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Valuing Child Health Utility 9D health states with young adults: insights from a time trade off study

Running title: Valuing Child Health Utility 9D health states with young adults

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Abstract

Objectives

In contrast to the proliferation of studies incorporating health state values from adults of all ages, relatively few studies have reported upon the application of the time trade off (TTO) approach to generate health state values from populations of younger adults. This study sought to employ a conventional TTO approach to obtain values for a selection of Child Health Utility 9D (CHU9D) health states from a sample of young adults aged 18 to 29 years and to compare with the values generated from application of the original UK adult standard gamble scoring algorithm and the Australian adolescent scoring algorithm.

Methods

A convenience sample of Flinders University undergraduate students aged 18 to 29 years were invited to participate in an interviewer administered conventional TTO task to value a series of five CHU9D health impairment states using the widely used variant developed by the York EQ-5D team.

Results

A total of 152 students within the target age range were approached to participate in the study of whom N=38 consented to participate, giving an overall participation rate of 25%. With the exception of one health state, the mean TTO values were consistently lower than those generated from application of the original scoring algorithm for the CHU9D elicited with adults of all ages. A significant proportion of participants (n=17, 45%) considered the most severe CHU9D (PITS) state to be worse than death.

Conclusions

This study adds to a growing body of evidence indicating that the values attached to identical health states are typically lower for younger people in comparison with adults of all ages and dependent upon the elicitation method utilised. The values obtained are applicable for re-scaling raw CHU9D health state values obtained from younger adolescent samples using profile case best worst scaling.

Key points for Decision Makers

- Relatively few studies have reported upon the application of the time trade off (TTO) approach with populations of younger adults
- This study indicates that the TTO values attached to identical health states are lower for younger people in comparison with those generated from application of the original adult scoring algorithm for the CHU9D comprising adults of all ages.
- The choice of elicitation method and whose values to use for the economic evaluation of health care treatments and services targeted for young people are important issues that may impact significantly upon the cost effectiveness estimates obtained.

1. Background

The Child Health Utility 9D (CHU9D) is a new generic preference based measure of health related quality of life (HrQoL) developed specifically for application with young people [1]. Since its introduction the instrument has been widely applied in several countries in both children and adolescents. Adolescence is a transitional stage of physical and mental human development which generally occurs between the ages of 11 and 17 years (commencing at the onset of puberty and terminating at legal adulthood) [2]. It is a time when individuals become increasingly responsible for their own health and health care and is also associated with several health risk behaviours, e.g. alcohol use, cigarette smoking and illicit drug use. As such, this period of human development represents a key point for the introduction of educational and preventative efforts that may have a significant impact upon both short and long term health outcomes. The CHU9D was designed principally for use in economic evaluation to facilitate assessment of the cost-effectiveness of educational and preventative interventions targeted for young people,although it may also be used to assess the HrQoL of populations in epidemiological studies. The instrument has also been adapted for, and successfully applied in, adult populations (aged 18 years and above) [3].

The CHU9D has 9 dimensions (worried, sad, pain, tired, annoyed, schoolwork, sleep, daily routine and ability to join in activities) with 5 levels within each dimension. A unique feature of this instrument is that it was developed exclusively with young people. The response scales, wording and formatting are based upon a qualitative study of interviews with over 70 young people with a wide range of acute and chronic health problems. The instrument has undergone psychometric testing in both general primary school and in clinical paediatric populations and has demonstrated good practicality and validity [1]. More recently the instrument has been widely applied in Australia with adolescents aged 11 to 17 years in community settings and its practicality, feasibility and construct validity has been demonstrated in this context [3-6].

The original scoring algorithm for the CHU9D is based upon UK adult general population values (n=300) and was generated using the standard gamble (SG) valuation method [7]. A second scoring

algorithm, based upon Australian adolescent values (aged 11-17 years, n=590) using profile case best worst scaling discrete choice experiment (BWS DCE) methods has also been developed [3]. Currently a programme of research is underway funded by the Australian National Health and Medical Research Council to generate a revised Australian adolescent scoring algorithm for the CHU9D utilising BWS DCE methods in a much larger community based sample of adolescents (n=2020) based throughout Australia.

