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ORIGINAL PAPER

Determinants of mental health and well-being within rural and remote communities

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Abstract
Background The individual and contextual factors influencing current mental health and well-being within rural communities are poorly understood.
Methods A stratified random sample of adults was drawn from non-metropolitan regions of NSW, Australia. One-quarter (27.7%) of the 2,639 respondents were from remote/very remote regions. An aggregate measure of current well-being was derived from levels of distress and related impairment (Kessler-10 LM), self-reported overall physical and mental health, functioning, satisfaction with relationships, and satisfaction with life. Multivariate methods investigated the contributions to current well-being of demographic/dispositional factors, recent events and social support, individual exposure to rural adversity, and district/neighbourhood level characteristics.
Results Respondents from very remote regions tended to be younger and have lower education. Univariate associations were detected between well being and exposure to rural adversity (greater drought-related worry, lower perceived service and support availability, greater number of years living in the current district). Multivariate analysis ($n = 2{,}462$) accounted for 41% of the variance in well-being scores. The major contributing variables were dispositional factors (trait neuroticism, marital status), recent adverse events and indices of social support. However, no additional effects were detected for district-level variables (drought severity, regional socioeconomic categorisation, population change). Similar associations were detected using the K-10 alone as the outcome measure.
Conclusions The chief determinants of current well being were those reflecting individual level attributes and perceptions, rather than district-level rural characteristics. This has implications for strategies to promote well being within rural communities through enhancing community connectedness and combating social isolation in the face of major adversities such as drought.

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Introduction

There is a well-recognised geographic distribution of the social, demographic, economic and environmental factors that may influence health status [40, 45]. There is also evidence of geographic disparity in the burden of ill-health between metropolitan and rural regions in many countries [2, 3, 49]. However, our understanding of the basis for health disadvantage has been obscured by the various ways in which "rural" regions are defined in the international research [45]. The influence of "rurality" in previous ecologic studies could be re-conceptualised as a simple proxy for the set of specific geographically dispersed health determinants that prevail in non-metropolitan areas [22, 32], including: socio-economic disadvantage (greater in many rural areas); greater exposure and vulnerability to environmental adversity (e.g., severe drought) and its socio-economic sequelae; vulnerability to change and related impacts on community infrastructure; poorer access to health and social services; and geographic isolation (and, more specifically, social isolation) [17, 40, 45].

Improving our understanding of the role, these factors play in the relationship between rurality and health, and identifying other health determinants that may be uniquely rural in nature (such as environmental adversity), can help in the development of programs to overcome the health disparity associated with rural life. The need for fine grained analysis of locality in relation to health is supported by a large European study [26], which suggests that locality size, with age and gender, can reveal important differences in rates of mental disorder across regions. Australian research has highlighted the influence of gender, socio-economic status and migration to rural areas in understanding rural suicide [31, 48] and the adverse impact of population decline on mental health in some rural areas [17]. These findings support the view that epidemiologic research to investigate mental health needs in diverse localities should incorporate more detailed understanding of the interaction of individual level determinants of health with the social and demographic characteristics in those regions [21]. Furthermore, most research regarding the influence of community/neighbourhood characteristics on health has focussed on urban environments—less attention has been paid to investigating how aspects of location or place in rural regions (such as economic, social, environmental characteristics) influence mental health [17]. Weich et al. [50] investigated the impact of similar contextual characteristics on mental health in a large UK study, but found no significant effect of these on regional variation in psychological symptoms. Their findings demonstrated the importance of household level influences (e.g., household income and characteristics) on variance in levels of mental health. Similarly, the findings from a large Australian study [10] confirm the contribution of household level factors to mental health. Although these studies were not specifically addressing rural populations, they reinforce the importance of investigating a range of contextual factors in improving our understanding of variations in mental health.

The potential vulnerability of people in rural areas to environmental adversity is starkly illustrated in the social and economic consequences of protracted drought in rural Australia. Greater reliance in rural areas on primary industry and agricultural productivity increases this vulnerability [45]. The limited research to date has highlighted the impact of severe drought, such as loss of employment, population and infrastructure decline, and related social change [41, 46]. These life stressors may be an important influence on health outcomes, particularly mental health outcomes, in rural communities. However, it is also essential that studies examining more comprehensive sets of rural factors do so against the backdrop of the traditional individual-level determinants of mental health and well-being that have consistently been identified in other studies, such as socio-demographic, dispositional, life events and social support factors [36].

The current study

The Australian Rural Mental Health Study (ARMHS) is a longitudinal population-based study established to examine the determinants of mental health in rural and remote communities, with specific reference to the interaction of individual, family/household and community level factors. This paper reports on a cross-sectional analysis of the baseline sample examining the contribution of individual dispositional factors, community characteristics and particular features of the rural environment to mental health and general well being. It focuses particularly on the role of geographically distributed characteristics. We hypothesised that factors known to exhibit significant variability across rural communities, such as the extent of remoteness and environmental adversity, would have a significant independent effect on the measures of mental health and well-being, after accounting for the role of individual dispositional characteristics and other factors that may moderate the level of health and well being (e.g., social support, social connectedness, perception of community characteristics). The findings reported here describe data from a subset of instruments used in the baseline ARMHS surveys (see [23], for further details).

Methods

Recruitment

Sixty local government areas (LGAs) were identified from three rural health service regions of New South Wales (NSW) using the rural, remote and metropolitan areas (RRMA) classification. These areas cover approximately 70% of the geographic region of non-metropolitan NSW. The sampling frame excluded metropolitan zones (i.e., capital city and other urban centres with populations >100,000); the remainder comprises rural and remote zones based on the population size. Over-sampling of the remote and very remote regions of NSW in the current study ensured sufficient sample sizes from these regions (see below).

