Evaluating quality of life in patients with sickle cell disease: Differences between adults and children

Avaliação da qualidade de vida em pacientes com anemia falciforme: diferenças entre adultos e crianças

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ABSTRACT

Sickle cell anemia is one of the most common inherited diseases worldwide. It is believed that quality of life (QoL) of the sickle cell patient is very low and that in its general socio-economic conditions and cultural well indicate lack in several aspects. The objective this study was to describe and analyze the QoL of patients with sickle cell anemia In a Hematology clinic of a teaching hospital in Southeastern Brazil. This is a cross-sectional study with application of the WHOQOL-BREF instrument, on the four domains, in adults (group 1) and children (group 2) carriers of sickle cell anemia. In the calculation of differences between proportions was employed the chi-square test. To check for differences between the means was used the Student t test for independent samples. For analysis of association between variables, we used prevalence ratio (PR) with its confidence interval at 95% (CI 95%), as estimates of magnitude. A significance level of 5% was considered in all analysis. In group 1 were selected 27 patients (54%) with mean age of 27.2 years old and 58.3% female, while in group 2 were 23 children (46%) whose mean age was 8.7 years old, with 57.1% of the sample consisted of male patients. QoL was higher among patients of the group 2 in physical and environmental domains ($p < 0.05$). The population studied presented a favorable QoL, with means above 11 in all domains. Patients aged ? 13 years old had better QoL compared to > 13 years, possibly indicating better physical functioning and less psychological conflicts.

Key-words: Quality of Life. WHOQOL-BREF. Anemia, Sickle Cell. Adult. Child.

Introduction

Sickle cell disease is one of the most common inherited diseases worldwide, affecting mainly the black population. The World Health Organization (WHO) estimates that each year are born in Brazil between 700 and 1000 children with sickle cell anemia.[1,2] Because it is the most prevalent hereditary disease in the country, and frequently present delayed diagnosis with high morbidity and mortality, sickle cell anemia should

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be considered a public health problem in Brazil and in the world.[3,4,5]

It is believed that patients with sickle cell disease has a quality of life (QoL) very low and that their overall socio-economic and cultural deficiency also point to several aspects,[6,7] so that the they has a better health status and QoL is needed proper guidance and assistance, both in medical and psychosocial terms, as well as studies that address the public health aspects.

Aiming to contribute to improving the care provided to these patients came to the conclusion that a study of QoL allow to identify the factors that influence the welfare of these people, determine the changes necessary to achieve their well-being, set magnitude of the problems of population, provide conditions for their rehabilitation and the sickle cell address in a comprehensive manner while focusing on their clinical symptoms with its psychosocial aspects, in order to improve their health and quality of life. Based on this, the objective this study was to describe and analyze the QoL of patients with sickle cell disease followed at the Hematology clinic, according to the WHOQOL-BREF[8,9] in the domains: physical, psychological, social relationships and environment.

Methods

This is a cross-sectional study in which the selected population consisted of patients with sickle cell disease followed at the Hematology Clinic of the Regional Blood Center of Federal University of Triangulo Mineiro (FUTM)-Brazil during 2010. Data were collected through the application of two instruments: the first for the characterization of the socio-demographic data, clinical and epidemiological (age, origin, marital status, education, income, occupation, physical activity, crises of pain, achievement of transfusion, medication and other disorders [Diabetes, bleeding, smoking among others]), and second, measurement of QoL, using the WHOQOL-BREF, proposed by the World Health Organization (WHO),[8] validated version in Portuguese.[9] The WHOQOL-BREF instrument has 26 facets, which, comprising four domains: physical, psychological, social relationships and environment.

Inclusion criteria

We selected patients with sickle cell anemia, treated in outpatient settings, with no record of severe comorbidities, who agreed to participate. The sample was composed of two different populations, forming two groups: Group 1, consisting of adolescent and adult patients older than 13 years and Group 2 consisted of children and adolescents younger than 13 years.

Exclusion criteria

Patients and/or guardians who have not agreed to participate in the study were ineligible. Patients who were eligible, but which had severe comorbidities were excluded.

