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Review Article

Quality of life of adult congenital heart disease patients: a systematic review of the literature

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Abstract *Aims:* This review explores the quality of life of adult congenital heart disease patients and the relationship between disease severity and quality of life. *Methods:* We searched seven electronic databases and the bibliography of articles. The 31 selected studies fulfilled the following criteria: adult population; quantitative; assessment of quality of life and/or impact of disease severity on quality of life using validated measures; English language. Data extraction forms were used to summarise the results. *Results:* There are evident methodological limitations within the reviewed studies such as heterogeneous populations, designs, and quality of life conceptualisations and measurements. Despite these problems, findings suggest that the quality of life of adult congenital heart disease patients is compromised in the physical domain compared with their healthy counterparts, whereas no differences were found in relation to the psychosocial and environmental/occupational domain. Some severity variables appear to be significant correlates of quality of life and could be considered in a future standardised classification of disease severity. *Conclusion:* The methodological limitations of past research in relation to the definition and measurement of quality of life, the study designs, and disease severity classifications need to be addressed in future studies in order to provide robust evidence and valid conclusions in this area of study. This will enable the development of targeted interventions for the improvement of quality of life in the adult population of congenital heart disease patients.

Keywords: Quality of life; congenital heart disease; adult; adults with congenital heart disease; GUCH; severity

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Approximately eight in 1000 children are born with congenital heart disease, with approximately two-thirds requiring treatment. Owing to advances in treatment, ~90% are now expected to survive into adulthood compared with 20% 50 years ago.[1] This has resulted in an estimated current population of 135,000 adult congenital heart patients in England.[2]

Traditionally, the outcome in congenital heart disease has been measured in terms of mortality and functional status. There is an increasing recognition that reliance on clinical measures in determining outcomes is not sufficient as it fails to capture the patients' perspective.[3] Consequently, interest has turned to examining the quality of life of adult congenital heart disease patients. Although a universally accepted definition of quality of life does not exist, it is usefully conceptualised in three broad domains, namely, physical, psychosocial, and environmental.

Research suggests that adult patients with congenital heart disease, like other patients with chronic conditions, are faced with physical health issues and psychosocial challenges.[4] A clear perspective of the evidence on adult congenital heart disease patients' quality of life is lacking. In order to clarify evidence regarding the quality of life of adult congenital heart disease patients, a systematic review of the literature was conducted. The purpose of the systematic review was fourfold:

- Describe the quality of life of adult patients with congenital heart disease.

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- Examine the evidence on the relationship between disease severity variables and quality of life.
- Identify the quality of the existing literature.
- Suggest areas for future investigations.

Methodology

In all, seven electronic databases – Science Direct, Pubmed, PsycInfo, Amed, Embase, CINAHL Plus, and Medline – were searched (see Supplementary Figure S1). Owing to the fact that the research domain is relatively new, a start date criterion was not applied in the search, and all relevant articles published until November, 2011 were reviewed. A language criterion was applied as the team could only review articles written in the English language. Initial search terms used were specific, for example "quality of life AND GUCH", but as the search did not retrieve many relevant articles it was broadened by using various word combinations, that is, *("quality of life" OR "life satisfaction" OR "well being") AND (GUCH OR ACHD OR congenital heart disease OR congenital cardiac disease OR congenital heart defect OR congenital cardiac defect)*. Where the search yielded too many results, additional filter terms were used, for example *AND adult*. In all, 31 articles met the following inclusion/exclusion criteria, including three identified from the reference lists.

Exclusion criteria

- Qualitative studies.
- Sample solely consisting of Marfan syndrome patients.
- Abstract quality of life measures, for example non-validated single-item measures or question sets.
- Study of the effects of individual psychosocial variables, for example anxiety, depression, coping, on quality of life.
- Reviews and meta-analyses.
- Opinion articles, commentaries, and reports.

Inclusion criteria

- Quantitative studies.
- Adult congenital heart disease patients.
- Intention to measure quality of life concept.
- Quality of life description and/or how disease severity variables influence quality of life.
- Validated measures of quality of life.
- English language.

These studies were reviewed by means of data extraction forms (see Supplementary Table S1).

Results

A total of 31 studies were reviewed; 26 examined the patients' quality of life in comparison with the general population and 22 examined the relationship of disease variables with quality of life.

Demographics and methodology

The number of participants ranged from 22 to 912, age ranged from 14 to 85 years, and gender was roughly balanced (see Table 1). The majority of the studies (23/31) included patients with a range of diagnoses, seven included patients with a single diagnosis, and one categorised patients in terms of the treatment they received. Most studies had a cross-sectional design, with two out of 31 studies using a longitudinal design. All but four studies included a comparison group of either normative data or matched controls.

Quality of life assessment

A variety of quality of life instruments were used (Table 1). Generic instruments included the Short Form-36 Health Survey (SF-36, 17 studies), TNO-AZL (TAAQOL, four studies), Sickness Impact Profile (SIP, two studies), Brief World Health Organisation Quality of Life assessment (WHOQOL-Bref, two studies), Duke Health Profile (one study), and Subjective Quality of Life (SQoL, one study). Single-item generic quality of life was assessed by the Linear Analogue Scale (LAS, one study) and Satisfaction with Life Scale (SWLS, one study). Disease-specific and individual measures included the TNO-AZL Congenital Heart Disease version (CHD-TAAQOL, two studies) and the Schedule for the Evaluation of Individual Quality of Life-Direct Weighting (SEIQoL-DW, one study), respectively.

