

The impact of health literacy on psychosocial and behavioural outcomes among people at low risk of cardiovascular disease

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1 Title

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3 The impact of health literacy on psychosocial and behavioural outcomes among people at low
4 risk of cardiovascular disease

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9

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41

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48

49 Abstract

50 This study aimed to explore the impact of health literacy on psychosocial and behavioural
51 outcomes for people who were not at high risk of cardiovascular disease receiving a
52 hypothetical blood pressure reading of 135/85mmHg. We performed a secondary analysis of
53 data from a national sample of Australians aged 40 to 50 years (n=1318) recruited online.
54 Health literacy was measured using the validated Newest Vital Sign (inadequate: 0-3;
55 adequate: 4-6). Analysed outcomes included: willingness to increase exercise and accept
56 medication; perceived severity; positive and negative affect; illness perceptions and impacts
57 on life and motivation. Participants with inadequate levels of health literacy perceived a
58 blood pressure reading of 135/85mmHg to be less serious compared to individuals with
59 adequate health literacy (Mean Difference [MD]:0.21; 95%CI 0.03-0.39; p=0.024; d=0.13),
60 and reported less motivation to eat well (MD:0.44; 95%CI 0.31-0.58; p<0.001; d=0.38) and
61 exercise (MD:0.43; 95%CI 0.31-0.58; p<0.001; d=0.36). However, they were more willing to
62 accept medication (MD:0.20; 95%CI 0.07-0.34; p=0.004; d=0.17). Participants with
63 inadequate health literacy also perceived the condition to have fewer negative impacts on
64 aspects of life and work than individuals with adequate health literacy, but reported greater
65 negative emotion and more negative illness perceptions (all p<0.001). Tailored
66 communication and behaviour change support may be needed when communicating blood
67 pressure information to people with lower health literacy and not at high risk of
68 cardiovascular disease given the differential impacts on medication (increased willingness)
69 and healthy exercise and diet behaviours (decreased willingness) observed in this study.

70

71

72 **The impact of health literacy on psychosocial and behavioural outcomes among people**
73 **at low risk of cardiovascular disease**

74

75 **1. Introduction**

76 Health literacy describes the skills that enable individuals to obtain, understand, and use
77 information to make decisions, and to take actions that will have an impact on health status¹.

78 Low health literacy is an important predictor of inequality in health outcomes, and is
79 associated with increased risk of hospitalization, chronic disease, mortality and risk factors
80 for health conditions including cardiovascular disease.² Low health literacy is common
81 worldwide, with estimates ranging from 27% to 60% of the population in Australia, Europe
82 and the United States of America.^{3,4}

83

84 A growing body of research suggests that health literacy plays an important role in the
85 cognitive and emotional interpretation and critical appraisal of health and medical
86 information. This includes high-level assessments of information quality,⁵ through to more
87 nuanced interpretations of numerical data and risk.⁶ Research conducted in 1998, for
88 example, showed that patients with poor health literacy were less likely to rate blood pressure
89 readings of 160/100 as high, compared with those with adequate health literacy.⁶ However,
90 diagnostic thresholds for hypertension have changed since 1998.⁷ New diagnostic thresholds
91 and risk categories for hypertension have been used in the 2017 American College of
92 Cardiology/American Heart Association (ACC/AHA) guideline, the 2018 European Society
93 of Cardiology/European Society of Hypertension (ESC/ESH) guideline and the 2019
94 National Institute For Health And Care Excellence (NICE) guideline. The impact of health
95 literacy on health behavioural intentions and psychosocial outcomes after receiving blood
96 pressure information applied by different guidelines is yet to be examined.

97
98 We recently conducted a study to investigate potential benefits and harms of different
99 terminology (labels) for a blood pressure reading of 135/85 mmHg among people not at high
100 risk of cardiovascular disease with different levels of health literacy.⁸ We used a blood
101 pressure reading of 135/85mmHg as this would be classified in one of three ways:
102 ‘*hypertension*’ according to the 2017 ACC/AHA hypertension guidelines, or ‘*high normal*’
103 according to the 2018 ESC/ESH guidelines, or have no specific label according to the 2019
104 NICE guidelines. In our primary study neither hypertension nor high-normal labels motivated
105 participants to change their diet or exercise more than control, but both labels had adverse
106 psychosocial outcomes, including increased worry about cardiovascular disease risk.⁸

107

108 In this paper we report the impact of health literacy on the secondary psychosocial and
109 behavioural outcomes assessed in the previous study. In so doing we hope to demonstrate
110 whether health literacy influences the cognitive and emotional interpretation of diagnostic
111 information about elevated blood pressure.

