Knowledge and attitudes among health professionals about poliomyelitis and post-poliomyelitis syndrome: a cross-sectional study in Brazil

CURRENT STATUS: UNDER REVIEW

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DOI: 10.21203/rs.2.11698/v1

SUBJECT AREAS
Educational Philosophy and Theory Neurology

KEYWORDS
post-poliomyelitis syndrome, knowledge, attitudes, medical education, neuromuscular disease, late effects of polio
Abstract

Background

Post-poliomyelitis syndrome is a clinical condition that can affect poliomyelitis survivors. Our aim was to evaluate post-poliomyelitis syndrome knowledge among Brazilian health professionals.

Methods

A self-administered questionnaire (30 questions) was designed to probe knowledge about poliomyelitis and post-poliomyelitis syndrome. From the questionnaire, we created a structured exam to evaluate the performance of the professionals. The exam was composed of 20 questions and a score was provided, varying from 0 (totally ill advised) to 20 (totally well-informed).

Results

In general, physicians, physiotherapists and nurses demonstrated a better understanding of poliomyelitis and post-polio syndrome. The health professionals who had received previous information about poliomyelitis and PPS had significantly higher scores than those that had never received information (p<0.001). On average, this difference was approximately 28.6%.

Conclusions

The findings of the present study indicate a critical need for the improvement of PPS knowledge among Brazilian health professionals.

1. Introduction

Poliomyelitis is an infectious viral disease that may attack people at any age. It affects the nervous system, resulting in paralysis and muscle spasms, and in some cases encephalitis [1,2]. There are several regions in the world certified as free from
poliomyelitis [3]. However, there are some endemic countries, such as Afghanistan, Nigeria and Pakistan, and there are registers of imported cases in some African countries [3]. In Brazil, despite poliomyelitis being eradicated, according to the Brazilian Health Ministry, 312 Brazilian municipalities have a vaccine coverage below 50% for the polio vaccine. This creates a state of alert and threatens the eradication of the disease. Therefore, there is a need to maintain permanent and effective actions of disease surveillance and adequate levels of immunological protection of the population [4].

Post-poliomyelitis syndrome (PPS) is the term used to describe a collection of signs and symptoms that may be experienced by persons afflicted by paralytic poliomyelitis after years of clinical and functional stability [5]. The signs and symptoms that characterize PPS are new muscle weakness, muscle fatigue, muscle atrophy, muscle and joint pain, sleep disturbances, intolerance to cold, respiratory and swallowing difficulties and a recent increase in body mass [2,6–8]. It is a slowly progressive disease, usually insidious, of subacute onset, sometimes resulting in significant restrictions of activities associated with everyday life [7,9–16].

Although the pathophysiology of PPS is not clear, different mechanisms have been proposed. The most accepted mechanism postulates that degeneration or dysfunction of giant motor units, manifested by peripheral deterioration (axon and/or neuromuscular junction), probably as a result of metabolic requirements of giant motor units (muscle overuse), has a central role in the etiology of the disease [9,17]. However, there are different hypotheses associated with the pathophysiology of the disease, that include: muscle disuse, the normal loss of motor units with age, predisposition to motor neuron degeneration due to glial vascular and lymphatic damage, reactivation of the virus or persistent infection, immunological factors related to poliomyelitis [9,15,18–20], the effect of growth hormone, the combined effect of overuse, disuse, pain, body mass gain or other
Regarding the diagnostic criteria for PPS, a clinical approach to the exclusion of other neurological diseases, orthopedic, psychiatric or even consequences linked to the aging process is required, since these conditions could develop the same signs and symptoms of PPS [9,21]. Therefore, it is extremely important that the patient is managed by a multidisciplinary health professional team that includes neurologists, rheumatologist, orthopedists, pulmonologists, physical education professionals, physiotherapists, nutritionists, nurses and psychologists [9,22,23].

Despite the significant decline in the incidence of paralytic poliomyelitis [3], PPS will remain a major health problem for many years. In western countries, where large epidemics date back to the 40s and 50s of the last century, many survivors of paralytic poliomyelitis are now aged between 70 and 80 years [24]. In Brazil, the last major outbreak was in 1984 [24]. Therefore, the future outlook is for continued or even increased rehabilitation programs/management of people with PPS [9,25]. In addition, it is estimated that there are about 20 million people alive who were affected by paralytic poliomyelitis [25,26]. As success in the treatment of any disease depends of knowledge that the health professional has about disease, the assessment of knowledge about poliomyelitis and PPS in health professionals is of great value. Previously, it was demonstrated that physical education professionals have misconceptions about poliomyelitis and PPS [8], therefore, it is reasonable to assume that other health professionals present similar misconceptions in regard to poliomyelitis and PPS.

Furthermore, other studies showed that health professionals can present misconceptions about epilepsy [27,28], acquired immune deficiency syndrome (AIDS) [29], cancer [30], hypertension and diabetes [31].

Thus, the aim of this study is to verify the knowledge of health professionals about diseases [9,18,20].
poliomyelitis and PPS regarding the pathophysiology, etiology, symptomatology and forms of treatment of PPS. We hypothesized that these professionals do not have the proper knowledge related to poliomyelitis and PPS and, therefore, the service provided by these professionals can be prejudiced.

2. Materials And Methods

2.1 Participants

A total of 578 participants (508 women and 287 men) were evaluated. Of these, 69 were physicians (19 women and 50 men), 151 physiotherapists (116 women and 35 men), 224 nurses (203 women and 21 men), 78 nutritionists (74 women and 4 men), 56 psychologists (42 women and 14 men), from different Brazilian regions. Out of the 578 participants approached, 305 (52.8%) had a specialization degree, 126 (21.8%) had a Ph.D., 86 (14.9%) had a master’s qualification, 59 (10.2%) had only an undergraduate degree and two (0.2%) did not report their highest graduation level. The other characteristics of the subjects are presented in Table 1.

