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ORIGINAL RESEARCH

Knowledge and Perceptions of Cerebral Venous Thrombosis Among the Adult Population: A Nationwide Cross-Sectional Study in Saudi Arabia

Wajd A Alhadi[1,*], Ebtihaj Yahya Alshehry[2,*], Nouf A Hamood[1,*], Lama Dafer Albishri[1,*], Ghaida Mohammed Al Hunaif[1,*], Roaa M Al Murayyi[1,*], Zainah Al-Qahtani[2,*], Syed Esam Mahmood[3,*]

[1]College of Medicine, King Khalid University, Abha, 61421, Saudi Arabia; [2]Neurology Department, Asir Central Hospital, Abha, 61421, Saudi Arabia; [3]Department of Family and Community Medicine, College of Medicine, King Khalid University, Abha, Saudi Arabia

*These authors contributed equally to this work

Correspondence: Syed Esam Mahmood, Email smahmood@kku.edu.sa

Background: The current annual incidence of cerebral venous thrombosis (CVT) is 3–4 cases per one million population. CVT manifests itself with varying degrees of clinical presentation that may cause vital or morbid consequences if not treated and managed promptly. Studies have suggested varied levels of CVT public awareness.

Aim: To assess the level of knowledge and public perception of CVT across the different socio-economic strata of the Saudi Adult population.

Methods: A descriptive cross-sectional study was conducted using a mixed-method approach (an electronic questionnaire and phone interviews) for collecting the data. A validated questionnaire was distributed to consenting study participants and filled out to the best of their ability. The study setting was a nationwide survey conducted in Saudi Arabia and involved a representative portion of the study population.

Results: A total of 1912 participants were included in this study. Overall, the majority of study participants (67.2%) had a low knowledge level of CVT on assessment, and only 2.6% had a high knowledge level of CVT. Younger age, female gender, working adults, higher education level, marital status, Saudi nationals, and place of residency were significantly associated with knowledge of CTV ($p < 0.001$).

Conclusion: This study indicates a lower index of knowledge of CVT which offers an opportunity for much improvement in public perception and awareness of CVT in the study population. Our results can be utilized to target the demographics with the lowest knowledge via the most popular ways to gain information.

Keywords: cerebral venous thrombosis, knowledge, cross-sectional, Saudi Arabia

Introduction

Cerebral venous thrombosis (CVT) is a distinct disorder that involves clot formation in the venous channels of the brain and is a cause that can contribute to cerebral infarction in incidences much less than those of arterial events. CVT manifests itself with varying degrees of clinical presentation that may cause vital or morbid consequences if not treated and managed promptly.[1]

The cerebral venous drainage system is comprised of mainly two units: the superficial and the deep venous systems. The drainage wells run in major dural sinuses (ie the superior sagittal sinus, inferior sagittal sinus, cavernous sinus, and straight sinus), then run on towards the internal jugular vein for drainage towards the heart. Deep white matter and basal ganglia drain, on the other hand, directly into the vein of Galen.[2]

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Dural sinuses are classified into the anterior sinuses (ie the superior/inferior petrosal sinuses and the cavernous sinus), and the posterior sinuses (ie the superior sagittal sinus, the inferior sagittal sinus, the lateral sinus, and the straight sinus). The lateral sinus has two sections of its own: the transverse and the sigmoid sinuses, which function to drain the cerebellum, brain stem, and posterior portions of the brain hemispheres. To finish off, the skull base houses the cavernous sinuses, into which cross the oculomotor nerve (CN III), trochlear nerve (CN IV), ophthalmic division (CN V1), and maxillary division (CN V2) branches of the trigeminal nerve (CN V). Via the petrosal sinuses, these cavernous sinuses drain into the internal jugular vein.[1]

The pathophysiology of CVT is essentially that of any thrombotic disorder. This can range from a singular underlying cause favoring coagulatory processes, such as pro-thrombotic medications and diseases causing hypercoagulable states (eg anti-phospholipid syndrome, factor V Leiden deficiency, and protein C/S deficiencies) or a circumstantial mix of several risk factors that predispose to higher chances of pro-coagulation events.[3]

A cause that is more specific to the pathophysiology of CVT is an infection in the anatomically adjacent structures to the brain and its veins. This includes the paranasal sinuses, more commonly the frontal sinus, and could include subdural empyema in its disease process. Bacterial meningitis could also be an underlying etiology of CVT.[4]

Otitis, mastoiditis, sinusitis, and meningitis can lead to CVT. Mastoiditis is the most common temporal bone infection and may cause septic thrombosis due to suppurative direct spread, sometimes requiring surgical intervention. Infection may also induce increased production of procoagulant compounds, resulting in a prothrombotic state and leading to dural venous sinus thrombosis.[5]

Presentations for CVT can include but are not limited to, headache, visual disturbances, focal neurological deficits, changes in the level of consciousness (LOC), and cranial nerve palsy. Less often, the severest forms of manifestation of this disease include subarachnoid hemorrhage (SAH) and transient ischemic attacks (TIA). Combinations of these symptoms are distinctly defined as CVT Syndromes depending on which sinuses are affected and which signs are apparent clinically.[3]

In general terms, the severity of CVT presentation and its overall outcome is partially determined by the patient's age, general health, the sinus cerebral veins involved, the extent of the thrombosis, and the extent of cerebral parenchymal damage.[3]

Treatment options for CVT include both medical and surgical routes. The use of anticoagulation therapy has been well established as a treatment option via the dural venous sinus and should be implemented in patients with severe deficits.[6] Anti-convulsant therapy must also be instilled in any case of seizure, with the mainstay choice being fosphenytoin.

