 times more likely to miss out on the VHT component of the

[5] This refers to children who received a referral to Disability Support Services before their fourth birthday

checks. It is possible that children with disability may be less likely to attend B4 School Checks due to their already high levels of contact with the health system; meaning the checks may not be considered necessary or appropriate. Further work is needed to understand if this is a choice made by parents/caregivers, or there are barriers to parents/caregivers accessing the B4 School Checks for their child with a disability.

Children not enrolled with a GP may miss their checks because they do not receive the B4SC invitations – which are often initiated by the PHO in which a child is enrolled.

There are several sociodemographic variables that have stronger associations with B4SC non-attendance in most DHBs, such as not having access to a motor vehicle, having a mother with no formal qualifications or living in large households. At the national level children with these sociodemographic characteristics are around 2 times more likely to miss out on the VHT component of the checks. However, there is more variability across DHBs in terms of how these variables rank.

Notable DHB specific differences

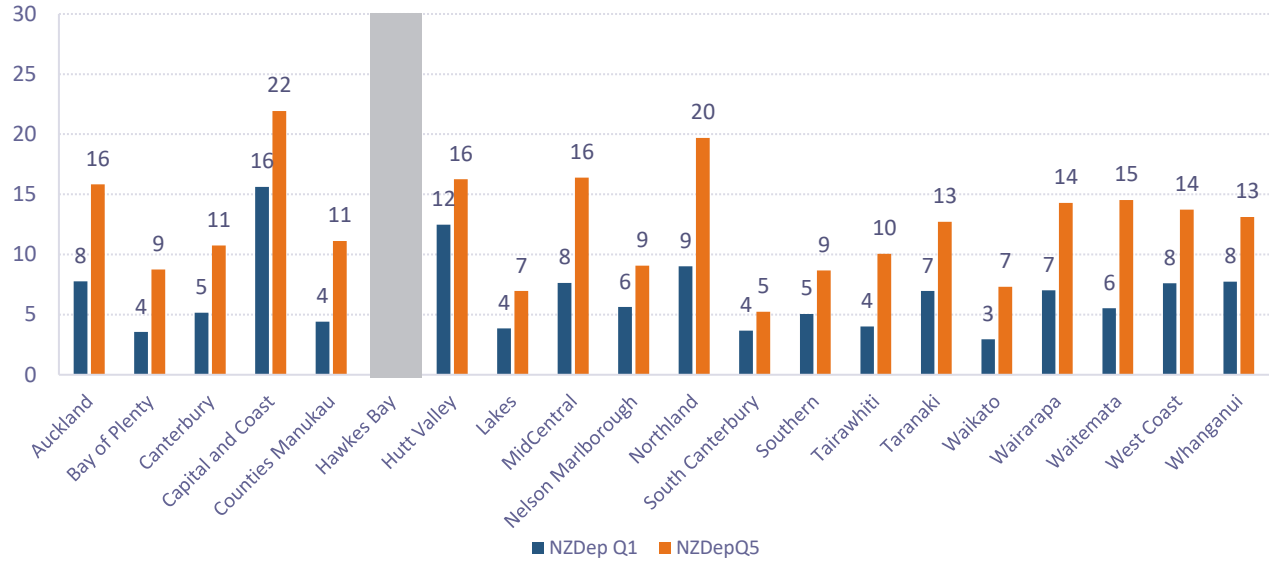
For the West Coast DHB, a gestational age at birth of more than 42 weeks and having 2+ siblings at the time of child's birth were strongly associated with non-attendance.

For the Wairarapa, Southern and Taranaki DHBs whether the child's mother spoke enough English to have a conversation about everyday things was a strong correlate of attendance at both VHT and nurse checks.

The complex relationship between socioeconomic deprivation and attendance at checks

Within DHBs, children who live in areas of high socioeconomic deprivation are more likely to miss out on the B4SC compared to other children in that DHB who do not live in deprived areas. This is demonstrated in Figure 2 using VHT non-attendance rates. However, DHBs with a relatively high percentage of children living in socioeconomically deprived areas can obtain very high attendance rates. For example, Lakes, Tairawhiti, Counties Manukau and Whanganui DHBs have some of the highest estimated attendance rates at the VHT component of the checks despite more than 40% of the four-year-olds in these DHBs residing in areas of high socioeconomic deprivation. Table 2 presents the attendance and completion rates for the 5 DHBs with highest percentage of four-year olds living in areas of high socioeconomic deprivation.

Figure 2: VHT non-attendance rates by DHB in 2018, disaggregated NZDep2013 quintile 1 (least deprived) and quintile 5 (most deprived)



Note: The data for Hawke's Bay DHB has been removed from this graph because some groups in Hawke's Bay have requested hearing and vision check data not be entered into the database. This means we have underestimated attendance at vision and hearing checks.

Table 2: B4 School Check attendance rates in 2018 for the DHB with the highest Percentage of four-year-olds living in NZDep2013 Q5

DHB	Percentage of four-year-olds living in NZDep2013 Q5	VHT attendance rate	Nurse check attendance rate	SDQ-T completion rate
Tairawhiti	54	96	91	82
Counties Manukau	48	95	87	30
Northland	45	87	83	54
Lakes	43	97	93	84
Whanganui	42	94	88	65
National Average	26	93	88	61

A higher percentage of children residing in deprived areas in a DHB is not associated with lower DHB attendance rates at VHT and nurse checks in 2018[6]. However, DHBs with a higher percentage of children living in socioeconomically deprived areas do tend to have lower SDQ-T completion rates.