2.2 Ethics, consent and permissions

All subjects were informed of the intent and experimental procedures and written informed consent was obtained from each participant before any data were collected. All procedures involved in this study were approved by the Federal University of Goiás Ethics Committee (protocol number: 198/2009) and followed the principles outlined in the Declaration of Helsinki.

2.3 Questionnaire

To evaluate knowledge about poliomyelitis and PPS, we used the same questionnaire
described by de Lira et al. [8]. This is a self-administered questionnaire divided into three parts: (i) personal data, (ii) knowledge about poliomyelitis and (iii) knowledge about PPS. The questionnaire consisted of 14 questions about poliomyelitis and 16 questions about PPS and addressed aspects related to pathophysiology, diagnosis, forms of treatment, prognosis and previous work experience, with simple scales for closed-type responses. This questionnaire has been prepared in accordance with previous recommendations [32,33]. The questions are shown in Tables 2 and 3.

In addition, a score was created (assessment test of knowledge) which aimed to show, objectively, the performance of the professionals interviewed. Therefore, the issues present in the questionnaire were analyzed those that had a correct response (20 questions). Therefore, the score ranged from 0 to 20 points. These questions are marked with an asterisk in Tables 2 and 3.

2.4 Statistical analysis

Descriptive statistics were used to analyze the findings (mean, standard deviation and absolute and relative frequencies). The Gaussian distribution of the sample was tested by the Kolmogorov-Smirnov test. One-way analysis of variance (ANOVA) was used to compare age and professional experience among categories of health professionals. The Chi-square test was used to determine the association between health professionals and knowledge about poliomyelitis and PPS. The Kruskal-Wallis test was used to compare score on questionnaire obtained by health professional categories, followed by Dunn post hoc comparison. The Mann-Whitney test was used to compare scores obtained in the questionnaire between the exposure (‘yes’ and ‘no’) groups. For all statistical procedures the level of significance assumed was 5%.

3. Results
3.1 Knowledge about poliomyelitis

The first part of the questionnaire was designed to assess knowledge about poliomyelitis.

Out of the 578 subjects approached, 576 (99.7%) had heard about poliomyelitis.

Surprisingly, 2 (0.3%) of the volunteers had never heard of poliomyelitis (Table 2). The Chi-square test did not reveal significant association between categories of health professionals and having heard about poliomyelitis (p = 0.530).

Out of the 578 subjects approached, 461 (79.8%) answered that they had received information about the disease through books, pamphlets and lectures. While approximately 90% of physicians, physical therapists and nurses had access to information on how to deal with poliomyelitis in their undergraduate courses, these values fall to approximately half among nutritionists (43.6%) and psychologists (50.0%) (Table 2).

The Chi-square test revealed a significant association between categories of health professionals and those who had received information about poliomyelitis (p<0.001).

With respect to the biological agent that causes poliomyelitis, some health professionals reported that they did not know that the disease is caused by virus (n = 44, 7.6%) and 4.0% (n = 23) of participants stated that poliomyelitis is not caused by virus. More than 90% of physicians, physical therapists and nurses and approximately 70% of nutritionists and psychologists correctly answered that poliomyelitis is caused by virus. The Chi-square test revealed significant association between categories of health professionals and knowledge of the biological agent that causes poliomyelitis (p<0.001).

Out of the 578 subjects approached, 78.3% of physicians, 39.7% of physical therapists, 54.5% of nurses, 21.8% of nutritionists and 25% of psychologists knew that poliomyelitis can be spread through water and/or food contaminated with feces from a sick person. The Chi-square test revealed significant association between categories of health professionals
and knowing that poliomyelitis can be spread through water and/or food contaminated with feces from a sick person (p<0.001).

Regarding the symptoms of poliomyelitis, 72.5% of physicians, 41.1% of physical therapists, 48.7% of nurses, 26.9% of nutritionists and 26.8% of psychologists knew that poliomyelitis can cause gastrointestinal symptoms. The Chi-square test revealed significant association between categories of health professionals and knowing that poliomyelitis can cause gastrointestinal symptoms (p<0.001).

Regarding neuromuscular symptoms, more than 90% of health professionals knew that poliomyelitis can cause neuromuscular symptoms such as paralysis, paresis, muscle atrophy, and weakness. The Chi-square test did not reveal any significant association between categories of health professionals and knowing that poliomyelitis can cause neuromuscular symptoms (p = 0.262).

About recovery of functional capacity after the acute poliomyelitis stage, 82.6% of physicians, 70.2% of physical therapists, 54% of nurses, 33.3% of nutritionists and 48.2% of psychologists knew that after the acute poliomyelitis stage, patients can recover functional capacity of affected structures. The Chi-square test revealed significant association between categories of health professionals and knowing that patients can recover functional capacity of affected structures (p<0.001).

Regarding epidemiology, between 60–80% of health professionals knew that poliomyelitis is a disease that has not been eradicated worldwide. The Chi-square test did not reveal a significant association between categories of health professionals and knowing that poliomyelitis is a disease that is not eradicated around the world (p = 0.406). Also, there was no significant association between health professionals in regards knowing about the availability of the poliomyelitis vaccine (p = 0.133). Indeed, more than 90% of health professionals knew that there is vaccine available to prevent poliomyelitis.
With regard to treatment, 94.2% of physicians, 78.8% of physical therapists, 73.7% of nurses, 33.3% of nutritionists and 30.4% of psychologists knew that poliomyelitis treatment can involve admission to the intensive care unit due to respiratory impairment. The Chi-square test revealed significant association between categories of health professionals and knowing that poliomyelitis treatment can involve admission to the intensive care unit due to respiratory impairment (p<0.001).

Surprisingly, 15 health professionals (2.6%) said they were afraid to live with people with poliomyelitis (Table 2). The Chi-square test revealed significant association between categories of health professionals and being afraid to live with people with poliomyelitis (p = 0.001).

