

# Communication Vulnerabilities in Working-age Australians with Musculoskeletal Conditions: A Cross-sectional Analysis

Dianne B. Lowe, Michael J. Taylor, and Sophie J. Hill

**ABSTRACT. Objective.** To estimate the prevalence of communication vulnerability (CV) among consumers of healthcare and its association with various health measures among working-age Australians with musculoskeletal conditions (MSK). The various vulnerability characteristics lead to inadequate communication between consumers and healthcare professionals.

**Methods.** Prevalence of CV among 18–64 year olds, with or without MSK, was analyzed using the Australian Bureau of Statistics' National Health Survey 2007–08 data. Associations between CV and measures of health complexity (accumulating multimorbidity and risk factors) and health burden (poorer self-rated health, psychological distress, and pain restricting work) in the MSK population were estimated using logistic regression. Further analyses were conducted for each vulnerability characteristic to determine the degree of association (crude and adjusted) with measures of interest.

**Results.** CV were more prevalent in working-age Australians with MSK (65%) than those without (51%). Adjusted for age and sex among working-age Australians with at least 1 MSK, those with 1 or more CV were more likely to have multimorbidity [adjusted OR (aOR) = 1.8, 95% CI 1.5–2.2], lifestyle risk factors (aOR = 2.1, 95% CI 1.5–2.8), poorer self-rated health (aOR = 3.4, 95% CI 2.7–4.2), greater psychological distress (aOR = 2.9, 95% CI 2.3–3.7), and pain restricting employment (aOR = 1.7, 95% CI 1.4–2.1) compared with those without CV.

**Conclusion.** For working-age people, there is an association between MSK and CV. For those with MSK, CV were associated with increased likelihood of health complexity and burden. These findings have policy and clinical relevance. Research is needed to determine whether interventions that address these specific CV characteristics reduce the burden of disease within these populations. (J Rheumatol First Release May 1 2015; doi:10.3899/jrheum.140989)

## Key Indexing Terms:

ARTHRITIS    MUSCULOSKELETAL CONDITIONS    COMMUNICATION    COMORBIDITY

Communication between consumers and health professionals is increasingly being recognized as important<sup>1</sup>. Poor communication contributes to serious adverse events<sup>2</sup>, poorer health

status<sup>3</sup>, and decreased medication adherence<sup>4</sup>. Additionally, communication underpins a key tenet of patient-centered care, tailoring interactions to individual's needs, preferences, and perspectives<sup>5</sup>.

Particular characteristics of individuals — such as speech, sensory, and cognitive impairments; limited English proficiency; sexual, cultural, and/or religious differences; and/or limited health literacy — may complicate clinical management and increase the potential for inadequate consumer—professional communication<sup>6,7</sup>. Blackstone, *et al* termed these characteristics “communication vulnerabilities”<sup>7</sup> (CV). People with CV experience health inequalities<sup>8</sup> and difficulties navigating healthcare systems, in addition to being underserved by them<sup>9,10</sup>.

CV affect health in various ways<sup>2</sup>. For example:

- Speech and sensory impairments and limited local language proficiency create difficulties for both consumers and health professionals when clarifying concerns, achieving understanding, and discussing health information<sup>2,6</sup>.
- Cognitive, intellectual, or psychological impairments impede memory, the ability to develop new skills, or to understand, prevent, and manage diseases or medications<sup>11</sup>.

*From the Centre for Health Communication and Participation; and Cochrane Consumers and Communication Review Group, School of Psychology and Public Health, College of Science, Health and Engineering, La Trobe University; and School of Allied Health, Australian Catholic University, Melbourne, Australia.*

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*D.B. Lowe, BA, BSc, Grad Cert Ed., PhD Student, Research officer, Centre for Health Communication and Participation, School of Psychology and Public Health, College of Science, Health and Engineering, La Trobe University; M.J. Taylor, BPharm (Hons), LLB (Hons), Grad Dip Legal Prac, MSc, PhD, Senior Lecturer in Public Health, School of Allied Health, Australian Catholic University, and Editor, Cochrane Consumers and Communication Review Group, School of Psychology and Public Health, College of Science, Health and Engineering, La Trobe University; S.J. Hill, BA (Hons), MA, PhD, Head of Centre for Health Communication and Participation, and Co-ordinating Editor, Cochrane Consumers and Communication Review Group, School of Psychology and Public Health, College of Science, Health and Engineering, La Trobe University.*

*Address correspondence to Ms. D.B. Lowe, Centre for Health Communication and Participation, School of Psychology and Public Health, College of Science, Health and Engineering, La Trobe University, Australia. E-mail: d.lowe@latrobe.edu.au*

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- Poor health literacy affects the capacity to obtain, process, and understand basic health information and services<sup>12</sup>.

