

# Youth labour force absence and chronic health conditions in Australia

E. J. Callander

Australian Institute of Tropical Health and Medicine, James Cook University, Townsville, Queensland 4811, Australia

Correspondence to: E. J. Callander, Australian Institute of Tropical Health and Medicine, Building 48, Douglas Campus, Townsville, Queensland 4811, Australia. Tel: +61 7 47816106; fax: +61 7 47815254; e-mail: emily.callander@jcu.edu.au

<b>Background</b>	Among older workers, chronic disease is known to be a key reason for early retirement.
<b>Aims</b>	To determine whether chronic health conditions act as a barrier to young Australians (aged 15–29) participating in the labour force.
<b>Methods</b>	Multiple logistic regression analysis to assess the adjusted odds ratio of people with different chronic health conditions being out of the labour force compared to those with no chronic conditions. Negative binomial regression models to predict the number of years people with different chronic health conditions would remain out of the labour force for.
<b>Results</b>	Of the 550 000 people aged 15–29 who were not in the labour force, 20% cited ill-health as the reason, reducing Australia's gross domestic product by around \$3.7 billion per annum. When adjusted for age and education attainment, males with mental and behavioural disorders had 5.95 times the odds (95% confidence interval [CI] 3.90–9.08) of being out of the labour force, and females with development/intellectual disorders had 2.90 times the odds (95% CI 1.47–2.51), compared to those with no chronic health conditions. Males and females with development/intellectual disorders who were out of the labour force were estimated to spend an additional 2.7 and 3.5 years out of the labour force over the next 5 years.
<b>Conclusions</b>	Prevention of chronic health conditions may help more younger Australians participate in the labour force, reducing the known long-term health and social problems associated with labour force absence.
<b>Key words</b>	Adolescent; chronic disease; early adulthood; income; labour force participation.

## Introduction

Australia, like most developed countries around the world, has an ageing population [1]. As such, increasing attention is being paid to maximizing the labour force participation of those who are of working age [2,3]. However, little attention has been paid to workers aged 15–29 who are just entering the workforce, and what can be done to maximize their labour force participation.

People aged 15–29 make up 31% of Australia's population of working age (15–65 years) [4], and currently, 33% of 15–24-year olds are out of the labour force [5]. Surprisingly, very little is known about these missing workers, despite considerable policy efforts to improve their labour force participation. The current Australian government has utilized welfare reform to encourage more young people to participate in the workforce, and addressing youth unemployment has strong bi-partisan support [6,7]. However, little attention is paid to the

reasons for their non-participation. Given the known impact chronic health conditions can have on labour force participation [8], it may be that chronic health conditions among Australia's youth are acting as a hurdle to their participation. If this is the case, the economic sticks in the form of welfare reform, to maximize youth employment may have little effect, and a more targeted approach aimed at the actual barriers to employment could be more effective.

Given the current evidence that health influences labour force participation of older people—improving the health status of an individual has been found to increase the probability of labour force participation [9]—it is hypothesized that young people with chronic health conditions will be more likely to be out of the labour force due to the impact poor health has on their ability to work. Furthermore, a recent systematic review has documented the negative influence that poor health has on the employment of younger people [10]; however,

such a relationship is yet to be demonstrated among young people in Australia.

The aim of this study was to answer the following research question: Do chronic health conditions act as a barrier to young Australians participating in the labour force?

## Methods

To answer the study question, the approach was to document the prevalence of workforce absence due to ill-health among Australia's youth, identify the chronic health conditions most commonly associated with youth being out of the labour force and utilize longitudinal data to model the future labour force participation of youth with different chronic health conditions. Within this study being 'out of the labour force' was defined as not being in employment, and not actively looking for employment; and 'chronic health conditions' were defined as any health condition that had lasted, or was likely to last for 6 months or more. The first part of this analysis utilized the *2012 Survey of Disability, Ageing and Carers* (SDAC) to undertake cross-sectional analysis to identify the health conditions associated with being out of the labour force. The SDAC was conducted by the Australian Bureau of Statistics (ABS), between August 2012 and March 2013. It aims to provide national estimates of the prevalence of disability in Australia, along with socio-economic characteristics of people with a disability. It is representative of the entire Australian population—both people with and without a disability—thus allowing comparisons to be made between those with and without disabilities. The SDAC covered rural and urban populations in each state and territory of Australia but excluded those living in very remote areas (those living in very remote areas make up less than 1% of the Australian population [11]). A key strength of the SDAC is that it covered both private and non-private dwellings, and as such included people living in cared-accommodation and other institutions such as hospitals. The SDAC consisted of 27 410 private dwelling with a response rate of 90%, and 518 non-private dwellings with a response rate of 80% [12]. Interviews were conducted face-to-face.