Only 230 (39.8%) had received information about how to deal with patients with poliomyelitis during their undergraduate course. Specifically, 59.5% of physicians, 59.6% of physical therapists, 40.6% of nurses, 3.8% of nutritionists and 8.9% of psychologists received information about poliomyelitis during their undergraduate course. The Chi-square test revealed a significant association between categories of health professionals and the provision of information about poliomyelitis during undergraduate courses (p<0.001).

Regarding physical exercise, 92.8% of physicians, 90.7% of physical therapists, 79.0% of nurses, 64.1% of nutritionists and 66.1% of psychologists responded that people with poliomyelitis sequelae can perform some kind of physical activity. The Chi-square test revealed significant association between categories of health professionals and knowing about physical exercise (p<0.001).

3.2 Knowledge about post-poliomyelitis syndrome
The second part of the questionnaire was designed to assess knowledge about PPS. Out of the 578 subjects approached, 243 (42%) heard about PPS (Table 3). Specifically, 60.9% of physicians, 67.5% of physical therapists, 34.8% of nurses, 12.8% of nutritionists and 19.6% of psychologists had heard about PPS. The Chi-square test revealed significant association between categories of health professionals and having heard about PPS (p<0.001).

Out of the 578 subjects approached, 373 (65.6%) answered that they had received no information about PPS. While 53.6% of physicians and 54.3% of physical therapists had received information about PPS, only 26.3% of nurses, 6.4% of nutritionists and 14.3% of psychologists had received information about PPS (Table 3). The Chi-square test revealed a significant association between categories of health professionals and having received information about PPS (p<0.001).

Regarding pathophysiology, 302 (52.2%) did not know that the PPS affects only people who have had paralytic poliomyelitis in the past. While 33.3% of physicians and 42.4% of physical therapists knew that PPS is a disease that only affects patients who have had paralytic poliomyelitis, only 29% of nurses, 19.2% of nutritionists and 16.1% psychologists understood this. The Chi-square test revealed a significant association between categories of health professionals and knowing that PPS is a disease that only affects patients who have had paralytic poliomyelitis (p<0.001).

In respect of restrictions that the patient must obey, 276 (47.8%) did not know whether there is restriction on physical activity for people with poliomyelitis sequelae and only 216 (37.4%) know that exercise should be limited in people with paralytic poliomyelitis sequelae (especially intense exercise). Specifically, 31.9% of physicians, 37.7% of physical therapists, 45.5% of nurses, 74.4% of nutritionists and 66.1% of psychologists did not know about any restriction of intense physical activity for PPS patients. The Chi-square
test revealed a significant association between categories of health professionals and knowing about any restriction of intense physical activity for PPS patients (p<0.001). Furthermore, 50% of health professionals answered that PPS patients can perform any type of physical activity and only 2.9% of health professionals correctly answered that PPS patients cannot perform any type of physical activity (Table 3). The Chi-square test revealed a significant association between categories of health professionals and knowing that PPS patients cannot perform any type of physical activity (p<0.001).

Regarding treatment, 386 (66.9%) believed that clinical follow-up is necessary, even years after acute poliomyelitis, while 156 (27.0%) did not know whether there is a need for clinical follow-up years after polio frame. The Chi-square test revealed a significant association between categories of health professionals and knowing about need for clinical follow-up of patients years after having been affected by poliomyelitis (p<0.001).

Still regarding treatment, approximately 61.1% of health professionals did not know if there is an effective treatment for PPS. Specifically, 42.0% of physicians, 50.3% of physical therapists, 63.8% of nurses, 84.6% of nutritionists and 71.4% of psychologists did not know about this issue. The Chi-square test revealed a significant association between categories of health professionals and this matter (p<0.001).

With respect to diagnosis, 287 (49.7%) did not know that the most appropriate way to diagnose PPS is based on symptomatology. Specifically, 34.8% of physicians, 38.4% of physical therapists, 47.8% of nurses, 71.8% of nutritionists and 75% of psychologists did not know about this issue. The Chi-square test revealed a significant association between categories of health professionals and this matter (p<0.001).

Regarding PPS etiology, only 104 (18.0%) knew that poliovirus is not responsible for PPS. Specifically, 44.9% of physicians, 23.2% of physical therapists, 14.3% of nurses, 2.6% of nutritionists and 7.1% of psychologists did not know about this issue. The Chi-square test
revealed a significant association between categories of health professionals and this matter \( (p<0.001) \).

Regarding PPS classification, 232 health professionals \((40.1\%)\) did not know that PPS is a neuromuscular disease. Specifically, 34.8\% of physicians, 26.5\% of physical therapists, 36.6\% of nurses, 62.8\% of nutritionists and 66.1\% of psychologists did not know about this issue. The Chi-square test revealed a significant association between categories of health professionals and this matter \( (p<0.001) \).

Regarding the main clinical manifestations presented by PPS patients, 285 of health professionals \((49.3\%)\) did not know that the main clinical manifestations of PPS are new weakness, fatigue, and muscle and/or joint pain. Specifically, while 58\% of physicians, 70.9\% of physical therapists and 46.4\% of nurses knew about this topic, only 25.6\% of nutritionists and 26.8\% knew that PPS patients can present with new weakness, fatigue, and muscle and/or joint pain. The Chi-square test revealed a significant association between categories of health professionals and this matter \( (p<0.001) \).

Furthermore, while 60.9\% of physicians, 64.9\% of physical therapists and 46.4\% of nurses knew that neuromuscular symptoms of PPS occur in limbs previously affected by poliomyelitis, only 25.6\% of nutritionists and 21.4\% of psychologists knew about this topic. The Chi-square test revealed a significant association between categories of health professionals and this matter \( (p<0.001) \). A similar pattern was found for answers to question 27.

Surprisingly, 15 \((2.6\%)\) said they are afraid to live with people with the PPS. The Chi-square test did not reveal any association between categories of health professionals and being afraid to live with a person who has PPS \( (p = 0.877) \).