The baseline sample comprised household residents aged 18 years or older living in private dwellings in rural communities in NSW recruited between 2006 and 2009. Individuals were randomly selected from the Australian electoral roll (AER) and linked telephone numbers were obtained using a national telephone directory. The survey excluded special dwellings (such as hospitals, nursing homes, prisons, hotels and hostels) and overseas visitors usually resident outside Australia. An introduction letter and brochure were provided, giving background to the survey, and information about associated interview processes. For households where residents could not be contacted in the first instance, another letter was sent and five contacts attempted before a household was classified as a non-contact. The project was approved by the Human Research Ethics Committees of the participating institutions.

Exclusion criteria

Participants aged 65 years or over were screened using the modified telephone interview for cognitive status (TICS-M) [14] and those with a TICS-M total score <17 were excluded. Non-english speaking members of a household, those with significant hearing impairment that impeded consent and/or interview, and those with no identifiable telephone contact number (after directory and electronic database search) were also excluded.

Instruments

Current psychological distress and well-being

The Kessler 10 + LM (K-10) [5, 25] was used to assess psychological distress (ten items) and related disability (e.g., days out of role) during the last month (four items). In addition, single item self-report measures were devised to assess general functioning over the same period on several domains: ability to perform everyday duties and tasks, overall physical health, overall mental health, satisfaction with relationships in general, and overall satisfaction with life. Responses were scored on 5-point Likert scales from 'poor' to 'excellent' for functioning, health and relationships, and from 'not at all satisfied' to 'extremely satisfied' for satisfaction with life. The K-10 and general functioning/health items were also combined to provide a single measure of well being (see below in "Data analysis").

Individual factors

These were measured using the following instruments

1. Personality—the 12-item short form EPI measure of neuroticism (EPI-12; [16]) was used, from which a 7-item subset was identified (i.e., being easily hurt, a nervous person, a worrier, being highly strung, suffering from nerves, worrying too long, and often guilty) that conceptually reflected predispositional or trait characteristics, and may be usefully delineated from current distress items. This reflects previous work by the investigators [11] and others [15, 35] regarding the confounding effect of state factors (such as current distress) on the scores obtained from measures of "neuroticism", and the potential overlap of some item content from the EPI and instruments such as K-10. A confirmatory factor analysis supported this approach, with the 7 selected items contributing to a distinct single factor (eigenvalue, 2.86) accounting for 41% of the variance in EPI-12 scores;
2. Recent adverse life events/difficulties—an inventory of events/difficulties in the preceding 12 months was adapted from the life events inventory [8];
3. Social support—a self report measure of availability of social supports was used (derived from the interview schedule for social interaction; [20]); and
4. Sense of community index [12]—this 12 item true/false self-report instrument assesses individual perceptions of place or district, across a number of key domains of social capital: 'shared emotional connection', 'community membership', 'community influence', and 'community reinforcement of needs'; sample items: "I think my district is a good place for me to live"; "I feel at home in this district"; "few people know me in this district"; "people in this district don't get along with each other".

Individual level contextual factors (i.e., personal exposure to and perception of rural characteristics)

These measures included:

1. Infrastructure and services accessibility—four items were specifically designed to reflect common concerns

in rural communities about infrastructure, including population change (e.g., access to health care or other services, concerns regarding fuel prices, and people moving in or out of the district). Each item was scored on 5-point Likert scales ranging from 'not at all' to 'a lot';
2. Perception of drought severity—a single item screening question regarding level of 'stress' caused by drought, using a similar Likert scale; and
3. Duration of participants' exposure to the specific rural environment and community—which was assessed through the number of years residing in the current rural district.

District/neighbourhood level contextual factors

District-level variables were obtained from existing databases linked to individual-level data by postcode. These data sets were extracted from the Australian Bureau of Statistics 2006 Census data (measures of population change, socioeconomic status) at either local government area (LGA) or postcode levels.

1. The Index of Relative Socio-Economic Disadvantage (IRSD) [6]—which is a standardised score based on collation of household level census data; higher IRSD scores indicate less disadvantage. It was chosen for its capacity to provide a postcode level average score representing key dimensions of disadvantage (including income, education, employment and household vehicle access). Remoteness is not included in this measure.
2. District population change—representing the percentage change (from 2002 to 2006) within the estimated resident population of the LGA, based on the birth and death registrations and net migration data.
3. Drought severity—exposure variables were calculated for our study regions by Ivan Hanigan at the National Centre for Epidemiology and Population Health of The Australian National University for the 12 months preceding data collection (using a PostgreSQL database [http://www.postgresql.org] with the PostGIS spatial extension [http://postgis.refractions.net]). The Australian Bureau of Meteorology's gridded monthly rainfall data 1890–2008, at a resolution of 0.25° latitude–longitude [33], were used to calculate a drought index based on six-monthly percentiles for each grid cell's rainfall record [44]. These grid values were then averaged within our spatial units with no weighting by population density as this is not relevant for drought exposures [19]. Further details are available from the corresponding author.
4. Remoteness
   a. The Accessibility/Remoteness Index of Australia Plus (ARIA+)—which is considered to be Australia's most authoritative measure of remoteness, developed by the GISCA (National Centre for Social Applications of Geographic Information Systems: www.gisca.adelaide.edu.au). ARIA describes remoteness from goods and services for any part of Australia. It relies on road distance as a surrogate for remoteness and on the population size of a service centre as a surrogate for the availability of services (p 6; [1]). The index is based on the distance to five categories of service centre. Socio-economic factors and locality population size are not included in the measure. The index values for any populated locality range from 0–12 (with a value of 0 representing the highest level of access to goods and services, and a value of 12 the highest level of remoteness).
   b. The Australian Standard Geographic Classification (ASGC)—which allocates classes of remoteness to localities based on ARIA index values: major cities, inner regional, outer regional, remote and very remote. This study selected people residing in non-metropolitan areas (i.e., outside major cities).

Data analysis

Data entry, cleaning, aggregation and analysis techniques primarily involved SPSS (version 17.0; SPSS, Chicago, IL, USA) and SAS (SAS V9.1; SAS Institute Inc., Cary, NC, USA) statistical software.

