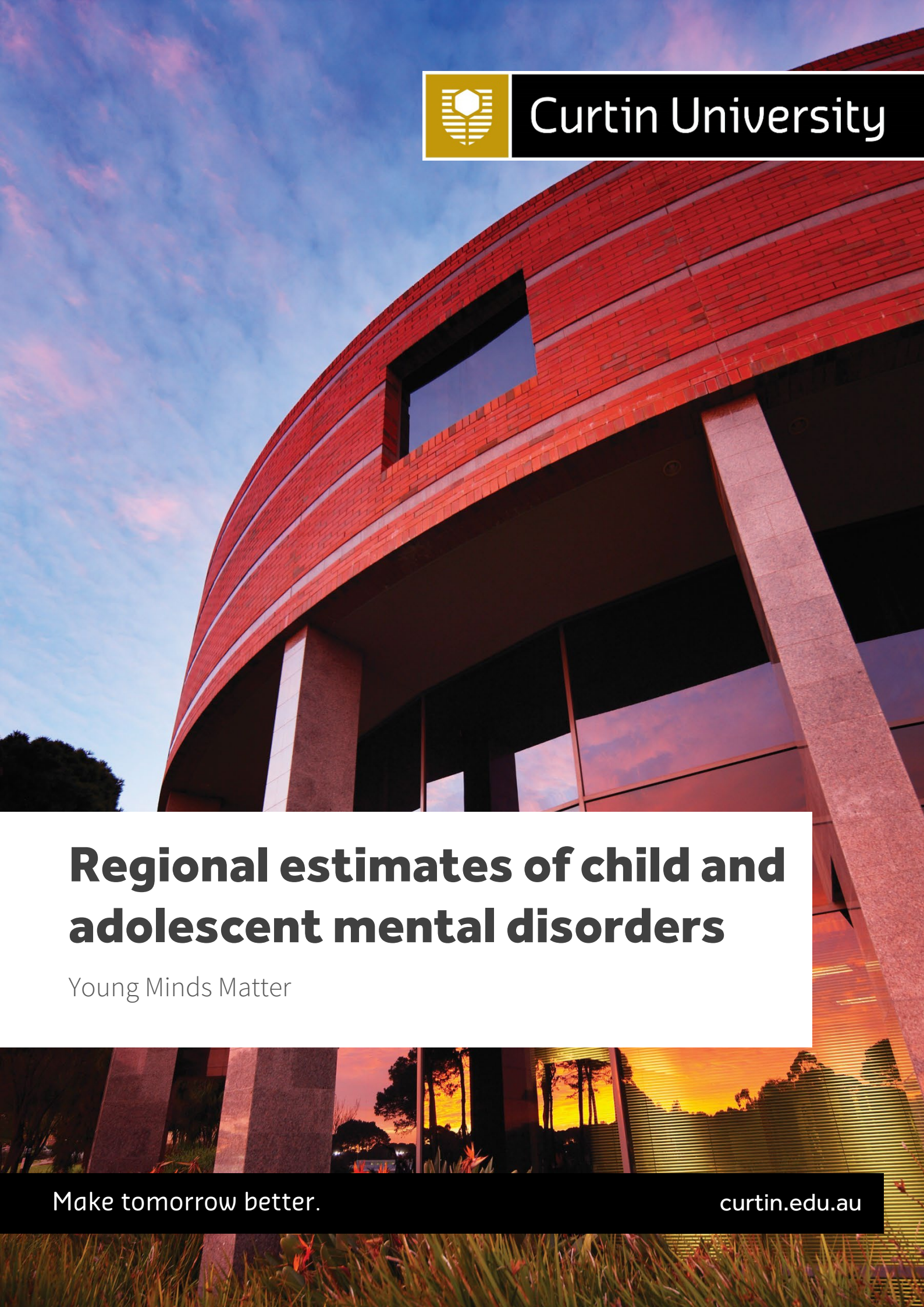
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Regional estimates of child and adolescent mental disorders
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Regional estimates of child and adolescent mental disorders

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Young Minds Matter: the second Australian Child and Adolescent Survey of Mental Health and Wellbeing

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EXECUTIVE SUMMARY

Young Minds Matter provided information on prevalence and severity of mental disorders in children and adolescents aged 4-17 years. The survey data were collected in 2013-14. To provide updated estimates on prevalence of mental disorders in children and young people in Australia, and demand for mental health services, data from *Young Minds Matter* has been combined with results from the 2021 Australian Census of Population and Housing to produce updated synthetic estimates of prevalence and demand for regional areas in Australia.