The heterogeneous nature of the measures hinders the combination of findings. For the purpose of describing the findings, the scales or sub-scales of each instrument were categorised into three broad domains, that is, physical, psychosocial, and environmental/occupational quality of life (see Supplementary Table S2). These domains included all relevant scales from the instruments that were measured in two or more studies.

Quality of life in adult congenital heart disease patients

Table 2 presents the findings of 26 studies that compared the quality of life of adult congenital heart disease patients with the general healthy population.

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Table 1. Demographic and methodological details of the studies.

Study	Design	Sample	Comparison group	QoL measure
Bol Raap et al (2007)[5]	Retrospective 13 years follow-up (QoL cross-sectional)	n = 28 (follow-up n = 25) Mean age (at surgery): 34 (19–50) Gender: 15 male, 13 female Diagnosis: all VSD	Normative data n = 4410	TAAQOL
van den Bosch et al (2004)[6]	Cross-sectional	n = 22 for QoL assessment (total n = 36) Mean age (at operation): 12 (2–34) Gender: 18 male, 18 female Diagnosis: 21 TA, 9 DILV, 6 other	Normative data	SF-36
Bruto et al (2007)[7]	Prospective (cross-sectional)	n = 912 Mean age: 30 (±11) Gender: 474 male, 438 female Diagnosis: obstructive lesions (79 COA, 67 AS), shunt lesions (99 VSD, 55 ASD, 45 AVSD), 9 complex acyanotic, complex cyanotic (169 TOF, 87 TGA) and other	Normative data	SF-36
Chen et al (2011)[8]	Prospective (cross-sectional)	n = 289 Mean age: 33.2 (±10.6) Gender: 105 male, 184 female Diagnosis: 86 ASDII, 64 VSD, 60 TOF*	Controls age- and gender-matched	WHOQOL-Bref-Taiwan
Cohen et al (2010)[9]	Cross-sectional	n = 27 Mean age: 68.6 (±5.7, 60–87) Gender: 10 male, 17 female Diagnosis: all ASDII	Controls age- and gender-matched n = 27 Mean age: 69.9 (±8.2, 60–78) Gender: 10 male, 17 female	CHD-TAAQOL Only symptoms subscale
Daliento et al (2005)[10]	Cross-sectional	n = 54 Mean age: 32 (±4) Gender: 24 male, 30 female Diagnosis: all TOF	Normative data	SF-36
Ebenroth and Hurwitz (2007)[11]	Longitudinal 10 years follow-up	n = 35 Mean age: 25.4 (19–37) Gender: 23 male, 12 female Diagnosis: all TGA	Normative data	SF-36 Only physical component

Table 1. *Continued*

Study	Design	Sample	Comparison group	QoL measure
Gratz et al (2009)[12]	Cross-sectional	n = 564 Median age: 24 (14–37) Gender: 309 male, 255 female Diagnosis: 32 cyanotic, 31 Fontan circulation, 98 TGA with arterial switch, 38 TGA no arterial switch, 96 TOF, 47 Ebstein anomaly, 33 PS/PR, 66 left heart obstruction AS/COA, 62 isolated shunt, 61 other	Normative data and controls n = 53 Median age: 25 (14–57) Gender: 33 male, 18 female	SF-36
Hager and Hess (2005)[13]	Prospective (cross-sectional)	n = 149 Median age: 23.8 (14–59.8) Gender: 89 male, 60 female Diagnosis: 13 SV, 47 TGA, 9 CCTGA, 32 TOF, 7 COA, 3 AS, 6 PS, 7 Ebstein's anomaly, 5 VSD, 3 ASD, 14 other	Normative data	SF-36
Immer et al (2005)[14]	Cross-sectional	n = 233 (QoL-n = 154) Mean age: 35 (±16) Gender: n/a Diagnosis: 125 ASD, 34 AVD/PVD, 21 COA, 17 TOF/TGA (cyanotic), 7 CAVCD	Normative data Age- and gender-matched	SF-36
Irtel et al (2005)[15]	Cross-sectional	n = 67 Median age: 25 (16–62) Gender: 39 male, 28 female Diagnosis: 32 TGA, 35 TOF	Normative data Age- and gender-matched	SF-36
Jefferies et al (2004)[16]	Cross-sectional	n = 32 Mean age: 27 (±9) Gender: 15 male, 17 female Diagnosis: 17 acyanotic (3 ASD, 2 MVP, 2 Marfan, 3 VSD, 3 AS, 2 COA, 2 PS) and 15 cyanotic (4 TOF, 3 TGA, 5 SV, 2 Down syndrome, 1 TA)	Normative data from two studies age-matched	SF-36
Kamphuis et al (2002a)[17]	Cross-sectional	n = 82 with mild CHD Mean age: 24.6 (17–32) Gender: 31 male, 51 female Diagnosis: 20 VSD, 7 PS, 6 ASD, 6 AS, 3 BAV, 2 APVD, 1 MVP, 37 spontaneous resolution	Controls n = 361 (SF-36) n = 831 (TAAQOL)	TAAQOL
Kamphuis et al (2002b)[18]	Cross-sectional	n = 78 with complex CHD Mean age: 24.3 (18–32) Gender: 44 male, 34 female Surgery type: 39 SRV, 23 conduit or MP, 11 SV, 5 POS	Controls age- and gender-matched n = 361 (SF-36) n = 831 (TAAQOL)	TAAQOL