For this analysis, we focused on musculoskeletal conditions (MSK) such as osteoarthritis (OA), inflammatory arthritis, or osteoporosis. MSK are grouped together as an Australian National Health Priority Area<sup>13</sup> because they are common<sup>14</sup> and typically require complex care by multiple health professionals, polypharmacy, physical therapy, and/or surgery<sup>15</sup>. Increasingly, people with MSK experience coexisting chronic health conditions (termed “multimorbidity”). In this context, effective communication is particularly important because multimorbidity affects quality of life<sup>16</sup> and contributes to adverse events and outcomes, and increases healthcare use<sup>17,18</sup>. Given these factors, a nationally representative population with MSK is a logical starting place to better understand the implications of CV. Establishing an association between CV and measures of health burden among this broad and already complex patient population may have policy and clinical implications.

Health complexity issues have been identified in older people<sup>19</sup>, but less so in working-age populations. Yet many chronic health conditions affect workforce participation and social roles, potentially creating additional social and economic burdens among individuals and society.

We therefore focused on the working-age population (ages 18–64 years) and aimed to estimate (1) the prevalence of CV among those with and without MSK, and (2) among those with MSK, the association between any, and specific, CV characteristics and measures of health. These measures include complexity (the presence of multimorbidity or disease risk factors), and burden (poorer self-rated health, distress, or pain restricting work).

## MATERIAL AND METHODS

This analysis used the nationally representative Australian Bureau of Statistics’ (ABS) National Health Survey 2007–08 (NHS07-08) data<sup>20</sup>. The survey covers a wide range of self-reported personal health information across all age groups, including health status, health-related risk factors, and healthcare use.

Detailed information about ABS sampling, survey design, and response rate is available elsewhere<sup>20</sup>.

**Population.** Our study focused on working-age adults (18–64 years, regardless of current employment status) with and without chronic MSK. “Musculoskeletal conditions” included OA, inflammatory arthritis, other arthritis or arthropathies, soft tissue disorders, gout, back pain, or other MSK not otherwise defined. MSK were considered “chronic” if self-reported as current and present for at least 6 months.

**Exposure.** Within the analyses, the presence of any 1 as well as specific “CV characteristics” were the exposures. Where possible, relevant NHS07-08 data were matched to the specific “CV characteristic” as defined by Blackstone, *et al*<sup>7</sup>. The specific characteristics included in Blackstone, *et al*’s established definition were speech; vision; hearing and cognitive impairments; limited English proficiency; religious, cultural, or sexual identity differences; and poor health literacy. Each characteristic increased the possibility for inadequate communication in health settings<sup>7</sup>. Within the NHS07-08, the majority of these characteristics, or a proxy, were available (Table 1). The proxy for poor health literacy was low education attainment (Yr 10 level or less). Migration from a country where English was not the

primary spoken language was the proxy for English proficiency. Data concerning religious, cultural, or sexual identity difference were unavailable and thus not included in this analysis. To ensure that vision impairments included only severe conditions, minor conditions were excluded (presbyopia, short or long sightedness, color blindness, or astigmatism).

**Measures of accumulated health complexity.** The presence of selected comorbidities (chronic conditions designated as Australian National Health Priority Areas)<sup>13</sup> and biomedical or lifestyle risk factors constituted “health complexity” (Table 1). Although sometimes considered a chronic health condition, obesity (i.e., a body mass index of 30 kg/m<sup>2</sup> or greater) was considered a risk factor in our study.

**Measures of health burden.** Measures of “health burden” included poorer self-rated health, distress, and pain restricting work. Poorer self-rated health was composed of a response of either “fair” or “poor” to the Medical Outcomes Study Short Form-12, question 2, overall rating of health<sup>21</sup>. Distress was defined as Kessler Psychological Distress Scale-10 (K-10) score of either high (> 22 points) or very high (30–50 points) severity of distress experienced in the 4 weeks prior to interview<sup>22</sup>. A response of “moderately” or “extremely” to bodily pain interfering on normal work during the previous 4 weeks constituted “pain restricting work”.

**Analyses.** Figure 1 illustrates the populations used in the analyses: the working-age sample population (A); those with any MSK (B); those with any of the specific (I–VI) CV characteristics (C); and those with CV alongside MSK (D). Weighted population prevalence<sup>23</sup> of any (C), and specific (I–VI) CV were estimated among the working-age sample with MSK (i.e.,  $D \div B$ ) and without MSK [i.e.,  $(C - D) \div (A - B)$ ]. Proportions were compared using the chi-square test.

For the variables “poorer self-rated health” and “pain restricting work”, the proportional odds assumption was violated. As these variables could not be treated as ordered categories, an ordinal logistic regression model was not appropriate. It was also not possible to treat the K-10 scores (measuring distress) as a continuous outcome because of non-normal distribution, and neither was it possible to transform the data to approximate normality.

Within those with MSK (B, in Figure 1), multiple logistic regression was used to assess the association between any CV (D, in Figure 1; i.e., exposure) and complexity or burden measures (i.e., outcomes) compared with those with MSK but no CV (B–D, in Figure 1). Further analyses were undertaken to determine whether the strength of associations varied for each specific (I–VI) CV.

All models were estimated using the ABS-generated replicant weights to account for the survey design. Crude and adjusted OR (aOR) and 95% CI are reported. Model 1 adjusts for age and sex. Model 2 further adjusts for quintiles of equivalized household income<sup>20</sup> and occupation as classified by the Australian and New Zealand Standard Classification of Occupations<sup>20</sup>. All statistical analyses were performed using Stata (version 10.1).

