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Evaluating public awareness and knowledge of multiple sclerosis in Tobruk, Libya: a comprehensive cross-sectional study

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Abstract

Background Multiple sclerosis (MS) is a chronic and often disabling disease that impacts the central nervous system, leading to significant public health concerns. This study aimed to assess the level of awareness and knowledge of MS among the population of Tobruk, Libya.

Methods A community-based cross-sectional study was conducted in Tobruk, Libya, during August 2023. A total of 1,427 participants were surveyed using the Multiple Sclerosis Knowledge Questionnaire (MSKQ-25). Data were collected via an online Google form and analyzed using RStudio and SPSS. The analysis included descriptive statistics, Chi-square tests, t-tests, Mann-Whitney tests, ANOVA, Kruskal-Wallis tests, and Pearson's correlation coefficients.

Results The study found a low level of MS awareness among participants, with a mean MSKQ-25 score of 8.32 ± 5.44 . Significant differences in MS knowledge were observed between individuals with relatives who had MS and those without ($p < 0.001$), and between medical field students and students from other backgrounds ($p < 0.001$). No significant association was found between MS knowledge scores and marital status or educational levels. However, significant associations were observed between MS knowledge and age, gender, and financial status ($p < 0.05$ for all). The majority of participants lacked knowledge about genetics, etiology, and treatment of MS.

Conclusion The findings highlight a critical need for comprehensive public outreach and education programs to improve MS awareness in Tobruk, Libya. Health education initiatives focused on MS are essential for increasing community knowledge, facilitating early detection, and improving disease management. Further research is needed to understand the reasons for misinformation and to develop strategies for increasing awareness across the country.

Keywords Multiple sclerosis, Neurological diseases, Health Knowledge, Attitudes, Practice, Tobruk

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Introduction

Multiple Sclerosis (MS) is a chronic autoimmune inflammatory disease of the central nervous system; this disease is characterized by variable pathophysiological mechanisms which causing variable clinical presentations that are influenced by genetic and environmental factors [1]. Predominantly affecting young adults, MS demonstrates a higher prevalence in women, though some individuals, particularly those with relapsing-remitting MS (RRMS), may present with their initial demyelinating episode during childhood or adolescence [2].

About 2.8 million people are affected by MS worldwide, with a global prevalence of 35.9 per 100,000. However, the incidence depends on the geographical location [3]. An increasing prevalence of MS has also been reported across the Middle East and North African region and comes mostly from Saudi Arabia, Iraq, Libya, Kuwait, Tunisia, and Jordan [4]. In Libya, the sole epidemiological study conducted in 1985 reported a crude prevalence rate of 4 per 100,000 and an age-adjusted prevalence rate of 5.9 per 100,000 [5].

MS is classified as an organ-specific disease, distinguished by the destruction of myelin and mediated by autoreactive T-helper 17 (Th17) and T-helper 1 (Th1) cells [2]. These T cells release proinflammatory cytokines that recruit additional immune cells to target and dismantle the myelin sheaths surrounding neuronal fibers, resulting in axonal injury and subsequent scarring. This pathology can severely impair mobility, vision, and cognitive function, underscoring the importance of early diagnosis and intervention [2]. The clinical presentation of MS is highly variable, contingent upon the specific regions of the brain or spinal cord affected by the disease. Neurological manifestations can include loss of balance, visual impairment, mood changes, fatigue, weakness, numbness, pain, bladder dysfunction, and cognitive impairments [6]. Given that RRMS is an inflammatory condition, attacks typically initiate gradually and escalate over several days [7].

This heterogeneity in clinical presentation contributes to delayed recognition of MS, which in turn leads to a worse outcome, highlighting the importance of early intervention for managing symptoms effectively and preventing long-term disability [6, 7]. Furthermore, patients with MS and their families experienced major psychological, physical, and social difficulties [8]. Since MS is an unexpected, debilitating condition affecting the central nervous system, the advantages of early intervention are greater the more people are informed about the disease.

Since there was limited data regarding the awareness of MS in Libya [5], the purpose of this study was to evaluate the knowledge and attitudes concerning MS among the Libian community residing in Tobruk city. This data might be used to create more focused public

health awareness campaigns that could support MS early intervention.

Methods

Study design and study period

This research was conducted as a community-based cross-sectional study aimed at evaluating the awareness and knowledge of Multiple Sclerosis (MS) among the general population in Tobruk, Libya. The study was carried out over the course of August 2023, encompassing a one-month data collection period. This design was chosen to capture a broad snapshot of the community's understanding of MS at a specific point in time, providing valuable insights into public health education needs in the region.