Table 1. *Continued*

Study	Design	Sample	Comparison group	QoL measure
Lane et al (2002)[19]	Cross-sectional	n = 276 Median age: 31 (16–85) Gender: 41.7% male, 58.3% female Treatment groups: 68 SC, 105 SCor, 23 SP, 70 ME, 10 IO	Normative data	SF-36
Loup et al (2009)[20]	Cross-sectional	n = 153 Mean age: 26 (±11) Gender: 94 male, 59 female Diagnosis: 43 TOF, 59 TGA, 51 VSD	Normative data age- and gender-matched	SF-36
Lu et al (2010)[21]	Cross-sectional	n = 62 Median age: 28.5 (14–69) Gender: 37 male, 25 female Diagnosis: all TOF	Normative data	SF-36
Mokhles et al (2011)[22]	Cross-sectional	n = 509 Mean age: 19 (0–66) (SF-36 ≥14 years) Gender: 301 male, 208 female Diagnosis: 170 AVP, 152 TOF, 63 PA/PS or VSD, 51 DVAC with PA or PS, 26 CAT, 26 PA/PS with IS, 3 AA with BH	Normative data	SF-36
Moons et al (2004)[23]	Cross-sectional	n = 89 Median age: 24 (20–26.5) Gender: 52 male, 37 female Diagnosis: 76.4% simple TGA, 23.6% complex TGA	n/a	LAS, SWLS and CHD-TAAQOL for determinants of QoL
Moons et al (2005)[24]**	Cross-sectional	n = 629 Median age: 24 (18–66) Gender: 378 male, 251 female Diagnosis: 112 TOF, 108 VSD, 89 COA, 65 AS, 48 PS, 37 TGA, 170 other	n/a	LAS, SWLS and SEIQoL-DW
Moons et al (2006)[25]**	Cross-sectional	n = 404 Median age: 13 (18–56) Gender: 221 male, 183 female Diagnosis: 79 VSD, 68 TOF, 62 COA, 42 AS, 31 PS, 20 TGA, 17 mixed AVD, 17 ASDII, 15 MIn, 12 SV, 7 DORV, 34 other	Controls age- and gender-matched n = 404 Median age: 23 (18–58) Gender: 221 male, 183 female	LAS, SWLS and CHD-TAAQOL for determinants of QoL
Muller et al (2010)[26]	Cross-sectional	n = 58 Median age: 27.9 Gender: 28 male, 30 female Diagnosis: 23 PS group (9 DILV, 5 TGA, 5 CC TGA + VSD, 1 TA, 1 PA, 1 HLHS, 1 AVSD), 35 ES group (21 VSD, 9 ASD, 6 AVSD)	Normative data	SF-36

Table 1. *Continued*

Study	Design	Sample	Comparison group	QoL measure
Rietveld et al (2002)[27]	Cross-sectional	n = 82 Mean age: 30.2 (17–77) Gender: 40 male, 42 female Diagnosis: 13 mild CHD (small VSD, ASDII, mild PVS), 44 moderate (COA, TOF, AS), 25 severe (Fontan, Rastelli, Mustard, IO)	n/a	SF-36
Rose et al (2005)[28]	Cross-sectional	n = 111 Mean age: 33 (±12) Gender: 56 male, 55 female Diagnosis: 21 TOF, 16 ASD, 12 VSD, 11 AS, 10 COA, 7 TGA, 6 AIn, 5 PR, 4 PDA, 4 ES, 15 other	Normative data	WHOQOL-Bref and GBB
Saliba et al (2001)[29]	Cross-sectional	n = 67 Enrolled = 89 Mean age: 22.7 (17–49) Gender: 42 male, 47 female Diagnosis: 35 TA, 13 MA, 24 DIV, 17 other	Normative data	Duke Heart profile
Simko and McGinnis (2003)[30]**	Cross-sectional, case–control	n = 124 Mean age: 26.4 Gender: 54 male, 70 female Diagnosis: 23 TOF, 21 VSD, 11 COA, 20 TGA, 6 SV, 12 ASD, 7 TA, 10 AS, 14 PS	Controls age-, gender-, race- and socio-economic status-matched n = 124 Mean age: 26.5 Gender: 54 male, 70 female	SIP
Simko and McGinnis (2005)[31]**	Cross-sectional	n = 124 Mean age: 26 (±8.5) Gender: 54 male, 70 female Diagnosis: cyanotic (23 TOF, 20 TGA, 6 SV, 7 TA) and acyanotic (21 VSD, 11 COA, 12 ASD, 10 AS, 14 PS)	Controls age- and gender-matched n = 124 Mean age: 26.5 Gender: 54 male, 70 female	SIP
Ternestedt et al (2001)[32]	Longitudinal (20 and 30 years post surgery)	n = 26 Mean age: 28.7 (30 years: 38.7) Gender: 15 male, 11 female Diagnosis: 12 TOF, 14 ASD***	n/a	SQoL
Vandekerckhove et al (2009)[33]	Cross-sectional	n = 39 Median age: 19.9 (15.8–28.1) Gender: 29 male, 10 female Diagnosis: 24 simple TGA, 7 TGA + VSD, 4 Taussig–Bing anomaly, 4 TGA/VSD with AO	Normative data	TAAQOL
Winter et al (2008)[34]	Cross-sectional	n = 47 Mean age: 35 (21–69) Gender: 20 male, 17 female Diagnosis: all SRV (31 TGA, 16 CCTGA)	Normative data age- and gender-matched	SF-36

Table 1. *Continued*

Study	Design	Sample	Comparison group	QoL measure
Winter et al (2010)[35]	Cross-sectional	n = 133 Mean age: 38 (18–75) Gender: 69 male, 64 female Diagnosis: 43 COA, 42 TGA, 36 Marfan, 12 ES	Normative data age- and gender-matched	SF-36

