



Original Article

## Awareness level of idiopathic normal pressure hydrocephalus among health-care providers

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### ABSTRACT

**Background:** Idiopathic normal pressure hydrocephalus (iNPH) is a disease that primarily affects the geriatric population. It was first introduced by Adams *et al.* in 1965. A gradual decline in cognitive function, urinary incontinence, and gait disturbances characterizes the disease. This condition is believed to be underdiagnosed, and awareness of such pathology is vital, as the treatment is very effective and can reverse the symptoms.

**Methods:** This questionnaire-based cross-sectional study aimed to assess awareness levels regarding iNPH among non-neuroscience healthcare providers in Saudi Arabia.

**Results:** A total of 269 healthcare providers participated in this study, with data collected through an online questionnaire. About 80.6% of the participants had heard of the disease, while 56.5% were aware of the disease symptomatology. About 50% of physicians did not encounter iNPH patients in clinical practice. Previous clinical exposure to iNPH patients correlates significantly with an awareness of disease symptoms, investigation, treatment modalities, and outcome. Clinical experience positively impacts physicians' awareness as it correlates with a better understanding of diagnostic methods and disease outcomes.

**Conclusion:** The study highlights the need for targeted educational interventions, especially among family physicians and general practitioners with no previous experience with iNPH patients, as well as interdisciplinary collaboration to address gaps in awareness and enhance early diagnosis of iNPH patients.

**Keywords:** Awareness, Idiopathic normal pressure hydrocephalus, Knowledge normal pressure hydrocephalus (NPH), Survey

### INTRODUCTION

Idiopathic normal pressure hydrocephalus (iNPH) is a disease that affects the geriatric population.<sup>[1,13,17]</sup> It was first introduced by Adams *et al.* in 1965.<sup>[1]</sup> A gradual decline in cognitive function, urinary incontinence, gait disturbances in the absence of raised intracranial pressure, and papillary edema typically characterize it.<sup>[1,13,17]</sup> Pathophysiology is not fully understood, but it is believed to be multifactorial. Several factors include increased cerebrospinal fluid (CSF)

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pulsatility, CSF malabsorption, blood-brain barrier alteration, focal ependymal hypoperfusion, neuroinflammation, and glymphatic channel disturbance.<sup>[10,13,17,19]</sup> iNPH poses a diagnostic challenge due to its varied clinical presentation and overlap with other neurological conditions such as Alzheimer's and Parkinson's diseases.<sup>[2,6,13,10]</sup> However, early detection is essential since effective treatment can significantly improve both the patient's quality of life and the burden on society. Therefore, it is essential to raise awareness among health-care providers about this condition and its symptoms to ensure that patients receive the correct diagnosis and treatment.

## MATERIALS AND METHODS

### Ethical approval

This study was approved by King Abdullah International Medical Research Center Institutional Review Board Study number: NRJ23/040/02.

### Design and setting

This is an observational cross-sectional online questionnaire-based study targeting physicians working in all specialties in Saudi Arabia. However, physicians specialized in neuroscience, dentists, pharmacists, nurses, physiotherapists, and medical students were excluded from the study. The selection of participants was done using the quota sampling technique. The questionnaire links were sent to each healthcare provider (WhatsApp) group. The composition of the questionnaire provided was identical across all links. Following the distribution of the questionnaire through links provided in WhatsApp groups, participants had the option to participate or decline voluntarily.

Moreover, participants could view the link's content before clicking and participating as a brief introduction of the aims and objectives of the study is displayed alongside the link provided in the WhatsApp groups. After clicking on the link, participants can review the aims and objectives of the study again, as well as the authors involved. Following that, they will need to confirm their participation in the study and choose either "agree" to continue with the study or "disagree," in either case, the participants' identity will remain anonymous. The data were collected from September 2023 to December 2023. The desirable sample size was calculated to be 384 through the Sample Size Calculator by Raosoft, Inc. A confidence interval of 95% was implanted for the calculation, with a margin of error of 5%, a population proportion of 50%, and an estimated total population of 228,717.

