Article

16Up: Outline of a Study Investigating Wellbeing and Information and Communication Technology Use in Adolescent Twins

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Abstract

The '16Up' study conducted at the QIMR Berghofer Medical Research Institute from January 2014 to December 2018 aimed to examine the physical and mental health of young Australian twins aged 16−18 years ($N = 876$; 371 twin pairs and 18 triplet sets). Measurements included online questionnaires covering physical and mental health as well as information and communication technology (ICT) use, actigraphy, sleep diaries and hair samples to determine cortisol concentrations. Study participants generally rated themselves as being in good physical (79%) and mental (73%) health and reported lower rates of psychological distress and exposure to alcohol, tobacco products or other substances than previously reported for this age group in the Australian population. Daily or near-daily online activity was almost universal among study participants, with no differences noted between males and females in terms of frequency or duration of internet access. Patterns of ICT use in this sample indicated that the respondents were more likely to use online information sources for researching physical health issues than for mental health or substance use issues, and that they generally reported partial levels of satisfaction with the mental health information they found online. This suggests that internet-based mental health resources can be readily accessed by adolescent Australians, and their computer literacy augurs well for future access to online health resources. In combination with other data collected as part of the ongoing Brisbane Longitudinal Twin Study, the 16Up project provides a valuable resource for the longitudinal investigation of genetic and environmental contributions to phenotypic variation in a variety of human traits.

Keywords: Twins; cohort study; longitudinal; genetics; mental health; adolescents; technology

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Health profiles of young people can change rapidly during adolescence and early adulthood as a result of the developmental changes associated with this period. It has been previously estimated that half of all lifetime mental health and substance use disorders start by age 14 years, and 75% by age 24 years (Kessler et al., 2005). Mental and substance use disorders are collectively the third leading cause of total disease burden in Australia and are the leading cause of disease burden in late childhood, adolescence and early adulthood (Australian Institute of Health and Welfare, 2016).

Mental health disorders significantly affect quality of life, with negative impacts on young people's relationships with family and friends, as well as their education, employment and overall health (Burns et al., 2013). With rapid advances in technology, an increasing number of individuals are using the internet to access healthcare information. This provides an opportunity for youth mental and physical health services to utilize information and communication technology (ICT) in order to reduce the disparities in access to healthcare in Australia as a result of isolation, stigma or cost (Burns et al., 2013).

Internet usage by young people in Australia is almost universal (Australian Bureau of Statistics, 2016), with most Australian adolescents spending more than 2 h per day online (Houghton et al., 2015). Young people aged 15 to 21 years, in particular, have been identified as a group that may benefit from the use of electronic mental health assessment tools to aid in the disclosure of sensitive information (Bradford & Rickwood, 2015). However, the effective

application of ICT to these ends requires a thorough understanding of how young people use internet technology in their everyday lives, including the stimuli that influence them to use it and the barriers that prevent engagement.

It has been reported that Australian children and adolescents enjoy a substantial level of flexibility and privacy in their access to the internet (Green et al., 2011), with both factors identified as contributing positively to young people's confidence in using the internet to explore sensitive issues (Burns et al., 2010). A study of young Australians aged 16−25 years (Burns et al., 2016) found that 44% had used the internet to access health information, but noted a significant difference with more young women using the internet for this purpose compared to young men (52% vs. 35%). Furthermore, the study did not distinguish between use of the internet to access physical health and mental health information.

The Young and Well CRC partnered with the QIMR Berghofer Medical Research Institute to explore the patterns of ICT use in the 16Up project, a study of Australian twins which aims to investigate a range of factors influencing the wellbeing of adolescents. The 16Up project makes a valuable contribution to the ongoing Brisbane Longitudinal Twin Study (BLTS) resource (Couvy-Duchesne et al., 2018; Mitchell et al., 2019; Wright & Martin, 2004), by providing new information on twins and triplets who have previously participated at ages 12 and/or 14 ($N = 457$), as well as recruiting additional participants to the cohort ($N = 419$). The extended twin design and longitudinal nature of this dataset will facilitate its use in examining relative contributions of genetic and environmental factors to particular measures of interest in cross-sectional and longitudinal analyses, as well as conducting genomewide association tests using genotypic data from the BLTS. This article describes the design of the 16Up study and presents results of univariate statistical analysis of a range of general physical and mental health measures, including age and sex differences. Patterns of ICT use and the experiences of young Australians in searching online for information on mental health, alcohol and substance use are also investigated.