Surgical intervention may be required for decompressive surgery exhibiting unilateral mass effect with good reported outcomes. Surgical care is also indicated in severe neurological deterioration in the form of open thrombectomy with local thrombolytic therapy.[7]

As for the incidence of the disease, it is difficult to report as of now. However, it is believed to increase its reporting due to better imaging techniques. Some estimates suggest an incidence of 9% in autopsied bodies,[8] and in 1995 a study in Saudi Arabia found an incidence of 7 cases per 100,000 hospital patients.[9] CVT's current annual incidence is 3–4 cases per one million population.[10]

Our study aims to assess and quantify the community's knowledge of Cerebral Sinus Thrombosis across Saudi Arabia. As well as establishing an updated view on whether the public needs further exposure and awareness on the topic.

Methodology

Study Design and Setting

A descriptive cross-sectional study was conducted after obtaining ethical approval. This study was conducted in accordance with the Declaration of Helsinki. The study setting was Saudi Arabia and involved a representative portion of the population nationwide. This study was conducted by trained medical students from March 2023 to October 2023. We invited a random sample from the original list of every mobile phone user to participate. All adult citizens who had mobile phones were included. The research team made the random allocation using an Excel program that generated the required mobile phone lists to eliminate any selection bias and forwarded them to the data collectors. Medical students filled out the answers of the callers in online questionnaires. Two of the authors were responsible for tracking the data

collectors and the participants' responses to ensure full compliance with the study methodology. The main aim of the telephone interviews was to encourage the participants to respond to the electronic paper questionnaire. The study included adults residing in different geographical locations of Saudi Arabia who consented to participate in the study and were enrolled in the study's final analysis. The participants were identified randomly from the list of mobile phone users. Persons who declined to consent were aged below 18 years, or spoke a language other than Arabic or English, and were excluded from the study.

Data Collection Methods

A mixed-method approach (an electronic questionnaire and phone interviews) was used in collecting the data.

A structured questionnaire was used to collect data from the study participants. The questionnaire was formulated based on the clinical symptoms and known presentations of CVT.

Data were collected using an adapted and modified questionnaire from the existing studies.[11,12] We set out in this study to develop and validate an instrument to be used for the assessment. A pilot survey was conducted on 30 participants before initiating the actual data collection; however, these pilot samples were excluded from the final sample size. The prime objective of the pilot survey was to guarantee the validity and reliability of the questionnaire. The face and content validity of the questionnaire was assessed by the principal and co-investigators themselves. Face validity was evaluated through the review and comments offered by a panel of experts related to readability, clarity of wording, layout, and feasibility of the questionnaire. Content validity was evaluated by the content validity index, which is the mean content validity ratio of all questions in a questionnaire. The questionnaire was translated from English to Arabic (local language) by a bilingual person to enable an easy understanding of the questions and avoid any questionnaire bias. An electronic questionnaire was distributed using data collectors from all parts of Saudi Arabia to target the nearby members of their community. The data collectors were instructed to diversify their sample to collect results from a varied group of people to reflect the real makeup of Saudi society.

The above-mentioned digital questionnaire first explained and obtained the consent of the participant, after which there is a series of questions as to the demographic of the participant, their knowledge of the signs and symptoms of CVT, and their knowledge of when medical help should be sought for the condition.

Data Analysis

Data analysis was performed using Statistical Package for the Social Sciences, SPSS 23rd version. Frequency and percentages were used to display categorical variables. Minimum, maximum, mean, and standard deviation were used to present numerical variables. Independent *t*-test and ANOVA test were used to test for factors associated with knowledge scores toward cerebral venous thrombosis. ANOVA test was followed by the Tukey post-hoc test to reveal where the exact difference between groups exists. The level of significance was set at 0.05.

The knowledge score was calculated based on a point system that awarded each correct answer with one point. According to the ranges of points, entries were classified into low knowledge and high knowledge.

IRB Approval

Ethical permission to conduct this research was obtained from the local Institutional Review Board Committee (ECM#2023-909) of King Khalid University.

Results

A total of 1912 participants were included in this study. Table 1 shows the sociodemographic profile of the participants. Nine hundred and fifty-nine (50.2%) of the participants were between 18 and 24 years old, 331 (17.3%) were between 25 and 30 years old, 247 (12.9%) were between 31 and 40 years old, 308 (16.1%) were between 41 and 55 years old, and 67 (3.5%) were older than 55 years. As for the gender, 499 (26.1%) were males, while 1413 (73.9%) were females.