AA = aortic atresia; AIn = aortic insufficiency; AO = arch obstruction; APVD = abnormal pulmonary venous drainage; AS = aortic stenosis; ASD = atrial septal defect; ASDII = secundum ASD; AVD = atrial valve diseases; AVP = aortic valve pathology; AVSD = atrioventricular septal defect; BAV = bifoliate aortic valve; BH = biventricular heart; CAT = common arterial trunk; CAVCD = complete atrioventricular canal defect; CCTGA = congenitally corrected TGA; CHD-TAAQOL = congenital heart disease-TAAQOL; COA = coarctation of the aorta; DILV = double-inlet left ventricle; DIV = double-inlet ventricle; DORV = double-outlet right ventricle; DVAC = discordant ventriculoarterial connection; ES = Eisenmenger syndrome; GBB = Giessener Complaints Questionnaire; HLHS = hypoplastic left heart syndrome; IO = inoperable; IS = intact septum; LAS = Linear Analogue Scale; MA = mitral atresia; ME = medical; Min = mitral insufficiency; MP = mechanical prosthesis; MVP = mitral valve prolapse; PA = pulmonary atresia; PDA = patent ductus arteriosus; POS = palliative operation shunt; PR = pulmonary regurgitation; PS = pulmonary stenosis; PVD = pulmonary valve diseases; PVS = pulmonary valve stenosis; SC = surgically cured; SCor = surgically corrected; SEIQoL-DW = schedule for the evaluation of individual QoL-direct weighting; SF-36 = Short Form-36; SIP = sickness impact profile; SP = surgically palliated; SQoL = subjective quality of life; SRV = systemic right ventricle; SV = single ventricle; SWLS = Satisfaction With Life Scale; TA = tricuspid atresia; TAAQOL = TNO-AZL Questionnaire for adult's health-related quality of life; TGA = transposition of the great arteries; TOF = tetralogy of Fallot; VSD = ventricular septal defect; WHOQOL-Bref = World Health Organization Quality of Life-Bref.
*Only conditions diagnosed in more than 10% of the sample were listed and compared
**Studies with common sample
***Diagnostic groups age- and gender-matched at operation and follow-up

Physical domain. Of the 22 studies, 17 reported poorer physical functioning, whereas five studies reported no differences between the patients and the general population. Risk factors for poorer functioning included younger age,[7,22] female gender,[8] disease severity,[12] and the presence of arrhythmias.[15] In all, eight out of 18 studies found more role limitations due to physical problems, whereas 10 out of 18 studies found no differences between patients and the general population. Risk factors for greater limitations were specific treatment groups, that is, cured, corrected, and inoperable – versus palliated and medical[19] – and arrhythmias.[15] In all, four out of 21 studies reported more pain in patients, 14 out of 21 reported no differences, and three out of 21 reported less pain than the general population. Risk factors for more pain were being inoperable[19] and arrhythmias.[15] In all, 15 out of 21 studies showed poorer general health perception in patients, five found no difference, and one found better general health perception in patients than in the general population. Risk factors were disease severity – cyanosis, Fontan physiology[12] – and arrhythmias.[15] All (2/2) studies reported more symptoms in patients than in controls. There was one (1/4) study that indicated poorer gross motor functioning, whereas three out of four found no difference. All (4/4) studies reported no differences between patients and controls in fine motor functioning. There was one (1/4) study that reported poorer cognitive functioning, whereas three out of four reported no differences between patients and controls. With regard to sleep, two out of five studies reported poorer results for patients, whereas three out of five found no difference.

Psychosocial domain. With regard to this domain, seven out of 23 studies indicated compromised psychological/mental functioning in patients, whereas 16 showed no difference. Risk factors for poorer functioning were female gender,[10] arrhythmias,[15] and specific treatment groups, that is, being inoperable and cured.[19] More role limitations due to emotional problems were reported in two out of 17 studies, less limitations in one out of 17, and no differences in 14 out of 17. Risk factors for more limitations were arrhythmias[15] and being surgically cured.[19] Out of 20 studies, seven indicated lower vitality in patients, whereas 13 showed no difference. Risk factors included arrhythmias[15] and being inoperable and cured.[19] All (4/4) studies indicated no differences in happiness and sexual functioning between patients and controls. In all, two out of 23 studies showed reduced social functioning in patients, whereas 21 out of 23 showed no differences. Risk factors

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Table 2. Quality of life in adult congenital heart disease patients in relation to the comparison group.