Seven scores were included in an aggregate measure of current well-being: two K-10 + LM based scores (i.e., overall K-10 score, and days out of role in the past month); and five Likert ratings (overall physical health and mental health, ability to perform everyday duties and tasks, satisfaction with relationships, and overall satisfaction with life). Based on a principal components analysis of these scores ($n = 2{,}620$), the current well-being measure demonstrated a robust single factorial structure (eigenvalue = 3.92, accounting for 56% of the variance), with factor loadings $>\pm 0.45$ for each component measure. A current well-being index score was calculated for each participant by standardising their raw scores for these measures (using the relevant baseline grand means and SDs), reversing the K-10 and days out of role standardised scores, and then averaging these scores. Participants with five or more of the seven measures were assigned a current well-being index score, with higher scores indicating greater well-being. The correlation between baseline current well-being and K-10 scores was $r = -0.78$.

For the major analyses, hierarchical multiple regressions were used, with a predetermined order of entry for the predictor variables, which reflected a mixture of factors, including the presumed order of influence of these variables

(e.g., chronological) and their immediacy (e.g., individual vs district-level variables). Planned orthogonal contrasts were used to characterise differences within several of the categorical variables (e.g., employment status and marital status). Aspects of reported personal exposure to rural factors were included in the hierarchical models before related district level characteristics (e.g., personal concerns about the drought versus drought severity indices). As a partial control for the number of statistical tests, the minimum threshold for statistical significance was set at $p < 0.01$.

Results

Response rates and sample biases

Sample characteristics and biases have been described previously [23] and are only summarised here. Because of the longitudinal nature of the study, priority during recruitment was on establishing a cohort that could be maintained over an extended period rather than on maximising the initial response rate. Letters of invitation were sent to 13,251 individuals, of whom 3,570 (26.9%) were unable to be contacted ($n = 3{,}152$); deemed ineligible ($n = 343$, for reasons such as: residency in excluded dwellings, non-English speaking, hearing impairment, cognitive impairment); or deceased ($n = 75$). Of the remaining 9,681 individuals, 5,565 (57.5%) were contacted and declined; and 1,477 (15.3%) gave initial verbal agreement by phone but did not reply to further contact. Of those contacted and eligible, 2,639 (representing 1,879 households) agreed to participate and completed an initial survey (participation rate of 27%). Participation rates varied across ASGC categories ($\chi^2_{(3)} = 18.20$, $p < 0.001$), with a marginally higher rate in remote regions (31.1%).

As remote and very remote regions were over-sampled, our examination of sampling and participation biases focussed on fluctuations within ASGC categories. There was no difference in gender distributions between those sampled and the ABS 2006 Census population data ($\chi^2_{(1)} = 0.30$, $p = 0.58$). Within ASGC categories, there were fewer people in the 18–47-year-old categories compared with population data (inner regional, $\chi^2_{(4)} = 118.25$, $p < 0.001$; outer regional, $\chi^2_{(4)} = 121.63$, $p < 0.001$; remote, $\chi^2_{(4)} = 145.55$, $p < 0.001$), except in very remote regions. Among those eligible, no significant participation bias was evident for gender, either among those who were unable to be contacted, declined to participate, or failed to return surveys. Among those deemed ineligible for reasons already outlined, there were significantly fewer males ($\chi^2_{(1)} = 19.28$, $p < 0.001$). Age category was also associated with contact rates ($\chi^2_{(12)} = 32.22$, $p < 0.001$) and survey return rates ($\chi^2_{(12)} = 35.77$, $p < 0.001$). In short, younger people in general, the oldest age group within inner regional areas, and younger people in very remote regions were among the most difficult to contact. Within the inner regional and very remote regions, younger people were also more likely to refuse to participate, or to agree but not return a survey.

The major regression analyses were based on 2,462 participants (i.e., those with complete data for the selected independent and dependent variables, see Table 3). For consistency, participant characteristics are reported for this subsample.

Sample and regional characteristics

Table 1 outlines the demographic and psycho-social characteristics of the sample, while Table 2 reports district-level characteristics by ASGC category. Significant differences were detected across remoteness categories for age, with participants from very remote regions tending to be younger ($p < 0.001$). Highest rates of employment, lowest rates of retirement, and lowest education levels were present in the very remote category ($p < 0.001$). Gender differences across categories did not reach statistical significance. Lowest well-being and highest total K-10 scores and "caseness" rates were also detected among participants in the very remote category ($p < 0.001$).

As shown in Table 2, key regional characteristics of interest demonstrated significant differences across ASGC categories. Predictably, ARIA index scores differed significantly in accordance with the criteria for ASGC/ARIA categorization of LGAs. IRSD scores were lowest in remote and highest in inner regional categories ($p < 0.001$), indicating greater disadvantage in remote regions; drought severity demonstrated significant variation by ASGC category with highest drought severity in the very remote category ($p < 0.001$). Inner and outer regional areas experienced minor population growth (0.50–0.87%), whereas in remote and very remote regions population decline was noted (−0.70 to −0.98%).

Determinants of mental health and well-being

Conceptually, related variables were grouped into five sets or domains, reflecting the study's theoretical interest in the role of predispositional, environmental and contextual factors with a focus on rural-related characteristics: set 1, basic demographic factors (age and gender); set 2, pre-dispositional factors (trait neuroticism, marital status, education); set 3, recent difficulties and support (adverse events/difficulties and employment status, perception of individual social support, sense of community); set 4, personal rural exposure (infrastructure and service accessibility, drought-related concern or worry, and duration of residence in rural