In common with all ordinal approaches to health state valuation, the estimates obtained from a BWS DCE task are not based on the 0-1 quality adjusted life years (QALY) scale [8]. Initially the estimates are anchored to the least valued attribute level. Since these estimates are on an interval scale, a linear transformation can be applied in order to ensure that the full health state takes the value 1 and the 'PITS' health state (the health state comprising the lowest level on each of the nine attributes of the CHU9D descriptive system) takes the lowest value. However, in order for the estimates to have QALY properties the zero must represent the dead state, not the PITS state. This can be achieved by using the most severe or PITS health state value, (comprising the lowest level on each of the nine attributes of the CHU9D descriptive system) from a traditional cardinal approach to health state valuation e.g. the time trade off (TTO) or SG methods to ensure that the 0 represents death [8]. This approach was adopted for the existing adolescent scoring algorithm for the CHU9D in that the adult general population value for the PITS state elicited using the SG method was used to re-scale the BWS DCE estimates to ensure that the zero represented death [4].

The reliance upon an adult general population value (including both younger and older adults) to re-scale the BWS DCE estimates obtained from adolescents may be viewed as a limitation of the existing adolescent scoring algorithm for the CHU9D. Ideally, in order to best reflect the health state preferences of adolescents, such re-scaling should be based upon cardinal values elicited from adolescents [9]. However our previous experience indicates that ethical concerns and sensitivities associated with the presentation of the concept of immediate death in adolescent samples will likely mean that both TTO and SG tasks need to be modified from their conventional formats to remove any

reference to death in the question framing [9]. Hence, it has been suggested that a sample of younger adults may offer a next best solution in terms of a relevant age range for the purpose of re-scaling BWS DCE estimates from adolescents whilst also potentially avoiding the problems associated with the need to modify conventional TTO and SG for administration with adolescents [9].

Conventional valuation methods for re-scaling best worst estimates

Although there is no accepted gold standard scaling method for eliciting health state values for the estimation of QALYs, historically the majority of health economists have tended to favour the choice based valuation methods of TTO and SG [10]. The SG method involves presenting the respondent with a choice between a certain intermediate outcome (the health state to be valued) and the uncertainty of a gamble with two possible outcomes, one of which is better than the certain intermediate outcome (typically described as full health) and one of which is worse (typically described as immediate death). The probability P of the best outcome is varied until the individual is indifferent between the certain intermediate outcome and the gamble. This probability P is the utility for the certain outcome, the health state to be valued. This technique is then repeated for all other health states to be valued. A modified version of SG can also be applied to elicit the value attached to health states considered worse than death and temporary health states [10].

TTO was developed specifically for use in health care by Torrance [11] as a less complex alternative to the SG that overcomes the problems of explaining probabilities to respondents. In common with the SG, TTO presents the respondent with a choice. However, in TTO the respondent is asked to choose between two alternatives of certainty rather than between a certain outcome and a gamble with two possible outcomes. The application of TTO to a chronic health state considered better than dead involves presenting individuals with a paired comparison with two alternatives. Alternative 1 involves living for a specified time period t (typically 10 years) in the health state to be valued. Alternative 2 involves full health for time period x where x is less than t. Time x is varied until the respondent is indifferent between the two alternatives. The value given to the less than full health state is then x/t.

In common with SG, a modified version of TTO can also be applied to elicit the value attached to health states considered worse than death and temporary health states [10]. In addition, two variants of the conventional TTO, namely lead-time and lag-time TTO, which involve using the same TTO task regardless of whether the state being valued is considered better or worse than death, have recently been developed [12]. However, in contrast to SG and conventional TTO methods these new approaches have not yet been applied extensively in adult populations.

