

3 ORIGINAL ARTICLE

4 Knowledge and awareness about
5 developmental dysplasia of the hip in
6 children among medical students in Madinah,
7 Saudi Arabia: a cross-sectional study

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11 ABSTRACT

12 **Background:** Developmental dysplasia of the hip (DDH) is a common pediatric orthopedic condition that can
13 lead to long-term morbidity if not detected early. This study assessed knowledge, awareness, and perceptions
14 of DDH among medical students in Madinah, Saudi Arabia.

15 **Methods:** A descriptive cross-sectional study was conducted among a convenience sample of 319 medical
16 students from the second to sixth academic years using a self-administered online questionnaire. Knowledge
17 was scored out of 16 and categorized as good, moderate, or poor. Associations were analyzed using chi-square
18 or Fisher's exact, Mann–Whitney *U*, and Kruskal–Wallis tests ($p < 0.05$).

19 **Results:** More than half of the participants (50.8%) had poor knowledge, and 30.1% had good knowledge
20 (mean score 7.52 ± 5.28 out of 16). Although 53.6% were familiar with DDH, only 26.3% had encountered a
21 case, and most rated their confidence ≤ 3 on a 5-point scale. Academic year and prior orthopedics/pediatrics
22 training were associated with higher knowledge, awareness, and confidence ($p < 0.001$); good knowledge was
23 more common among students with such training (53.8% vs. 13.4%). Most participants (88.4%) supported
24 greater emphasis on DDH in the medical curriculum.

25 **Conclusion:** Medical students in Madinah showed suboptimal knowledge of DDH and limited clinical exposure
26 despite moderate awareness. Earlier, structured DDH teaching combined with clinical exposure is recom-
27 mended to support timely diagnosis and referral.

28 **Keywords:** Developmental dysplasia of the hip, pediatric orthopedics, Saudi Arabia, medical students.

29 Introduction

30 Developmental dysplasia of the hip (DDH) encompasses
31 a spectrum of malformations affecting the acetabulum,
32 the femoral head, or both. Acetabular dysplasia presents
33 as an underdeveloped, shallow acetabulum and may lead
34 to subluxation or complete dislocation of the hip joint
35 [1]. DDH includes not only congenital malformations but
36 also disturbances that occur during development [2]. The
37 incidence of DDH varies and depends on several factors;
38 ~1 in 1,000 infants is born with a dislocated hip, whereas
39 10 in 1,000 may exhibit hip subluxation [1,3]. When
40 DDH is missed, symptoms may first manifest during
41 adolescence, and untreated dysplasia is an established
42 cause of degenerative joint disease. A systematic review

showed that girls are more likely than boys to develop 43
DDH [4]. Clinical tests such as the Ortolani and Barlow 44
maneuvers can help detect DDH by eliciting a “clunk” 45
when the hip joint is manipulated, and the Galeazzi sign 46