Methods

Study Design and Ethics

Data for this project were collected from Queensland twins and triplets who were aged between 16 and 18 years in 2015 or 2016, and who had either registered with the Queensland Twin Registry or previously participated in one or more waves of the BLTS (Gillespie et al., 2013). In total, 876 individuals participated in the 16Up study, consisting of 371 complete twin pairs and 18 triplet sets.

The 16Up study protocol consisted of online questionnaires to all subjects as well as physical measures of activity, sleep and stress (as hair cortisol) to subsamples, as summarized in Table 1. The online questionnaire and physical measurement phases of the study were conducted independently of each other — physical measurements could be collected either before or after completion of the online questionnaire, and participation in one component was not a prerequisite for participation in another. In order to collect longitudinal data, only twins who had previously participated in actigraphy (motor activity monitoring) during one or more waves of the BLTS were eligible to participate in the physical measurement components of the 16Up study.

Study participation invitations were sent to the most recently listed email address on the Queensland Twin Registry or BLTS database for prospective participants over 18 years of age at time of approach ($N = 1625$). All participants provided informed consent for the study ($N = 1071$). For participants under the age of 18 years, emails seeking consent to contact the twins/triplets directly were sent to the nominated parent or guardian in the first instance, with study invitations then emailed to the twins/triplets once parental/guardian consent had been obtained. Ethics approval for this study was obtained from the QIMR Berghofer Medical Research Institute Human Research Ethics Committee (P2055).

Online Questionnaires

Study participants completed a primary online questionnaire consisting of a variety of demographic, education, physical health and mental health measures (see Table 1 for summary). On completing the primary questionnaire, they were presented with the opportunity to complete a supplementary questionnaire containing additional education and mental health measures, as well as items relating to specific physical phenotypes, health conditions and personality (also summarized in Table 1). The two questionnaires were created separately due to the large number of measures included. Participants were able to exit the questionnaires at any time and resume at the same place.

Demographic Data

Study participants were asked to provide information about their current relationship status, history of residential mobility, languages spoken in the home and whether they identified as Aboriginal and/or Torres Strait Islander. Measures of education and employment included highest level of education for the participant (Blanchard et al., 2014), main occupational activity and number of hours spent in education, paid employment and volunteer work in the past week.

Physical Health

Study participants were asked to rate their overall physical health on a 5-point scale (*very good/good/moderate/bad/very bad*) and identify any major medical problems that had affected their everyday life with age of onset and age at which the condition was most recently experienced. They were also asked how many days in the 4 weeks prior to completing the questionnaire they were unable to carry out their usual activities fully (days out of role) and how many days they stayed in bed all or most of the day because of illness or injury (bed disability).

Actigraphy

Participants were provided with an actigraphy monitoring device (GENEActiv, Activinsights, Kimbolton, UK) and asked to wear it on their nondominant wrist for 14 days. These devices record motor activity continuously across the recording period. Participants concurrently completed a sleep diary to record bed times, wake times, estimated time to fall asleep, how they felt when they woke (refreshed or tired), if their sleep was disturbed, caffeine consumption before bed and if they took a daytime nap.

Mental Health and Behavior

Study participants were asked to rate their overall mental health on the same 5-point scale as their physical health and identify any major mental health or behavioral problems that had affected their everyday life with age of onset and age at which the condition was most recently experienced. The Somatic and Psychological Health Report (SPHERE-34; Hickie et al., 2001) and Kessler Psychological