As previously highlighted, the original scoring algorithm for the CHU9D is based upon application of the SG method with adults of all ages (age range: 16 to 87 years). Historically, studies reporting upon the application of conventional valuation methods specifically with populations of younger people have been much less prevalent. In a previous study reported upon in this journal to compare BWS DCE, TTO and SG methods in a young adolescent population Ratcliffe et al. [9] noted that the majority of participants experienced difficulties in understanding and interpreting TTO and SG tasks. Participants were randomised and asked to value a series of CHU9D health states using either an SG or a TTO procedure. For SG, participants expressed difficulties in identifying a point of indifference between the gamble and the certain outcomes. Participants also tended to overlook the certain outcome when making choices and focused predominantly upon the probabilities within the gamble alternative leading to little variation in the values obtained for different health states of varying severity. The majority of participants who received TTO exhibited strong risk aversion, a reluctance to trade healthy life years, and struggled to identify a point of indifference. Whilst these problems may possibly be alleviated through the use of an older adolescent sample, there are additional difficulties due to the ethical concerns of the presentation of “immediate death” which may be viewed as a sensitive issue in adolescent population groups even within the context of a hypothetical exercise.

The main purpose of this study was to employ a traditional cardinal approach to health state valuation to obtain values for a series of CHU9D health states (including the PITS state) for the purposes of re-scaling the BWS DCE estimates obtained from an adolescent sample onto the 0 = death 1= full health QALY scale. Previous health state valuation exercises have indicated that TTO tasks are generally

easier for respondents to understand and complete than SG and a wide variety of empirical studies have demonstrated that the conventional TTO task is a practical, reliable and acceptable method of health state valuation [10]. For these reasons, we opted to apply the conventional TTO for this study. Due to the difficulties previously highlighted with the application of TTO methods in adolescent samples we chose to administer the conventional TTO method in a sample of young adults (aged 18-29 years). The health state values obtained will subsequently be used to re-scale the profile case BWS DCE estimates obtained from a large community based sample of Australian adolescents to produce an up-dated adolescent specific scoring algorithm for the CHU9D.

2. Methods

Participants

Permission was sought and ethical approval was granted (Approval no: 6347) to conduct the sub-study in a convenient sample of Flinders University students from the Faculty of Medicine, Nursing and Health Sciences aged 18 to 29 years located in the southern suburbs of metropolitan Adelaide. Students were recruited to the study via an invitation letter, an information sheet and consent form distributed via an email student distribution list.

Measures

Participants were asked to self-complete the adult version of the CHU9D as the first phase of the interview prior to undertaking the TTO task. The adult version of the CHU9D was identical to the original CHU9D with the exception that 'schoolwork' in the CHU9D descriptive system was replaced with 'work/study' to make this dimension more applicable for university student participants. The initial completion of the CHU9D helped to familiarise the participants with the wording and formatting of the CHU9D health states for valuation. Following completion of the CHU9D, participants undertook the TTO task with a trained interviewer. Participants were asked to value a total of five CHU9D health states from across the CHU9D descriptive system (reflecting increasing levels of impairment according to the health state description and their associated health state values, plus the PITS state comprising the lowest level for each of the nine attributes of the CHU9D – see

Appendix 1) using the TTO method. A maximum of five health states were chosen for valuation to provide a balance between achieving adequate representation of the range of health state values incorporated within the CHU9D descriptive system for the purposes of re-scaling and the practical need to avoid presenting a large number of health states for valuation and thereby potentially over-burdening study participants through a lengthy and intensive interview process. The health states were presented in a random order to remove the potential for any ordering effects.

