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Research Article **Open Access**

Exploring Anatomical Variations of the Vermiform Appendix on Multidetector CT

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Abstract

Acute appendicitis is the most common cause of acute abdominal pain requiring urgent abdominal surgery. CT is the preferred imaging examination for evaluation of patients. The appendix is a highly variable organ with many possible configurations of its location. Depending on its position, the signs and symptoms of appendicitis may also vary and mimic other surgical conditions. The study aims to describe the prevalence of anatomical variations of the vermiform appendix on multidetector CT. A retrospective review of consecutive abdominal CT exams (age ≥ 15) was done. The final cohort was 669 patients. The location of the appendix was subcecal in 26.9%, pelvic in 22.9%, midline in 19.4%, retrocecal in 14.9%, postileal in 4.3%, paracecal in 3%, others in 2.8%, antececal in 2.7%, hepatic in 2.1%, preileal in 0.9%. The pelvic and postileal positions of the appendix were statistically significantly higher in females compared to males. In Conclusion, the most common position for the visible appendix on multidetector CT is subcecal. The prevalence of specific locations of the appendix also differs according to patient gender. To improve patient diagnosis of acute appendicitis in clinical and surgical settings, it is important to take into account the frequency of different appendix positions.

Keywords: Acute Appendicitis; Appendix Apex Position; Multidetector CT; Anatomical Variations; Gender-Specific Variations.

INTRODUCTION

Acute appendicitis is the most common cause of acute abdominal pain requiring urgent abdominal surgical intervention in order to avoid serious complications such as ileus, peritonitis, and even death (Guan et al., 2023; Zacharzewska- Gondec et al., 2019). There is an 8.6 % and 6.7% lifetime risk of developing appendicitis for males and females, respectively (Guan et al., 2023; Kryzak & Mulrooney, 2020). The appendectomy procedure is one of the most commonly performed general surgeries and carries a reported mortality rate between 0.03 and 0.24% (de Wijkerslooth, 2020; Kacprzyk et al., 2020).

Imaging has become central to the diagnosis of appendicitis (Monsonis et al., 2020). Routine imaging is associated with a reduction in the negative appendectomy rate to 4.5% compared to a 15.4% negative appendectomy rate without pre-operative imaging. It not only reduces unnecessary operations but also results in considerable healthcare savings and better outcomes for

patients (Drake et al., 2012; D'Souza et al., 2018). Computed tomography (CT) is the preferred imaging examination for patient evaluation due to the high sensitivity and specificity of over 95% (Krisem et al., 2023). The development of the Multidetector CT (MDCT) is considered a significant advancement in CT imaging, "MDCT has a higher acquisition speed than conventional CT; and more importantly, MDCT acquires volume data instead of individual slice data. These two factors, together with thin section slices, enable the new technique to provide almost isotropic data that can be arranged in different planes without compromising the spatial resolution of the original axial images" (Burrill et al., 2007).

The high temporal and spatial resolution of MDCT has therefore increased the visualization of the appendix imaging (Charoensak et al., 2010). Understanding the anatomy and dimensions of the normal appendix on CT is required for radiologists in order to diagnose appendicitis (Kacprzyk et al., 2020). The vermiform appendix is a cecal diverticulum, which usually lies in the right lower quadrant of the abdomen. However, the appendix is a highly variable viscus with many possible configurations of its location (Whitley et al., 2009; Zacharzewska-Gondec et al., 2019). Depending on the position of the appendix, the signs and symptoms of appendicitis may also vary and mimic other surgical conditions, which makes the diagnosis challenging for radiologists (Kacprzyk et al., 2020; Lee et al., 2014). The anatomical relationship between the ileocecal valve and the appendix helps the identification of the appendix on CT (Whitley et al., 2009). Different locations of the appendix have been identified in literature with widely variable classifications and reported incidence (Kacprzyk et al., 2020; Lee et al., 2014). The most typical appendix position, according to the traditional standard surgical textbook, is retrocecal. However, the results of several recent studies regarding the position of the appendix revealed contradictory results to this claim (Lee et al., 2014). In the literature, only three recent studies could be found regarding the position of the appendix using a CT abdomen (De León et al., 2021; Lee et al., 2014; Willekens et al., 2014). The most recent report based on CT abdomen revealed the deep pelvis as the most common position of the appendix (De León et al., 2021).

The main aim of this study was to investigate the frequency of different locations of the vermiform appendix on MDCT and to assess whether gender is related to the appendix location. Secondary aims were to describe the location of the appendix base relative to the ileocecal valve, the morphology of the visible appendix in terms of maximal outer diameter, the single wall thickness, and intraluminal content, and to assess whether age and gender are related to appendiceal diameter.

MATERIALS AND METHODS

Study design and population:

This study is a retrospective study of consecutive abdominal CT scans performed from January to November 2021 period at the radiology department of Omer Almukhtar Hospital. Abdominal CT images of 823 consecutive patients aged 15 years or older who had undergone CT abdomen or CT chest and abdomen with various indications were initially included. After image reviewing, patients who were excluded from the study consisted of:

-Patients with a non-visualized appendix on CT images.
-Patients with CT evidence of appendicitis including periappendiceal fat stranding, phlegmon, fluid collection, periappendiceal air, periappendiceal fluid and ascites.
The final study population consisted of 669 patients, 317 men and 352 women. The mean age was 51.85 years ± 16.39 (SD), and the age range was 15-91 years.

CT scan technique

All CT images were obtained from the hepatic dome to the pelvic floor, using a 16-detector row 32-slice scanner (Aquilion, Canon (Toshiba) Medical systems Sensation) with 120 kVp and automatic exposure controls of the tube current. The CT parameters included 16-slice acquisition with a slice thickness of 0.8 mm; beam collimation, 16x1.5 mm; a reconstruction interval of 4 mm for axial and coronal images; helical pitch, 1.5; gantry rotation time, 0.75.

367 (55%) of all patients received 80-100 mL of intravenous contrast material (Iohexol, omnipaque 350 mg I/mL, GE HealthCare; Iopromide, Ultravist 370 mg I/mL, Bayer AG, Germany), thirty-four patients received oral contrast material.

Image review process:

The CT studies were retrospectively obtained from the picture archiving and communicating system (PACS) of CharruaSoft (Version 6.31.0) on a hard disc. The CT images were later evaluated on RadiAnt DICOM viewer (2020.2.3 version) by the radiologist with no prior knowledge of the clinical history of the patients. The axial and coronal reformatted images of each study were analyzed simultaneously, and images were magnified to optimize the visualization of the appendix.

Attention was paid to the following five details regarding the appendix:

1- The position of the appendix apex which was redefined and reclassified to include all possible appendix locations. The modified classification system used in this study was reproduced from the classification system used by Kacbprzyk et al. (2020) and Lee et al. (2014).

Ten possible locations of the appendix apex (examples are shown in Fig. 1) are described as follows:

Type 1- Retrocecal, the apex of the appendix is located behind the cecum and/or ascending colon (Fig. 1a).

Type 2- Pelvic, the appendix is directed downward over the psoas muscle with the apex located within the pelvic peritoneal cavity i.e. below the right external iliac vessels (Fig. 1b).

Type 3- Midline, the appendix is directed toward the midline with the apex within the peritoneal cavity above or at the sacral promontory level (Fig. 1c).

Type 4- Subcecal, the appendix is located below the level of the cecum with the apex within the right lower quadrant or iliac fossa but not medial to the right external iliac vessels (Fig. 1d).

Type 5- Preileal, the apex is directed upward anterior to the terminal ileum (Fig. 1e).

Type 6- Postileal, the apex is directed upward posterior to the terminal ileum (Fig. 1f).

Type 7- Paracecal, the apex is located lateral or posterolateral to the cecum and/or the ascending colon (Fig. 1g).

Type 8- Antececal, the apex is located anterior to the cecum and/or ascending colon (Fig. 1h).

Type 9- Hepatic, the appendix is directed upwards with the apex located in the subhepatic space (Fig.1i).

Type 10- Others, the position of the appendix apex does not fit into any of the above locations.

The remaining details noted about the appendix were:

2- The location of the base of the appendix concerning the ileocecal valve was described as superior or inferior, anterior or posterior, and medial or lateral to the ileocecal valve.

3- Measuring the maximal outer diameter of the appendix. All measuring procedures were performed with an electronic caliper after magnifying the actual images.

4- Measuring single wall thickness. All measurements were done to the nearest 0.1 mm.

5- Identifying the content of the appendiceal lumen as faeces, air, fluid, contrast, appendicolith (solid high attenuation intraluminal contents), non-solid high-density material, low-density

material, or collapsed with no content.

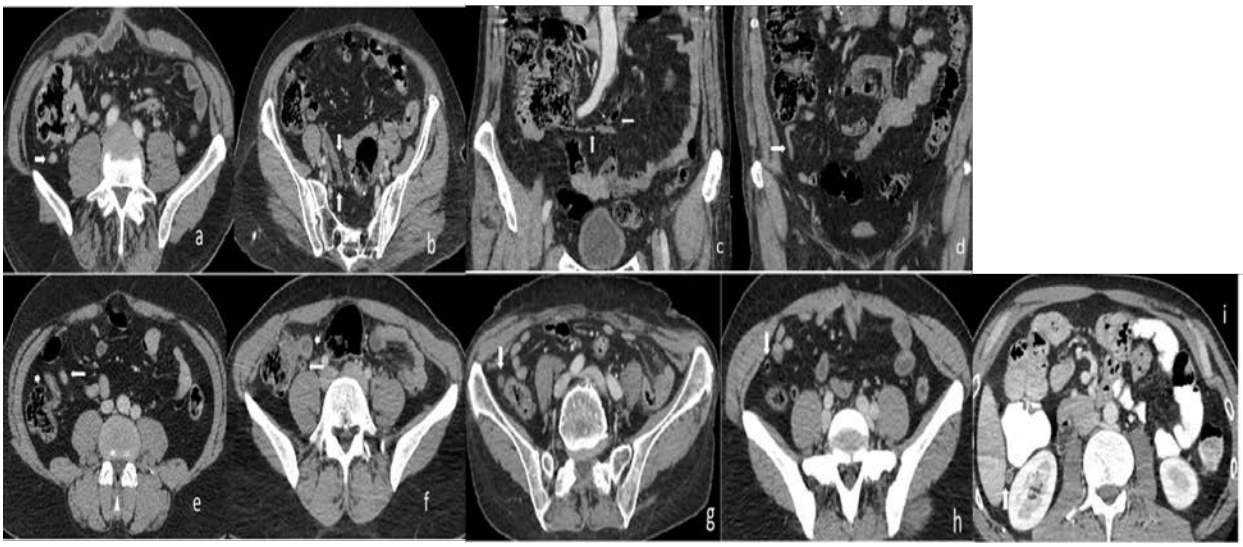


Figure (1): Examples of the classification types used for the appendix apex positions. (a,b,e,f,g,h,i) are axial, (c,d) are coronal reformatted contrast-enhanced CT images. Type 1 (retrocecal) is shown in image a, the appendix apex (arrow) is located behind the cecum. Type 2 (pelvic) is shown in image b, the appendix (arrows) located at the pelvis medial to right external iliac vessels. Type 3 (midline) is shown in image c, the appendix (arrows) directed toward the midline. Type 4 (subcecal) is shown in image d, the appendix (arrow) directed below the cecum. Type 5 (preileal) is shown in image e, the appendix (arrow) is located anterior to the terminal ileum (arrowhead). Type 6 (post-ileal) is shown in image f, the appendix (arrow) is located posterior to the terminal ileum (arrowhead). Type 7 (paracecal) is shown in image g, the appendix (arrow) is located lateral to the cecum. Type 8 (antececal) is shown in image h, the appendix (arrow) is located anterior to the cecum. Type 9 (hepatic) is shown in image i, the appendix (arrow) is located in subhepatic space.

Statistical analysis:

The chi-square test was used to compare the frequencies of the appendiceal apex positions in relationship to the patient's gender. The mean and range of the maximum appendiceal diameter and the appendiceal wall thickness were calculated.

The Welch's t-test (unequal variance t-test) was used to determine the correlation between gender and appendiceal diameter. Pearson Correlation was used to determine the correlation between age and appendiceal diameter. A p-value of < 0.05 was considered statistically significant. Statistical analysis was performed using MedCalc software Ltd, version 20.027.

RESULTS

The most common location of appendix apex in the study population was the subcecal position, encountered in 180 (26.9%) out of the 669 patients, followed by the pelvic position in 153 (22.9%) patients, and the midline position in 130 (19.4%) patients. The appendiceal apex position was retrocecal in 100 (14.9%), postileal in 29 (4.3%), paracecal in 20 (3%), others in 19 (2.8%), antececal in 18 (2.7%), hepatic in 14 (2.1%), preileal in 6 (0.9%) patients.

The relative frequency of appendiceal apex positions in relationship to patient gender are summarized in Table 1 and Fig.2, and their P values are summarized in Table 1.

The most common position of appendix apex in the female subgroup was the pelvic position (103 (29.3%) of 352 females) whereas the subcecal position was the most common in the male

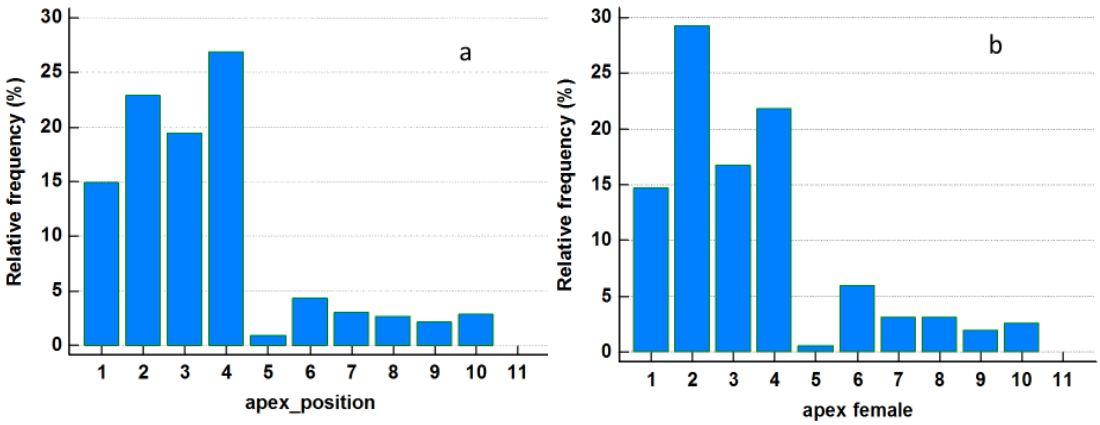
subgroup (103 (22.4%) of 317 males).

According to patient gender, the pelvic and postileal positions of the appendix were statistically significantly higher in females compared to males; the pelvic appendix was present in 103 (29.3%) in female subgroup vs. 50 (15.8%) in male subgroup, (P<0.0001), and the postileal appendix was present in 21 (6%) in female subgroup vs. 8 (2.5%) in male subgroup, (P=0.0158).

Table (1): Frequency of appendiceal apex positions according to patient gender

positions	All patients	Male	Female	P value
Retrocecal	100 (14.9%)	48 (15.1%)	52 (14.8%)	0.6892
Pelvic	153 (22.9%)	50 (15.8%)	103 (29.3%)	<0.0001
Midline	130 (19.4%)	71 (22.4%)	59 (16.8%)	0.2926
Subcecal	180 (26.9%)	103 (32.5%)	77 (21.9%)	0.0526
Preileal	6 (0.9%)	4 (1.3%)	2 (0.6%)	0.4142
Postileal	29 (4.3%)	8 (2.5%)	21 (6%)	0.0158
Paracecal	20 (3%)	9 (2.8%)	11 (3.1%)	0.6547
Antececal	18 (2.7%)	7 (2.2%)	11 (3.1%)	0.3458
Hepatic	14 (2.1%)	7 (2.2%)	7 (2%)	1.0000
Others	19 (2.8%)	10 (3.2%)	9 (2.6%)	0.8185
Total	669 (100%)	317 (100%)	352 (100%)	

Note. All figures are numbers (%).



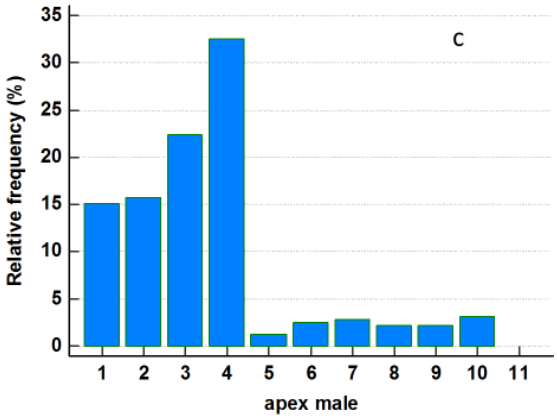


Figure (2): Histograms illustrating the relative frequency of appendix apex positions in all patients (a), female subgroup (b), and male subgroup (c). 1 retrocecal; 2 pelvic; 3 midline; 4 subcecal; 5 preileal; 6 psotileal; 7 paracecal; 8 antececal; 9 hepatic; 10 others.