Waves 1–12 of the Household Income and Labour Dynamics in Australia (HILDA) Survey were utilized in this study to estimate 5 years of future labour force status for people aged 15–29 who were out of the labour force. The HILDA survey is nationally representative of the Australian population living in private dwellings and aged 15 years and over. The survey has been conducted annually since 2001 (wave 1 in 2001, wave 2 in 2002, etc.), and comprises a mixture of face-to-face or telephone and self-completed paper-based surveys. The reference population for wave 1 were all members of private dwellings in Australia [13]. This study used the balanced panel of the HILDA survey, which only

included respondents who participated in waves 1–12 of the survey, this excludes people who dropped out of the continuing person sample through death or by choice. Of the persons participating in wave 1, 57% participated in each wave through to 2012 [13]. To adjust for the bias likely to be introduced by attrition, the HILDA dataset is released by the data custodians to users with longitudinal weights designed specifically for use with the balanced panel. These weights ensure that the results will be nationally representative, despite attrition from the survey, and have been described in detail elsewhere [14].

Because the age group 15–29 covers the age when people are undertaking schooling and higher education, the analysis excluded those people who stated they were still at school or were studying full-time. As they are participating in education activities, it is expected that these people would be out of the labour force. The current 'learn or earn' policy of the Australian Government supports this view, whereby Australian youth who are not in school or undertaking study full-time are expected to be in the labour force [15]. It was assumed that those studying part-time could also be in employment.

The initial descriptive analysis was undertaken on the SDAC to identify the labour force characteristics of the 15- to 29-year-old Australian population. The impact on Australian GDP of the number of people in this age group who were out of the labour force was then calculated with the Australian Treasury's formula [16]. The main chronic health condition self-reported by each individual was then identified from the SDAC, and the proportion of people who were out of the labour force was identified for each chronic health condition (a chronic health condition was defined on the SDAC as any condition that had lasted, or was likely to last, for 6 months or more [12]). The variable identifying the *main* chronic health condition was used for this analysis, so if more than one condition was reported, the condition respondents reported as being their main condition was utilized. The odds ratio of being out of the labour force for each condition was then calculated. People with no chronic health condition were used as the reference group. The model included age group (15–19 years, 20–24 years and 25–29 years) and level of highest education attainment (university level degree, advanced diploma or diploma, certificate III or IV, year 12, and year 11 or below) as confounding variables. Advanced diplomas and diplomas are non-tertiary levels of education usually of 12–18 months in length. Certificate III and certificate IV degrees are non-tertiary levels of education usually of 6 months in length.

The HILDA dataset was then utilized, limited to people aged 15–29 who were not in school or not studying full-time in wave 1. Those who were not in the labour force in wave 1 were identified, and the number of years over the following 5 years that they spent out of the labour force was identified (i.e. wave 2, 3, 4, 5 and 6). For

those who were in the labour force in wave 1, but were not in the labour force in wave 2, the number of years they spent out of the labour force in the next 5 years was identified (i.e. wave 3, 4, 5, 6 and 7). This was repeated up to wave 7 (i.e. labour force participation in waves 8, 9, 10, 11 and 12 was assessed). The data for the number of years out of the labour force were skewed, which was not corrected by log transformation, and so were modelled as count data. Due to overdispersion, a negative binomial model, as opposed to a Poisson model, was constructed. Age group (15–19 years, 20–24 years and 25–29 years), children (has children, has no children), married (married or defacto, not married or defacto), highest level of education attainment (university level degree, advanced diploma or diploma, certificate III or IV, year 12, and year 11 or below) and having a chronic health condition or disability that respondents stated limits their amount or type of work were all included as confounding variables. Confounding variables were limited to what variables were common to both datasets (SDAC and HILDA) and were all demonstrated in the literature to be significantly related to labour force participation [17,18]. The final model had a scaled Pearson chi-square value of 463.39, with 410 degrees of freedom ( $P > 0.05$ ), indicating that the model fitted the data well.