## RESULTS

**Prevalence.** Of the 20,800 NHS07-08 survey respondents, 12,604 were working-age adults. Overall, 55.6% of the working-age sample had at least 1 CV characteristic. Of the working-age with at least 1 MSK ( $n = 4555$ ), 65.0% had a CV compared with 50.9% among those without MSK ( $p < 0.01$ ; Table 2). The most common CV were low education attainment (32.9%), migration from a country where English is not the primary spoken language (18.9%), and hearing impairment (9.0%; Table 2).

Among the MSK sample, those with and without any CV differed on a number of demographic factors (Table 3). Those with any CV were older, a greater number reported income level in the lowest quintile, more were not currently working, and fewer were partnered parents with children (Table 3).

**Table 1.** Categories of CV, selected chronic conditions, and risk factors with their corresponding Australian Bureau of Statistics' National Health Survey (NHS) 2007–08 data category. Data self-reported unless otherwise specified.

Variable Categories	Corresponding NHS07-08 Category
Communication vulnerability categories	
Hearing impairment	Complete or partial deafness or other hearing loss.
Vision impairment	Complete or partial blindness in 1 or both eyes; diabetes-related vision disability; glaucoma; macular degeneration or other disorders of choroid and retina; other visual disturbances or loss of vision.
Speech impairment	Any speech difficulty.
Cognitive disability	Intellectual disability; psychological disability; or head injury, or stroke- or brain damage-related disability.
Low educational attainment (as proxy for health literacy)	Completed up to secondary education of Yr 10 level (or less).
Country of birth (ESL; as proxy for English proficiency)	Country of birth where English was not the main language spoken; with subcategories of timing of arrival in Australia: 1. Recently migrated (up to 10 yrs prior to survey). 2. Medium-term migrant (between 10–20 yrs prior). 3. Longstanding migrant (migrated more than 20 yrs ago).
Chronic condition categories	
Cardiovascular disease	Angina; other ischemic heart diseases; diseases of the arteries, arterioles, and capillaries; cerebrovascular diseases; edema and heart failure; other diseases of the circulatory system; cardiac murmurs and cardiac sounds; and other symptoms and signs involving the circulatory system.
Cancer	Malignant neoplasms of the skin, other malignant neoplasms, and site unknown.
Diabetes	Type 1, type 2, and type unknown.
Asthma	Asthma.
COPD	Bronchitis and emphysema.
Mental health	Alcohol and drug problems; other mood (affective) disorders; feeling depressed; anxiety-related problems; problems of psychological development; behavioral and emotional problems with usual onset in childhood/adolescence; other mental and behavioral problems; and symptoms/signs involving cognition, perceptions, emotional state, and behavior.
MSK	Arthritis – OA (97% responses in this category were OA; other responses included degeneration of specific joint, knee OA, and hip OA). Arthritis – rheumatoid (95% responses included RA; other responses included RA autoimmune; AS; arthritis inflammatory). Arthritis – other/type unknown and other arthropathies, other soft tissue disorders and rheumatism, back pain/problems (sciatica, disc disorders, curvature of the spine), gout, osteoporosis, other MSK (symptoms, signs involving nervous and musculoskeletal system, other diseases musculoskeletal system, and connective tissue).
Risk factor categories	
Biomedical	High blood pressure (reading of 140/90 mmHg or higher, measured during NHS07-08 interview), high cholesterol, obesity (BMI of 30.00 kg/m <sup>2</sup> or more), and high blood sugar.
Lifestyle	Risky level of alcohol consumption (considers average daily alcohol consumed during previous 3 days and the total number of days alcohol was consumed in the week prior to interview: men 5–6 standard drinks, women 3–4 standard drinks), current smoker (regularly smoked 1 or more cigarettes, cigars, or pipes per day at the time of the interview), insufficient vegetable intake (less than 5 servings of vegetables per day for adults), insufficient fruit intake (less than 2 servings of fruit per day for adults), and low physical activity levels (very little or no exercise).

CV: communication vulnerabilities; ESL: English as a second language; COPD: chronic obstructive pulmonary disease; MSK: musculoskeletal conditions; OA: osteoarthritis; RA: rheumatoid arthritis; AS: ankylosing spondylitis; BMI: body mass index.

Adjusted for age and sex, higher odds of having 1 or more CV were observed for the working-age population with MSK compared with those without MSK (aOR = 1.4, 95% CI 1.2–1.6; Table 2, Model 1). Those with MSK were more likely to have hearing or vision impairments, cognitive disability, or lower education level than those without MSK, despite controlling for potential confounders (Table 4, Models 1 and 2). No difference was observed for speech impairment; however, speech impairment was uncommon (Table 2). People with MSK were less likely to have migrated to Australia during the previous 20 years than those without MSK (Table 2).