Table 1. Summary of 16Up study protocol

	Primary questionnaire	Supplementary questionnaire	Other measures
Demographics			
Places of residence (number, locations)	✓		
Languages in the home	✓		
Disability	✓		
Number of biological children	✓		
Living circumstances	✓		
Relationship status	✓		
Education and employment			
Highest level of education (Blanchard et al., 2014)	✓		
Main occupational activity	✓		
Hours in education/paid employment/volunteer work	✓		
Schooling (highest grade, age at starting school, repeating years, number of schools)		✓	
Core subject performance (Telethon Kids Institute, 2015)		✓	
School connectedness (Telethon Kids Institute, 2015)		✓	
Queensland Core Skills Test (Queensland Curriculum and Assessment Authority, 2016)			✓
Physical health			
Self-rating (5-point scale)	✓		
Physical health problems checklist	✓		
Days out of role and bed disability	✓		
Physical activity (Craig et al., 2003)	✓		
14-day actigraphy recording			✓
Mental health and behavior			
Self-rating (5-point scale)	✓		
Assessment of functioning (adapted from Endicott et al., 1976)			
General mental health (Hickie et al., 2001; Kessler et al., 2003)	✓		
Mental health condition checklist	✓		
Screening for mental health disorders (Kessler & Ustün, 2004; Morey, 1991; adaptations from Altman et al., 1997 and Yung et al., 2009)	✓	✓	
Suicidality (Kann et al., 2014; Van Spijker et al., 2014)	✓		
Substance use	✓		
Motives for substance use (adapted from Cooper, 1994)			
Stress (Cohen, 1988; Kearney et al., 1993)		✓	
Hair cortisol			✓
Internet and technology use			
Internet usage and online activities (Blanchard et al., 2014; Burns et al., 2010; Livingstone et al., 2011)		✓	
Use of internet as a communication tool (Livingstone et al., 2011)		✓	
Use of internet as physical/mental health information resource (Burns et al., 2010)		✓	
Cyber-bullying		✓	
Sexting		✓	
Social network and relationships			
Attachments and conflictual relationships (Bond et al., 2004)	✓		
Supportive and negative interactions (Schuster et al., 1990)	✓		
Loneliness (Hughes et al., 2004)		✓	
Parental bonding (Todd et al., 1994)		✓	
Intimate bonding (Todd et al., 1994)		✓	

(Continued)

Table 1. (Continued)

	Primary questionnaire	Supplementary questionnaire	Other measures
Social support (Coventry et al., 2004)		✓	
Life events (Coventry et al., 2010)		✓	
Sleep			
Recent and preferred sleep and activity patterns	✓		
Insomnia and hypersomnia (Rush et al., 2003)	✓		
Sleep quality (Buysse et al., 1989)		✓	
Insomnia severity (Bastien et al., 2001)		✓	
14-day sleep diary			✓
Food			
Type of diet	✓		
Recent consumption from specific food groups	✓		
Eating disorder symptoms (Ålgars et al., 2014; Bulik et al., 2010; Hay & Carriage, 2012; Rush et al., 2003)	✓	✓	
Personality			
TIPI (Gosling et al., 2003)	✓		
NEO-FFI-3 (McCrae & Costa, 2010)		✓	
TDDS pathogen and moral disgust factors (Tybur et al., 2009)		✓	
Other			
Cognition (adapted from Stip et al., 2003) and perceived IQ	✓		
Pubertal development (Carskadon & Acebo, 1993)	✓		
Migraine (Nyholt et al., 2004)		✓	
Asthma, eczema and allergic rhinitis		✓	
Self-report zygosity		✓	
Intra-pair twin contact		✓	
Physical appearance (natural eye color, hair color/texture)		✓	
Self-rating of physical attractiveness		✓	

Distress Scale (K10; Kessler et al., 2003) were used to provide measures of recent general mental health. Levels of psychological distress among participants were classified as 'low, 'moderate', 'high' or 'very high' using established K10 scoring criteria associated with predicted probabilities of mental disorders (Slade et al., 2011).

Questions on substance use were included for alcohol, tobacco, cannabis, cocaine, amphetamine-type stimulants, inhalants, sedatives, hallucinogens and opioids. Items for each of these substances included lifetime use, age at first use and frequency of use during last 12 months and previous week.

Information and Communication Technology

General questionnaire items relating to technology use included use of the internet, means of accessing the internet, patterns of online activity and online activities in the past month (Blanchard et al., 2014; Burns et al., 2010; Livingstone et al., 2011). Questionnaire items relating to online communication focused on use of the internet to contact other young people (including to talk about problems), use of the internet as a source of information for a physical, mental health, alcohol or substance use problem (Burns et al., 2010), comparison of online and offline communication (Livingstone et al., 2011) and nature of online contacts (Livingstone et al., 2011).

Statistical Analysis

Data quality control and basic statistical analysis were conducted using SPSS 22.0 (SPSS Inc., Chicago, IL, USA). Significance of differential responses between participants was assessed using Chi-squared tests and Spearman's correlations.

Results

Participation

A total of 1625 individuals were approached to take part in the 16Up study, of whom 876 participants responded to the primary questionnaire (54% compliance), and 92% of these (805/876) also responded to the supplementary questionnaire. The median time taken to complete the primary questionnaire was 55 min (interquartile range [IQR]: 40–105 min), and the median time to complete the supplementary question was 65 min (IQR: 46–168 min). Of the participants who progressed to the supplementary

questionnaire, 67% started the supplementary questionnaire within 24 h of finishing the primary questionnaire, and 93% within 30 days of finishing the primary questionnaire. The longest interval between finishing the primary questionnaire and starting the supplementary questionnaire was 121 days.