This study was exempt from ethics approval as all analysis was conducted on existing survey data, which is publicly available, upon request. All analysis was conducted in accordance with the Declaration of Helsinki.

## Results

There were 9497 records of individuals aged 15–29 on the 2012 SDAC who were not currently at school and not studying full-time, representing an estimated 3465000 people in the population aged 15–29 years once weighted. Of this population, 48% were female, 12% were in the 15- to 19-year-old age group, 36% were in the 20- to 24-year-old age group and 51% were in the 25- to 29-year-old age group. In 2012, 59% of this population were employed full-time, 18% were employed part-time, 8% were unemployed and 16% were not in the labour force. Of those who were not in the labour force, 21% stated they were not in the labour force

because of their ill-health (113400 people). The 113400 people being out of the labour force equated to a cost of \$3728980000 in lost GDP in 2012 (2015 Australian dollars).

Table 1 shows the labour force status of those who were not at school or studying full-time, stratified by sex. It shows that a lower proportion of females were employed and working full-time, and a higher proportion was employed and working part-time or were not in the labour force, compared to males. Of the males who were not in the labour force, 36% stated they were not in the labour force due to ill-health; of the females who were not in the labour force, only 13% stated they were not in the labour force due to ill-health.

Table 2 shows the long-term health conditions experienced by males aged 15–29 years who were not at school and not studying full-time. The conditions with the highest proportion of males not in the labour force were other mental and behavioural disorders (36% not in the labour force), development/intellectual disorders (34% not in the labour force) and depression (28% not in the labour force) (Table 2). Table 2 also shows the odds ratio of being not in the labour force for males with different chronic health conditions, compared to males with no chronic health condition, adjusted for age and level of education attainment. Those with other mental and behavioural disorders had 5.95 times the odds of being not in the labour force (95% confidence interval [CI] 3.90–9.08) and those with diseases of the nervous system had 4.52 times the odds of being not in the labour force (95% CI 2.51–8.16), compared to those with no chronic health conditions (Table 2).

Table 3 shows the long-term health conditions experienced by females aged 15–29 years who were not at school and not studying full-time. The conditions with the highest proportion of females not in the labour force were development/intellectual disorders (52% not in the labour force), other mental and behavioural disorders (40% not in the labour force) and depression (33% not in the labour force). Table 3 also shows the odds ratio of being not in the labour force for females with different chronic health conditions, compared to females with no chronic health condition, adjusted for age and level of education attainment. Those with other development/

**Table 1.** Labour force status of 15- to 29-year-old Australian population not at school and not studying full-time, 2012

Labour force status	Males		Females	
	Weighted frequency	%	Weighted frequency	%
Employed working full-time	1 225 800	69	817 100	49
Employed working part-time	229 900	13	395 100	23
Unemployed looking for work	150 300	8	101 100	6
Not in the labour force	180 700	10	365 100	22

**Table 2.** Long-term health conditions and labour force status, Australian population aged 15–29 who were not at school and not studying full-time, 2012, males