*Measures of accumulated health complexity.* Working-age people with at least 1 MSK who had any CV were more

likely to have multimorbidity than those with MSK but no CV (aOR = 1.8, 95% CI 1.5–2.2; Table 4, Model 1). Among the MSK population, the presence of any CV was strongly associated with 2 or more, and 3 or more, comorbidities alongside MSK, even after adjusting for potential confounders compared with no CV (Table 4).

For the multimorbidity analyses, psychological disability was included as a cognitive impairment in the CV variable (i.e., part of the exposure). However, mental health was included as part of the multimorbidity outcome (Table 1). The overlap between the exposure and outcome (psychological disability and mental health, respectively) may have inadvertently inflated the associations between CV and comorbidities

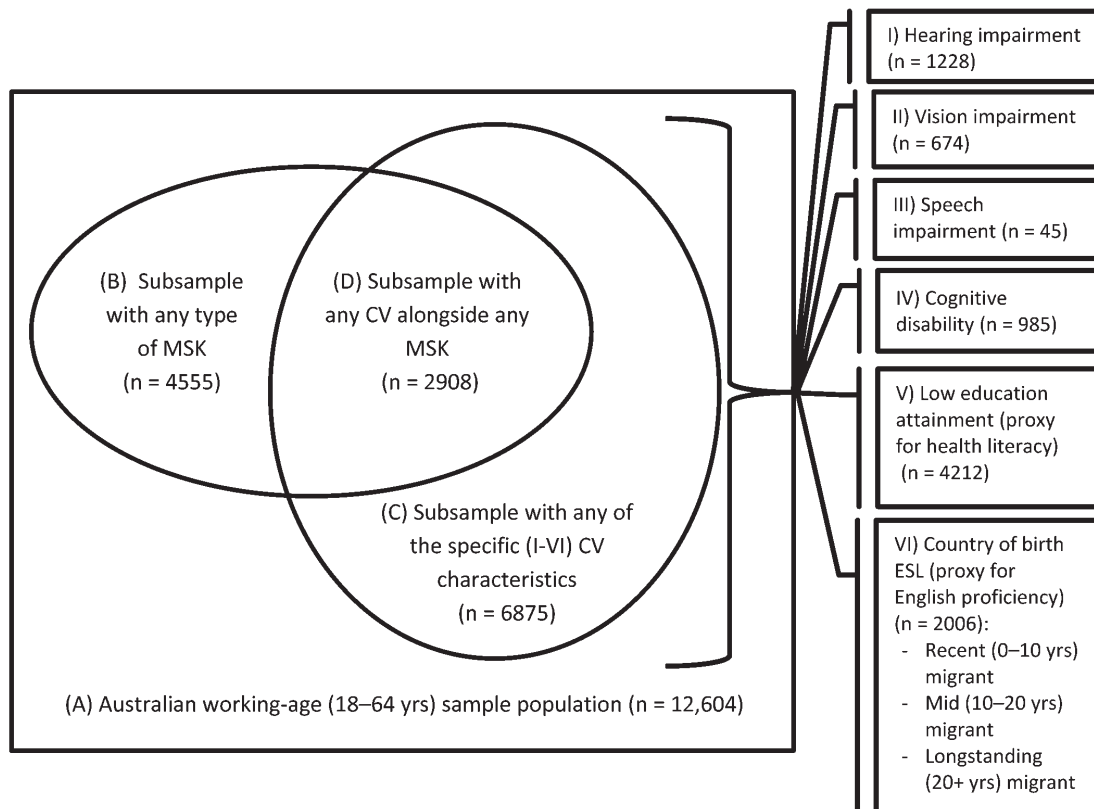


Figure 1. Illustration of populations used in analyses. (A) Working-age sample population. (B) Subsample with any MSK. (C) Subsample with any of the specific (I-VI) CV characteristics. (D) Subsample with any CV alongside any MSK. MSK: musculoskeletal condition; CV: communication vulnerabilities; ESL: English as a second language.

Table 2. Prevalence of any and specific CV among the Australian working-age (18–64 yrs) population with at least 1 MSK or without MSK, and associations (OR) between at least 1 MSK and at least 1 CV in working-age population.

Variables	Working-age Population Prevalence, %			Adjusted OR (95% CI) <sup>a</sup>	
	All, n = 12,604	With at Least 1 MSK, n = 4555	With No MSK, n = 8049	Model 1*	Model 2**
Any CV	55.6	65.0	50.9	1.4 (1.2–1.6)	1.3 (1.1–1.4)
Specific CV					
Hearing impairment	9.0	15.1	5.9	2.1 (1.7–2.5)	2.1 (1.7–2.5)
Vision impairment	5.1	7.5	3.9	1.5 (1.2–1.9)	1.5 (1.2–1.8)
Speech impairment	0.4	0.3	0.4	0.9 (0.4–2.2)	0.9 (0.4–2.0)
Cognitive disability	7.1	11.4	5.0	2.5 (2.0–3.0)	2.3 (1.6–2.8)
Low educational attainment	32.9	43.3	27.6	1.4 (1.3–1.6)	1.3 (1.2–1.5)
Country of birth (ESL)	18.9	15.7	20.5	0.7 (0.6–0.8)	0.6 (0.5–0.7)
Recent migrant, 0–10 yrs	7.8	3.8	9.8	0.5 (0.4–0.7)	0.5 (0.4–0.6)
Medium-term migrant, 10–20 yrs	4.5	3.5	5.1	0.6 (0.5–0.8)	0.6 (0.5–0.8)
Longstanding migrant, 20+ yrs	6.6	8.5	5.6	0.9 (0.7–1.1)	0.8 (0.7–1.1)

<sup>a</sup> Multiple logistic regression: each communication vulnerability is used as outcome, and MSK as predictor. \* Associations are adjusted for age and sex.