Sample size

The sample size was initially calculated using the Rao-soft Sample Size Calculator, which determined that 1200 participants would be sufficient to achieve a 95% confidence level and a 5% margin of error [9]. This calculation assumed a response distribution of 50%, which is a conservative estimate ensuring the sample size is large enough to capture variability in the population. However, the final sample size reached 1,427 participants, surpassing the initial estimate due to a higher response rate than anticipated. This larger sample size significantly increases the study's statistical power. Specifically, by increasing the sample size beyond the minimum requirement, we reduce the standard error, which in turn narrows the confidence intervals around the study estimates. This reduction in variability enhances the precision of our results and strengthens the ability to detect even small effects or differences within the data, thereby increasing the reliability and validity of our findings. Furthermore, the increased sample size also improves the generalizability of the results to the broader population of Tobruk. By exceeding the calculated sample size, the study benefits from a more robust dataset, which mitigates potential biases arising from sampling error and contributes to more stable and replicable outcomes.

Inclusion and exclusion criteria

The study included adult Libyans residing in Tobruk who were aged 18 and above, representing a broad range of age groups and locations to ensure a comprehensive assessment of MS awareness in the general population. Exclusion criteria were established to maintain the focus on general public knowledge and avoid potential biases. Individuals under 18 years of age were excluded to concentrate on adult perspectives. Healthcare workers were excluded to prevent skewed results due to their potentially higher level of MS awareness stemming from professional training. Additionally, patients already

diagnosed with MS were excluded, as their experiences and potential educational interventions related to their condition could influence the study's outcomes and not accurately reflect the general public's knowledge level.

Tools and measurement

The survey comprised two sections: demographic data and the Multiple Sclerosis Knowledge Questionnaire (MSKQ-25). The MSKQ-25, used to assess participants' awareness and knowledge of MS, consists of 25 items with three to five possible responses each, scoring one point per correct answer, with a total possible score ranging from 0 to 25 [10]. The MSKQ-25 was originally developed and validated as a self-assessed instrument for newly diagnosed MS patients. The development process involved a multidisciplinary panel that created 30 multiple-choice statements, which were pre-tested and refined to an intermediate 26-item version. This version was tested on 54 MS patients to assess internal consistency, content, and construct validity, resulting in the final 25-item version. The internal consistency of the MSKQ-25 was confirmed with a Kuder-Richardson-20 coefficient of 0.76, demonstrating satisfactory reliability. The questionnaire was further validated in the SIMS-Trial, where it was used as a primary outcome measure to evaluate the impact of an information aid on MS knowledge. The study showed that the MSKQ-25 is sensitive to educational interventions and has good clinometric properties [10]. The MSKQ-25 was translated into Arabic by experts proficient in both languages using a structured process that included forward and backward translation to ensure linguistic and cultural accuracy. This translation was carried out in a study conducted in Saudi Arabia [11], was then piloted with 45 participants to further refine the tool for the target population. We obtained permission to use both the original and translated versions of the questionnaire [10, 11]. For easier interpretation of the data, the level of awareness and knowledge was categorized into three main levels: less than 50% for low knowledge, 50–70% for medium knowledge, and more than 70% for high knowledge. This categorization approach was also applied in the Saudi study, providing a consistent framework for evaluating MS knowledge levels across different populations [11]. On average, participants completed the questionnaire in approximately 6 min, a brief and manageable duration that minimized respondent fatigue.

Data collection

Data was collected using an online Google form, distributed through various social media platforms to reach a wide audience in Tobruk. To ensure the integrity of the data, several measures were implemented. Participants were required to provide unique identifiers, such as a

valid email address to google forms not us from the settings of the form, to prevent duplication of responses. Additionally, the survey included screening questions to filter out non-MS patients and individuals who did not meet the inclusion criteria. Instructions emphasized the importance of honest and accurate responses, and the purpose of the study was clearly stated to minimize the likelihood of false answers. Consent for voluntary participation was obtained, and all responses were kept confidential.