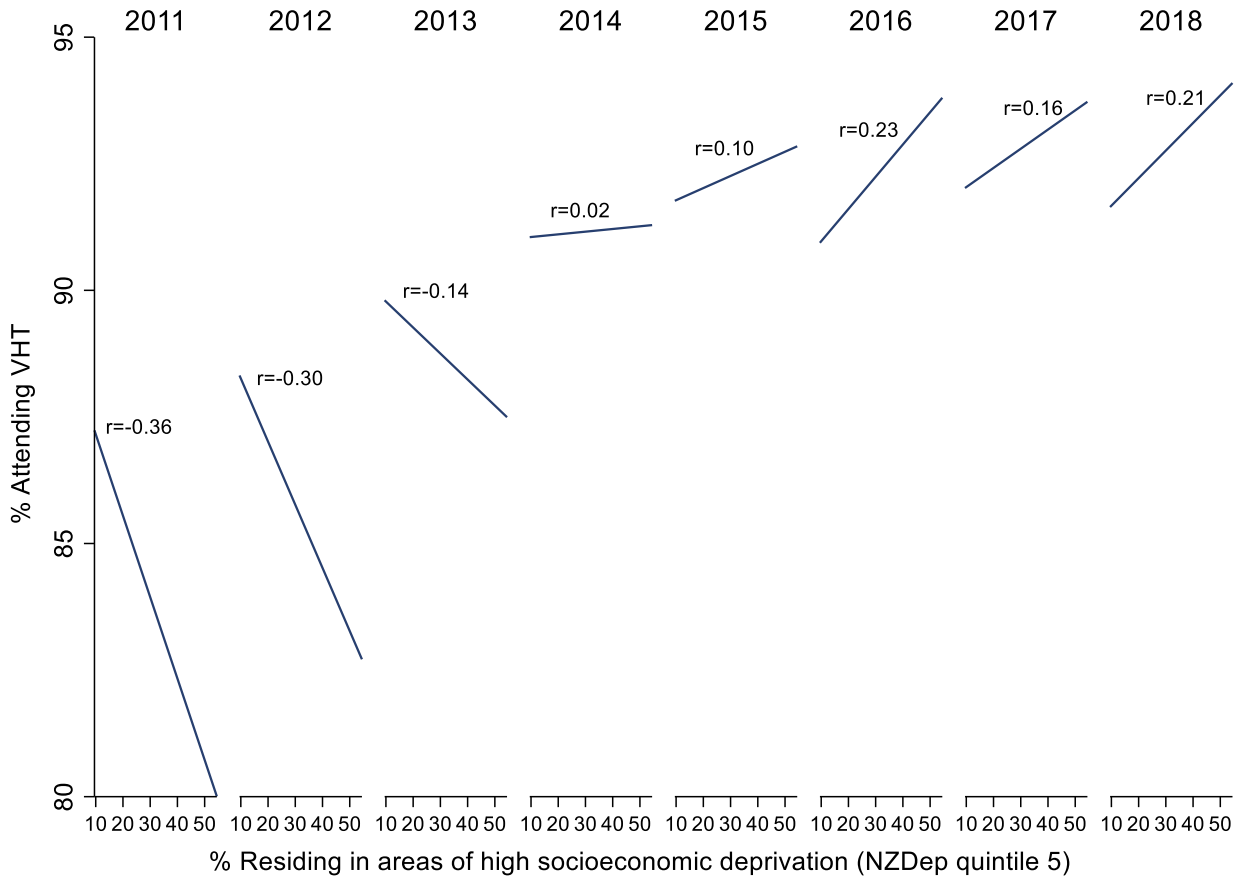
[6] At the DHB-level (20 DHBs) we estimated both the Pearson correlation between the percentage of children residing in deprived areas and attendance rates at VHT (r=0.21,) nurse checks (r=0.01) and SDQ-T completion (r=-0.32) in 2018. We excluded Hawkes Bay from the VHT correlation estimates as attendance at VHT underreported for Hawkes Bay.

While in the early years of the check there was a tendency for DHBs with a higher percentage of children living in socioeconomically deprived areas to have lower VHT and nurse attendance rates, this is no longer the case. Figure 3 demonstrates how this relationship has changed over time using VHT check attendance. The relationship for attendance at nurse checks shows a similar pattern over time. For SDQ-T completion rates the association has persisted over time[7].

This improvement for VHT and nurse checks for high deprivation areas may be linked to a couple of factors:

- In DHBs where there is a high percentage of children residing in areas of high deprivation, systems may have been developed over time for reaching those at risk of non-attendance for VHT and Nurse checks. Whereas ECEs may have less influence over attendance and engagement.
- High coverage rates for 'vulnerable groups' including children living in areas of high socioeconomic deprivation is encouraged by linking a portion of DHB funding for B4SC to achieving a specified level of coverage for these children.

Figure 3: The association between VHT attendance rates and the percentage of children residing in NZDep2013 quintile 5 (most deprived) areas within DHBs, by year.



In 2011 and 2012 DHBs with a higher percentage of children living in high deprivation areas had lower VHT attendance rates on average. Over time the relationship inverted and DHBS with a higher percentage of children living in high deprivation areas had higher VHT attendance rates on average.

