The Stata Journal

The *Stata Journal* publishes reviewed papers together with shorter notes or comments, regular columns, book reviews, and other material of interest to Stata users. Examples of the types of papers include 1) expository papers that link the use of Stata commands or programs to associated principles, such as those that will serve as tutorials for users first encountering a new field of statistics or a major new technique; 2) papers that go "beyond the Stata manual" in explaining key features or uses of Stata that are of interest to intermediate or advanced users of Stata; 3) papers that discuss new commands or Stata programs of interest either to a wide spectrum of users (e.g., in data management or graphics) or to some large segment of Stata users (e.g., in survey statistics, survival analysis, panel analysis, or limited dependent variable modeling); 4) papers analyzing the statistical properties of new or existing estimators and tests in Stata; 5) papers that could be of interest or usefulness to researchers, especially in fields that are of practical importance but are not often included in texts or other journals, such as the use of Stata in managing datasets, especially large datasets, with advice from hard-won experience; and 6) papers of interest to those who teach, including Stata with topics such as extended examples of techniques and interpretation of results, simulations of statistical concepts, and overviews of subject areas.

The *Stata Journal* is indexed and abstracted by *CompuMath Citation Index*, *Current Contents/Social and Behavioral Sciences*, *RePEc: Research Papers in Economics*, *Science Citation Index Expanded* (also known as *SciSearch*), *Scopus*, and *Social Sciences Citation Index*.

For more information on the *Stata Journal*, including information for authors, see the webpage

http://www.stata-journal.com

Subscriptions are available from StataCorp, 4905 Lakeway Drive, College Station, Texas 77845, telephone 979-696-4600 or 800-STATA-PC, fax 979-696-4601, or online at

http://www.stata.com/bookstore/sj.html

Subscription rates listed below include both a printed and an electronic copy unless otherwise mentioned.

U.S. and Canada		Elsewhere	
Printed & electronic		**Printed & electronic**	
1-year subscription	$115	1-year subscription	$145
2-year subscription	$210	2-year subscription	$270
3-year subscription	$285	3-year subscription	$375
1-year student subscription	$ 85	1-year student subscription	$115
1-year institutional subscription	$345	1-year institutional subscription	$375
2-year institutional subscription	$625	2-year institutional subscription	$685
3-year institutional subscription	$875	3-year institutional subscription	$965
Electronic only		**Electronic only**	
1-year subscription	$ 85	1-year subscription	$ 85
2-year subscription	$155	2-year subscription	$155
3-year subscription	$215	3-year subscription	$215
1-year student subscription	$ 55	1-year student subscription	$ 55

Back issues of the *Stata Journal* may be ordered online at

http://www.stata.com/bookstore/sjj.html

Individual articles three or more years old may be accessed online without charge. More recent articles may be ordered online.

http://www.stata-journal.com/archives.html

The *Stata Journal* is published quarterly by the Stata Press, College Station, Texas, USA.

Address changes should be sent to the *Stata Journal*, StataCorp, 4905 Lakeway Drive, College Station, TX 77845, USA, or emailed to sj@stata.com.

The *Stata Journal* (ISSN 1536-867X) is a publication of Stata Press. Stata, Stata, Stata Press, Mata, Mata, and NetCourse are registered trademarks of StataCorp LP.

The Stata Journal (2015)
15, Number 4, pp. 1060–1074

EORTC QLQ-C30 descriptive analysis with the qlqc30 command

Caroline Bascoul-Mollevi
Biostatistics Unit
CTD INCa, Institut régional du Cancer de Montpellier
Montpellier, France
Caroline.Mollevi@icm.unicancer.fr

Florence Castan
Biostatistics Unit
CTD INCa, Institut régional du Cancer de Montpellier
Montpellier, France

David Azria
Department of Radiation Oncology
Institut régional du Cancer de Montpellier
Montpellier, France

Sophie Gourgou-Bourgade
Biostatistics Unit
CTD INCa, Institut régional du Cancer de Montpellier
Montpellier, France

Abstract. Health-related quality of life is often an endpoint in oncology clinical trials. The European Organization for Research and Treatment of Cancer (EORTC) developed the cancer-specific quality of life questionnaire (QLQ-C30), which includes five functions, nine symptoms, and a global health status. These questionnaires are completed by the patients themselves throughout the process of care. The recommended approaches for processing EORTC QLQ-C30 data are usually descriptive and graphic.