Regarding the appendix base, the most common location relative to the ileocecal valve was inferior, posterior, and medial in 230 (34.4%) of 669 patients. The appendiceal base was inferior and medial in 118 (17.6%); inferior and posterior in 72 (10.8%); inferior, posterior, and lateral in 53 (7.9%); inferior in 39 (5.8%); inferior, anterior, and medial in 36 (5.4%); posterior and medial in 35 (5.2%); inferior and lateral in 20 (3%); posterior and lateral in 14 (2.1%); inferior, anterior, and lateral in 12 (1.8%) patients. Other locations were posterior in 10 (1.5%); inferior and anterior in 10 (1.5%); medial in 6 (0.9%); superior, posterior, and medial in 4 (0.6%); superior, posterior, and lateral in 4 (0.6%); superior and posterior in 2 (0.3%); anterior and medial in 2 (0.3%); superior, anterior, and medial in 1 (0.1%); superior and medial in 1 (0.1%) patients. see Table 2.

Table (2): The total number and percentage of appendiceal base locations relative to the ileocecal valve.

Superior	Inferior	Not sup nor inf.	anterior	posterior	Not ant nor post	Medial	lateral	Not med nor lat
12/669 (1.8%)	590/669 (88.2%)	67/669 (10%)	61/669 (9.1%)	424/669 (63.4%)	184/669 (27.5%)	433/669 (64.7%)	103/669 (15.4%)	133/669 (19.9%)

The most common appendix base location was inferior, posterior, and medial in most appendix apex positions including retrocecal, (22%, 22 of 100), pelvic (35%, 54 of 153), midline (42%, 55 of 130), subcecal (37.7%, 68 of 180), postileal (48%, 14 of 29), antececal (38.8%, 7 of 18) and others (31.5%, 6 of 19) appendices. Whereas, inferior, posterior, and lateral were the most common base locations encountered in paracecal (20%, 4 of 20), and hepatic (28.5%, 4 of 14) appendices.

Regarding the maximum appendix diameter, the mean of the maximum appendiceal diameter was 5.36 mm ± 1.73 (SD), range (2-23 mm). The maximum appendiceal diameter was greater than 6 mm but not greater than 10 mm in 154 patients (23%) and was greater than 10 mm in eight patients (1.2%), see Fig 3.

The appendix with the largest diameter (23 mm) had a focal saccular-like dilated segment that contained faeces, air, and appendicolith, see Fig. 4.

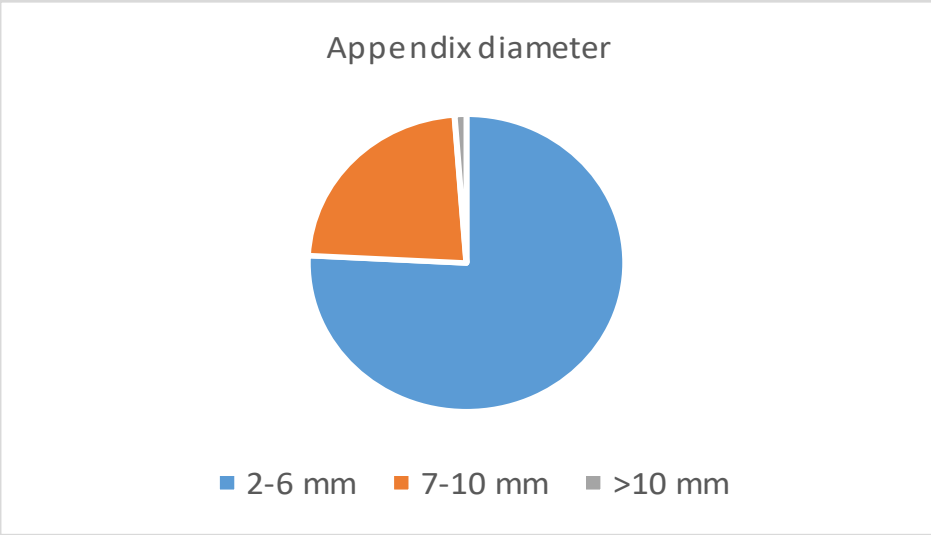


Figure (3): The chart shows the percentage of appendices with a diameter ≤ 6mm, 7-10 mm, and > 10 mm.

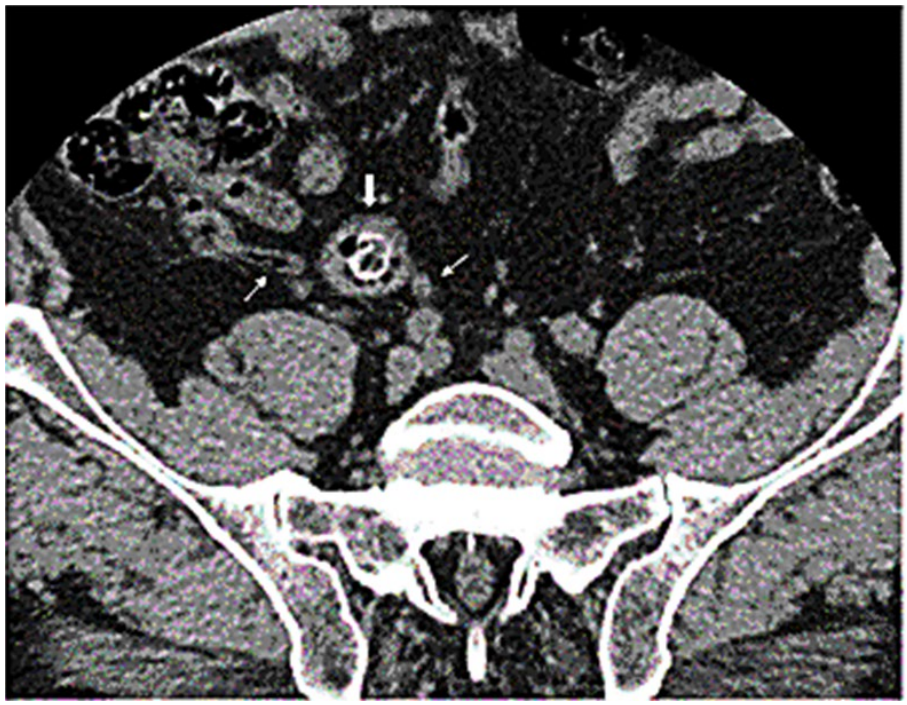


Figure (4): The appendix that had the greatest diameter contained air, fecal content, and appendicolith at the largest segment (thick white arrow). The thin white arrows point to the much smaller appendix segments.

According to patient gender, the mean of maximum appendiceal diameter was 5.64 mm ± 1.96 (SD), (range; 2-23 mm) in men, and 5.11 mm ± 1.45 (SD), (range; 2-12 mm) in women. There was a statistically significant correlation between appendix diameter and gender (P=0.0001).

There was no statistically significant correlation between diameter and patient age (P=0.3866).

As for measurement results of the single wall thickness of the appendix, the single wall thickness was indiscernible in 205 of 699 patients due to a collapsed appendix lumen with no content in 197 patients or collapsed lumen with small appendicoliths in eight patients. In the remaining

464 patients, the single wall thickness of the appendix ranged from 0.3 to 3.5 mm and a mean value of 1.03 mm ± 0.43 (SD).

The luminal contents of the appendix were identified in 472 patients (70.6%) out of 669 patients. In the remaining 197 patients (29.4%), the appendix was collapsed with no luminal content. The most common luminal content encountered in the study group was air only (280/669 patients, 41.8%). The appendix contained air and faeces (32/669, 4.8%); air and appendicoliths (32/669, 4.8%); air and fluid (24/669, 3.6%); air and non-solid high density (23/669, 3.4%). Fluid only (15/669, 2.2%); appendicoliths only (13/669, 1.9%); faeces only (12/669, 1.8%); low density (12/669, 1.8%); air, faeces, and appendicoliths (7/669, 1%), fluid and appendicoliths (4/669, 0.6%); air, fluid, and appendicoliths (2/669, 0.3%).

Overall, appendicoliths were detected in 58 patients (8.7%). Of the 34 patients, where oral contrast was given, the appendix lumen contained contrast medium in 16 patients (16/34, 47%).

DISCUSSION

The primary objective of this study was to estimate the prevalence of different locations of the visible normal appendix on MDCT. Despite the surgical and pathological importance of the appendix, there is no standardized classification method for the anatomical location of the appendix. In this study, a clear and basic classification system was employed. It included all the typical locations (retrocecal, pelvic, Midline, subcecal, ileal, paracecal, and antececal) plus hepatic and other locations. All are clinically relevant and were regularly described in the literature (De León et al., 2021; Kacprzyk et al., 2020; Lee et al., 2014; Mwachaka et al., 2014; Willekens et al., 2014). Knowledge of all these possible locations of the appendix should facilitate the regular identification of the appendix on CT abdomen studies, therefore allowing early diagnosis and treatment of acute appendicitis, especially in cases with atypical presentation caused by appendix position (De Souza et al., 2015).

The amount of previous studies that describe the prevalence of anatomical variations of appendix position over the years is large and beyond the scope of this study. Moreover, they cannot be compared to the present study due to a different methodology in the analysis or different definitions of the appendix location have been used. Most of these studies whose analysis was intraoperative on inflamed appendices or postmortem on cadavers reported the retrocecal appendix as the most common (Chidambaram et al., 2021; De Souza et al., 2015; Mwachaka et al., 2014; Nur Bazlaah et al., 2021; Parmar et al., 2017). It has been hypothesized that the kinking of the appendix by loaded cecum or ascending colon may be the cause of the prevalence of retrocecal appendix among appendicitis patients (Khatun et al., 2019). In addition, the change in intraabdominal pressure and the effect of gravity postmortem may change the position of the appendix relative to the in vivo location (Lee et al., 2014).

In the current study, whose analysis was based on the in vivo location of the vermiform appendix on MDCT, most appendices were subcecal (27%) followed by pelvic (23%). These results are concordant with a similar study from Korea, which also found subcecal appendix prevalence (42.8 %) followed by pelvic (16.2%) (Lee et al., 2014). Other similar studies, contrary to the present study, reported a predominant pelvic position of the appendix, 66% in a study from Belgium (Willekens et al., 2014) and 24% in another study from Columbia (De León et al., 2021). The discrepancy in the results of the appendix apex position between the present study and the two previous studies could be explained by multiple factors. Firstly, the study sample size. The current study had a large sample size of 669 patients compared to the two studies,

which had a smaller sample size of 186 and 83 cases, respectively. Secondly, there are ethnic and geographical variations between the populations studied, which may account for the anatomical differences in the appendix. Thirdly, Wilkenens et al. (2014) broadly classified the appendix location in their study into only four locations: retrocecal, paracecal, pelvic, and midline, which means all subcecal appendices were defined in their study as pelvic, resulting in a much higher percentage of pelvic appendix location.

Regarding patient gender, there were statistically significant gender differences in the pelvic and post-ileal appendiceal positions, with a higher prevalence in females ($P<0.0001$ and $P=0.015$, respectively). The higher female predominance in the pelvic position is likely due to anatomical variations between male and female pelvises. The male pelvis is taller, narrower, and more compact, while the female pelvis is larger and broader, allowing more space for the appendix to descend into the pelvis (Lewis et al., 2017). The finding of pelvic appendix position being the most common in females also has important clinical implications on diagnosing abdominal pain in female patients, as the pelvic appendix might be difficult to detect on CT in thin females with a crowded pelvis, efforts must be made to identify the appendix before rolling out appendicitis and narrowing the differential to gynecological etiology. Azhagiri et al. (2019), in their cohort of appendicitis cases examined by CT, reported the pelvic appendix position as the most common in females, in addition to a higher percentage of post ileal appendix found in females than in males. These results are in accordance with the results of the present study (table 1). Similar to the current study, Lee et al. (2014) also reported statistically significant results regarding gender differences in appendix position on MDCT. However, in contrast to the current study, they reported a higher male prevalence in the antececal, postileal, midline, and subcecal positions.

From clinical experience, a radiologist can identify the appendix position on MDCT studies by first identifying its base and then following along its course to the tip. The base of the appendix has a constant anatomical relationship to the ileocecal valve, which allows the identification of the appendix origin from the cecum on both ultrasound and CT (Whitley et al., 2009). To the best of my knowledge, only one study commented on the location of the base of the appendix identified on CT with respect to the ileocecal valve (Willekens et al., 2014). Similar to the present study, the most common location of the appendiceal base was inferior, posterior, and medial (37% compared to 34.4% in the current study). In the present study, the second most common location was inferior and medial (17.6%), followed by inferior and posterior (10.8%), while in Willekens et al. (2014) cohort, it was inferior, posterior, and lateral (17%), and inferior and medial (8.6%) respectively. Overall, in the present study, the base was more likely to be found inferior (88.2%) than superior (1.8%), posterior (63.4%) than anterior (9.1%), and medial (64.7%) than lateral (15.4%) relative to ileocecal valve (table 2), which was consistent with Willekens et al. (2014) results.

Regarding the diameter of the normal appendix, the 6 mm diameter cut-off value for detecting appendicitis was derived from ultrasound studies, which used a graded compression technique during the scan. Therefore, it cannot be adapted to a CT scan where the appendix is not compressed during acquisition (Krisem et al., 2023). Other authors suggested a threshold of 10 mm for appendicitis diagnosis on CT (Willekens et al. 2014). In the present study, the mean maximum appendiceal diameter was 5.64 mm ± 1.96 (SD). About 24% of visualized appendices had a diameter greater than 6mm, and only 1.5% of the appendices had a diameter greater than 10 mm. The lack of access in the current study to clinical information, limits the capacity of analysis in the large-diameter appendices, as clinical correlation is needed in such cases that do not

exhibit periappendiceal fat stranding to suggest appendicitis. Other authors have reported that a normal appendix on CT scans can be distended to ≥10 mm (Charoensak et al., 2010; Whitley et al., 2008; Willekens et al., 2014). Charoensak et al. (2010) reported as high as 62% of normal appendices in their CT series had a maximum diameter greater than 6mm, and 2.5% were greater than 10 mm in diameter, which could explain the findings of the present study. These results support the claim that the appendiceal diameter alone should not be relied upon to diagnose appendicitis (Moskowitz et al., 2019).

The appendix with the maximum outer diameter in the present study was filled with air, faeces, and appendicolith at the distended segment, which is in accordance with previous reports that correlated the presence of intraluminal contents with a larger appendiceal diameter (Ozer et al., 2021; Tamburrini et al., 2005).

In the current study, there was a correlation between appendiceal diameter and gender, with larger appendices observed in males. To our knowledge, only one previous study examined the appendiceal diameter on CT according to gender. The mean appendix diameter was higher in males, but in contrast to the present study, the difference was not statistically significant (Ozer et al., 2021). There was no correlation between diameter and age.

The appendix wall thickness in the present study had a mean of 1.03 mm ± 0.43 (SD) and a range of 0.3 to 3.5 mm. The criteria suggested for the mural thickness of the appendix in appendicitis are variable between different reports, with a cutoff value of more than 3 mm being frequently used (Kim et al., 2014). The results of the current study are consistent with this value, as only one appendix (0.2%) had a mural thickness greater than 3 mm. A similar study by Wilekens et al. (2014) reported a wall thickness > 3 mm in 8% of normal appendices on CT.

The majority of the visible appendices had contents in their lumen, and most of the content was air. Air is a common finding in appendiceal CT. Hong et al. (2016) results indicated that Intraappendiceal air is a typical finding in the normal appendix and is seen more frequently within the normal appendix than within the inflamed appendix. Appendicular appendicoliths were visualized in 8.7% (58/669). This is in accordance with one recent CT series that showed appendicoliths in 4.4% (11/248) of normal appendices (Ranieri et al., 2021). Appendicoliths are not specific signs of appendicitis and are usually found accidentally in abdominal CT (Kaya & Eris, 2011). However, they are more prevalent among appendicitis patients (nearly 40%) and associated with a higher risk of perforation (Ranieri et al., 2021).

CONCLUSION

Knowledge of anatomical variants of the vermiform appendix and reporting its location as a CT finding is important for the diagnosis of acute appendicitis. The most common position of the normal appendix seen on MDCT images is subcecal. The relative frequency of certain positions of the appendix also differs according to patient gender, with the pelvic and postileal positions being more predominant in females. Considering the prevalence of specific locations of the appendix is relevant in clinical and surgical settings for better diagnosis of patients.

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ETHICS

After approval by the hospital radiology department, a retrospective review of images was acquired in keeping with ethical standards.

Duality of interest: There is no duality of interest, no conflict of interests.

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REFERENCES

Azhagiri, R., Anitha, M., & Hemapriya J. (2019). Prevalence Of Anatomical Variations of The Position of Appendix in Acute Appendicitis by Ct Scan. *International Journal of Anatomy and Research*, *7*(4.1), 7051-7055. DOI: 10.16965/ijar.2019.304

Burrill, J., Dabbagh, Z., Gollub, F., & Hamady, M. (2007). Multidetector computed tomographic angiography of the cardiovascular system. *Postgraduate medical journal*, *83*(985), 698–704. https://doi.org/10.1136/pgmj.2007.061804

Charoensak, A., Pongpornsup, S., & Suthikeeree, W. (2010). Wall thickness and outer diameter of the normal appendix in adults using 64 slices multidetector CT. *Journal of the Medical Association of Thailand = Chotmaihet thangphaet*, *93*(12), 1437–1442.