[7] The estimated Pearson correlation for each year is consistently ~-.3 to -.4

Limitations of this analysis and caveats for interpretation

This analysis is descriptive – it shows trends and associations but cannot say whether a particular aspect caused higher or lower attendance at the checks. We present bivariate (i.e. two variable) associations - these do not account for the potential influence of other characteristics of four-year-olds and their families on the association. To do this we would need to undertake 'adjusted' analyses (e.g. through multiple regression). We have not undertaken adjusted analyses in this project because it would result in substantial loss of sample size and potentially introduce bias. Some groups of individuals are more likely to have missing information than others (for example Māori and Pacific people are less likely to complete the census) and therefore removing these individuals may introduce selection bias. It is possible that adjusted analyses could be completed in future work (See the section titled 'suggestions for future work').

There are high correlations between some of the sociodemographic variables. For example, DHBs with relatively high rates of children living in areas of high socioeconomic deprivation (NZDep quintile 5) also tend to have a relatively high percentage of:

- households that received income from benefit,
- where no father was listed on the birth record
- children living in households with no motor vehicle access,
- children living in rented homes
- mothers aged under 20 years at birth

Further work is required to understand whether some of these sociodemographic variables are solely functioning as indicators of socioeconomic deprivation, or whether they suggest a potential additional policy lever for improving attendance. For example, attendance rates are lower where there is no access to a motor vehicle in the household in which the child lives. This may indicate difficulties in accessing B4SC testing locations. Alternatively, or additionally, this may be functioning as another indicator of socioeconomic deprivation. The further work required is detailed in the section titled 'suggestions for future work'.

It is possible that the greater variability and volatility in SDQ completion rates may reflect differences across DHBs in how these data are recorded, rather than real differences in completion rates. These findings need to be shared with those who undertake the checks and are responsible for reporting so that findings like this can be put into context.

It is worth noting that the attendance estimates here are not directly comparable to the Ministry of Health's estimates. We use a different denominator ('eligible' population) to that used by the Ministry of Health in tracking the performance of the B4 School Checks. The Ministry of Health uses estimates based on the Primary Health Organisaton (PHO) register, and we used the resident population table in the IDI, removing children who had lived outside NZ for at least 12 of the last 16 months. Furthermore, ethnicity is reported as 'total response' not 'prioritised'[8].

[8] Boven, N., Exeter, D., Sporle, A., & Shackleton, N. (2020). The implications of different ethnicity categorisation methods for understanding outcomes and developing policy in New Zealand. Kōtuitui: New Zealand Journal of Social Sciences Online, 15(1), 123-139.

Suggestions for future work

Sharing with those who have the operational knowledge

This work, including 20 DHB specific reports, has been shared with the Ministry of Health who will use the outputs and insights to inform on-going conversation with DHBs. These data may lead to more meaningful insights when combined with the experience and knowledge of the DHBs, as well as the providers. There are some trends or patterns in the data that will be most usefully interpreted with contextual information to support the data.

Extending the analyses to understand mechanisms and uncover potential policy levers

An extension of this work would be to undertake further work exploring adjusted associations where appropriate. This can be done using a subset of the variables (those that are available for almost every child) or sample (e.g. those with census records). Alternatively, further work could focus on minimising missing data (especially for census variables) and understanding and accounting for the potential bias introduced by missing data.

Adjusted analyses will allow us to better understand the relationships between the sociodemographic and health variables considered here and attendance. This will also allow us to answer more complex questions such as whether motor vehicle access is associated with attendance purely because it is a marker of deprivation, or whether it is correlated with attendance once we control for socioeconomic deprivation – potentially suggesting a mechanism based on access.

Gain insights about the lived experience

To gain valuable information related to the lived experience, it would be useful to undertake qualitative research by speaking to families, and to providers, about the barriers families face in attending these checks. This is important for understanding why children with disability are consistently much less likely to attend B4 School Checks.

Apply this methodology to other aspects of system use

This project has demonstrated the value in performing analysis of service use at a local level as well as a national level as there can be significant variation in service use between different geographies and potential opportunities for different services providers & commissioners to learn from each other.

The code created for this project can be adapted to look at other aspects of children's engagement with the system (such as immunisations) – this would allow us to see whether it is the same group of children who consistently miss out, and the characteristics of these children and their families within a local area. This information can help inform policy and provider solutions to increasing service uptake and improving equity in uptake.

From a systems perspective, it is also important to know if certain children (e.g. those with disabilities) are consistently underrepresented in data sets that are used for tracking the progress and wellbeing of children. If we use these data to inform policy decisions, we need to be clear about who is included.

Appendix

Appendix A: Analytic report

Creating area level B4 School Check profiles

Analytical report

October 2020

Sheree Gibb, Eileen Li, Barry Milne

A Better Start National Science Challenge

Overview of project

This report describes the methodology and findings from the 'Creating area level B4 school check profiles' project. This project was completed by A Better Start National Science Challenge Big Data team (ABS-BD) for the Social Wellbeing Agency (SWA) in November 2020.

The major aim of this project was to increase understanding of who is not accessing the B4 School Check (B4SC). The area level focus of this analysis aims to provide DHBs with specific information on attendance rates and the correlates of attendance in the areas they cover. Specifically the aims of the analysis were:

- To measure B4SC attendance rates in each territorial authority/local board (TALB) area within District Health Boards (DHBs) in New Zealand
- To examine the sociodemographic and health factors associated with differences in B4SC attendance rates in each TALB area within DHBs.