As for the occupation status, 571 (29.9%) were working, 315 (16.5%) were unemployed, 110 (5.8%) were retired, and 916 (47.9%) were students. Among the participants, 482 (25.2%) were healthcare workers, while 1430 (744.8%) were not. As for the education level, 466 (24.4%) were high school students, 1329 (69.5%) had a college degree, and 117

Table 1 Socio-Demographic Profile of the Participants (n = 1912)

Demographical Characteristics	n	%
Age		
18–24 years	959	50.20
25–30 years	331	17.30
31–40 years	247	12.90
41–55 years	308	16.10
Older than 55	67	3.50
Gender		
Male	499	26.10
Female	1413	73.90
Occupation status		
Working	571	29.90
Unemployed	315	16.50
Retired	110	5.80
Student	916	47.90
Education level		
High school	466	24.40
College degree	1329	69.50
Master's degree	117	6.10
Marital Status		
Single	1182	61.80
Married	676	35.40
Divorced	40	2.10
Widowed	14	0.70
Nationality		
Saudi	1810	94.70
Non-Saudi	102	5.30
Place of residency		
Northern region	352	18.40
Eastern Region	103	5.40
Western Region	418	21.90
Southern region	772	40.40
Central Region	267	14.00

(*Continued*)

Table 1 (Continued).

Demographical Characteristics	n	%
Are you a healthcare worker?		
Yes	482	25.20
No	1430	74.80

(6.1%) had a master's degree. As for the marital status, 1182 (61.8%) were single, 676 (35.4%) were married, 40 (2.1%) were divorced, and 14 (0.7%) were widowed.

As for the nationality, 1810 (94.7%) were Saudi, and 102 (5.3%) were non-Saudi. As for the place of residency, 352 (18.4%) were living in the northern region, 103 (5.4%) were living in the eastern region, 418 (21.9%) were living in the western region, 772 (40.4%) were living in the southern region, and 267 (14%) were living in the central region.

Figure 1 displays the participant's answers to "Have you ever had/heard about cerebral venous thrombosis?". Seven hundred and six (36.9%) of the participants reported hearing about/having cerebral venous thrombosis (CVT) from before, while 1206 (63.1%) reported they did not.

Figure 2 presents the source of information about CVT for those who heard about/had a history of cerebral venous thrombosis. The most commonly reported sources of information were social media reported by 414 (58.6%), friends reported by 136 (19.3%), and family members reported by 133 (18.8%).

Figure 3 demonstrates the participant's answers to "Which one of these symptoms have you experienced/or heard about?" directed for participants who heard about/had a history of cerebral venous thrombosis. The most commonly reported symptoms were headache (moderate to severe) reported by 566 (80.2%), weakness or loss of movement reported by 465 (65.9%), and seizure or abnormal movements reported by 409 (57.9%).

Table 2 illustrates the participant's knowledge assessment of cerebral venous thrombosis (CVT). The minimum knowledge score was 0, the maximum was 41, and the mean was 18.06 + 7.73.

Figure 4 shows the participant's knowledge levels of cerebral venous thrombosis. One thousand two hundred and eighty-four (67.2%) of the participants had low knowledge level (less than 50% of total score) (a score of 21 or less), 579

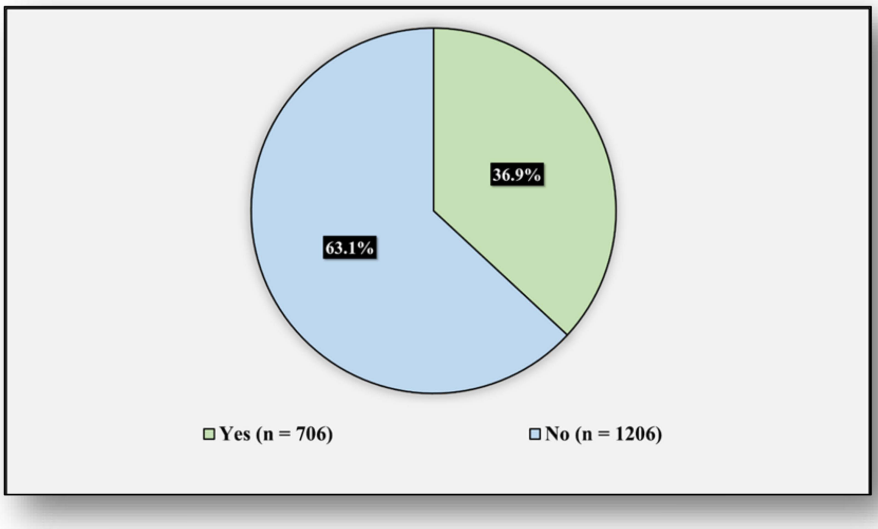

Figure 1 Have you ever heard about cerebral venous thrombosis?.

