The Utility of Health States After Stroke
A Systematic Review of the Literature

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Background—To perform decision analyses that include stroke as one of the possible health states, the utilities of stroke states must be determined. We reviewed the literature to obtain estimates of the utility of stroke and explored the impact of the study population and the elicitation method.

Summary of Review—We searched various databases for articles reporting empirical assessment of utilities. Mean utilities of major stroke (Rankin Scale 4 to 5) and minor stroke (Rankin Scale 2 to 3) were calculated, stratified by study population and elicitation method. Additionally, the modified Rankin Scale was mapped onto the EuroQol classification system. Utilities were obtained from 23 articles. Patients at risk for stroke assigned utilities of 0.26 and 0.55 to major and minor stroke, respectively. Stroke survivors assigned higher utilities to both major (0.41) and minor stroke (0.72). The EuroQol completed by stroke survivors revealed a utility of 0.32 and 0.71 for major and minor stroke, respectively. Utilities elicited by the Standard Gamble were generally higher, while those obtained by the Visual Analogue Scale were lower than the Time Trade Off values. Remaining variation between utilities may be caused by differences in definitions of the health states. The mapped EuroQol indicated a utility of 0.64 for minor stroke and a value just below zero for major stroke.

Conclusions—For minor stroke, a utility between 0.50 and 0.70 seems to be reasonable for both decision analyses and cost-effectiveness studies. The utility of major stroke may range between 0 and 0.30 and may possibly be negative. **(*Stroke*. 2001;32:1425-1429.)**

Key Words: cost-benefit analysis ■ decision analysis ■ outcome ■ quality of life

Cost-effectiveness is becoming an important criterion in the evaluation of new treatments. The health state stroke occurs in many decision analyses and cost-effectiveness analyses, eg, in the evaluation of treatment of stroke,[1] atrial fibrillation,[2] or deep vein thrombosis.[3] Quality-adjusted life-years (QALYs) are usually the main outcome in these type of analyses. QALYs are calculated by multiplying the time spent in each health state by the value assigned to the particular health state.[4] To calculate QALYs, numerical judgments of the desirability of the various outcomes must be determined. These values are called utilities. Most health states have a utility between 0 (death) and 1 (perfect health). Utilities of very poor health states may even be negative. Utilities can be assigned by experts or can be elicited from patients or healthy people. In the present study we restricted attention to elicitations. Common methods for eliciting utilities are the Time Trade Off method (TTO), the Standard Gamble (SG), and the Visual Analogue Scale (VAS).[4] They are also used in health state classification systems such as the Health Utility Index (HUI)[5] or the EuroQol.[6] In these systems, patients in a health state complete a descriptive quality-of-life questionnaire. Utilities are assigned by means of a scoring table based on preferences elicited from the general public. The latter are measured through the SG, TTO, or VAS method.[7]

There have been many debates on the appropriate population from which utilities should be elicited. It has been argued that the healthy community is appropriate for cost-effectiveness analyses from the societal perspective and that patients at risk for stroke are more suited for decision analyses from the patients' perspective.[8] Nonetheless, the effect of the type of study population on utility scores for stroke has not been studied extensively. Hallan et al[9] elicited utilities from 3 different study populations and reported a utility of 0.54 for major stroke (at ages 45 to 64 years) for healthy people but a utility of up to 0.85 for stroke survivors.

We performed a systematic review of the literature on the utility of stroke and explored the impact of the study population and the elicitation method on the utility estimates. We compared these estimates with utilities obtained by the EuroQol classification system.

Methods

We searched the literature using the electronic databases of MEDLINE 1966–2000 (US National Library of Medicine, Bethesda, Md),

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TABLE 1. Main Characteristics of the Included Studies