Long-term health condition	Total			Not in the labour force		OR of being not in the labour force			
	No. in survey	Weighted no.	Percentage of people out of population aged 15–30, not studying	Weighted no.	Percentage of people with that condition	OR adjusted for age and sex	95% CI		P value
No condition	3656	1 378 000	77	108 700	8	Reference			
Diabetes	23	10 200	0.6	300	3	0.37	0.05	2.80	NS
Other mental and behavioural conditions <sup>a</sup>	120	48 900	2.7	17 700	36	5.95	3.90	9.08	<0.001
Depression	55	19 100	1.1	5 300	28	3.97	1.94	8.10	<0.001
Development/intellectual conditions	88	34 200	1.9	11 600	34	4.23	2.54	7.06	<0.001
Diseases of the nervous system	75	29 800	1.7	8 000	27	4.52	2.51	8.16	<0.001
Deafness/hearing loss	32	12 400	0.7	0	0	–	–	–	<0.001
Asthma	192	71 000	4.0	4 400	6	0.73	0.36	1.49	NS
Diseases of the digestive system	25	8 300	0.5	1 300	16	1.54	0.49	4.88	NS
Arthritis	21	7 500	0.4	0	0	–	–	–	<0.001
Back problems	134	51 400	2.9	5 200	10	1.27	0.73	2.21	NS
Other diseases of the musculoskeletal system <sup>b</sup>	13	5 100	0.3	700	14	2.50	0.62	9.78	NS
Congenital malformations, deformations and chromosomal abnormalities	27	11 200	0.6	5 800	52	12.58	5.05	31.29	<0.001
Symptoms/signs and abnormal clinical and laboratory findings	14	7 700	0.4	1 200	16	1.30	0.28	6.12	NS
Injury/accident	160	57 000	3.2	6 300	11	1.45	0.83	2.51	NS

NS, non-significant; OR, odds ratio.

<sup>a</sup>Dementia, schizophrenia, phobic and anxiety disorders, nervous tension/stress.<sup>b</sup>Repetitive strain injury/occupational overuse syndrome, other soft tissue/muscle disorders (including rheumatism), osteoporosis.

intellectual disorders had 2.90 times the odds of being not in the labour force (95% CI 1.47–2.51) and those with depression had 2.16 times the odds of being not in the labour force (95% CI 1.39–3.36), compared to those with no chronic health conditions.

The results from the HILDA survey show that between 2001 and 2012, 35% of people aged 15–29 who were out of the labour force spent at least 5 years out of the labour force. Table 4 shows the results of the negative binomial regression model estimating the number of years not in the labour force. Young people who are out of the labour force that have a chronic health condition or disability that influences the amount or type of work they can do, were expected to spend on an additional 1.3 more years out of the labour force than those who do not.

Table 5 uses the model shown in Table 4 to project the number of years not in the labour force in the 5 years following 2012. Results for the median figure are presented, separately for males and females. Males with no health condition who were out of the labour force were expected to spend a further 2.2 years out of the labour

force. Males with development/intellectual disorders and ‘other mental health conditions’ were expected to spend a further 2.7 years out of the labour force. Females with no health conditions who were out of the labour force were expected to spend a further 2.8 years out of the labour force. Females with development/intellectual disorders were expected to spend a further 3.5 years out of the labour force.

## Discussion

This study found that chronic health conditions were a large contributor to Australian youth being out of the labour force. Of the nearly 550 000 young people who were out of the labour force in 2012, 20% of these were attributed to chronic disease and at an estimated cost of \$3.7 billion dollars of lost GDP in 2012. Multiple studies have shown that chronic disease is responsible for taking large numbers of older workers out of the labour force [19,20]. However, most likely due to the relatively low prevalence of chronic disease among younger age groups [21], this phenomenon

**Table 3.** Long-term health conditions and labour force status, Australian population aged 15–29 who were not at school and not studying full-time, 2012, females