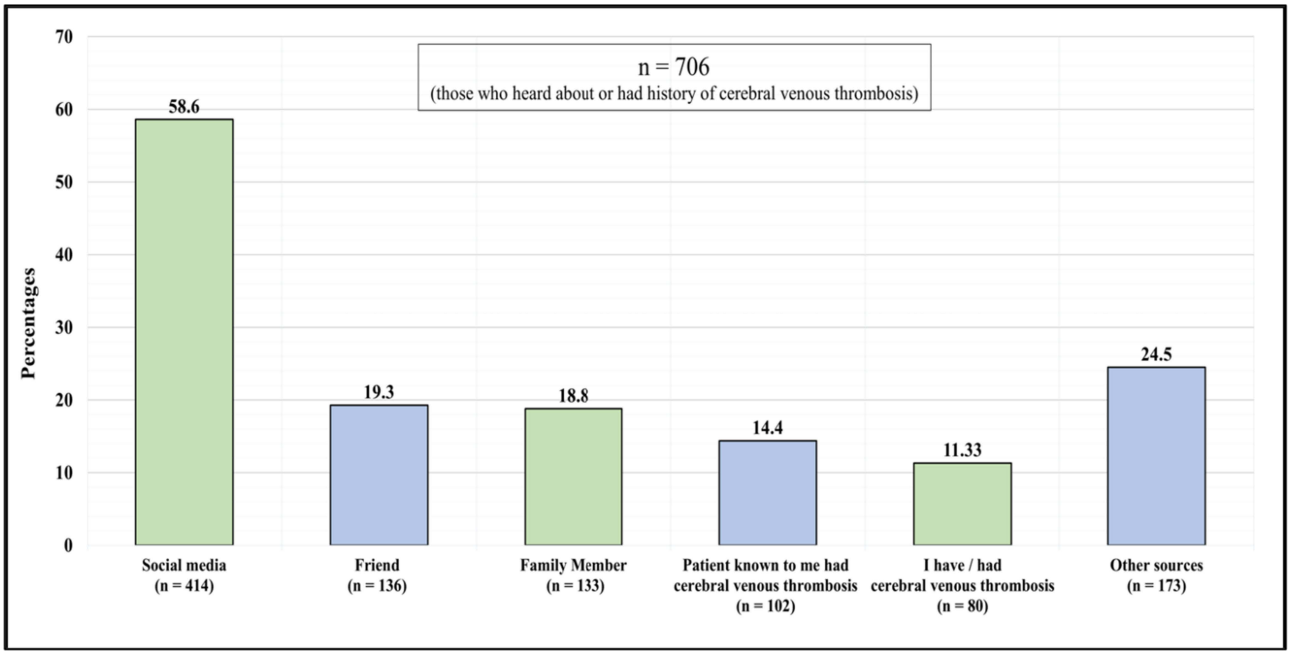

Figure 2 Source of information about CVT for those who heard about / had a history of cerebral venous thrombosis.

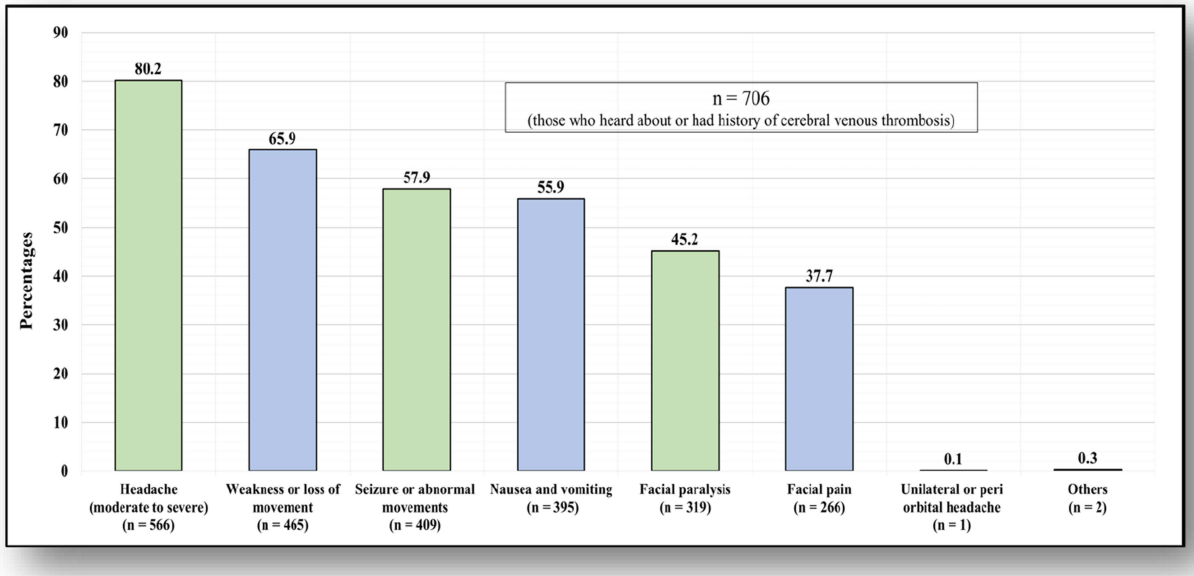

Figure 3 Which one of these symptoms have you experienced / or heard about?".