The conventional TTO task employed was based upon the widely used variant developed by the York EQ-5D team for interviewer administration, using props in the form of a sliding scale to represent life years [13] and to assist in identifying a point of indifference. Participants were asked to consider each health state in turn and asked to indicate a point of indifference between living in that health state for 10 years and a shorter period of time in full health. In cases where the health state under consideration was viewed as worse than being dead then the modified version of the TTO task developed by the York EQ-5D team was employed [10,13]. This procedure involves respondents choosing between alternative 1: immediate death and alternative 2: spending a length of time (y) in the health state under consideration followed by x years in full health where $x + y = t$. Time x is varied until the respondent is indifferent between the two alternatives. The value for state h_i is then given by $h_i = -x/(t - x)$. Hence, the more time that is required in full health to compensate for the time spent in the health state under consideration the lower is the score for that particular health state. As for SG, one practical difficulty with this technique is that, although it imposes an upper limit of 1.0 on chronic health states preferred to death, it imposes no comparable lower limit on health states which are considered worse than death. This results in a scale ranging from minus infinity to +1.0, thereby giving greater weight to negative values in the calculation of mean scores and presenting problems for statistical analysis. It has therefore been recommended that the preference values of states considered worse than death are re-scaled such that the worst possible state is assigned a preference value of –1.0 [13, 16]. This transformation was applied for states considered worse than death.

Basic socio-demographic information including age and gender and additional questions relating to whether or not the respondent had a disability or long standing health condition, were collected in the final section of the survey. Socio-economic status was measured by applying the Family Affluence Scale (FAS), a measure of socioeconomic position designed for young person self-report [14]. The FAS is constructed as a 0-7 point scale with lower scores representing lower levels of affluence and vice versa. The FAS was collected in eight categories ranging from 0 to 7, which were recoded into 3 groups for the analysis, low: 0-3, intermediate: 4-5 and high: 6-7 [14]. Participants were also asked to indicate how difficult they found the TTO task was to complete on a scale from 1 to 4 where 1 indicates 'not difficult' and 4 indicates 'very difficult'.

Data Analysis

The data were analysed in STATA version 12.1 [15]. Individual responses to the CHU9D were converted to values by applying the original UK adult general population algorithm developed by Stevens [7]. For comparative purposes the Australian adolescent scoring algorithm was also applied to generate Australian specific values [4]. For comparative purposes, the TTO values obtained from the Australian university student adult sample for the five selected health states were compared with the values generated from application of the existing UK adult general population sample based upon the SG method [7] and the Australian adolescent specific scoring based upon the BWS DCE method [4] for the same five health states. Descriptive summary statistics including means, standard deviations, medians and inter-quartile ranges were estimated.

3. Results

A total of 152 students within the target age range were invited to participate in the study of whom N=38 consented to participate, giving an overall participation rate of 25%. The socio-demographic characteristics of the participants are summarised in Table 1. It can be seen that the majority of participants were male (76%) and the mean age of participants was 23 years. The vast majority of participants (87%) were classified as either intermediate or high family affluence according to their responses to the FAS and most (82%) indicated that they were living without any long-standing

illness, disability or medical condition/s. All participants fully completed both the CHU9D and the TTO task. A minority of participants (11%) indicated that they found the TTO task moderately difficult to complete, with 37% of participants indicating slight difficulty and 53% indicating no difficulty.

The frequencies of responses to the CHU9D are presented in Table 2. Participants generally reported themselves in good health according to the CHU9D classification, although no participant reported themselves in full health, corresponding to the highest level for all 9 CHU9D attributes. The mean CHU9D health state values corresponding to these response patterns was generally high with an overall mean of 0.87 where the UK adult scoring algorithm was applied and an overall mean of 0.81 where the Australian adolescent scoring algorithm was applied. These values are consistent with the findings from a previous study conducted in a community based samples of younger Australians aged 11-17 years where the mean CHU9D value was 0.85 [5].

The results from comparisons of the TTO and SG values are summarised in Table 3. It can be seen that with the exception of health state 1 (HS1), the mean TTO values generated are lower on average than those elicited from application of the original CHU9D scoring algorithm based upon the SG method with adults of all ages. The PITS health state value is noticeably lower relative to the PITS health state values generated from application of the original adult scoring algorithm. A significant proportion of young adult participants (n=17, 45%) considered the PITS state to be worse than death when directly valuing it using the TTO method. Whilst the majority (55%) of young adult participants considered the PITS state to be better than dead, the strength of preference for those who considered the PITS state to be worse than death was such that, overall, the mean health state value for the PITS state was lower than zero and therefore worse than death according to the QALY scale. The standard deviations around the mean TTO estimates indicate that there is some variation at the individual level with the extent of the variation being highest for the PITS health state.