Chidambaram, B., Rajasekaran V, Selvam VM, & Shanmugam, G. (2021). A cross-sectional study of the position of the appendix in the South Indian population, comparison with the Western population, and its diagnostic dilemma. *Journal of Evidence-Based Medicine and Healthcare*, *8*(25), 2127-2131. DOI: 10.18410/jebmh/2021/399

De León, L. & De León, J. (2021). Anatomical variations of the caecal appendix on tomography, a retrospective study. *Revista Ciencias Biomédicas, 10*(3), 163-171. https://doi.org/10.32997/rcb2021-3350

De Souza, S. C., Da Costa, S. R. M. R., & De Souza, I. G. S. (2015). Vermiform appendix: positions and length – a study of 377 cases and literature review. *Journal of Coloproctology*, *35*(4), 212-216. https://doi.org/10.1016/j.jcol.2015.08.003

de Wijkerslooth, E. M. L., van den Boom, A. L., & Wijnhoven, B. P. L. (2020). Disease burden of appendectomy for appendicitis: a population-based cohort study. *Surgical endoscopy*, *34*(1), 116–125. https://doi.org/10.1007/s00464-019-06738-6

Drake, F. T., Florence, M. G., Johnson, M. G., Jurkovich, G. J., Kwon, S., Schmidt, Z., Thirlby, R. C., Flum, D. R., & SCOAP Collaborative (2012). Progress in the diagnosis of appendicitis: a report from Washington State's Surgical Care and Outcomes Assessment Program. *Annals of Surgery*, *256*(4), 586–594. https://doi.org/10.1097/SLA.0b013e31826a9602

D'Souza, N., Marsden, M., Bottomley, S., Nagarajah, N., Scutt, F., & Toh, S. (2018). Cost-effectiveness of routine imaging of suspected appendicitis. *Annals of the Royal College of Surgeons of England*, *100*(1), 47–51. https://doi.org/10.1308/rcsann.2017.0132

Guan, L., Liu, Z., Pan, G., Zhang, B., Wu, Y., Gan, T., & Ouyang, G. (2023). The global, regional, and national burden of appendicitis in 204 countries and territories, 1990-2019: a systematic

analysis from the Global Burden of Disease Study 2019. *BMC gastroenterology*, *23*(1), 44. https://doi.org/10.1186/s12876-023-02678-7

Hong, H. S., Cho, H. S., Woo, J. Y., Lee, Y., Yang, I., Hwang, J. Y., Kim, H. M., & Kim, J. W. (2016). Intra-Appendiceal Air at CT: Is It a Useful or a Confusing Sign for the Diagnosis of Acute Appendicitis?. *Korean journal of radiology*, *17*(1), 39–46. https://doi.org/10.3348/kjr.2016.17.1.39

Kacprzyk, A., DroŚ, J., Stefura, T., Krzysztofik, M., JasiŃska, K., PĘdziwiatr, M., Major, P., & KHołda, M. (2020). Variations and morphometric features of the vermiform appendix: A systematic review and meta-analysis of 114,080 subjects with clinical implications. *Clinical anatomy (New York, N.Y.)*, *33*(1), 85–98. https://doi.org/10.1002/ca.23474

Kaya, B., & Eris, C. (2011). Different clinical presentation of appendicolithiasis. The report of three cases and review of the literature. *Clinical medicine insights. Pathology*, *4*, 1–4. https://doi.org/10.4137/CPath.S6757

Khatun, S., Thakur, D., & Shah, D. K. (2019). Prevalence of Retrocaecal Appendix among Patients with Appendicitis in A Tertiary Care Hospital of Nepal. *JNMA; Journal of the Nepal Medical Association*, *57*(217), 150–153. https://doi.org/10.31729/jnma.4370

Kim, M. Y., Kim, Y., Ryu, J. A., & Kim, T. Y. (2014). How to evaluate appendices with borderline diameters on CT: proposal of a quick solution to overcome the limitations of the established CT criteria. *Academic radiology*, *21*(12), 1573–1578. https://doi.org/10.1016/j.acra.2014.07.005

Krisem, M., Jenjitranant, P., Thampongsa, T., & Wongwaisayawan, S. (2023). Appendiceal wall thickness and Alvarado score are predictive of acute appendicitis in patients with equivocal computed tomography findings. *Scientific reports*, *13*(1), 998. https://doi.org/10.1038/s41598-023-27984-8

Krzyzak, M., & Mulrooney, S. M. (2020). Acute Appendicitis Review: Background, Epidemiology, Diagnosis, and Treatment. *Cureus*, *12*(6), e8562. https://doi.org/10.7759/cureus.8562

Lee, S. L., Ku, Y. M., Choi, B. G., & Byun, J. Y. (2014). In Vivo Location of the Vermiform Appendix in Multidetector CT. *Journal of the Korean Society of Radiology, 70*(4), 283-289. https://doi.org/10.3348/jksr.2014.70.4.283

Lewis, C. L., Laudicina, N. M., Khuu, A., & Loverro, K. L. (2017). The Human Pelvis: Variation in Structure and Function During Gait. *Anatomical record (Hoboken, N.J.: 2007)*, *300*(4), 633–642. https://doi.org/10.1002/ar.23552

Monsonis, B., Mandoul, C., Millet, I., & Taourel, P. (2020). Imaging of appendicitis: Tips and tricks. *European journal of radiology*, *130*, 109165. https://doi.org/10.1016/j.ejrad.2020.109165

Moskowitz, E., Khan, A. D., Cribari, C., & Schroeppel, T. J. (2019). Size matters: Computed tomographic measurements of the appendix in emergency department scans. *American journal of surgery*, *218*(2), 271–274. https://doi.org/10.1016/j.amjsurg.2018.12.010

Mwachaka, P., El-Busaidy, H., Sinkeet, S., & Ogeng'o, J. (2014). Variations in the position and length of the vermiform appendix in a black Kenyan population. *ISRN anatomy*, *2014*, 871048. https://doi.org/10.1155/2014/871048

Nur Bazlaah, B., Khairuzi, S., Nabiha, F., Mohd Nadzri, M., Nur Bazilah, B., Hirdayu, A. B., & Fazlin, F. (2021). Incidence of Retrocaecal Acute Appendicitis at the Hospital Sultanah Nora Ismail (HSNI) Batu Pahat. *The Medical Journal of Malaysia*, *76*(2), 223–228.

Ozer, H., Yazol, M., & Senturk, M. (2021). Appendix Vermiformis Morphology in the Adult Age Group: What we've learned from more than 250 Patients on Computer Tomography. *Gazi Medical Journal*, *32*, 628-631. https://medicaljournal.gazi.edu.tr/index.php/GMJ/article/download/2745/2398/34079

Parmar, P.D., Dave, J., Vekariya, M., & Pandya, K. (2017). Study of variations in position of appendix in 100 operated cases of appendicitis. *Journal of Health Sciences & Research*, *7*(5), 42-46.

Ranieri, D. M., Enzerra, M. D., & Pickhardt, P. J. (2021). Prevalence of Appendicoliths Detected at CT in Adults With Suspected Appendicitis. *AJR. American Journal of roentgenology*, *216*(3), 677–682. https://doi.org/10.2214/AJR.20.23149

Tamburrini, S., Brunetti, A., Brown, M., Sirlin, C., & Casola, G. (2005). CT appearance of the normal appendix in adults. *European Radiology*, (15), 2096–2103. https://doi.org/10.1007/s00330-005-2784-z

Whitley, S., Sookur, P., McLean, A., & Power, N. (2009). The appendix on CT. *Clinical radiology*, *64*(2), 190–199. https://doi.org/10.1016/j.crad.2008.06.015

Willekens, I., Peeters, E., De Maeseneer, M., & de Mey, J. (2014). The normal appendix on CT: does size matter?. *PloS one*, *9*(5), e96476. https://doi.org/10.1371/journal.pone.0096476

Zacharzewska-Gondek, A., Szczurowska, A., Guziński, M., Sąsiadek, M., & Bladowska, J. (2019). A pictorial essay of the most atypical variants of the vermiform appendix position in computed tomography with their possible clinical implications. *Polish Journal of Radiology*, *84*, 1-8. https://doi.org/10.5114/pjr.2018.81158 .

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Research Article **Open Access**

Maternal Mortality at Al-Wahda Tertiary Hospital/ Derna -Libya

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Abstract

Maternal mortality is one of the major challenges which face the developing countries throughout the world. The maternal mortality ratio (MMR) is the main public health indicator that determines the quality of health care services and the women's status. However, maternal mortality is much higher in developing countries compared to developed nations due to lack of adequate medical care; high prevalence of infectious diseases, higher total fertility rate and due to health care system difference. Countries with high maternal mortality ratio have less reliable vital statistics registry system; as a result level of maternal mortality is usually underestimated and little information is available regarding locally specific risk factors for maternal death. The aim of this study is to calculate, identify the risk factors and the causes of maternal mortality at Al-Whahda Tertiary hospital/Derna-Libya. This was a retrospective descriptive study of ten years conducted at Al-Wahda hospital Derna, Libya. Detailed retrospective reviews of the data were undertaken from the casenotes of 31782 admissions in the obstetrics unit during 10 years period from 2013 to 2022. The information was retrieved from the case notes available in the medical records department of the hospital as well as from the daily records in the maternity and delivery worlds of the hospital during the study period. There was a total of 31782 deliveries conducted during the study period. The maternal mortality ratio was 34.84 per 100,000 live-births in the year 2013 to 2022. The mean age of maternal deaths was34.36±5.54 years. Most of deaths occur in postpartum period. The major causes of deaths were pulmonary and amniotic fluid embolism followed by postpartum haemorrahge. The maternal mortality is high despite the availability of comprehensive emergency obstetric care at the hospital. Pulmonary and amniotic fluid embolism are the leading causes of death in one of the tertiary care teaching hospitals in Libya.

Keywords: Maternal Health, Maternal Mortality Rate, Libya, Derna**.**

INTRODUCTION

Maternal mortality is one of the major challenges which face the developing countries throughout the world. The maternal mortality ratio (MMR) is the main public health indicator that determines the quality of health care services and the women's status (WHO, 2013). The maternal mortality ratio showed a significant reduction in maternal deaths globely, which decreased by 38% from 342 to 211 deaths per 100,000 live births from 2007 to 2017, according to United nations (UN) interagency estimates. However, 94% of all maternal death has occurred in low income countries. The MMR in low-income countries in 2017 was 462 per 100,000 live- births versus 11 per 100,000 live-births in high-income countries (WOH, 2019). According to The

World Bank in 2017, Libya has a maternal mortality rate (MMR) of 72 deaths per 100,000 live-births (The World Bank).

WHO found that, the majority of maternal deaths are due to hemorrhage, infection, unsafe abortion, hypertensive disorders of pregnancy and obstructed labor. The major causes of deaths are poverty; inadequate, inaccessible, and unaffordable health care; low status of women, and illiteracy (Abyeji, 1998; WOH, 2019). However, maternal mortality is much higher in developing countries compared to developed nations due to lack of adequate medical care; high prevalence of infectious diseases, higher total fertility rate and due to differences in health care system. The developing countries with high maternal mortality ratio have less reliable vital statistics registry system; which result in underestimation of maternal mortality level and little information is available regarding locally specific risk factors for maternal death (WHO & Organization, 2010; WOH, 2019). Reduction of the preventable maternal and perinatal deaths can be achived by improving access to health care and quality care in pregnancy. So, MMR indicator is necessary for planning, implementing and monitoring initiatives to improve maternal health.

Objective: The aim of this study was to calculate, identify the risk factors and the causes of maternal mortality, in Al-Wahda hospital Derna, is a tertiary care center located in the Eastern part of Libya, where almost high number of deliveries occurs in a year.

MATERIALS AND METHODS

This was a retrospective descriptive study of ten years period conducted at Al-Wahda hospital Derna, Libya. Data were collected from record files. After obtaining permission from the department of obstetrics and gynecology and medical affair at Al Whadal hospital/ Derna for conducting this study. Detailed retrospective reviews of the data were undertaken from the case notes of 31782 admissions in the obstetrics unit during the period from 2013 to 2022. The information obttained was age of women, gravaidity, time of death **(**antenatal, intrapartum, postpartum) and the cause of death.

RESULTS

The calculated maternal mortality ratio (MMR) was 34.84 per 100,000 live births from which the total 31782 deliveries and 31445 live-births over the study duration of ten years. During this period, there were 11 maternal deaths and the mean age and standard deviations of women was 34.36±5.54 and ranged from 28 to 42 years. The mean and standard deviations of parity was 2.45±2.42 and mean and standard deviations of gravidity was 4.00±2.32 (Table 1).

Table (1). Maternal mortality and its characteristics (n = 11)

	No	%
Age		
≤35	7	63.6
≥ 36	4	36.4
Gravidity		
Primgravida	1	9.1
Multigravida	10	90.9

There were variations in the maternal mortality rate during the period of study (Figure 1). The maternal mortality ratio decreased from 2014 to 2021 (50.49 and 32.89 per 100 000 live- births

respectively). There was no maternal deaths in year 2015, 2018 and 2020. However, the MMR increase in 2022 to be 110.98 per 100000 live births (Table 2).

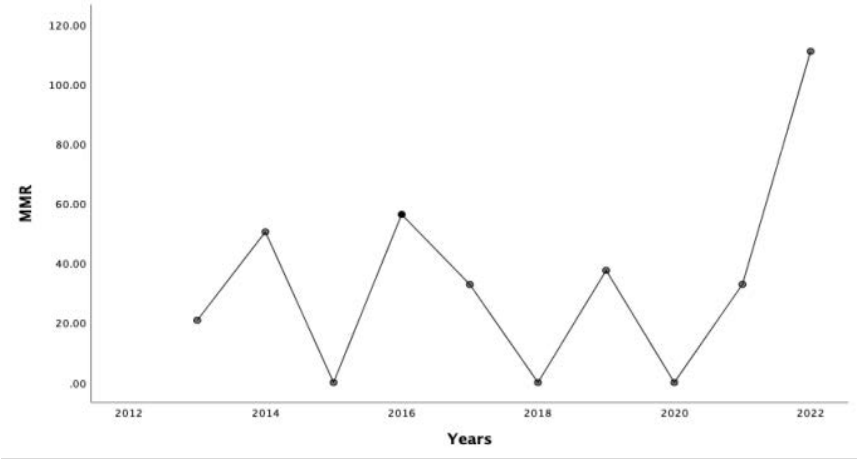

Figure (1). Trends in maternal mortality ratio (MMR) from 2013 to 2022

Table (2). Maternal mortality ratio (MMR) from 2013 to 2022

Year	Number of deliveries	Number of live births	Still Birth	Maternal deaths	Maternal Mortality rates
2013	4773	4794	55	1	20.85
2014	3930	3961	32	2	50.49
2015	2921	2929	37	0	0.0
2016	3548	3550	43	2	56.33
2017	3041	3044	30	1	32.85
2018	1977	1982	20	0	0.0
2019	2665	2660	44	1	37.59
2020	3197	3209	28	0	0.0
2021	3036	3040	24	1	32.89
2022	2694	2703	24	3	110.98

Table (3). Time of death

	No	%
Antenatal	3	27.3
Intrapartum	2	18.2
Postpartum	6	54.5

Among 11 women 6 (54.5%) of them were died during the postpartum period, only 3 (27.3%) had died on antenatal period and 2 (18.2%) women had died during the intrapartum period (Table 3).

The main cause of death in the 10 years was three cases pulmonary embolism; one of them due to covid 19 (27.27%) follow by amniotic fluid embolism two cases (18.18%).Two cases PPH; one case rupture uterus, and other case vaginal septum(18.18%) and the others due to different causes; DM, pneumonia, abruptio placenta(DIC), acute fulmenant hepatitis (autopsy) and sever peeclampsia and pulmonary odema, adult respiratory distress syndrome (ARDS) (Table 4).

Table (4). Cause of death

Cause of death	No	%
DM, pneumonia	1	9.09
Abruptio placenta, DIC	1	9.09
Acute fulmenant hepatitis (Autopsy)	1	9.09
Amniotic fluid embolism	2	18.18
Pulmonary embolism/ COVID-19	3	27.27
Postpartum haemorrahge (PPH)	2	18.18
Sever PE	1	9.09

DM: diabetes millatus, DIC: disseminated intravascular coagulopathy, PE:preeclampsia, PPH: postpartum haemorrahge.

DISCUSSION

Maternal death indicates the quality of maternal services provided to women in thesociety. A high rate of MMR shows poor antenatal care, latere ferral, illiteracy and low socioeconomic status. The maternal mortality ratio is 34.84per 100,000 live-births in the year 2013 to 2022 from total of 31782 deliveries conducted during the study period, which is lower as compared to the study done in developing countries for example, in a tertiary care centre in Eastern Nepal; the maternal mortality ratio was 129.34 per 100,000 live-births in the year 2015 to 2020 (Sitaula et al., 2021), in Paropakar Maternity and Women's Hospital (PMWH) Thapathali Kathmandu, Nepal was 356.64/100000 live birth (Upadhyaya, 2014) and in the department of Obstetrics and Gynaecology at the Government Mohan Kumaramangalam Medical College Hospital, Salem, India was 802/1,00,000 live births (Sundari et al., 2016).While in India the MMR declined by about 70% from 398/ 100 000 live births in 1997–98 to 99/100 000 (90–108) in 2020 which is higher than this study (Meh et al., 2022). The higher incidence of deaths is due to late referral of cases from periphery and delayed interventions. The higher rates in other developing countries could be attributed to poor management by obstetricians and delays in seeking medical care by women and their families.

In the tertiary care hospital experience in upper Egypt the maternal mortality ratio decreased progressively from 2009 to 2014 (228 and 89 per 100000 live birth respectively) in spite this the rate is higher than ours.

However, in China the overall MMR was 15.91 per 100,000 live- births, the MMR due to direct and indirect obstetric causes shown a downward trend ($P<0.001$) and the gap between them narrowed to 14.29% during 2015–2022 (Wang et al., 2023).