(30.3%) had moderate knowledge level (between 50% and 75% of total score) (a score between 22 and 33), and 49 (2.6%) had high knowledge level (higher than 75% of total score) (a score of 34 or higher).

Table 3 displays the participant's personal experience with cerebral venous thrombosis. Among the participants, 80 (4.2%) reported previously having cerebral venous thrombosis. When asked about the symptoms that pushed the participants who experience CVT to seek medical help, the most commonly reported symptoms were headache (moderate to severe) reported by 26 (32.5%), seizure or abnormal movement reported by 24 (30%), and weakness or loss of movement either generalized or to part of the body reported by 21 (26.25%).

Table 2 Participants' Knowledge Assessment Toward Cerebral Venous Thrombosis (CVT) (n = 1912)

Question	n	%
Do you think headache is one of cerebral venous thrombosis symptoms?		
Yes (correct answer)	1104	57.7
No	199	10.4
I do not know	609	31.9
Do you think that a patient with cerebral venous thrombosis may suffer from a vision change? (either double vision or loss of vision)		
Yes (correct answer)	1261	66
No	108	5.6
I do not know	543	28.4
Do you think that the patient may have nausea or vomiting related to Cerebral venous thrombosis?		
Yes (correct answer)	990	51.8
No	244	12.8
I do not know	678	35.5
Do you think a seizure attack (abnormal movement of the body or part of the body) may be part of the presentation of a patient with CVT?		
Yes (correct answer)	957	50.1
No	271	14.2
I do not know	684	35.8
Do you think patients with CVT may suffer from tinnitus (hearing sound buzzing or whistling or ringing)?		
Yes (correct answer)	855	44.7
No	293	15.3
I do not know	764	40
Do think patients with CVT may have facial palsy (weakness of the face partially or completely on one side of the face)?		
Yes (correct answer)	865	45.2
No	275	14.4
I do not know	772	40.4
Do think that a patient with CVT may have weakness in some parts of the body?		
Yes (correct answer)	1229	64.3
No	128	6.7
I do not know	555	29
Do you think that the patient may have a peri orbital headache (around the eye)?		
Yes (correct answer)	1084	56.7
No	165	8.6
I do not know	663	34.7

(*Continued*)

Table 2 (Continued).

Question	n	%
Do think a CVT patient will have periorbital swelling (edema)?		
Yes (correct answer)	680	35.6
No	276	14.4
I do not know	956	50
Which of the following would make you seek medical help (ER or OPD)? (more than one answer can be chosen)		
Headache (moderate to severe) (correct answer)	742	38.81
Nausea and vomiting (correct answer)	677	35.41
Seizure or abnormal movements (correct answer)	1288	67.36
Weakness or loss of movement either generalized or to part of the body (correct answer)	1321	69.09
Facial pain	581	30.39
Facial paralysis (correct answer)	1083	56.64
Other	6	0.31
None of it	174	9.10
What are the factors that can affect the speed of seeking medical help when facing these symptoms? (more than one answer can be chosen)		
Presence of symptoms only (correct answer)	511	26.73
Severity of symptoms (correct answer)	1158	60.56
No change in the condition for a certain period (correct answer)	623	32.58
Deterioration in the patient's condition (correct answer)	1088	56.90
Appearance of additional symptoms since the first symptom began (correct answer)	762	39.85
Other	168	8.79
How long can you wait since the onset of symptoms to seek medical help?		
Less than 6 hours (correct answer)	813	42.5
More than 6 hours and less than a day (correct answer)	272	14.2
1 day (correct answer)	335	17.5
2–5 days	257	13.4
A week	94	4.9
More than a week	120	6.3
Other	21	1.1
Which of the following do you think is a risk factor for CVT? (more than one answer can be chosen)		
Oral contraceptive pills (correct answer)	518	27.09
Blood clotting disorder (antiphospholipid syndrome, factor v Leiden, protein c deficiency, protein s deficiency)	1161	60.72
Hematological disorder (polycythemia, SCA) (correct answer)	879	45.97

(*Continued*)

Table 2 (Continued).