Long-term health condition	Total			Not in the labour force		OR of being not in the labour force		
	No. in survey	Weighted no.	Percentage of people out of population aged 15–30, not studying	Weighted no.	Percentage of people with that condition	OR adjusted for age and sex	95% CI	<i>P</i> value
No condition	3572	1 271 100	75.7	258 800	20	Reference		
Diabetes	25	9500	0.6	2000	21	1.28	0.43 3.82	NS
Other mental and behavioural conditions <sup>a</sup>	161	54 600	3.3	18 100	33	1.66	1.13 2.45	<0.05
Depression	109	36 300	2.2	14 400	40	2.16	1.39 3.36	<0.001
Development/intellectual conditions	45	16 700	1	8700	52	2.90	1.47 5.21	<0.01
Diseases of the nervous system	152	51 500	3.1	12 900	25	1.07	0.69 1.65	NS
Deafness/hearing loss	14	3400	0.2	100	3	0.11	0.01 0.86	<0.05
Asthma	228	78 000	4.7	14 700	19	0.87	0.60 1.26	NS
Diseases of the digestive system	33	11 600	0.7	1500	13	0.63	0.21 1.91	NS
Arthritis	28	8800	0.5	2200	25	1.56	0.60 4.05	NS
Back problems	145	49 800	3.0	15 500	31	1.56	1.02 2.37	<0.05
Other diseases of the musculoskeletal system <sup>b</sup>	22	7600	0.5	500	7	0.42	0.12 1.48	NS
Congenital malformations, deformations and chromosomal abnormalities	24	9700	0.6	3100	32	1.49	0.59 3.75	NS
Symptoms/signs and abnormal clinical and laboratory findings	28	9200	0.6	1900	21	0.84	0.29 2.38	NS
Injury/accident	60	18 700	1.1	4900	26	1.29	0.64 2.61	NS

NS, non-significant; OR, odds ratio.

<sup>a</sup>Dementia, schizophrenia, phobic and anxiety disorders, nervous tension/stress.<sup>b</sup>Repetitive strain injury/occupational overuse syndrome, other soft tissue/muscle disorders (including rheumatism), osteoporosis.**Table 4.** Model of the number of years not in the labour force over a 5-year time period, young Australians aged 15–29 who were not in the labour force and not studying full-time

Parameter	Estimate	SE	Wald 95% confidence limits		Wald $\chi^2$	<i>P</i> value
Intercept	1.0828	0.1388	0.8108	1.3549	60.85	<0.001
Male	-0.2596	0.0834	-0.4230	-0.0962	9.70	<0.01
Aged 20–24	0.0037	0.0926	-0.1778	0.1853	0.00	NS
Aged 25–29	-0.0609	0.0949	-0.2468	0.1250	0.41	NS
No children	-0.1302	0.0664	-0.2604	0.0000	3.84	NS
Married	0.0911	0.0688	-0.0438	0.2260	1.75	NS
Advanced diploma or diploma	0.0824	0.1359	-0.1839	0.3487	0.37	NS
Certificate III or IV	0.1638	0.1168	-0.0652	0.3928	1.97	NS
Year 12	0.0779	0.0984	-0.1151	0.2708	0.63	NS
Year 11 or below education	0.1741	0.0984	-0.0187	0.3669	3.13	NS
Has a chronic health condition or disability that impacts ability to participate in the labour force	0.2050	0.0802	0.0478	0.3622	6.53	NS

NS, non-significant.

**Table 5.** Model of additional years out of the labour force by chronic health condition, Australian population aged 15–29, not in the labour force in 2012

Long-term health condition	Males		Females	
	Total	Projected number of years not in the labour force between 2012 and 2017	Total	Projected number of years not in the labour force between 2012 and 2017
	Weighted no.	Median number of years	Weighted no.	Median number of years
No condition	1 378 000	2.2	1 271 100	2.8
Diabetes	10 200	2.7	9 500	3.3
Other mental and behavioural disorders <sup>a</sup>	48 900	2.7	54 600	3.5
Depression	19 100	2.7	36 300	3.5
Development/intellectual disorders	34 200	2.7	16 700	3.5
Diseases of the nervous system	29 800	2.7	51 500	3.5
Deafness/hearing loss	12 400	2.7	3 400	3.4
Asthma	71 000	2.7	78 000	3.5
Diseases of the digestive system	8 300	2.7	11 600	3.5
Arthritis	7 500	2.5	8 800	3.7
Back problems	51 400	2.7	49 800	3.5
Other diseases of the musculoskeletal system <sup>b</sup>	5 100	2.5	7 600	3.3
Congenital malformations, deformations and chromosomal abnormalities	11 200	2.7	9 700	3.6
Symptoms/signs and abnormal clinical and laboratory findings	7 700	2.7	9 200	3.5
Injury/accident	57 000	2.7	18 700	3.5

<sup>a</sup>Dementia, schizophrenia, phobic and anxiety disorders, nervous tension/stress.