	Physical QoL									Psychosocial QoL						Environmental/ occupational QoL
	Physical functioning	Role physical	Pain	General health	Symptoms	Gross motor functioning	Fine motor functioning	Cognitive functioning	Sleep	Psychological/ mental health	Role emotional	Vitality	Happiness	Sexual functioning	Social functioning	Environment and daily activities
Bol Raap et al (2007)[5]			=			=	=	↓	↓	=		=	=	=	=	=
van den Bosch et al (2004)[6]	↓	↓	=	↓						↓	=	=			=	
Bruto et al (2007)[7]	↓	=	↑	↓						=	=	=			=	
Chen et al (2011)[8]	↓									↓					=	↑
Cohen et al (2010)[9]					↓											
Daliento et al (2005)[10]	↓	=	=	=						=	=	=			=	
Ebenroth and Hurwitz (2007)[11]	↓	=	=	↓								↓			=	
Gratz et al (2009)[12]	↓	=	=	↓						=	=	=			=	
Hager and Hess (2005)[13]	↓	=	=	↓						=	=	↓			=	
Immer et al (2005)[14]	=	=	=	=						=	=	=			=	
Irtel et al (2005)[15]	↓	↓	↓	↓						↓	↓	↓			↓	
Jefferies et al (2004)[16]	↓	↓	=	↓						=	=	=			=	
Kamphuis et al (2002a)[17]	=	=	=	=		=	=	=	=	=	=	=	=	=	=	=
Kamphuis et al (2002b)[18]	↓	↓	=	↓		↓	=	=	=	=	=	↓	=	=	=	=
Lane et al (2002)[19]	↓	↓	↓	↓						↓	↓	↓			↓	
Loup et al (2009)[20]	=	=	=	=						=	=	=			=	
Lu et al (2010)[21]	=	=	↓	↓						=	=	=			=	
Mokhles et al (2011)[22]	↓	=	↑	↓						=	↑	=			=	
Moons et al (2006)[25]				↑												
Muller et al (2010)[26]	↓	↓	=	↓						=	=	↓			=	
Rose et al (2005)[28]	↓			↓	↓					↓					=	
Saliba et al (2001)[29]	=		=	=						=					=	
Simko and McGinnis (2003)[30]	↓								↓	↓						↓
Vandekerckhove et al (2009)[33]			=			=	=	=	=	↓		↓	=	=	=	=
Winter et al (2008)[34]	↓	↓	↑	↓						=	=	=			=	
Winter et al (2010)[35]	↓	↓	↓	↓						=	=	=			=	
Total	17↓	8↓	4↓	15↓	2↓	1↓	4=	1↓	2↓	7↓	2↓	7↓	4=	4=	2↓	1↓
	5=	10=	14=	5=		3=		3=	3=	16=	14=	13=			21=	4=
			3↑	1↑							1↑					1↑

↓ = poorer QoL; ↑ = better QoL; = = similar QoL (in relation to controls); blank = not measured; QoL = quality of life

included arrhythmias[15] and being inoperable, cured, or corrected.[19]

Environmental/occupational domain. Out of six studies, one reported more disability in environment and daily activities in patients, four showed no difference, and one indicated better environmental circumstances compared with the controls.

Disease severity and quality of life

In all, 22 studies examined the association between disease severity variables and quality of life (see Table 3).

Cyanosis. In all, six out of nine studies reported poorer quality of life in cyanotic patients, mainly in physical quality of life, that is, physical functioning and general health, whereas three showed no difference.

Diagnosis. Of the seven studies assessing quality of life by diagnosis, only one study[34] reported better quality of life in the severe group, for example tetralogy of Fallot, than the structurally simpler group, for example atrial septal defect, whereas the majority (6/7) reported diminished quality of life in the more complex diagnoses, for example single ventricle, Fontan, Marfan syndrome, mainly in relation to physical and environmental quality of life.

Exercise capacity. Of the six studies, five reported an association between exercise capacity as measured by peak oxygen uptake (VO_2) and physical quality of life that is, physical functioning, general health, whereas one found no association.

Functional status. In all, four out of seven studies found an association between functional status – New York Heart Association, Ability, Warnes & Somerville Indexes – and quality of life, that is, physical functioning, environmental, whereas three out of seven found no association.

Ventricular dysfunction. Ventricular dysfunction was not found to be associated with quality of life in four out of five studies, whereas one study reported an association with physical quality of life.

Arrhythmias. Out of four studies, two reported an association between arrhythmias and quality of life – general health, role limitations due to emotional problems – whereas two studies found no association.

Treatment type. Of the two studies assessing quality of life by treatment type, one reported better quality of life in patients who were treated with recent surgical techniques, that is, recent arterial switch versus Mustard & Senning. Contrary to expectations, the second study reported that "cured" (curative surgery) patients have poorer quality of life, that is, mental health, social functioning, than patients with corrections, that is, further operation possibility, and medical patients, that is, no surgery. Palliated – further operation possibility – and medical patients were similar. Inoperable patients had poorer quality of life than all groups except for similar social functioning and vitality to "cured" patients.

Severity. Few of the above and other studies categorised disease severity in different ways (see Table 4). In all, four out of eight studies reported significant associations between severity – assessed by diagnosis, objective physical index, cyanosis – and mainly physical quality of life and four reported no association, the latter measured severity by diagnosis.

Discussion

The first objective of this review was to investigate the quality of life of adult congenital heart disease patients. The pattern of results indicated that there is strong evidence that adult patients with congenital heart disease experience reduced quality of life in the physical domains, that is, reduced physical functioning, poorer general health, and more symptoms than the general population. These conclusions are similar to a previous literature review.[36] Although these findings are likely to reflect the position of adult congenital heart disease patients, it raises an important issue regarding expectations. Given that quality of life is patient-reported, it is possible that the findings may reflect a perceived lack of understanding, leading patients to develop unrealistic expectations and misconceptions about their physical functioning. An unclear disease course may leave patients feeling uncertain and insecure about their condition and prognosis.[37] Although predicting a clear prognosis is difficult, it may be important to review the information that is provided by healthcare professionals to patients.

It is also important that in some domains of physical quality of life, for example, pain, sleep, gross/fine motor functioning, as well as psychosocial and environmental/occupational quality of life, results indicated that patients are not different from the healthy population. The finding of no impact on psychosocial functioning in the adult patients with congenital heart disease has a number of potential explanations. One is patients having a strong sense of coherence about their condition because growing up with congenital heart disease made them understand, manage, and find meaning in their experiences.[38] Another possible explanation is change in internal standards, values, and priorities,[39] that is, response shift. Patients may develop different internal health values from healthy individuals.[40] In one of the reviewed studies,[7] younger patients reported poorer quality

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Table 3. Associations between severity variables and quality of life.