Our aim was to develop a user-written command that provided an automatic descriptive analysis of EORTC QLQ-C30 data, consisting of profile plots per visit and longitudinal plots per functional and symptom scale.

Keywords: dm0084, qlqc30, health-related quality of life, QLQ-C30, functional scale, symptom scale, profile plot, longitudinal plot

1 Introduction

The health-related quality of life (HRQoL) is a multidimensional, subjective, and dynamic concept incorporating at least three domains: physical, psychological, and social functioning. It overlaps the definition of health given by the World Health Organization

in 1948. This concept refers to a patient's perception of his or her treatment and illness, although indirect consequences such as unemployment or financial difficulties are sometimes considered.

HRQoL falls within the scope of "patient-reported outcomes" (Gotay et al. 2008), that is, of measures reported by the subjects themselves. According to the American Society of Clinical Oncology and to the Food and Drug Administration (Beitz, Gnecco, and Justice 1996), when an experimental intervention has no significant effect on overall survival, HRQoL should be considered a second primary endpoint.

The European Organization for Research and Treatment of Cancer (EORTC) has developed the cancer-specific quality of life questionnaire (QLQ-C30) (Aaronson et al. 1993), which consists of five functional scales (physical, role, cognitive, emotional, and social); nine symptom scales (fatigue, pain, nausea and vomiting, dyspnea, loss of appetite, insomnia, constipation, diarrhea, and financial difficulties); and a global health status/quality of life (GHS/QoL). Based on 30 questions in total, the scores range from 0 to 100. This questionnaire was approved and psychometrically validated (as well as each of its translations) for use in oncology clinical trials. Such standardization allows the comparison of results. Generally, the questionnaires are collected at different times predefined in the study protocol according to the EORTC recommendations (Fayers et al. 2001). The EORTC QLQ-C30 is a common basis often supplemented by tumor-specific modules, such as the QLQ-BR23, QLQ-OES18 or QLQ-OG25, and QLQ-PAN26 modules adapted to breast, esophageal, and pancreatic cancers, respectively. These uni- or multi-item scores allow one to indirectly evaluate the patients' quality of life in each dimension.

The EORTC proposed a descriptive and transversal approach for processing QLQ-C30 data. Using Stata, we developed a QLQ-C30-specific command, `qlqc30`, that implements the scoring procedures according to the algorithms recommended by the EORTC (Fayers et al. 2001) and includes descriptive analyses at each measurement time as well as transversal and longitudinal graphics. In section 2, we introduce the scoring procedure recommended by the EORTC. In section 3, we describe the command and present the obtained syntax, options, and outputs. In section 4, we provide an example with results based on data from a clinical trial. In section 5, we conclude.

2 Method

The scoring methodology is mainly based on the observation of scores that are supposed to be close to the "real" score. Therefore, the observed raw score is a direct measurement of the patients' HRQoL and is estimated by the average of the items composing the scale. The standardized score is expressed on a 0-to-100 scale after a linear transformation. Table 1 summarizes the items to be considered in the score calculation for the GHS, the functional, and the symptom scales (QLQ-C30 version 3). Only the five items of the physical functioning (`q1`–`q5`) were modified in the third version of the questionnaire: they switched from dichotomous items (no or yes) in QLQ-C30 version 2 to ordinal items (not at all, a little, quite a bit, or very much) in QLQ-C30 version 3. The command allows both versions of the questionnaire to be considered.

Table 1. GHS, functional, and symptom scales

	Scale	Number of items	Number of levels	Item numbers	Score
Functional scales		high response = low ability			high score = high ability
Physical functioning	PF2	5	4	q1–q5	$X = \left\{ 1 - \dfrac{\left(\frac{1}{n}\sum_{k=1}^{n} I_k\right) - 1}{r} \right\} \times 100$
Role functioning	RF2	2	4	q6, q7	
Emotional functioning	EF	4	4	q21–q24	
Cognitive functioning	CF	2	4	q20, q25	
Social functioning	SF	2	4	q26, q27	
Symptom scales		high response/score = strong symptom			
Fatigue	FA	3	4	q10, q12, q18	
Nausea and vomiting	NV	2	4	q14, q15	
Pain	PA	2	4	q9, q19	
Dyspnea	DY	1	4	q8	
Insomnia	SL	1	4	q11	$X = \dfrac{\left(\frac{1}{n}\sum_{k=1}^{n} I_k\right) - 1}{r} \times 100$
Appetite loss	AP	1	4	q13	
Constipation	CO	1	4	q16	
Diarrhea	DI	1	4	q17	
Financial difficulties	FI	1	4	q28	
GHS		high response/score = high GHS			
GHS/QoL	QL2	2	7	q29, q30	