4. Discussion

The findings from this study indicate the practicality of the conventional TTO approach using an interview mode of administration with young people. The mean TTO values obtained from this study will be utilised indirectly to facilitate the development of an up-dated Australian adolescent specific scoring algorithm for the CHU9D by re-scaling the ordinal values obtained for a selection of CHU9D health states onto the 0 = death 1= full health QALY scale. The ordinal values were obtained using BWS DCE methods from a large Australia-wide community based sample of adolescents (N=1982, aged 11 to 17 years). Previously we have used the UK SG adult general population value (including adults of all ages) for the most severe or PITS health state for the purposes of re-scaling BWS DCE estimates obtained from adolescents. This study represents an improvement on this previous research through the use of a more targeted young adult sample and the incorporation of a series of CHU9D health state values (rather than a single health state value only) generated using a conventional TTO approach for the purposes of re-scaling.

The main limitations of this study relate to the sample size which was relatively small and composed of a convenience sample of University students. The sample may not, therefore, be considered as representative of the young adult population of Australia. Further work should investigate the development of more precise TTO health state values for the CHU9D through the use of larger and more diverse community based samples of young people and the potential for the use of more sophisticated econometric modelling approaches for the purposes of re-scaling DCE estimates on to the full health-dead QALY scale [16].

The TTO method was generally well received in our young adult sample with the vast majority being prepared to trade healthy life years and indicating either no or only slight difficulty with the approach. This finding is in direct contrast to a previous study we conducted in a younger adolescent sample to compare TTO, SG and best worst scaling methods which found that the majority of participants exposed to the TTO approach expressed a strong reluctance to trade healthy life years [9]. A reluctance to trade healthy life years has also been found in other studies applying the TTO with adolescents. Tong and colleagues found that adolescent kidney transplant recipients reported

consistently high values for their current quality of life and were willing to give up almost no life expectancy for perfect health [17]. Similarly, Yi and colleagues found that adolescents living with cystic fibrosis were willing to trade very little of their life expectancy to attain perfect health [18]. The findings from this study indicate that in contrast to adolescents, young adults are able to contemplate the notion of sacrificing life expectancy and have a stronger capacity to reflect on long-term outcomes, both of which form essential components for the practicality and feasibility of the conventional time trade off approach. These findings are also consistent with evidence from the psychological and decision-making literatures which indicate that key executive functions commensurate with an understanding of the TTO approach (including the abilities to plan strategically and the organization of goal directed behaviours) are still developing during adolescence but tend to reach peak development during young adulthood [19,20].

With the exception of the first health state (HS1), the mean health state values generated from application of the conventional TTO method are noticeably lower than those generated using SG. These findings are consistent with evidence from the literature to indicate that the SG method tends to produce higher health state values than TTO for identical health states [21]. The findings are also consistent with our previous research which has applied a common valuation method and focused upon the differences in values attributable to population groups. We conducted a study to apply BWS DCE methods to value a series of identical CHU9D health states with adolescent and adult samples. It was found that the adolescent values were generally lower that the adult values and the differences were most pronounced in relation to mental health impairments [22]. Hence, this study adds to a body of evidence to demonstrate that both the choice of valuation method and the population group from whom the values are elicited may impact significantly upon the resulting health state values.

From a public policy perspective, it may be argued that the preferences and values of adults should be used to inform QALY calculations. Adults are eligible to vote under constitutional law and are eligible to pay general taxation which provides financial support for the health systems of many countries [22]. However, it may also be argued that the incorporation of the preferences of adolescents

into cost-effectiveness analyses of treatment and service programmes designed for this age group has the potential to facilitate the development of treatment and service programmes that are more relevant to their needs, ultimately leading to improvements in service utilization by adolescents. The choice of method for eliciting health state values and the question of whose values to apply in the calculation of QALYs are important issues to address for economic evaluation and for guiding decision-making in relation to health policy.