Demographic Results

The average age of participants was 16.3 years (SD 0.7 years), and 57% of participants were female. A small number of participants ($N = 6$) completed the questionnaire prior to their 16th birthday. The participants represented 469 family groups, consisting of 371 twin pairs, 18 sets of triplets and 80 single twins (Table 2). Fifteen participants (2%) were identified as being of Aboriginal and/or Torres Strait Islander origin. English was spoken as the main household language in all except five families (99% English speaking). All participants reported to be in some form of education, employment or training. The majority of participants (92%) stated that their main current activity was education (including secondary and tertiary education), with 71% having spent more than 30 h per week on average on education in the last month. More than half of the participants (54%) had also participated in at least some paid work in the past month; the majority for less than 15 h per week on average. Almost a quarter of participants (24%) engaged in some form of volunteer work during the past month, and 58% performed some unpaid domestic work or caring work in their household, typically less than 5 h per week on average No significant sex differences were found in the amount of hours spent in education per week ($x_2^2 = 5.08$, $p = .08$) or paid work ($x_2^2 = 5.99$, $p = .05$) or volunteer work ($x_1^2 = 0.02$, $p = .88$).

Health

Self-reported Physical and Mental Health. The majority of participants (87%) rated themselves as having either 'very good' or 'good' overall health, with 79% rating themselves as having at least good physical health and 73% rating themselves as having at least good mental health (Table 3). Overall health self-rating values were more highly correlated with physical health self-ratings ($p = .67$, $SE = 0.03$) than mental health self-ratings ($p = .50$, $SE = 0.03$).

Approximately, 14% of participants indicated that they had ever experienced a major medical problem affecting everyday life, and a similar percentage indicated they had ever experienced a mental health or behavioral problem affecting everyday life. Self-report of ever having experienced a major mental health or behavioral problem was more common among participants who self-reported having ever experienced a major medical problem than among those who did not ($OR = 5.67$, 95% CI [3.3, 10.6]).

Actigraphy. Actigraphy monitoring was completed by 216 individuals. Based on sleep diary reports, the average bedtime was 10:30 pm and average wake time was 07:09 am. Average time in bed was 8 h and 38 min.

Tobacco, Alcohol, Cannabis and Other Substances. Over 80% of all study participants stated that they had never tried tobacco products. However, the proportion of smoking status varied across age groups ($x_2^2 = 41.67$, $p < .001$). Only 12% of participants aged 16 or younger had ever smoked, 20% of 17-year-olds had tried smoking, and 41% of 18-year-olds had tried smoking. Rates of having tried alcohol were considerably higher, with 60% of all participants reporting having tried alcoholic beverages. Of participants aged

16 years and younger, 53% had tried alcohol; these percentages rose to 74% for 17-year-olds and 88% for 18-year-olds. Use of cannabis and other substances (cocaine, amphetamines, inhalants, sedatives/sleeping pills, hallucinogens and opioids) was much less prevalent, with 11% of participants having tried cannabis, and 4% having tried at least one of the other substances. No statistically significant differences were found between male and female participants in having ever tried tobacco products ($x_1^2 = 2.53$, $p = .11$), alcohol ($x_1^2 = .17$, $p = .68$), cannabis ($x_1^2 = 1.62$, $p = .20$) or other substances ($x_1^2 = 1.05$, $p = .31$).

Psychological Distress. High (criterion score 22–29) or very high (criterion score 30–50) levels of psychological distress, as measured by the Kessler 10 (K10) scale, were evident in approximately 18% of study participants. No significant differences in prevalence of psychological distress were observed between the various age groups. However, a higher proportion of female participants met psychological distress criteria (14% 'high', 9% 'very high' psychological distress) than male participants (9% 'high', 4% 'very high' psychological distress) ($x_3^2 = 14.06$, $p = .003$).

Internet Access and Online Behaviors

Access. A summary of the internet access and online behaviors of the study participants who completed the supplementary questionnaire is shown in Table 4. Of the 805 participants who completed the supplementary questionnaire, 761 (95%) indicated that they use the internet, with almost all (754; 94%) using the internet every day or nearly every day. The most common places to access the internet were a bedroom or other private room in the home (79%), followed by public rooms in the home (56%) and at educational facilities (48%). The most common devices nominated as a main means of internet access were smart phones (80%), with personal laptops (65%) and tablet computers (32%) the next most common. Over one-third of participants (39%) spent between 2 and 4 h per day on weekdays on the internet, while 33% spent between 4 and 8 h online and 10% spent 8 h or more. Weekend internet usage was higher (Wilcoxon signed rank test for related samples, $p < .001$), with 42% of study participants spending between 4 and 8 h online per day, and 12% spending 8 h per day or more online. No significant differences in hours spent online were observed between male and female participants on either weekdays (Mann–Whitney U test, $p = .88$) or weekends (Mann–Whitney U test, $p = .34$).