Table 1 Participant characteristics by ASGC (remoteness) category

Variable	Australian standard classification (ASGC) category				*p* value	Total ($n = 2,462$)
	Inner regional ($n = 875$)	Outer regional ($n = 910$)	Remote ($n = 482$)	Very remote ($n = 195$)		
Demographic characteristics						
Age						
Mean (SD)	55.6 (14.5)	55.4 (14.1)	53.6 (15.0)	51.2 (14.7)	<0.001	54.8 (14.5)
Median (min, max)	57.0 (18.0, 87.0)	56.0 (18.0, 89.0)	56.0 (18.0, 84.0)	50.0 (18.0, 83.0)		56.0 (18.0, 89.0)
Gender						
Female	483 (55%)	537 (59%)	307 (64%)	124 (64%)	0.02	1,451 (59%)
Employment status						
Employed	480 (55%)	497 (55%)	306 (63%)	135 (69%)	<0.001	1,418 (58%)
Unemployed	18 (2.1%)	18 (2.0%)	5 (1.0%)	7 (3.6%)		48 (1.9%)
Student/carer/home duties	49 (5.6%)	45 (4.9%)	33 (6.8%)	10 (5.1%)		137 (5.6%)
Permanently unable to work	52 (5.9%)	61 (6.7%)	19 (3.9%)	6 (3.1%)		138 (5.6%)
Retired	276 (32%)	289 (32%)	119 (25%)	37 (19%)		721 (29%)
Marital status						
Never married	67 (7.7%)	65 (7.1%)	41 (8.5%)	20 (10%)	0.06	193 (7.8%)
Divorced or separated	86 (9.8%)	96 (11%)	30 (6.2%)	19 (9.7%)		231 (9.4%)
Married or de facto	674 (77%)	686 (75%)	379 (79%)	142 (73%)		1,881 (76%)
Widowed	48 (5.5%)	63 (6.9%)	32 (6.6%)	14 (7.2%)		157 (6.4%)
Education						
≥12 years	638 (73%)	602 (66%)	290 (60%)	116 (59%)	<0.001	1,646 (67%)
Mental health and well-being						
Total K10 score						
Mean (SD)	15.1 (6.0)	14.6 (5.1)	14.4 (5.5)	16.1 (6.0)	0.001	14.9 (5.6)
Median (min, max)	13.0 (10.0, 44.0)	13.0 (10.0, 40.0)	13.0 (10.0, 47.0)	14.0 (10.0, 40.0)		13.0 (10.0, 47.0)
K-10 "threshold caseness"						
Total K-10 > 15	280 (32%)	265 (29%)	127 (26%)	80 (41%)	<0.001	752 (31%)
Current well-being						
Mean (SD)	−0.02 (0.76)	0.04 (0.72)	0.07 (0.72)	−0.19 (0.74)	<0.001	0.01 (0.74)
Median (min, max)	0.10 (−3.20, 1.17)	0.16 (−3.74, 1.17)	0.22 (−3.98, 1.17)	−0.14 (−2.95, 1.17)		0.12 (−3.98, 1.17)
Adverse events (total)						
Mean (SD)	1.54 (1.57)	1.49 (1.52)	1.53 (1.58)	1.52 (1.57)	0.90	1.52 (1.56)
Median (min, max)	1 (0, 10)	1 (0, 9)	1 (0, 12)	1 (0, 9)		1 (0, 12)

district); and set 5, rural contextual factors (secondary data sources regarding district characteristics: remoteness category, population change over time, regional index of socioeconomic disadvantage, and regional drought severity over the preceding 12 months).

Table 3 reports the univariate associations (i.e., Pearson correlations) between these variables and the well-being score and total K-10 scores. Significant univariate associations were detected between approximately 60% of the predictor variables and both outcome scores, with the strongest associations ($r > \pm 0.30$) detected for neuroticism scores, recent adverse events/difficulties, and personal social support ($p < 0.001$)—indicating that higher well-being (and lower K-10 scores) were associated with lower neuroticism, fewer adverse events, and higher social support. The associations between sense of community index scores and rural service and support accessibility were also statistically significant. Of interest is that worry about drought, years in the district and remoteness demonstrated only modest associations with well-being scores. Contextual factors such as population change, regional socioeconomic ranking, and 1-year drought data were not associated with well-being or K-10 scores.

A five-step hierarchical regression analysis (see Table 3) was conducted using these five sets of variables, effectively giving higher priority to individual demographic and predispositional factors, followed by recent difficulties and support (as proposed moderating factors), then personal and

Table 2 District characteristics by ASGC (remoteness) category

Variable	Australian standard geographic classification (ASGC) category				*p* value	Total ($n = 2,462$)
	Inner regional ($n = 875$)	Outer regional ($n = 910$)	Remote ($n = 482$)	Very remote ($n = 195$)		
District/regional characteristics						
ARIA score (LGA)						
Mean (SD)	1.50 (0.54)	3.39 (0.74)	7.08 (0.72)	11.59 (0.75)	<0.001	4.09 (3.04)
Median (min, max)	1.36 (0.88, 2.39)	3.28 (2.45, 5.47)	6.68 (6.51, 8.67)	11.1 (11.1, 12.8)		3.04 (0.88, 12.82)
IRSD (2006 postcode level)						
Mean (SD)	958.44 (35.27)	930.32 (34.53)	919.12 (27.33)	933.04 (21.60)	<0.001	938.34 (36.15)
Median (min, max)	958 (864, 1,049)	925 (816, 1,011)	912 (831, 1,012)	950 (898, 950)		940 (816, 1,049)
Months in drought out of last 12						
Mean (SD)	2.9 (2.3)	2.0 (3.2)	1.7 (1.7)	4.5 (2.5)	<0.001	2.4 (2.7)
Median (min, max)	4.0 (0.0, 8.0)	0.0 (0.0, 12.0)	2.0 (0.0, 6.0)	5.0 (0.0, 7.0)		2.0 (0.0, 12.0)
% Population change (LGA)						
Mean (SD)	0.87 (0.28)	0.50 (0.74)	−0.98 (0.91)	−0.70 (1.26)	<0.001	0.25 (1.02)
Median (min, max)	0.90 (0.10, 1.20)	0.60 (−1.10, 1.50)	−1.30 (−2.30, 0.30)	0.00 (−3.40, 0.00)		0.50 (−3.40, 1.50)