5. Conclusions

This study employed the conventional TTO method, a traditional cardinal approach to health state valuation, with a sample of young adults to obtain values for a series of health states (including the PITS state) defined by the CHU9D instrument. With the exception of one health state, the mean TTO values were consistently lower than those elicited using direct standard gamble valuation with adults. A significant proportion of participants (n=17, 45%) considered the most severe CHU9D (PITS) state to be worse than death. The values obtained will be utilised to re-scale the BWS DCE estimates obtained from a large community based sample of adolescents (aged 11 to 17 years) onto the 0 = death 1= full health QALY scale to generate an up-dated Australian adolescent scoring algorithm for the CHU9D. The revised algorithm will have wide applicability in health economics, health services research, epidemiology and public health for incorporation into the economic evaluation of health and preventive programs and in the assessment of the health related quality of life for populations of younger people.

Author contributions

All authors contributed to the design of the study and JR wrote the draft manuscript with input from all authors. LC and SB conducted the TTO interviews and collected the data. GC analysed the data with assistance from JR and KS. All authors provided critical review of the manuscript and final approval of the version to be submitted for publication. JR is the guarantor for the overall content.

Compliance with Ethical Standards

This study was supported by a Flinders University seeding grant and an Australian NHMRC Project Grant 1021899 entitled 'Adolescent values for the economic evaluation of adolescent health care treatment and preventive programs'. There are no conflicts of interests for any of the authors (Julie Ratcliffe, Gang Chen, Katherine Stevens, Sandra Bradley, Leah Couzner, John Brazier, Michael Sawyer, Rachel Roberts, Elisabeth Huynh, Terry Flynn). This study was approved by the Flinders University Social and Behavioural Research Ethics Committee (project no: 6347) and has been performed in accordance with the ethical standards of the Declaration of Helsinki. Informed consent was obtained from all participants included in the study.

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References

1. Stevens K (2009). Developing a descriptive system for a new preference-based measure of health related quality of life for children. *Quality of Life Research* 18: 1105-13.

2. Williams P, Holmbeck G, Greenley R (2002). Adolescent Health Psychology. *Journal of Consulting and Clinical Psychology* 70: 828-842.

3. Ratcliffe J, Stevens K, Flynn T, Brazier J, Sawyer M (2012). Whose values in health? An empirical comparison of the application of adolescent and adult values for the CHU9D and AQOL-6D in the Australian adolescent general population. *Value in Health* 15(5): 730-36.

4. Ratcliffe J, Flynn T, Terlich F, Brazier J, Stevens K, Sawyer M (2012). Developing adolescent specific health state values for economic evaluation: an application of profile case best worst scaling to the Child Health Utility-9D. *Pharmacoeconomics* 30(8): 713-27.

5. Stevens K, Ratcliffe J (2012). Measuring and valuing health benefits for economic evaluation in adolescence: an assessment of the practicality and validity of the Child Health Utility 9D in the Australian adolescent population. *Value in Health* 15(8): 1092-9.

6. Ratcliffe J, Stevens K, Flynn T, Brazier J, Sawyer M (2012). An assessment of the construct validity of the CHU9D in the Australian adolescent general population. *Quality of Life Research* 21(4): 717-2.

7. Stevens K (2012). Valuation of the Child Health Utility 9D Index. *Pharmacoeconomics* 30: 729-47.

8. Flynn T, Louviere J, Marley A, Peters T, Coast J (2008). Rescaling quality of life tariffs from discrete choice experiments for use as QALYs: a cautionary tale. *Population Health Metrics* 6: 6.

9. Ratcliffe J, Couzner L, Flynn T, Sawyer M, Stevens K, Brazier J, Burgess L (2011). Valuing Child Health Utility 9D health states with a young adolescent sample: a feasibility study to compare best-worst scaling discrete-choice experiment, standard gamble and time trade-off methods. *Applied Health Economics and Health Policy* 9(1): 15-27.