Statistical analysis

The questionnaires were entered in Excel software, and stored with tabulation, consolidation and analysis employing the software Epi-Info 6.04 and SPSS® version 20 in the syntax of the WHOQOL-BREF. The highest scores corresponded to better quality of life, and after processing the syntax, the values of domains and facets ranging from four to 20. In the calculation of differences between proportions was employed the chi-square test. To check for differences between the means was used the Student t test for independent samples. When we chose to investigate the distribution and differences between median was used the Kruskal-Wallis test. For analysis of association between variables, we used prevalence ratio (PR) with its confidence interval at 95% (CI 95%), as estimates of magnitude. A significance level of 5% was considered in all analysis.

Ethical aspects

The research project was reviewed and approved by the Research Ethics Committee of the FUTM, (Number 0823). Before the study began, the interviewer presented the objectives of the study to patients and requested their participation. Only after the consent of the interviewee and signing the consent form, there was an application of the questionnaire.

Results

We interviewed 50 patients with sickle cell anemia, 27 (54%) aged over 13 years and 23 in group ? 13 years. Among those over 13 years old, the mean age was 27.2 (± 8.3) years, minimum 15 and maximum of 40 years. Among children the mean age was 8.7 (± 3.5) years, ranging from two to 13 years old. In the adult group, 41.7% of patients were male, while among children, were 57.1% (Table 1), no significant difference (PR 0.73, [95% 0.4 to 1.3]).

Table 1
Characteristics of the biological variables among adults and children with sickle cell disease assisted in the hematology ward, FUTM-2010.

	Group		
Variables	**Adults**	**Childrens**	**P value**
N (%)	27 (54)	23 (46)	>0,05*
Age (years)			
(Mean ± PD)	27,2 (± 8,3)	8,7 (± 3,5)	<0,05#
(max - min)	(15 - 40)	(2 - 13)	
Sex			
Male - N (%)	11 (41,7)	13 (57,1)	>0,05*
Female - N (%)	16 (58,3)	10 (42,9)	>0,05*

* Z test; # t' Student test

In group 1, 92.6% were unmarried, 3.7% married and 3.7% separated. In the same group, 37.0% of patients were attending school at the time of data collection, with the majority of patients presented elementary education level, 33.3% of cases. Only five patients had tertiary education. With regard to family income, the majority of patients (48.4%) had low monthly income. Most respondents (92.6%) lived with their relatives. Regarding the frequency of pain crises, the majority (48.1%) said they rarely have them, no difference was observed between adults and children (PR = 1.57 [95% CI 0.38 to 6.40], p = 0.45). With regard to the intensity of pain crises, 40.7% of patients reported that their attacks are strong, while 25.9% reported being very strong and moderate, respectively, while only 3.7% of patients reported having pain of low and very low intensity, respectively. When analyzing the responses of adults and children, it is observed that there was no difference (PR = 1.01 [95% CI 0.84 to 1.22], p = 0.64). When there is a report of blood transfusion, it is observed that among adults, the event was recorded in 95.8% of patients, while among children the same occurred in 85.7% of cases, with no difference between both groups (PR = 1.12 [95% CI 0.92 to 1.36], p = 0.32). On the use of medicines due to illness, 95.8% of adult patients and 90.5% of children reported use, especially folic acid and analgesics, with no differences between the two groups (PR = 1.06 [95% 0.90 to 1.25], p = 0.59). Regarding co-morbidity, most (33.3%) declared not to present, while 25.9% reported more than one co-morbidity, with no difference in the prevalence among adults and children (PR = 0.93 [95% CI 0.52 to 1.64], p = 0.94). When analyzing the physical activity, we found that among adults the report was positive in 29.2% of respondents, while among children was 42.8%, however, no difference was found between the prevalence of two groups (PR = 0.68 [95% CI 0.31 to 1.51], p = 0.51]).

Evaluation of QoL

In group 1, most patients (51.9%) judged their quality of life as good. About satisfaction with their health, 48.1% said they were satisfied or very satisfied. Regarding the influence of physical pain in carrying out activities, 44.4% of patients considered that this prevents them enough. About 48.0% of respondents stated that they need a lot of medical treatment to bring your daily life. Around 37.0% of said selected rather enjoy life and when asked about the extent to which life has meaning, the same percentage considered as having extreme sense.