Methods

General information about B4SC

The B4SC is a universal programme offered to all families in NZ with 4-year-old children (1, 2). If a child is enrolled with a Primary Healthcare Organisation (PHO), a letter or email will be sent to parents inviting them to bring the child along for a B4SC. Parents can also request a check by approaching a general practitioner (GP) or other B4SC provider. The checks are carried out by registered nurses or nurse practitioners with experience in child health, with assistance from vision and hearing technicians (3). One component (SDQ – Teacher) is completed by a child's early childhood education (ECE) teacher, who receives the Strengths and Difficulties Questionnaire (SDQ) directly from the B4SC provider and is responsible for returning it to the provider (4). ECE coverage is high in NZ with more than 95% of children enrolled in ECE in the 6 months prior to starting school (5). The B4SC is undertaken in different locations including preschools, kōhanga reo (Māori language immersion early childhood education centres), doctors' clinics and other community venues such as churches and marae, depending on the needs of the community. In some cases, parts of the B4SC are carried out in the child's home. The percentage attending the B4SC was estimated by MoH as 79% in 2011/2012, 80% in 2012/2013, 91% in 2013/2014, 92% in 2014/2015, 92% in 2015/2016, 94% in 2016/2017, and 93% in 2017/2018 (6). High coverage of vulnerable groups (Māori children and children from areas of high socioeconomic deprivation) is encouraged by linking a portion of DHB funding for B4SC to achieving a specified level of coverage for these groups. In 2017/2018, the coverage for Māori children was 93%, for Pacific children it was 91%, and for children from high deprivation areas, the coverage was 92% (6).

Data sources

All data were sourced from the July 2020 (20200720) refresh of the Integrated Data Infrastructure (IDI) (7, 8).

B4SC attendance rates were measured for each fiscal year (1 July to 30 June) from 2011/12 to 2018/19. At the time of writing B4SC data were available up to July 2019, making the 2018/19 fiscal year the latest that we were able to include. B4SC data are available from September 2008, however the early years of the program have low coverage, especially in the Auckland region where it was rolled out gradually. For this reason we usually exclude the first years of data when measuring attendance. Attendance stabilises around 2011. In this project we have used 2011/12 as the first year in the data series to ensure that trends in attendance over time are not due to incomplete rollout of the program. This leaves eight fiscal years included in this project (2011/12 to 2018/19).

How we calculated attendance rates

The B4SC program aims to measure children sometime during their fifth year i.e. between the fourth and fifth birthdays. Occasionally the check is completed slightly earlier or later than this.

Denominator (number of children in eligible population)

To determine an 'eligible population' for B4SC attendance in a given year we included all children who were resident in New Zealand (as defined below) and had turned 4 in the previous year. This allowed each child at least a year after their fourth birthday to get their check completed.

We used the resident population table in the IDI (data.snz_respop) to determine residency. This table includes children in the resident population for a given year if they meet any of the following criteria:

- NZ birth record in the last 5 years
- NZ visa record (excluding visitor or transit visas) in the last 5 years
- Tax, health or education record in the last 2 years

Children who had lived outside NZ for at least 12 of the last 16 months were removed from the resident population.

The table below shows the total number of children in the eligible population for each fiscal year.

Year	N in eligible population
2011/2012	61,155
2012/2013	62,538
2013/2014	61,503
2014/2015	62,538
2015/2016	61,785
2016/2017	61,329
2017/2018	61,356
2018/2019	59,892

Numerator (number of children who completed checks)

The B4SC consists of a series of checks. For the purposes of this report we have collapsed these checks into three groupings. These groupings were developed in consultation with the Ministry of Health and reflect the way in which the components are typically completed. The groupings are:

VHT: Vision and hearing checks. These are usually completed together by vision and hearing technicians

Nurse: These include assessments of growth, dental, immunisation, Parental Evaluation of Developmental Status (PEDS) usually completed by a nurse; as well as the Strengths and Difficulties questionnaire (SDQ) completed by the child's main caregiver.

SDQ-T: SDQ completed by the child's early childhood education teacher. Teachers receive the questionnaire directly from the B4SC provider and are responsible for returning it to the provider.

In some locations, these groups of checks are administered in separate visits; in other locations, they are combined into a single visit. If a child had completed any check within a component, they were considered to have attended that component. B4SC coverage was calculated as the number of children attending a B4SC component divided by the total number of children in the eligible population for that year.

Labelling of fiscal years on graphs

Note that fiscal years in the graphs are labelled with the fiscal year in which most of the checks were completed. For example, the year labelled 2018/19 uses the base population of children who turned 4 in the previous (2017/18) fiscal year, most of these children would have completed their checks in 2018/19 year.

How we defined DHB and TALB areas

For each child we were able to determine their meshblock of residence using the address notification table in the IDI. The most recently updated address prior to the child's fourth birthday was used. If there were no address updates prior to fourth birthday then we took the first address update in the 12 months after the fourth birthday. From these meshblocks we were able to assign children to a territorial authority / local board (TALB, see below and also (9)) area and to a DHB. Children from Chatham Islands were excluded due to very low numbers in this area.