Communication Approaches. Most participants (82%) reported primarily being in contact online with people whose acquaintance was first made face to face. When comparing approaches to online and offline communication, approximately half the study participants (51%) said that it was 'a bit true' (36%) or 'very true' (15%) that they find it easier to be themselves when online than when with people face to face. Talking about different things online than when face to face with people was at least 'a bit true' for 56% of study participants, and 29% of participants said that it was at least 'a bit true' that they talked about private things online that they did not share in face-to-face communication. There was no significant difference between male and female participants neither in approaches to online communication (easier being themselves : $\chi_2^2 = 5.67$, $p = .06$; talking about different things : $\chi_2^2 = 0.66$, $p = .72$; talking about private things : $\chi_2^2 = 4.22$, $p = .12$) nor in whether they mostly were in contact online with known people,

Table 2. Demographic characteristics of study participants (*n* = 876)

Characteristic	Number (% participants)
Age group	
15 years	6 (1%)
16 years	650 (75%)
17 years	136 (16%)
18 years	81 (9%)
Sex	
Female	501 (57%)
Male	375 (43%)
Zygosity	
Twin pairs	
MZ female	71 pairs
MZ male	60 pairs
DZ female	82 pairs
DZ males	53 pairs
DZ opposite sex	49 pairs
Not yet determined	56 pairs
Triplet trios	
MZ female trio	2 trio
MZ male pair with DZ female	3 trio
MZ male pair with DZ male	3 trios
DZ trio (2 female, 1 male)	10 trios
Main language spoken at home	
English	867 (99%)
Another language	9 (1%)
Indigenous status	
Aboriginal	13 (2%)
Torres Strait Islander	0 (0%)
Aboriginal and Torres Strait Islander	2 (<1%)
Relationship status	
Single, never married	724 (84%)
Married or living with partner	3 (<1%)
In a relationship but not living with partner	131 (15%)
Residential mobility	
Always lived in same place	370 (57%)
Lived in more than one place	494 (42%)
Highest educational level	
Completed or partially completed junior high school (Grades 8–10) or lower	166 (19%)
Completed or partially completed senior high school (Grades 11–12)	633 (72%)
Completed or partially completed certificate or diploma (including TAFE or trade qualification)	19 (2%)
Completed or partially completed university degree or higher qualification	47 (5%)
Main current activity	
Student attending school	726 (83%)
Student attending university, TAFE or other education	80 (9%)
Full-time work (≥30 h paid employment per week)	12 (1%)
Part-time work (<30 h paid employment per week)	26 (2%)

(*Continued*)

Table 2. (*Continued*)

Characteristic	Number (% participants)
Apprenticeship/traineeship	11 (1%)
Volunteer work	0 (0%)
Unemployed/looking for work	6 (0.5%)
Home duties	1 (0%)
Not working, currently receiving sickness allowance or disability support pension	0 (0%)
Hours of education in the past month	
None, or less than 5 h per week on average	50 (6%)
5 to 14 h per week on average	66 (8%)
15 to 29 h per week on average	123 (14%)
30 h or more per week on average	624 (71%)
Hours of paid work in the past month	
None	379 (43%)
Less than 5 h per week on average	121 (14%)
5 to 14 h per week on average	256 (29%)
15 to 29 h per week on average	64 (7%)
30 h or more per week on average	36 (4%)

Note: MZ, monozygotic; DZ, dizygotic; TAFE, Technical and Further Education.

friends/family/colleagues of known people or people with whom they had no other connection ($\chi_2^2 = 2.18$, $p = .34$).