In the present study most of the deaths 63.6% occurred at ≤35 years age groups and the mean age and standard deviation of maternal deaths was 34.36±5.54 years. Which are similar to the studies that reports maximum deaths occurred at 21-30 years age group (Sundari et al., 2016; Verma et al., 2008).Other studies found the most deaths occurred at 21-25 years (64.2%) age group and (58%) of the death women were at 20–29 years (Meh et al., 2022).

In our study 90.9% of maternal deaths among multigravida.Similar observation was seen from New Delhi in India (Mediratta et al., 2015).More deaths occurred among multi parous women in other studies in India conducted by (Garg, 2016; Khandale et al., 2017; Murthy et al., 2013; Patel et al., 2018). However, more than half of maternal mortality (50.49%) were among primigravidae in Kerala, India study (Sreekumari et al., 2018).

Post-partum deaths accounted in about 54.5% whereas in other studies was 70% (Khumanthem et al., 2012), 93% of death had occurred in the postpartum period (Sitaula et al., 2021) and

Post-partum deaths accounted for about 92.5% whereas in other studies it was only 70% (Khumanthem et al., 2012).

The main causes of deaths were pulmonary and amniotic embolism followed by postpartum haemorrahge as compared to study done in a tertiary care centre in Eastern Nepal;Obstetric hemorrhage, hypertensive disorder of pregnancy and sepsis were the main causes of maternal death. The main causes of maternal death were obstetric haemorrhage (47%; higher in poorer states), sepsis (12%) and hypertensive disorders of pregnancy (7%) (Meh et al., 2022).In a study conducted in Nigeria, found six leading causes of maternal mortality were hemorrhage, eclampsia/ preecampsia, sepsis, ruptured uterus, complications of abortion, and prolonged obstructed labor. Among these causes, 43.4% accounted for hemorrhage followed by 36.0% of preeclampsia and eclampsia which coincides with the finding seen in our study (Sitaula et al., 2021). However, the delay in seeking health care andreaching health care facility are prime contributory factors (type I delay:40.9%) (Sitaula et al., 2021).

Moreover, we found that the indirect causes of maternal mortality accounted for 24.9 % of all mortalities. As regards the direct causes of maternal mortality, preeclampsia remained the major cause and represented 27.7 % of the avoidable causes. The second most frequent cause of direct maternal death was postpartum hemorrhage (PPH), which represented 26.8 % (Abbas et al., 2016).

The is no aviable information about antenatal care and socioeconomic factors of women.

CONCLUSION

As compared to developing countries MMR in our hospital is low but still higher than that in developed countries.

The maternal mortality is high despite the availability of comprehensive emergency obstetric care at the hospital. Pulmonary and amniotic fluid embolism are the leading causes of death in one of the tertiary care teaching hospitals in Libya.

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REFERENCES

Abbas, A. M., Amin, M. T., Ali, S. S., & Salem, N. Z. J. I. J. R. C. O. G. (2016). Maternal mortality: a tertiary care hospital experience in Upper Egypt. *5*(5), 1466-1471.

Abyeji, A. J. I. J. G. O. (1998). IJGO. Trends in maternal mortality in Ilon. *63*, 183-184.

Garg, P. J. I. J. M. R. R. (2016). To study maternal mortality and complications leading to maternal death in the tertiary care centre. *4*(3), 347-352.

Khandale, S. N., Kedar, K. J. I. J. o. R., Contraception, Obstetrics, & Gynecology. (2017). Analysis of maternal mortality: a retrospective study at tertiary care centre. *6*(4), 1610-1614.

Khumanthem, P. D., Chanam, M. S., Samjetshabam, R. D. J. T. J. o. O., & India, G. o. (2012). Maternal mortality and its causes in a tertiary center. *62*, 168-171.

Mediratta, G., Khullar, H., & Bhandari, S. J. J. I. A. C. M. (2015). An observational study of maternal mortality in a tertiary care hospital in New Delhi. *16*(2).

Meh, C., Sharma, A., Ram, U., Fadel, S., Correa, N., Snelgrove, J.,…Gynaecology. (2022). Trends in maternal mortality in India over two decades in nationally representative surveys. *129*(4), 550-561.

Murthy, B. K., Murthy, M. B., & Prabhu, P. M. J. I. j. o. p. m. (2013). Maternal mortality in a tertiary care hospital: a 10-year review. *4*(1), 105.

Patel, D. M., Patel, M. M., Salat, V. K. J. I. J. o. R., Contraception, Obstetrics, & Gynecology. (2018). Two year review of maternal mortality at a tertiary care hospital of GMERS, Valsad, Gujarat, India. *7*(6), 2283-2287.

Sitaula, S., Basnet, T., Agrawal, A., Manandhar, T., Das, D., Shrestha, P. J. B. P., & Childbirth. (2021). Prevalence and risk factors for maternal mortality at a tertiary care centre in Eastern Nepal-retrospective cross sectional study. *21*, 1-8.

Sreekumari, U., Nair, S. J. I. J. o. R., Contraception, Obstetrics, & Gynecology. (2018). Trends in causes of maternal mortality in a tertiary care centre in Kerala, India. *7*(11), 4370-4375.

Sundari, K. M., Priya, R. P. J. I. J. o. R., Contraception, Obstetrics, & Gynecology. (2016). Maternal mortality: analysis of causes and preventable factors. *5*(6), 1719-1722.

Upadhyaya, I. J. J. o. t. N. M. A. (2014). Maternal Death Reviews of a Tertiary Care Hospital. *52*(193).

Verma, A., Minhas, S., & Sood, A. J. J. O. G. I. (2008). A study on maternal mortality. *58*(3), 226-229.

Wang, W., Zhu, Y., Cheng, Y., Chen, X., & Luo, Y. J. F. i. P. H. (2023). Levels and trends of maternal death in Baoan district, Shenzhen, China, 1999–2022. *11*, 1051717.

WHO, U. J. U., & Organization, T. W. B. G. W. H. (2010). UNFPA, The World Bank. Trends in maternal mortality: 1990 to 2008 Estimates developed by WHO, UNICEF.

WHO, W. H. O. (2013). WHO guidance for measuring maternal mortality from a census.

WOH, W. H. O. (2019). *Trends in maternal mortality 2000 to 2017: estimates by WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division: executive summary*.

The World Bank. Libya - World Bank Gender Data Portal. https://genderdata.worldbank.org/countries/ Libya.

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Research Article

Open Access

Clinical Manifestations of Gastro-esophageal Reflux among Patients with Chronic Laryngitis in Benghazi, 2018

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Abstract

Gastroesophageal reflux disease is a chronic, complex condition that may present with atypical symptoms, including laryngitis. The study aims to demonstrate the relationship between signs of reflux laryngitis in patients with typical manifestations of gastroesophageal reflux disease (GERD). The present study included a total of 60 patients suffering chronic laryngitis with an age range of 23 to 88 years in a descriptive study in Benghazi Medical Center in the year 2018. History was collected, indirect laryngoscopy was done for cases, and data were analyzed using SPSS 23.0. Results: the most common symptoms were hoarseness of voice, throat clearing, dysphagia, throat discomfort, and globus sensation, and no significant association of symptoms with the gender of the patients. The most common laryngeal findings were hyperemia, vocal cord changes, and posterior commissure hypertrophy. The significant association included only posterior commissure hypertrophy and infraglottal edema. Conclusions and recommendations: many patients didn't seek medical advice, and most had no diagnostic procedure. Stronger study designs using proper diagnostic techniques and patient education with staff training are recommended.

Keywords: Gastroesophageal reflux disease, Chronic laryngitis, Hoarseness of voice.

INTRODUCTION

Gastroesophageal reflux disease (GERD) is a chronic, complex condition that carries a risk of morbidity and complications. Gastroesophageal reflux disease clinical features present mainly as heartburn and regurgitation. It may also present with atypical features known as extraesophageal symptoms. Atypical manifestations include chronic cough, hoarseness, chronic sore throat, laryngitis, dental erosions, asthma, and noncardiac chest pain (Heidelbauget al, 2008).

There is not much information that describes the exact cause of gastroesophageal reflux disease, and the data on how it occurs remains very limited. Symptoms could be classical (heartburn and regurgitation) or unusual nonesophageal symptoms such as coughing, dyspnea, and sore throat. Signs of inflammation may be absent or severe, such as esophageal stricture or ulceration (Parsons et al., 2010). GERD should be strongly considered in the differential diagnosis in patients presenting with atypical symptoms when other diagnoses have been excluded. Suspected patients should

undergo prompt endoscopy regardless of whether other symptoms are typical or atypical (Heidelbaugh et al., 2008). laryngopharyngeal reflux (LPR) was first reported in 1968 by Cherry and Margulies. There are debates regarding LPR on whether to consider it as an atypical presentation of GERD or an entirely different disease. It could be defined as the reflux of gastric contents into the upper aerodigestive tract, with the absence of classical symptoms of GERD (heartburn and regurgitation). (Yazici et al, 2010 and Koufman et al, 2002).

The term laryngopharyngeal reflux disease (reflux laryngitis) refers to clinical manifestations of gastric reflux on the upper airways and was adopted in 2002 by the American Academy of Otolaryngology and Head and Neck Surgery (Koufman et al., 1991 and Dilen da Silva et al., 2015). With devices that are able to measure the acidity both on the proximal and distal esophagus and the pharynx and also using the fiber-optic laryngoscope, the effect of regurgitation on larynx is assessed (Pribuisiene et al., 2002). Even though many findings are nonspecific, some suggest that signs, such as edema, erythema, and congestion, seen mainly in the posterior parts of the larynx (posterior laryngitis), could be because of the effect of inflammation as a result of reflux (Koufman et al., 1991; Dilen da Silva et al., 2015).

Symptoms of LPR include cough, hoarseness of voice, sore throat, globus sensation, repetitive throat clearing, excessive sputum, odynophagia, heartburn, and voice fatigue (Yuksel et al., 2012). LPR signs include congestion and lymphoid hyperplasia of the posterior pharyngeal wall, edema and congestion of the larynx, vocal cord polyps, subglottic stenosis, granulomas, Reinke`s edema, and posterior glottic stenosis (Yuksel et al., 2012). In professional voice users with signs of chronic laryngitis, laryngoscopic changes such as arytenoid edema, inter-arytenoid edema, vocal folds edema, ventricular bands edema, and laryngeal edema may suggest the concomitance of GERD in professional voice users with dysphonia (Cobzeanu et al., 2012).

The study's aim demonstrates the relationship between signs of reflux laryngitis in patients with typical manifestations of GERD.

MATERIALS AND METHODS

Study Participants

Selected cases with chronic laryngitis who attended otolaryngology outpatient services in Benghazi Medical Center (BMC) during the period from 1/3/2018 to 31/6/2018 (spring season) were enrolled in this case series study. The patients were diagnosed based on symptoms and laryngoscopic findings. Inclusion criteria included adult patients aged 18 and older, both male and female, who presented with symptoms of chronic laryngitis for six weeks or more. Exclusion criteria include trauma, tumor, neurological abnormalities (e.g., bulbar or pseudo bulbar palsy, cerebrovascular accident, multiple sclerosis, *etc*.) as well as alcohol consumption.

Ethical statement

The following considerations were taken carefully during the conduction of the study: informed consent regarding study aims and methods, ensuring confidentiality and privacy of the data, and acknowledging co-investigators and data collectors in the study.

Data Collection

The data was collected using a history sheet, clinical examination, and reviewing patient files for important investigations. To avoid selection bias, questions such as age and original residency were asked. Additional questions on employment, marital status, smoking habits, alcohol consumption,

and past medical and surgical history were asked. The cases were questioned on the symptoms of chronic laryngitis in general, such as sore throat, hoarseness of voice, dry cough, symptoms of LPR such as frequent throat clearing, globus pharyngeus, and any symptoms suggestive of GERD, such as regurgitation and/or heartburn during laryngitis or within last three months or ever. The clinical examination was guided by the history's findings. Head and neck examinations were done, and patients with hoarseness were subjected to flexible nasopharyngoscopy and/or rigid laryngoscopy.

Sampling technique and sample size

A purposive sampling technique was used to get the required sample. The study population is the number of cases attending the otolaryngology outpatient services in Benghazi Medical Center during the study period. There were up to 3000. The sample size was calculated taking into consideration an accepted margin error of 5% and a confidence level of 95% with the above-mentioned data. The calculated sample size was 60 cases.

Statistical analysis

Descriptive statistics of study population characteristics were done using SPSS IBM 20.0. Analysis of data was performed including rate, means, medians, confidence intervals, and range values as appropriate, measurement of risk ratio confidence intervals for outcomes for the set of assigned events, analysis of associations using chi-square (Likelihood ratio) or its alternative and t-test (or Mann-Whitney U test for non-normally distributed data). Significant results would be indicated with $P \leq 0.05$.

RESULTS

A total of 60 patients with ages ranging from 23 to 88 years had a mean of 49.72 (SD= 15.077) and a median of 49.5 years. Males and females were nearly equal, with a slight predilection for males (Figure 1).

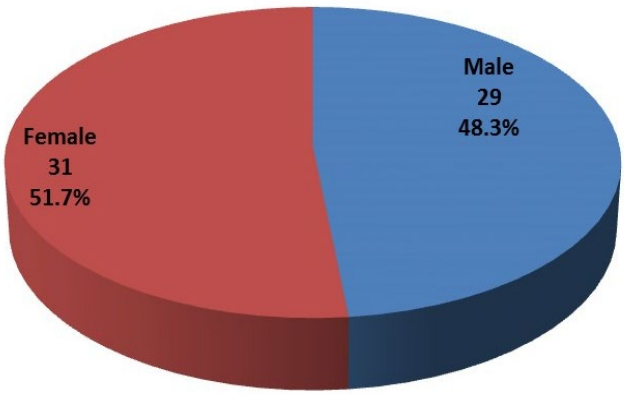

Figure (1): Gender distribution of the study population

Regarding most prevalent symptoms, 59 (98.3%) patients presented with hoarseness of voice and heartburn, and 58 (96.7%) had a clearing of the throat (figure 2). Other symptoms include globus sensation in 7 (11.7%) patients, dysphagia/odynophagia in 42 (70%) of patients, and throat discomfort in 27 (45%) patients (figure 3). Statically, gender shows no significant difference among different symptoms. (Table 1).

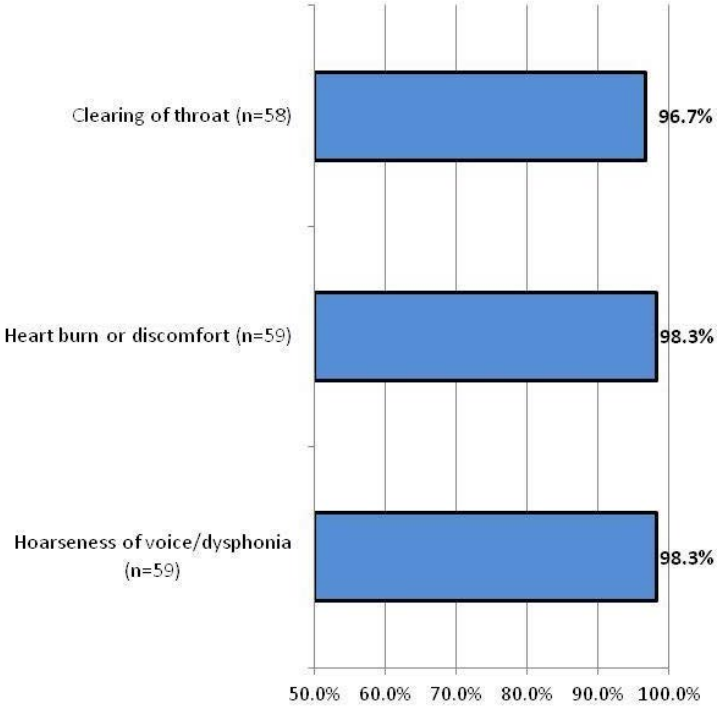

Figure (2): The rates of the most prevalent symptoms among the study population

Table (1): Gender differences across different symptoms

Gender	Globus	Dysphagia / odynophagia	Throat discomfort
Male	3	21	14
	10.3%	72.4%	48.3%
Female	4	21	13
	12.9%	67.7%	41.9%
Test statistic (*P*)	(1.000)	0.156 (0.693)	0.243(0.622)

Regarding laryngoscopic findings among the study population, vocal cord hyperemia was found in 56 (93%) patients, subglottic edema was found in 3 (5%) patients, vocal cord edema was found in 18 (30%) patients, posterior commissure hypertrophy was found in 15 (25%) patients and edematous arytenoids found in 4 (6.7%) patients, (figure 3). Statically gender shows no significant difference among different laryngoscopic findings. (Table 2).