Estimates of prevalence and severity of mental disorders in regional areas can be useful for service planning and funding allocation. Analysis of *Young Minds Matter* survey data identified several socio-demographic characteristics that were strongly associated with prevalence of mental disorders. These socio-demographic characteristics are known to vary across geographic areas in Australia, and data is available from the 2021 Census that describes these variations.

Synthetic estimates of prevalence and severity of mental disorders have been produced by combining statistical modelling of factors associated with mental disorder status from the *Young Minds Matter* data, with information on the geographic distribution of those factors from the 2021 Census. Synthetic estimates have several limitations. They rely on the underlying assumption that the spatial variation in mental disorders can be described by the socio-economic factors that are available in the survey and the census. Synthetic estimates are useful when there is no direct source of data for regional areas.

Synthetic estimates have been calculated for internalising disorders (anxiety disorders and major depressive disorder), externalising disorders (attention-deficit/hyperactivity disorder and conduct disorder) and all disorders at the following levels:

- disorder type by age group (4-11 years and 12-17 years) and sex
- disorder type by severity (mild, moderate, severe)

Regional profiles have been created for each SA4 area, Primary Health Network (PHN) region and each Commonwealth Electoral Division (CED) in Australia. In addition, a dataset of estimates at the SA3 level is provided.

The synthetic estimation modelling process was not able to adjust for changes in prevalence of mental health conditions over time independent of socio-economic characteristics, for example any changes that might have arisen as a result of the COVID-19 pandemic. However, until another national survey is conducted, these synthetic estimates provide estimates of how growth and movement in Australia's population may have affected the prevalence of mental disorders and demand for services at a local level.

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INTRODUCTION

Young Minds Matter

Young Minds Matter, the second Australian Child and Adolescent Survey of Mental Health and Wellbeing was conducted by the Telethon Kids Institute at The University of Western Australia in partnership with Roy Morgan Research on behalf of, and funded by, the Australian Government Department of Health. Fieldwork was conducted between May 2013 and April 2014. *Young Minds Matter* was a household survey of parents and carers of 4-17 year-old children and adolescents with 6,310 randomly selected families participating. In addition, information was collected from 2,967 adolescents aged 11 years and older via a self-completed questionnaire on a tablet computer. While it has been some years since the survey was conducted it remains the most recent national survey data of prevalence of mental health and wellbeing in children and adolescents in Australia.

The aims of *Young Minds Matter* were to determine:

- how many children and adolescents had which mental health problems and disorders
- the nature and impact of these
- how many children and adolescents had used services for mental health problems
- the role of the education sector in providing these services.

Young Minds Matter used the Diagnostic Interview Schedule for Children Version IV (DISC-IV) to assess seven mental disorders based on Diagnostic and Statistical Manual of Mental Disorders Version IV (DSM-IV) criteria. These were:

- Anxiety disorders
    - Social phobia
    - Separation anxiety disorder
    - Generalised anxiety disorder
    - Obsessive-compulsive disorder
- Major depressive disorder
- Attention-Deficit/Hyperactivity Disorder (ADHD)
- Conduct disorder.

The primary carer of each survey child was administered each of these DISC modules. In addition, young people aged 11-17 years completed the youth self-report version of the DISC-IV Major depressive disorder module. The survey also collected a wide range of contextual information including demographic information and family and neighbourhood characteristics.

During the design process for *Young Minds Matter*, a number of decisions were taken about priorities for the survey which shaped the survey methodology. One of these was that the survey would be primarily designed to produce Australia-wide estimates of prevalence of disorder, and the survey would not be specifically designed to produce estimates for individual jurisdictions or any other geographic levels smaller than national level.

As the sample design for *Young Minds Matter* does not support direct estimates of prevalence of mental disorders for jurisdictions and smaller geographic levels, synthetic estimation techniques have been used to model estimates at smaller geographic levels. This report describes the methodology that has been used to produce these estimates. Regional estimates can be useful to support service planning and funding allocations based on estimates of demand at local levels.

Small araea estimation

Unless they have a very large sample size, household surveys are usually unable to provide direct estimates for small geographic areas. *Young Minds Matter* collected information from 6,310 participating families living in 566 SA1s across Australia (from a total of 54,772 SA1s in Australia, just over 1%).