\*\* Associations are adjusted for age, sex, income, and occupation. CV: communication vulnerabilities; MSK: musculoskeletal conditions; ESL: English as a second language.

(Table 4). Therefore, a sensitivity analysis was undertaken by excluding mental health from the comorbidity count. Although reduced, associations between CV and 1 or more comorbidity alongside MSK remained significant (sensitivity

analysis: Model 1, aOR = 1.5, 95% CI 1.2–1.8,  $p > 0.0001$ ; Model 2, aOR = 1.3, 95% CI 1.0–1.6,  $p > 0.021$ ). Removing mental health strengthened associations between CV and 2 or more comorbidities alongside MSK, although estimates

**Table 3.** Prevalence of demographic characteristics in the sample of working-age respondents (18–64 years) with musculoskeletal conditions (All); those with communication vulnerabilities (With CV); and those without CV (No CV); adjusted for survey design. Values are % unless otherwise specified.

Demographic Characteristics	Prevalence in Working-age Sample with MSK			p
	All, n = 4555	With CV, n = 2278	No CV, n = 1777	
Age group				< 0.01
18–34	21.5	15.7	32.3	
35–49	34.8	34.2	36.1	
50–64	43.7	50.1	31.6	
Sex				0.97
Male	49.7	49.7	49.6	
Female	50.3	50.3	50.4	
Household equivalized income quintile				< 0.01
First quintile	13.6	17.7	5.9	
Second quintile	14.9	17.5	10.2	
Third quintile	19.6	19.7	19.4	
Fourth quintile	19.1	17.1	22.7	
Fifth quintile	17.9	13.4	26.3	
Not stated	14.8	14.5	15.5	
Hours worked				< 0.01
None	29.0	36.2	15.6	
1–34 h	20.7	18.9	24.2	
35+ h	50.3	44.9	60.2	
Region of Australia				0.08
Major cities	65.1	63.9	67.4	
Inner regional	23.1	23.4	22.6	
Other areas	11.8	12.7	10.1	
Household structure				0.01
Partnered parent with children	39.7	37.0	44.7	
Couple only	27.5	28.8	25.0	
Parent and children	7.9	8.3	7.2	
Single person	13.2	13.5	12.7	
Other	11.7	12.4	10.4	

MSK: musculoskeletal conditions.

**Table 4.** Associations (OR) between CV and markers of complexity (selected comorbidities and risk factors) among working-age respondents with an MSK.

Variables	OR (95% CI)	Adjusted OR (95% CI)	
	Crude	Model 1 <sup>a</sup>	Model 2 <sup>a</sup>
Selected comorbidities, MSK plus <sup>b</sup>			
1 or more	1.9 (1.6–2.3)	1.8 (1.5–2.2)	1.6 (1.3–2.0)
2 or more	3.5 (2.5–5.0)	3.2 (2.3–4.5)	2.5 (1.7–3.6)
3 or more	8.4 (3.2–22.0)	8.4 (3.3–21.2)	5.6 (2.2–14.4)
Selected biomedical risk factors <sup>c</sup>			
1 or more	1.5 (1.3–1.8)	1.3 (1.1–1.5)	1.2 (1.0–1.4)
2 or more	1.4 (1.2–1.6)	1.2 (1.0–1.4)	1.1 (0.9–1.3)
3 or more	1.2 (1.0–1.5)	1.1 (0.9–1.4)	1.1 (0.9–1.3)
Selected lifestyle risk factors <sup>d</sup>			
1 or more	1.6 (1.1–2.2)	2.1 (1.5–2.8)	1.9 (1.4–2.6)
2 or more	1.5 (1.3–1.8)	1.9 (1.6–2.1)	1.7 (1.4–2.0)
3 or more	1.4 (1.1–1.7)	1.6 (1.3–2.0)	1.5 (1.2–1.8)

<sup>a</sup> Multiple logistic regression: Model 1: associations are adjusted for age and sex. Model 2: associations are adjusted for age, sex, income, and occupation. <sup>b</sup> Selected comorbidities: cardiovascular disease, cancer, diabetes, asthma, chronic obstructive pulmonary disease, and mental health. <sup>c</sup> Biomedical risk factors: obesity, high blood pressure, high cholesterol, high blood sugar. <sup>d</sup> Lifestyle risk factors: risky level of alcohol consumption, current smoker, insufficient vegetable intake, insufficient fruit intake, and low physical activity levels. CV: communication vulnerabilities; MSK: musculoskeletal conditions.