Statistical analysis

The collected data were exported from Microsoft Excel 2019 and analyzed using RStudio Version 1.4.1717 and SPSS Version 25. Quantitative variables were expressed as measures of central tendency, with mean and standard deviation used for normally distributed data and median and interquartile range for non-normally distributed data. Qualitative variables were presented as frequencies and percentages. To address the specific research questions and data characteristics, a range of statistical tests were employed. The Chi-square test was utilized for analyzing associations between qualitative variables, such as gender and MS knowledge levels, due to its suitability for categorical data. To assess the normality of numerical data distributions, the Shapiro-Wilk and Kolmogorov-Smirnov tests were applied, given their sensitivity to different distribution characteristics. For comparing the means of two groups with normally distributed data, such as MS knowledge scores between male and female participants, the Student's t-test was chosen, as it is effective for testing mean differences under the assumption of normality. In cases where data were not normally distributed, the Mann-Whitney U test was used for two-group comparisons, as it is a robust non-parametric alternative. When comparing more than two groups with normally distributed variables, one-way ANOVA was employed, while the Kruskal-Wallis test served as the non-parametric counterpart for non-normally distributed data. Pearson's correlation coefficients were calculated to assess the degree of correlation between normally distributed continuous variables, such as age and MS knowledge scores. To control the risk of Type I errors resulting from multiple comparisons, the Bonferroni correction was applied. This adjustment, detailed in the relevant sections, involved dividing the significance level ($\alpha=0.05$) by the number of comparisons to reduce the likelihood of false-positive results. Additionally, effect sizes were calculated and reported for key comparisons to provide insight into the magnitude of observed differences, complementing the *p*-values. Confidence intervals (95% CI) were consistently reported to reflect the precision of our estimates, enhancing the reliability and interpretability of

the findings. All p -values less than 0.05 were considered statistically significant.

Results

Demographic data

The study included a diverse sample of 1,427 participants aged 18 to 82 years, with a mean age of 27.84 ± 11.43 years. The gender distribution revealed a predominance of females, accounting for 82.8% ($n=1181$), while males represented 17.2% ($n=246$). Additionally, 13.5% ($n=192$) of the participants had a relative diagnosed with MS, and 49.1% ($n=700$) were from the medical field. Information regarding participants' marital status, financial status, and education level is presented in (Table 1). The mean score on the MSKQ-25 was 8.32 ± 5.44 , with a median of 9 (IQR: 4–12). The majority of participants (78%, $n=1113$) scored below 50%, indicating a low level of MS

Table 1 Sociodemographic features of the participants

Characteristic	$n = 1427$
Age	
Mean (\pm SD)	27.84 (\pm 11.43)
Gender	
Female	1181 (82.8%)
Male	246 (17.2%)
Marital status	
Single	899 (63%)
Married	484 (33.9%)
Divorced	24 (1.7%)
Widow	20 (1.4%)
Financial status	
Very low	13 (0.9%)
Low	53 (3.7%)
Moderate	1219 (85.4%)
High	142 (10%)
Educational level	
uneducated	18 (1.3%)
Secondary	243 (17.1%)
Primary school	42 (2.9%)
Middle school	42 (2.9%)
Academic	1082 (75.8%)
Relative with MS	
Yes	192 (13.5%)
No	1235 (86.5%)
Medical field	
Yes	700 (49.1%)
No	727 (50.9%)
Score	
Mean (\pm SD)	8.32 (\pm 5.44)
Score Percentile	
MSKQ score < 50%	1113 (78%)
MSKQ Score 50–70%	254 (17.8%)
MSKQ score > 70%	60 (4.2%)

MSKQ-25: Multiple sclerosis knowledge questionnaire; n: number of participants. Data are expressed as n (%) and mean \pm SD

knowledge, while 17.8% ($n=254$) scored between 50% and 70%, and only 4.2% ($n=60$) scored above 70%.

Analysis of sociodemographic factors and MS knowledge

The analysis revealed significant differences in MSKQ-25 scores across various demographic characteristics. Age was significantly associated with MS knowledge scores ($p < 0.001$), with older participants scoring higher on average, with an effect size of 0.13. For participants with MSKQ scores below 50%, ages were [mean = 27.6 years, 95%CI(26.9 to 28.3)], participants scoring between 50% and 70% on the MSKQ [mean = 27.3, 95%CI(25.9 to 28.7)], and participants scoring above 70% on the MSKQ, the average age is higher [mean = 34.9, 95%CI(32.1 to 37.8)]. Gender also showed a significant association, with males scoring higher than females ($p = 0.003$) with an effect size of 0.18 (Table 2). Marital status did not significantly affect MS knowledge scores ($p = 0.07$). However, financial status was significantly related to MS knowledge, with participants in the high financial status category scoring higher than those in other categories ($p < 0.001$) with an effect size of 0.3. Educational level did not show a significant association with MS knowledge scores ($p = 0.6$).

Having a relative with MS and being in the medical field were both significantly associated with higher MS knowledge scores ($p < 0.001$ for both), with an effect size of 0.58, and 0.39 respectively. Participants with a relative diagnosed with MS had a mean score of 11.13, compared to 7.88 for those without a relative with MS [mean difference = 3.25, 95%CI (4.14, 2.36)]. Similarly, participants from the medical field had a mean score of 9.37, compared to 7.3 for those not in the medical field [mean difference = 2.06, 95% CI (2.62, 1.51)]. (Figures 1 and 2; Table 2).