112

113 **2. Method**

114 Ethical approval was obtained from the University of Sydney Human Research Ethics
115 Committee (protocol number: 2018/828). Study methods are described in full elsewhere⁸ and
116 summarised below with a focus on health literacy.

117

118 Australian adults aged 40-50 years were recruited online through a social research company
119 as detailed previously.⁸ To recruit a study population not at high risk of cardiovascular
120 disease, participants were excluded if they self-reported being a current smoker or having a
121 diagnosis of heart disease, diabetes, kidney disease, hypercholesterolaemia (total cholesterol
122 reading of 7+ mmol/L or 273 mg/dL) or diagnosed hypertension.

123

124 Demographic information collected included age in years, gender, country of birth, language
125 spoken at home, identification as an Aboriginal or Torres Strait Islander person, and
126 educational level attained. Health literacy was measured using the Newest Vital Sign (NVS),
127 a validated tool for health literacy assessment converted for online use.⁹ Participants were
128 categorized as having inadequate (score 0-3 on NVS) or adequate (score 4-6 on NVS) health
129 literacy.

130

131 After completing demographic and health literacy screening questions, participants were
132 asked to imagine visiting their doctor (primary care physician) for a check-up and the doctor
133 had taken their blood pressure a “few times recently”. Each participant was given the same
134 blood pressure reading (135/85 mmHg) and randomly assigned to one of three study arms,
135 each with a different label (hypertension / high normal blood pressure / no label [control]).
136 Within each arm, participants were then randomized to receive subsequent information about
137 their absolute risk of heart attack or stroke in the next 10 years or no further information
138 (absolute risk described vs not described 1:1). This secondary analysis explored the main
139 effects of health literacy on health behavioural intentions and psychosocial outcomes in the
140 entire sample averaged across the labelling and absolute risk conditions.

141

142 Outcome measures included in this secondary analysis (including their scoring and
143 interpretation) are presented in Table 1, with full details available in ⁸. Multivariable linear
144 regression models were used to analyze the main effects of health literacy on outcomes. The
145 regression models also included label, absolute risk description, and their interaction.

146 Exploratory post-hoc analyses were conducted including age and education as covariates in
147 regression models; the inclusion of these additional covariates did not impact on the health

148 literacy effects observed, and therefore, have been omitted in favour of more parsimonious
149 models.

150

151 A p-value of <0.05 for main effects of health literacy was considered statistically significant.

152 Estimated marginal means (i.e., controlling for label, absolute risk description, and their

153 interaction) and mean differences, their corresponding 95% confidence intervals, were

154 calculated. Cohen's *d* values (calculated using the unadjusted pooled standard deviation of

155 outcome variables across health literacy groups) are provided as a measure of effect size. All

156 analyses were carried out using Stata/IC v16.1 (College Station, Texas, USA).

157

158

159 **3. Results**

160 The final sample comprised 1318 individuals with a mean age of 44.7 years. The majority

161 identified as female (59.9%), spoke English at home (95.8%) and had a graduate diploma or

162 greater level of education (59.2%). Using the NVS, 32.5% had inadequate health literacy.

163 Demographic characteristics of the final sample, presented by health literacy adequacy and

164 overall, are shown in Table 1.

165

166

167 **Table 1.** Demographic characteristics of analysis sample, presented by health literacy adequacy and overall
 168 (N=1318). Data are displayed as frequencies (relative frequencies) unless otherwise specified.

		Health Literacy ^a		Total
		Inadequate (n=428)	Adequate (n=890)	(N=1318)
Age (years), mean (SD)		44.8 (3.3)	44.7 (3.2)	44.7 (3.2)
Sex	Male	191 (44.6%)	336 (37.8%)	527 (40.0%)
	Female	236 (55.1%)	553 (62.1%)	789 (59.9%)
	Other	1 (0.2%)	1 (0.1%)	2 (0.2%)
English language spoken at home		393 (91.8%)	869 (97.6%)	1262 (95.8%)
Country of birth	Australia	306 (71.5%)	684 (76.9%)	990 (75.1%)
	United Kingdom	15 (3.5%)	45 (5.1%)	60 (4.6%)
	New Zealand	9 (2.1%)	21 (2.4%)	30 (2.3%)
	Other	98 (22.9%)	140 (15.7%)	238 (18.1%)
Identifies as an Aboriginal and/or Torres Strait Islander		5 (1.2%)	8 (0.9%)	13 (1.0%)
Education	High school or less	206 (48.1%)	332 (37.3%)	538 (40.8%)
	Diploma or greater	222 (51.9%)	558 (62.7%)	780 (59.2%)
Previous diagnosis of cancer		19 (4.4%)	41 (4.6%)	60 (4.6%)
Previous diagnosis of asthma		60 (14.0%)	120 (13.5%)	180 (13.7%)
Family history of chronic condition ^b		244 (57.0%)	600 (67.4%)	844 (64.0%)
Randomised label condition	Hypertension	139 (32.5%)	311 (34.9%)	450 (34.1%)
	High Normal	151 (35.3%)	297 (33.4%)	448 (34.0%)
	Control	138 (32.2%)	282 (31.7%)	420 (31.9%)
Randomised absolute risk condition	No Absolute Risk Described	194 (45.3%)	471 (52.9%)	665 (50.5%)
	Absolute Risk Described	234 (54.7%)	419 (47.1%)	653 (49.5%)