Question	n	%
Malignancy (correct answer)	685	35.83
Non-surgical procedure (eg lumbar puncture) (correct answer)	421	22.02
Facial Infections (sinusitis, mid-facial infection like cellulitis) (correct answer)	456	23.85
Brain abscesses (after having spread of infection from the cavities of the middle ear, nose, or paranasal sinuses in the skull cavity) (correct answer)	748	39.12
Dental infection (correct answer)	204	10.67
Other	8	0.42
I do not know	75	3.92
Which of the following do you think is part of the management of CVT? (more than one answer can be chosen)		
Anticoagulant (correct answer)	1276	66.74
Antibiotics (correct answer)	442	23.12
Anti-fungal (correct answer)	210	10.98
Endovascular intervention (thrombolysis, thrombectomy) (correct answer)	1128	59.00
Surgical intervention (correct answer)	854	44.67
Other	1	0.05
I do not know	54	2.82
Which of the following do you think is one of the complications of CVT? (more than one answer can be chosen)		
Intra-cerebral hemorrhage (correct answer)	851	44.51
Strokes (correct answer)	1351	70.66
Deep venous thrombosis (correct answer)	374	19.56
Hypopituitarism (correct answer)	326	17.05
Seizure (correct answer)	820	42.89
Intracranial hypertension (correct answer)	864	45.19
Death (correct answer)	686	35.88
Other	3	0.16
I do not know	60	3.14
Knowledge Score (lowest possible score = 0, highest possible score = 44)		
Minimum	0	
Maximum	41	
Mean	18.06	
Standard deviation	7.73	

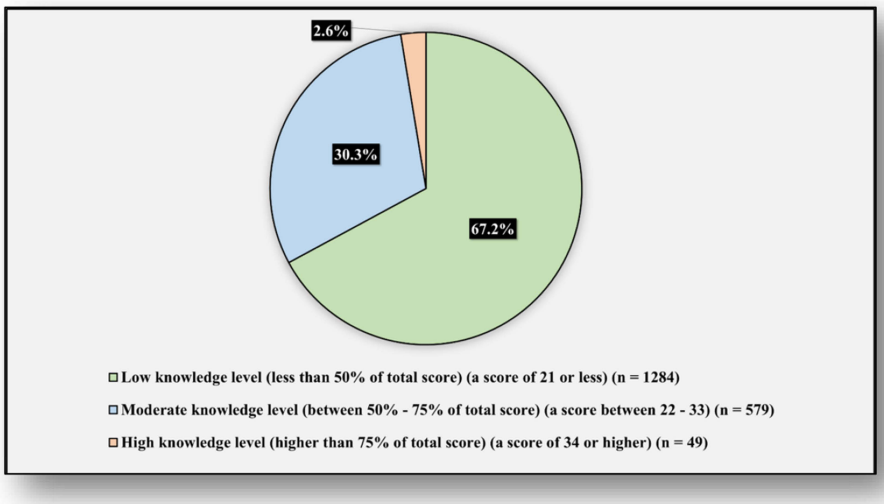

Figure 4 Participant's knowledge levels towards cerebral venous thrombosis.

As for the factors that affected the speed of seeking medical help, the most commonly reported factors were severity of symptoms for 26 (32.5%), no change in the condition for a certain period for 22 (27.5%), and presence of symptoms only for 20 (25%). As for the duration of time that patients waited after the onset of symptoms until they sought medical help, 18 (22.5%) waited for less than 6 hours, 17 (21.3%) waited for more than 6 hours, 16 (20%) waited for 1 day, 13 (16.3%) waited for 2–5 days, 10 (12.5%) waited for a week, and 6 (7.5%) waited for more than a week.

Table 4 presents the participant's awareness and attitude change toward cerebral venous thrombosis after taking the questionnaire. One thousand five hundred and thirty-four (80.2%) of the participants reported that their awareness toward

Table 3 Participants Personal Experience with Cerebral Venous Thrombosis (CVT)

Question	n	%
Have you had a cerebral venous thrombosis?		
Yes	80	4.2
No	1832	95.8
If the answer is yes, what symptoms pushed you to seek medical help? (more than one answer can be chosen) (n = 80)		
Headache (moderate to severe)	26	32.50
Nausea and vomiting	14	17.50
Seizures or abnormal movements	24	30.00
Weakness or loss of movement either generalized or to part of the body	21	26.25
Facial pain	12	15.00
Facial paralysis	6	7.50
Other	2	2.50

(*Continued*)

Table 3 (Continued).

Question	n	%
What are the factors that can affect the speed of seeking medical help when facing these symptoms? (more than one answer can be chosen) (n = 80)		
The presence of symptoms only	20	25.00
Severity of symptoms	26	32.50
No change in the condition for a certain period	22	27.50
Deterioration in the patient's condition	17	21.25
Appearance of additional symptoms since the first symptom began	13	16.25
How long can you wait since the onset of symptoms to seek medical help? (more than one answer can be chosen) (n = 80)		
Less than 6 hours	18	22.5
More than 6 hours and less than a day	17	21.3
1 day	16	20
2–5 days	13	16.3
A week	10	12.5
More than a week	6	7.5

Table 4 Participants' Awareness and Attitude Change Toward Cerebral Venous Thrombosis After Taking the Questionnaire

Question	n	%
After completing this questionnaire, did your awareness of the disease increase?		
Yes No	1534 378	80.2 19.8
After completing this questionnaire, would your reaction change if you encountered these symptoms?		
Yes No	1758 154	91.9 8.1

CVT increased after completing the questionnaire, and 1758 (91.9%) reported that after completing the questionnaire their reaction would change if they encountered these symptoms.