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51	is another useful finding that can be assessed between 3	The eligible population comprised 1,671 male and	108
52	and 6 months of age [2]. When subluxation or dislocation	female students at Taibah University and other medical	109
53	is identified early in the neonatal period, management	schools in Madinah. Assuming a 95% confidence level,	110
54	commonly involves a Pavlik harness, typically worn with	a 5% margin of error, and an anticipated proportion of	111
55	the hips abducted between 30° and 60°. In children aged	50%, the minimum required sample size was calculated	112
56	6-18 months, the Pavlik harness becomes less effective	to be ~313 students. The final sample of 319 students met	113
57	for hip reduction, and closed or open reduction combined	and slightly exceeded this requirement.	114
58	with spica cast immobilization is often used instead [5].		
59	A systematic review from Saudi Arabia reported a	Data collection instrument	115
60	DDH prevalence of 10.46 per 1,000 live births, with	Data were collected using a self-administered online	116
61	associated risk factors including consanguinity, breech	questionnaire created in Google Forms (Supplementary	117
62	presentation, and a family history of the condition [6].	File 1). The questionnaire was developed by the	118
63	A cross-sectional study of 1,232 participants in the	authors and reviewed for content validity by a pediatric	119
64	western and southern regions of Saudi Arabia found that	orthopedic surgeon with expertise in the field. It was	120
65	60% of respondents had poor knowledge of DDH [7],	then piloted among 15 students, who were not included	121
66	and another cross-sectional study of 412 participants in	in the final sample, to confirm that all items were clear	122
67	the Riyadh region found that 45.6% had never heard of	and comprehensible; together with the expert review,	123
68	DDH [8]. These studies recommended that healthcare	this step was intended to minimize measurement bias.	124
69	institutions, including medical schools, hospitals, and	The questionnaire comprised four sections covering	125
70	primary care centers, provide education on DDH to	demographic characteristics (gender, university,	126
71	address the awareness gap in the community. However,	academic year, and completion of orthopedics or	127
72	to our knowledge, no published study has explored	pediatrics clinical training), awareness of DDH	128
73	knowledge of DDH among medical students. Therefore,	(familiarity with the condition and prior exposure to	129
74	this study aimed to assess the knowledge, awareness, and	DDH cases), knowledge of DDH, and perceptions	130
75	perceptions of DDH, including its risk factors, diagnosis,	(confidence in identifying DDH and views on its	131
76	treatment, and complications, among medical students in	emphasis in the medical curriculum).	132
77	Madinah, Saudi Arabia.		
78	Subjects and Methods	Knowledge scoring	133
79	Study design and setting	The knowledge section comprised ten items (questions 7	134
80	This descriptive cross-sectional study was conducted	and 9-17) addressing the definition, risk factors, clinical	135
81	in Madinah, Saudi Arabia, between April 2025 and	features, imaging, treatment, screening, and long-term	136
82	February 2026. Ethical approval was obtained from the	consequences of DDH. Each correct answer was awarded	137
83	Research Ethics Committee of the College of Medicine,	1 point, whereas incorrect and “I don’t know” responses	138
84	Taibah University (CM-REC; study ID: STU-25-016,	scored 0, with no deduction for incorrect selections. The	139
85	dated 5 April 2025) before data collection began. All	two multiple-response items on risk factors (question	140
86	participants provided electronic informed consent before	9) and signs and symptoms (question 10) carried 3 and	141
87	completing the survey, and participation was voluntary	5 points, respectively (1 point per correct option), and	142
88	and anonymous. The study was conducted in accordance	the remaining eight items carried 1 point each, giving a	143
89	with the Declaration of Helsinki and is reported in line	maximum total score of 16. Knowledge was classified	144
90	with the Strengthening the Reporting of Observational	using predefined cut-offs as good ($\geq 75\%$; score 12-16),	145
91	Studies in Epidemiology guidelines for cross-sectional	moderate (50%-74%; score 8-11), or poor ($< 50\%$; score	146
92	studies.	0-7). Confidence in identifying DDH was rated on a	147
93	Participants and sampling	5-point scale (1 = not confident; 5 = very confident).	148
94	Medical students in their second to sixth academic	Statistical analysis	149
95	years at Taibah University and other medical schools in	All statistical analyses were performed using IBM	150
96	Madinah were eligible to participate. First-year students	Statistical Package for the Social Sciences Statistics	151
97	were excluded, as were respondents who did not fully	version 26.0 (IBM Corp., Armonk, NY, USA). Categorical	152
98	complete the questionnaire. A convenience sampling	variables are presented as frequencies and percentages.	153
99	technique was used, and the questionnaire link was	The total knowledge score is presented as the mean $\pm$	154
100	distributed to students through social media messaging	SD and, because it was not normally distributed, also as	155
101	platforms (WhatsApp and Telegram). To limit selection	the median and interquartile range (IQR). Associations	156
102	bias, the questionnaire was circulated to all eligible	between demographic characteristics and knowledge	157
103	academic years at the participating medical schools	level, familiarity with DDH, prior exposure to DDH	158
104	rather than to a single class; nevertheless, some selection	cases, and views on curricular emphasis were assessed	159
105	bias may remain because sampling was non-random. The	using the chi-square test, or Fisher’s exact test when	160
106	final analyzed sample comprised 319 medical students,	more than 20% of cells had expected counts below five.	161
107	of whom 295 (92.5%) were enrolled at Taibah University.	Because confidence scores were not normally distributed,	162
		they were compared using the Mann–Whitney <i>U</i> test for	163
		two groups and the Kruskal–Wallis <i>H</i> test for three or	164
		more groups. Only fully completed questionnaires were	165