<sup>b</sup>Repetitive strain injury/occupational overuse syndrome, other soft tissue/muscle disorders (including rheumatism), osteoporosis.

among young people has been relatively unexplored in Australia until now.

The finding that mental health conditions were the largest contributor to youth being out of the labour force is in line with the findings of other studies that have highlighted the impact that mental health conditions can have on employment. For example, within Britain, it has been documented that depression was responsible for 109.7 million lost working days in 1999–2000 [22], and longitudinal data have shown that current mental health status can predict future unemployment [23]. Multiple studies have also focused on the impact of mental ill-health among older workers. Over half of the people of older working age who have depression are out of the labour force within Australia [19,24] and older workers who had retired prematurely were more likely to have mental disorders [25,26]. This study adds to these findings by highlighting the influence mental health conditions are having on the labour force participation of young people.

The experience of being out of the labour force at such young ages is particularly concerning given the known long-term impacts unemployment can have. Being out of the labour force is known to be associated with high poverty rates and welfare dependency [27], which have significant direct costs to government regarding welfare payments, and could also result in the intergenerational transmission of welfare dependency when these young

people have children [28]. This later point should be highlighted as the results have shown that people with children were more likely to be out of the labour force for longer periods of time. Furthermore, unemployment is known to be strongly associated with poorer health outcomes among younger people [29], potentially resulting in a negative spiral for health status.

The use of nationally representative data that covered all people with and without health conditions was a key strength of this study, identifying the chronic health conditions that may be taking young people out of the labour force. However, two key weaknesses of the study are that it was based upon self-reported health conditions, and there was no investigation as to how the health conditions were affecting their ability to participate in the labour force. Further analysis utilizing clinically validated health conditions, and looking specifically at specific health conditions may be warranted, to further identify the barriers and enablers to labour force participation for young people.

Youth unemployment has been highlighted as a key social and economic burden in multiple countries, not just Australia [30]. Surprisingly little research has been conducted into exploring the barriers to youth unemployment. That ill-health may be acting as an impediment to labour force participation comes at a double cost—both regarding the health burden and also the financial burden

from lost productivity. These findings are likely to have relevance to all developed nations dealing with ageing workforces and relatively low rates of youth employment.

### Key points

- Poor health was cited as the reason for labour force absence for one in five young Australians.
- Numerous chronic health conditions were associated with significantly higher odds of young males and young females being out of the labour force, relative to those with no chronic health conditions.
- Young people who were out of the labour force were expected to spend several more years out of the labour force.

### Funding

Part of E.J.C.'s salary came from an NHMRC Early Career Fellowship (APP1052742).

### Acknowledgements

This paper uses unit record data from the Household, Income and Labour Dynamics in Australia (HILDA) Survey. The HILDA Project was initiated and is funded by the Australian Government Department of Social Services (DSS) and is managed by the Melbourne Institute of Applied Economic and Social Research (Melbourne Institute). The findings and views reported in this paper, however, are those of the author and should not be attributed to either DSS or the Melbourne Institute.

### Competing interests

None declared.