The EORTC recommends calculating algorithms as follows. We defined n ($n = 1, \ldots, 5$) as the number of items contributing to the scale being considered, $(I_1, \ldots, I_n)$ as the responses to items, and r (item range) as the difference between the possible maximum and the minimum response to individual items (for example, in the case of an item whose responses range from 1 to 4, $r = 4 - 1 = 3$). The score is then equal to $X = [\{(1/n \sum_{k=1}^{n} I_k) - 1\}/r] \times 100$ for symptom and GHS/QoL scales and $X = (1 - [\{(1/n \sum_{k=1}^{n} I_k) - 1\}/r]) \times 100$ for functional scales. For functional scales and GHS/QoL, a high score reflects a high level of functional capacity (physical, role, etc.) or GHS with a good QoL. Conversely, for symptom scales, a high score is the expression of strong symptoms (fatigue, nausea and vomiting, etc.) associated with a poor QoL. Moreover, the scores can be calculated even in the event of missing data. Indeed, if at least half the items are known, the score is valid and becomes the standardized mean of the nonmissing items.

3 Program description

A flowchart describing `qlqc30` is presented in figure 1.

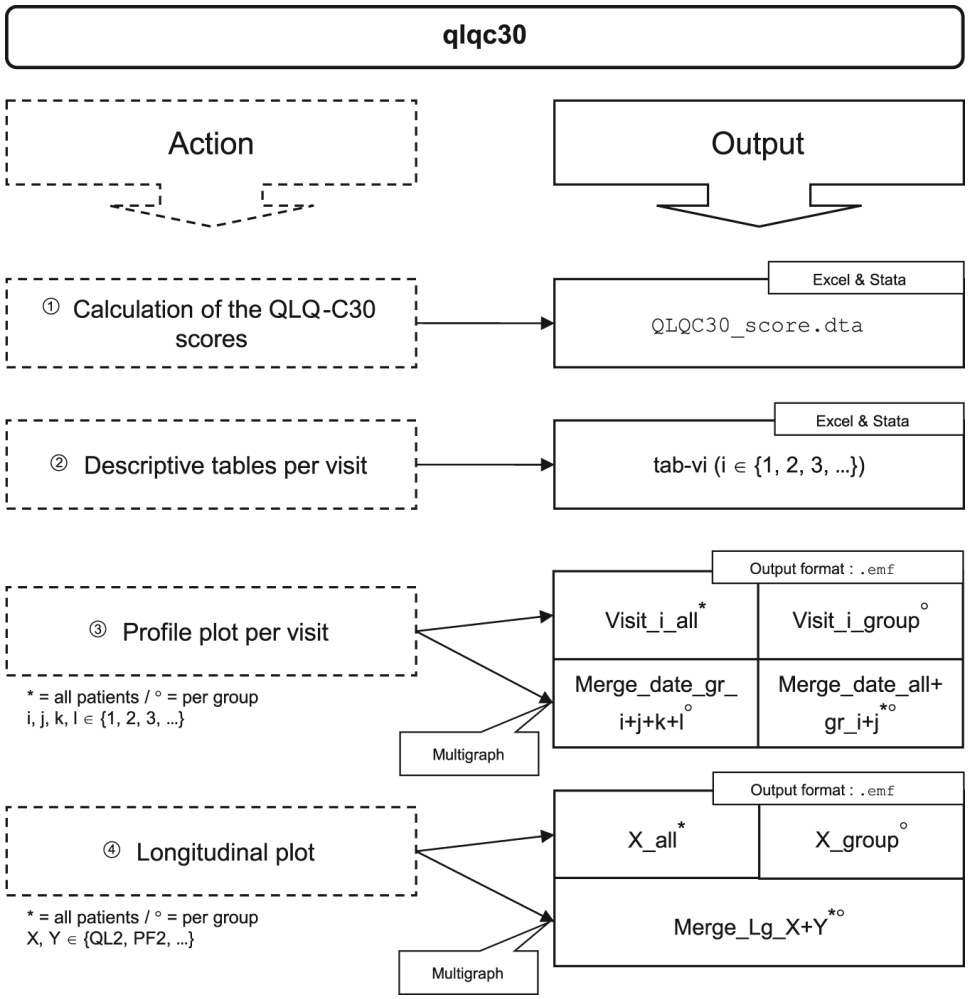

Figure 1. Flowchart describing the `qlqc30` command

The `qlqc30` command performs the following:

- It computes the different QLQ-C30 dimensions and creates a Stata dataset and an Excel file containing the calculated dimensions (named `QLQC30_score.dta` and `QLQC30_score.xls`, respectively).