Small area estimation techniques are methods that can be used to produce estimates from sample surveys for small geographic regions when direct estimates cannot be produced. There are a range of methodologies that can be used for producing regional estimates, however, some of these methodologies are only useful in the situation where there is at least some sample in all of the regions for which estimates are sought. Models are then used to improve on the quality of the direct survey estimates (which may have high variability because of small sample size in each area) by using information from neighbouring areas or other parts of the sample. These techniques are not applicable to producing regional estimates from *Young Minds Matter*, because of the large number of geographic areas that were not included in the sample.

Synthetic estimates

Synthetic estimation techniques can be used in situations where direct survey estimates are unavailable for each of the small geographic regions. In synthetic estimation, the survey data is combined with auxiliary data that is available for all geographic areas, for instance socio-demographic characteristics reported in the Census. Relationships within the survey data are applied to the auxiliary data to produce synthetic estimates. The quality of synthetic estimates depends upon the

quality of the auxiliary data that is available, and the strength of the relationships between survey outcomes of interest and available auxiliary data.

Young Minds Matter identified a number of socio-demographic characteristics that were strongly associated with the prevalence of mental disorders in children and adolescents. These include:

- family type
- household income
- country of birth
- parent or carer education
- parent or carer labour force status
- housing tenure
- index of relative socio-economic disadvantage
- remoteness.

Information on the distribution of these characteristics is available for all SA1 areas in Australia from the 2021 Census of Population and Housing.

Synthetic estimation utilises the relationship between prevalence of mental disorder and socio-demographic characteristics (as determined by statistical modelling from the survey data), and the distribution of these socio-demographic characteristics within small geographic areas (as determined from the 2021 Census) to estimate the prevalence of disorders in small geographic areas.

Modelling approaches

There are a variety of modelling approaches that can be used to generate synthetic estimates. Broadly these can be described as individual models, area-level models and mixed models (which are a combination of individual and area-level models).

In individual models, relationships between individual characteristics of the child and family and the prevalence of mental disorder are estimated from the survey data. These modelled relationships are applied to individual level Census data to estimate the probability of each child in Australia having a mental disorder. By summing these probabilities within geographic areas, synthetic estimates of prevalence can be produced. The applicability of this technique is limited because individual level Census data is not accessible outside the ABS.

Area-level models are more practical as area-level summary information is readily available from the Census. In this approach, the survey data is used to model the relationship between prevalence of disorder and socio-demographic characteristics of

small areas (such as the proportion of sole parent families, or the proportion of families with income below a set threshold) using all areas included in the sample. These relationships are then applied to census tables at the small area level to estimate the prevalence of disorder within each small area. While this technique can readily be applied using *Young Minds Matter* and 2021 Census data, it may be less accurate than an individual level modelling approach, as often the relationship between individual characteristics and prevalence of mental disorder is stronger than the relationship between area-based characteristics and prevalence of disorder.

A mixed model approach combines both individual and area-level characteristics in a single model. A mixed model can also account for clustering in the survey data by small areas, by the inclusion of random effects.

This was done by artificially re-creating a person level census file for a small number of variables from a single census table. For example, if it is known from a census tabulation that there are 8 male Aboriginal children and 6 female Aboriginal children is a small area, a file with 14 records could be created with Aboriginality identified and 8 records having sex identified as male, and 6 records having sex identified as female. This approach cannot be extended to recreating person level data from multiple census tables as there is no way of knowing from multiple tables what the correlation between the variables would be. For instance, if two census tables were available, one by family type and one by labour force status, the information could be used to re-create a person level file for either family type or labour force status, but it would not be possible to include both family type and labour force status on the same file.

In a mixed modelling approach, the variable that is most strongly predictive of prevalence of mental disorder status is identified and included as an individual level parameter, and the remaining variables are included as area-level factors in the model. This is the approach that has been taken to produce small area estimates from *Young Minds Matter*.

REGIONAL SYNTHETIC ESTIMATES OF MENTAL DISORDER PREVALENCE

Objective

To provide information to support planning for services for children and young people, the objective of the project was to produce regional estimates of prevalence of mental disorder at the following levels:

- Disorder type by age group (4-11 years and 12-17 years) and sex
- Disorder type by severity (mild, moderate, severe)

Disorder type

Disorders were grouped as either internalising disorders (anxiety disorders or major depressive disorder), or externalising disorders (ADHD and conduct disorder).