	Physical QoL									Psychosocial QoL						Environmental/ occupational QoL
	Physical functioning	Role physical	Pain	General health	Symptoms	Gross motor functioning	Fine motor functioning	Cognitive functioning	Sleep	Psychological/ mental health	Role emotional	Vitality	Happiness	Sexual functioning	Social functioning	Environment and daily activities
Cyanosis																
Bruto et al (2007)[7]	Y	Y	–	Y						Y	–	Y			Y	
Jefferies et al (2004)[16]	Y	Y	–	Y						–	–	Y			–	
Lane et al (2002)[19]	Y	Y	Y	Y						Y	–	Y			Y	
Saliba et al (2001)[29]	Y		–	–						–					–	
Gratz et al (2009)[12]	Y	–	–	Y						–	–	–			–	
Simko and McGinnis (2005)[31]	–								–	–						Y
Daliento et al (2005)[10]	–	–	–	–						–	–	–			–	
Loup et al (2009)[20]	–	–	–	–						–	–	–			–	
Moons et al (2005)[24]				–												
Diagnosis																
Gratz et al (2009)[12]	–	–	–	Y						–	–	–			–	
Irtel et al (2005)[15]	–	–	–	–						Y	–	Y			–	
Muller et al (2010)[26]	Y	–	–	–						–	–	–			Y	
Saliba et al (2001)[29]	–		–	Y						–					–	
Simko and McGinnis (2005)[31]	Y								Y	Y						Y
Winter et al (2010)[35]	Y	Y	Y	Y						–	–	–			–	
Ternestedt et al (2001)[32]										Y					Y	Y
Exercise capacity																
Gratz et al (2009)[12]	Y	–	–	Y						–	–	–			–	
Hager and Hess (2005)[13]	Y	–	–	Y						–	–	–			–	
Irtel et al (2005)[15]	Y	Y	Y	Y						–	Y	–			–	
Muller et al (2010)[26]	Y	Y	–	Y						–	–	Y			–	
Rose et al (2005)[28]	Y			Y	–					–					–	
Ebenroth and Hurwitz (2007)[11]	–	–	–	–								–			–	
Functional status																
Chen et al (2011)[8]	Y									–					–	Y
Ebenroth and Hurwitz (2007)[11]	Y	Y	–	–								–			–	
Kamphuis et al (2002b)[18]	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	–	Y	Y	Y
Moons et al (2005)[24]				Y												
Rietveld et al (2002)[29]	–	–	–	–						–	–	–			–	
Cohen et al (2010)[9]					–											
Daliento et al (2005)[10]	–	–	–	–						–	–	–			–	
Ventricular dysfunction																
Lu et al (2010)[21]	Y	Y	Y	Y						–	–	–			–	
Moons et al (2005)[24]				–												
Daliento et al (2005)[10]	–	–	–	–						–	–	–			–	
Ebenroth and Hurwitz (2007)[11]	–	–	–	–								–			–	
Irtel et al (2005)[15]	–	–	–	–						–	–	–			–	
Arrhythmias																
Bruto et al (2007)[7]	–	–	–	Y						–	Y	–			–	
Irtel et al (2005)[15]	Y	Y	Y	Y						Y	Y	Y			Y	
Loup et al (2009)[20]	–	–	–	–						–	–	–			–	
Daliento et al (2005)[10]	–	–	–	–						–	–	–			–	
Treatment type																
Loup et al (2009)[20]	–	–	–	Y						Y	–	Y			–	
Lane et al (2002)[19]	Y	Y	Y	Y						Y	Y	Y			Y	

Y = association with QoL; – = no association with QoL; blank = not measured; QoL = quality of life

Table 4. Disease severity and quality of life.

Study	Severity measure	Associations
Bruto et al (2007)[7]	Diagnosis, native cyanosis, surgery type (obstructive, shunt, complex)	No
Moons et al (2004)[23]	Diagnosis (structural complexity)	No
Moons et al (2005)[24]	Diagnosis (Task Force 1: mild, moderate, severe)	No
Rietveld et al (2002)[27]	Diagnosis (cardiologist: mild, moderate, severe)	No
Chen et al (2011)[8]	Diagnosis (Task Force 1: mild, moderate, severe)	Physical QoL
Jefferies et al (2004)[16]	Cyanosis	Physical QoL
Kamphuis et al (2002b)[18]	Cyanosis, arrhythmias, heart failure, residual defects (objective physical index: score 0–4)	Gross motor and cognitive functioning
Simko and McGinnis (2005)[31]	Cyanosis	Work

of life compared with their peers, whereas older patients reported normal quality of life. This may signify redefinition of standards, values, and priorities and modification of quality of life expectations with increasing age. The lack of differences in environmental/occupational quality of life may signify that patients have no problems in work, access to healthcare, or daily activities.

A few studies grouped patients based on various severity factors. The findings indicate no differences in quality of life between the severity groups that used composite severity ratings, suggesting that categorising patients in this way may reflect clinical issues but may mask significant effects of individual severity indicators. For instance, when cyanosis was combined with other factors into a severity classification, it did not associate with quality of life, but when considered independently it was found to associate with most quality of life domains.[9] Considering each variable individually, the severity indicators that were associated with quality of life were diagnosis, cyanosis, exercise capacity, arrhythmias, and functional status. It appears more valuable to assess the independent impact of specific variables and their relation to quality of life, rather than constructing a broader-based categorisation such as severity.