analyzed; therefore, no imputation of missing data was required. A p -value < 0.05 was considered statistically significant.

Results

The study included 319 medical students from the second to sixth academic years. Most participants were male (189, 59.2%), and the vast majority were from Taibah University (295, 92.5%). The largest group comprised sixth-year students (100, 31.3%), followed by fifth-year students (81, 25.4%). Slightly more than half of the participants (187, 58.6%) reported no prior training or coursework in orthopedics or pediatrics. Detailed demographic characteristics are presented in Table 1.

Using the predefined scoring system (good, 12-16; moderate, 8-11; poor, 0-7), more than half of the participants (162, 50.8%) had poor knowledge, 61 (19.1%) had moderate knowledge, and only 96 (30.1%) had good knowledge (Figure 1).

The mean total knowledge score was 7.52 ± 5.28 (range, 0-16), and the median score was 7 (IQR, 10), indicating that most participants had limited knowledge of DDH (Table 2).

Table 1. Sociodemographic characteristics of medical students in Madinah, Saudi Arabia ($n = 319$).

Variable	Category	Frequency
Gender	Male	189 (59.2%)
	Female	130 (40.8%)
University	Taibah	295 (92.5%)
	Other	24 (7.5%)
Academic year	Second	33 (10.3%)
	Third	57 (17.9%)
	Fourth	48 (15.0%)
	Fifth	81 (25.4%)
	Sixth	100 (31.3%)
Orthopedics/pediatrics training completed	Yes	132 (41.4%)
	No	187 (58.6%)

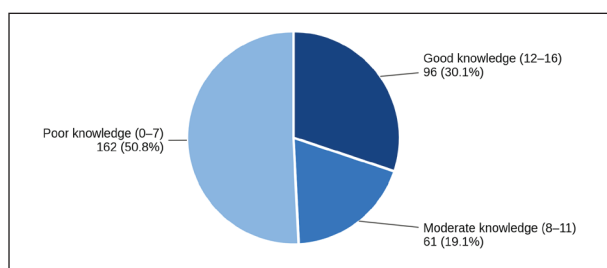


Figure 1. Distribution of knowledge levels regarding DDH among medical students in Madinah, Saudi Arabia ($n = 319$).

Table 2. Knowledge scores regarding DDH among medical students in Madinah, Saudi Arabia ($n = 319$).

Category	Mean $\pm$ SD	Median (IQR)	Range
Total score	7.52 ± 5.28	7 (10)	0-16

Just over half of the participants (171, 53.6%) reported being familiar with DDH; however, clinical exposure was limited, with only 84 (26.3%) having encountered a DDH case (Table 3).

Most participants reported low confidence in identifying DDH: 102 (32.0%) rated their confidence as 1, 54 (16.9%) as 2, and 97 (30.4%) as 3, whereas only 48 (15.0%) and 18 (5.6%) selected 4 and 5, respectively. Despite this, a large majority (282, 88.4%) agreed that DDH should receive greater emphasis in the medical curriculum (Table 4).