ARIA Accessibility Remote Index of Australia (ARIA+ version), *LGA* local government area, *IRSD* Index of Relative Socio-economic Disadvantage. Significance tests (*p* values) refer to overall comparisons between ASGC categories, from one-way ANOVAs (continuous variables) or overall χ^2 tests (categorical variables)

geographic level rural contextual factors—thereby, enabling investigation of the impact of rurality measures on well-being after accounting for other predisposing and moderating factors. This model accounted for between 41% and 45% of total variance in well-being and K-10 scores, respectively. With respect to the total well-being index scores, the predispositional factors accounted for 22% of the variance (chiefly neuroticism, and to a lesser extent marital status). Recent difficulties and support accounted for a further 18% of the variance (chiefly adverse events and difficulties, employment status, social support and neighbourhood/community support). Rural exposure and remoteness factors made a minor contribution in this model (e.g., perceptions of infrastructure and services, standardised regression weight = −0.11). Not surprisingly K-10 scores followed a similar pattern, although there was a minor but significant effect for age (standardised regression weight = −0.15), with younger participants reporting higher distress on the K-10.

We also conducted a parallel series of regression analyses excluding neuroticism, although the items most likely to reflect current distress had already been dropped from the neuroticism measure. Apart from overall reductions in explained variance (well-being: to 32%; K-10: to 29%), the pattern of significant predictors was unchanged.

In summary, the factors chiefly associated with well-being and its component K-10 scores were predispositional (neuroticism), recent adversity, and personal social support and social capital measures. Personal rural exposure also had a significant additive effect on the primary outcome measures. Postulated rural factors such as drought worry failed to demonstrate a significant effect in these models and years of living in a rural area did not influence well-being or K-10 scores in either direction.

In view of the significant contribution of recent adverse events and difficulties, these associations were examined in more detail (see Table 4). Almost a third (29.5%) of participants reported no events during the previous 12 months, 49.1% reported 1–2 life events, and 20.4% reported 3 or more events. It is of interest to note the extent of difference across these categories, with substantial lowering of well-being scores and elevation of mean K-10 scores at what appears to be a threshold level of three or more life events. As shown in the lower-half of Table 4, those events associated with the highest distress scores reflected problems in personal social networks (e.g., arguments, financial crisis, or loss of job) or serious personal accidents. There was no significant difference in the total number of life events/difficulties across ASGC categories (see Table 1).

Discussion

Research within rural communities provides an important opportunity to investigate individual and community factors contributing to mental health and well-being, and the influence of place or locality [17]. The ARMHS project will provide comprehensive longitudinal data from rural and remote communities, with a particular focus on individual, social and environmental factors pertinent to non-urban Australian settings. The baseline (cross-sectional) phase of

Table 3 Predictors of current well-being and Kessler 10 (K-10) scores—results from five-step hierarchical regression analyses ($n = 2{,}462$)

Step	Predictor variable	Outcome variable					
		Current well-being score			Kessler 10 (K-10) score		
		Pearson correlation	Adjusted r^2	Standardised estimate	Pearson correlation	Adjusted r^2	Standardised estimate
1. Demographics	Age	0.04	0.002	0.04	−0.15**	0.021	−0.15**
	Gender (1. male; 2. female)	0.03		0.04	0.01		0.00
2. Predispositional factors	Trait neuroticism	−0.44**	0.218	−0.44**	0.55**	0.326	0.54**
	Education level (≥12 years education)	0.05		0.04	−0.01		−0.01
	Widowed versus other (−1,−1,−1,3)	0.01		0.03	−0.02		−0.01
	Never married versus married/de facto/ divorced/separated (2,−1,−1,0)	−0.05*		0.00	0.07**		−0.01
	Divorced/separated versus married/de facto (0,1,−1,0)	−0.16**		−0.14**	0.17**		0.13**
3. Recent events and support	Retired versus all others (−1,−1,−1,−1,4)	0.08**	0.393	0.12**	−0.15**	0.441	−0.11**
	Permanently unable to work versus able to work (−1,−1,−1,3,0)	−0.22**		−0.16**	0.13**		0.09**
	Students/home duties/carers versus workforce (−1,−1,2,0,0)	−0.06*		0.02	0.02		−0.02
	Looking for work versus employed (−1,1,0,0,0)	−0.12**		−0.07	0.05		0.07
	Adverse events/difficulties (last 12 months)	−0.38**		−0.26**	0.38**		0.23**
	Social support	0.35**		0.18**	−0.32**		−0.17**
	Sense of community index	0.26**		0.11**	−0.23**		−0.06**
4. Rural exposure	Perceptions of infrastructure and services	−0.28**	0.406	−0.11**	0.26**	0.450	0.08**
	Worry about drought	−0.11**		−0.02	0.13**		0.03
	Years living in the district	0.05*		−0.02	−0.09**		0.03
5. District-level factors	Remoteness: mean ARIA score (LGA)	−0.03	0.406	−0.01	0.02	0.449	−0.02
	% Population change 2003–2008	0.01		0.00	−0.01		−0.01
	District socio-economic disadvantage (IRSD)	0.05		0.01	−0.02		0.00
	Drought severity index (past 12 months)	0.00		−0.02	0.00		0.02

Univariate (Pearson correlations) and multivariate associations (standardised regression weights) from five-step hierarchical regression analyses; orthogonal contrasts were used to characterise differences within the employment status and marital status variables (the contrast coefficients shown in brackets parallel the sub-group sequence shown in Table 1)

* $p < 0.01$, ** $p < 0.001$

the study, reported here, aimed to investigate the influence of a range of factors within rural districts reported at an individual level and also examined through district-level data. Rural characteristics that were assessed included specific rural adversity (e.g., perceived adverse impacts of drought), perceived accessibility of health and other services, community connectedness and community population changes. District-level contextual variables assessed severity of drought, population change, area-based indices of remoteness and socioeconomic disadvantage.