### References

1. Organisation for Economic Co-operation and Development. *Ageing Societies, in OECD Factbook 2008*. Paris, France: OECD, 2008.
2. Australian Treasury. *The 2010 Intergenerational Report*. Canberra, Australia: Australian Government, 2010.
3. Australian Government. *Towards Responsible Government: The Report of the National Commission of Audit—Phase One (Section 1.4)*. Canberra, Australia: Australian Government, 2014.
4. Australian Bureau of Statistics. *Australian Demographic Statistics, June 2014. ABS Cat. No. 3101.0*. Canberra, Australia: ABS, 2015.
5. Australian Bureau of Statistics. *Labour Force, Australia, June 2015 ABS Cat. No. 6202.0*. Canberra, Australia: ABS, 2015.
6. Australian Labour. *Youth Jobs Connect*. 2015. [http://www.alp.org.au/youth\\_jobs\\_connect](http://www.alp.org.au/youth_jobs_connect) (14 November 2017, date last accessed).
7. Australian Government. *Youth Employment Strategy, in Budget 2015*. Canberra, Australia: Australian Government, 2015.
8. Callander E, Schofield D, Shrestha R. Multi-dimensional poverty in Australia and the barriers ill health imposes on the employment of the disadvantaged. *J Socio Econ* 2011;**40**:736–742.
9. Cai L, Cong C. Effects of health and chronic diseases on labour force participation of older working-age Australians. *Austr Econ Papers* 2009(June):166–182.
10. Hale DR, Bevilacqua L, Viner RM. Adolescent health and adult education and employment: a systematic review. *Pediatrics* 2015;**136**:128–140.
11. Australian Bureau of Statistics. *Regional Population Growth, Australia, 2014–15, ABS Cat. No. 3218.0*. Canberra, Australia: ABS, 2016.
12. Australian Bureau of Statistics. *Disability, Ageing and Carers, Australia: Summary of Findings, 2012*. Canberra, Australia: ABS, 2013.
13. Summerfield M, Freidin S, Hahn M, et al. *HILDA User Manual—Release 12*. Melbourne, Australia: The University of Melbourne, 2013.
14. Watson N. *Longitudinal and Cross-sectional Weighting Methodology for the HILDA Survey, HILDA Project Technical Paper Series No. 2/12*. Melbourne, Australia: Melbourne Institute of Applied Economic and Social Research, University of Melbourne, 2012.
15. Australian Government. *Budget 2014–15 Social Services*. Canberra, Australia: Australian Government, 2014.
16. The Treasury, *Intergenerational Report 2015*. Canberra, Australia: Australia Government, 2015.
17. Evans MD, Kelley J. Trends in women's labor force participation in Australia: 1984–2002. *Soc Sci Res* 2008;**37**:287–310.
18. COAG Reform Council. *National Education Agreement: Baseline Performance Report for 2008*. Sydney, Australia: COAG Reform Council, 2009.
19. Schofield DJ, Shrestha RN, Passey ME, Earnest A, Fletcher SL. Chronic disease and labour force participation among older Australians. *Med J Aust* 2008;**189**:447–450.
20. Robroek SJ, Schuring M, Croezen S, Stattin M, Burdorf A. Poor health, unhealthy behaviors, and unfavorable work characteristics influence pathways of exit from paid employment among older workers in Europe: a four year follow-up study. *Scand J Work Environ Health* 2013;**39**:125–133.
21. Australian Institute of Health and Welfare. *Australias Health, 2014*. Canberra, Australia: Australian Government, 2014.
22. Thomas CM, Morris S. Cost of depression among adults in England in 2000. *Br J Psychiatry* 2003;**183**:514–519.
23. Butterworth P, Leach LS, Pirkis J, Kelaher M. Poor mental health influences risk and duration of unemployment: a prospective study. *Soc Psychiatry Psychiatr Epidemiol* 2012;**47**:1013–1021.
24. Schofield DJ, Shrestha RN, Percival R, Passey ME, Callander EJ, Kelly SJ. The personal and national costs of mental health conditions: impacts on income, taxes, government support payments due to lost labour force participation. *BMC Psychiatry* 2011;**11**:72.
25. Butterworth P, Gill SC, Rodgers B, Anstey KJ, Villamil E, Melzer D. Retirement and mental health: analysis of the Australian national survey of mental health and well-being. *Soc Sci Med* 2006;**62**:1179–1191.
26. Gill SC, Butterworth P, Rodgers B, Anstey KJ, Villamil E, Melzer D. Mental health and the timing of men's retirement. *Soc Psychiatry Psychiatr Epidemiol* 2006;**41**:515–522.