As shown in Table 5, there was a statistically significant association between knowledge level and both academic year and prior completion of orthopedics/pediatrics training ($p < 0.001$ for both). Students in their fifth and sixth years had the highest proportions of good knowledge (39.5% and 55.0%, respectively), while most students in their second, third, and fourth years had poor knowledge (75.8%, 89.5%, and 77.1%, respectively). Furthermore, among students who had completed orthopedics or pediatrics training, 53.8% ($n = 71$) had good knowledge, compared with only 13.4% ($n = 25$) of those without such training. Gender and university were not significantly associated with knowledge level.

Significant associations were found between academic year, training completion, and familiarity with DDH (Table 6). Familiarity with DDH was significantly associated with academic year ($p < 0.001$), with the lowest familiarity among third-year students (12.3%) and the highest among sixth-year students (87.0%). Similarly, 84.8% of students who had completed orthopedics/pediatrics training were familiar with DDH, compared with only 31.6% of those who had not ($p < 0.001$). The same pattern was observed for prior exposure to DDH cases ($p < 0.001$).

Regarding perception (Table 7), students in higher academic years and those who had completed relevant

Table 3. Awareness of DDH among medical students in Madinah, Saudi Arabia ($n = 319$).

Variable	Category	Frequency
Familiarity with DDH	Yes	171 (53.6%)
	No	148 (46.4%)
Prior exposure to DDH cases	Yes	84 (26.3%)
	No	235 (73.7%)

Table 4. Perceptions of DDH among medical students in Madinah, Saudi Arabia ($n = 319$).

Variable	Category	Frequency
Confidence identifying DDH (1-5, 1 = not confident, 5 = very confident)	1	102 (32.0%)
	2	54 (16.9%)
	3	97 (30.4%)
	4	48 (15.0%)
	5	18 (5.6%)
DDH deserves more emphasis in the medical curriculum	Yes	282 (88.4%)
	No	37 (11.6%)

Table 5. Association between demographic characteristics and knowledge level among medical students in Madinah, Saudi Arabia (n = 319).

Variable	Category	Good knowledge (12-16) n (%)	Moderate knowledge (8-11) n (%)	Poor knowledge (0-7) n (%)	p-value
Gender	Male	64 (33.9%)	39 (20.6%)	86 (45.5%)	0.071
	Female	32 (24.6%)	22 (16.9%)	76 (58.5%)	
University	Taibah	92 (31.2%)	54 (18.3%)	149 (50.5%)	0.211 ^a
	Other	4 (16.7%)	7 (29.2%)	13 (54.2%)	
Academic year	Second	3 (9.1%)	5 (15.2%)	25 (75.8%)	<0.001
	Third	3 (5.3%)	3 (5.3%)	51 (89.5%)	
	Fourth	3 (6.3%)	8 (16.7%)	37 (77.1%)	
	Fifth	32 (39.5%)	21 (25.9%)	28 (34.6%)	
	Sixth	55 (55.0%)	24 (24.0%)	21 (21.0%)	
Orthopedics/pediatrics training completed	Yes	71 (53.8%)	26 (19.7%)	35 (26.5%)	<0.001
	No	25 (13.4%)	35 (18.7%)	127 (67.9%)	

Chi-square test; ^aFisher's exact test.

p-values were calculated using the chi-square test unless otherwise indicated.

*Fisher's exact test. Bold values indicate statistical significance ($p < 0.05$).

Table 6. Association between demographic characteristics and awareness of DDH among medical students in Madinah, Saudi Arabia (n = 319).