Minimal support was found for our original hypothesis regarding the impact of remoteness and environmental adversity on mental health and well-being, but the study demonstrated an important moderating effect of a set of personal characteristics and individual level contextual factors. Within the univariate analyses (see Table 2), an expected regional variation was detected (across ASGC categories) in a range of postulated district-level influences on mental health (e.g., socio-economic disadvantage, population change, drought severity), and regional variability was also detected in levels of psychological distress and well-being (see Table 1), with the poorest health in very remote regions. Nevertheless, district level impacts on mental health were not evident in the major regression analyses (see Table 3).

Overall, the study findings suggest that despite these regional differences, the most significant contributors to well-being in this sample were those relating to personal predispositional factors, life events and aspects of social support, rather than the district or locality factors that we measured. These findings are consistent with those from other large scale studies such as the UK National Mental Health Study, which demonstrated that geographic location was far less relevant to mental health outcomes than

Table 4 Profile of adverse life events during the last 12 months ($n = 2,462$)

Variable	*n* (%)	Current well-being score mean (SD)	Kessler 10 (K-10) score mean (SD)
Number of events			
0	733 (29.5)	0.22 (0.60)	13.27 (4.16)
1	713 (28.7)	0.14 (0.65)	14.03 (4.77)
2	508 (20.4)	0.01 (0.63)	14.84 (4.91)
3	266 (10.7)	−0.26 (0.78)	16.49 (5.90)
4	125 (5.0)	−0.46 (0.89)	18.82 (6.98)
5	54 (2.2)	−0.90 (0.91)	21.46 (8.74)
>5	63 (2.5)	−1.13 (0.95)	23.41 (8.30)
Key categories of adverse events			
Relative or friend died	1,020 (41.0)	−0.04 (0.76)	15.16 (5.68)
Relative ill	784 (31.5)	−0.10 (0.79)	15.85 (6.29)
Argument outside household	220 (8.9)	−0.47 (0.92)	18.63 (7.59)
Demoted or become unemployed	125 (5.0)	−0.53 (0.90)	18.66 (7.13)
Major financial crisis	348 (14.0)	−0.50 (0.88)	18.72 (7.46)
Serious accident	55 (2.2)	−0.57 (0.93)	18.92 (7.37)
Argument within household	291 (11.7)	−0.62 (0.86)	19.27 (7.57)

personal and experiential factors (marital status, life events, social support) [36], and consistent with international research indicating more complex interactions between location, socio-demographic factors and mental health than can be addressed in simple rural–urban comparisons (ESEMED study) [26]. The effects of locality that were significant were reflected in findings regarding sense of community (indicative of individual perception of community), suggesting a significant influence of social capital factors on well-being. Neuroticism accounted for the greatest proportion of variance in measures of distress and well-being (over 20–30%). There is a large body of research regarding neuroticism as a measure of individual propensity to poorer mental health, including poorer outcomes in response to adversity (e.g., [24]). There has also been considerable debate about the state and trait characteristics of neuroticism [15, 35]. In this study, we delineated a set of items that most closely identified longer term emotional responses and characteristics in an abbreviated measure, building on previous research undertaken by the investigators [11, 29], arguably strengthening the capacity to capture trait characteristics that will be assessed in more detail in subsequent phases of this study. Nevertheless, trait neuroticism may lead to a reporting bias that influences propensity to endorse difficulties or adverse events, or may, through greater interpersonal sensitivity, contribute to an increased likelihood of reporting problems within social networks (e.g., perception of poorer social support or household difficulties/arguments).

An independent association between life events/difficulties and mental health and well-being was detected in this study. It is possible that the measure of life events/difficulties represented a proxy measure for factors reflecting geographic differences, but the absence of an association between well-being and the district-level variables used in this study would argue against this. The life events with greatest impact on the outcomes measured in this study related to financial strain and interpersonal difficulties. This may reflect the impact of common forms of adversity in rural regions, and provide further evidence of the potential importance of personal economic and interpersonal factors. More detailed study of the geographic distribution of life events is necessary to identify potential "rural" experiences embedded in these data (e.g., financial impact of drought).

The increasing recognition of the significant influence of community characteristics on health is reflected in a growing literature examining the role of social capital in health outcomes [37]. This concept encapsulates both individual and community-level characteristics, such as perceived trust, shared values, security, participation, and community resources, amenities and services [4]. Attention has been given to such factors, and the role they might play in understanding geographic health variations [13, 51]. This includes subjective ratings of quality of communities [18], social support [9, 47], social integration and attachment [39], access to services [52], confidence in getting help from neighbours [28], and key socioeconomic factors such as income inequality [51]. After taking account of individual-level characteristics, community-level socioeconomic characteristics have been associated with depressive symptoms and higher rates of major depression in urban settings [42]. Lower rates of depression among rural residents in a large Canadian study were significantly

associated with a stronger sense of community belonging and higher social support [38]. These studies highlight the importance of research on individual, household and community level characteristics as a critical context that may moderate individual mental health over time. It is also important to consider differences between the impact of districts on people (contextual factors) and "compositional factors" (i.e., the impact that people make on a district) [27], requiring more fine-grained investigation in multilevel modelling, particularly when considering supportive behaviours and connections within communities.

The potential importance of location was demonstrated by the small but significant contribution of perceived barriers to services and supports, and the important role detected for perceived community support. More detailed pathways investigating how these factors interact with rural events such as drought are needed. The univariate findings identified stress/worry related to drought rather than drought effects per se (or at least those evident in the geographic data used). It is possible that longer term drought severity data (including long term versus shorter term drought exposure, or drought in those regions previously less affected by drought, as compared with those "accustomed" to drought impact), and attention to other environmental events (such as severe storms and floods that also affect communities in this study) will be necessary. It is possible that worries about drought and general levels of distress coexist, with drought being a dominant theme among those currently anxious or depressed, and the worries being a symptom of that distress rather than a trigger for such distress. These cross-sectional data are limited in their capacity to clarify the causal pathways, but longitudinal data such as that being collected on this sample at the time of writing, could inform this issue. While there was a significant overlap between the current distress (K-10) and well-being measures used here, more comprehensive assessments of overall functioning are likely to be indicative of longer term aspects of well-being.