Regarding the provision of information about this disease during the undergraduate course, only 62 \((10.7\%)\) participants reported that during their undergraduate course they
had access to information about the management of PPS, and only 83 health professionals (14.4%) reported that they have already provided services to people with PPS (Table 3). The Chi-square test did not reveal any association between the categories of health professionals and these topics (p<0.001).

3.3 Performance of the professionals on the knowledge assessment test on the paralytic poliomyelitis and PPS

With regard to the questionnaire created, professionals scored on average 11.0 ± 4.4 (which corresponds to approximately 55% of the total score), out of a maximum score of 20. Specifically, the Kruskal-Wallis test [$X^2(4) = 107.500; p<0.001$] demonstrated that the performance of physicians, physiotherapists and nurses was significantly higher than nutritionists and psychologists (p<0.05, Figure 1) and the performance of physicians and physical therapists was significantly higher than that of nurses, nutritionists and psychologists (p<0.05).

We also found that health professionals who had received previous information about poliomyelitis and PPS had significantly higher scores than those who had never received information (p<0.001). On average, this difference was approximately 28.6% (Figure 2). Five volunteers did not respond to this question.

4. Discussion

This study evaluated knowledge about paralytic poliomyelitis and PPS among health professionals (physicians, physical therapists, nurses, nutritionists and psychologists). Considering that the success of treatment of a disease depends on the knowledge level
that the health professional has about etiology, signals and symptoms and management of the disease, studies that aim to investigate the knowledge of these professionals about a particular disease are very important. Despite finding misconceptions about poliomyelitis and PPS in all health professional categories assessed, our results revealed that physicians, physical therapists and nurses present a higher knowledge about poliomyelitis and PPS than nutritionists and psychologists. Furthermore, we found that those who had received previous information about poliomyelitis and PPS had significantly higher scores than those that had never received information.

Previous studies have investigated health professional knowledge about certain diseases. Morin et al. [34] investigated physicians’ knowledge about cryptosporidiosis and reported that these professionals do not have adequate knowledge about this disease. Vancini et al. [27] investigated the knowledge of physical education professionals about epilepsy and also found low knowledge among these professionals. Regarding paralytic poliomyelitis and PPS, de Lira et al. [8] found that physical education professionals had low knowledge about these diseases. Therefore, our results are in line with the literature.

The low knowledge about paralytic poliomyelitis and PPS can be explained because poliomyelitis is an eradicated disease in various countries (including Brazil) [35]. In addition, PPS is a relatively unknown disease and physicians commonly confound the signals and symptoms of disease with the aging process. Only recently, as a result of an initiative led by professionals from the Federal University of São Paulo, PPS was included in the International Classification of Diseases [36]. Therefore, our findings are expected.

It is necessary to highlight that low levels of knowledge demonstrated by health professionals (especially by nutritionists and psychologists) are worrying, because professional attitudes about an illness can be influenced by the professional knowledge level [8,27,28]. In this context, we found that health professionals who had received
previous information about poliomyelitis and PPS had significantly higher scores than those who had never received information. This result suggests that universities should include information about poliomyelitis and PPS in their undergraduate curricula to improve attitudes in students and, consequently, in future professionals. Not least, this result suggests that continuing education programs should be implemented as a government initiative. Furthermore, the low knowledge about paralytic poliomyelitis and PPS is worrying, because it is reasonable to assume that low knowledge could decrease professionals’ counseling about the importance of vaccines.

We also found that physicians, physical therapists and nurses presented a higher knowledge than psychologists and nutritionists, as demonstrated by the scores in the knowledge assessment test. Considering that approximately 90% of physicians, physical therapists and nurses had access to information on how to deal with poliomyelitis in their graduate studies and that these values fall to approximately 50% among nutritionists and psychologists, this result is expected. In particular, it is extremely important that physicians have a high knowledge about the criteria for diagnosing PPS, because it is a syndrome whose symptoms include new muscle weakness and muscle fatigue, for those patients who have a history paralytic poliomyelitis [22,25]. However only 33% of physicians had the knowledge that PPS affects those who have had polio in the past and this is important because it is the main diagnostic criterion.

Regards knowing that PPS is considered a progressive neuromuscular disease, with a slow worsening of signs and symptoms, approximately 51% of physicians had the right knowledge, while 42% of physiotherapists, 43% of nurses, 21% of physical education professionals, 26% of nutritionists and 27% of psychologists had the correct knowledge. This shows a wide difference in knowledge among health professionals. This result can probably be explained by the fact that physicians, physiotherapists and nurses are directly
involved in diagnosis and treatment in hospitals and clinics [25]. Whereas physical education professionals only have a participation in treatment via provision of physical exercise regimes [8] and the participation of nutritionists and psychologists is associated with ameliorating secondary symptoms, such as recent body mass gain [37] and mood disorders [35].

Despite paralytic poliomyelitis being eradicated in most countries (including Brazil), there are still some countries with new cases of paralytic poliomyelitis [38]. In 2018, WHO recorded 32 cases of poliomyelitis derived from wild poliovirus and 105 cases of poliomyelitis derived from circulating vaccine-derived poliovirus [38]. Furthermore, in the recent humanitarian crisis due to civil war in Syria, the WHO officially acknowledged an outbreak on October 29, 2013. In May 2014, the WHO declared polio a global health emergency for the first time in the organization’s history. It was a substantial challenge to the 25-year-old efforts of the Global Polio Eradication Initiative, which had been successful in eliminating polio from Syria in 1995 [39]. Specifically in Brazil, authorities have reported difficulties in attaining vaccine coverage in the 2018 campaign against paralytic poliomyelitis [40]. For this reason, Brazilian authorities have launched another vaccine campaign in order to reach the vaccine coverage recommended by the WHO [40].

Altogether, this information reinforces the need to improve attitude and increase knowledge about poliomyelitis and PPS among health professionals.