Table 5 demonstrates the factors associated with knowledge of cerebral venous thrombosis. Age was significantly associated with knowledge of CVT ($p < 0.001$), where it was observed that the younger the age group, the higher they knew CVT. Post-hoc tests revealed that those aged 18–24 had a significantly higher knowledge score compared to those aged 31 −40 years, those aged 41–55 years, and those older than 55 years, respectively ($p < 0.05$). It was also revealed that those aged 25–30 had a significantly higher knowledge score compared to those aged 31 −40 years, those aged 41–55 years, and those older than 55 years, respectively ($p < 0.05$).

Females also had a significantly higher knowledge score toward CTV compared to males ($p < 0.001$) (18.48 + 7.48 vs 16.86 + 8.28). Occupation status was also significantly associated with knowledge toward CTV ($P < 0.001$), where it was observed that students had the highest knowledge score compared to other groups. Post-hoc tests revealed that students had a significantly higher knowledge score compared to every other occupation status, respectively ($p < 0.05$).

Table 5 Factors Associated with Knowledge of Cerebral Venous Thrombosis

Factor	Knowledge Score		P-value
	Mean	Standard deviation	
Age			< 0.001*
18–24 years	19.4	7.71	
25–30 years	18.35	7.72	
31–40 years	16.27	7.41	
41–55 years	15.85	7.32	
Older than 55	14.18	6.06	
Gender			< 0.001*
Male	16.86	8.28	
Female	18.48	7.48	
Occupation status			< 0.001*
Working	17.12	7.62	
Unemployed	16.18	7.51	
Retired	14.43	6.15	
Student	19.73	7.65	
Education level			0.001*
High school	17.67	7.21	
College degree	18.40	7.89	
Master's degree	15.81	7.42	
Marital Status			< 0.001*
Single	19.27	7.75	
Married	16.06	7.27	
Divorced	16.98	7.80	
Widowed	15.43	5.69	
Nationality			0.024*
Saudi	18.16	7.70	
Non-Saudi	16.38	7.96	
Place of residency			< 0.001*
Northern region	18.19	8.02	
Eastern Region	17.17	7.36	
Western Region	17.63	7.90	
Southern region	18.92	7.63	
Central Region	16.43	7.17	

(*Continued*)

Table 5 (Continued).

Factor	Knowledge Score		P-value
	Mean	Standard deviation	
Are you a healthcare worker?			< 0.001*
Yes	21.44	7.78	
No	16.92	7.37	
Have you had a cerebral venous thrombosis?			< 0.001*
Yes	12.91	6.01	
No	18.29	7.72	

Note: *Significant at level 0.05.

It was also revealed that those who were working had a significantly higher knowledge score compared to those who were retired ($p < 0.05$). Education level was also significantly associated with knowledge toward CTV ($p = 0.001$), where it was observed that those with college degrees had the highest knowledge score. Tukey posthoc test revealed that those with college degrees had a significantly higher knowledge score compared to those with master's degrees ($P < 0.05$). Marital status was also significantly associated with knowledge toward CTV ($p < 0.001$), where it was observed that those who were single had the highest knowledge score. Tukey post-hoc test revealed that those who were single had a significantly higher knowledge score compared to those who were married ($p < 0.05$) (19.27 + 7.75 vs 16.06 + 7.27).

Saudis had a significantly higher knowledge score compared to non-Saudis ($p = 0.024$) (18.16 + 7.7 vs 16.38 + 7.96). Place of residency was also significantly associated with knowledge toward CTV ($p < 0.001$), where it was observed that those from the southern region had the highest knowledge score compared to other regions. Tukey post-hoc test revealed that those from the southern region had a significantly higher knowledge score compared to those from the central region, and the western region respectively ($p < 0.05$).

It also revealed that those from the northern region had a significantly higher knowledge score compared to those from the central region ($p < 0.05$). Healthcare workers had a significantly higher knowledge score compared to non-healthcare workers ($p < 0.001$) (21.44 + 7.78 vs 16.92 + 7.37). Those who had a history of CVT had a significantly lower knowledge score toward CVT compared to those who never had a history of CVT ($p < 0.001$) (12.91 + 6.01 vs 18.29 + 7.72).

Discussion

The public knowledge of CVT must match the up-to-date epidemiological and medical facts of the disease. Particularly as the natural course of this disease is an urgent and possibly catastrophic one if unrecognized.

The findings of this study clearly show that the public knowledge of CVT was lacking overall. It is important to note that such a study has never been conducted in Saudi Arabia, to our knowledge, and it proposes important findings for possible future public health interventions regarding CVT.

Our study noted that only 36.9% of our included participants had heard of CVT, with their main source of information being social media. When asked which symptoms were related to CVT, 80.2% reported headache as the most common symptom based on their existing knowledge of this disease.

When all participants were assessed for knowledge of CVT-presenting symptoms, red flags, risk factors, and management, they scored a mean of 18 points out of 41. A score of 21 points or less was considered as low or insufficient knowledge of CVT.