Geographic level

Small area estimates were produced at the SA1 level as the primary building block for the project. These were aggregated to the SA3 level, the SA4 level, the Primary Health Network (PHN) level, and the Commonwealth Electoral Division level, using concordances that map SA1 areas to each of these other geographic classifications.

Source Data

Customised tabulations were obtained from the ABS 2021 Census of Population and Housing, on a place of usual residence basis. The following tables were obtained:

For each SA1 in Australia:

- Number of Aboriginal and/or Torres Strait Islander children aged 4-11 years and the number aged 12-17 years
- For all non-Indigenous children aged 4-11 years and 12-17 years:
    - Number of children by sex
    - Number of children born in Australia and born overseas
    - Number who speak a language other than English as their main language at home
    - Country of birth of parents/carers broken down into 5 categories: both carers born in Australia; one carer born in Australia, one carer born overseas; both carers born overseas; sole carer born in Australia; sole carer born overseas

- Family type broken down into 6 categories: families with two parents or carers; original family; step family; blended family; other family; families with one parent or carer
- Family income broken down into 3 categories: less than $52,000 per year; $52,000-$129,000 per year; $130,000 or more per year
- Median household income
- Median weekly rent for rented dwellings
- Average household size
- Number of children attending public schools, catholic schools and other private schools, by primary or secondary school and number of young people attending vocational training or university
- Highest level of parent or carer education broken down into 4 categories: Bachelor degree or higher; diploma or certificate III or IV; Year 11 or 12; Year 10 or below
- Labour force status of both primary and secondary carer broken down into 5 categories: both carers employed; one carer employed, one carer not in employment; both carers not in employment; sole carer employed; sole carer not in employment
- Housing tenure broken down into 5 categories: owned outright; owned with a mortgage; rented – public housing; rented – other; other
- Dwelling type broken down into 5 categories: separate houses, semi-detached houses, flats or apartments, caravans, other dwellings.

In addition, each SA1 area was classified by SEIFA and by remoteness.

Due to the way the ABS processes Census data, these cross-tabulations were only available for children who were identified as living in families on census night. While the Census household form does collect information on children who are usually resident in the dwelling but were absent on census night, the characteristics of these children are not available, and where the child is listed on another Census form on census night, that information is not matched back to their usual place of residence. As a result, the 2021 Census tables from the ABS excluded children living in non-private dwellings on census night (such as in hospital or at boarding school), children who were away from home on census night, and children living in families where insufficient information was provided on the census form to enable the family type to be classified. Based on these exclusions, a total of 312,430 children aged 4-17 years were not included in the Census tabulations. While the ABS census estimate of the total population aged 4-17 years was 4,322,915, the Census tables provided by the ABS represented a total of 4,010,485 4-17 year-olds.

In addition to the Census tabulations, ABS also provided the SEIFA indexes and remoteness values for all SA1s in Australia, as well as the Estimated Resident Population (ERP) of 4-17 year-olds as at 30 June 2021 for each SA1 in Australia.

The ERP adjusts for population growth between 2013 and 2021, under-enumeration in the 2021 Census, and most importantly, for the exclusions from the Census data due to missing and incomplete data and children being away from home on census night. The total Estimated Resident Population of 4-17 year-olds as at 30 June 2021 was 4,401,100.

Variables included in the model

Family type and Indigenous status were identified as the two strongest predictors of mental disorder status from the *Young Minds Matter* data.

Based on the tables provided by the ABS, it was possible to re-create a person level Census file for Aboriginal and/or Torres Strait Islander children by age group (4-11 years and 12-17 years) and sex, and for non-Indigenous children by family type, age group and sex.

The following variables were included in the model at the individual level:

- Age group (4-11 years, 12-17 years)
- Sex
- Indigenous status
- Family type (non-Indigenous children only) - original families, step families, blended families, other two parent or carer families, and one parent or carer families. Family type was not available for Aboriginal children because of small cell sizes.