Our study has some limitations. Firstly, as for all studies employing questionnaires, the present results rely on the honesty and level of recall of respondents. Secondly, the reliability and validity of the instrument used to gather the data for this study has not been determined, although the questionnaire was previously evaluated by two experienced researchers. Nevertheless, we believe that these limitations do not prevent the study’s conclusions from being drawn.
In conclusion, our study showed that, overall, there is a lack of knowledge about PPS and poliomyelitis (especially among psychologists and nutritionists). Therefore, the services given by these professionals may be compromised. Furthermore, government initiatives should be implemented to increase knowledge among health professionals.

Declarations

Acknowledgements: We would like to thank all of the participants who volunteered their time to participate in the study.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Funding: This work was supported by the Fundação de Amparo à Pesquisa do Estado de Goiás (FAPEG-Brazil) (grant number 201210267001056) and financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001. DATS had a fellowship from the Programa de Apoio à Capacitação Docente e de Técnicos Administrativos da Universidade do Estado da Bahia (PAC-DT/UNEB, Brazil) and RBV had a fellowship from Coordenação de Aperfeiçoamento de Pessoal de Ensino Superior (CAPES, Brazil).

Ethics, consent and permissions: All subjects were informed of the intent and experimental procedures and written informed consent was obtained from each participant before any data were collected. All procedures involved in this study were approved by the Federal University of Goiás Ethics Committee (protocol number: 198/2009) and followed the principles outlined in the Declaration of Helsinki.

Consent for publication: Not applicable

Competing interests: The authors declare that they have no competing interests.

Author contributions: CABL: study concept and design, data acquisition, analysis,
interpretation, and manuscript preparation; DATS and RBV: data acquisition, data analysis, and manuscript preparation; JMG, JNSO, SABR, BSS, MGS and RLV: study concept and design, data analysis, interpretation, and manuscript preparation; MSA: study concept and design, data analysis, interpretation, manuscript preparation, and critical revision of the manuscript.

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Tables

Table 1: Characteristics of participants (n=162).
| Variable                  | Medicine (n=96) | Physiotherapy (n=151) | Nursing (n=225) | Nutrition (n=78) | Psychology (n=56) |
|---------------------------|-----------------|-----------------------|-----------------|-----------------|------------------|
| Age                       | 42.0±13.4       | 32.1±8.3*             | 33.7±14.0*      | 30.3±8.0†       | 36.1±11.5*       |
| Professional experience   | 17.8±12.6       | 8.2±8.0*              | 7.9±8.8*        | 7.3±9.1*        | 11.2±9.3*        |

Data are presented as mean ± standard deviation.

*Statistically different from medicine (one-way ANOVA, Turkey post-test. p<0.05).
†Statistically different from psychology (one-way ANOVA, Turkey post-test. p<0.05).

Table 2 Answers of health professionals related to poliomyelitis.

| Questions                                                                 | Medicine (n=69 (%)) | Physiotherapy (n=151 (%)) | Nursing (n=224 (%)) | Nutrition (n=78 (%)) | Psychology (n=56 (%)) | p Value of $\chi^2$ test |
|---------------------------------------------------------------------------|---------------------|---------------------------|---------------------|---------------------|------------------------|--------------------------|
| Have you heard about poliomyelitis?                                       |                     |                           |                     |                     |                        |                          |
| Yes                                                                       | 69 (100)            | 151 (100)                 | 222 (99.1)          | 78 (100)            | 56 (100)               | 0.004                    |
| No                                                                        | 0 (0.0)             | 0 (0.0)                   | 2 (0.9)             | 0 (0.0)             | 0 (0.0)                |                          |
| a/b/c/d                                                                  |                     | a/e/f/g                   | b/e/h/i             | c/f/h/j             | d/g/i/j                |                          |
| Have you had information about poliomyelitis (books, pamphlets and lectures)? |                     |                           |                     |                     |                        |                          |
| Yes                                                                       | 64 (92.8)           | 137 (90.7)                | 198 (88.4)          | 34 (43.6)           | 28 (50)                | <0.001                   |
| No                                                                        | 5 (7.2)             | 14 (9.3)                  | 26 (11.6)           | 44 (56.4)           | 28 (50)                |                          |
| Did not know                                                              | 0 (0.0)             | 0 (0.0)                   | 0 (0.0)             | 0 (0.0)             | 0 (0.0)                |                          |
| Did not answer                                                            | 0 (0.0)             | 0 (0.0)                   | 0 (0.0)             | 0 (0.0)             | 0 (0.0)                |                          |
| a/b                                                                      |                     | a/c                       | b/c                 | d                   | d                       |                          |
| Is poliomyelitis caused by a virus?*                                      |                     |                           |                     |                     |                        |                          |
| Yes                                                                       | 68 (98.6)           | 137 (90.7)                | 209 (93.3)          | 56 (71.8)           | 39 (69.6)              | <0.001                   |
| No                                                                        | 0 (0.0)             | 5 (3.3)                   | 8 (3.6)             | 4 (5.1)             | 6 (10.7)               |                          |
| Did not know                                                              | 1 (1.4)             | 7 (4.6)                   | 7 (3.10)            | 18 (23.1)           | 11 (19.6)              |                          |
| Did not answer                                                            | 0 (0.0)             | 2 (1.3)                   | 0 (0.0)             | 0 (0.0)             | 0 (0.0)                |                          |
| a/b/c                                                                     |                     | a/d/e                     | b/d/f               | g                   | c/e/f/g                 |                          |
| Can poliomyelitis be spread through water and/or food contaminated with feces from a sick person?* |                     |                           |                     |                     |                        |                          |