### Questionnaire

Fifteen neuroscience consultants with experience in diagnosing and treating iNPH patients were asked to review the

#### Questionnaire:

##### First part:

- Demographics data
  1. Age
  2. Nationality
  3. City of Practice
  4. Hospital affiliation
    - University
    - Ministry of Health
    - Private
    - Government
  5. Years of practice
    - Less than 1 year
    - 1–5 years
    - More than 5 years
  6. Graduation year from University/College
  7. Specialty

##### Second part:

- Idiopathic normal pressure hydrocephalus (iNPH)
  1. Have you heard or read about idiopathic normal pressure hydrocephalus?
    - Yes
    - No
  2. The triad of normal pressure are as follows:
    - Dementia/aphasia/seizure
    - Dementia/urine incontinence/gait abnormality
    - Gait abnormality/visual abnormality/psychosis
    - Seizure/visual abnormality/urine incontinence
    - Do not know
  3. Have seen patients with NPH in the past 5 years?
    - Yes
    - No
  4. How many patients have you referred for confirmation of the diagnosis of NPH in the past 5 years?
  5. The best initial test for iNPH diagnosis is:
    - LP
    - MRI
    - EEG
    - Psychological assessment
  6. What is the most common treatment of iNPH?
    - Acetazolamide
    - CSF diversions
    - Anti-seizure drugs
    - Antipsychotic drugs
    - Don't know
  7. NPH is considered a potentially reversible disorder
    - Yes
    - No

**Figure 1:** Questionnaire parts.

questionnaire elements [Figure 1]. The responses were collected and edited according to their feedback. The survey was created using Google Forms and consisted of two main sections. In the first section, participants were asked to provide their demographics, including age, gender, nationality, city of practice, hospital, years of practice, and subspecialty. The second section asked the physicians if they

had heard of the disease. If they answered yes, they were asked a series of questions to assess their level of awareness of iNPH, diagnostic modality, treatment modalities, and prognosis. The level of awareness of iNPH was determined by whether the physician knew the three typical symptoms (cognitive deterioration, urinary incontinence, and gait disturbance). The awareness of diagnostic modalities was determined by whether the physician chose neuroimages as the first step in management. Regarding the awareness of treatment and outcomes, if the physician chose CSF diversions and good outcomes, respectively. Several independent data collectors sent the questionnaire to the participants, and the participants sent their responses to the authors.

### Data analysis

Data entry was conducted by the researchers on an Excel file. Afterward, data were transferred to the Statistical Package for the Social Sciences software version 20.0 for analysis. Mean and standard deviation were used to describe variables that are normally distributed, while median and interquartile range were used to describe variables that are skewed. Shapiro-Wilk test was used to assess the normality. To estimate the association between demographics and awareness of normal pressure hydrocephalus (NPH), the Chi-square test was used (Fisher's exact test was used when the event rate was 5 or less). Statistical significance was considered at  $P < 0.05$ .

## RESULTS

### Descriptive analysis of demographics

Two hundred and sixty-nine participants participated in the study, representing 70% of the calculated sample size of 384. Out of these, 245 were Saudi, and 216 had heard about iNPH. The majority of the participants, 118, were from the Western region. The healthcare providers who participated mainly worked at Ministry of Health hospitals, with 128 participants having 1–5 years of clinical experience. Medicine was the dominant specialty, with 152 participants. Notably, 135 participants did not see a patient of iNPH in their practical clinical experience. The study found that 80.4% of participants had heard about iNPH, while 56.5% of the physicians were aware of the typical clinical presentations of iNPH. About 76.2% were aware of the disease outcomes. About 52.4% of the participants were aware of diagnostic modalities, and 43.5% were aware of treatment modalities [Table 1].

### Awareness of iNPH clinical presentation

There was no significant difference in awareness between Saudi and non-Saudi participants ( $P = 0.5$ ,  $\chi^2=0.4538$ ). Similarly, there was no statistically significant difference in awareness among different types of hospitals ( $P = 0.1845$ ,