169 * as measured by the Newest Vital Sign

170 ^ chronic conditions included at least one of cancer, heart disease, hypertension, asthma, hypercholesterolemia,
 171 diabetes, or kidney disease.

172

173 As previously reported,⁸ health literacy was not associated with level of worry and did not
 174 appear to modify the label effect. However, across labelling conditions (*'hypertension'*;
 175 *'high-normal'*; no label), individuals with inadequate health literacy rated their willingness to
 176 change their diet after receiving blood pressure information as lower than individuals with
 177 adequate health literacy⁸.

178

179 As shown in Table 2, irrespective of disease labels and absolute risk information, individuals
 180 with inadequate levels of health literacy were less willing to increase exercise compared to
 181 individuals with adequate health literacy. However, they were more willing to accept
 182 medication. Participants with inadequate health literacy also perceived the condition to be
 183 less serious for them and to have fewer negative impacts on aspects of life and work (ability

184 to get insurance, to work, and overall happiness) than individuals with adequate health
185 literacy. They also reported greater negative emotion and more negative illness perceptions.
186 See Table 2.
187
188

189 **Table 2.** Estimated means controlling for label, description of absolute risk, and their
 190 interaction, as a function of health literacy (inadequate, adequate) and estimated mean
 191 differences (with 95% confidence intervals).
 192

Outcome measure (and scoring)	Health Literacy Adequacy		Mean Difference (Inadequate – Adequate) (95% CI)	Effect size (Cohen’s <i>d</i>)	Health Literacy main effect / p-value
	Inadequate (n=428)	Adequate (n=890)			
Willingness to increase exercise (1 to 5; higher values indicate higher willingness)	3.99	4.29	-0.30 (-0.41, -0.20)	0.32	F(1,1311)=31.24, p<.001
Willingness to accept medication (1 to 5; higher values indicate higher willingness)	3.62	3.42	0.20 (0.07, 0.34)	0.17	F(1,1311)=8.58, p=.004
Perceived severity ^a (1 to 7; higher values indicate higher perceived severity)	4.68	4.89	-0.21 (-0.38, 0.03)	0.13	F(1,1298)=5.11, p=.024
Affect (standard deviation units) ^b					
<i>Negative affect</i>	0.38	-0.18	0.56 (0.34, 0.78)	0.29	F(1,1300)=24.65, p<.001
<i>Positive affect</i>	-0.01	0.01	-0.02 (-0.23, 0.20)	0.01	F(1, 1300)=0.03, p=.87
Illness perceptions and beliefs ^c (0-70; higher values indicate more negative perceptions)	33.69	32.18	1.51 (0.80, 2.23)	0.24	F(1,1302)=17.21, p<.001
Perceived life impact (-3 [worse] to +3 [better]; 0=no impact) ^d					
<i>Ability to obtain insurance products</i>	-0.02	-0.53	0.51 (0.37, 0.66)	0.40	F(1,1296)=46.64, p<.001
<i>Ability to work</i>	0.17	-0.13	0.29 (0.18, 0.41)	0.30	F(1,1296)=25.55, p<.001
<i>Ability to be employed</i>	-0.02	-0.44	0.42 (0.28, 0.55)	0.35	F(1,1296)=36.80, p<.001
<i>Overall happiness</i>	0.15	-0.12	0.28 (0.17, 0.38)	0.29	F(1,1295)=25.13, p<.001
<i>Support from family and friends</i>	0.76	0.64	0.11 (-0.01, 0.24)	0.10	F(1,1296)=3.06, p=.080
Impacts on motivation (-3 to 3) ^d					
<i>Motivation to eat well</i>	1.25	1.69	-0.44 (-0.58, -0.31)	0.38	F(1,1296)=43.10, p<.001
<i>Motivation to exercise</i>	1.22	1.65	-0.43 (-0.57, -0.29)	0.36	F(1,1296)=37.80, p<.001

^aCopp et al., (2017)¹⁰

^bItems adapted from Thompson (2007)¹¹; scores derived by principal components analysis. The value reflects the number of standard deviation units an individual is away from the sample mean (e.g., a value of 0 indicates responses at the sample mean of the scale, a value of 1 indicates responses 1 standard deviation above the sample mean of the scale).