...
| Question                                                                 | Yes          | No            | Did not know | Did not answer | a/b | a/c/d | b/c/e | d/e |
|--------------------------------------------------------------------------|--------------|---------------|--------------|---------------|-----|-------|-------|-----|
| Can poliomyelitis cause gastrointestinal symptoms?*                     | 50 (72.5)    | 8 (11.6)      | 11 (15.9)    | 0 (0.0)       |     |       |       |     |
|                                                                          | 62 (41.1)    | 25 (16.6)     | 63 (41.7)    | 1 (0.7)       |     |       |       |     |
|                                                                          | 109 (48.7)   | 61 (27.2)     | 54 (24.1)    | 0 (0.0)       |     |       |       |     |
|                                                                          | 21 (26.9)    | 25 (32.1)     | 32 (41)      | 0 (0.0)       |     |       |       |     |
|                                                                          | 15 (26.8)    | 8 (14.3)      | 33 (58.9)    | 0 (0.0)       |     |       |       |     |
| Can poliomyelitis cause neuromuscular symptoms such as paralysis, paresis, muscle atrophy and weakness?* | 68 (98.6)    | 0 (0.0)       | 0 (0.0)      | 0 (0.0)       |     |       |       |     |
|                                                                          | 146 (96.7)   | 2 (1.3)       | 3 (2)        | 0 (0.0)       |     |       |       |     |
|                                                                          | 222 (99.1)   | 1 (0.4)       | 1 (0.4)      | 0 (0.0)       |     |       |       |     |
|                                                                          | 76 (97.4)    | 2 (2.6)       | 2 (2.6)      | 0 (0.0)       |     |       |       |     |
|                                                                          | 52 (92.9)    | 3 (5.4)       | 3 (5.4)      | 0 (0.0)       |     |       |       |     |
| After the acute poliomyelitis stage, can patients recover functional capacity of affected structures fully or partially?* | 57 (82.6)    | 9 (13)        | 1 (1.4)      | 2 (2.9)       |     |       |       |     |
|                                                                          | 106 (70.2)   | 41 (27.2)     | 4 (2.6)      | 0 (0.0)       |     |       |       |     |
|                                                                          | 121 (54)     | 63 (28.1)     | 40 (17.9)    | 0 (0.0)       |     |       |       |     |
|                                                                          | 26 (33.3)    | 17 (21.8)     | 34 (43.6)    | 1 (1.3)       |     |       |       |     |
|                                                                          | 27 (48.2)    | 11 (19.6)     | 18 (32.1)    | 0 (0.0)       |     |       |       |     |
| Is poliomyelitis eradicated around the world?*                           | 9 (13)       | 55 (79.7)     | 5 (7.2)      | 0 (0.0)       |     |       |       |     |
|                                                                          | 36 (23.8)    | 96 (63.9)     | 19 (12.6)    | 0 (0.0)       |     |       |       |     |
|                                                                          | 53 (23.7)    | 148 (66.1)    | 23 (10.3)    | 0 (0.0)       |     |       |       |     |
|                                                                          | 17 (21.8)    | 50 (64.1)     | 11 (14.1)    | 0 (0.0)       |     |       |       |     |
|                                                                          | 11 (19.6)    | 36 (64.3)     | 9 (16.1)     | 4 (5.1)       |     |       |       |     |
| Is there a vaccine available to prevent poliomyelitis?*                 | 69 (100)     | 0 (0.0)       | 0 (0.0)      | 0 (0.0)       |     |       |       |     |
|                                                                          | 148 (98)     | 1 (0.7)       | 2 (0.9)      | 0 (0.0)       |     |       |       |     |
|                                                                          | 220 (98.2)   | 2 (0.9)       | 4 (5.1)      | 0 (0.0)       |     |       |       |     |
|                                                                          | 74 (94.9)    | 0 (0.0)       | 3 (5.4)      | 0 (0.0)       |     |       |       |     |
Did not answer 0 (0.0) 0 (0.0) 0 (0.0) 0 (0.0) 0 (0.0)

May poliomyelitis treatment involve admission to the intensive care unit due to respiratory impairment?*

|       | Yes     | 65 (94.2) | 119 (78.8) | 165 (73.7) | 26 (33.3) | 17 (30.4) |
|-------|---------|-----------|------------|------------|-----------|-----------|
|       | No      | 2 (2.9)   | 6 (4)      | 20 (8.9)   | 2 (2.6)   | 4 (7.1)   |
|       | Did not know | 2 (2.9) | 26 (17.2) | 39 (17.4) | 50 (64.1) | 35 (62.5) |
|       | Did not answer | 0 (0.0) | 0 (0.0)   | 0 (0.0)    | 0 (0.0)   | 0 (0.0)   |

Are you afraid to live with a person who had poliomyelitis?

|       | Yes     | 0 (0.0)   | 0 (0.0)    | 13 (5.8)   | 0 (0.0)   | 2 (3.6)   |
|-------|---------|-----------|------------|------------|-----------|-----------|
|       | No      | 69 (100)  | 146 (96.7) | 207 (92.4) | 77 (98.7) | 53 (94.6) |
|       | Did not know | 0 (0.0) | 0 (0.0)   | 0 (0.0)    | 0 (0.0)   | 0 (0.0)   |
|       | Did not answer | 0 (0.0) | 5 (3.3)   | 4 (1.8)    | 1 (1.3)   | 1 (1.8)   |

During your undergraduate course, have you had access to information on how to handle patients with poliomyelitis in your future profession?

|       | Yes     | 41 (59.4) | 90 (59.6) | 91 (40.6) | 3 (3.8)   | 5 (8.9)   |
|-------|---------|-----------|-----------|-----------|-----------|-----------|
|       | No      | 28 (40.6) | 60 (39.7) | 128 (57.1)| 75 (96.2) | 51 (91.1) |
|       | Did not know | 0 (0.0) | 0 (0.0)   | 0 (0.0)    | 0 (0.0)   | 0 (0.0)   |
|       | Did not answer | 0 (0.0) | 1 (0.7)   | 5 (2.2)    | 0 (0.0)   | 0 (0.0)   |

In your practice, have you ever provided a service for people with sequelae of poliomyelitis?