Table 5. Associations between any or specific CV and measures of health burden (fair to poor self-rated health, psychological distress, pain restricting work) among working-age respondents with musculoskeletal conditions.

Variables	OR (95% CI)	Adjusted OR (95% CI)	
	Crude	Model 1*	Model 2*
<b>Fair/poor self-rated health</b>			
Any CV	3.8 (3.1–4.7)	3.4 (2.7–4.2)	2.5 (2.0–3.1)
Hearing impairment	1.5 (1.2–1.8)	1.3 (1.0–1.6)	1.4 (1.1–1.7)
Vision impairment	2.6 (1.9–3.5)	2.5 (1.8–3.4)	2.2 (1.5–3.3)
Speech impairment	0.8 (0.2–3.5)	0.9 (0.2–3.6)	0.7 (0.1–3.0)
Cognitive disability	5.2 (3.8–7.1)	5.5 (4.0–7.4)	4.2 (3.1–5.7)
Low educational attainment	2.2 (1.8–2.7)	2.0 (1.6–2.5)	1.6 (1.3–2.0)
Country of birth (ESL)	1.7 (1.2–2.2)	1.6 (1.2–2.1)	1.3 (1.0–1.7)
Recent migrant, 0–10 yrs	1.0 (0.5–1.9)	1.1 (0.6–2.1)	0.7 (0.4–1.5)
Medium-term migrant, 10–20 yrs	2.5 (1.5–4.0)	2.4 (1.5–3.8)	2.0 (1.2–3.4)
Longstanding migrant, 20+ yrs	1.7 (1.1–2.4)	1.5 (1.0–2.2)	1.3 (0.9–2.0)
<b>Psychological distress</b>			
Any CV	2.7 (2.1–3.3)	2.9 (2.3–3.7)	2.3 (1.8–3.0)
Hearing impairment	1.0 (0.7–1.4)	1.2 (0.8–1.8)	1.2 (0.8–1.8)
Vision impairment	1.4 (1.0–2.1)	1.5 (1.0–2.2)	1.4 (1.0–2.0)
Speech impairment	0.7 (0.2–3.6)	0.7 (0.1–3.5)	0.5 (0.1–2.8)
Cognitive disability	13.1 (10.2–16.9)	13.1 (10.1–17.1)	11.5 (8.6–15.4)
Low educational attainment	1.3 (1.0–1.7)	1.5 (1.2–1.9)	1.2 (0.9–1.6)
Country of birth (ESL)	1.6 (1.2–2.2)	1.7 (1.2–2.3)	1.5 (1.1–2.0)
Recent migrant, 0–10 yrs	1.3 (0.6–2.5)	1.1 (0.6–2.2)	0.9 (0.4–1.8)
Medium-term migrant, 10–20 yrs	1.4 (0.8–2.6)	1.4 (0.8–2.6)	1.2 (0.7–2.3)
Longstanding migrant, 20+ yrs	1.9 (1.3–2.7)	2.2 (1.5–3.1)	2.0 (1.4–2.8)
<b>Pain restricting work</b>			
Any CV	1.8 (1.4–2.2)	1.7 (1.4–2.1)	1.4 (1.2–1.8)
Hearing impairment	1.1 (0.9–1.4)	1.2 (0.9–1.5)	1.2 (0.9–1.6)
Vision impairment	1.6 (1.2–2.0)	1.5 (1.2–2.0)	1.4 (1.0–1.9)
Speech impairment	2.4 (0.6–9.7)	2.4 (0.6–9.9)	1.9 (0.4–8.3)
Cognitive disability	3.1 (2.6–3.8)	3.1 (2.5–3.8)	2.5 (2.0–3.1)
Low educational attainment	1.5 (1.3–1.8)	1.5 (1.3–1.8)	1.3 (1.1–1.6)
Country of birth (ESL)	1.2 (0.9–1.5)	1.1 (0.9–1.5)	1.0 (0.8–1.3)
Recent migrant, 0–10 yrs	1.3 (0.9–1.9)	1.3 (0.8–1.9)	1.0 (0.7–1.6)
Medium-term migrant, 10–20 yrs	1.0 (0.7–1.6)	1.0 (0.7–1.6)	0.9 (0.6–1.4)
Longstanding migrant, 20+ yrs	1.1 (0.8–1.7)	1.1 (0.8–1.6)	1.0 (0.7–1.5)

\* Multiple logistic regression: Model 1: associations are adjusted for age and sex. Model 2: associations are adjusted for age, sex, income, and occupation. CV: communication vulnerabilities; ESL: English as a second language.

were less precise (sensitivity analysis: Model 1, aOR = 4.7, 95% CI 2.8–7.7,  $p > 0.0001$ ; Model 2, aOR = 3.4, 95% CI 2.0–5.9,  $p > 0.0001$ ). When mental health was excluded from the count, there were too few people with 3 or more comorbidities to estimate associations.

For working-age people with MSK, CV increased the likelihood of accumulated lifestyle risk factors (Table 4). In contrast, CV was not associated with accumulated biomedical risk factors (Table 4).