**Table 1:** Questionnaire parts.

Total number of participants=269			
Variable	Category	Count	Percentage
Nationality	Saudi	245	91.1
	Non-Saudi	24	08.9
City of practice	Western	118	43.8
	Central	92	34.2
	Other	59	21.9
Hospital	Ministry of Health	128	47.6
	Government	79	29.4
	University	47	17.5
	Private	15	05.6
Years of practice	Less than 1 year	70	26.0
	1–5 years	112	41.6
	More than 5 years	87	32.4
Subspecialty	Surgery	117	43.5
	Medicine	152	56.5
	Family and general practice	43	16.0
	Emergency	19	07.1
Heard of iNPH	Yes	216	80.6
	No	53	19.4
Clinical exposure to iNPH	None	135	50.0
	Less than 5 patients	121	45.0
	More than 5 patients	13	05.0

iNPH: Idiopathic normal pressure hydrocephalus

$\chi^2 = 4.8324$ ) or across different years of practice ( $P = 0.1559$ ,  $\chi^2 = 23.7158$ ). However, there was a significant difference in awareness across different subspecialties, with 54.3% of those in medicine, 50% in surgery, 55.8% in family medicine/general practice, and 84.2% in emergency medicine indicating awareness ( $P = 0.0316$ ,  $\chi^2 = 8.8299$ ). Clinical exposure to iNPH also influenced awareness; there was a significant difference among those who have seen patients with iNPH in the past 5 years ( $P < 0.0001$ ,  $\chi^2 = 35.4847$ ) [Table 2].

### Awareness of diagnostic modality

The study found no significant difference in awareness between Saudi and non-Saudi participants ( $P = 0.2999$ ,  $\chi^2 = 1.0743$ ). Similarly, there was no significant difference in awareness across different types of hospitals ( $P = 0.8967$ ,  $\chi^2 = 0.5987$ ) and different subspecialties ( $P = 0.3161$ ,  $\chi^2 = 3.5359$ ). However, the difference in awareness across different years of practice was statistically significant ( $P = 0.0017$ ,  $\chi^2 = 12.711$ ). Finally, the study found that the difference in awareness among those who have seen patients with NPH in the past 5 years was statistically significant ( $P = 0.0428$ ,  $\chi^2 = 6.303$ ) [Table 3].

### Awareness of treatment modalities

The study found no significant difference in awareness of treatment modalities of iNPH between Saudi and non-

**Table 2:** Awareness of iNPH clinical presentation.

Awareness of iNPH clinical presentation	% (Yes)*	% (No)*	Significance
Nationality			
Saudi	57.1 (140)	(105)	$P=0.5005$
Non-Saudi	50.0 (12)	(12)	$\chi^2=0.4538$
Hospital			
Ministry of Health	59.4 (76)	(52)	$P=0.1845$
Government	57.0 (45)	(34)	$\chi^2=4.8324$
University	44.7 (21)	(26)	
Private	73.3 (11)	(4)	
Years of practice			
Less than 1 year	47.1 (33)	(37)	$P=0.1559$
1–5 years	61.6 (69)	(43)	$\chi^2=23.7158$
More than 5 years	57.4 (50)	(37)	
Subspecialty			
Surgery	50.4 (59)	(58)	$P=0.0316$
Medicine	62.2 (93)	(59)	$\chi^2=8.8299$
Family and GP	55.8 (24)	(19)	
Emergency	84.2 (16)	(3)	
Seen patients with iNPH in the past 5 years			
None	38.5 (52)	(83)	$P\leq 0.0001$
Less than 5 years	75.2 (91)	(30)	$\chi^2=35.4847$
More than 5 years	69.2 (9)	(4)	

\*Number of participants, iNPH: Idiopathic normal pressure hydrocephalus, GP: General practitioner

**Table 3:** Awareness of iNPH Diagnostic Modality.

Awareness of diagnostic modality	%Yes (n)*	% (No)*	Significance
Nationality			
Saudi	51.4 (126)	(119)	$P=0.2999$
Non-Saudi	62.5 (15)	(9)	$\chi^2=1.0743$
Hospital			
Ministry of Health	54.7 (70)	(58)	$P=0.8967$
Government	49.4 (39)	(40)	$\chi^2=0.5987$
University	51.0 (24)	(23)	
Private	53.3 (8)	(7)	
Years of practice			
Less than 1 year	41.4 (29)	(41)	$P=0.0017$
1–5 years	65.1 (73)	(39)	$\chi^2=12.711$
More than 5 years	44.8 (39)	(48)	
Subspecialty			
Surgery	55.6 (65)	(52)	$P=0.3161$
Medicine	50.0 (76)	(76)	$\chi^2=3.5359$
Family and GP	58.1 (25)	(18)	
Emergency	52.6 (10)	(9)	
Seen patients with iNPH in the past 5 years			
None	45.9 (62)	(73)	$P=0.0428$
Less than 5 years	61.2 (74)	(47)	$\chi^2=6.303$
More than 5 years	38.5 (5)	(8)	