^cAdapted from the Brief Illness Perception Questionnaire¹²

^dNegative values indicate reduced ability, happiness, support or motivation.

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199 **4. Discussion**

200 The results of this study confirm and extend the evidence base which suggests that health
201 literacy is associated with behavioural intentions, treatment preferences and psychosocial
202 outcomes, in this instance in the context of (hypothetical) cardiovascular disease prevention
203 decision making.

204

205 The finding that participants with lower health literacy were less willing and motivated to
206 exercise and eat well (recommended by all guidelines) but more willing to accept medication
207 (not recommended as first line management by any of the guidelines) after receiving blood
208 pressure and cardiovascular risk information is in line with past research. Although early
209 systematic reviews (e.g. ¹³) found that health literacy was consistently associated with lower
210 mammography screening and influenza vaccine uptake, more recent work has shown stronger
211 preferences for more health care (as measured by the Minimizer Maximizer Scale)¹⁴ and a
212 desire for more invasive treatment options (e.g. total thyroidectomy in the context of thyroid
213 cancer)¹⁵, but fewer preventative health behaviours such as exercise¹⁶. To our knowledge, this
214 is the first time differential preferences for medication and healthy exercise and diet
215 behaviours have been highlighted in a cardiovascular context among people with no self-
216 reported pre-existing risk factors. We also found that participants with lower health literacy
217 had greater negative emotion and more negative illness perceptions when they received a
218 blood pressure reading of 135/85 mmHg. Building on past research, we have shown that the
219 impact of health literacy on such outcomes prevails, irrespective of disease labels and the
220 provision of absolute risk information.

221

222 However, albeit statistically significant, differences in outcomes between groups were often
223 small (e.g. a difference 0.2 on a 5-point scale for willingness to accept medication; small

224 effect size: 0.17). The study is also limited by the online experimental design and use of a
225 hypothetical scenario; people are likely to respond differently to health information presented
226 in real clinical contexts compared with a hypothetical medical encounter. It is also possible
227 that this effect could differ by literacy status. Further limitations include the use of self-
228 reported outcome measures (including willingness to change behaviour) and the lack of
229 additional demographic information, including individual-level income/wealth. We did,
230 however, purposefully evaluate both positive (e.g. feeling more alert, determined, active,
231 motivated and reassured) and negative outcomes.

232

233 Another strength of this study is use of a performance-based instrument to identify
234 individuals with inadequate health literacy; the NVS, in particular, has been found to serve as
235 a more sensitive discriminator than other health literacy measures.¹⁷ However, we had a
236 smaller proportion of people with low health literacy (32.5%) compared to nationally-
237 representative Australian surveys which have also used performance based measures (60%)¹⁸.

238

239 ***4.1 Implications***

240 It is necessary to consider health literacy when conveying blood pressure information to
241 people not at high risk of cardiovascular disease. Evidence-based communication techniques
242 (such as teachback where patients are asked to explain back in their words the information
243 they have received and the clinician clarifying and tailoring the explanation if needed) could
244 help ensure that patients have a better understanding of what blood pressure readings mean in
245 terms of their cardiovascular disease risk. All patients – including those with lower levels of
246 literacy – should be made aware of different treatment and prevention options (including their
247 efficacy, risks and benefits) and supported to act appropriately in terms of their
248 cardiovascular disease risk. There is some evidence to suggest that patients with higher and

249 lower health literacy may need different strategies to support behavioural changes relating to
250 eating well and exercising. A recent randomised controlled trial of interventions to prevent
251 unhealthy snacking, for example, showed that participants with lower health literacy who
252 used a health-literate action plan (which was less cognitively demanding) reported less
253 unhealthy snacking compared to a standard action plan; the reverse was true for those with
254 higher health literacy scores.¹⁹

255

256 ***4.2 Conclusion***

257

258 Our analysis suggests that health literacy impacts psychosocial and behavioural outcomes
259 related to cardiovascular disease prevention and may impact treatment decision making in
260 this context. Attention to health literacy and the implementation of literacy sensitive
261 communication strategies and interventions are needed, as recommended by the American
262 Heart Association.

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275

276 Disclosures

277

278 None to declare

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