Using the Internet to Discuss and Resolve Mental Health Problems. Almost half of participants (43%) indicated that it was 'a bit true' or 'very true' that they go online less often when they are going through a difficult time, while a similar percentage (48%) indicated that it was 'a bit true' or 'very true' that going online makes them feel better when they are going through a difficult time. No difference was observed in responses between males and females for either questionnaire item (online less often: $\chi_2^2 = 8.45$, $p = .02$; feeling better online : $\chi_2^2 = 4.50$, $p = .11$). Although most participants in this study reported using the internet to contact other young people (76%), a lower proportion (23%) have used the internet to talk with other young people about their problems. Of those who did, the majority (60%) found talking on the internet about their problems helpful, while 27% had a neutral opinion. Very few (3%) found the experience harmful. No sex differences were observed in whether participants talked about their problems online ($\chi_1^2 = 1.46$, $p = .23$) or proportions of those who found it helpful ($\chi_2^2 = 4.76$, $p = .09$).

Seeking Mental Health Information Online. Participants in this study were significantly more likely to have used the internet to find information for a physical health problem (49%) than for a mental health, alcohol or substance use problem (21%; Table 4) ($\chi_1^2 = 60.96$, p .001). Study participants who rated their mental health as 'good', 'moderate' or 'bad/very bad' were more likely to have used the internet to find information on mental health problems, alcohol or substance use than participants who rated their mental health as 'very good' (Table 5), with the likelihood of internet use increasing with decreasing levels of perceived mental health. A similar, but smaller, relationship was observed between self-rated mental health and use of the internet to find information on physical health problems. Participants with poorer

self-rated physical health were more likely to have used the internet to search for information on physical or mental health problems than those who rated their physical health as 'very good', but most of these results did not reach statistical significance.

Search engines were the usual starting point for information searches relating to mental health, alcohol or substance use (Table 6). The majority of study participants who had used the internet to find information for a mental health, alcohol or substance use problem reported that the information they received on the internet was 'somewhat' (53%) or 'very much' (44%) what they needed, and 68% indicated that the information 'helped a little' (46%) or 'helped a lot' (18%) in dealing more effectively with the problem. Overall, study participants were generally either 'somewhat satisfied' (66%) or 'very satisfied' (21%) with the information they received. No sex differences were observed for whether the information obtained was helpful ($\chi_3^2 = 1.30$, $p = .73$) or overall satisfaction level ($\chi_3^2 = 2.38$, $p = .50$). If information sourced from the internet was discussed with someone else (online or offline), it was most likely to have been with close friends (68%) or family (63%). However, only 29% of study participants who had sourced such information from the internet 'always' or 'nearly always' discussed it with someone else.

Discussion

This study provides data from a population-based twin study of Australian adolescents on a range of factors relating to wellbeing, mental health and substance use in the context of ICT access and utility. Key findings include that a majority of young Australians find talking about their problems online to be helpful and that participants who perceived their mental health to be poor were much more likely to have sought information online about mental health, alcohol or substance use than those who rated themselves as having better mental health. This suggests that while people are generally less likely to go online to find mental health information than

Table 3. Physical health, mental health, and behavioral characteristics of study participants (*n* = 876)

Characteristic	Number (% participants)
Self-rating of overall health	
Very good	331 (38%)
Good	419 (49%)
Moderate	105 (12%)
Bad	11 (1%)
Very bad	1 (<1%)
Self-rating of physical health	
Very good	289 (33%)
Good	400 (46%)
Moderate	151 (17%)
Bad	23 (3%)
Very bad	3 (<1%)
Self-rating of mental health	
Very good	246 (28%)
Good	393 (45%)
Moderate	173 (20%)
Bad	43 (5%)
Very bad	5 (0 < 1%)
Ever experienced major problem affecting everyday life	
Medical problem	121 (14%)
Mental health or behavioral problem	113 (13%)
Psychological distress (Kessler 10 scale)	
Low	543 (62%)
Moderate	166 (19%)
High	105 (12%)
Very high	52 (6%)
Smoking history	
Never smoked	717 (81%)
Have smoked but never on daily basis	91 (10%)
Used to smoke on daily basis, but not now	5 (<1%)
Current daily smoker	10 (<1%)
Self-classification of current alcohol consumption status	
Never tried alcohol	219 (25%)
Ex-drinker	0 (0%)
Non-drinker	157 (18%)
Occasional drinker	88 (10%)
Light drinker	26 (3%)
Social drinker	142 (16%)
Heavy drinker	2 (<1%)
Binge drinker	3 (<1%)
Ever used cannabis	
No	752 (86%)
Yes	95 (11%)
Ever used cocaine, amphetamine-type stimulants, inhalants, sedatives/sleeping pills, hallucinogens, opioids	
No	790 (90%)
Yes	55 (6%)

Table 4. Internet access and online behaviors of study participants who completed supplementary questionnaire ($n = 805$)