\*Number of participants, iNPH: Idiopathic normal pressure hydrocephalus, GP: General practitioner

Saudi participants ( $P = 0.8499$ ,  $\chi^2 = 0.0358$ ). Regarding hospital affiliation, the difference in awareness across different types of hospitals was statistically significant ( $P = 0.0235$ ,  $\chi^2 = 9.4835$ ). Across years of practice the difference in awareness across different years of practice was not statistically significant ( $P = 0.0747$ ,  $\chi^2 = 5.1894$ ) among different subspecialties. The difference in awareness across different subspecialties was not statistically significant ( $P = 0.3302$ ,  $\chi^2 = 3.4287$ ). Finally, among those who had encountered patients with iNPH in the past 5 years, the difference in awareness among those who have seen patients with iNPH in the past 5 years was statistically significant ( $P < 0.0001$ ,  $\chi^2 = 35.75$ ) [Table 4].

**Awareness of iNPH prognosis**

There was no significant difference in awareness between Saudi and non-Saudi participants ( $P = 0.517$ ,  $\chi^2 = 0.4199$ ). Similarly, there was no significant difference in awareness across different types of hospitals ( $P = 0.2381$ ,  $\chi^2 = 4.2255$ ). However, there was a statistically significant difference in awareness across different years of practice ( $P = 0.0285$ ,  $\chi^2 = 7.1169$ ). There was no significant difference in awareness among different subspecialties ( $P = 0.3076$ ,  $\chi^2 = 3.6038$ ). Finally, among those who had encountered patients with iNPH in the past 5 years, there was a statistically significant difference in awareness ( $P < 0.0001$ ,  $\chi^2 = 20.38$ ) [Table 5].

**DISCUSSION**

iNPH is a diagnosis by exclusion,<sup>[6,10,13,17,18]</sup> awareness of such pathology is vital since the treatment is very effective and can reverse the symptoms.<sup>[13,17,19]</sup> In 2004, the Japanese Neurosurgery Society and the Japanese Society of NPH published guidelines for managing iNPH. This publication significantly increased awareness and surgical treatment of iNPH throughout Japan.<sup>[11]</sup> It demonstrates the importance of disseminating knowledge and guidelines to health-care providers.<sup>[11]</sup> A survey of 166 health-care professionals was conducted in the Yangpu Community to measure the awareness level of iNPH before and after education intervention.<sup>[4]</sup> The results revealed that 41.5% of surveyed health-care professionals had never learned about iNPH, and this dropped to 4.76% after a training program. Another study by Conn and Lobo surveyed 166 physicians and discovered that one-third had not heard of the disease, even though the survey did not exclude neuroscience physicians.<sup>[5]</sup> However, our data showed a better awareness level, with only 19.4% of the physicians participating in the study having not heard of iNPH. This could be attributed to the fact that 80% of the participants in the first study were physiotherapists, while the second study was relatively old, and much evidence and recommendations have been published to enrich the medical literature. To the best of our knowledge, this is the first study to address the awareness level of iNPH among

**Table 4:** Awareness of iNPH Treatment Modalities.

Awareness of treatment modalities	% (Yes)*	% (No)*	Significance
Nationality			
Saudi	43.4 (107)	138	$P=0.8499$
Non-Saudi	41.7 (10)	14	$\chi^2=0.0358$
Hospital			
Ministry of Health	52.8 (67)	61	$P=0.0235$
Government	39.2 (31)	48	$\chi^2=9.4835$
University	27.6 (13)	34	
Private	46.6 (7)	8	
Years of practice			
Less than 1 year	32.7 (23)	47	$P=0.0747$
1–5 years	50.0 (56)	56	$\chi^2=5.1894$
More than 5 years	44.8 (39)	48	
Subspecialty			
Surgery	41.0 (48)	69	$P=0.3302$
Medicine	46.0 (70)	82	$\chi^2=3.4287$
Family and GP	47.6 (20)	22	
Emergency	63.2 (12)	7	
Seen patients with NPH in the past 5 years			
None	26.6 (36)	99	$P\leq0.0001$
Less than 5 years	54.6 (77)	44	$\chi^2=35.75$
More than 5 years	38.5 (5)	8	