MS knowledge items

A detailed analysis of responses to MS knowledge items revealed significant differences across various aspects of MS awareness (Table 3). For instance, awareness of the organs involved in MS was significantly higher among those with higher MSKQ-25 scores ($p < 0.001$). Similarly, knowledge about the composition of the central nervous system (CNS), the impact of MS on life expectancy, and the role of myelin and axon damage in MS showed significant associations with MS knowledge scores (all $p < 0.001$). In terms of prevalence and predisposing factors, participants with higher MSKQ-25 scores demonstrated significantly better knowledge of MS prevalence worldwide, age of onset, sex ratio in MS prevalence, and the impact of pregnancy on MS (all $p < 0.001$). Additionally, knowledge about the etiology of MS, the transmission of MS to offspring and other family members, and diagnostic methods and procedures were significantly

Table 2 Relation between demographic features of participants and MSKQ score

Characteristic	MSKQ score < 50% (n = 1113)	MSKQ score 50–70% (n = 254)	MSKQ score > 70% (n = 60)	p-value
Age				< 0.001*
Mean (±SD)	27.59 (±11.32)	27.3 (±10.7)	34.9 (±14)	
Gender				0.003*
Female	929 (78.7%)	212 (17.9%)	40 (3.4%)	
Male	184 (74.8%)	42 (17.1%)	20 (8.1%)	
Marital status				0.07
Single	699 (77.8%)	172 (19.1%)	28 (3.1%)	
Married	378 (78.1%)	78 (16.1%)	28 (5.8%)	
Divorced	20 (83.3%)	2 (8.3%)	2 (8.3%)	
Widow	16 (80%)	2 (10%)	2 (10%)	
Financial status				< 0.001*
Very low	12 (92.3%)	1 (7.7%)	0 (0%)	
Low	42 (79.3%)	10 (18.8%)	1 (1.9%)	
Moderate	956 (78.4%)	222 (18.2%)	41 (3.4%)	
High	103 (72.5%)	21 (14.8%)	18 (12.7%)	
Educational level				0.6
Uneducated	16 (88.9%)	2 (11.1%)	0 (0%)	
Secondary	196 (80.7%)	36 (14.8%)	11 (4.5%)	
Primary school	34 (81%)	5 (11.9%)	3 (7.1%)	
Middle school	35 (83.3%)	5 (11.9%)	2 (4.8%)	
Academic	832 (76.9%)	206 (19%)	44 (4.1%)	
Relative with MS	118 (61.4%)	46 (24%)	28 (14.6%)	< 0.001*
Medical field	511 (73%)	159 (22.7%)	30 (4.3%)	< 0.001*

* Statistically significant was established at $P < 0.05$

MS: Multiple sclerosis; MSKQ-25: Multiple sclerosis knowledge questionnaire; n: number of participants. Data are expressed as n (%) and mean ± SD

higher among those with higher MSKQ-25 scores (all $p < 0.001$). Regarding types and treatment of MS, significant associations were found between MSKQ-25 scores and knowledge of the definition of remittent MS, benign MS, curative treatment, and types of MS disease targeted by current therapies (all $p < 0.001$).

Discussion

The aim of this study was to evaluate the level of awareness and knowledge about Multiple Sclerosis (MS) among the population of Tobruk, Libya. Our findings revealed a generally low level of MS knowledge, as indicated by the overall MSKQ-25 scores. This study identified significant differences in knowledge based on gender, with females scoring higher on average than males, and individuals with relatives diagnosed with MS also demonstrating higher awareness. Additionally, medical field students exhibited greater knowledge compared to those from other backgrounds.

Multiple sclerosis is a chronic, often disabling disease that affects the central nervous system. It is a significant cause of neurological disability in young and middle-aged adults, making it a major public health concern. The symptoms and severity of MS can vary widely, making it a complex disease to understand and manage [12].

The median age for developing MS is 30. It has an especially detrimental effect on relationships in the family, social circle, and profession because this is the age when people are starting families and employees have not yet realized their full earning potential. In MS patients, early detection and treatment are essential to preventing permanent, long-term consequences [13].

Our investigation, along with that of Farran et al., highlighted significant gender differences in MSKQ-25 scores [14]. However, other studies have not consistently found such correlations, suggesting that these differences may be influenced by varying access to information and healthcare between genders [15, 16]. This underscores the need for inclusive educational initiatives that cater to all demographics.