Author	Participants	n	Age, y	% Male	Method
Adar[11]	Healthy adults/stroke survivors	167/11			VAS
Bosworth[20]	Stroke survivors	327	Mean: 66		TTO
Dorman[1]	Stroke survivors	152			EuroQol
Duncan[22]	Stroke survivors	459	Mean: 70	47%	TTO
Fryback[23]	Stroke survivors	13			VAS
Gage[2]	Patients with atrial fibrillation	57	Mean: 70	86%	TTO
Gage[17]	Patients with atrial fibrillation	70	Mean: 70	86%	TTO
Gold[24]	Stroke survivors	102			VAS
Gore[25]	Stroke after thrombolysis	99	Mean: 70	59%	TTO
Grootendorst[26]	Stroke survivors	173	Mean: 63	64%	HUI
Hallan[9]	Healthy/stroke	66/41	Range: 20–84	40/61%	SG
Indredavik[27]	Stroke survivors	32			VAS
Kalish[28]*	Stroke 6 mo after myocardial infarction	714	Mean: 60	74%	TTO
Kwa[29]	Patients with cerebral infarction	97	Mean: 63	54%	VAS
Lenert[30]	Healthy volunteers	60	Median: 35	27%	SG
Man-Son-Hing[31]	Healthy participants	46	Mean: 71	65%	VAS
Mathias[32]	Patients with ischemic stroke	33	Mean: 69	59%	HUI
Mittmann[33]	Stroke survivors in a community	16	>12		HUI
O'Meara[3]	Various patients	20	>50		SG
Samsa[15]	Patients at risk for stroke/stroke survivors	654/415	Mean: 65	52%	TTO
Shin[34]	Patients with arteriovenous malformation	31	Mean: 37	55%	SG
Solomon[12]	Patients undergoing carotid ultrasound	117	Mean: 73	55%	VAS
Thomson[35]	Patients with atrial fibrillation	57	Mean: 73	54%	SG

*Methods in Glasziou et al.[36]

the Web of Science 1988–2000 (Institute of Scientific Information), and the Cochrane Library (issue 4, 2000. Oxford, UK: Update Software), using the following search terms: stroke, cerebrovascular accident, cerebral arterial diseases, cerebrovascular disorders, cerebral thrombosis, carotid artery thrombosis, Wallenberg syndrome, cerebral hemorrhage, cerebral hematoma, apoplexy, hemiplegia, and hemiparesis. These terms were combined with the following terms: utility, quality of life, decision analysis, cost-benefit analysis, cost-effectiveness analysis, and cost-utility analysis.

We examined the reference lists of all included articles for other relevant references. Furthermore, we contacted experts in the field to obtain published or unpublished studies reporting assessments of utilities for stroke.

Articles were included if utilities for stroke had been elicited. The articles were required to include the following in the Methods section: (1) a description of the study population and (2) a description of the method of utility elicitation. The first author did the first selection of articles through the electronic databases. The exclusion criteria were applied by 2 authors (P.N.P. and P.P.W.), who also abstracted the information, mutually independent and blinded. Disagreements were resolved through discussions. We grouped the articles according to the study population into the following categories: healthy participants, patients at risk for stroke, or stroke survivors.

The utilities for major as well as minor disability after stroke were examined. These 2 states were distinguished by the modified Rankin Scale.[10] Minor stroke corresponded to Rankin Scale grade 2 to 3 (minor or moderate handicap; some or significant restrictions in lifestyle), and major stroke corresponded to Rankin Scale grade 4 to 5 (moderately severe or severe handicap; precludes independent existence). If stroke survivors were asked to value their own health state, we sought to obtain information about the degree of disability of these patients. We matched the health states used in the included publications as much as possible with those described above. However, we included the utility in the "unspecified stroke" category whenever the degree of severity had not been specified. If utilities in 1 study were assessed among 2 or more groups of participants, the group size–weighted mean of these utilities was taken.

It is incorrect to compare a utility assessed with the use of death as the lower reference point with a utility that uses another lower reference point. The same holds true for an upper reference point other than perfect health. Therefore, when death was not assigned a utility of 0 or perfect health was not assigned a utility of 1, utilities were normalized according to the following:

$$\frac{U - U_{death}}{U_{perfect\ health} - U_{death}}$$

Mean utilities weighted for sample size were calculated for each study population (healthy participants, patients at increased risk for stroke, and stroke survivors) and for each elicitation method (viz, TTO, SG, VAS, HUI, EuroQol).

Additionally, the authors scored the EuroQol according to the health state described by the modified Rankin Scale for both major and minor stroke.[10]

Results

A total of 23 articles satisfied our criteria. The main characteristics of the included studies are displayed in Table 1. Most authors used the TTO or the SG; others used the VAS, HUI, or EuroQol. Many participants were at risk for stroke and generally middle-aged or older, with a slight male dominance.