The following variables were included in the model at the area level:

- SEIFA Index of Relative Socio-Economic Disadvantage (IRSED) in quintiles
- Remoteness (4 categories - Major Cities, Inner Regional, Outer Regional, and Remote and Very Remote combined)
- Country of birth of child (Australia or overseas)
- Country of birth of parents or carers (both carers born in Australia, one carer born in Australia, one carer born overseas, both carers born overseas, sole carer born in Australia, sole carer born overseas
- Median household income
- Average household size

- Proportion of children and adolescents attending a public school or a private school
- Dwelling type (Separate house, semi-detached house, flat or apartment, caravan, other)
- Highest level of parent or carer education (Bachelor degree or higher; Diploma or certificate III or IV; Year 11 or 12; Year 10 or below)
- Labour force status of parents or carers (both carers employed; one carer employed, one carer not in employment; both carers not in employment; sole carer employed; sole carer not in employment)
- Housing tenure (owned outright, owned with a mortgage, rented – public housing, rented – other, other)

The models were fitted using PROC GLIMMIX in SAS Version 9.4, which fits mixed models using the method of iterative generalised least squares based on the pseudolikelihood, and models included a random effect for survey data being clustered at the SA1 level.

Modelling procedure

The first step involved fitting models to the *Young Minds Matter* data to predict the probability of having a mental disorder. These models were fitted by disorder type, age group and sex.

Separate models were fitted for internalising disorders, externalising disorders and all disorders, to allow for comorbidity between disorders. As separate models were being used for disorder types, boundary conditions were applied to ensure that estimates were consistent. These boundary conditions were applied to ensure that in each region the number of children or adolescents with internalising disorders, and the number with externalising disorders were no greater than the total number of children with any disorder, and that the sum of the number of children with internalising disorders and the number with externalising disorders was at least as large as the total number of disorders. Binary logistic regression was used for these models.

The second step involved fitting a model to predict the proportion of mild, moderate and severe cases. These proportions were then applied to the numbers estimated from the models fitted in step one to estimate the number of mild, moderate and severe cases. Multinomial logistic regression was used for these models.

Model fit

The primary model used in this project took the form of a binary logistic regression. The fit of the model and its predictive ability can be examined by looking at the number of cases in the survey data that would be correctly identified by the model.

This type of assessment is most important for models that are used to develop predictions at the individual level, rather than small area models, however it is a useful indicator of a model's predictive ability. The area under the receiver operating characteristic curve (AUC) is one such measure. It ranges from 0.5 to 1.0 with a value of 0.5 indicating the model is no better than random chance at predicting cases, and 1.0 indicating a model that can predict all cases accurately.

The model which predicts the prevalence of any disorder using all the variables listed above had an AUC of 0.67. This would be considered a moderate level of predictive ability. As an example, Kessler reports an AUC of 0.74 when using the K6 to predict CIDI diagnostic status in the United States National Comorbidity Survey — Adolescent Supplement (Green *et al*, 2010).

This suggests that there are factors associated with whether an individual child has a mental disorder other than the socio-demographic characteristics included in the model. The literature on the epidemiology of child and adolescent mental disorders has identified a range of factors that are correlated with mental disorder. These included socio-demographic factors that are available for modelling, including racial or ethnic group, income, poverty, social class, age and sex, and other factors which are not available in the census data, such as parental mental health, family functioning, parenting skills, parental substance use, experience of adverse childhood experience and child maltreatment, life stress events and exposure to stress, and drug use. While *Young Minds Matter* collected information about many of these factors, information about the geographic distribution of these factors is not available through the Census, and so these factors cannot be included in the synthetic estimation process.

Whether this is an important limitation to the synthetic estimates hinges on whether these associations vary based on geographic region or whether they occur randomly. For instance, evidence strongly suggests that there is a genetic component to the occurrence of mental illness. If parental mental illness is distributed randomly across geographic areas, or if the geographic variation in parental mental illness can be explained by geographic variation in the socio-demographic factors included in the model, then this would only affect the ability of the model to identify the mental health status of an individual child based on the area they live in, and would not necessarily impact on the accuracy of area level synthetic estimates of prevalence.

Unfortunately it is not possible to say with any certainty whether or not there are other factors that are associated with prevalence of mental disorder that have not been included in the model. While it is largely unknown whether any of the non socio-demographic risk factors for mental disorder have spatial variation, there is no current literature to suggest that there is spatial variation in the way parental mental health, family functioning, parenting skills, parental substance use, experience of life stress events and exposure to stress, experience of abuse, or drug use are related to the prevalence of child and adolescent mental disorder.

Limitations on accuracy of synthetic estimates

The major limitation of synthetic estimates is that they are not direct estimates from the survey for individual regions. They are based on a model with a set of assumptions. Where these assumptions are violated, the predictions of the model will not be accurate. It is not possible to test these assumptions with the data that is available.