We modified the standard 2018 territorial authority classification (10) in two ways to create our TALB classification:

1. We split the large Auckland territorial authority area (containing more than 1.5 million people) into local boards . This allowed for finer-grained analysis of trends within the Auckland region. We chose local board (rather than ward, SA2 or other possible classifications) because local board areas align better with local government and local policy jurisdictions.
2. We combined some smaller territorial authorities with neighbouring territorial authorities where numbers of 4-year-old children were too small to allow for meaningful analysis. We also combined two local boards with small numbers. Without combining these areas there would have been a large amount of suppression when we modelled B4SC non-attendance at the TALB level (due to Stats NZ confidentiality rules requiring us to suppress counts less than 6). This analysis was originally planned to be part of this project but was dropped later. We have however retained the

combined TALB structure because it creates more stable attendance trends over time for the smaller TA areas. Where possible we have tried to combine areas that have similar geographic, urban and demographic features although this was not possible in all cases. The areas that were combined were:

- Waitomo and Otorohanga
- Waimate and Mackenzie
- Kaikoura and Hurunui
- Westland and Grey
- Carterton and South Wairarapa
- Kawerau and Whakatane
- Queenstown Lakes and Central Otago
- Gore and Southland
- Waiheke local board, Great Barrier Island local board, and Waitemata local board

This gave a total of 76 TALB areas (49 TAs, 8 combined TAs, 18 local boards for the Auckland area, and one combined local board for the Auckland area). Chatham Islands territorial authority was excluded.

How we decided on the 'component' TALB areas for each DHB

For the analyses where DHB areas are broken down into 'component' TALBs some extra work was needed. TALB areas do not fit exactly into DHBs: some TALBs span more than one DHB. However for clarity of presentation we wanted each TALB to be assigned to a single DHB only. For TALBs that spanned more than one DHB we assigned them to the DHB where most of the TALB resident population lives (according to 2013 census data). In most cases this was straightforward as >90% of the TALB population lives in one DHB. The exceptions were:

- Kapiti Coast District (84% of population in Capital and Coast, 16% in Mid Central, assigned to Capital and Coast)
- Ruapehu (67% in Waikato, 33% in Whanganui, assigned to Waikato)
- Waikato District (76% in Waikato, 24% in Counties Manukau, assigned to Waikato)
- Whau local board (54% in Auckland, 46% in Waitemata, assigned to Auckland)

Variable definitions and coverage

Selection of predictors was based on a previous paper (11) showing that B4SC coverage is associated with a range of sociodemographic and health variables. Some variables were added or removed based on discussion between the ABS-BD team and SWA staff about the likely policy relevance and impact of some variables.

Early childhood education attendance is likely associated with B4SC completion (and is a requirement for completion of the SDQ-T component) but was not used here. Based on conversations with other researchers we believe that the early childhood education data contained in IDI is recorded at the point of entry into school, rather than being a prospective measure of ECE enrolment. There was no metadata available to confirm this. Furthermore, levels of ECE enrolment in NZ are very high due to government subsidies for ECE, therefore we believe the variable would be of limited use in identifying groups at high risk of not completing B4SC.

Sex

Male or female, taken from the personal detail table in the IDI which collates sex information from across a range of IDI datasets. Sex was available for more than 99.99% of the sample.

Ethnicity

Ethnicity measures were taken from the personal detail table in IDI. The table collates ethnicities that are reported to different administrative collections in IDI and ranks these sources to provide an ethnic profile for each individual. Ranking is based on how closely the ethnicities reported for an individual in the administrative source match those reported in the census. From this, we constructed four dichotomous ethnicity variables representing whether children were recorded as identifying with each of the following major ethnic groups: Māori, Pacific, Asian and European. Individuals could belong to none, one or more than one of these ethnic groups. The MELAA (Middle Eastern, Latin American and African) and Other categorisations were not used in this analysis due to small numbers in these groups. Ethnicity information was available for all children in the sample.

Socioeconomic deprivation

NZ Deprivation Score (NZDep) was calculated using the standard 2013 NZDep concordance (12) and the child's meshblock of usual residence (as described above in 'How we defined DHB and TALB areas'). Each meshblock was assigned a decile from 1 (least deprived) to 10 (most deprived). These were then grouped into quintiles. NZDep was available for 98.6% of the sample.

Urbanicity

The child's meshblock of usual residence was also used to define urbanicity. The standard classification of urban/rural areas in NZ (13) is a five-point scale: (1) main urban (centred on a city or major urban area (population of at least 30 000), (2) secondary urban (centred on larger regional centres (population 10 000–29 999), (3) minor urban (centred around smaller towns (population 1000–9999), (4) rural centre (population 300–999) and (5) other rural (population <300). These were collapsed into two groups: urban (main urban, secondary urban and minor urban area) and rural (rural centre and other rural). Urbanicity was available for 98.7% of the sample. This variable was not used for Auckland DHB as there is no variation within the DHB (ie every area is urban).

Residence changes

The total number of different addresses lived at from birth to fourth birthday (minus one to give the number of changes, capped at 5+ changes) was calculated from the address notification table in IDI, which collates address updates reported to data providers. This variable was available for all children in the sample.

Child born in NZ / Mother born in NZ

If the child had a NZ birth record in the Department of Internal Affairs records, or their individual census record (2013 or 2018, prioritised as described in the census variables section) indicated NZ as their country of birth they were classified as being born in NZ. An analogous variable was constructed for the child's mother using census information only: if census information indicated NZ as the mother's country of birth

they were classified as being born in New Zealand, otherwise the mother was classified as not born in New Zealand. There were no missing data when classified in this way.