- It computes the descriptive analysis of all scales for each visit and generates a Stata dataset and an Excel file containing the descriptive results for each visit.
- It displays profile plots (Fayers and Machin 2007) that are a form of transversal presentation particularly useful in HRQoL analyses (all scales are simultaneously presented at one specific visit).
- It displays longitudinal plots that represent the evolution over time of each dimension (the mean score is plotted for each visit with its 95% confidence interval if the number of patients is greater than or equal to 10).

The graphical representations may be performed for all patients or for a specified group, for example, according to the treatment arm.

3.1 Syntax

`qlqc30, filename(`*string*`) version(`*integer*`) grp(`*integer*`)` [`path(`*string*`) table(yes) graph(yes)`]

`filename()` can be personalized, but the file structure should keep the same format. Each line contains an observation per pair patient-visit, whereas the columns contain the following variables:

Variable	Description
`npat`	patient number
`q1`–`q30`	QLQ-C30 items in numerical format: `q1` to `q5` variable values must range from 1 to 2 for the QLQ-C30 version 2 and from 1 to 4 for the QLQ-C30 version 3; `q6` to `q28` variable values must range from 1 to 4; and `q29` and `q30` variable values must range from 1 to 7
`arm`	coded `1` or `2`; coded `2` only if the study comprises two arms and a comparison of those is sought; otherwise, the variable can be present and is always coded `1`
`visit`	number of time units from the beginning of the study. For example, the value of this variable is equal to 0 at baseline, to 3 at three months, etc.

3.2 Options

`filename(`*string*`)` specifies the filename to use. `filename()` is required.

`version(`*integer*`)` specifies the version of QLQ-C30 used, either `2` or `3`. `version()` is required.

`grp(`*integer*`)` specifies `1` for a single-arm study (one group) and `2` for a double-arm study (two groups). `grp()` is required.

`path(`*string*`)` specifies a direct file path.

`table(yes)` specifies that the descriptive tables in the specific subdirectory `Table` be obtained.

`graph(yes)` specifies that the profile and longitudinal plots in the specific subdirectory `Graph` be obtained.

The command does not support missing values in the following variables: `npat`, `arm`, and `visit`. Errors are due to missing data in the previous variables.

3.3 Displayed outputs

The `qlqc30` command displays results such as tables and graphs (only if desired) that are automatically saved in the working subdirectories named `Table` and `Graph`, respectively.

Output datasets (and Excel files), named `tab-v`i`.dta` (and `tab-v`i`.xls`), with i being the number of the described visit, contain the descriptive tables. Each scale is summarized by its mean, standard deviation (SD), median, and range for all patients or per treatment arm. The dimensions between the groups are compared using the Wilcoxon rank-sum test and the Student's t test.

Output profiles and longitudinal graphs are saved under Windows Enhanced Metafile format. Several output multigraphs are also saved; three kinds of combinations are proposed:

- a combination of global and per-group profile graphs for each visit: (`Merge_date_all+gr_i+j.emf`, $i, j \in \{1, 2, 3, \ldots\}$);
- a combination of profile graphs for several consecutive visits: (`Merge_date_gr_i+j+k+l.emf`, $i, j, k, l \in \{1, 2, 3, \ldots\}$); and
- a combination of global and per-group longitudinal graphs for each dimension: (`Merge_Lg_X+Y.emf`, $X, Y \in \{\text{QL2}, \text{PF2}, \ldots\}$).