There are a number of limitations to this study. Sampling bias is unavoidable with any recruitment strategy. The primary aims of this study concern the patterns of association and determinants of mental health over time, rather than determining cross-sectional prevalence rates per se, hence lessening the potential impact of any response bias [30]. Although the response rate is low, it matches other population-based surveys in rural communities [7, 21] and those using telephone-based recruitment [34]. Procedures recommended to maximise the response to telephone recruitment were incorporated in the study methods [34] and a strategy of timely local community promotion, with the survey conducted through local rurally based research units, was also part of the strategy to enhance local support for the study. An urban sample was not included as the study's focus was on rural characteristics and the distribution and type of risk factors across rural areas. Whether these models are replicated in urban areas will be examined in future analyses linked to other comparable Australian urban data sets (e.g., [43]).

Despite these limitations, the current ARMHS project has a number of strengths. The investigation includes a broad range of individual and district level variables, including well-established individual-level determinants of mental health, individual perception of community characteristics and contextual factors reflecting important aspects of rural adversity (such as drought severity). As such, it is one of the few research studies to assess this range of individual and contextual factors within non-urban populations.

The findings suggest that the personal predispositional factors and individual perception of social context (including factors reflecting aspects of social capital) are the major determinants of well-being. There are inherent limitations in the reliance on cross-sectional data and the influence of current distress on perceptions of support and community characteristics. Nevertheless, the findings provide qualified support for the importance of focusing on enhancing community connectedness and personal support, and reducing isolation, as a means of promoting resilience and adaptation in these regions and the important potential moderating effect of these factors when considering the impact of environmental adversity in rural areas.

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References

1. AIHW (2004) Rural, regional and remote health: a guide to remote classifications. In: Cat. No. PHE 53. Australian Institute of Health and Welfare, Canberra
2. AIHW (2006) Rural, regional and remote health. Mortality trends 1992-2003. In: Rural Health Series No. 7 Cat No. PHE 71. Australian Institute of Health and Welfare, Canberra
3. AIHW (2008) Rural, regional and remote health: indicators of health system performance. In: Rural Health Series No. 10. Cat. No. PHE 103. Australian Institute of Health and Welfare, Canberra
4. Almedom AM (2005) Social capital and mental health: an interdisciplinary review of primary evidence. Soc Sci Med 61:943–964
5. Andrews G, Slade T (2001) Interpreting scores on the Kessler Psychological Distress Scale (K10). Aust N Z J Public Health 25:494–497