\*Number of participants, NPH: Normal pressure hydrocephalus

**Table 5:** Awareness of iNPH Prognosis.

Awareness of iNPH prognosis	% (Yes)*	% (No)*	Significance
Nationality			
Saudi	76.7 (188)	57	$P=0.517$
Non-Saudi	70.8 (17)	7	$\chi^2=0.4199$
Hospital			
Ministry of Health	80.5 (103)	25	$P=0.2381$
Government	74.7 (59)	20	$\chi^2=4.2255$
University	66.0 (31)	16	
Private	80.0 (12)	3	
Years of practice			
Less than 1 year	65.7 (46)	24	$P=0.0285$
1–5 years	76.8 (86)	26	$\chi^2=7.1169$
More than 5 years	84.0 (73)	14	
Subspecialty			
Surgery	76.0 (89)	28	$P=0.3076$
Medicine	76.3 (116)	36	$\chi^2=3.6038$
Family and GP	67.4 (29)	14	
Emergency	89.5 (17)	2	
Seen patients with iNPH in the past 5 years			
None	64.4 (87)	48	$P\leq0.0001$
Less than 5 years	87.6 (106)	15	$\chi^2=20.38$
More than 5 years	92.3 (12)	1	

\*Number of participants, iNPH: Idiopathic normal pressure hydrocephalus

non-neuroscience physicians. In our study, we conducted a comprehensive analysis of healthcare providers' awareness

regarding iNPH in the Kingdom of Saudi Arabia. The purpose of this investigation was to explore whether awareness levels of healthcare providers vary based on certain demographic factors. The study looked at health-care providers' nationality, years of professional experience, hospital affiliation, and knowledge of iNPH prognosis, treatment, and diagnostic modalities. The research revealed that emergency physicians have a high level of awareness of iNPH clinical presentation, diagnostic methods, and disease outcomes. This is because they often request CT brain scans to evaluate geriatric patients who have acute or subacute neurological symptoms, such as confusion, delirium, or weakness. The computed tomography (CT) reports should comment on the ventricular system and whether or not there is evidence of ventriculomegaly. Since iNPH is a slowly progressive neurological disease, patients commonly go to primary health clinics for further evaluation. It was surprising to note that family and general practitioners had an insignificant level of awareness of iNPH. Physicians from various specialties who follow up with patients previously diagnosed with iNPH tend to be more knowledgeable about the disease symptoms, diagnostic and treatment modalities, and disease outcomes. The data indicate that clinical experience has a positive impact on physicians' awareness as it is correlated with a better understanding of diagnostic methods and disease outcomes. The study also found a positive correlation between hospitals operated by the Ministry of Health and the awareness of treatment modalities. This can be explained by the fact that most hospitals in Saudi Arabia are ministry of health (MOH)-operated, and geriatric patients, who are more likely to have iNPH, have easy access to them.<sup>[3]</sup> The prevalence of idiopathic normal-pressure hydrocephalus is probably underdiagnosed due to diagnostic challenges, as not all the cases will present with the typical iNPH symptoms triad.<sup>[2,6,9,10,14,20]</sup> In addition, iNPH may present with atypical symptoms or overlap with other neurodegenerative diseases, such as Alzheimer's and Parkinson's disease, which again make the diagnosis of iNPH challenging; a study conducted in Italy found that 41% of iNPH patients received a negative result from CT brain when they presented to the emergency department before their diagnosis.<sup>[2,6,10,13]</sup> In a prospective and population-based study, the prevalence of iNPH was 3.7% among individuals 65 years and older and more common in the higher age group, 80 years and above.<sup>[20]</sup> Another study estimated the incidence of iNPH in subjects above 70 years old at 1.2/1000 persons per year from a 10-year community-based study. Another two studies from Japan reported a prevalence of iNPH among patients aged 65 and older of 2.9% ( $n = 170$ ) and 1.4% ( $n = 567$ ), respectively. Neuro-images such CT and magnetic resonance imaging (MRI) are a noninvasive investigation, relatively easy to access and almost available in all hospitals. It has become the cornerstone for diagnosing iNPH.<sup>[2,7,10,13,14]</sup> MRI offers diagnostic features that could confirm the diagnosis, such as