The current research was conducted to assess the level of awareness of MS among the population of Tobruk, Libya. All participants' average MSKQ score was lower than average. This finding demonstrates the individuals' incredibly low level of MS awareness. This finding is in accordance with previous investigations that showed the awareness of MS ranges from low to moderate in the Middle East and North Africa [4, 14, 15]. The previous result might be explained by certain cultural beliefs that make MS sufferers feel alone and make them conceal their sickness from others, which reduces the number of

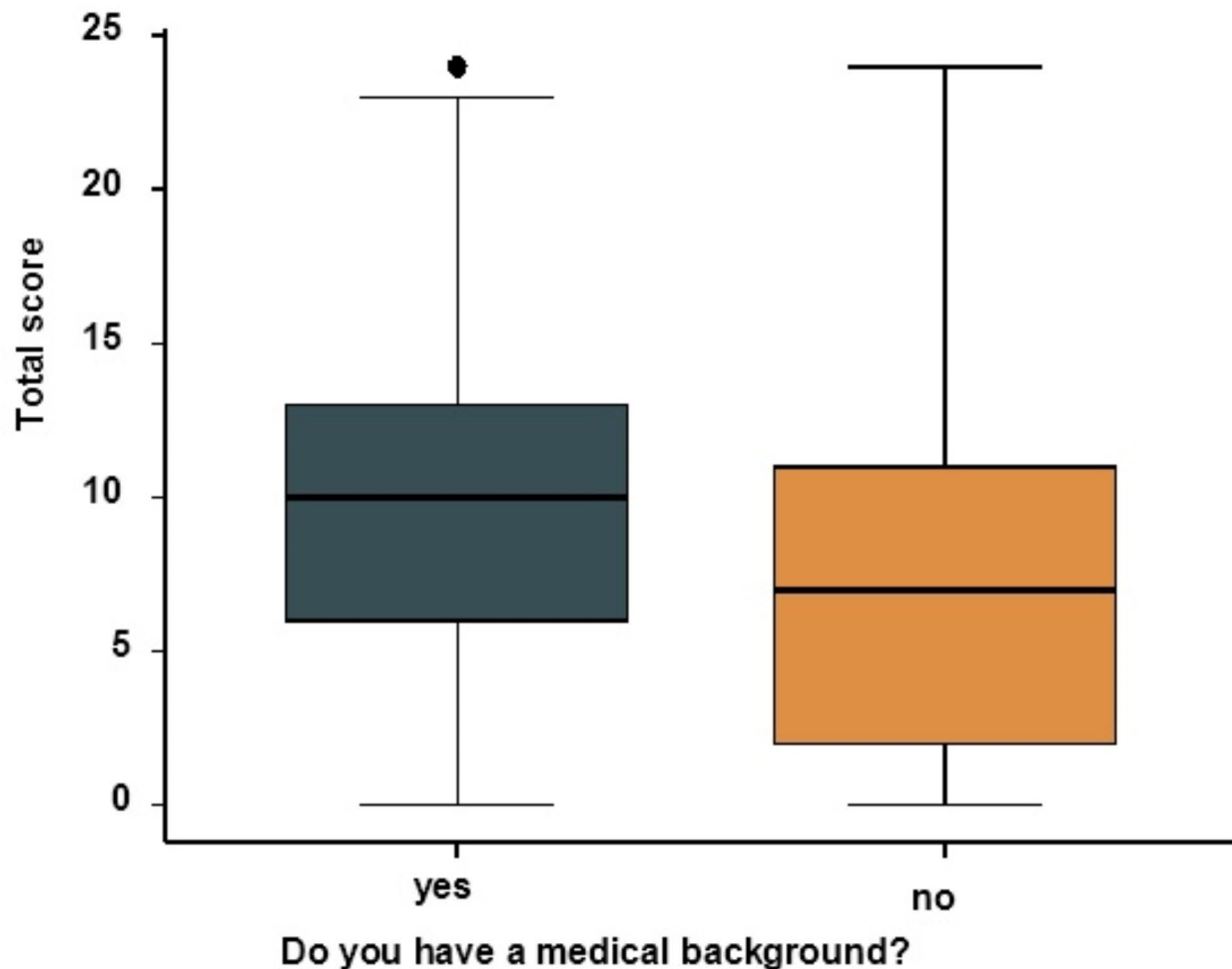


Fig. 1 The box plot of the MSKQ-25 score between participants with and without medical background

individuals who are aware of the condition. Moreover, a lack of awareness and knowledge regarding the etiology and symptoms of the disease can lead to delayed diagnosis and treatment, which can negatively impact the prognosis and quality of life for individuals with MS [17].