There are numerous methodological issues that are apparent in the research reviewed. One difficulty is that by definition adult congenital heart disease patients as a group will be heterogeneous. This is exacerbated in some studies by the failure to distinguish between different diagnostic categories. Whereas some studies focused on single diagnoses, others included different diagnoses. Bruto et al[7] argued that it is over-simplistic to categorise patients on the basis of initial diagnosis and native anatomy, and that emphasis should be given to disease course and patient characteristics. In general, the heterogeneity makes for large variability and difficulty in comparing studies. Mixed and unexpected findings can also be attributed to methodological weaknesses such as small sample sizes, cross-sectional designs, and different quality of life measures and diagnosis categorisations. Convenience sampling may have increased type II error and selection biases.

The absence of a quality of life definition in the reviewed studies is important because previous studies report that patients distinguish between quality of life – predominantly affected by psychological functioning – and perceived health status – affected by physical functioning.[41] Evidence suggests that quality of life should also be distinguished from health-related quality of life, a term to be used when illness is relevant, but this is not always applied in the literature.[42] A clear definition of quality of life is needed to guide the selection of the most appropriate measures. Moons et al[43] provide a review of methodological problems around quality of life measurement in adult congenital heart disease.

To address these methodological limitations, future studies should include larger patient groups, thus allowing generalisability of the findings. Longitudinal studies will allow investigation of quality of life changes at different time-points and detection of associations between quality of life and its determinants, as well as potential age differences. Sound quality of life conceptualisation and measurement is also suggested. Finally, more research needs to be conducted towards a consensus regarding disease severity classification.

Limitations

The studies' heterogeneity challenged the synthesis and comparison of findings. Application of stricter inclusion criteria, however, would have subsequently limited the number of studies, thus compromising the generalisability of findings. Other psychosocial factors that may influence quality of life, for example coping, anxiety, depression, have not been reviewed,

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as the plethora of evidence suggests the potential for an independent review in this area.

Conclusion

The quality of life of adult patients with congenital heart disease appears to be compromised in physical domains and there are indicative disease severity variables that may be included in a standardised classification system of disease severity. Future research needs to address important methodological limitations of previous studies. Knowledge about the patients' quality of life and the influencing factors can potentially lead to the development of targeted interventions for the improvement of quality of life in the adult population of congenital heart disease patients.

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Supplementary materials

For supplementary material referred to in this article, please visit http://dx.doi.org/10.1017/S1047951112002351

References

1. British Heart Foundation. Adults with congenital heart disease (ACHD). Factfile 09/2004.
2. Department of Health Vascular Programme Team. A commissioning guide for services for young people and adults with congenital heart disease (also known as Grown Ups with Congenital Heart Disease or GUCH). 2006.
3. Skevington SM, Lotfy M, O'Connell KA. The World Health Organization's WHOQOLBREF quality of life assessment: psychometric properties and results of the international field trial. A report from the WHOQOL group. Qual Life Res 2004; 13: 299–310.
4. Kovacs AH, Sears SF, Saidi AS. Biopsychosocial experiences of adults with congenital heart disease: review of the literature. Am Heart J 2005; 150: 193–201.
5. Bol Raap G, Meijboom FJ, Kappetein AP, Galema TW, Yap S-C, Bogers AJJC. Long-term follow-up and quality of life after closure of ventricular septal defect in adults. Eur J Cardiothorac Surg 2007; 32: 215–219.
6. van den Bosch AE, Roos-Hesselink JW, van Domburg R, Bogers AJJC, Simoons ML, Meijboom FJ. Long-term outcome and quality of life in adult patients after the Fontan operation. Am J Cardiol 2004; 93: 1141–1145.
7. Bruto VC, Harrison DA, Fedak PWM. Determinants of health-related quality of life in adults with congenital heart disease. Congenit Heart Dis 2007; 2: 301–313.
8. Chen CA, Liao SC, Wang JK, et al. Quality of life in adults with congenital heart disease: biopsychosocial determinants and sex-related differences. Heart 2011; 97: 38–43.
9. Cohen M, Daniela M, Yalonetsky S, Gagin R, Lorber A. Psychological functioning and health-related quality of life (HRQoL) in older patients following percutaneous closure of the secundum atrial septal defect (ASD). Arch Gerontol Geriatr 2010; 50: e5–e8.
10. Daliento L, Mapelli D, Russo G, et al. Health related quality of life in adults with repaired tetralogy of Fallot: psychosocial and cognitive outcomes. Heart 2005; 91: 213–218.
11. Ebenroth ES, Hurwitz RA. Long-term functional outcome of patients following the Mustard procedure: the next decade of follow-up. Congenit Heart Dis 2007; 2: 235–241.
12. Gratz A, Hess J, Hager A. Self-estimated physical functioning poorly predicts actual exercise capacity in adolescents and adults with congenital heart disease. Eur Heart J 2009; 30: 497–504.
13. Hager A, Hess J. Comparison of health related quality of life with cardiopulmonary exercise testing in adolescents and adults with congenital heart disease. Heart 2005; 91: 517–520.
14. Immer FF, Althaus SM, Berdat PA, Saner H, Carrel TP. Quality of life and specific problems after cardiac surgery in adolescents and adults with congenital heart diseases. Eur J Cardiovasc Prev Rehabil 2005; 12: 138–143.
15. Irtel TA, Vetter C, Stuber T, et al. Impact of arrhythmias on health-related quality of life in adults with congenital cardiac disease. Cardiol Young 2005; 15: 627–631.
16. Jefferies JL, Noonan JA, Keller BB, Wilson JF, Griffith C III. Quality of life and social outcomes in adults with congenital heart disease living in rural areas of Kentucky. Am J Cardiol 2004; 94: 263–266.
17. Kamphuis M, Vliegen HW, Vogels T, et al. The need for cardiac follow-up in adults with mild congenital cardiac disease. Cardiol Young 2002a; 12: 74–478.
18. Kamphuis M, Ottenkamp J, Vliegen HW, et al. Health related quality of life and health status in adult survivors with previously operated complex congenital heart disease. Heart 2002b; 87: 356–362.
19. Lane DA, Lip GYH, Millane TA. Quality of life in adults with congenital heart disease. Heart 2002; 88: 71–75.
20. Loup O, von Weissenfluh C, Gahl B, Schwerzmann M, Carrel T, Kadner A. Quality of life of grown-up congenital heart disease patients after congenital cardiac surgery. Eur J Cardiothorac Surg 2009; 36: 105–111.
21. Lu JC, Cotts TB, Agarwal PP, Attili AK, Dorfman AL. Relation of right ventricular dilation, age of repair, and restrictive right ventricular physiology with patient-reported quality of life in adolescents and adults with repaired tetralogy of Fallot. Am J Cardiol 2010; 106: 1798–1802.
22. Mokhles MM, van de Woestijne PC, de Jong PL, et al. Clinical outcome and health-related quality of life after right-ventricular-outflow-tract reconstruction with an allograft conduit. Eur J Cardiothorac Surg 2011; 40: 571–578.
23. Moons P, De Bleser L, Budts W, et al. Health status, functional abilities, and quality of life after the Mustard or Senning operation. Ann Thorac Surg 2004; 77: 1359–1365.
24. Moons P, Van Deyk K, De Geest S, Gewillig M, Budts W. Is the severity of congenital heart disease associated with the quality of life and perceived health of adult patients? Heart 2005; 91: 1193–1198.
25. Moons P, Van Deyk K, De Bleser L, et al. Quality of life and health status in adults with congenital heart disease: a direct comparison with healthy counterparts. Eur J Cardiovasc Prev Rehabil 2006; 13: 407–413.
26. Muller J, Hess J, Hager A. Exercise performance and quality of life is more impaired in Eisenmenger syndrome than in complex cyanotic congenital heart disease with pulmonary stenosis. Int J Cardiol 2010; 150: 177–181.
27. Rietveld S, Mulder BJM, van Beest I, et al. Negative thoughts in adults with congenital heart disease. Int J Cardiol 2002; 86: 19–26.