the callosal angle, Evans' index, enlargement of the ventricular system, and the presence of periventricular edema.<sup>[7,10,13-15]</sup> A meta-analysis showed the callosal angle's high diagnostic performance in predicting iNPH, with a sensitivity of 91% and specificity of 93%. The same result was obtained by Evans' index, which revealed a high sensitivity of 96% but a relatively low specificity of 83%. Both the callosal angle and Evans' index revealed excellent interobserver agreement.<sup>[12]</sup> Recently, multiple studies have shown encouraging results in the imaging diagnosis of iNPH using volumetric results from auto-segmentation in brain magnetic resonance.<sup>[15]</sup> Despite the ongoing challenges in diagnosing iNPH, multiple studies have shed light on the efficacy of surgical treatment in carefully selected patients.<sup>[8,9,13,14,17,19]</sup> As highlighted in the literature, shunting demonstrates an overall positive effect, particularly when patients undergo a thorough evaluation, including CSF dynamic testing and other confirmatory examinations.<sup>[17]</sup> A meta-analysis estimated clinical improvement after shunting in more than 75% of patients.<sup>[3]</sup> Another systematic review revealed clinical improvement following shunt insertion in 71% of patients.<sup>[17]</sup> A report from Sweden showed both an excellent shunt response rate (89%) and a low complication rate (6%) in patients operated in rural hospitals.<sup>[8]</sup> Among iNPH symptoms, cognitive improvement responds less favorably, while gait ataxia often progressively improves over the first 3–6 months.<sup>[9]</sup> Gait amelioration is reported in 80–83% of patients 3 years-after ventriculoperitoneal (VP) shunting and in 87% of patients after 7 years.<sup>[9]</sup> Cognitive function improved in more than 50% of patients who underwent shunting and 50–84% improvement in incontinence.<sup>[9]</sup> Despite the positive outcome of surgical treatment on iNPH, the previous prevalence studies indicate that iNPH is under-diagnosed and under-treated.<sup>[8,14]</sup> The complication rates for patients treated with shunts ranged from 13% to 38%, the majority occurring within the 1<sup>st</sup> year after surgery.<sup>[8,9,16,17]</sup> It was also estimated that 20–33% of patients treated with VP shunts required additional surgery, with 15% undergoing shunt revision during a 1-year period.<sup>[8,9,18]</sup> Subdural hematoma is a common complication after shunt insertion; the modern iNPH series reports nontraumatic subdural collection rates of 0–16%.<sup>[5,7-9,16]</sup> Based on the data in this meta-analysis, most subdural hematomas regressed spontaneously after increasing the valve working pressure, with only 10% of cases requiring surgical evacuation.<sup>[8]</sup> In regard to the impact of early diagnosis on the patient and society, several studies have shown a positive relationship between early detection and response to treatment. Tullberg *et al.* proved the effectiveness of shunt surgery in iNPH patients as they will benefit from 2.2 additional life years and 1.7 quality-adjusted life years with a lower personal healthcare burden.<sup>[18]</sup> Petrella *et al.* showed that early iNPH diagnosis could reduce disease-related costs by 81% a year.<sup>[13]</sup>

## CONCLUSION

We conclude that awareness levels regarding iNPH vary among healthcare workers in Saudi Arabia. Overall, there is moderate awareness, with notable disparities across professional groups. The study underscores the need for targeted educational interventions, especially among family physicians and general practitioners with no previous experience with iNPH patients, as well as interdisciplinary collaboration to address gaps in awareness and enhance early diagnosis of iNPH patients. The study contributes to the growing body of literature on iNPH awareness and highlights the importance of raising awareness among healthcare providers to improve diagnostic accuracy and patient outcomes.

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## Ethical approval

The research/study was approved by the Institutional Review Board at King Abdullah International Medical Research Center (KAIMRC), number IRB/2360/23, dated September 18, 2023.

## Declaration of patient consent

Patient's consent was not required as there are no patients in this study.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

## Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

## REFERENCES

1. Adams RD, Fisher CM, Hakim S, Ojemann RG, Sweet WH. Symptomatic occult hydrocephalus with normal cerebrospinal-fluid pressure: A treatable syndrome. *N Engl J Med* 1965;273:117-26.