Table (2): Gender differences across different laryngoscopic findings

Gender	Subglottal edema	Vocal cord edema	Posterior commissure hypertrophy	Edematous arytenoids
Male	3	10	9	3
	10.3%	34.5%	31.0%	10.3%
Female	0	8	6	1
	0.0%	25.8%	19.4%	3.2%
Test statistic (*P*)	(0.107)	0.537(0.464)	1.09(0.296)	(0.346)

***** Statistically significant according to a 95% confidence limit. †*P* value by Fisher exact test

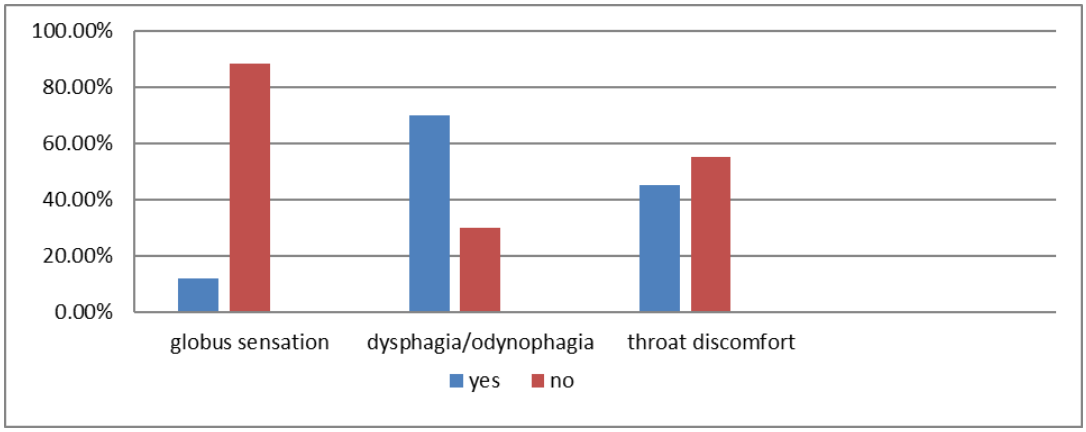

Figure (3): Distribution of other symptoms among the study population

Statistically significant according to a 95% confidence limit. †*P* value by Fisher exact test

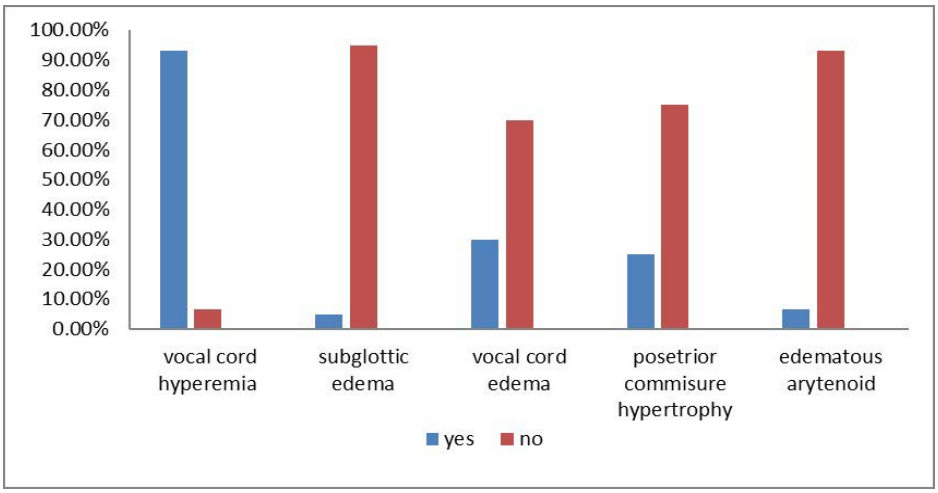

Figure (4): Distribution of most common laryngoscopic findings among the study population

DISCUSSION

Gastroesophageal reflux disease is a chronic, complex, and relapsing disease that presents as heartburn and regurgitation with atypical or extraesophageal symptoms, including laryngitis and chronic sore throat (Heidelbaugh et al., 2008). According to El-Serag, et al. (2013), in the Middle East, data show a prevalence of at least weekly heartburn and/or regurgitation that varied between 8.7% and 33.1%. The overall incidence was 0.84 – 5 per 1000 person-years. Obesity, smoking, and male gender are reported risk factors for GERD. The Global Consensus Group in Montreal in 2006 stated that chronic laryngitis is highly associated with gastroesophageal reflux disease (GERD). Among 42 patients with chronic hoarseness, LPR was confirmed in 35 patients (83.33%). The most frequent inflammatory changes noticed included erythema of the arytenoids and interarytenoid regions (posterior laryngitis). The most frequent symptom among patients with LPR was throat clearing, followed by hoarseness (Dymek et al., 2012).

The present study included a total of 60 patients suffering chronic laryngitis with an age range of 23 to 88 years, with a mean of 49.72 (SD= 15.077) and a median of 49.5 years. Males and females in this study were nearly equal, with a slight predilection for males. According to Koufman JA, et al.

(2002), the definition of LPR is signs of the effect of gastric contents into the upper aerodigestive tract with the absence of classical symptoms of GERD (heartburn and regurgitation).

Dilen da Silva, et al. (2015) stated that the term laryngopharyngeal reflux disease (reflux laryngitis) was adopted in 2002 by the American Academy of Otolaryngology and Head and Neck Surgery and refers to clinical manifestations of gastric reflux on the upper airways. According to De Bortoli N et al. (2012), atypical manifestations of GERD include chronic cough and laryngopharyngeal symptoms (LPS), like hoarseness of voice, feeling a lump in the throat, and throat discomfort. In this study, heartburn (98.3%: 59/60), hoarseness of voice/dysphonia (98.3%: 59/60), and throat clearing (96.7%: 58/60) were prevalent symptoms among the patients. According to Heidelbaugh J et al. (2008), classic reflux symptoms are present in 6.0 – 45.0% of patients with ear, nose, and throat (ENT) symptoms. The high rates of GERD symptoms are noticeable among the study population. Dymek A et al. (2012) also reported that in patients with chronic dysphonia, LPR was confirmed in 35 patients (83.33%). The most frequent inflammatory changes noticed included erythema of the arytenoids and interarytenoid regions (posterior laryngitis).

The most frequent symptom among patients with LPR was throat clearing followed by hoarseness. In the present study, the most common symptoms among patients with chronic laryngitis were hoarseness of voice/dysphonia (98.3%: 59/60), throat clearing (96.7%: 58/60), Dysphagia: 70.0% (42/60), Throat discomfort: 45.0% (27/60) and Globus sensation: 11.7% (7/60). There was no significant association of symptoms with any demographic characteristics of the patient. According to Alharethy S, et al. (2018), Dysphonia, frequent throat cleaning, and a globus sensation are common presentations of LPR and allergic rhinitis/ laryngitis. This might be explained by the fact that the co-existence of LPR can increase patients' self-perception of allergic problems. Vocal cord hyperemia 93.3% (56/60), vocal cord changes: 30.0% (18/60), and Posterior commissure hypertrophy: 25.0% (15/60) were the most common findings among the population of the study. Edematous arytenoids was 6.7% (4/60).

Posterior commissure hypertrophy is associated with advanced age ($P = 0.014$). Those findings were concordant with Dilen da Silva C, et al. (2015), who demonstrated posterior laryngitis due to acid reflux in up to 80% of cases. Gender in the present study showed no effect on findings suggesting that the role of smoking can be excluded. Those findings are concordant with Dilen da Silva C, et al. (2015). There was a strong positive correlation between the findings of indirect laryngoscopy and symptoms of reflux. According to Reiter R, et al. (2015), chronic laryngitis has an incidence of 3.5 /1000 in the general population and is a precursor of vocal cord cancer. Gastroesophageal reflux with laryngopharyngeal involvement is claimed to be a risk factor.

This warrants good assessment of patients with chronic laryngitis to explore reflux disease regarding comprehensive management.

CONCLUSION

The most common symptoms among patients with chronic laryngitis were hoarseness of voice/dysphonia, throat clearing, dysphagia, throat discomfort, and globus sensation. There was no significant association of symptoms with any demographic characteristics of the patient. The most common laryngeal findings were vocal cord hyperemia, vocal cord changes, and posterior commissure hypertrophy. Posterior commissure hypertrophy was significantly associated with advanced age, and subglottal edema was significantly associated with increased weight. Gender and other factors showed no significant association. Many didn't seek medical advice, and most had no diagnostic procedure.

RECOMMENDATIONS

Further works cover the point of patient recruitment with a better chronological design of the study and proper diagnostic procedure. Interventional trials, including treatment of reflux among patients with laryngitis, are needed from a clinical point of view. Patient education and staff training regarding reflux disease in patients suffering chronic laryngeal symptoms are warranted for better treatment.

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REFERENCES

Alharethy S, Baqays A, Mesallam T, Syouri F, Al Wedami M, Aldrees T, and AlQabbani A. (2018). Correlation between Allergic Rhinitis and LaryngopharyngealReflux BioMed ResearchInternational https://doi.org/10.1155/2018/2951928.

Cobzeanu MD, Voineag M,Drug VL,Ciubotaru A,Cobzeanu BM, Palade OD.(2012). Laryngeal morphological changes due to gastroesophageal reflux disease. Rev Med Chir Soc Med Nat Iasi. 116(4), pp.1011-1015.

De Bortoli N, Nacci A, Savarino E, Martinucci I, Bellini M, Fattori B, Ceccarelli L, Costa F, Mumolo MG, Ricchiuti A, Savarino V, Berrettini S and Marchi S. (2012). How many cases of laryngopharyngeal reflux suspected by laryngoscopy are gastroesophageal reflux disease-related? World J Gastroenterology 18(32), pp. 4363-4370.

Dilen da Silva C, Niedermeier B and Portinho F. (2015). Reflux Laryngitis: Correlation between the Symptoms Findings and Indirect Laryngoscopy. Int Arch Otorhinolaryngol. 19, pp. 234–237.

Dymek A, Dymek L, Starczewska-Dymek L, Bożek A, Dymek T and Nowak K. (2012). Laryngopharyngeal Reflux (LPR) in patients with persistent hoarseness. Otolaryngol Pol. 66(1), pp. 33-8.

El-Serag HB, Sweet S, Winchester CC, Dent J. (2013). Update on the epidemiology of gastro-oesophageal reflux disease: a systematic review. Gut. 63(6), pp. 871–880. doi:10.1136/gutjnl-2012-304269.

Heidelbaugh J, Gill A, Harrison R, and Nostrant T. (2008). Atypical Presentations of Gastroesophageal Reflux Disease. Am Fam Physician. 78(4), pp. 483-488.

Koufman J. (1991). The otolaryngologic manifestations of gastroesophageal reflux disease (GERD): A clinical investigation of 225 patients using ambulatory 24-hour ph monitoring and an experimental investigation of the role of acid and pepsin in the development of laryngeal injury, The Laryngoscope. vol. 101, pp. 1–78.

Koufman, J, Aviv J, Casiano R, and Shaw G. (2002). Laryngopharyngeal reflux: a position statement of the committee on speech, voice, and swallowing disorders of the American Academy of Otolaryngology-head and neck surgery. Otolaryngology-Head and Neck Surgery, vol. 127, pp. 32– 35.

Parsons P. and Mastronarde G. (2010). Gastroesophageal reflux disease and asthma, *Current* opinion in pulmonary medicine, vol.16, no 1, pp 60-63.

Pribuisiene R, Uloza V,andJonaitis L. (2002). Typical and atypical symptoms of laryngopharyngeal reflux disease. *Medicina (Kaunas)*, vol. 38 (7), pp. 699–705.

Reiter R, Hoffmann TK, Pickhard A, Brosch S (2015). Hoarseness—causes and treatments. Dtsch Arztebl Int 112, pp. 329–337.

Yazici Z, Sayin I, Kayhan F, and Biskin S. (2010). Laryngopharyngeal reflux might play a role on chronic nonspecific pharyngitis, European Archives of Oto-Rhino- Laryngology. 267 (4), pp. 571–574.

Yuksel ES and Vaezi MF. (2012). New Developments in Extraesophageal Reflux Disease Gastroenterology & Hepatology.8(9), pp.256-261.

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Research Article

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Cochlear Implant Complications in Children: Libyan Scenario and Experience

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Abstract:
A cochlear implant (CI) is considered a safe procedure. However, complications may happen either due to the presence of the implant itself, which acts as a foreign body, or congenital anomalies of the ear. One hundred eighty-two children implanted by the cochlear implant team in the Specialty Surgical Center (SSC)/Benghazi-Libya between May 2012 and December 2021, were recruited in this study. Demographic data: name, age and sex, vaccination history, audiological and radiological assessment in the form of a CT scan of the temporal bone and brain MRI, surgical procedures, and any difficulties encountered during the operation were recorded. Complications encountered were grouped as major and minor ones. One hundred eighty-two patients were studied; the age range was from seventeen months to twelve years. The major complications that need hospitalization or surgical interventions were seen at 3.29%, whereas minor complications that do not require hospitalization but resolve spontaneously or are treated in an outpatient department account for 13.7%. Accidental trauma was the major risk factor seen in both major and minor complications. Cochlear implantation in children continues to be reliable and safe in experienced hands, with a low percentage of severe complications as long as long-term medical follow-up is available. Major Complications of CI in children in SSC are related to trauma and hematoma formation as a major factor.

Keywords: Children, Cochlear Implantation, Cochlear Implant Complications, Complications.

INTRODUCTION:

Cochlear implantation (CI) is a relatively safe procedure (Arnoldner et al., 2005; Beadle et al., 2005; Black et al., 2007; Lassig et al., 2005). However, complications may occur. The rate of complications or re-implantation also has a direct economic impact (Sefein, 2018). Complications of cochlear implant surgery reflect the operation complexity, the skill of the surgical team, and the inherent risks of the procedure itself and risks inherent to the deep insertion of a large foreign body below the scalp (Cohen & Hoffman, 1993). Surgery has greatly changed, aiming at reducing the incidence of medical perioperative and postoperative complications, besides the efforts of the device manufacturing companies to correct system failures. Despite all of these, complications still happen, having an incidence of 12% in Cochlear Implant Centers in the USA (Cohen et al., 1991).

Complications are classified into major if they require additional surgery or hospitalization and minor when they resolve in an outpatient clinic or even with no treatment, as advocated by (Cohen et al., 1988). Major complications involve meningitis, flap necrosis, device failure, electrode extrusion, facial nerve paralysis, and others, while minor complications involve facial nerve stimulation, electrode migration, vertigo, tinnitus, and others. The major complications that require surgery review, especially those associated with device insertion, are not common (Webb et al., 1991). American Cochlear Implant Centers reported an incidence of major and minor complications of 8% and 4.3%, respectively, in a sample of 2,751 implanted patients (Cohen & Hoffman, 1993).

The risk of bacterial meningitis, while low, is about thirty times as high compared to people who don't undergo CI procedures. Vaccination prior to the procedure is recommended. The surgical procedure most often used to implant the device is called mastoidectomy with a facial recess approach (Yawn et al., 2015).

MATERIALS AND METHODS

The present retrospective study was carried out at a specialty surgical center (SSC) for ENT & Urology in Benghazi/Libya, which is a governmental tertiary hospital. Children from 17 months to 12 years underwent cochlear implantation by the cochlear implant team in the SSC cochlear implant unit. Informed written consent was taken from the parents of the children in the specific informed consent form. The current study was approved by the Institute of Ethics Review Board.

This study highlighted the cochlear implant complications in one hundred eighty-two children ranging between seventeen months and twelve years of age. All the clinical data collected were studied for major and minor complications.

Surgeries were done between May 2012 and December 2021. The postoperative complications were classified into A) Minor when they resolved with minimal or no treatment and B) Major when they require additional surgery or hospitalization. Each child has a preoperative evaluation and a vaccination card that includes

HIB (Hemophilus influenza B), Meningococcal, and pneumococcal vaccines are obligatory to administer to children in Libya. Hearing aid trials (for 3-6 months) and speech rehabilitation were undertaken. The following assessments were made in the children who participated in the procedure: Clinical, audiological, and radiological assessment in the form of a CT Scan of the Temporal Bone and an MRI Brain scan.

There were three cases of renal tubular acidosis and one child with Alport syndrome on peritoneal dialysis. Systemic antibiotic ceftriaxone sodium (Augmentin) was given one day before surgery and one week post-operatively. A systemic steroid was given intraoperatively and for three to four days post-operatively.

A surgical approach is a post-auricular cortical mastoidectomy followed by a posterior tympanotomy, then a cochleostomy or round window approach. The round window approach is the main procedure in most of the cases. Drilling the device bed and tunnel for the electrode for the stability of the device was done in all cases. Device activation was done after four weeks post-surgery. Complications vary from one center to another because of different classification methods. Some reports consider device failure a major complication. However, others exclude it as it is not related to medical or surgical consequences but rather a manufacturer failure, as seen in Table 1.

Table (1) shows the results of major & minor complications at different centers in comparison with SSC.

No.	Author/year	Major complications	Minor complications	Total
1.	(Cohen et al., 1988)	12%	7%	19%
2.	(Loundon et al., 2010)	5.5%	4.4%	9%
4.	(Sefein, 2018)	10.7%	8.03%	18.73%
5.	(de Jong et al., 1998)	3.8%		3.8%
6.	(Webb et al., 1991)	13%	0.7%	13.7%
7.	(Kempf et al., 1999)	3		3%
8.	SSC (Benghazi/Libya)	3.29%	13.7%	16.99%

This variation in the incidence of complications is because some centers include adults and children in the same study, and others do not. Device failure is not a surgical or medical complication. Some authors include it in major complications, while others exclude it.

A study (Cohen & Hoffman, 1993) characterized implant-related complications as major if they required revision surgery and minor if they resolved conservatively. In this study, fifty-five major (12%) and thirty-two minor (7%) complications.were reported Another published report by (Webb et al., 1991) reported their experience of one hundred fifty-three patients. They report 13% major and 0.3% minor complications. In a third study at the Clinical Center of Vojvodina, a center for CI, complications were observed in 10.05% of performed surgical procedures (Dankuc et al., 2014)**.**

A study in Egypt in 2018 by (Sefein, 2018), reported major complications in twelve cases (10.7%), of which two (1.79%) patients required re-implantation, and the number of minor complications was nine (8.03%). Trauma to the mastoid area was shown to correlate with major delayed complications.