Hospitalisations

The following variables were obtained from hospital records: total number of hospital admissions (excluding the child's birth and any emergency department visits that did not result in hospital admission) from birth to fourth birthday categorised into 0, 1, or 2 or more; and whether or not the child had ever had an emergency department visits from birth to fourth birthday. This variable was available for all children in the sample.

GP enrolment

The extent to which a child had continuous enrolment with a GP was estimated by counting the number of quarters in which a child was enrolled with a Primary Healthcare Organisation (PHO; an umbrella organisation for GPs) from birth to their fourth birthday (the maximum number of quarters in which a child could be enrolled was 16). This was grouped into 0-3 quarters, 4-7, 8-11, and 12 or more quarters enrolled. This variable was available for all children in the sample.

Disability

Children who received a referral to Disability Support Services before their fourth birthday were classified as having received disability support. This variable was available for all children in the sample.

Information from birth record

Overall 93.3% of children had birth records available. The following variables were obtained from the child's birth record: the child's birth weight, categorised into <2500 grams or 2500+ grams; gestational age, categorised into <37 weeks, 37–42 weeks, and more than 42 weeks; whether a father was recorded on the child's birth certificate; age of the child's mother at the time of the child's birth, grouped into under 20; 20–24; 25–29; 30–34; 35 years and over; number of siblings at the time of the child's birth, grouped into 0, 1, or 2 or more. These variables were available for 93.1% to 93.3 % of children in the sample.

Information from census records

We used data from 2013 and 2018 censuses to create additional variables. Household benefit income was not available in the 2018 census dataset at the time of writing, so we have used 2013 data only for that variable. For all other census-based variables we have combined 2013 and 2018 census data in the following way in order to use the census data that is closest in time to the reference date for measurement (the child's fourth birthday). For years 2011/12 to 2015/16 we used 2013 census information if it was available for that individual. If 2013 census information was not available we used 2018 census information. For years 2016/17 to 2018/19 we used 2018 Census information if available for that individual. If 2018 census information was not available we used 2013 census information.

Household variables were obtained by linking to the household form (for 2013 census) or dwelling form (2018 census) connected to the child's census record; 93.4% of children had census household information available. Mother census variables were obtained by first linking to the child's birth record to identify mother, and then linking to individual census records for the mother. 89.0% of children had mother census

information available. All census variables are recorded as at Census day (5 March 2013 or 6 March 2018). The variables from Census were:

- size of household (including child), grouped into: <5 people, 5–7 people and 8 or more people, available for 93.3% of children;
- whether the dwelling was rented or owned (including those held in family trusts), available for 92.2%;
- whether any member of the child's household received benefit income in the year to census day, available for 69.8%;
- whether the child's mother spoke enough English to have a conversation about everyday things, available for 89.0%;
- the highest qualification of the child's mother at the time of the census, classified into: no formal qualifications, high school qualifications, tertiary qualification below bachelor's degree, bachelor's degree or higher, available for 87.0%;
- the number of motor vehicles available to the household, grouped into none, 1, or 2 or more, available for 90.4%.

How we decided on key characteristics for DHB-level analysis

The tables and some of the forest plots contain a reduced set of variables for clarity (we trialled these tables and plots with the full set of variables but both ABS-BD and SWA staff agreed that they were overwhelming and difficult to read).

We decided on the group of 11 variables to use for these tables and plots as follows:

- ethnicity variables (Māori, Pacific, Asian, European) and NZDep were included due to their policy and strategic importance in equity discussions
- an additional six variables were selected based on the strength of their association with B4SC attendance. Strength of association was assessed using the entire sample (ie all of NZ) and the same set of predictors was then used for each area. To test this approach (using the same set of predictors for each DHB) we manually inspected the predictors with the strongest associations for each DHB, and for the most part they were the same for each DHB. If a variable had multiple levels (eg motor vehicle access) the strongest association amongst those levels was used in the ranking, even if associations for the other levels of that variable were weak. The variables selected were: household size; age of mother; rented home; mother highest educational qualification; number of quarters enrolled with a GP; and motor vehicle access. Disability support was also considered for inclusion as it has a strong relationship with B4SC completion, however it was not included as the proportion of children receiving disability support varies little between DHBs (<1%).

Analysis

Initial data extraction and manipulation was done in SAS within the Datalab environment. Raw data files were output and graphs were made outside the Datalab environment using R Studio. Rate ratios were calculated by dividing the relevant rate of B4SC non-completion (number not completing divided by total number in category) by the rate of B4SC non-completion for the reference group. Confidence intervals for the rate ratio (RR) were calculated using the formula:

ln(RR) ± 1.96*(sqrt((((n1-x1)/x1)/n1) + (((n2-x2)/x2)/n2)))

where x1 is the number of children not completing a B4SC for a given category, n1 is the total number of children in that category, x1 is the number of children not completing a B4SC in the reference category, and n2 is the total number of children in the reference category.

Description of outputs

Data files

The file 'RawData2Nov20' contains the raw data for this project.