28. Rose M, Köhler K, Köhler F, Sawitzky B, Fliege H, Klapp BF. Determinants of the quality of life of patients with congenital heart disease. Qual Life Res 2005; 14: 35–43.
29. Saliba Z, Butera G, Bonnet D, et al. Quality of life and perceived health status in surviving adults with univentricular heart. Heart 2001; 86: 69–73.
30. Simko LC, McGinnis KA. Quality of life experienced by adults with congenital heart disease. AACN Adv Crit Care 2003; 14: 42–53.
31. Simko LC, McGinnis KA. What is the perceived quality of life of adults with congenital heart disease and does it differ by anomaly? JCN 2005; 20: 206–214.
32. Ternestedt B-M, Wall K, Oddsson H, Riesenfeld T, Groth I, Schollin J. Quality of life 20 and 30 years after surgery in patients operated on for tetralogy of Fallot and for atrial septal defect. Pediatr Cardiol 2001; 22: 128–132.
33. Vandekerckhove KDHM, Blom NA, Lalezari S, Koolbergen DR, Rijlaarsdam MEB, Hazekamp MG. Long-term follow-up of arterial switch operation with emphasis on function and dimensions of left ventricle and aorta. Eur J Cardiothorac Surg 2009; 35: 582–588.
34. Winter MM, Bouma BJ, van Dijk APJ, et al. Relation of physical activity, cardiac function, exercise capacity, and quality of life in patients with systemic right ventricle. Am J Cardiol 2008; 102: 1258–1262.
35. Winter MM, Reisma C, Kedde H, et al. Sexuality in adult patients with congenital heart disease and their partners. Am J Cardiol 2010; 106: 1163–1168.
36. van Rijen EHM, Utens EMWJ, Roos-Hesselink JW, et al. Longitudinal development of psychopathology in an adult congenital heart disease cohort. Int J Cardiol 2005; 99: 315–323.
37. Claessens P, Moons P, de Casterlé BD, Cannaerts N, Budts W, Gewillig M. What does it mean to live with a congenital heart disease? A qualitative study on the lived experiences of adult patients. Eur J Cardiovasc Nurs 2005; 4: 3–10.
38. Moons P, Norekvai TM. Is sense of coherence a pathway for improving the quality of life of patients who grow up with chronic diseases? A hypothesis. Eur J Cardiovasc Nurs 2005; 5: 16–20.
39. Schwartz CE, Sprangers MAG. Methodological approaches for assessing response shift in longitudinal health-related quality-of-life research. Soc Sci Med 1999; 48: 1531–1548.
40. Moons P, van Deyk K, Marquet K, De Bleser L, De Geest S, Budts W. Profile of adults with congenital heart disease having a good, moderate, or poor quality of life: a cluster analytic study. Eur J Cardiovasc Nurs 2009; 8: 151–157.
41. Smith KW, Avis NE, Assmann SF. Distinguishing between quality of life and health status in quality of life research: a meta-analysis. Qual Life Res 1999; 8: 447–459.
42. Pike NA, Evangelista LS, Doering LV, Koniak-Griffin D, Lewis AB, Child AS. Health-related quality of life: a closer look at related research in patients who have undergone the Fontan operation over the last decade. Heart Lung 2007; 36 (1): 3–15.
43. Moons P, van Deyk K, Budts W, De Geest S. Caliber of quality-of-life assessments in congenital heart disease. Arch Pediatr Adolesc Med 2004; 158: 1062–1069.