The inner ear malformations are another causative factor of major complications. Natalie Loundon et al. and their co-workers (Loundon et al., 2010) in Brazil reported a complication of 9.9% (major 5.5%, minor 4.4%). The major complication rate was one of two hundred sixty-two patients (0.4%) in Iran (Ajallouyean et al., 2011). In a multicenter analysis of implantation in the United States, (Cohen et al., 1991) reported a major complication rate of 3.9% for three hundred nine children, though it seems that device failure was included in their criteria as a major complication. (Kempf et al., 1999) reported a major complication rate of 3% among one hundred cases (Kempf et al., 1999).

(Ray et al., 2004) reported a major complication rate of 6% in the first one hundred adults who underwent implantation in Sydney, but they include an obliterated cochlea that could not be implanted, as a surgical complication. (de Jong et al., 1998) reported major complications in two out of fifty-two (3.8%) children who underwent implantation in Toronto, one of which was a device failure. In a large single-center pediatric series, (de Jong et al., 1998) reported 8.9% and 7.8% of major and minor complications.

RESULTS

In this current study, one hundred eighty-two (182) children were included, with equal male and female distribution and age ranges from 17 months to 12 years. 91.2% of the cases are at the age of 6 years and below (166 patients), as seen in Figure 1. Complications are seen in 16.99% of cases, as seen in Figure 2. Minor complications are seen in 25 cases (13.7%), as shown in Table 2, whereas major complications are seen in 6 cases (3.29%), as shown in Table 3.

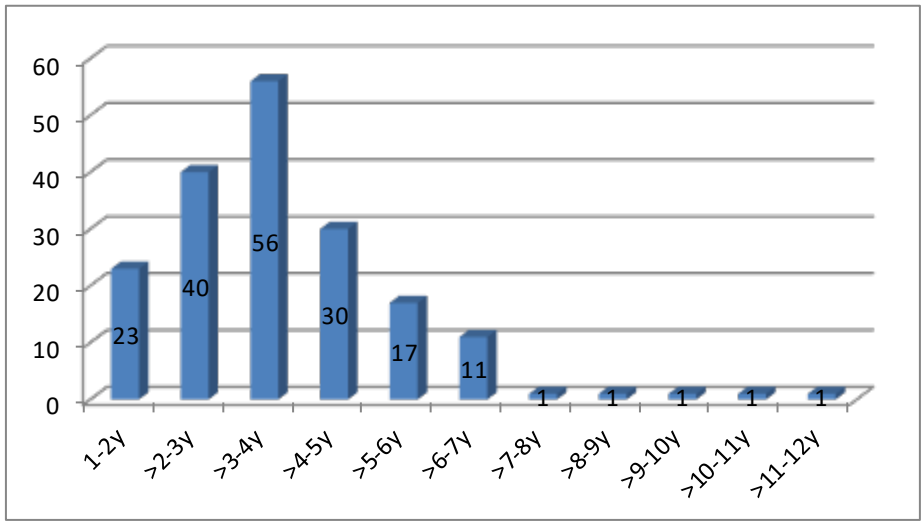

Figure (1). Distribution of cases according to age in years:

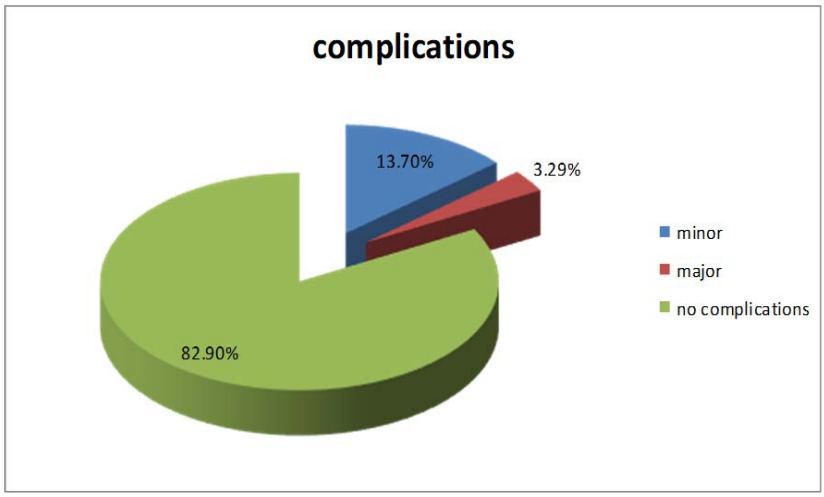

Figure (2): Percentage of major and minor complications:

Table (2): Minor complications and their management & outcome

No	Complications	Number of cases	Outcome
1.	Minimal swelling at the operation site	3	resolved by bandage dressing
2.	Corneal abrasion and keratitis	4	antibiotic ointment &drops
3.	Incomplete insertion of the electrode	2	Did well post-operative
4.	Minimal epistaxis	2	Stop spontaneously
5.	Do not use an external device.	1	Family education and reassurance
6.	Vomiting	5	Antiemetic
7.	Transient facial nerve paresis	1	Resolved spontaneously
8.	Accidental injury of the external auditory canal and dura	5	Passed without any harmful effect
9.	Eye twitches in two cases	2	Reprogramming
10	Total No. of complications	25	

Table (3). Major complications and their management

No.	Complications	Number of cases	Management
1.	Wound gap (clean wound).	2	Re-stitched in the operation room
2.	Haematoma formation. First week post-operative	2	Aspiration or incision and drainage then re-stitched in the operation room
3.	Late Haematoma formation (after 9 yrs.)	2	*Incision and drainage and repositioning of CI in one case *Re-implantation on the other side in the other case
	Total No. of complications	6	

Wound gap and hematoma healed well when recognized early. Late hematoma after accidental head trauma may occur at any time as children play and move without caution. In one case, drainage was done. The area was cleaned, and the wound edges were re-stitched. It did well for some time, but then the wound dehiscence recurred again. The wound was cleaned under anesthesia and the site of the implant was changed on the same ear. The wound was stitched and the patient did well. Another case comes with an infected hematoma after a fall. Dressing and cleaning of the wound were tried many times, but biofilm formed and was removed from the implant, cleaning of the wound was done, and re-implantation on the other ear was performed. Cases of corneal abrasions on the same side of an operated ear were treated by an ophthalmologist using local antibiotics and eye closure for a few days without any subsequent harmful effects.

DISCUSSION:

The success of cochlear implantation (CI) as an auditory rehabilitative tool requires a thorough knowledge of indications, limitations, and potential risks (Dankuc et al., 2014). Although CI is a safe procedure, complications still happen.

The youngest implanted child in this series was at the age of 17 months. More than 77% of the cases were below the age of 4. Early diagnosis of hearing loss leads to early intervention and less hearing deprivation of neural cells. This improves post-operative results in terms of language and speech development and early school integration.

With regard to hematoma formation or swelling around the device, bandage dressing should be kept for the first week postoperatively to avoid swelling at the operation site and to avoid the risk of post-operative wound infection. Corneal abrasions were noticed in four cases; a head drape during surgery is thought to be the reason for that. Careful eye closure with plaster should be done before the operation to avoid accidental corneal abrasion by dressing during surgery.

No case of meningitis has been recorded in this series. Completion of the vaccination program was insisted on before the operation.

Two cases of hematoma developed after nine years of implantation, which highlights that long-term close follow-up is needed to pick up and treat hematoma before infection and biofilm development. Results of SSC/Benghazi/Libya in major complications are favorable. We selected straightforward cases for surgery. We didn't face gusher or post-operative meningitis in this series of cases. Minor complications were greater (13.7%) because post-operative anesthesia complications, such as vomiting in minor complications, were included. No cases of device failure have been reported in this

series. However, one patient did not use his external device. We include this as a minor complication.

CONCLUSION

To conclude, our current study reported that precautions should be taken to minimize complications in CI surgery. In this study, accidental trauma and hematoma formation act as a precursor for infection and wound breakdown with possible device extrusion. It should be taken into consideration from the immediate post-operative day and for life. If these complications are recognized early, aspiration alone is sufficient. Delayed recognition and intervention lead to infection, biofilm formation, wound breakdown down, and even extrusion of the implant. Long-term close follow-up is necessary for early recognition of complications. Major complications of CI in children in SSC are related to trauma and hematoma formation as a major factor.

Cochlear implantation in children continues to be reliable and safe in specialized centers of CI and experienced hands, with a low percentage of severe complications as long as long-term regular medical follow-up is available.

Our recommendations are family education and taking preventive measures to avoid trauma, especially in the head as much as possible.

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REFERENCES:

Ajallouyean, M., Amirsalari, S., Yousefi, J., Raeesi, M.-A., Radfar, S., & Hassanalifard, M. J. I. J. o. P. (2011). A report of surgical complications in a series of 262 consecutive pediatric cochlear implantations in Iran. *21*(4), 455.

Arnoldner, C., Baumgartner, W. D., Gstoettner, W., & Hamzavi, J. J. A. o.-l. (2005). Surgical considerations in cochlear implantation in children and adults: a review of 342 cases in Vienna. *125*(3), 228-234.

Beadle, E. A., McKinley, D. J., Nikolopoulos, T. P., Brough, J., O'Donoghue, G. M., Archbold, S. M. J. O., & Neurotology. (2005). Long-term functional outcomes and academic-occupational status in implanted children after 10 to 14 years of cochlear implant use. *26*(6), 1152-1160.

Black, I., Bailey, C., Albert, D., Leighton, S., Hartley, B., Chatrath, P., & Patel, N. J. C. I. I. (2007). The Great Ormond Street Hospital paediatric cochlear implant programme 1992–2004 a review of surgical complications. *8*(2), 53-67.

Cohen, N. L., Hoffman, R. A., Stroschein, M. J. A. o. O., Rhinology, & Laryngology. (1988). Medical or surgical complications related to the Nucleus multichannel cochlear implant. *97*(5_suppl2), 8-13.

Cohen, N. L., & Hoffman, R. A. J. A. i. O.-r.-l. (1993). Surgical complications of multichannel cochlear implants in North America. *48*, 70-74.

Cohen, N. L., Hoffman, R. A. J. A. o. O., Rhinology, & Laryngology. (1991). Complications of cochlear implant surgery in adults and children. *100*(9), 708-711.

Dankuc, D., Šegan, D., Komazec, Z., Vlaški, L., Lemajić-Komazec, S., & Sokolovac, I. J. M. p. (2014). Cochlear implant surgery at the Clinical Center of Vojvodina-ten-year experience. *67*(suppl. 1), 25-31.

de Jong, A. L., Nedzelski, J., Papsin, B. C. J. J. o. O.-H., & Surgery, N. (1998). Surgical outcomes of paediatric cochlear implantation: the Hospital for Sick Children's experience. *27*(1), 26.

Kempf, H.-G., Johann, K., & Lenarz, T. J. E. a. o. o.-r.-l. (1999). Complications in pediatric cochlear implant surgery. *256*, 128-132.

Lassig, A.-A. D., Zwolan, T. A., Telian, S. A. J. O., & Neurotology. (2005). Cochlear implant failures and revision. *26*(4), 624-634.

Loundon, N., Blanchard, M., Roger, G., Denoyelle, F., Garabedian, E. N. J. A. o. O. H., & Surgery, N. (2010). Medical and surgical complications in pediatric cochlear implantation. *136*(1), 12-15.

Ray, J., Gibson, W., & Sanli, H. J. C. i. i. (2004). Surgical complications of 844 consecutive cochlear implantations and observations on large versus small incisions. *5*(3), 87-95.

Sefein, I. K. J. T. E. J. o. O. (2018). Surgical complications and morbidity in cochlear implantation. *34*, 33-41.

Webb, R. L., Laszig, R., Lehnhardt, E., Pyman, B. C., Clark, G. M., Franz, B. K.-H. J. A. o. O., Rhinology, & Laryngology. (1991). Surgical complications with the cochlear multiple-channel intracochlear implant: experience at Hannover and Melbourne. *100*(2), 131-136.

Yawn, R., Hunter, J. B., Sweeney, A. D., & Bennett, M. L. J. F. R. (2015). Cochlear implantation: a biomechanical prosthesis for hearing loss. *7*.

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Research Article

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Prevalence of Congenital Heart Disease Among Preterm Newborns Between 28 and 35 Weeks Admitted at Al Bayda Medical Center, Libya (2021)

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Abstract

Congenital heart diseases (CHDs) are defined as structural abnormalities of the heart. CHD can be simple (isolated lesions) or complex (multiple lesions). Premature infant (newborn delivered before 37 weeks of geospatial age). This study was carried out to determine the prevalence of CHD among very preterm to moderate premature newborns and to investigate associated risk and mortality. A prospective cohort study was designed with concurrent timing of data collection and was carried out in the Department of the Neonatal Intensive Care Unit (NICU) at Al Bayda Medical Center (2021), Gestational age was calculated as postnatal assessment by the Dubowitz/Ballard method. Echocardiography was done to identify the presence and types of congenital heart defects. Out of 60 admitted preterm infants, 43 were found to have congenital heart disease. The prevalence rate was (71.67%) of admissions. Out of the total defects, Echocardiographic findings showed that atrial septal defect (ASD) was the most common structural defect no=30 (69.77%), (Patent ductus arteriosus) PDA no=12 (27.91%), and ventricular septal defect (VSD) no=10 (23.26%). Of the studied premature infants, 9 patients died during the study period. The case fatality rate (CFR) was (15%). Death rates were higher for premature neonates with CHD 7 (16.3%) than those with normal hearts, which were 2 (11.8%), but the observed difference was statistically not significant. Congenital heart anomalies are not significantly associated with birth weight and gender or maternal age, consanguinity, maternal socioeconomic state, and maternal illness. Conclusion: CHD was found to be high among preterm. The most common heart defect was ASD, followed by PDA and VSD.

Keywords: Congenital heart disease, Prevalence, Premature, Mortality, Risk factors, NICU.

INTRODUCTION

Congenital heart disease, representing structural or functional abnormalities present at birth, is a global health challenge, affecting 8 million newborns annually, available by (Mashuda et al., 2014; Shetty et al., 2023). CHDs are diagnosed according to the International Pediatric and Congenital Cardiac Code (IPCCC) (Franklin et al., 2017). CHDs usually in need of intervention

or close follow-up the first year of life were defined as severe CHDs (Lytzen et al., 2018): [Single ventricle, hypo-plastic left heart syndrome (HLHS), transposition of the great arteries (TGA), congenitally corrected TGA (ccTGA), tetralogy of Fallot (TOF), double outlet right ventricle (DORV), truncus arteriosus, coarctation of the aorta (CoA) aortic arch hypoplasia, and interrupted aortic arch (IAA), atrioventricular septal defect (ASD, VSD), total anomalous pulmonary venous connection (TAPVC), and other complex CHD].

Preterm birth is defined as the birth of a baby less than 37 weeks of gestational age (Quinn et al., 2016). According to the World Health Organization (WHO, 2023), preterm births are those delivered before 37 weeks of pregnancy. Preterm birth is further subdivided based on gestational age: extremely preterm (less than 28 weeks), very preterm (28 to less than 32 weeks), and moderate to late preterm (32 to 37 weeks). Worldwide 5%-18% of newborns are born premature, and preterm birth is considered the leading cause of childhood mortality and morbidity (Liu et al., 2016; Saigal & Doyle, 2008). Preterm delivery remains a significant clinical problem, accounting for all neonatal morbidity and mortality. Preterm birth is a leading cause of death in children under five years of age globally (IGME, 2018).

Congenital heart diseases are major causes of morbidity and remain the leading cause of childhood mortality and morbidity (Jacobs et al., 2016; Lopes et al., 2018; Mackie et al., 2017). Preterm birth has also been associated with the risk of cardiovascular disease in adult life (Markopoulou et al., 2019; Saigal & Doyle, 2008).

The combination of CHD and preterm birth has shown higher increases in mortality and morbidity. Previous studies have shown associations between some subgroups of CHD and increased risks of preterm birth (Laas et al., 2012; van Velzen et al., 2016). The lower the gestational age, the higher the frequency of onset of PDA (Jasani et al., 2023).

Prevalence of CHDs and defect types depended upon factors like the nature of the study center (whether it is a tertiary level hospital where all critical obstetrical cases were admitted, nature of the sample, source of information, spot examination by a pediatric cardiologist, whether Eco cardiology is done for all suspected cases who are at risk of having CHD. This study aimed to determine the prevalence of congenital heart disease among very preterm to moderate premature newborns and associated risk and mortality.

MATERIALS AND METHODS

Study design and settings: A prospective cohort study design with concurrent timing of data collection was carried out to investigate the prevalence of CHD and associated risk factors among newborns delivered at Al Bayda Medical Center (secondary hospital). This study was conducted from the 1st of January to the 31st of December through the year (2021) on 60 preterm infants with and without CHDs.

Sampling method: Purposive sampling was used to target all premature newborns born through one year (2021). Inclusion criteria involve all premature infants in the study reference period and screened by echocardiogram. Exclusion criteria: extremely preterm, as their conditions are usually critical, in addition to those critically ill, were excluded, also, late preterm >36 were usually well and discharged, in addition to newborns discharged against medical advice and those referred to other centers after birth due to additional reasons.

Source of data: A questionnaire was prepared by the researcher where the study group was pre-

term infants with and without CHDs, which included detailed history regarding preterm babies, such as gestational age, birth weight, and cause of admission, which were recorded. All preterm infants were investigated by echocardiogram. The maternal history was also recorded for mothers, including age, weight, height, history of exposure to radiation, chronic maternal disease, maternal infection, vaginal bleeding, severe abdominal pain, and history of anomalies in other babies.