Variable	Category	Familiarity with DDH, n (%)		p-value	Prior exposure to DDH cases, n (%)		p-value
		Yes	No		Yes	No	
Gender	Male	116 (61.4%)	73 (38.6%)	0.001	53 (28.0%)	136 (72.0%)	0.403
	Female	55 (42.3%)	75 (57.7%)		31 (23.8%)	99 (76.2%)	
University	Taibah	157 (53.2%)	138 (46.8%)	0.629	76 (25.8%)	219 (74.2%)	0.418
	Other	14 (58.3%)	10 (41.7%)		8 (33.3%)	16 (66.7%)	
Academic year	Second	14 (42.4%)	19 (57.6%)	<0.001	10 (30.3%)	23 (69.7%)	<0.001
	Third	7 (12.3%)	50 (87.7%)		4 (7.0%)	53 (93.0%)	
	Fourth	12 (25.0%)	36 (75.0%)		3 (6.3%)	45 (93.8%)	
	Fifth	51 (63.0%)	30 (37.0%)		20 (24.7%)	61 (75.3%)	
	Sixth	87 (87.0%)	13 (13.0%)		47 (47.0%)	53 (53.0%)	
Orthopedics/pediatrics training completed	Yes	112 (84.8%)	20 (15.2%)	<0.001	57 (43.2%)	75 (56.8%)	<0.001
	No	59 (31.6%)	128 (68.4%)		27 (14.4%)	160 (85.6%)	

p-values were calculated using the chi-square test; bold values indicate statistical significance ($p < 0.05$).

training reported significantly higher confidence in identifying DDH ($p < 0.001$). Male students also reported higher confidence than female students (median 3 vs. 2, $p = 0.013$). While most students agreed that DDH needs more curricular emphasis, this agreement was significantly higher among students without orthopedics/pediatrics training (92.5% vs. 82.6%, $p = 0.006$) and varied significantly by academic year ($p = 0.038$).

Discussion

This study assessed knowledge, awareness, and perceptions regarding DDH among medical students in Madinah, Saudi Arabia. The overall knowledge level was suboptimal, with a mean score of 7.52 ± 5.28 out of 16, and more than half of participants were classified within the poor knowledge category. These findings are consistent with previous reports demonstrating limited DDH awareness in Saudi Arabia. A cross-sectional study in the western and southern regions reported that 60% of the general population had poor knowledge [7],

while a study in Riyadh found that 45.6% had never heard of DDH [8]. A multicenter Saudi study further found that practicing pediatricians and family physicians demonstrated inadequate knowledge and clinical skills related to DDH screening [9], and international guidelines continue to stress the consequences of delayed recognition and the need for timely referral [10]. Taken together, these findings suggest that gaps in DDH awareness may originate during undergraduate training and persist into clinical practice.

Academic year was significantly associated with knowledge, awareness, and confidence ($p < 0.001$). Good knowledge was observed in 55.0% of sixth-year students compared with only 5.3% of third-year students, likely reflecting the gradual accumulation of clinical experience over the training years. Poor knowledge was nonetheless identified in 21% of sixth-year students, suggesting that progression through medical school does not reliably translate into competency in DDH-related knowledge and screening principles.

Table 7. Association between demographic characteristics and perceptions of DDH among medical students in Madinah, Saudi Arabia ($n = 319$).

Variable	Category	Confidence in identifying DDH, median (IQR)	p -value	DDH deserves more emphasis in the curriculum, n (%)		p -value
				Yes	No	
Gender	Male	3 (1)	0.013^a	164 (86.8%)	25 (13.2%)	0.273
	Female	2 (2)		118 (90.8%)	12 (9.2%)	
University	Taibah	3 (2)	0.872 ^a	261 (88.5%)	34 (11.5%)	0.749 ^c
	Other	2.5 (1)		21 (87.5%)	3 (12.5%)	
Academic year	Second	2 (2)	<0.001^b	31 (93.9%)	2 (6.1%)	0.038^c
	Third	1 (1)		54 (94.7%)	3 (5.3%)	
	Fourth	1 (2)		46 (95.8%)	2 (4.2%)	
	Fifth	3 (1)		67 (82.7%)	14 (17.3%)	
	Sixth	3 (1)		84 (84.0%)	16 (16.0%)	
Orthopedics/pediatrics training completed	Yes	3 (2)	<0.001^a	109 (82.6%)	23 (17.4%)	0.006
	No	2 (2)		173 (92.5%)	14 (7.5%)	

Confidence was rated on a 5-point scale (1 = not confident; 5 = very confident). Unmarked p -values were calculated using the chi-square test; bold values indicate statistical significance ($p < 0.05$).