The results of the current study demonstrated a noteworthy distinction between individuals who had relatives who had MS and those who did not. Furthermore, a significant positive association had been observed between medical field students and other students from different backgrounds. These findings are in line with those of Amer et al. and Farran et al. [14, 16]. This difference may have resulted from the fact that both groups learned the same fundamental information about illness from their communities, which indicates the value of awareness

received from influential environments [18]. They will thus receive comparable results from the surveys. Given these findings, it is crucial to leverage community-based education to enhance awareness about MS. Collaborating with community leaders and using platforms such as social media, local workshops, and public seminars can further disseminate accurate information and foster a supportive environment for individuals with MS and their families [19]. Establishing peer support groups and providing resources through healthcare institutions can also play a pivotal role in maintaining and enhancing public awareness and education about MS [20].

The current study revealed that there was no significant association between the knowledge score and both marital status and educational levels, in accordance with

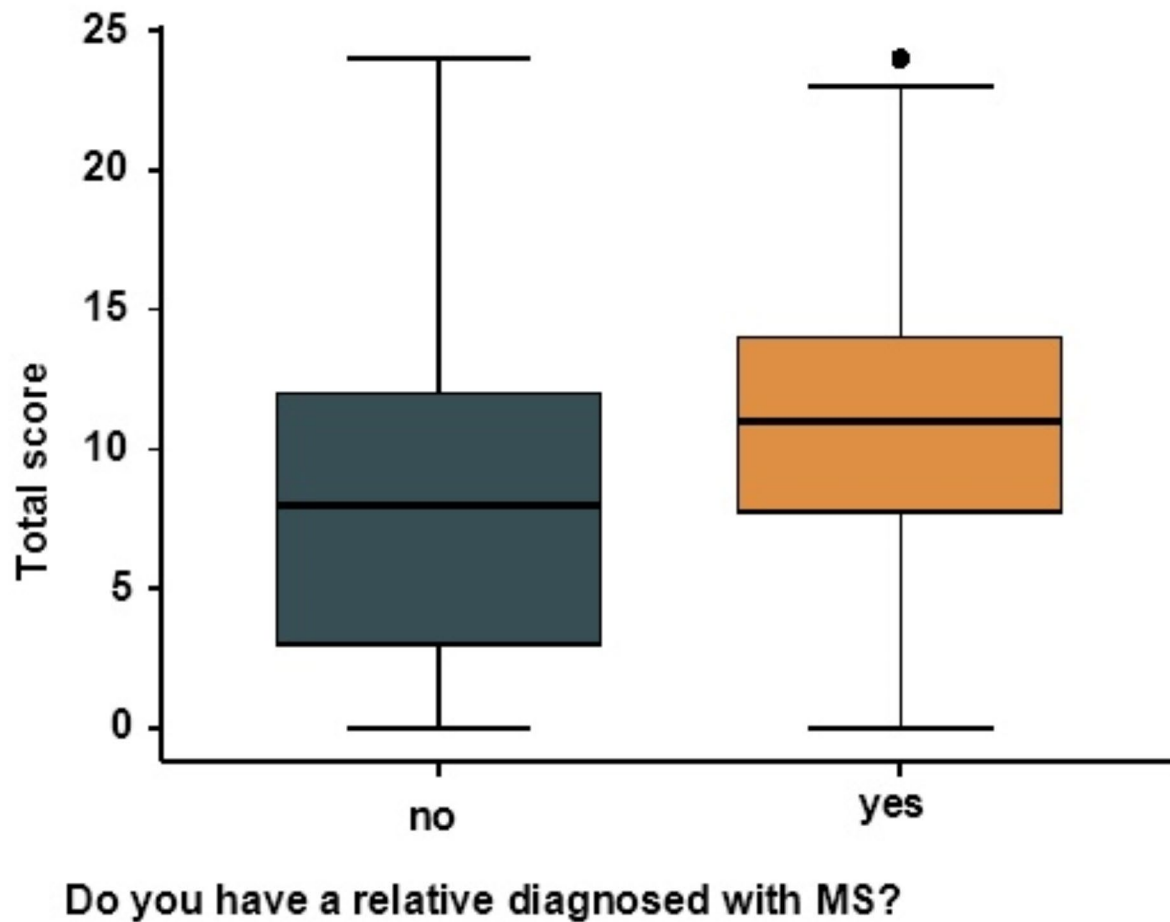


Fig. 2 The box plot of the MSKQ-25 score between participants with and without relatives diagnosed with MS

Amer et al., and Dahlawi et al. [16, 21]. In harmony with our data, Farran et al. concluded that there was a significant association in knowledge between age, gender, and financial status [14]. This demonstrates that there is no particular distribution of knowledge levels by age or gender; as a result, while implementing an educational campaign, it is necessary to evaluate the entire population, encompassing all age groups and both genders. While the current study included respondents with different marital statuses and educational backgrounds, these diversities were unable to detect any significant association between the subclasses. The previous findings are sufficient to warrant an alarm about the declining awareness of MS [14, 16, 22].