Behavior/attitude	Number (% participants)
Most common access to internet (multiple responses possible)	
Living room or other public room at home	448 (56%)
Own bedroom or other private room at home	635 (79%)
School, TAFE or tertiary institution	386 (48%)
At work	54 (7%)
At a friend's home	214 (27%)
At a relative's home	105 (13%)
Other public places	158 (20%)
While traveling 'out and about'	199 (25%)
Main devices used to access the internet (multiple responses possible)	
Smart phone	641 (80%)
Tablet	255 (32%)
Shared desktop computer	131 (16%)
Own desktop computer	115 (14%)
Shared laptop	35 (8%)
Own laptop	523 (65%)
Smart/connected/hybrid television	94 (12%)
Television	200 (25%)
Games console	191 (24%)
Portable gaming device	36 (8%)
Other handheld portable device	79 (10%)
Hours online per day during the week	
Up to 2 h	144 (18%)
More than 2 h but less than 4 h	314 (39%)
More than 4 h but less than 8 h	269 (33%)
8 h or more	80 (10%)
Hours online per day during the weekend	
Up to 2 h	112 (14%)
More than 2 h but less than 4 h	217 (39%)
More than 4 h but less than 8 h	338 (33%)
8 h or more	97 (12%)
Use the internet after 11 pm	
Never	393 (52%)
Less than once a week	80 (10%)
1 to 3 nights a week	163 (20%)
4 to 5 nights a week	58 (6%)
6 to 7 nights a week	50 (7%)
Most common types of internet contacts	
People first met in person face-to-face	626 (82%)
People first met on the internet, but who are friends/family/colleagues of known people	48 (6%)
People first met on the internet, no other connection	32 (4%)
Don't know	54 (7%)
Comparison of online and offline communication	
Easier to be myself online	
Not true	350 (46%)
A bit true	276 (36%)

(Continued)

Table 4. (*Continued*)

Behavior/attitude	Number (% participants)
Very true	115 (15%)
Don't know	19 (3%)
Talk about different things online	
Not true	287 (38%)
A bit true	321 (42%)
Very true	138 (18%)
Don't know	14 (2%)
Talk about private things not shared face-to-face	
Not true	523 (69%)
A bit true	184 (24%)
Very true	41 (5%)
Don't know	12 (2%)
Specific uses of the internet (multiple responses possible)	
To contact other young people	612 (76%)
Talk about problems with other young people	185 (23%)
Find information for physical health problem	394 (49%)
Find information for mental health, alcohol or substance use problem	169 (21%)

Table 5. Relationship between self-rated health measures and use of the internet to find information on health problems

Self-rated health measure	Odds ratio (95% CI in square brackets) Have used internet to find information on …	
	Physical health problems	Mental health, alcohol or substance use problems
Physical health		
Very good	1	1
Good	0.94 [0.62, 1.41]	1.30 [0.78, 2.19]
Moderate	0.97 [0.58, 1.63]	**2.66 [1.48, 4.78]**
Bad/Very bad[a]	1.34 [0.42, 4.28]	1.97 [0.58, 6.75]
Mental health		
Very good	1	1
Good	**1.74 [1.16, 2.63]**	**2.00 [1.09, 3.68]**
Moderate	**2.13 [1.23, 3.67]**	**5.72 [2.92, 11.23]**
Bad/Very bad[a]	**2.67 [1.08, 6.60]**	**22.50 [8.16, 62.07]**

Note: [a]Categories 'bad' and 'very bad' combined due to low endorsement frequencies. Bold type indicates statistically significant associations ($p < .05$).

physical health information, the internet is recognized as a potentially useful source of mental health information by those who want to access it. Given the thorough embedding of technology in the lives of this age group, ICT provides an enormous opportunity to improve the mental health literacy and wellbeing of Australian adolescents.

Typical patterns of internet access for participants in the present study included accessing the internet daily or nearly daily, accessing the internet at home in private spaces, and using a mobile or personal device (such as a smart phone or personal laptop) as a primary means to access the internet. Compared to the most similarly aged group of participants interviewed in 2010 the AU Kids Online study (Green et al., 2011; 15 and 16 years old), participants in the present study spent more time online, but were less likely to have contacts online that they first met on the internet. Participants in the present study were also more likely to say that they found it easier to be themselves when online than when talking to people face to face than the most comparable AU Kids Online age group. These differences may be at least partly due to factors such as increased availability of internet access in this age group via handheld devices in the 5 years since the AU Kids Online study was conducted.