Key assumption

Synthetic estimates are based on the assumption that prevalence of mental disorder in any region can be determined based on knowing the socio-demographic characteristics of the area, and that the relationship between socio-demographic characteristics and prevalence of disorder does not vary between geographic areas.

There is some basis for making this assumption as the prevalence of child and adolescent mental disorders has remained relatively stable across time and between developed countries where measurements have been made. However, it is not possible to test this assumption without the availability of detailed regional data on actual numbers of cases. For instance, if a particular community happens to have an effective prevention program that is not available elsewhere, or if there is some environment factor in the local environment that is a risk factor for mental disorder, these factors would not be captured by a synthetic estimation approach.

While synthetic estimates are the best available regional data that can be used for service and program planning and delivery, the actual number of cases of disorder in any region can vary from the model prediction if there are unique factors of that area that are not included in the model.

Region size

While SA3s have been designed to have approximately similar population sizes, there are some SA3s in Australia that have no population and some that have very small populations. The accuracy of synthetic estimates declines as regions become smaller, because there is more individual variation in the census data. Where there is no population in the SA3 the synthetic estimates of mental disorders must be assumed to be zero. For some SA3s with very small populations it was not possible to calculate synthetic estimates because there were insufficient numbers to populate the census tabulations for that area. For this reason, synthetic estimates have not been produced for SA3 areas that have a population of less than 100 children aged 4-17 years. Out of 336 SA3s in Australia, 3 have population less than 100.

Cohort ageing

These regional estimates have been prepared using data from *Young Minds Matter* which was collected between May 2013 and April 2014, and applied to small area

socio-demographic data taken from the 2021 Census and updated to June 2021 using ERP.

Children who were aged 4-17 years in 2013 would be aged 12-25 years in 2021. As such it is important to recognise that synthetic estimates produced from modelling Young Minds Matter data in combination with Census data do not represent individual children and adolescents who participated in the Young Minds Matter survey.

ESTIMATED DEMAND FOR SERVICE USE

In conjunction with the National Mental Health Services Planning Framework, data from *Young Minds Matter* has been used to estimate the relationship between prevalence of disorder and demand for health and support services (Pagliaro et al, 2022). Survey data were used to classify children and adolescents into four groups:

- children and adolescents with a mental disorder in the past 12 months
- children and adolescents with a mental disorder that has remitted for more than 12 months
- children and adolescents with sub-threshold mental health problems in the past 12 months
- children and adolescents with no need for help.

Within the first group, children and adolescents with a mental disorder in the past 12 months, the National Mental Health Services Planning Framework is based on the assumption that all children and adolescents with a severe disorder, 80% of those with a moderate disorder and 50% of those with a mild disorder should receive help. These proportions were used to estimate demand for services among children and adolescents with a mental disorder in the past 12 months.

For children and adolescents with a lifetime history of mental disorder but who did not have a mental disorder in the past 12 months, it is recognised that many of these children and adolescents no longer meet diagnostic criteria for mental disorder because of the benefit that they have received from the therapy that they have been receiving. *Young Minds Matter* found that 50% of children and adolescents with a lifetime disorder but no disorder in the past 12 months sought help for mental health issues in the 12 months prior to the survey. In order to support the goal of relapse prevention in children and adolescents with a history of mental illness, the proportion of 50% was used to estimate demand for services among children and adolescents with a lifetime disorder but no 12-month disorder.

For children and adolescents with sub-threshold mental health problems (i.e. meets half or more of the criteria for a DSM-IV mental disorder), the survey found that 30% of 4-11 year-olds and 45% of 12-17 year-olds sought help for a mental health problem in the 12 months prior to the survey. To support the goal of early intervention to prevent

the development of mental disorders, these proportions were used to estimate demand for services among children and adolescents who had a sub-threshold mental health problem in the past 12 months.

MAPPING REGIONAL ESTIMATES

Maps of overall prevalence of disorder have been provided for each SA4 region, Primary Health Network and Commonwealth Electoral Division. A challenge in mapping prevalence estimates of any disorder arises due to the nature of the distribution of the population. Each of the levels of the Australian Statistical Geography Standard (ASGS) such as the SA1, SA2 and SA3 are designed to have roughly equal population sizes. This means that in densely populated areas the spatial units are small in physical area, and in less densely populated areas they are physically larger.