Data and statistical analysis: Data were fed to the computer using SPSS software package version 20.0 (Armonk, NY: IBM Corp). The chi-square test and Mann-Whitney test: were used for abnormally distributed variables to compare between two studied groups.

Limitations: The study limitations include when the mother was unhelpful in giving information about medical history, financial income, and age. Also, among the obstacles was the small sample size in addition to all data being taken from one hospital.

RESULTS

Out of 60 admitted preterm infants, 43 were found to have congenital heart disease, while 17 were normal. The prevalence rate was 71.67% (Figure 1).

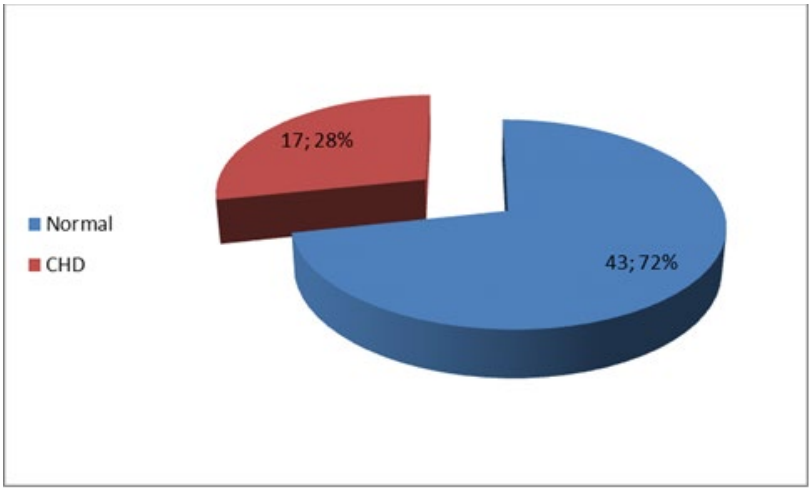

Figure (1). Distribution of the studied cases according to the prevalence of CHD in preterm infants (n = 60)

Regrding general character, the distribution of CHD in preterm by gestational age between 28-35 weeks and birth weight (0.9-2.5 grams) with a mean of (1.66±0.38) was shown. The distribution by gender was: males (58.3%) and females (41.7%). Mother ages ranged from 18-42 years, with mean ± SD31.32±6.71. Their weights ranged between 50-108 kg with means of 72±14.66 (BMI =15-44, means 28.17±6.06) (Table 1).

Table (1). General character for a profile of the studied sample N=60

Maternal history	Mean
Gestational age (weeks, mean -+SD)	(28.0 – 35.0 weeks, 31.85 ± 1.98)
Admission weight (grams, mean -+SD)	(0.90 – 2.50 gram, 1.66 ± 0.38)
Sex distribution	
Male	35 (58%)
Female	(25) 41.7%
Maternal ages	18-42 years, (mean +-SD 31.32+-6.71)

The echocardiographic findings showed: ASD was the most common structural defect (n=30) (69.77%), then PDA (n=12) (27.91%), VSD (n=10) (23.26%), and other anomalies were uncommon and findings were 1 for each (2.33%): Dilated left atrium, left ventricle thick wall (Figure 2).

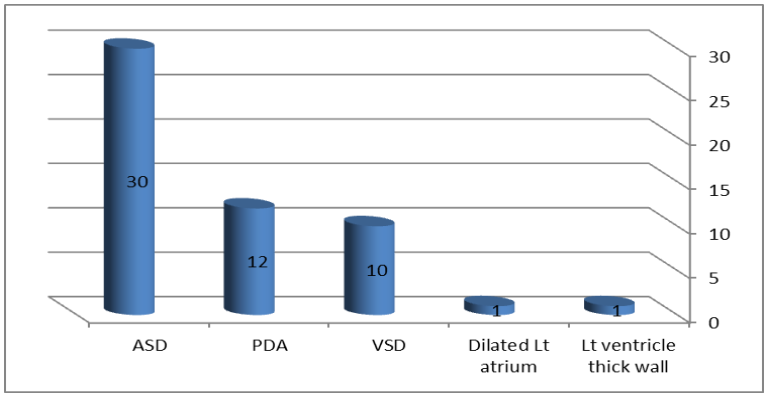

Figure (2). Distribution of the studied premature babies according to the prevalence of CHD

Associated maternal risk factors in preterm infants diagnosed with CHD: gestational diabetes was found in (6.7%), hypertension in (15%), drug intake, like antiepileptic (18.3%), and radiation exposure (1.7%), while (58.3%) of mothers did not register any disease during pregnancy (Figure 3).

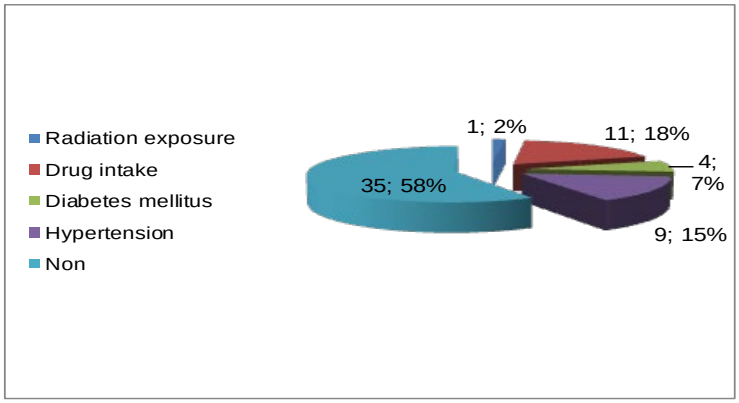

Figure (3). Distribution of diseases during pregnancy of the studied sample

Of the 60 mothers from the studied sample, 18% of them were consanguineous married and had CHD in their babies (figure 4).

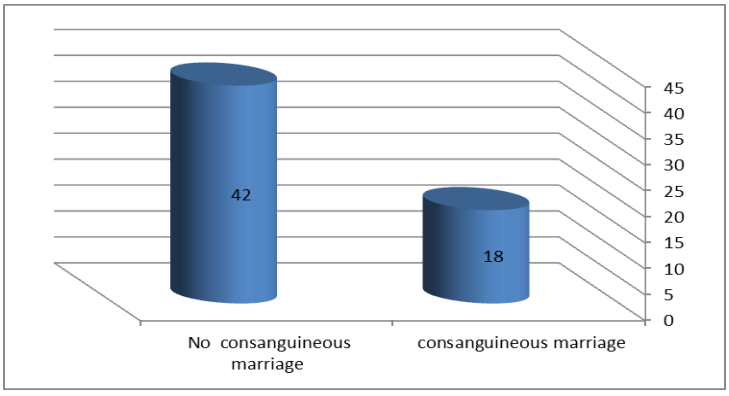

Figure (4). Relation of CHD and consanguineous marriage

Of the studied premature infants, 9 patients died during the study period, CFR (15%) (Figure 5).

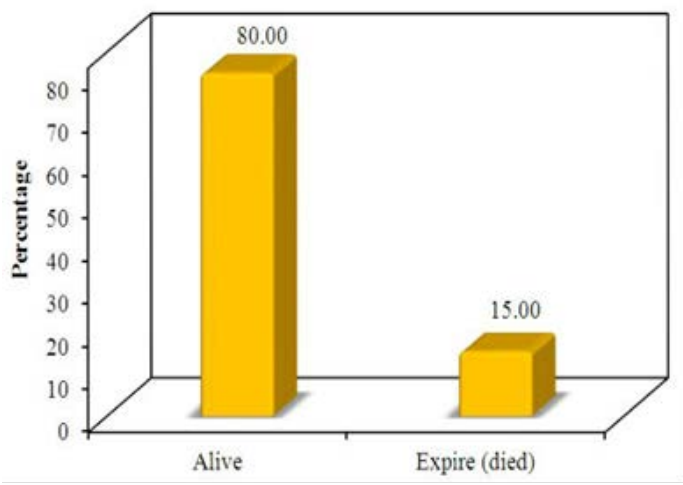

Figure (5). Distribution of the studied cases according to mortality

Out of the total deaths, the proportion of 9 premature infants with CHD (16.3%) was higher than normal (11.8%), and the observed difference was (p> 0.05), which was statistically not significant (Table 2).

Table (2). Distribution of the studied premature babies according to the outcome.

Outcome	Normal		CHD		$\chi 2$	FE_p
	(n =17)		(n =43)			
	No.	%	No.	%		
Alive	15	88.2	36	83.7	115.567	0.550
Expired (died)	2	11.8	7	16.3	0.195	1.000

This study also focused on the relation between the age of mothers of premature babies, with and without CHD (Table 3).

Table (3). Relation between mothers' age and CHD babies

Age (years)	Normal (n =17)	CHD(n =43)	U	p
Min. – Max.	18.0 – 42.0	19.0 – 42.0		
Mean ± SD.	31.59 ± 6.99	31.21 ± 6.67		
		31.0*: Statistically significant at p ≤ 0.05	358.500	0.908
Median	35.0			

The observed differences in the risk factors concerning hypertension, smoking exposure, mal-nutrition, low socioeconomic state, and maternal infection between normal heart and CHD mothers were (0.255), (0.832),(0.073), (0.073), (0.440), respectively, and the difference was statistically not significant (p>0.05) (Table 4).

Table (4). Distribution of maternal risk factors for the studied patients (no = 60).

Variable	normal No=17	CHD No=43	P value
High blood pressure			
Yes	79.1	94.1	0.255
No	20.9	5.9	
Smoking			
Yes	55..8	58.8	0.832
No	44.2	41.2	
No			
Maternal nutrition			
Good	51.2	76.5	0.073
Average	48.4	23.5	
Socioeconomic state			
Good	51.2	76.5	0.073
Average	48.4	23.5	
Maternal infection			
Yes	86%	76.50%	0.448
No	14%	23.50%	

No statistical significance was observed using the Chi-square test ($P > 0.05$)

DISCUSSION

The present study described the results of the prevalence of CHD in hospital-based preterm infants. In this study, males were more common than females. This gender distribution was in accordance with observations reported by (Mollah et al., 2002). Maternal age was significantly associated with CHD in preterm babies in a study in Saudia Arabia (Hashim Jr et al., 2020). The current study found mothers who are older than 35 years are more likely to have babies with VSD and PDA. In the current study, the most common congenital heart defect was ASD (n=30, 69.77%) versus the literature. VSD was the commonest defect in contrast to other studies done by (Mollah et al., 2002; Sallout et al., 2008) which show VSD (29%) contrary to our finding VSD (n=10. 23.26%). This could be explained by the birth prevalence of CHDs, as observed differences in environmental and/or genetic risk factors that could refer to different phenotypes may also be possible for dissemination patterns. The expansion in the availability of diagnostic technologies and skills across different participating hospitals, and probably the advances in diagnostic methods, had the most impact in detecting mild CHDs. Other studies (Begum & Ahmed, 2001) support our finding that many small-sized VSDs, particularly if associated with TOF, may not manifest by neonatal time.

The overall high prevalence of CHDs in premature infants is partly driven by a high prevalence of ASDs, which are more commonly diagnosed in premature infants due to the increased likelihood of receiving an echocardiogram, which is consistent with other studies (Reller et al., 2008; Van Der Linde et al., 2011). Other defects in the current study: PDA (27.91%), complex congenital heart disease (8%), TGA (8%), and TOF (6%), were correlated with other studies (Begum & Ahmed, 2001; Rahman et al., 1992).

The presenting study also shows that there is no significant association between smoking (p=0.832), socioeconomic state, and maternal nutrition and development of CHD (p=0.073),

contrary to the results of several studies conducted in the United States followed by Europe and Asia (Kučienė & Dulskienė, 2009; Long et al., 2010; Williams et al., 2004) that examined socioeconomic variables (mother education, nutrition, income levels), in addition to CHD researchers (Loffredo et al., 2001; Vrijheid et al., 2000) who reported that low socioeconomic status increased the risk of structural heart defects. Study results by (Malik et al., 2008) showed the association between the risk of septal defects in infants and exposure to moderate and heavy smoking. Consanguineous marriage accounted for 18% of CHD in this studied sample, comparatively lower than a study reported by (Taksande et al., 2010) in central India. All these contrary findings could be explained by the small size of our study.

Regarding maternal illness, (6.7%) were diabetic, (15%) were hypertensive, and (18.3%) had a history of ingestion of drugs, as anti-epileptic drugs have been found in this study as observed in the literature. As in previous studies, maternal diabetes mellitus was observed to be a significant risk factor for CHD overall and for almost all subtypes of CHD. Numerous studies by (Lisowski et al., 2010; Nielsen et al., 2005) have shown that diabetes mellitus causes cardiovascular malformations. Congenital heart disease has already been recognized as one of the significant causes of neonatal mortality and morbidity. The overall mortality rate was 15% in the current study.

This report is lower than the 44% - 55% in-hospital mortality rates reported in two previous database studies (Archer et al., 2011; Lynema et al., 2016) that focused on very low birth weight neonates (< 1500 grams) with severe CHDs. Some differences may reflect that our study included patients with a birth weight > 1500. The other possibility to account for our mortality rates may be explained by the small size sample. Prospective researches with a large sample are highly recommended.

CONCLUSION

Our study shows a high prevalence of CHD in the studied premature infants (69.77%). The case fatality rate was (15%). Death rates were higher for premature infants with CHD (16.3%) than those with normal hearts (11.8%) with no statistical significance. There is a need for targeted prenatal care for mothers with known high-risk CHDs to delay delivery to the latest possible gestational age to avoid premature births to reduce neonatal mortality.

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CONSENT

Informed consent was obtained from the patient's parents regarding the study objectives and methods.

ETHICS

The authors assured that informed consent was obtained during admission as a teaching center for data use. The proposal was provided by the Ethical Committee of the Libyan Board of Medical Specialties.

Duality of interest: There is a conflict of interest.

Author contributions: A. developed the theoretical formalism. B supervised the project. A, C, and D performed the analytic calculations and performed the numerical simulations. All authors read, reviewed, and approved the final manuscript.

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REFERENCES

Archer, J. M., Yeager, S. B., Kenny, M. J., Soll, R. F., & Horbar, J. D. J. P. (2011). Distribution of and mortality from serious congenital heart disease in very low birth weight infants. *127*(2), 293-299.

Begum, N., & Ahmed, Q. J. B. J. c. h. (2001). Pattern of Heart disease among neonates and their outcome: one year experience in non-invasive cardiac laboratory of Combined Military Hospital, Dhaka. *25*, 48-52.

Franklin, R. C., Béland, M. J., Colan, S. D., Walters, H. L., Aiello, V. D., Anderson, R. H.,…Gaynor, J. W. J. C. i. t. Y. (2017). Nomenclature for congenital and paediatric cardiac disease: the International Paediatric and Congenital Cardiac Code (IPCCC) and the Eleventh Iteration of the International Classification of Diseases (ICD-11). *27*(10), 1872-1938.

Hashim Jr, S. T., Alamri, R. A., Bakraa, R., Rawas, R., Farahat, F., & Waggass, R. J. C. (2020). The association between maternal age and the prevalence of congenital heart disease in newborns from 2016 to 2018 in single cardiac center in Jeddah, Saudi Arabia. *12*(3).

IGME, U. (2018). Levels & trend in child mortality: Estimates developed by the UN Inter-Agency Group for UN Inter-Agency Group for Child Mortality Estimation Child Mortality Estimation.

Jacobs, J. P., He, X., Mayer Jr, J. E., Austin III, E. H., Quintessenza, J. A., Karl, T. R.,…Pasquali, S. K. J. T. A. o. t. s. (2016). Mortality trends in pediatric and congenital heart surgery: an analysis of the Society of Thoracic Surgeons Congenital Heart Surgery Database. *102*(4), 1345-1352.

Jasani, B., Weisz, D. E., Reese, J., & Jain, A. (2023). Combination pharmacotherapy for patent ductus arteriosus: Rationale and evidence. Seminars in perinatology,

Kučienė, R., & Dulskienė, V. J. M. (2009). Maternal socioeconomic and lifestyle factors during pregnancy and the risk of congenital heart defects. *45*(11), 904.

Laas, E., Lelong, N., Thieulin, A.-C., Houyel, L., Bonnet, D., Ancel, P.-Y.,…Khoshnood, B. J. P. (2012). Preterm birth and congenital heart defects: a population-based study. *130*(4), e829-e837.

Lisowski, L., Verheijen, P., Copel, J., Kleinman, C., Wassink, S., Visser, G., & Meijboom, E. J. C. p. (2010). Congenital heart disease in pregnancies complicated by maternal diabetes mellitus. An international clinical collaboration, literature review, and meta-analysis. 120.

Liu, L., Oza, S., Hogan, D., Chu, Y., Perin, J., Zhu, J.,…Black, R. E. J. T. L. (2016). Global, regional, and national causes of under-5 mortality in 2000–15: an updated systematic analysis with implications for the Sustainable Development Goals. *388*(10063), 3027-3035.

Loffredo, C. A., Silbergeld, E. K., Ferencz, C., & Zhang, J. J. A. j. o. e. (2001). Association of transposition of the great arteries in infants with maternal exposures to herbicides and rodenticides. *153*(6), 529-536.

Long, J., Ramadhani, T., Mitchell, L. E. J. B. D. R. P. A. C., & Teratology, M. (2010). Epidemiology of nonsyndromic conotruncal heart defects in Texas, 1999–2004. *88*(11), 971-979.

Lopes, S. A. V. d. A., Guimarães, I. C. B., Costa, S. F. d. O., Acosta, A. X., Sandes, K. A., & Mendes, C. M. C. J. A. b. d. c. (2018). Mortality for critical congenital heart diseases and associated risk factors in newborns. A cohort study. *111*, 666-673.