4 Example

We used the `qlqc30` command to analyze HRQoL data from the CO-HO-RT (concomitant hormono-radio therapy) clinical trial. This trial assessed the acute and late radiation-induced skin toxicities in 150 patients with breast cancer (Azria et al. 2010). After breast-conserving surgery, women were randomly assigned to receive concurrent radiotherapy and letrozole (arm 1, $n = 74$) or sequential radiotherapy and letrozole (arm 2, $n = 75$). QLQ-C30 evaluations were performed before the beginning of the treatment (baseline) and every 3 months over a 24-month period. Baseline compliance with the completion of QLQ-C30 was high: 73 (99%) and 70 (93%) questionnaires were completed in the concurrent and sequential groups, respectively. Thereafter, the compliance for the questionnaire completion decreased over time to reach 81% (60/74) in the concurrent group and 80% (60/75) in the sequential group at 24 months.

Table 2 provides a descriptive analysis of all domains at baseline, globally or per treatment arm. HRQoL at baseline did not differ significantly between the two groups. The results were similar for all the other visits (data not shown).

Table 2. Descriptive analysis of all scales at baseline

		Concurrent group (Arm 1)				
		*N*1	Mean1	SD1	Median1	Range1
GHS						
		73	69.63	(23.67)	75.00	[0,100]
	Missing	0				
Physical functioning						
		73	83.29	(19.72)	100.00	[20,100]
	Missing	0				
Role functioning						
		73	82.65	(26.71)	100.00	[0,100]
	Missing	0				
Emotional functioning						
		73	73.21	(23.42)	75.00	[0,100]
	Missing	0				
Cognitive functioning						
		73	77.85	(24.07)	83.33	[0,100]
	Missing	0				
Social functioning						
		73	89.73	(20.72)	100.00	[0,100]
	Missing	0				
Fatigue						
		73	27.32	(27.12)	22.22	[0,100]
	Missing	0				
Nausea and vomiting						
		73	4.79	(12.87)	0.00	[0,83.33]
	Missing	0				
Pain						
		73	21.00	(26.94)	16.67	[0,100]
	Missing	0				
Dyspnea						
		72	13.89	(24.86)	0.00	[0,100]
	Missing	1				
Insomnia						
		72	36.11	(33.45)	33.33	[0,100]
	Missing	1				
Appetite loss						
		71	9.39	(19.67)	0.00	[0,100]
	Missing	2				
Constipation						
		72	18.52	(29.01)	0.00	[0,100]
	Missing	1				
Diarrhea						
		72	9.26	(17.89)	0.00	[0,66.67]
	Missing	1				
Financial difficulties						
		73	6.85	(20.00)	0.00	[0,100]
	Missing	0				

Continued on next page

		Sequential group (Arm 2)				
		$N2$	Mean2	SD2	Median2	Range2
GHS						
		69	70.77	(23.60)	75.00	[0,100]
	Missing	1				
Physical functioning						
		70	84.50	(17.45)	90.00	[40,100]
	Missing	0				
Role functioning						
		70	84.29	(23.21)	100.00	[0,100]
	Missing	0				
Emotional functioning						
		69	73.35	(22.99)	83.33	[8.33,100]
	Missing	1				
Cognitive functioning						
		69	76.09	(22.59)	83.33	[0,100]
	Missing	1				
Social functioning						
		69	92.75	(15.25)	100.00	[33.33,100]
	Missing	1				
Fatigue						
		69	27.54	(22.84)	33.33	[0,100]
	Missing	1				
Nausea and vomiting						
		70	5.95	(12.70)	0.00	[0,66.67]
	Missing	0				
Pain						
		70	18.81	(25.68)	0.00	[0,100]
	Missing	0				
Dyspnea						
		70	12.86	(20.69)	0.00	[0,100]
	Missing	0				
Insomnia						
		70	32.86	(30.29)	33.33	[0,100]
	Missing	0				
Appetite loss						
		70	7.14	(16.92)	0.00	[0,66.67]
	Missing	0				
Constipation						
		69	15.94	(26.57)	0.00	[0,100]
	Missing	1				
Diarrhea						
		67	6.97	(18.84)	0.00	[0,100]
	Missing	3				
Financial difficulties						
		69	7.73	(22.25)	0.00	[0,100]
	Missing	1				