With respect to the concentration, 44.4% reported able to concentrate on more or less. About security in their daily lives, 40.7% of patients were considered safe enough. With respect to the physical environment, 33.3% of respondents said it is more or less healthy, while 37.0% thought nothing or very little insurance and 29.6% considered it very or extremely healthy. Regarding the willingness and energy for the day to day, the majority (44.4%) stated that average amount of the attribute. Regarding the acceptance of physical appearance, 70.3% considered to agree very well or completely. About the amount of money to meet the needs, 37.0% of patients said they had very little money, while only 18.5% said they very or quite satisfied. Most adults (40.7%) considered to have an availability of information needed for day to day. When asked about the opportunity of leisure activities, 48.1% had little or no opportunity. As to walking ability, 51.8% of patients said to move well or very well. Regarding sleep satisfaction, 48.1% thought they were satisfied. On the ability to perform day-to-day, the majority (44.4%) reported being satisfied. In relation to satisfaction with personal relationships (friends, relatives, acquaintances, colleagues), 44.4% considered themselves satisfied, and being that same percentage was found as they researched to satisfaction with sex life, that is, the majority stated be satisfied. More than half

of respondents (55.5%) reported being satisfied or very satisfied with the access to health services.

When comparing the physical (Domain 1), psychological (Domain 2), social relationships (Domain 3) and environment (Domain 4), between adults and children, can be observed that there were differences between groups in physical and environment domains, whose values were significantly higher among patients aged below 13 years (Table 2), the same was found when comparing the overall QoL.

As for the psychological and social relations were no significant differences between the two groups.

Discussion

In this study, the oldest respondent was 40 years old, being within the current life expectancy of the U.S. population with sickle cell anemia which is 42 years for men and 48 years for women.[2,10] According to the literature, mortality is higher in the first two years of life, and infections, especially bacterial, the main causes.[10,11] In group 2 of the study, in which the youngest patient was two years old, we cannot be said that there was an even higher mortality in this age population, therefore, was not taken into account in the methodology of this study, tracking patients and the lifting of those who died, so it was not possible to verify this outcome or association.

Sickle cell anemia primarily affects black people[12] that historically in Brazil, are socio-economically disadvantaged.[13] Although this study did not take into account issues of race, we can say that the socio-economic characteristics of the study population are consistent with the literature, since the majority of respondents reported having an income below two minimum wages and low education. The fact that this work was done in a public service where the medical assistance is made solely by the Brazilian Health Unified System (HUS), may have contributed to this finding.

The clinical manifestations of disease usually appear after six months of life, extending over a lifetime and show great variability. The main clinical manifestations are painful crises.[5,14] Most patients said they rarely have any pain crises, contradicting what is in the world literature,[5,10] however, our findings may reflect an appropriate medical monitoring, as well as patient compliance due to greater availability of effective treatment and also currently offered by specialized services.

Patients with sickle cell disease have a chronic anemia which is associated with a greater capacity for oxygen release by hemoglobin S, allowing them to be mildly symptomatic in relation to anemia and do not require a routine red blood cell transfusion, which is held usually in the presence of acute complications.[15,16,17] According to the results, the majority of patients with sickle cell disease, stated that had determined frequency of blood transfusion, showing that the use of this procedure is not periodic for most respondents, which may be due to the effectiveness of drug treatment and monitoring. So, how in the world literature, this study showed that blood transfusion in patients with sickle cell disease is most often used to treat acute and not a routine therapeutic use.

Table 2
Distribution of mean values of the domains of QoL (WHOQOL-BREF) in adults and children with sickle cell disease assisted in the hematology ward, FUTM-2010.