Graph and table files

Attendance plots

These plots show the percentage of eligible children that attended a B4SC check for each fiscal year from 2011/12 to 2018/19. There are three plots per DHB area: one for VHT checks, one for nurse checks, and one for SDQT. Within each plot there is a line for each TALB area within that DHB. There is an additional line showing the national attendance rate for comparison.

Forest plots

These plots show the rate ratio and confidence interval for B4SC non-attendance for a series of sociodemographic and health variables. B4SC attendance rates are measured over the whole time period 2011/12 to 2018/19. Rate ratios above 1 (to the right of the centre line) indicate that children with that characteristic were less likely to attend a B4SC than children in the comparison group. Rate ratios less than 1 (to the left of the centre line) indicate that children with that characteristic were more likely to attend a B4SC than children in the comparison group. Rate ratios are presented on a log scale so that the left and right sides of the graph are comparable (eg a rate ratio of 0.5 is the inverse of a ratio of 2.0 and both should appear equidistant from the centre line, the log scale achieves this). There is one file per DHB and each file contains three plots (VHT, nurse and SDQT) side-by-side.

Composition plots

These plots show the extent to which selected characteristics of children in each DHB are different to the national average. Specifically the plots show the difference, in percentage points, between the proportion of children with a characteristic in this DHB compared to the national proportion of children with that characteristic. For example, if 65% of Children in a DHB are European and 75% of children nationally are European then the plot would show -10. This plot is based on data pooled over the entire time period 2011/12 to 2018/19. There is one plot per DHB.

Characteristic tables

These tables show the characteristics of children in each TALB area. The set of characteristics is the same as that used in the composition plots. There is one table per DHB and within that table there is one column per TALB area. The numbers represent the percentage (to the nearest whole percent) of children in that

TALB who had the specified characteristic. The percentages are based on the pooled data from the whole time period 2011/12 to 2018/19.

Code

There are a number of SAS and R code files that were used in this project. The code files are available here: https://github.com/COMPASS-UoA/B4SC-

Interpretation of results and caveats

B4SC coverage over time

For VHT and nurse checks coverage has been stable, or has increased slightly, over the period 2011/12 to 2018/19 in most DHB and TALB areas. The exception is Hawkes Bay, where coverage has decreased since 2016/17, especially in Wairoa TA. Discussions with MoH staff have suggested that the low completion rates in Hawkes Bay may be due to a B4SC provider in that area that has not been reporting to the national dataset. Therefore, it is likely that actual B4SC completion rates in Hawkes Bay are higher than suggested in these graphs.

SDQT coverage is lower than for VHT and nurse checks, although most areas do show an increase or no change over time. The exception is Auckland, where coverage decreased from 2013/14 to 2015/16 and has been stable since.

Characteristics of children in different areas

There are differences between areas in the characteristics of children. The largest differences are in ethnic composition (especially Māori and European) and in the proportion of children living in the most deprived quintile areas. For example, Tairawhiti, Northland and Lakes DHBs all have a proportion of Māori children that is more than 25 percentage points above the national average, while Nelson/Marlborough, South Canterbury, West Coast and Southern DHBs all have a proportion of European children that is more than 20 percentage points above the national average.

It is plausible that these variations in characteristics between areas will explain some of the differences in B4SC completion between areas. For example, if B4SC attendance is lower in NZDep 5 areas, than a DHB with a large proportion of high NZDep areas will have lower attendance rates than a DHB with very few high NZDep areas. We have not tested this hypothesis but it could be tested in future work.

A limitation of these plots is the use of an actual percentage point variance measure rather than a relative measure. For example, if the national average is 20% and a DHB is 25% this difference will be represented as an increase of ‘5’ (rather than an increase of 25%, which is the relative increase). This method was chosen for simplicity of presentation and understanding. However a limitation of this presentation method is that small percentages (i.e. categories where the percentage of children in the category is small, such as households with no access to a motor vehicle where only 4% of children are in this category) will vary less than larger percentages. For example, a change in the proportion of Māori ethnicity from 20% to 30% will

be represented as 10 percentage points, and is a relative change of 50%. However a change in the proportion of children with no household access to a motor vehicle from 4% to 6% will be represented as 2 percentage points (and appears much smaller than a 10 point change), even though the relative change is the same as the Māori example (50%).

Associations between B4SC non-attendance and sociodemographic/health variables

B4SC non-attendance is associated with a wide range of sociodemographic and health variables.

For the most part the pattern of association is similar across the three groups of B4SC checks (VHT, nurse and SDQT). That is, the same characteristics are associated with attendance throughout all components of B4SC. In many areas the strength of the associations is smaller for SDQT than for the VHT and nurse components.

The variables most strongly and consistently associated with B4SC non-attendance across most areas, along with some possible (speculative) reasons for these associations, are:

- Receiving disability support. We speculate that this may be due to B4SC being seen as not necessary or not appropriate for children with disability, given their already high levels of contact with the health system.
- Not being enrolled with a GP. Given that B4SC invitations are often initiated by the PHO in which a child is enrolled, children not enrolled in a PHO will not receive these invitations and therefore are more likely to miss their check.
- Having no access to a motor vehicle. This may indicate difficulties in accessing B4SC testing locations. Alternatively (or additionally) it may be functioning as an indicator of socioeconomic deprivation.
- Having a mother with no formal qualifications. This may be functioning as an indicator of socioeconomic deprivation.