10. Brazier J, Ratcliffe J, Salomon J, Tsuchiya A (2007). *Measuring and valuing health benefits for economic evaluation*. Oxford University Press, 2007.

11. Torrance GW (1976). Social preferences for health states: an empirical evaluation of three measurement techniques. *Socio-Economic Planning Sciences* 10: 129-36.

12. Augustovski F, Rey-Ares L, Irazola V, Oppe M, Devlin NJ (2013). Lead versus lag-time trade-off variants: does it make any difference? *European Journal of Health Economics* Jul;14 Suppl 1:S25-31.

13. Dolan P, Gudex C, Kind P, Williams A (1996). The time trade-off method: results from a general population study. *Health Economics* 5: 141-52.

14. Anderson A, Krølner R, Currie C, Dallago L, Due P, Richter M, Orkényi A, Holstein BE (2008). High agreement on family affluence between children and parents' self-reports. *Journal of Epidemiology and Community Health* 62: 1092-4.

15. StataCorp, L.P. (2011). Intercooled stata 12.1 for windows. College Station, Texas: StataCorp, L.P.

16. Rowen D, Brazier J, Van Hout B (2015). A comparison of methods for converting DCE Values onto the Full Health-Dead QALY scale. *Medical Decision Making* 35: 328-40.

17. Tong A, Tjaden L, Howard K, Wong G, Morton R, Craig J (2011).
Quality of Life of Adolescent Kidney Transplant Recipients *Journal of Pediatrics* 159:670-75.

18. Yi MS, Britto MT, Wilmott RB, Kotagal UR, Eckman MH, Nielson DW, et al (2003). Health values of adolescents with cystic fibrosis. *Journal of Pediatrics* 142:133-40.

19. De Luca C, Wood S, Anderson V, Buchanan J, Proffitt T, Mahony K,:Pantelis C (2003). Normative data from the Cantab. I: development of executive function over the lifespan. *Journal of Clinical and Experimental Neuropsychology* 25: 242-254.

20. Romine C, Reynolds C (2005). A model of the development of frontal lobe functioning: findigns from a meta-analysis. *Applied Neuropsychology* 12: 190-201.

21. Bleichrodt H (2002). A new explanation for the difference between time trade-off utilities and standard gamble utilities. *Health Economics* 11: 447-56.

22. Gunning JP. *Understanding democracy: an introduction to public choice*. Taiwan: Nomad press, 2003

Table 1: Participants

Variable	***n (%)***
Gender	
Male	29 (76%)
Female	9 (24%)
Age (Mean, SD)	23.18 (2.85)
Family Affluence Score (FAS)	
Low (FAS score ≤ 3)	5 (13.16)
Medium (FAS score = 4 or 5)	16 (42.11)
High (FAS score ≥ 6)	17 (44.74)
Long-term disability, illness, or medical conditions	
Yes	7 (18.42)
No	31 (81.58)
Difficulty with the Time Trade Off approach	
Very difficult	0
Moderately difficult	4 (10.53)
Slightly difficult	14 (36.84)
Not difficult	20 (52.63)

Table 2: Mean values and summary of responses to CHU9D (n=38)