As many regions of Australia contain a combination of more and less densely populated areas, maps may appear to be dominated by physically large areas with small populations, and some densely populated areas may be so small that there are difficult, if not impossible, to see on the scale of the map.

To help with interpretation of the maps, two steps have been taken:

i) each map of prevalence of disorder is also accompanied by a map showing estimated density of cases per square kilometre

ii) regions that would be too small to see on the scale of the map have been overlaid with a larger dot. This is particularly useful in rural areas where the structure of the ASGS is such that there is often a small spatial unit containing a country town surrounded by a larger sparsely settled spatial unit, with the country town spatial unit often too small to be visible on a map.

As an example, Figure 1 shows the estimated prevalence of any mental disorder in 4-17 year-olds in the Banks Commonwealth Electoral Division, and Figure 2 shows the

Figure 1: Synthetic estimates of 12-month prevalence of mental disorders among 4-17 year-olds in the Commonwealth Electoral Division of Banks

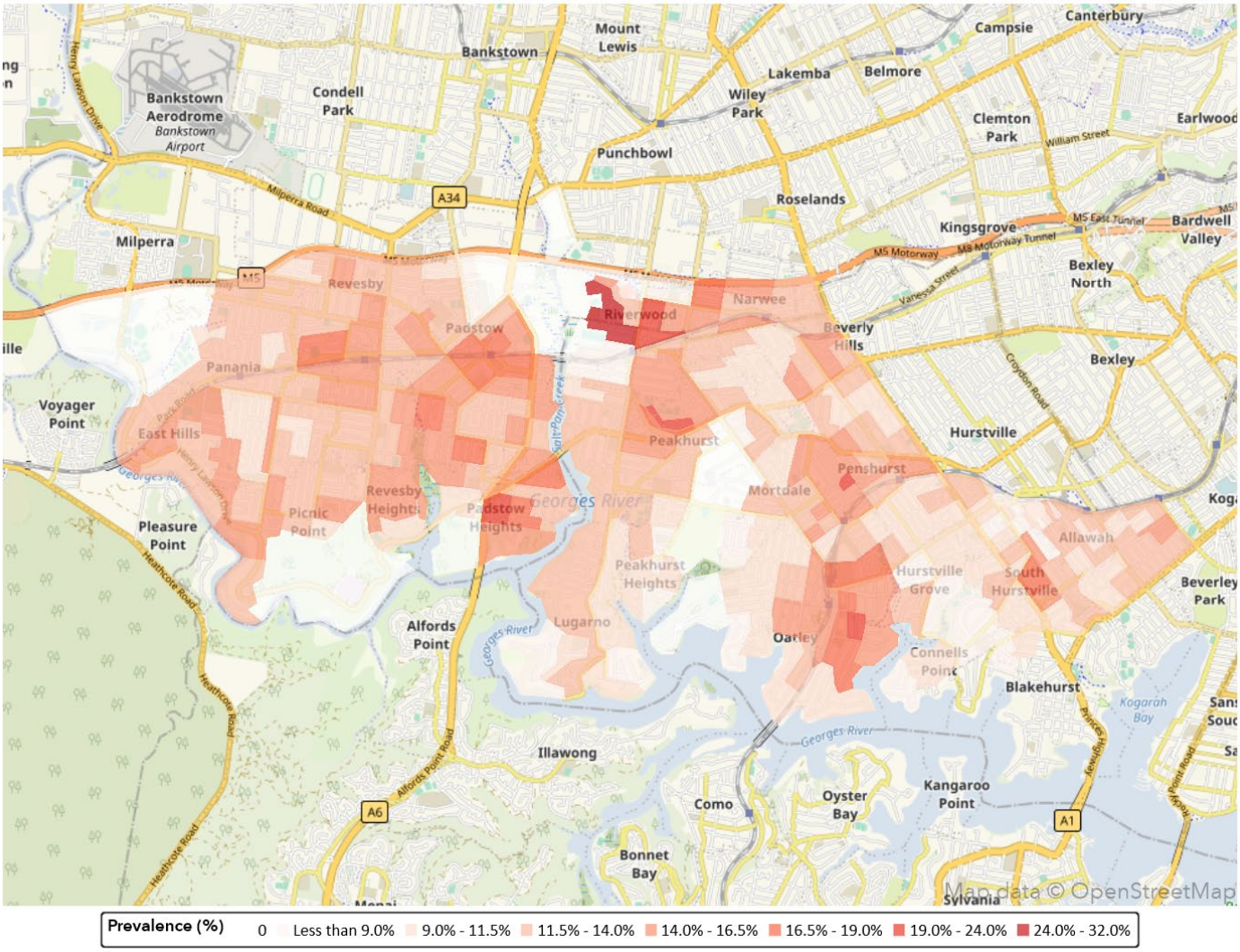
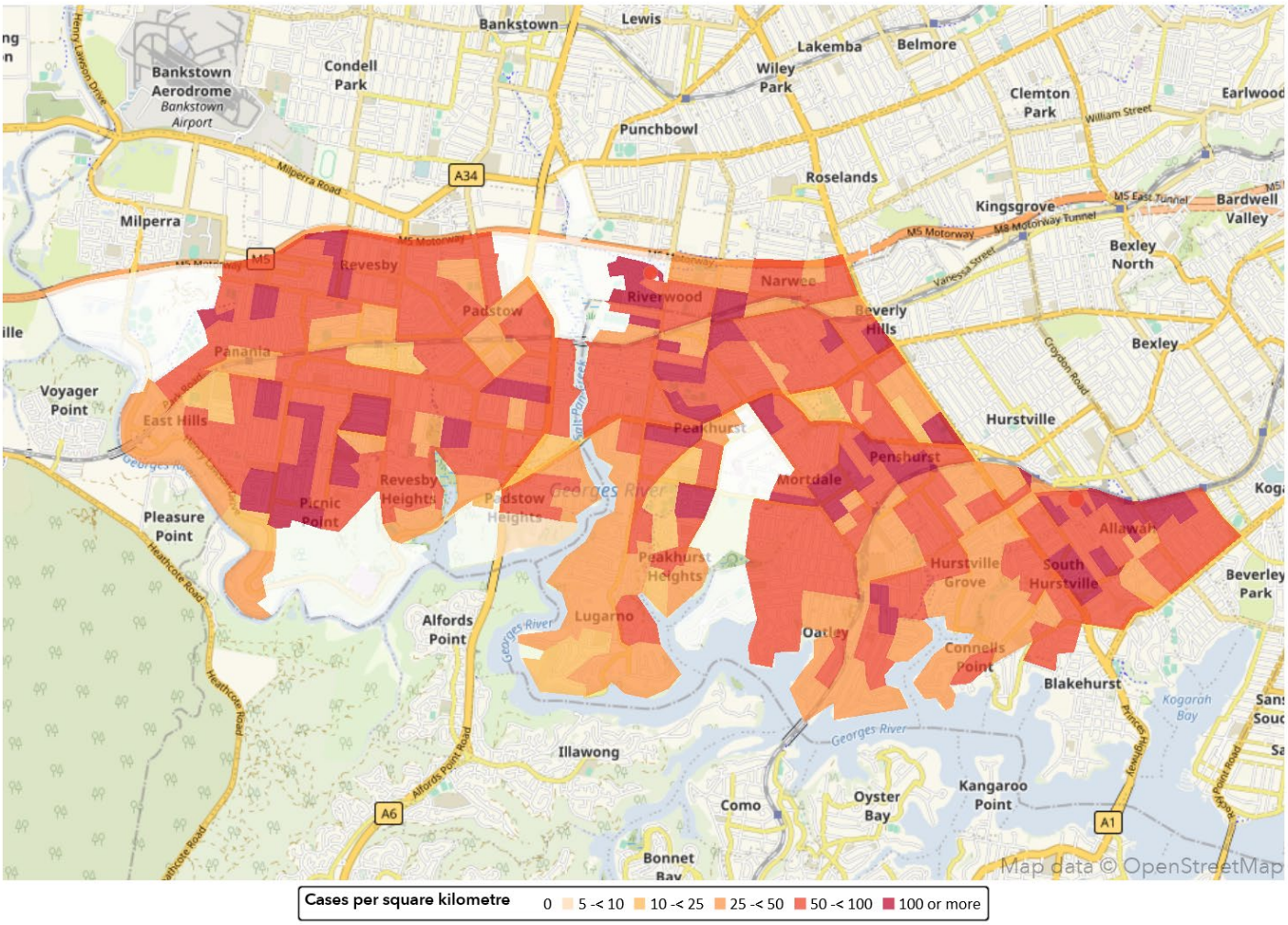


Figure 2: Synthetic estimates of the number of 4-17 year-olds with a mental disorder per square kilometre in the Commonwealth Electoral Division of Banks



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