	Mean (± PD)		
	Group		
Domain	**> 13 years old**	**≤ 13 years old**	**P value**
Physical	12.16 (± 2.77)	14.55 (± 1.72)	< 0,05
Psychological	14.69 (± 2.55)	15.58 (± 2.59)	> 0,05
Social Relationships	13.55 (± 4.42)	11.93 (±2.47)	>0,05
Environment	11.95 (± 2.82)	13.64 (± 1.62)	< 0,05
Overall QoL	11.96 (± 2.83)	13.65 (± 1.61)	< 0,05

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In sickle cell disease there are few specific therapeutic options,[18,19,20] being fundamental institution of general and preventive measures to lessen the consequences of chronic anemia, sickle cell crises, and susceptibility to infections.[21,22] Patients with sickle cell disease have chronic hemolysis, and in an attempt to compensate the anemia, there is an increased production of red blood cells, which consume folic acid, so it is recommended that supplementation with 1-2 mg of folate daily. With respect to drug therapy of patients studied, most reported about using folic acid.

Patients with sickle cell disease have increased susceptibility to infections by capsulated organisms, mainly due to loss of splenic function (auto-splenectomy) due to frequent thrombosis and infarction,[22] thus, it is recommended prophylaxis with penicillin for all children with sickle cell disease, should be made from three months to five years old. You can use either orally (penicillin V) or parenteral (benzathine penicillin). This study included five patients aged less than five years, but 11 patients in group < 13 years reported using penicillin. In the group > 13 years of age, only one person reported using penicillin. The use of penicillin prophylaxis in sickle cell outside the recommended age may have been a medical management for individual patients in such service where the study was conducted.

Although physical activity is able to trigger painful crises, their practice is not formally contraindicated, may be recommended if it is regular and moderate, with the effort progresses slowly and under supervision.[23] In the groups studied here, the majority stated that physical activities. We can not say that this finding is a contraindication, as the service that hosted the study, this is not usual recommendation. Even having the hereditary disease most prevalent in Brazil, the national literature about the sickle cell disease, has little research on aspects and impacts related to public health. The issues most frequently raised about the disease are associated with clinical and epidemiological factors such as population prevalence studies.[24,25] Because of this, difficulties were encountered in comparing the results of this study with other studies on the subject, because we found no publications on quality of life in patients with sickle cell disease in the Brazilian literature.

When analyzing the contribution of different domains in the QoL of the respondents, it was observed that in both groups, the social and psychological domains showed the highest, ie the mean values were higher. Regarding the contribution of the physical domain for QoL, we observed that in patients ≤ 13 years old, this was higher than in patients > 13 years ($p<0.05$). This could be explained by greater functional capacity expected in the younger group of patients, besides knowing the literature, that patients with longer disease duration, ie those with higher age are more intense and painful episodes more severe, thus leading a major limitation and disability.[26,27,28] Another explanation could be that the disease is well controlled and thus interfere little in the physical aspects of those younger patients.

In both groups the environmental domain was the one with a smaller contribution in the QoL, however, group 2 had an average higher than group 1 ($p <0.05$). This data can be correlated with the findings of a socioeconomic questionnaire, where the majority of patients reported having low purchasing power, which may have contributed to less access to information, less opportunity for leisure, less access to health services, environment more physical harm, among others. You can also, in some way infer that the younger patients, like those in the group aged 13 years or less, have less awareness of environmental issues as a component of QoL, increasing the values when compared to patients older. Considering the range of 4 to 20 for the syntax of QoL of the WHOQOL-BREF, the social relationships, physical, psychological and environmental values were above 11 in both groups. It is considered that values above 11 expressed a positive perception of the QoL. Patients younger than or equal to 13 years showed higher average scores in all domains rather than > 13 years old. This result can be expected by the fact that respondents ≤ 13 years old are generally less concerned with issues of day-to-day, less accountability, better functional capacity, among other aspects to be considered as biological and social.

Conclusion

When analyzing the results of the WHOQOL-BREF, it follows that the population has a favorable QoL, since they were found with mean values above 11 in all domains of the questionnaire. Furthermore, in relation to overall QoL, most patients in both groups evaluate their QoL as good. Patients aged ≤ 13 years had better QoL compared to > 13 years, possibly indicating better physical functioning and less psychological conflicts. Regarding the clinical profile of patients

studied, we conclude that the majority has controlled disease, as it declared that rarely have pain crises, the main manifestation of the disease. But the dependence on medication for the disease was observed in most patients.

Considering the socioeconomic profile, we conclude that the majority of the interviewees belong to economically disadvantaged classes, as reported to have low income and low education. Therefore, studies like this that are described in every socio-economic and clinical-epidemiological study of a specific population may be important for planning and implementing actions in an attempt to improve the QoL of these people.