^aMann–Whitney U test.

^bKruskal–Wallis H test.

^cFisher’s exact test.

Prior orthopedics or pediatrics training was associated with better outcomes across all domains. Students who completed such training were significantly more likely to demonstrate good knowledge (53.8% vs. 13.4%), familiarity with DDH (84.8% vs. 31.6%), and prior case exposure (43.2% vs. 14.4%), in addition to reporting higher confidence ($p < 0.001$). This is consistent with evidence that musculoskeletal knowledge and clinical confidence depend heavily on structured clinical exposure rather than classroom instruction alone [11,12].

Male students reported higher familiarity (61.4% vs. 42.3%; $p = 0.001$) and confidence (median 3 vs. 2; $p = 0.013$), although no significant difference was found in knowledge scores. The gap between self-reported perception and objective performance warrants cautious interpretation, as confidence does not always reflect actual competence [13].

A notable finding was that 88.4% of participants believed DDH deserves greater curricular emphasis, with this view being more pronounced among those without prior clinical training (92.5% vs. 82.6%; $p = 0.006$). Students who had not yet completed relevant rotations were the most vocal about the gap, which in itself makes a case for earlier curricular integration of DDH content [14]. Introducing structured teaching, case discussions, and clinical exposure in earlier years may reduce the reliance on senior clerkships as the primary driver of DDH competency.

Limitations

The study was conducted in a single city, which limits the generalizability of the findings to other regions of Saudi Arabia. Data were collected through a self-administered online questionnaire distributed via social media platforms, which may have introduced response bias. Furthermore, the cross-sectional design captures

knowledge at a single point in time and cannot establish causal relationships between training exposure and knowledge levels. The questionnaire was developed by the authors and, although it was reviewed by a pediatric orthopedic surgeon and piloted, its reliability was not formally tested. Convenience sampling may have favored more engaged students, and students from other medical schools in Madinah were underrepresented ($n = 24$). Training exposure was self-reported, and because the survey was completed online without supervision, some participants may have consulted external sources. Finally, academic year and clinical training are closely related, and the bivariate analyses could not separate their independent effects.

Implications

The findings of this study highlight the importance of strengthening undergraduate medical education in musculoskeletal and pediatric screening. Improving awareness and knowledge of DDH among medical students may contribute to earlier recognition, timely referral, and better patient outcomes. Incorporating structured teaching, clinical exposure, and practical skill-based training within the curriculum could enhance student competency and confidence. In addition, increasing emphasis on common yet potentially under-recognized conditions such as DDH aligns with broader efforts to improve preventive healthcare and early diagnosis in clinical practice.

Conclusion

Knowledge of DDH among medical students in Madinah was suboptimal, with more than half of the participants (50.8%) showing poor knowledge. Higher academic year and prior orthopedics or pediatrics training were associated with better knowledge, familiarity, and

confidence, yet 21% of sixth-year students still had poor knowledge. Most students (88.4%) supported greater curricular emphasis on DDH. Earlier and more structured DDH teaching, supported by clinical exposure, may help future physicians recognize and refer DDH in a timely manner.

Acknowledgment

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List of Abbreviations

DDH	Developmental dysplasia of the hip
IQR	Interquartile range
IRB	Institutional Review Board

Conflict of interests

The authors declare that there is no conflict of interest regarding the publication of this article.

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None.

Consent for participation

Informed consent was obtained electronically from all participants before they completed the questionnaire. Participation was voluntary and anonymous.

Consent for publication

Not applicable.

Ethical approval

Ethical approval was granted by the Research Ethics Committee, College of Medicine, Taibah University (CM-REC) via reference/letter number STU-25-016 dated: 5 April 2025. The study was conducted in accordance with the principles of the Declaration of Helsinki.

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Supplementary content (If any) is available online.

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