Stroke survivors assigned higher values to this health state than patients at risk for stroke or healthy participants (Table 2). Patients at risk for stroke assigned slightly lower utilities

TABLE 2. Mean Estimates and Range of Utilities for Minor and Major Stroke According to Study Population and Method

		Minor Stroke			Major Stroke			Unspecified Stroke		
Participants	Method	Mean	Range	Studies	Mean	Range	Studies	Mean	Range	Studies
Stroke survivors	TTO	0.72	0.71–0.81	22, 25	0.41	0.37–0.71	15, 22, 25	0.78	0.76–0.79	20, 28
	SG	0.89	0.81–0.95	9, 34	0.72	0.45–0.93	9, 34			
	VAS	0.46	0.42–0.49	11, 24	0.25	0.12–0.27	11, 24	0.55	0.48–0.68	23, 24, 27, 29
	HUI†							0.57	0.54–0.68	26, 32, 33
	EuroQol†	0.71		1	0.32		1			
At risk for stroke	TTO	0.55	0.39–0.75	2, 17	0.26	0.11–0.39	2, 15, 17			
	SG	0.81	0.81	34	0.45	0.45	34	0.29	0.29	3
	VAS	0.49	0.33–0.64	12, 35	0.05	−0.02–0.19	12, 35			
Healthy participants	TTO									
	SG	0.90	0.90	9	0.57	0.54–0.60	9, 30			
	VAS	0.57	0.43–0.70	11, 31	0.20	0.16–0.21	11, 31			
EuroQol*		0.64	0.52–0.71		−0.04	−0.30–0.20				

*Completed by the authors; see Methods.

†Although obtained from stroke survivors, these utilities are considered preferences from the general public.[7]

than healthy participants. The utility of an unspecified stroke was on average close to the utility of minor stroke. Utilities elicited by TTO were generally lower than SG utilities. VAS and HUI utilities were lower than TTO utilities.

Part of the variation may be explained by differences in the health states descriptions. As is shown in Table 3, considerable variation could be observed in the description of the particular health states. Therefore, the mean utilities in Table 2 should be considered with care. From Table 3, utilities for more specific stroke states can be read. Whereas the utility of hemiplegia is 0.28 according to Adar et al,[11] it is 0.13 if aphasia is coexistent. A severe motor deficit has the lowest utility (−0.08) according to Solomon et al,[12] followed by −0.02 for a severe cognitive deficit and 0.06 for a severe language deficit.

The EuroQol, as completed by the authors, indicated a very low, even negative, utility of major stroke (Table 2). For minor stroke, the EuroQol revealed a utility similar to that elicited from healthy participants or patients at risk for stroke.

Discussion

Combining the results of 23 studies, we obtained estimates of the utility of health states after stroke. The variation between the reported utilities may be due to the different study

TABLE 3. Utilities of Various Health States After Stroke (Unspecified Stroke Not Presented)

Author	Method	Participants	Minor Stroke	Utility	Major Stroke	Utility
Adar[11]*	VAS	Healthy	Hemiparesis nondominant side	0.50	Hemiplegia without aphasia	0.28
Adar[11]*	VAS	Healthy	Hemiparesis, dominant side	0.36	Hemiplegia+aphasia	0.13
Dorman[1]	EuroQol	Stroke	Independent, but not recovered after stroke	0.71	Dependent after stroke	0.32
Duncan[22]	TTO	Stroke	Rankin 2–3	0.71	Rankin 4–5	0.44
Gage[2]	TTO	At risk	Neurological event+mild residua	0.81	Moderate to severe residua	0.39
Gage[17]	TTO	At risk	Rankin 1–2	0.76	Rankin 4–5	0.11
Gold[24]	VAS	Stroke	Hemiparesis	0.42	Hemiplegia	0.27
Gore[25]	VAS	Stroke	Substantial limitation of activity and capability	0.81	Inability to live independently or work	0.71
Hallan[9]	SG	Healthy	Rankin 2–3	0.90	Rankin 4–5	0.54
Kwa[29]	VAS	Stroke	Mildly disabled; mean Rankin score: 2	0.59		
Lenert[30]	SG	Healthy			Hemiplegia+aphasia	0.60
Samsa[15]	TTO	At risk			Hemiplegia, dependent	0.27
Shin[34]	SG	At risk	Other disabling stroke	0.81	Dense hemiparesis or severe aphasia	0.45
Solomon[12]*	VAS	At risk	Moderate motor deficit	0.37	Severe motor deficit	−0.08
Solomon[12]*	VAS	At risk	Moderate cognitive deficit	0.30	Severe cognitive deficit	−0.02
Solomon[12]*	VAS	At risk	Moderate language deficit	0.33	Severe language deficit	0.06
Thomson[35]	SG	At risk	Mild stroke	0.64	Severe stroke	0.19

*Mean of these rows used for Table 2.

populations, different elicitation methods, and variation in the health state descriptions. A recent survey of 1000 utility estimates also included several articles in which utilities of stroke assigned by experts were reported.[13] We deliberately chose not to include such utilities.