**Measures of health burden.** Among people with MSK, the additional presence of any CV was strongly associated with all measures of health burden, including ratings of poorer health (aOR = 2.5, 95% CI 2.0–3.1), experiencing distress (aOR = 2.3, 95% CI 1.8–3.0), or pain restricting work (aOR = 1.4, 95% CI 1.2–1.8; Table 5, Model 2) compared with those with MSK but no CV. Additional adjustment for multimorbidity did not substantively change the associations

observed between any CV and poor health (aOR = 2.3, 95% CI 1.8–2.9), psychological distress (aOR = 2.0, 95% CI 1.5–2.7), or pain restricting work (aOR = 1.4, 95% CI 1.1–1.7).

Associations with all health burden measures were observed for sensory impairments, low education attainment, and were strongest for cognitive disability (Table 5). Migration from a country where English was not the main spoken language was associated with poorer self-rated health and distress. When considered by duration since arrival, associations were significant only for longstanding migrants for distress and for midstanding to longstanding migrants for poorer self-rated health (Table 5).

## DISCUSSION

In this population-representative study of working-age Australians, CV were more prevalent in those with at least 1

MSK compared with those with none. Almost two-thirds of working-age people with an MSK also had at least 1 CV. The associations between CV and MSK were independent of the effects of age, sex, income level, and occupation type. Moreover, among the MSK population, having a CV was associated with lifestyle risk factors, multimorbidity, poorer self-rated health, and experiencing psychological distress or pain restricting work when compared with those without a CV, even after controlling for age, sex, income, occupation, and multimorbidity. There were no differences in association for biomedical risk factors in the MSK population with or without CV.

Major strengths of our study included the large representative national sample, and although the NHS07-08 was not specifically designed to examine CV, there were comprehensive data available on a broad range of communication characteristics. This enabled the estimation of the proportion of the MSK working-age population with a broad range of CV defined as closely as possible to that stipulated by Blackstone, *et al*, or a proxy where no alternative was available<sup>7</sup>. Where possible, to address the limited information on the severity of the CV, these characteristics (and comorbidities or risk factors) were restricted to those present for at least 6 months and to those potentially functionally limiting.

Examining CV extends the focus beyond previously researched established barriers to healthcare based on skills and abilities, such as health literacy, and expands our understanding of factors contributing to health complexity and burden. Although MSK conditions are heterogeneous in terms of etiology, this patient population typically has complex medical needs. Combining MSK conditions enabled the examination of the potential implications added by CV among those managing these existing chronic conditions. The majority of CV characteristics are unlikely to spontaneously change, highlighting that the onus is on the healthcare systems and providers to consider and address the challenges raised by a range of CV. Especially in the MSK population, given associations exist between CV and measures of complexity and burden beyond that induced by MSK alone.

Differentiating associations by the duration since arrival for migrants from non-English-speaking countries revealed complex relationships. Migrants arriving in Australia less than 20 years prior to the survey (from non-English-speaking countries) were significantly less likely to report MSK. This may be because of (1) language difficulties delaying initial diagnosis in Australia or altering healthcare-seeking behavior, or (2) recent migrants generally being healthier<sup>24,25</sup>. The lack of MSK diagnosis and suggestive presence of a healthy migrant effect may not be simply interpreted as an absence of vulnerability or an indication of health equity<sup>25</sup>. Our findings support previous research<sup>24,26</sup> suggesting that the apparent protective association appears to diminish with longer duration because migrants residing in Australia beyond 10 years reported poorer health and higher distress,

even after controlling for age and sex. Additionally, rates of MSK among migrants born in non-English-speaking countries residing in Australia beyond 20 years exceeded rates of those born in Australia or who migrated from English-speaking countries.

The relationships between socioeconomic status (SES) factors (such as income and occupation), CV, and MSK are also complex. SES have the potential to be both (1) an outcome (e.g., either MSK or CV could restrict ability to work, thereby reducing capacity to earn income or gain employment), and (2) a confounder (e.g., an individual of low SES may engage in employment that results in increased risk of developing both back pain, such as manual work, and industrial deafness, such as a noisy workplace). Where lower SES is an outcome of MSK and/or CV, adjusting for SES would be inappropriate and would underestimate the true associations between CV and MSK. However, if SES is a confounder, adjusting for SES is appropriate.

To address both possibilities, Model 1 adjusts for age and sex, while Model 2 additionally adjusts for SES markers (income and occupation type). Adjustment for SES markers (Model 2) reduced the associations between CV and MSK, and reduced associations between CV and complexity and burden measures among those with MSK. However, some association remained, suggesting that these relationships are independent to those of age, sex, income, and occupation. Because education level was part of the exposure CV, this SES marker was not adjusted for.

Irrespective of their nature, the fact that associations exist is an important observation with relevance to healthcare contexts, and warrants confirmation in other populations. Additionally, further research can establish whether the relationships observed for CV among those with MSK are because of interaction effects and whether association between CV and disease complexity and burden measures differ for people with different types of MSK (such as inflammatory or noninflammatory arthritis).

These findings need to be interpreted in the context of the study limitations. A key limitation is the cross-sectional nature of the data; it is inappropriate to interpret the relationships observed between CV and MSK as causal in nature. However, our study was not intended to address the issue of causation.