|       | Yes     | 48 (69.6) | 78 (51.7) | 82 (36.6) | 10 (12.8) | 12 (21.4) |
|-------|---------|-----------|-----------|-----------|-----------|-----------|
|       | No      | 21 (30.4) | 69 (45.7) | 137 (61.2)| 68 (87.2) | 43 (76.8) |
|       | Did not know | 0 (0.0) | 0 (0.0)   | 0 (0.0)    | 0 (0.0)   | 0 (0.0)   |
|       | Did not answer | 0 (0.0) | 4 (2.6)   | 5 (2.2)    | 0 (0.0)   | 1 (1.8)   |

Can people with sequelae of poliomyelitis perform any type of physical activity?*

|       | Yes     | 64 (92.8) | 137 (90.7) | 177 (79)  | 50 (64.1) | 37 (66.1) |
|-------|---------|-----------|------------|-----------|-----------|-----------|
|       | No      | 1 (1.4)   | 3 (2)      | 18 (8)    | 2 (2.6)   | 4 (7.1)   |
|       | Did not know | 4 (5.8) | 11 (7.3)   | 29 (12.9) | 26 (33.3) | 15 (26.8) |
|       | Did not answer | 0 (0.0) | 0 (0.0)   | 0 (0.0)    | 0 (0.0)   | 0 (0.0)   |

*Question that composed the knowledge assessment test on the paralytic poliomyelitis
Table 3 Answers of health professionals related to post-poliomyelitis syndrome (PPS).

| Questions                                                                 | Medicine          | Physiotherapy | Nursing       | Nutrition   | Psychology | p Value |
|---------------------------------------------------------------------------|-------------------|---------------|---------------|-------------|------------|---------|
| Have you heard about PPS?                                                |                   |               |               |             |            |         |
| Yes                                                                       | 42 (60.9)         | 102 (67.5)    | 78 (34.8)     | 10 (12.8)   | 11 (19.6)  | <0.001  |
| No                                                                        | 26 (37.7)         | 29 (32.5)     | 145 (64.7)    | 68 (87.2)   | 45 (80.4)  |         |
| Did not know                                                              | 0 (0.0)           | 0 (0.0)       | 0 (0.0)       | 0 (0.0)     | 0 (0.0)    |         |
| Did not answer                                                            | 1 (1.4)           | 0 (0.0)       | 1 (0.4)       | 0 (0.0)     | 0 (0.0)    |         |
| Have you received information about PPS?                                  | 37 (53.6)         | 82 (54.3)     | 59 (26.3)     | 5 (6.4)     | 8 (14.3)   | <0.001  |
| No                                                                        | 32 (46.4)         | 69 (45.7)     | 159 (71)      | 72 (92.3)   | 47 (83.9)  |         |
| Did not know                                                              | 0 (0.0)           | 0 (0.0)       | 0 (0.0)       | 0 (0.0)     | 0 (0.0)    |         |
| Did not answer                                                            | 0 (0.0)           | 0 (0.0)       | 6 (2.7)       | 1 (1.3)     | 1 (1.8)    |         |
| Is PPS a disease that only affects patients who have had paralytic poliomyelitis?* | 23 (33.3)         | 64 (42.4)     | 65 (29)       | 15 (19.2)   | 9 (16.1)   | <0.001  |
| No                                                                        | 19 (27.5)         | 27 (17.9)     | 41 (18.3)     | 4 (5.1)     | 9 (16.1)   |         |
| Did not know                                                              | 27 (39.1)         | 60 (39.7)     | 118 (52.7)    | 59 (75.6)   | 38 (67.9)  |         |
| Did not answer                                                            | 0 (0.0)           | 0 (0.0)       | 0 (0.0)       | 0 (0.0)     | 0 (0.0)    |         |
| Is there any restriction of intense physical activity for poliomyelitis patients?* | 30 (43.5)         | 72 (47.7)     | 83 (37.1)     | 16 (20.5)   | 15 (26.8)  | <0.001  |
| No                                                                        | 17 (24.6)         | 22 (14.6)     | 39 (17.4)     | 4 (5.1)     | 4 (7.1)    |         |
| Did not know                                                              | 22 (31.9)         | 57 (37.7)     | 102 (45.5)    | 58 (74.4)   | 37 (66.1)  |         |
| Did not answer                                                            | 0 (0.0)           | 0 (0.0)       | 0 (0.0)       | 0 (0.0)     | 0 (0.0)    |         |
| Can people with PPS perform any type of physical activity?*               | 48 (69.6)         | 104 (68.9)    | 95 (42.4)     | 23 (29.5)   | 19 (33.9)  | <0.001  |
| No                                                                        | 1 (1.4)           | 2 (1.3)       | 12 (5.4)      | 1 (1.3)     | 1 (1.8)    |         |
| Did not know                                                              | 20 (29)           | 45 (29.8)     | 117 (52.2)    | 54 (69.2)   | 36 (64.3)  |         |
| Did not answer                                                            | 0 (0.0)           | 0 (0.0)       | 0 (0.0)       | 0 (0.0)     | 0 (0.0)    |         |
Is there a need for clinical follow-up of patients years after having been affected by poliomyelitis?*

|        | Yes        | No         | Did not know | Did not answer |
|--------|------------|------------|--------------|---------------|
|        | 48 (69.6)  | 115 (76.2) | 156 (69.6)   | 40 (51.3)     |
|        | 8 (11.6)   | 4 (2.6)    | 17 (7.6)     | 4 (5.1)       |
|        | 13 (18.8)  | 31 (20.5)  | 51 (22.8)    | 34 (43.6)     |
|        | 0 (0.0)    | 1 (0.7)    | 0 (0.0)      | 0 (0.0)       |