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RESUMO

A anemia falciforme é uma das doenças hereditárias mais comuns em todo o mundo. Acredita-se que a qualidade de vida (QV) do paciente com a doença falciforme é muito baixa e que suas condições socioeconômicas e culturais indicam deficiências em vários aspectos. O objetivo deste estudo foi descrever e analisar a QV dos pacientes com anemia falciforme assistidos em um ambulatório de hematologia de um hospital de ensino no sudeste do Brasil. Este é um estudo transversal com aplicação do instrumento WHOQOL-BREF em adultos (grupo 1) e crianças (grupo 2) com anemia falciforme. No cálculo de diferenças entre proporções foi utilizado o teste do qui-quadrado. Para verificar diferenças entre as médias foi utilizado o teste t de Student para amostras independentes. Para análise da associação entre as variáveis, foi empregada a razão de prevalência (RP) com seu intervalo de confiança a 95% (IC95%), como estimadores de magnitude. Considerou-se um nível de significância de 5% em todas as análises. No grupo 1 foram selecionados 27 pacientes (54%) com média de idade de 27,2 anos, sendo 58,3% do sexo feminino, enquanto que no grupo 2 foram 23 crianças (46%), cuja média de idade foi de 8,7 anos, com 57,1% da amostra do sexo masculino. A QV foi maior entre os pacientes do grupo 2 nos domínios físicos e ambiental ($p<0,05$). A população estudada apresentou uma QV favorável, com valores médios acima de 11 em todos os domínios. Pacientes com idade ? 13 anos apresentaram melhor QV em relação aos com idade > 13 anos, possivelmente indicando melhor funcionalidade e menos conflitos emocionais e psicológicos.

Palavras-chave: Qualidade de Vida. WHOQOL-BREF. Anemia Falciforme. Adulto. Criança.

References

1. Rees DC, Williams TN, Gladwin MT. Sickle-cell disease. The Lancet 2010; 376 (9757): 2018-31.
2. Prabhakar H, Haywood CJr, Molokie R. Sickle cell disease in the United States: looking back and forward at 100 years of progress in management and survival. Am J Hematol 2010; 85:346-53.
3. Ilozue C, Cipolotti R, Melo CA, Gurgel RQ, Cuevas LE. Estimating the post-neonatal prevalence of sickle cell disease in a Brazilian population. Trop Med Internat Health 2010; 15:1125-31.
4. Loureiro MM, Rozenfeld S. Epidemiologia de internações por doença falciforme no Brasil. Rev de Saude Publica 2005; 39:943-9. [Portuguese]
5. Smith WR, Scherer M. Sickle-cell pain: advances in epidemiology and etiology. Hematology/American Society of Hematology Education Program 2010; 409-15.
6. Asnani MR, Lipps GE, Reid ME. Validation of the SF-36 in Jamaicans with sickle-cell disease. Psychology, Health & Medicine 2009; 14:606-18.
7. Cruz LN, Camey SA, Fleck MP, Polanczyk CA. World Health Organization quality of life instrument-brief and Short Form-36 in patients with coronary artery disease: do they measure similar quality of life concepts? Psychology, Health & Medicine 2009; 14:619-28.
8. Skevington SM, Lotfy M, O'Connell KA, WHOQOL Group. The World Health Organization's WHOQOL-BREF quality of life assessment: psychometric properties and results of the international field trial. A report from the WHOQOL group. Quality of Life Research 2004;13:299-310.
9. Fleck MPA, Louzada S, Xavier M, Chachamovic E, Vieira G, Santos L, et al. Aplicação da versão em português do instrumento abreviado de avaliação da qualidade de vida "WHOQOL-BREF". Rev Saude Publica 2000; 34:178-83. [Portuguese]

10. Hassell KL. Population estimates of sickle cell disease in the U.S. Am J Prev Med 2010; 38(4 Suppl):S512-21.

11. Platt OS, Brambilla DJ, Rosse WF, et al. Mortality in sickle cell disease: Life expectancy and risk factors for early death. New England Journal of Medicine 1994; 330:1639-44.