Other variables with weaker or more variable associations are:

- Having a mother aged <20. This may be functioning as an indicator of socioeconomic deprivation.
- Having a lot of address changes. Children who move house frequently may have lower levels of GP enrolment (due to frequent PHO and GP changes), may be less likely to receive mail B4SC invitations to the correct address, and may experience administrative difficulties such as a check being initiated in one PHO but the child leaves that PHO before it is completed.
- Living in an area of high deprivation. This may be functioning as an indicator of socioeconomic deprivation.
- Being in a large household. This may be functioning as an indicator of socioeconomic deprivation.

For some variables with multiple categories there is a dose response relationship where the likelihood of B4SC attendance decreases as the variable increases (NZDep, number of address changes) or the variable decreases (GP enrolment, younger mother age).

For some variables the confidence intervals are very wide due to the small number of children in that category. These results should be interpreted cautiously.

An important limitation of this analysis is that it presents the bivariate (ie two variable) associations only. Associations between a variable and B4 School Check attendance have not been adjusted for the effects of other variables. For example, the association between B4SC attendance and ethnicity may reduce if we were to adjust for NZDep.

We have not undertaken adjustment in this project because it would result in substantial loss of sample size and potentially introduce bias. Full adjustment can only be done for individuals with information available on all variables. In our cohort this is less than 83% of people. Some groups of individuals are more likely to have missing information than others (eg we know that Māori and Pacific people are less likely to complete the census) and therefore removing these individuals may introduce selection bias. It is possible that full adjustment could be completed in future work by 1. Minimising missing data especially for census variables, and 2. Undertaking additional analytical work to understand the potential bias introduced by missing data.

Many of the variables in this analysis have strong associations with socioeconomic deprivation. The specific causal relationships between, for example, NZDep, family benefit income, and how they both relate to B4SC attendance is not known. Detailed modelling of the causal structure of the associations between indicators of socioeconomic deprivation and B4 School Check attendance is unlikely to be successful given the structure of the available data in the IDI.

Glossary

ABS_BD	A Better Start National Science Challenge Big Data team
B4SC	B4 School Check
DHB	District Health Board
IDI	Integrated Data Infrastructure
SDQP	Strengths and Difficulties Questionnaire Parent version
SDQT	Strengths and Difficulties Questionnaire Teacher version
SWA	Social Wellbeing Agency
TALB	Territorial Authority / Local Board area
VHT	Vision and Hearing tests

References

1. Ministry of Health. B4 School Check information for the health sector 2016 [Available from: http://www.health.govt.nz/our-work/life-stages/child-health/b4-school-check/b4-school-check-information-health-sector.
2. Ministry of Health. The B4 School Check: A handbook for practitioners. Wellington: Ministry of Health; 2008.
3. Ministry of Health. Well Child / Tamariki Ora Programme Practitioner Handbook: Supporting families and whānau to promote their child's health and development – Revised 2014. Wellington; 2013.
4. Ministry of Health. B4 School Check information for early learning services 2015 2015. Available from: https://www.health.govt.nz/our-work/life-stages/child-health/b4-school-check/b4-school-check-information-early-learning-services.
5. Ministry of Health. Indicator Report: Prior Participation in ECE. Wellington: Ministry of Health; 2017.
6. Ministry of Health. Over Time Report2019.
7. Statistics New Zealand. Integrated Data Infrastructure [Available from: https://www.stats.govt.nz/integrated-data/integrated-data-infrastructure/.
8. Milne BJ, Atkinson J, Blakely T, Day H, Douwes J, Gibb S, et al. Data resource profile: the New Zealand integrated data infrastructure (IDI). International journal of epidemiology. 2019;48(3):677-e.
9. Statistics New Zealand. Territorial Authority Local Board 2020 (generalised)2020. Available from: https://datafinder.stats.govt.nz/layer/104256-territorial-authority-local-board-2020-generalised/.
10. Statistics New Zealand. Geographic Area Files 2018 [Available from: http://archive.stats.govt.nz/browse_for_stats/Maps_and_geography/Geographic-areas/geographic-area-files.aspx#gsc.tab=0.
11. Gibb S, Milne B, Shackleton N, Taylor BJ, Audas R. How universal are universal preschool health checks? An observational study using routine data from New Zealand's B4 School Check. BMJ open. 2019;9(4):e025535.
12. Atkinson J, Salmond C, Crampton P. NZDep2013 index of deprivation. New Zealand, Ministry of Health. 2014.
13. Statistics New Zealand. Classifications and related statistical standards: Urban Area Statistics New Zealand,2016 [Available from: http://www.stats.govt.nz/methods/classifications-and-standards/classification-related-stats-standards/urban-area.aspx.

Disclaimer

Access to the data used in this study was provided by Statistics New Zealand under conditions designed to give effect to the security and confidentiality provisions of the Statistics Act 1975. The results presented in this study are the work of the authors, not Statistics NZ.

The results are based in part on tax data supplied by Inland Revenue to Statistics NZ under the Tax Administration Act 1994. This tax data must be used only for statistical purposes, and no individual information may be published or disclosed in any other form, or provided to Inland Revenue for administrative or regulatory purposes. Any person who has had access to the unit record data has certified that they have been shown, have read, and have understood section 81 of the Tax Administration Act 1994, which relates to secrecy. Any discussion of data limitations or weaknesses is in the context of using the IDI for statistical purposes, and is not related to the data's ability to support Inland Revenue's core operational requirements.