It is concerning that the majority of participants have a low level of knowledge about the genetics, etiology, and treatment of MS. These findings are consistent with

studies conducted by Abulaban et al. [23], and Farran et al. [14]. Moreover, we revealed that a considerable proportion of the participants have a low level of awareness regarding prevalence, predisposing factors, and diagnostic methods, but previous studies found that participants possess adequate knowledge of the same items. However, the investigation reported by Farran et al. (2021) revealed lower levels of knowledge among their respondents regarding these parameters [14]. The difference between the investigations can be explained by the diversity of cultures and the level of education [24]. Our findings indicate that the characteristics are typically ignored and call for further public outreach.

Our recommendation is to employ multi-media platforms and collaborative sessions led by healthcare experts to launch comprehensive educational programs aimed at addressing the poor level of knowledge and awareness

Table 3 Responses of participants to MS knowledge items

Q	Characteristic	MSKQ score < 50% (n = 1113)	MSKQ Score 50–70% (n = 254)	MSKQ score > 70% (n = 60)	Overall (n = 1427)	p-value
Nature of the disease						
1	Organs involved in MS	660 (59.3%)	234 (92.1%)	60 (100%)	954 (66.9%)	< 0.001*
2	CNS composition	325 (29.2%)	111 (43.7%)	54 (90%)	490 (34.3%)	< 0.001*
3	Impact of MS on life expectancy	188 (16.9%)	109 (42.9%)	51 (85%)	348 (24.4%)	< 0.001*
4	MS as immune disease	435 (39.1%)	208 (81.9%)	59 (98.3%)	702 (49.2%)	< 0.001*
5	MS as a contagious disease	644 (57.9%)	226 (89%)	55 (91.7%)	925 (64.8%)	< 0.001*
6	Myelin/axon damage	279 (25.1%)	110 (43.3%)	54 (90%)	443 (31%)	< 0.001*
7	Myelin function	402 (36.1%)	208 (81.9%)	58 (96.7%)	668 (46.8%)	< 0.001*
Prevalence and predisposing factors						
8	Prevalence of MS worldwide	171 (15.4%)	124 (48.8%)	53 (88.3%)	348 (24.4%)	< 0.001*
9	Age of onset	308 (27.7%)	187 (73.6%)	59 (98.3%)	554 (38.8%)	< 0.001*
10	Ratio of sex in MS prevalence	158 (14.2%)	161 (63.4%)	57 (95%)	376 (26.4%)	< 0.001*
11	Pregnancy impact on MS	149 (13.4%)	54 (21.3%)	17 (28.3%)	220 (15.4%)	< 0.001*
Causation and genetic factor						
12	MS etiology	341 (30.6%)	177 (69.7%)	57 (95%)	575 (40.3%)	< 0.001*
13	Transmission of MS to offspring	207 (18.6%)	113 (44.5%)	56 (93.3%)	376 (26.4%)	< 0.001*
14	Transmission of MS to other family member	94 (8.5%)	85 (33.5%)	52 (86.7%)	231 (16.2%)	< 0.001*
Diagnostic method and procedure						
15	Used tests to diagnose MS	253 (22.7%)	120 (47.2%)	50 (83.3%)	423 (29.6%)	< 0.001*
16	MRI role in MS diagnosis	449 (40.3%)	224 (88.2%)	56 (93.3%)	729 (51.1%)	< 0.001*
17	Gadolinium injections' role during MRI	93 (8.4%)	61 (24%)	49 (81.7%)	203 (14.2%)	< 0.001*
18	MRI role on disease follow-up	376 (33.9%)	210 (82.7%)	57 (95%)	643 (45.1%)	< 0.001*
19	Definite diagnosis of MS	354 (31.8%)	181 (71.3%)	55 (91.7%)	590 (41.4%)	< 0.001*
20	Role of lumbar puncture	310 (27.9%)	193 (76%)	46 (76.7%)	549 (38.5%)	< 0.001*
21	Frequency of lumbar puncture	54 (4.9%)	61 (24%)	15 (25%)	130 (9.1%)	< 0.001*
Types and treatment						
22	Definition of remittent MS	167 (15%)	138 (54.3%)	51 (85%)	356 (25%)	< 0.001*
23	Benign MS	153 (13.8%)	109 (42.9%)	49 (81.7%)	311 (21.8%)	< 0.001*
24	Curative treatment	365 (32.8%)	183 (72.1%)	56 (93.3%)	604 (42.3%)	< 0.001*
25	Types of MS disease targeted by current therapies	48 (4.3%)	38 (15%)	40 (66.7%)	126 (8.8%)	< 0.001*