6. Australian Bureau of Statistics (2008) An introduction to Socio-Economic Indexes for Areas (SEIFA), 2006: information paper, ABS Catalogue No. 2039.0. Commonwealth of Australia, Canberra
7. Banks E, Redman S, Jorm L, Armstrong B, Bauman A, Beard J, Beral V, Byles J, Corbett S, Cumming R, Harris M, Sitas F, Smith W, Taylor L, Wutzke S, Lujic S (2008) Cohort profile: the 45 and up study. Int J Epidemiol 37:941–947
8. Brugha TS, Cragg D (1990) The list of threatening experiences: the reliability and validity of a brief life events questionnaire. Acta Psychiatr Scand 82:77–81
9. Brugha TS, Morgan Z, Bebbington P, Jenkins R, Lewis G, Farrell M, Meltzer H (2003) Social support networks and type of neurotic symptom among adults in British households. Psychol Med 33:307–318
10. Butterworth P, Rodgers B, Jorm AF (2006) Examining geographical and household variation in mental health in Australia. Aust N Z J Psychiatry 40:491–497
11. Carr VJ, Lewin TJ, Kenardy JA, Webster RA, Hazell PL, Carter GL, Williamson M (1997) Psychosocial sequelae of the 1989 Newcastle earthquake: III. Role of vulnerability factors in post-disaster morbidity. Psychol Med 27:179–190
12. Chipuer HM, Pretty GMH (1999) A review of the sense of community index: current uses, factor structure, reliability, and further development. J Community Psychol 27:643–658
13. Cullen M, Whiteford H (2001) The Interrelations of Social Capital with Health and Mental Health. Discussion Paper. Commonwealth of Australia 2001
14. de Jager CA, Budge MM, Clarke R (2003) Utility of TICS-M for the assessment of cognitive function in older adults. Int J Geriatr Psychiatry 18:318–324
15. Duncan-Jones P, Fergusson DM, Ormel J, Horwood LJ (1990) A model of stability and change in minor psychiatric symptoms: results from three longitudinal studies. Psychol Med Suppl 18:1–28
16. Eysenck SBG, Eysenck HJ, Barrett P (1985) A revised version of the psychoticism scale. Pers Individ Dif 6:21–29
17. Fraser C, Jackson H, Judd F, Komiti A, Robins G, Murray G, Humphreys J, Pattison P, Hodgins G (2005) Changing places: the impact of rural restructuring on mental health in Australia. Health Place 11:157–171
18. Greiner KA, Li C, Kawachi I, Hunt DC, Ahluwalia JS (2004) The relationships of social participation and community ratings to health and health behaviors in areas with high and low population density. Soc Sci Med 59:2303–2312
19. Hanigan IC, Hall GV, Dear KBG (2006) A comparison of methods for calculating population exposure estimates of daily weather for health research. Int J Health Geogr 5:38
20. Henderson S, Duncan-Jones P, Byrne DG, Scott R (1980) Measuring social relationships. The interview schedule for social interaction. Psychol Med 10:723–734
21. Judd F, Cooper AM, Fraser C, Davis J (2006) Rural suicide—people or place effects? Aust N Z J Psychiatry 40:208–216
22. Judd FK, Jackson HJ, Komiti A, Murray G, Hodgins G, Fraser C (2002) High prevalence disorders in urban and rural communities. Aust N Z J Psychiatry 36:104–113
23. Kelly BJ, Stain HJ, Coleman C, Perkins D, Fragar L, Fuller J, Lewin TJ, Lyle D, Carr VJ, Wilson JM, Beard JR (2010) Mental health and well-being within rural communities: the Australian Rural Mental Health Study (ARMHS). Aust J Rural Health 18:16–24
24. Kendler KS, Kuhn J, Prescott CA (2004) The interrelationship of neuroticism, sex, and stressful life events in the prediction of episodes of major depression. Am J Psychiatry 161:631–636
25. Kessler RC, Andrews G, Colpe LJ, Hiripi E, Mroczek DK, Normand SLT, Walters EE, Zaslavsky AM (2002) Short screening scales to monitor population prevalences and trends in non-specific psychological distress. Psychol Med 32:959–976
26. Kovess-Masfety V, Alonso J, de Graaf R, Demyttenaere K (2005) A European approach to rural-urban differences in mental health: the ESEMeD 2000 comparative study. Can J Psychiatry 50:926–936
27. Kubzansky LD, Subramanian SV, Kawachi I, Fay ME, Soobader MJ, Berkman LF (2005) Neighborhood contextual influences on depressive symptoms in the elderly. Am J Epidemiol 162:253–260
28. Lehtinen V, Michalak E, Wilkinson C, Dowrick C, Ayuso-Mateos JL, Dalgard OS, Casey P, Vazquez-Barquero JL, Wilkinson G (2003) Urban–rural differences in the occurrence of female depressive disorder in Europe—evidence from the ODIN study. Soc Psychiatry Psychiatr Epidemiol 38:283–289
29. Lewin TJ, Carr VJ, Webster RA (1998) Recovery from post-earthquake psychological morbidity: who suffers and who recovers? Aust N Z J Psychiatry 32:15–20
30. Lundberg I, Damstrom Thakker K, Hallstrom T, Forsell Y (2005) Determinants of non-participation, and the effects of non-participation on potential cause-effect relationships, in the PART study on mental disorders. Soc Psychiatry Psychiatr Epidemiol 40:475–483
31. Morrell S, Taylor R, Slaytor E, Ford P (1999) Urban and rural suicide differentials in migrants and the Australian-born, New South Wales, Australia 1985–1994. Soc Sci Med 49:81–91
32. Murray G, Judd F, Jackson H, Fraser C, Komiti A, Hodgins G, Pattison P, Humphreys J, Robins G (2004) Rurality and mental health: the role of accessibility. Aust N Z J Psychiatry 38:629–634
33. National Climate Centre (2009) http://www.austehc.unimelb.edu.au/asaw/biogs/A000918b.htm. Commonwealth Bureau of Meteorology, Canberra
34. O'Toole J, Sinclair M, Leder K (2008) Maximising response rated in household telephone surveys. BMC Med Res Methodol 8:71
35. Ormel J, Rosmalen J, Farmer A (2004) Neuroticism: a non-informative marker of vulnerability to psychopathology. Soc Psychiatry Psychiatr Epidemiol 39:906–912
36. Paykel E, Abbott R, Jenkins R, Brugha T, Meltzer H (2003) Urban–rural mental health differences in Great Britain: findings from the National Morbidity Survey. Int Rev Psychiatry 15:97–107
37. Putnam R (2004) Commentary: "Health by association": some comments. Int J Epidemiol 33:667–671
38. Romans S, Cohen M, Forte T (In Press) Rates of depression and anxiety in urban and rural Canada. Soc Psychiatry Psychiatr Epidemiol. doi:10.1007/s00127-00010-00222-00122
39. Romans SE, Walton VA, Herbison GP, Mullen PE (1992) Social networks and psychiatric morbidity in New Zealand women. Aust N Z J Psychiatry 26:485–492
40. Rost K, Forney J, Fischer E, Smith J (2002) Use, quality and outcomes of care for mental health: The rural perspective. Med Care Res Rev 59:231–265
41. Sartore G, Hoolahan B, Tonna A, Kelly B, Stain H (2005) Wisdom from the drought: recommendations from a consultative conference. Aust J Rural Health 13:315–320
42. Silver E, Mulvey EP, Swanson JW (2002) Neighborhood structural characteristics and mental disorder: Faris and Dunham revisited. Soc Sci Med 55:1457–1470
43. Slade T, Johnston A, Browne MAO, Andrews G, Whiteford H (2009) 2007 National Survey of Mental Health and wellbeing: methods and key findings. Aust N Z J Psychiatry 43:594–605
44. Smith D, Hutchinson M, McArthur R (1992) Climatic and agricultural drought: payments and policy. Centre for Resource and Environmental Studies, Australian National University, Canberra
45. Smith KB, Humphreys JS, Wilson MGA (2008) Addressing the health disadvantage of rural populations: how does epidemiological evidence inform rural health policies and research? Aust J Rural Health 16:56–66
46. Speldewinde PC, Cook A, Davies P, Weinstein P (2009) A relationship between environmental degradation and mental health in rural Western Australia. Health Place 15:880–887

47. Stain HJ, Kelly B, Lewin TJ, Higginbotham N, Beard JR, Hourihan F (2008) Social networks and mental health among a farming population. Soc Psychiatry Psychiatr Epidemiol 43:843–849
48. Taylor R, Page A, Morrell S, Harrison J, Carter G (2005) Social and psychiatric influences on urban–rural differentials in Australian suicide. Suicide Life Threat Behav 35:277–290
49. Weich S, Araya R (2004) International and regional variation in the prevalence of common mental disorders: do we need more surveys? Br J Psychiatry 184:289–290
50. Weich S, Holt G, Twigg L, Jones K, Lewis G (2003) Geographic variation in the prevalence of common mental disorders in Britain: a multilevel investigation. Am J Epidemiol 157:730–737
51. Weich S, Twigg L, Lewis G, Jones K (2005) Geographical variation in rates of common mental disorders in Britain: prospective cohort study. Br J Psychiatry 187:29–34
52. Wrigley S, Jackson H, Judd F, Komiti A (2005) The role of stigma and attitudes towards help-seeking from a GP for mental health problems in a rural town. Aust N Z J Psychiatry 39:514–521