Participants in the present study were less likely to have tried tobacco products, alcoholic beverages or cannabis than their counterparts of the same age in the general Australian population (White & Bariola, 2012; White & Williams, 2015). For the majority of health measures, no significant difference was observed between male and female participants. The higher proportion of females in this age group reporting high or very high levels of psychological distress in the present study as compared to males was in line with observations in the general Australian population aged 16 −17 years (Lawrence et al., 2015). However, the overall prevalence of psychological distress was lower in the present study than observed by Lawrence et al. These differences across a range of measures may well be as a result of the sampling biases discussed above, since a variety of factors such as self-perceived health and health risk factors are known to differ between major cities and the rural and remote areas of Australia (Australian Institute of Health and Welfare, 2014).

Despite the similar self-report rates for major physical health problems and major mental health or behavioral problems in this study, significantly fewer participants had ever used the internet to find information for a mental health, alcohol or substance use problem. This may mean that young people are more likely to consider online information sources for researching physical health issues than for mental health or behavioral issues. This may in turn indicate a lower level of mental health literacy (knowledge and

Table 6. Experiences of seeking information online for a mental health, alcohol or substance use problem ($n = 167$)

Experience	Number (% participants)
Starting point for information seeking (multiple responses possible)	
Search engine	158 (95%)
Specific website	21 (13%)
Accidentally-found link	12 (7%)
Other	5 (3%)
Don't know	0 (0%)
Found information they needed by using internet	
Not at all	2 (1%)
Somewhat	88 (53%)
Very much	73 (44%)
Don't know	4 (2%)
Would recommend internet as information source to family member/close friend	
Definitely not	4 (2%)
Probably not	40 (24%)
Probably	79 (47%)
Definitely	30 (18%)
Don't know	14 (8%)
Internet helped them to deal more effectively with the problem	
Made it a lot worse	0 (0%)
Made it a little worse	2 (1%)
Neither	44 (27%)
Helped a little	77 (46%)
Helped a lot	30 (18%)
Don't know	13 (8%)
Overall satisfaction with information received on internet	
Very dissatisfied	3 (1%)
Somewhat dissatisfied	10 (6%)
Somewhat satisfied	110 (66%)
Very satisfied	35 (21%)
Don't know	9 (4%)
Ever discussed internet-sourced information with others (multiple responses possible)	
Mental health professional	63 (38%)
Close friends	113 (68%)
Family	105 (63%)
Online discussion or support group	30 (18%)
Online or email counselling	25 (15%)
Other health professional	31 (19%)
Other people on internet	35 (21%)
Other	13 (8%)
Frequency of discussing internet-sourced information with anyone	
Never	27 (16%)
Not often	28 (16%)
Sometimes	62 (37%)
Nearly always	30 (18%)
Always	18 (11%)

beliefs about mental disorders that aid their recognition, management or prevention (Jorm et al., 1997) than physical health literacy among this cohort, or reflect negative attitudes towards mental illness (Perry et al., 2014). However, there are other possible interpretations for these data; for example, some of the internet research may be for minor physical health conditions, thus skewing the results towards physical health.

Study participants generally reported that the information on mental health, alcohol and substance use problems found on the internet was 'somewhat' what they needed, 'helped a little' in dealing more effectively with the problem, and that they were 'somewhat satisfied' with the information they obtained. Adolescents also often do not discuss mental health information that they find online with anyone. It is therefore currently unclear whether (1) the existing online mental health resources are insufficient to meet the needs of this adolescent audience, (2) the audience is not successfully accessing the relevant information, or (3) the audience is accessing the relevant information but is unable to appropriately interpret the information and translate it to their own situation. Further research is required to determine where the barriers exist, and the most effective way to overcome them.

A potential limitation of this study is that it may not be representative of the Australian population. Recruitment processes for this study heavily weighted participation towards individuals living in or who had previously lived in south-east Queensland, which will have resulted in underrepresentation of Australians living in regional and remote areas. The proportion of participants identifying as being of Aboriginal or Torres Strait Islander origin was approximately in line with national and regional estimates (Australian Bureau of Statistics, 2013; Queensland Government Statistician's Office, 2016). Nationally, English is spoken as the only language at home in 77% of Australian households, with the percentage somewhat higher (82%) in Brisbane. This indicates that people from non-English speaking backgrounds are likely to be underrepresented in this study, based on the proportion of households in which English is spoken as the only language at home in this sample, as compared to national estimates (Australian Bureau of Statistics, 2012).

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