A potential limitation is that the data are self-reported, which may result in non-reporting or overreporting of conditions. However, it has been demonstrated that self-reported diagnoses are valid<sup>27</sup>, even when people are cognitively impaired or disabled<sup>28</sup>. Further, where self-report is inaccurate, it is likely to result in underreporting<sup>28,29</sup>. Although it was possible to separate them, we combined conditions with and without general practitioner (GP) diagnosis. This was because even the GP diagnoses were not definitive diagnoses because this information was also self-reported.

Limitations of the NHS07-08 data itself included that

there were hardly any respondents with speech impairments and no data regarding religious, cultural, and sexual difference. Therefore, conclusions cannot be drawn concerning these groups. Defining religious, cultural, and sexual difference is a challenge because it may vary with the social environment in which the study is conducted and with how people perceive themselves. By omitting this form of vulnerability, our study likely underestimates the prevalence of CV.

Finally, relying on imperfect surrogates for measures not directly available in the NHS07-08 limits the strength of the conclusions regarding these particular characteristics. The proxy used for English language proficiency was migration from a country where English is not the primary spoken language, a commonly used surrogate for cultural and linguistic diversity and non-English first language<sup>30</sup>. We used this proxy because people migrating from non-English-speaking countries are potentially at risk of CV, irrespective of local language proficiency, because of unfamiliarity with navigating and accessing the healthcare system<sup>31</sup>. Research to determine whether English language proficiency or the commonly used proxies (language spoken at home and language of interview)<sup>31</sup> are also associated with poorer health outcomes is needed.

In the absence of a direct measure of health literacy, we used low education attainment (Yr 10 level or less) as a proxy for limited health literacy<sup>32</sup>. The rationale for this is 2-fold: (1) direct measures of individual health literacy<sup>33,34,35,36,37</sup> are logistically complex to administer within population health surveys, and (2) predictive models of health literacy<sup>32,38,39,40</sup> are typically validated in elderly and/or clinical/administrative populations. As the sociodemographic factors predicting health literacy potentially differ with the age and source of the population<sup>32,40</sup>, predictive models may not be representative of working-age people who may face barriers to attending GP.

It is unclear whether the method of data collection (interviews) actually biased against persons with severe CV. Safeguards were present within NHS07-08; when prevented from responding (through illness, intellectual disability, or language difficulties), a person nominated by the respondents or an interpreter/interviewer fluent in the respondent's language could respond on their behalf or act as an interpreter. Three attempts were made to reschedule with the participant and their nominated interpreter. Where rescheduling was not achieved, findings from these analyses may underestimate associations between CV and the measures of interest.

Previous research has also identified higher prevalence of specific CV (cognitive impairment, hearing loss, and limited health literacy)<sup>19</sup> among specific MSK subgroups (systemic lupus erythematosus<sup>41</sup> and rheumatoid arthritis<sup>42</sup>). Limited local language proficiency and health literacy are additionally implicated in patient-rated suboptimal shared decision-making communication with their clinicians<sup>43</sup>. Further,

ethnicity is associated with differences in prescribing disease-modifying antirheumatic drugs<sup>44</sup>, and discord between patient and physician assessment of "disease control" for patients of low SES and ethnic minority groups<sup>45</sup>. The current study expands on this research by identifying that a broader range of CV characteristics are associated with poorer health outcomes, extending across MSK populations.

Taken together, these results suggest CV have implications for communicating information about disease prevention<sup>46</sup> and treatment. Although the CV are personal characteristics, they have implications for health professionals. For example, health professionals caring for patients with severe CV may lack familiarity with using different modes of communication, even where patients have alternative modes of communication<sup>47</sup>, and may be reluctant to examine and diagnose issues above and beyond the communication characteristic itself<sup>48,49</sup>.

The associations between CV and lifestyle risk factors may suggest that current health promotion messages may be ineffective at reaching these groups<sup>46</sup>. If so, then health prevention and management information needs to be tailored to a Year 10 education level (or less, to be maximally inclusive) and to consider the linguistic, sensory, and cognitive contexts of people with MSK.

Comorbidities were more common among the MSK population with CV than those without a CV. This finding highlights the importance of interprofessional communication because managing MSK in the context of both CV and multimorbidity<sup>17,18</sup> is likely to further complicate treatments and result in intensive healthcare services use, increasing the potential for communication failure and adverse outcomes.

The broad range of CV with potential health implications identified suggests that an equally broad range of policy measures that support strategies to improve communication are required. General communication may be improved with communication skills training<sup>4</sup>. Enlisting the aid of translators, interpreters, and speech pathologists, and presenting information at appropriate literacy levels and in linguistically appropriate formats may all additionally ease CV among those with MSK<sup>7</sup>.

If replicated by other studies, particularly those examining potential causal mechanisms, these results may indicate the need to further develop and implement evidence-based techniques to help overcome these potential communication barriers in healthcare settings. Given that low educational attainment and sensory and cognitive impairments were most common and strongly associated with measures of worse health burden, these communication characteristics require particular attention.

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