Continued on next page

		Total					Student's t test	Wilcoxon rank-sum test
		N	Mean	SD	Median	Range	p-value	p-value
GHS							0.775	0.835
		142	70.19	(23.56)	75.00	[0,100]		
	Missing	1						
Physical functioning							0.698	0.886
		143	83.88	(18.59)	100.00	[20,100]		
	Missing	0						
Role functioning							0.697	0.838
		143	83.45	(24.98)	100.00	[0,100]		
	Missing	0						
Emotional functioning							0.972	0.985
		142	73.28	(23.13)	77.78	[0,100]		
	Missing	1						
Cognitive functioning							0.653	0.485
		142	77.00	(23.30)	83.33	[0,100]		
	Missing	1						
Social functioning							0.325	0.673
		142	91.20	(18.27)	100.00	[0,100]		
	Missing	1						
Fatigue							0.959	0.469
		142	27.43	(25.04)	22.22	[0,100]		
	Missing	1						
Nausea and vomiting							0.589	0.526
		143	5.36	(12.76)	0.00	[0,83.33]		
	Missing	0						
Pain							0.619	0.601
		143	19.93	(26.26)	16.67	[0,100]		
	Missing	0						
Dyspnea							0.789	0.856
		142	13.38	(22.83)	0.00	[0,100]		
	Missing	1						
Insomnia							0.545	0.655
		142	34.51	(31.86)	33.33	[0,100]		
	Missing	1						
Appetite loss							0.469	0.593
		141	8.27	(18.33)	0.00	[0,100]		
	Missing	2						
Constipation							0.584	0.749
		141	17.26	(27.78)	0.00	[0,100]		
	Missing	2						
Diarrhea							0.463	0.405
		139	8.15	(18.32)	0.00	[0,100]		
	Missing	4						
Financial difficulties							0.804	0.977
		142	7.28	(21.05)	0.00	[0,100]		
	Missing	1						

Profile plots (figure 2) display all dimensions simultaneously, globally or divided according to the treatment variable. At baseline, the pattern was similar between the two groups.

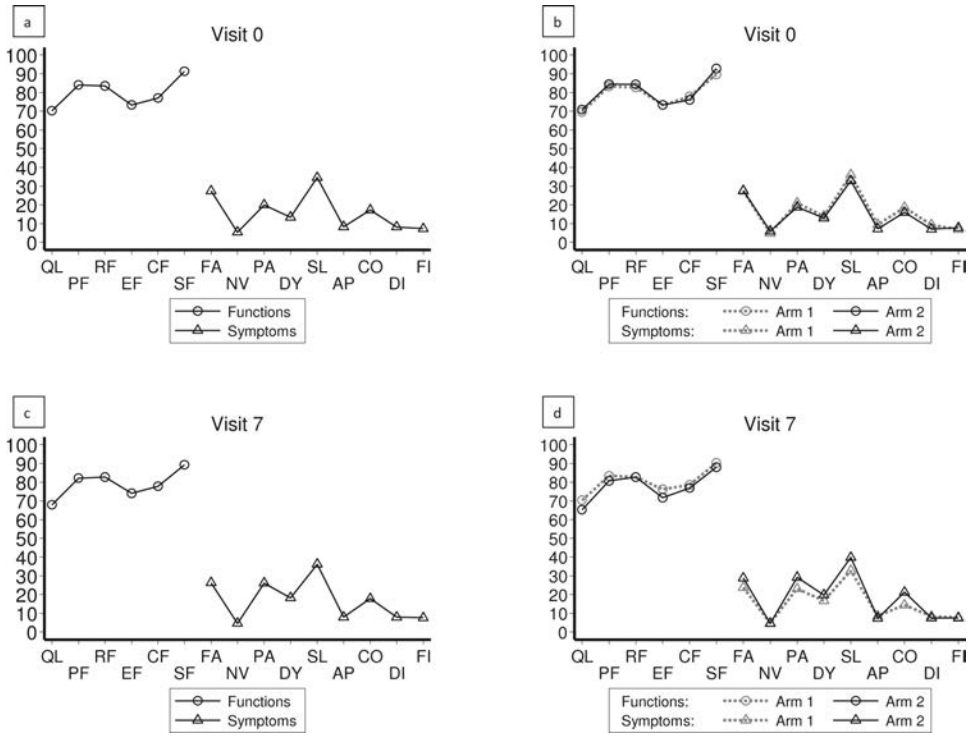

Figure 2. Profile plots at baseline (visit 0), globally (2a) and per group (2b), and at the 24th-month visit (visit 7), globally (2c) and per group (2d)

Longitudinal plots are also represented globally or per treatment arm for GHS/QoL (figure 3) and for some functional or symptom domains (figures 4 and 5). No difference could be observed between the treatment arms for any of the functional or symptom scales. Functional scores were high, and the less marked symptoms were nausea and vomiting, appetite loss, and diarrhea.