<0.001

Is the most appropriate way to diagnose PPS based on symptomatology?*

|        | Yes        | No         | Did not know | Did not answer |
|--------|------------|------------|--------------|---------------|
|        | 39 (56.5)  | 86 (57)    | 106 (47.3)   | 16 (20.5)     |
|        | 6 (8.7)    | 6 (4)      | 11 (4.9)     | 6 (7.7)       |
|        | 24 (34.8)  | 58 (38.4)  | 107 (47.8)   | 56 (71.8)     |
|        | 0 (0.0)    | 1 (0.7)    | 0 (0.0)      | 0 (0.0)       |

<0.001

Because it is a poorly understood syndrome, there is still no effective form of treatment.*

|        | Yes        | No         | Did not know | Did not answer |
|--------|------------|------------|--------------|---------------|
|        | 30 (43.5)  | 34 (22.5)  | 52 (23.2)    | 8 (10.3)      |
|        | 10 (14.5)  | 39 (25.8)  | 29 (12.9)    | 4 (5.1)       |
|        | 29 (42)    | 76 (50.3)  | 143 (63.8)   | 66 (84.6)     |
|        | 0 (0.0)    | 2 (1.3)    | 0 (0.0)      | 0 (0.0)       |

<0.001

Is the poliovirus responsible for onset of PPS?*

|        | Yes        | No         | Did not know | Did not answer |
|--------|------------|------------|--------------|---------------|
|        | 13 (18.8)  | 42 (27.8)  | 76 (33.9)    | 11 (14.1)     |
|        | 31 (44.9)  | 35 (23.2)  | 32 (14.3)    | 2 (2.6)       |
|        | 25 (36.2)  | 73 (48.3)  | 115 (51.3)   | 65 (83.3)     |
|        | 0 (0.0)    | 1 (0.7)    | 1 (0.4)      | 0 (0.0)       |

<0.001

Is PPS considered a neuromuscular disease?*

|        | Yes        | No         | Did not know | Did not answer |
|--------|------------|------------|--------------|---------------|
|        | 44 (63.8)  | 104 (68.9) | 138 (61.6)   | 28 (35.9)     |
|        | 1 (1.4)    | 6 (4)      | 4 (1.8)      | 1 (1.3)       |
|        | 24 (34.8)  | 40 (26.5)  | 82 (36.6)    | 49 (62.8)     |
|        | 0 (0.0)    | 1 (0.7)    | 0 (0.0)      | 0 (0.0)       |

<0.001

Are the following main clinical manifestations presented by PPS patients: new weakness, fatigue, and muscle and/or joint pain?*

|        | Yes        | No         | Did not know | Did not answer |
|--------|------------|------------|--------------|---------------|
|        | 40 (58)    | 107 (70.9) | 104 (46.4)   | 20 (25.6)     |
|        | 3 (4.3)    | 0 (0.0)    | 2 (0.9)      | 0 (0.0)       |

<0.001
### Questionnaire Results

| Question                                                                 | Yes (%) | No (%) | Did not know (%) | Did not answer (%) |
|--------------------------------------------------------------------------|---------|--------|------------------|-------------------|
| Did not know paralytic poliomyelitis?                                    | 26 (37.7) | 42 (27.8) | 118 (52.7) | 58 (74.4) | 41 (73.2) |
| Did not answer                                                           | 0 (0.0) | 2 (1.3) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| Can neuromuscular symptoms of PPS occur in limbs previously affected by poliomyelitis? * | 42 (60.9) | 98 (64.9) | 104 (46.4) | 20 (25.6) | 12 (21.4) | <0.001 |
| Did not know                                                           | 3 (4.3) | 1 (0.7) | 6 (2.7) | 0 (0.0) | 1 (1.8) |
| Did not answer                                                           | 24 (34.8) | 50 (33.1) | 114 (50.9) | 58 (74.4) | 43 (76.8) |
| Can PPS be considered a progressive neuromuscular disease, presenting a slow worsening of signs and symptoms? * | 35 (50.7) | 62 (41.1) | 98 (43.8) | 20 (25.6) | 15 (26.8) | <0.001 |
| Did not know                                                           | 7 (10.1) | 26 (17.2) | 14 (6.2) | 1 (1.3) | 2 (3.6) |
| Did not answer                                                           | 27 (39.1) | 60 (39.7) | 112 (50) | 56 (71.8) | 39 (69.6) |
| Are you afraid to live with a person who has PPS?                       | 1 (1.4) | 3 (2) | 7 (3.1) | 2 (2.6) | 2 (3.6) | 0.57 |
| Did not know                                                           | 68 (98.6) | 146 (96.7) | 214 (95.5) | 76 (97.4) | 54 (96.4) |
| Did not answer                                                           | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| During your undergraduate course, have you had access to information on how to handle PPS? | 10 (14.5) | 40 (26.5) | 12 (5.4) | 0 (0.0) | 0 (0.0) | <0.001 |
| Did not know                                                           | 59 (85.5) | 109 (72.2) | 208 (92.9) | 78 (100) | 56 (100) |
| Did not answer                                                           | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| In your practice, have you ever provided a service for people with PPS? | 18 (26.1) | 46 (30.5) | 16 (7.1) | 2 (2.6) | 1 (1.8) | <0.001 |
| Did not know                                                           | 50 (72.5) | 103 (68.2) | 204 (91.1) | 75 (96.2) | 55 (98.2) |
| Did not answer                                                           | 1 (1.4) | 2 (1.3) | 4 (1.8) | 1 (1.3) | 0 (0.0) |

*Question that composed the knowledge assessment test on paralytic poliomyelitis and
PPS. Frequencies followed by similar letters, in the rows, do not differ.

Figures

![Box plot showing questionnaire results](image)

**Figure 1**

Questionnaire result (0–20) separated by categories of health professionals.

*Statistically different from medicine; †Statistically different from physiotherapy; ‡Statistically different from nursing (Kruskal-Wallis Test, Dunn post-test. p<0.05).
Questionnaire result (0–20) separated by health professionals with (n = 191) or without (n = 387) access to information about poliomyelitis and post-poliomyelitis syndrome. *Statistically different from ‘No’. The Mann-Whitney test (p<0.05).