Study Population

Whereas the utility of major stroke assigned by healthy participants was fairly similar to that assigned by patients at risk for stroke, stroke survivors generally assigned higher utilities. It is a common finding that patients actually experiencing an impaired health state evaluate it higher than other people. This is generally explained by psychological processes such as coping and adaptation.[14] Moreover, since severely ill patients cannot be included in studies assessing utilities, the utility of stroke may be spuriously increased if assigned by stroke survivors because of selection bias.

In 2 studies, stroke survivors also assigned higher utilities to hypothetical stroke states than healthy participants[9] or subjects at risk for stroke.[15] In contrast, Adar et al[11] observed fairly similar utilities for stroke survivors and healthy participants.

There have been many debates on which group of subjects should be used to elicit utilities for various decisions. Patients who have experienced stroke know best what life after stroke entails. They are, however, not the people facing the decisions regarding stroke. Gold et al[8] suggested that utilities to be used in cost-effectiveness analyses from the societal perspective are best elicited from the general public because policy decisions concern the money of the general public. They suggested that utilities for clinical decisions are better inferred from patients. In the latter case, patients at risk are most similar to patients at the moment of decision; hence, if such similarity is deemed important, the utilities of patients at risk for stroke may be deemed most appropriate.

Elicitation Method

In general, it has been found that SG scores are higher than TTO scores, which in turn are higher than VAS scores.[16] Our results are in agreement with this general finding. Two studies elicited utilities from the same study populations by 2 different methods. Hallan et al[9] observed the highest utility for SG (0.61), followed by TTO (0.51) and VAS (0.31). Gage et al[17] observed a higher utility for major stroke when elicited by SG (0.26) than by TTO (0.11).

An explanation for these findings may be as follows. The SG method is prone to a number of biases, such as probability transformation, which can lead to large overestimations.[18] The method is also cognitively demanding. VAS scores do not relate to tradeoffs and decisions and hence are less valid for decision making. TTO scores do not consider risk or discounting but are not prone to extreme biases. For these reasons the TTO scores are presently most frequently used in medical decision making, and we also recommend their use.

Health State Descriptions

It is likely that variations in health state descriptions play a role in the variation between the reported utilities because various definitions were used to describe minor or major stroke. Moreover, if specific negative aspects of stroke are explicitly included in the definition, participants tend to judge this health state as less desirable. Adar et al[11] reported a lower utility when aphasia was included in the description of major stroke (in addition to hemiplegia). Solomon et al[12] observed a paramount aversion to a severe motor impairment. A severe cognitive deficit also elicited a negative utility, and a severe language deficit received a utility of just above zero.

The utility of major stroke obtained by completion of the EuroQol was lower than that reported by studies that used healthy participants to elicit utilities. It was also lower than the utility obtained when the EuroQol was completed by stroke survivors in 1 study.[1] For minor stroke, the utility was fairly similar to that elicited from healthy participants or patients at risk for stroke. Unfortunately, some items (eg, anxiety/depression) could not be scored unambiguously.[6] We solved this problem by entering the extreme values in the range (including the score for "I am not anxious or depressed" and the score for "I am extremely anxious or depressed"), after which the utility of major stroke ranged from −0.30 to 0.20. It has been shown that EuroQol is a valid measure of health-related quality of life after stroke and is able to discriminate between various stroke states.[19] The most likely explanation of the discrepancy may be that anxiety, depression, and pain or discomfort were not included in the health state descriptions of the included studies assessing utilities directly. Only Bosworth et al[20] stratified their study population according to the presence of depression. Depressed stroke survivors assigned a mean utility of 0.61 to their health state compared with 0.79 for nondepressed patients. Emotional disorders such as depression are frequently present in the year after stroke.[21] Therefore, inclusion of depression in the description of a health state after major stroke should be considered.

Conclusions

As argued before, TTO utilities may be least prone to biases, and utilities for clinical decision analyses may be best elicited from patients at risk.[8] These observations imply that a utility of 0.55 is reasonable for minor stroke and a utility of 0.25 is reasonable for major stroke. For cost-effectiveness analyses from the societal perspective, Gold et al[8] argue that utilities should be elicited from the general public, preferably a health state classification system, such as HUI or EuroQol. Since the EuroQol is based on the TTO, a utility between 0.60 and 0.70 seems reasonable for minor stroke, while a utility between 0 and 0.30 should be considered for major stroke. If a very severe stroke state (including a severe motor and language deficit) is to be included in the analysis, a utility of zero or below zero could be considered.

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