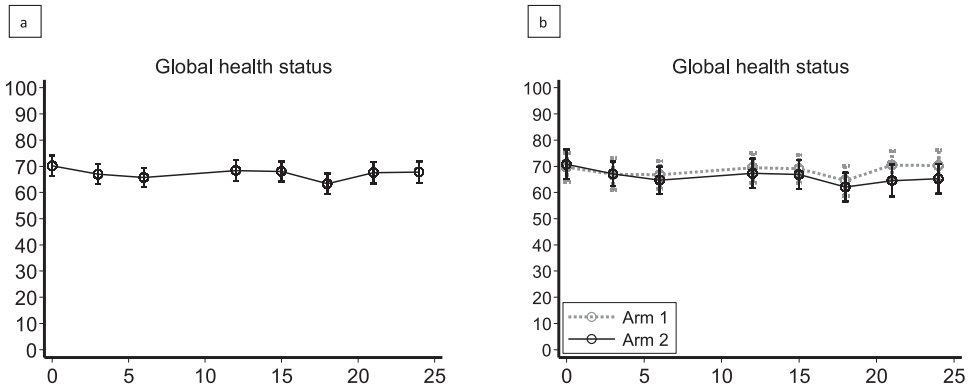

Figure 3. Change in mean EORTC QLQ-C30 GHS/QoL score over time, globally (3a) and per group (3b). For GHS/QoL, a high score indicates a good quality of life.

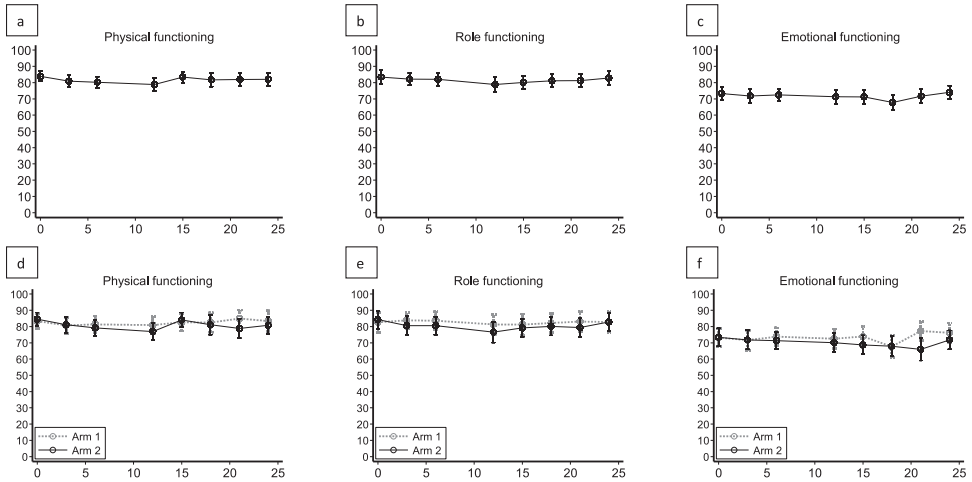

Figure 4. Change in mean EORTC QLQ-C30 functional scores over time, globally (4a, 4b, 4c) and per group (4d, 4e, 4f). For functional scales, a high score indicates a better function.

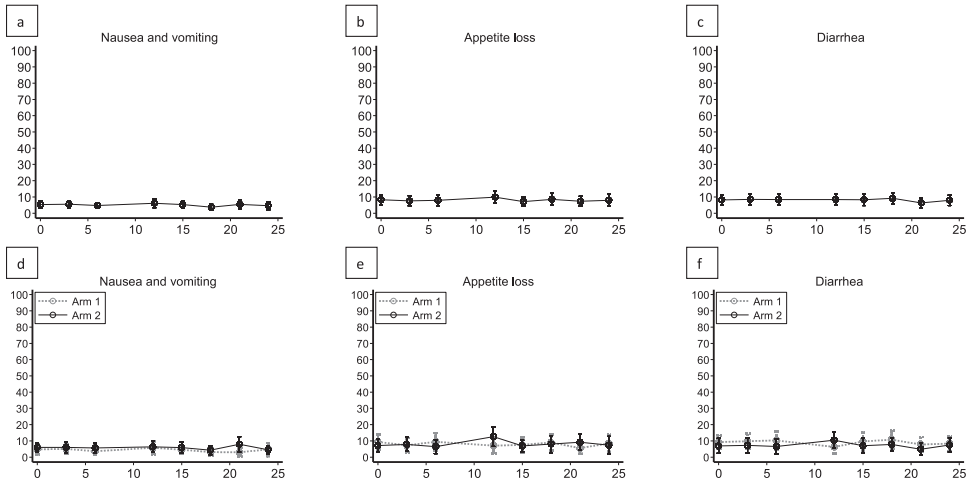

Figure 5. Change in mean EORTC QLQ-C30 symptom scores over time, globally (5a, 5b, 5c) and per group (5d, 5e, 5f). For symptom scales and financial difficulties, a high score indicates stronger symptoms or difficulties.