27. Nepal B, Payne A, Brown L. *Health, Wealth and Wise? The Relationship Between Health, Employment and Earnings in Australia, in AMP:NATSEM Income and Wealth Report, Issue 23, July 2009*. Sydney, Australia: AMP, 2009.
28. Bellani L, Bia M. Measuring intergenerational transmission of poverty. Paper presented en el congreso ECINEQ. 2013.
29. Viner RM, Ozer EM, Denny S *et al*. Adolescence and the social determinants of health. *Lancet* 2012;**379**:1641–1652.
30. Organisation for Economic Co-operation and Development (OECD). *Unemployment Set to Remain High in OECD Countries Through 2014—Youth and Low-Skilled Hit Hardest*. Paris, France: OECD, 2014.

doi:10.1093/occmed/kqx176

## Occupational eye hazard of Renaissance sculptor Benvenuto Cellini and the recurrent theme of pigeon's blood

Benvenuto Cellini (1500–71), an Italian sculptor, is known for his bronze sculpture 'Perseus with the Head of Medusa', which is now located in the Loggia dei Lanzi in Florence. Cellini also wrote a famous autobiography in which the following occupational eye injury is described [1] occurring when Cellini worked with his sculpture 'Narcissus' in the 1540s.

"One morning I was preparing some small chisels for my work on it, and an extremely fine splinter of steel flew into my right eye, and it was so far embedded into my pupil that I could not find a way to remove it. I thought for certain that I would lose the sight of that eye. After several days I summoned Master Raffaello de' Pili, a surgeon who took two live pigeons, and making me lie on my back on a table, he took the pigeons, and with a little knife, pierced a large vein they have in their wings so that the blood ran into my eye; I immediately felt relief as a result, and in the space of two days the steel splinter came out and I remained free of pain and my vision improved."

The type of Cellini's ocular injury was most likely a superficial corneal foreign body. It is unclear how common this type of injury was in the Renaissance, but nowadays it is the most common occupational ocular trauma associated particularly with grinding [2], a work Cellini was performing before the injury. No contemporary practitioner of medicine would suggest using living pigeon's blood but it has been used as a treatment since antiquity and is found as a remedy for eye diseases in *Naturalis Historia* by Pliny the Elder (d. 79) [3]. Fresh pigeon's blood, especially as a cure for eye injuries, is also mentioned in *De Materia Medica* by Dioscorides (d. 90) [4], which was the principal book on herbs and other remedies in Europe for over 1500 years.

The unifying theoretical principle for these remedies was provided by Galen (b. 129) in his doctrines of humoral medicine [5]. Treatment consisted of finding a medicine with qualities that counterbalanced the disease. Since the eye itself was considered a phlegmatic organ (cold and wet), the blood of the pigeon

would balance the humors. Interestingly, Cellini does not mention the use of forceps, although Byzantine physician Aetios Amidinos (d. 574) wrote in one of his books that forceps should be used to extract small foreign bodies from the eye [6]. Afterwards, dove's blood should be poured onto the injured eye. Instructions for using pigeon's blood can even be found in late 17th century recipe books, which included not only culinary but also medical information. In Lady Ayscough's recipe book from 1692, pigeon's blood is suggested "For A stroke in the Eyes if there Grow pain thereby or if you be pricked in ye Eyes by any thing" [7].

**Timo Hannu**

*e-mail: timo.hannu@helsinki.fi*

### References

1. Cellini B. *My Life*. Translated by Julia Conaway Bondanella and Peter Bondanella. New York: Oxford University Press, 2009; 323.
2. Thompson GJ, Mollan SP. Occupational eye injuries: a continuing problem. *Occup Med (Lond)* 2009;**59**:123–125.
3. Pliny the Elder. Cures for eye diseases. In: *Natural History, Volume VIII: Books 28–32*. Translated by W. H. S. Jones. Loeb Classical Library 418. Cambridge, MA: Harvard University Press, 1963; 263–264.
4. Pedanius Dioscorides of Anazarbus. *De materia medica*. Translated by Lily Y. Beck. Hildesheim: Olms-Weidmann, 2005; 123.
5. Siraisi NG. *Medieval and Early Renaissance Medicine*. Chicago: University of Chicago Press, 1990; 145.
6. Fronimopoulos J, Lascaratos J. "Eye injuries" by the Byzantine writer Aetios Amidinos. *Doc Ophthalmol* 1988;**68**:121–124.
7. Lady Ayscough's recipe book of 1692. Manuscript 1026/30, Wellcome Library, London, UK.