* Statistically significant was established at $P < 0.05$

MRI: Magnetic resonance imaging; MS: Multiple sclerosis; MSKQ-25: Multiple sclerosis knowledge questionnaire; Data are expressed as n (%)

about MS in Tobruk, Libya. To guarantee widespread and efficient education, disease awareness should also be incorporated into school curricula, and community healthcare providers should be trained for personalized home visits [25]. Increasing outreach will come from collaborating with community groups and NGOs, as well as faith-based organizations.

Future research should focus on understanding the underlying reasons for misinformation and knowledge gaps about MS in Tobruk, Libya. Specific research questions could include: "What are the main sources of information about MS for the public?" and "How do cultural and socioeconomic factors influence perceptions of MS?" Methodologies might involve qualitative studies, such as focus groups and interviews, to explore these questions in depth. Additionally, comparative studies across different regions in Libya and other Middle Eastern countries could provide valuable insights into the variability of MS

awareness and the effectiveness of targeted educational interventions.

Limitations

This study, despite being a valuable exploration of MS awareness in Tobruk, Libya, has multiple limitations. The generalizability of the findings is a significant concern, as the results may not be applicable to other regions or the entire country due to varying socioeconomic statuses, healthcare access, and cultural attitudes. Tobruk's unique socioeconomic conditions, such as limited healthcare infrastructure and a predominantly conservative cultural environment, may not reflect the diversity found in other Libyan or Middle Eastern populations. The study's sample was predominantly female and academically educated, potentially introducing selection bias and not accurately representing the general population's knowledge and attitudes towards MS. This could skew the

results towards a more informed subset of the population, thereby limiting the applicability of the findings.

Self-reported data collected through the MSKQ can be subject to various biases, including recall bias and social desirability bias. Participants may not accurately recall their knowledge or experiences related to MS, or they may provide answers they believe are socially acceptable rather than truthful. To mitigate these biases, the study employed anonymous data collection methods and emphasized the importance of honesty in responses, though these measures cannot fully eliminate such biases. Additionally, the significant lack of knowledge about MS among participants raises concerns about the appropriateness of the MSKQ for assessing knowledge in diverse populations. The questionnaire may be too challenging or not culturally adapted to adequately measure the understanding of MS among the general populace in Tobruk, highlighting a potential area for improvement in future research tools.

Conclusion

The present study reveals that there is a considerable lack of awareness about MS in Tobruk, Libya, despite its significance as a public health concern. This lack of awareness is evident even among respondents from the medical field and those who have a relative with MS. The low scores on the MSKQ indicate a clear need for improvement in understanding the disease. Additionally, the study also shows that personal and professional experience with MS can increase knowledge about the disease, but a comprehensive understanding is still lacking for many.

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Author contributions

Study design, proposal writing, and ethical approval were conducted by ZM. Data collection was carried out by ZM. Analysis and interpretation of data were performed by IAH, MB and IA. Manuscript drafting was done by MB, ZM, IAH, RYF, MB, ARA, and IA. Critical revision for important intellectual content and manuscript editing were performed by MB and ARA. All authors (ZM, IAH, RYF, MB, ARA, and IA) read and approved the final manuscript for publication.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethical approval and consent to participate

This study adhered to stringent ethical standards and received prior approval from the Institutional Review Board (IRB) of Tobruk University (Reference number: NBC:009. H.23.26). The IRB reviewed and approved all study procedures, including data handling protocols, to ensure the protection of participant privacy and sensitive data. Before participating in the online survey, individuals were directed to an informed consent page outlining the study's purpose, emphasizing voluntary participation, and assuring complete anonymity and confidentiality. Participants formally indicated their consent by clicking a designated checkbox after reviewing the information. No personal identifying information was collected, and data security measures employed by Google Forms were detailed. Access to the anonymized dataset is restricted to the authors, and data will be securely stored in accordance with Tobruk University's data retention policy as stipulated by the IRB before appropriate disposal.

Consent for publication

All authors listed have given their explicit consent for the publication of this work.

Competing interests

The authors declare no competing interests.

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