5 Conclusion

EORTC QLQ-C30 is completed by the patients themselves throughout the process of care. These uni- or multi-item scores indirectly reflect the patient's QoL. For the processing of such data, the EORTC recommends approaches that are usually descriptive and graphic. We developed a command providing an automatic descriptive analysis, profile plots per visit, and longitudinal plots per domain.

HRQoL data from clinical cancer trials are still underused and should be easier to process with such automatic programs. Indeed, the descriptive methodology is not optimal, and exploring longitudinal methods should provide a better assessment of the HRQoL of patients.

6 Acknowledgments

This study was supported by a grant from the French Public Health Research Institute (http://www.iresp.net/) under the 2012 call for projects as part of the 2009–2013 Cancer Plan.

We would like to thank Dr. Julie Courraud and Dr. Hélène de Forges for their editorial assistance.

7 References

Aaronson, N. K., S. Ahmedzai, B. Bergman, M. Bullinger, A. Cull, N. J. Duez, A. Filiberti, H. Flechtner, S. B. Fleishman, J. C. J. M. de Haes, S. Kaasa, M. Klee, D. Osoba, D. Razavi, P. B. Rofe, S. Schraub, K. Sneeuw, M. Sullivan, and F. Takeda. 1993. The European Organization for Research and Treatment of Cancer QLQ-C30: A quality-of-life instrument for use in international clinical trials in oncology. *Journal of the National Cancer Institute* 85: 365–376.

Azria, D., Y. Belkacemi, G. Romieu, S. Gourgou, M. Gutowski, K. Zaman, C. L. Moscardo, C. Lemanski, M. Coelho, B. Rosenstein, P. Fenoglietto, N. E. A. Crompton, and M. Ozsahin. 2010. Concurrent or sequential adjuvant letrozole and radiotherapy after conservative surgery for early-stage breast cancer (CO-HO-RT): A phase 2 randomised trial. *Lancet Oncology* 11: 258–265.

Beitz, J., C. Gnecco, and R. Justice. 1996. Quality-of-life end points in cancer clinical trials: The U.S. Food and Drug Administration perspective. *Journal of the National Cancer Institute* Monographs: 7–9.

Fayers, P. M., N. K. Aaronson, K. Bjordal, M. Groenvold, D. Curran, A. Bottomley, and on behalf of the EORTC Quality of Life Group. 2001. *The EORTC QLQ-C30 Scoring Manual*. 3rd ed. Brussels: European Organisation for Research and Treatment of Cancer.

Fayers, P. M., and D. Machin. 2007. *Quality of Life: The Assessment, Analysis and Interpretation of Patient-Reported Outcomes*. 2nd ed. Chichester, UK: Wiley.

Gotay, C. C., C. T. Kawamoto, A. Bottomley, and F. Efficace. 2008. The prognostic significance of patient-reported outcomes in cancer clinical trials. *Journal of Clinical Oncology* 26: 1355–1363.

About the authors

Caroline Bascoul-Mollevi is a biostatistician and methodologist in the Biostatistics Unit of the Institut régional du Cancer de Montpellier/Val d'Aurelle, Comprehensive Cancer Center of Montpellier, France.

Florence Castan is a biostatistician in the Biostatistics Unit of the Institut régional du Cancer de Montpellier/Val d'Aurelle, Comprehensive Cancer Center of Montpellier, France.

David Azria is a radiation oncologist in the Department of Radiation Oncology of the Institut régional du Cancer de Montpellier/Val d'Aurelle, Comprehensive Cancer Center of Montpellier, France.

Sophie Gourgou-Bourgade is the head of the Biostatistics Unit of the Institut régional du Cancer de Montpellier/Val d'Aurelle, Comprehensive Cancer Center of Montpellier, France.