Overall, the majority of study participants (67.2%) had a low knowledge level on assessment, and only 2.6% had a high knowledge level on the topic. This indicates a lower index of knowledge which offers up an opportunity for much improvement in public perception and awareness of CVT.

Survivors of CVT also comprised some of the study population, making up about 4.2% and offering valuable insight on the subject. Their most common presenting symptoms were headache (32.5%) and seizure (30%); this is by the recent literature and will be explored further along in the paper. Unfortunately, this demographic seemed to score lower on the knowledge questions than its negative history counterpart.

When asked which symptoms would be red flags and cause participants to seek medical help, the most prominent were weakness/loss of movement (69%), seizure (67.36%), and facial paralysis (56.64%). The time frame within which participants would seek help if faced with these symptoms was also assessed, with the majority (42.5%) reporting they would seek medical services in less than 6 hours of the onset of symptoms.

At the end of the questionnaire, a huge portion of the study participants (91.9%) came away with the understanding that this survey highlighted the importance of awareness of CVT and the vitality of early recognition of the disease.

To summarize, our study results found that certain demographical factors were very significant in dictating the overall knowledge and awareness of CVT among the general public. Factors that indicate a significantly higher knowledge of CVT include (but are not limited to) female gender, younger age, Saudi nationality, collegial education level, and occupation as a health worker.

Many previous studies in the literature support the findings we present in our scientific paper. Firstly, a 2020 study by Alqahtani et al, on the epidemiological pattern of CVT in the Aseer Region, Saudi Arabia that included 119 patients from two tertiary hospitals in the area found that the mean age of patients was 35.5, with a predominant female makeup (81.5%). The most prevalent presenting symptoms in these patients were headaches (82.4%), vomiting (30.3%), and altered sensorium.[13] This aligns with our findings where the majority of participants acknowledged headache as the most common presentation. Similar findings have also been reported by other studies.[14,15]

A retrospective study by Daghriri et al in 2021 looked at the cases of CVT in Jazan, Saudi Arabia from 2010 onward to 2019. Fifty-one patients were included in this study, and the results found that the most common presenting symptom was headache (76.5%) followed by seizures (45.1%). Their study also concluded that the commonest risk factors were protein S deficiency (57%), followed by anemia (51%). Daghriri et al also noted the presence of acute complications in 13.7% of the cases, namely venous infarction and hemorrhage.[16]

Another study by Algahtani et al done in Saudi Arabia and spanning 20 years concluded that among 111 patients diagnosed with CVT, the main risk factors involved in the development of CVT were pregnancy/postpartum period, anti-phospholipid syndrome, oral contraceptive pills, malignancy and infections.[10] This matches up with our national findings where hypercoagulable status, malignancy, and infectious causes were recognized as the most prominent risk factors for CVT, respectively.

This study also highlighted the outcomes of CVT. The majority of patients experienced some kind of recovery, with only 10 deaths recorded. Bad prognostic factors concluded in the study were status epilepticus, incurable co-morbidities, and late recognition/presentation of the symptoms.[16]

In 2011, Saposnik et al performed a review and found that possible treatment modalities for CVT included anti-coagulation therapy, minimally invasive interventions (mechanical thrombectomies and thrombolysis), and possible surgical management in complicated life-threatening cases.[17] In our findings, participants identified a good amount of knowledge towards treatment strategies of CVT with 66% being knowledgeable about anti-coagulant therapy and 59% acknowledging endovascular interventions as possible management.

In 2023, Alajmi et al performed a retrospective cohort study on 73 patients to determine the complications of CVT. The percentage of patients who developed intracranial hemorrhage as a complication was 54%.[18]

Another review by Ulivi et al in 2020 found that brain infarcts were present in 36.4% of cases and another 17% of cases progressed to hemorrhagic events in the brain.[19] Our study population reported similar knowledge to these findings of complications post-CVT, with 70.66% of them recognizing arterial stroke and 44.5% acknowledging intra-cerebral hemorrhage as a complication of CVT.

Age was significantly associated with knowledge of CVT ($p < 0.001$), where it was observed that the younger the age group, the higher they knew CVT in this study. Cerebral venous thrombosis (CVT) is an important cause of stroke particularly in younger patients and potentially fatal if diagnosis is delayed.[20]

The limitations of our study include the relatively limited number of participants included, particularly from the older and lower socio-economic demographics in Saudi Arabia. The cross-sectional design of this study cannot confirm the causality of the relationship between compared variables. The self-reported response could over or underestimate the results. We recommend further research should be conducted on the implication of low-level knowledge of CVT in the various demographics and how improvement could be achieved with national public health awareness initiatives in Saudi Arabia.

Conclusion

In conclusion, our study highlights the need for public health incentives to increase health education and awareness of CVT, particularly among older and high-risk demographics and less informed groups. Our results can be utilized to target the demographics with the lowest knowledge via the most popular ways to gain information in these groups.

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Disclosure

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