2. Andersson J, Rosell M, Kockum K, Lilja-Lund O, Söderström L, Laurell K. Prevalence of idiopathic normal pressure hydrocephalus: A prospective, population-based study. *PLoS One* 2019;14:e0217705.
3. Asmri MA, Almalki MJ, Fitzgerald G, Clark M. The public health care system and primary care services in Saudi Arabia: A system in transition. *Eastern Mediterr Health J* 2020;26:468-76.
4. Chen Z, Wang Y, Cao N, Chen C, Wang Y, Ru Y. A survey on normal-pressure hydrocephalus in Shanghai community health-care professionals in Yangpu Community Training Program for rehabilitation medicine. *J Int Soc Phys Rehabil Med* 2019;2:151-8.
5. Conn HO, Lobo FM. What do physicians know about normal pressure hydrocephalus and when did they know it? A survey of 284 physicians. *Yale J Biol Med* 2008;81:19-29.
6. Derya KA, Isik AT. Cerebrospinal fluid biomarkers for normal pressure hydrocephalus. *Biomark Neuropsychiatry* 2023;9:100071.
7. Forsberg L. Outcomes of hydrocephalus ventriculoperitoneal shunt surgery at a rural hospital; 2022.
8. Giordan E, Palandri G, Lanzino G, Murad MH, Elder BD. Outcomes and complications of different surgical treatments for idiopathic normal pressure hydrocephalus: A systematic review and meta-analysis. *J Neurosurg* 2018;131:1024-36.
9. Ishida T, Murayama T, Kobayashi S. Current research of idiopathic normal pressure hydrocephalus: Pathogenesis, diagnosis and treatment. *World J Clin Cases* 2023;11:3706.
10. Molde K, Söderström L, Laurell K. Parkinsonian symptoms in normal pressure hydrocephalus: A population-based study. *J Neurol* 2017;264:2141-8.
11. Mori E, Ishikawa M, Kato T, Kazui H, Miyake H, Miyajima M, *et al.* Guidelines for management of idiopathic normal pressure hydrocephalus. *Neurol Med Chir (Tokyo)* 2012;52:775-809.
12. Park, H. Y., Kim, M., Suh, C. H., Lee, D. H., Shim, W. H., & Kim, S. J. (2021). Diagnostic performance and interobserver agreement of the callosal angle and Evans' index in idiopathic normal pressure hydrocephalus: a systematic review and meta-analysis. *European radiology*, 31(7), 5300–5311. <https://doi.org/10.1007/s00330-020-07555-5>
13. Petrella G, Ciarlo S, Elia S, Piazz RD, Nucera P, Pompucci A, *et al.* Idiopathic normal pressure hydrocephalus: The real social and economic burden of a possibly enormous underdiagnosis problem. *Tomography* 2023;9:2006-15.
14. Rigamonti D, Yasar S, Vivas-Buitrago T, Rigamonti K. Letter to our colleagues family practitioners, geriatricians, and radiologists to increase awareness regarding idiopathic normal pressure hydrocephalus. *World Neurosurg* 2024;181:e291-3.
15. Thavarajasingam SG, El-Khatib M, Vemulapalli K, Iradukunda HA, Sajeenth Vishnu K, Borchert R, *et al.* Radiological predictors of shunt response in the diagnosis and treatment of idiopathic normal pressure hydrocephalus: A systematic review and meta-analysis. *Acta Neurochir* 2023;165:369-419.
16. Toma AK, Papadopoulos MC, Stapleton S, Kitchen ND, Watkins LD. Systematic review of the outcome of shunt surgery in idiopathic normal-pressure hydrocephalus. *Acta Neurochir* 2013;155:1977-80.
17. Torsnes L, Blåfjeldal V, Poulsen FR. Treatment and clinical outcome in patients with idiopathic normal pressure hydrocephalus-a systematic review. *Dan Med J* 2014;61:A4911.
18. Tullberg M, Persson J, Petersen J, Hellström P, Wikkelsø C, Lundgren-Nilsson Å. Shunt surgery in idiopathic normal pressure hydrocephalus is cost-effective-a cost utility analysis. *Acta Neurochir* 2018;160:509-18.
19. Wang Z, Zhang Y, Hu F, Ding J, Wang X. Pathogenesis and pathophysiology of idiopathic normal pressure hydrocephalus. *CNS Neurosci Ther* 2020;26:1230-40.
20. Williams MA, Malm J. Diagnosis and treatment of idiopathic normal pressure hydrocephalus. *Continuum (Minneapolis)* 2016;22:579-99.

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