CHU9D mean (SD) values: UK SG adult algorithm	0.866 (0.062)
CHU9D mean (SD) values: Australian BWS DCE adolescent algorithm	0.811 (0.111)
CHU9D Attributes and levels	**Frequency (%)**
Worried	
1. I don't feel worried today	44.74
2. I feel a little bit worried today	39.47
3. I feel a bit worried today	7.89
4. I feel quite worried today	5.26
5. I feel very worried today	2.63
Sad	
1. I don't feel sad today	84.21
2. I feel a little bit sad today	13.16
3. I feel a bit sad today	2.63
4. I feel quite sad today	0
5. I feel very sad today	0
Pain	
1. I don't have any pain today	63.16
2. I have a little bit of pain today	28.95
3. I have a bit of pain today	7.89
4. I have quite a lot of pain today	0
5. I have a lot of pain today	0
Tired	
1. I don't feel tired today	15.79
2. I feel a little bit tired today	50.00
3. I feel a bit tired today	28.95
4. I feel quite tired today	5.26
5. I feel very tired today	0
Annoyed	
1. I don't feel annoyed today	76.32
2. I feel a little bit annoyed today	10.53
3. I feel a bit annoyed today	10.53
4. I feel quite annoyed today	2.63
5. I feel very annoyed today	0
Work/Study	
1. I have no problems with my work/study today	44.74
2. I have a few problems with my work/study today	39.47
3. I have some problems with my work/study today	15.79
4. I have many problems with my work/study today	0
5. I can't do my work/study today	0
Sleep	
1. Last night I had no problems sleeping	52.63
2. Last night I had a few problems sleeping	34.21
3. Last night I had some problems sleeping	13.16
4. Last night I had many problems sleeping	0
5. Last night I couldn't sleep at all	0
Daily routine	
1. I have no problems with my daily routine today	84.21
2. I have a few problems with my daily routine today	13.16
3. I have some problems with my daily routine today	2.63
4. I have many problems with my daily routine today	0
5. I can't do my daily routine today	0
Able to join in activities	
1. I can join in with any activities today	68.42
2. I can join in with most activities today	7.89
3. I can join in with some activities today	13.16
4. I can join in with a few activities today	10.53
5. I can join in with no activities today	0

Table 3: A comparison of Time Trade Off (N=38) and Standard Gamble values for selected CHU9D health states

Health State	**HS1:434243545**	**HS2:414355432**	**HS3:231345314**	**HS4:423141114**	**HS4:555555555**
TTO mean (SD)	0.52 (0.20)	0.34 (0.26)	0.46 (0.22)	0.63 (0.20)	-0.21 (0.45)
TTO median (IQR)	0.50 (0.35 to 0.60)	0.35 (0.10 to 0.50)	0.50 (0.25 to 0.65)	0.65 (0.45 to 0.75)	0 (-0.65 to 0.20)
SG mean[1]	0.41	0.56	0.73	0.83	0.33
BWS mean[2]	0.39	0.53	0.60	0.73	0.33

[1] from application of the original UK adult general population scoring algorithm.
[2] from application of the Australian adolescent specific scoring algorithm.

Abbreviations:
TTO=time trade off
SG=standard gamble
BWS=best worst scaling
HS=health state
SD=standard deviation
IQR=inter-quartile range

Appendix 1: Descriptions of health states presented

CHU9D dimensions	HS1:434243545	HS2:414355432	HS3:231345314	HS4:423141114	HS4:555555555
Worried	I feel quite worried today	I feel quite worried today	I feel a little bit worried today	I feel quite worried today	I feel very worried today
Sad	I feel a bit sad today	I don't feel sad today	I feel a bit sad today	I feel a little bit sad today	I feel very sad today
Pain	I have quite a lot of pain today	I have quite a lot of pain today	I don't have any pain today	I have a bit of pain today	I have a lot of pain today
Tired	I feel a little bit tired today	I feel a bit tired today	I feel a bit tired today	I don't feel tired today	I feel very tired today
Annoyed	I feel quite annoyed today	I feel very annoyed today	I feel quite annoyed today	I feel quite annoyed today	I feel very annoyed today
Work/study	I have some problems with my work/study today	I can't do my work/study today	I can't do my work/study today	I have no problems with my work/study today	I can't do my work/study today
Sleep	Last night I couldn't sleep at all	Last night I had many problems sleeping	Last night I had some problems sleeping	Last night I had no problems sleeping	Last night I couldn't sleep at all
Daily routine	I have many problems with my daily routine today	I have some problems with my daily routine today	I have no problems with my daily routine today	I have no problems with my daily routine today	I can't do my daily routine today
Able to join in activities	I can join in with no activities today	I can join in with most activities today	I can join in with a few activities today	I can join in with a few activities today	I can join in with no activities today