12. Lemos GC, Farias JG. African gene flow to north Brazil as revealed by HBB*S gene haplotype analysis. Am J Human Biol 2006;18:93-98.

13. Hijmans CT, Fijnvandraat K, Oosterlaan J, Heijboer H, Peters M, Grootenhuis MA. Double disadvantage: a case control study on health-related quality of life in children with sickle cell disease. Health and Quality of Life Outcomes 2010; 8:121.

14. Platt OS, Thorington BD, Brambilla, DJ, et al. Pain in sickle cell disease, rates and risk factors. New England Journal of Medicine 1991; 325:11-16.

15. Adams R, McKie V, Hsu L, Files B, Vichinsky E, Pegelow C, et al. Prevention of a first stroke by transfusions in children with sickle cell anemia and abnormal results on transcranial Doppler ultrasonography. New England Journal of Medicine 1998; 339: 5-11.

16. Cançado RD, Chiattone CS. Anemia de Doença Crônica. Rev Bras Hematol Hemot 2002; 24: 127-36. [Portuguese]

17. Stypulkowski JB, Manfredini V. Alterações hemostáticas em pacientes com doença falciforme. Rev Bras Hematol Hemot 2010; 32: 56-62. [Portuguese]

18. Gladwin MT, Kato GJ, Weiner D, Onyekwere OC, Dampier C, Hsu L, et al. Nitric oxide for inhalation in the acute treatment of sickle cell pain crisis: a randomized controlled trial. JAMA 2011; 305:893-902.

19. Ruggeri A, Eapen M, Scaravadou A, Cairo MS, Bhatia M, Kurtzberg J, et al. Umbilical Cord Blood Transplantation for Children with Thalassemia and Sickle Cell Disease. Biology of Blood and Marrow Transplantation 2011; doi:10.1016/j.bbmt.2011.01.012

20. Friedrich MJ. Advances reshaping sickle cell therapy. JAMA 2011; 305:239-40, 242.

21. Hebbel RP. (2011) Reconstructing sickle cell disease: A data-based analysis of the "hyperhemolysis paradigm" for pulmonary hypertension from the perspective of evidence-based medicine. Am J Hematol 2011; 86:123-54.

22. Ramakrishnan M, Moisi JC, Klugman KP, et al. Increased risk of invasive bacterial infections in African people with sickle-cell disease: a systematic review and meta-analysis. The Lancet Infect Dis 2010;10:329-37.

23. Al-Rimawi H, Jallad S. Sport participation in adolescents with sickle cell disease. Pediat Endocrinol Rev 2008; Suppl 1: 214-6.

24. Neto JP, Lyra IM, Reis MG, Goncalves MS. The association of infection and clinical severity in sickle cell anaemia patients. Transactions of the Royal Society of Tropical Medicine and Hygiene 2011; 105:121-6.

25. Nomura RM, Igai AM, Tosta K, da Fonseca GH, Gualandro SF, Zugaib M. Maternal and perinatal outcomes in pregnancies complicated by sickle cell diseases. Rev Bras Ginecol Obstet 2010; 32:405-11. [Portuguese]

26. McClish DK, Penberthy LT, Bovbjerg VE, Roberts JD, Aisiku IP, Levenson JL, Roseff SD, Smith WR. Health related quality of life in sickle cell patients: the PiSCES project. Health and Quality of Life Outcomes 2005; 3:50. doi:10.1186/1477-7525-3-50

27. Dampier C, Setty BN, Eggleston B, Brodecki D, O'neal P, Stuart M. Vaso-occlusion in children with sickle cell disease: clinical characteristics and biologic correlates. J Pediat Hematology/Oncology 2004; 26:785-90.

28. Dampier C, LeBeau P, Rhee S, Lieff S, Kesler K, Ballas S, Rogers Z, Wang W. Comprehensive Sickle Cell Centers (CSCC) Clinical Trial Consortium (CTC) Site Investigators. Health-related quality of life in adults with sickle cell disease (SCD): A report from the comprehensive sickle cell centers clinical trial consortium. Am J Hematol 2011; 86:203-5. doi: 10.1002/ajh.21905.