Lynema, S., Fifer, C. G., & Laventhal, N. T. J. P. C. (2016). Perinatal decision making for preterm infants with congenital heart disease: determinable risk factors for mortality. *37*, 938-945.

Lytzen, R., Vejlstrup, N., Bjerre, J., Petersen, O. B., Leenskjold, S., Dodd, J. K.,…Søndergaard, L. J. J. c. (2018). Live-born major congenital heart disease in Denmark: incidence, detection rate, and termination of pregnancy rate from 1996 to 2013. *3*(9), 829-837.

Mackie, A. S., Tran, D. T., Marelli, A. J., & Kaul, P. J. C. J. o. C. (2017). Cost of congenital heart disease hospitalizations in Canada: a population-based study. *33*(6), 792-798.

Malik, S., Cleves, M. A., Honein, M. A., Romitti, P. A., Botto, L. D., Yang, S.,…Pediatrics, N. B. D. P. S. J. (2008). Maternal smoking and congenital heart defects. *121*(4), e810-e816.

Markopoulou, P., Papanikolaou, E., Analytis, A., Zoumakis, E., & Siahanidou, T. J. T. J. o. p. (2019). Preterm birth as a risk factor for metabolic syndrome and cardiovascular disease in adult life: a systematic review and meta-analysis. *210*, 69-80. e65.

Mashuda, F., Zuechner, A., Chalya, P. L., Kidenya, B. R., & Manyama, M. J. B. r. n. (2014). Pattern and factors associated with congenital anomalies among young infants admitted at Bugando medical centre, Mwanza, Tanzania. *7*, 1-7.

Mollah, M., Begum, N., Islam, M., Mahmud, R., Haq, M., Nahar, N., & Rashid, M. J. B. h. J. (2002). Clinical profile of congenital heart diseases (CHD): An analysis of 218 cases. *17*, 62-67.

Nielsen, G. L., Nørgard, B., Puho, E., Rothman, K., Sørensen, H. T., & Czeizel, A. J. D. m. (2005). Risk of specific congenital abnormalities in offspring of women with diabetes. *22*(6), 693-696.

Quinn, J.-A., Munoz, F. M., Gonik, B., Frau, L., Cutland, C., Mallett-Moore, T.,…Nunes, T. J. V. (2016). Preterm birth: Case definition & guidelines for data collection, analysis, and presentation of immunisation safety data. *34*(49), 6047-6056.

Rahman, S., Ahmed, M., Rahmatullah, K., & Alam, M. J. D. H. (1992). The incidence of congenital heart diseases diagnosed by non-invasive technique-Ten years study in Bangladesh. *8*, 5-15.

Reller, M. D., Strickland, M. J., Riehle-Colarusso, T., Mahle, W. T., & Correa, A. J. T. J. o. p. (2008). Prevalence of congenital heart defects in metropolitan Atlanta, 1998-2005. *153*(6), 807-813.

Saigal, S., & Doyle, L. W. J. T. L. (2008). An overview of mortality and sequelae of preterm birth from infancy to adulthood. *371*(9608), 261-269.

Sallout, B. I., Al Hoshan, M. S., Attyyaa, R. A., & Al Suleimat, A. A. J. A. o. S. m. (2008). Antenatal diagnosis, prevalence and outcome of major congenital anomalies in Saudi Arabia: a hospital-based study. *28*(4), 272-276.

Shetty, N., Mantri, S., Agarwal, S., Potdukhe, A., Wanjari, M. B., Taksande, A. B., & Yelne, S. J. C. (2023). Unraveling the Challenges: A Critical Review of Congenital Malformations in Low Socioeconomic Strata of Developing Countries. *15*(7).

Taksande, A., Vilhekar, K., Chaturvedi, P., & Jain, M. J. I. j. o. h. g. (2010). Congenital malformations at birth in Central India: A rural medical college hospital based data. *16*(3), 159.

Van Der Linde, D., Konings, E. E., Slager, M. A., Witsenburg, M., Helbing, W. A., Takkenberg, J. J., & Roos-Hesselink, J. W. J. J. o. t. A. C. o. C. (2011). Birth prevalence of congenital heart disease worldwide: a systematic review and meta-analysis. *58*(21), 2241-2247.

van Velzen, C. L., Türkeri, F., Pajkrt, E., Clur, S. A., Rijlaarsdam, M. E., Bax, C. J.,…Haak, M. C. J. A. o. e. g. S. (2016). Pregnancy complications in singleton pregnancies with isolated fetal heart defects. *95*(11), 1273-1280.

Vrijheid, M., Dolk, H., Stone, D., Abramsky, L., Alberman, E., & Scott, J. J. A. o. D. i. C. (2000). Socioeconomic inequalities in risk of congenital anomaly. *82*(5), 349-352.

WHO, W. H. O. (2023). *WHO presence in countries, territories and areas: 2023 report*. World Health Organization.

Williams, L. J., Correa, A., Rasmussen, S. J. B. D. R. P. A. C., & Teratology, M. (2004). Maternal lifestyle factors and risk for ventricular septal defects. *70*(2), 59-64.

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Research Article Open Access

Correlation Between Health Assessment and RLE 2 Courses at Tobruk University

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Abstract

Health Assessment (HA) and Related Learning Experience 2 (RLE 2) are foundational courses for nursing students at Tobruk University. This study aimed to investigate the potential correlation between student performance in HA and RLE 2 to enlighten curriculum adjustments and improve student preparation for clinical practice. This study employed quantitative methodology consisting of three batches from the school year endings 2021, 2022, and 2023. A total of 263 student records were selected for this study. The collected data were measured using the Pearson product-moment correlation coefficient based on the final grades in both HA and RLE 2, together with the semester grade average (SGA). As for the mean, RLE was higher than HA in all batches. The highest correlation between HA and RLE2 belonged to batch 2021, with r=0.6197. Correlation for batch 2023 was the highest between HA and SGA with r=0.8777. Batch 2021 tops in RLE2 and SGA correlation with r=0.73119. Other study findings were also presented in terms of variation and graphical presentation. Limitations and suggestions for further research were addressed. This study sought to inform the relationship between theoretical knowledge and clinical skill development in nursing students. The research findings can contribute to decision-making potential for possible curriculum development at the University, and consequently, bring about continuous improvement in the area of nursing education and practice.

Keywords: Clinical Skills; Health Assessment; Nursing Education; Related Learning Experience; Skills Laboratory.

INTRODUCTION

The curriculum that outlines student expectations is a vital part of the educational system (Akinoglu, 2017). Nursing curricula change to accommodate the needs of stakeholders, although accrediting bodies offer broad recommendations but do not enforce particulars (Abbott et al., 2023). Among the many obstacles facing nursing education in the twenty-first century are the rapidly evolving medical field and technological advancements (Alaban et al., 2023). Producing clinically competent nurses who can significantly contribute to the provision of high-quality, safe nursing care while adjusting to shifting practice environments is the main objective of a nursing education program (Landeen et al., 2016; Alaban et al., 2023). Nursing education often incorporates Related Learning Experiences (RLEs) to bridge the gap between theory and practice (Buhat-Mendoza et al., 2018). At Tobruk University, RLE serves as a crucial compo-

nent of the nursing curriculum, offering students hands-on skills and laboratory experience in preparation for various clinical settings. Typically, there are two aspects of nursing education: theory and practice (Arkan et al., 2018). A significant segment of a student's nursing education experience is dedicated to clinical learning (Mikkonen et al., 2016). It is also critical to note that nursing faculty tend to mold nursing students to have self-confidence and self-trust in their ability to perform holistically, interpersonally, and transculturally while participating in RLE when they provide them with the proper orientation, attention, and information (Gumabay, 2017). The University's College of Nursing implements a unique curriculum, incorporating Related Learning Experiences (RLE) courses alongside traditional lecture-based subjects as performed by nursing faculty members.

Health Assessment (HA) serves as a foundational course in nursing education, providing students with theoretical knowledge and skills in physical assessment (Jarvis, 2023; Tan et al., 2021), patient communication, and critical thinking (McDonald, 2023). The methodical and prompt process of gathering and analyzing data regarding a person's health from developmental and transcultural viewpoints is known as HA (Jarvis, 2023).

RLE is a crucial clinical/laboratory practice that allows students to apply their theoretical knowledge to a simulated setting with real-world patient care scenarios under the supervision of experienced nurses (Koukourikos et al., 2021). Considered a core subject, HA introduces students to skills and tools that serve as the foundation for other competencies (Egilsdottir et al., 2019; Tan et al., 2021) including RLE courses. Investigating the correlation between these two courses (specifically RLE 2) can provide valuable insights into the effectiveness of the curriculum in preparing students for clinical practice.

This study aimed to investigate the potential correlation between student performance in the HA course and their subsequent performance in RLE 2. Understanding this correlation can enlighten curriculum adjustments and improve student preparation for clinical practice. This study seeks to answer the following research question:

- What is the class performance of students in HA and RLE 2?
- What is the students’ Semester grade average (SGA)?
- Is there a statistically significant correlation between students’ final grades in HA and their performance in RLE 2?
- Is there a statistically significant correlation between HA and SGA as well as RLE 2 and SGA?

In this study, we hypothesized that there is a positive correlation between HA and RLE 2.

By gathering nursing students' records available at the Registrar's Office, this study attempts to provide valuable information on the possible relationship between knowledge in theory and skill development in terms of clinical practice at Tobruk University. The result of data measurement is expected to prove the reliability of the RLE 2 program for the development of practical skills based on the foundation laid by HA.

The acquired knowledge can be used to shape the curriculum by increasing the incorporation of theoretical concepts into RLE activities. It can also improve the emphasis on HA topics related to students' clinical performance. Finally, the study aims to support the ongoing reforms in nursing education at Tobruk University to prepare students for clinical practice and the provision of quality healthcare services.

MATERIALS AND METHODS

A retrospective quantitative method was used to conduct the study using data from the academic records of nursing students at Tobruk University who have taken both the HA course and RLE 2 skills laboratory performance from 2021 to 2023. The data includes the results of student performance via course grades in HA and skills evaluations in RLE 2. In addition, both courses will later be compared with SGA.

Variables:

- Final grade in HA.
- Final grade in RLE 2.
- SGA of the semester.

Sample and Sampling Method:

The study population was 1st year nursing students at the university. Purposive sampling was used to determine the sample size. A total of 263 students were selected after meeting the inclusion criteria explained below.

Data collection:

The Registrar's Office is where the data were gathered before recording and data measurements.

Inclusion and exclusion criteria:

The authors covered the last three years of the academic year of the study (A.Y. 2021, 2022, 2023). These were first-year students in their second semester. This was based on the 1st assessment record which included both passing and failing scores. This study did not include repeaters. The results of the second assessment were also eliminated. All 2nd-semester courses (seven courses) must have been taken by students up to the final exam to be considered eligible.

Data measures:

The collected data are tabulated in tables. The mean, SD, observation, and SGA were calculated For the HA and RLE 2. The Pearson product-moment correlation coefficient was used to compare HA and RLE 2, HA and SGA, and RLE 2 and SGA. The statistical measurements and graphical presentations were performed using Mini Tab version 17 and MS Excel.

Data Analysis:

The Pearson product-moment correlation coefficient was used to determine the strength and direction of the relationship between the two variables. Statistical significance was defined at $p < 0.05$.

Ethical Considerations:

This study was conducted following the ethical principles of informed consent, data confidentiality, and anonymity of the participants. All data were gathered and analyzed according to the university, and research ethics guidelines were followed.

RESULTS

Tables 1 and 2 show the mean, SD, and number of observations (students) for the final grades in HA and RLE 2 across the three batches (2021, 2022, and 2023). It can be observed that students in 2022 generally performed better in both courses compared to the other batches. 2023 had the lowest mean grade in HA but the second-highest in RLE 2.

Table:(1). Final Grade in Health Assessment

Batch	Mean	SD	Observation (n)
2021	37.9178	13.0902	73
2022	51.1250	14.8655	88
2023	39.8824	16.6806	102

SGA was presented in Table 2 in place of observation (Table 1) to avoid duplicating parts of the table. Similarly, batch 2022 had the highest SGA (46.0163) among the three school years.

Table:(2). Final Grade in RLE 2

Batch	Mean	SD	SGA
2021	50.5479	14.3072	35.0361
2022	56.3636	10.2992	46.0163
2023	56.2843	11.0502	38.6019

Table 3 shows correlation coefficients (r), p-values, and r interpretations for the correlation between the HA and RLE 2 grades for each batch. All three batches have positive correlations, indicating that students who perform well in HA tend to perform well in RLE 2 and vice versa. The correlation was strongest in 2021 (r=0.61970), interpreted as a moderate positive correlation, and weakest in 2023 (r=0.42996) or low positive but with a definite correlation. All p-values were less than 0.00001, indicating statistically significant correlations in all batches.

Table:(3). Correlation between HA and RLE 2

Batch	r	p-value	Interpretation
2021	0.61970	<0.00001	Moderate
2022	0.48243	<0.00001	Low
2023	0.42996	<0.00001	Low

A comparative scatter plot shows the correlation of HA and RLE 2 across the three batches where a smoother trend was found in figure 1 compared to r in figures 2 and 3.

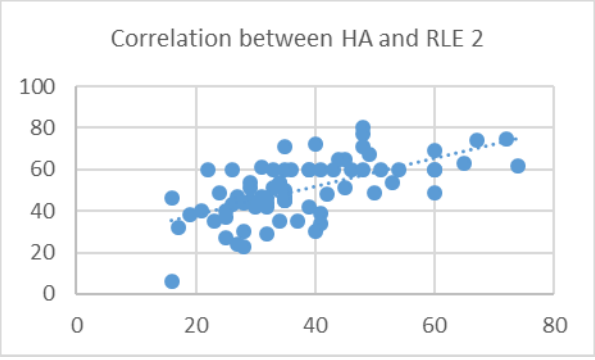

Figure: (1). Correlation of HA and RLE 2 year 2021

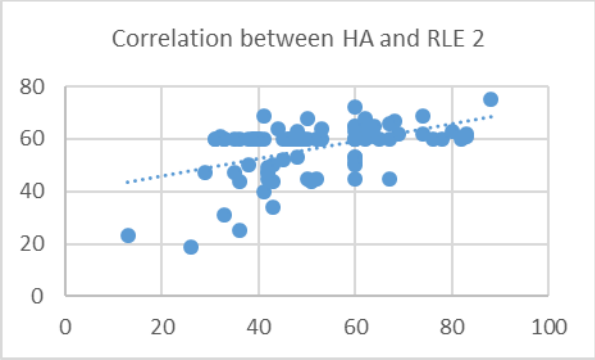

Figure: (2). Correlation of HA and RLE 2 year 2022

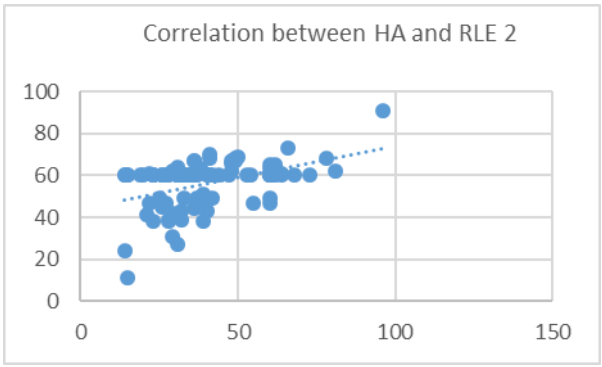

Figure: (3). Correlation of HA and RLE 2 year 2023

All batches recorded r>0.86 and p<0.00001 (high positive correlations) as shown in Table 4. This indicates a strong relationship between HA grades and SGA across all batches, meaning students who perform well in HA tend to have higher SGAs overall.

Table:(4). Correlation between HA and SGA

Batch	r	p-value	Interpretation
2021	0.86197	<0.00001	High
2022	0.87250	<0.00001	High
2023	0.87770	<0.00001	High

Compared with Figures 1-3, the higher r from the correlation of HA and SGA resulted in a smoother scatter plot in Figures 4, 5, and 6.

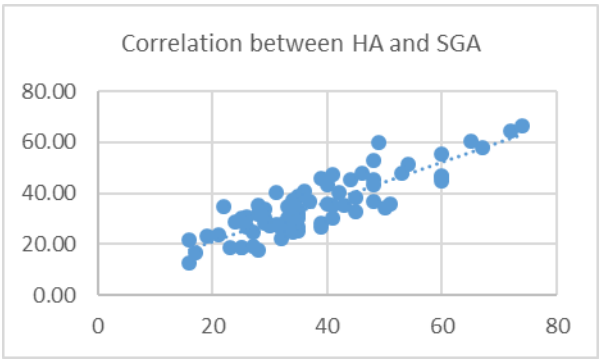

Figure: (4). Correlation of HA and SGA year 2021

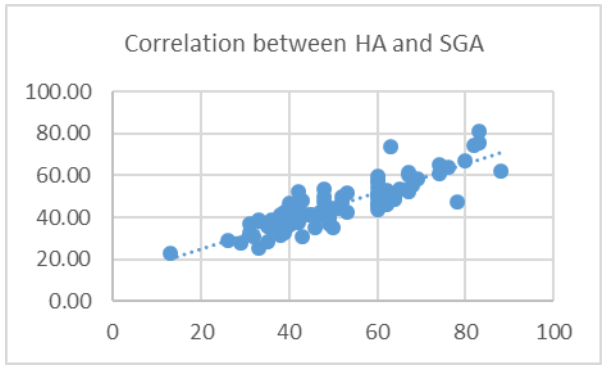

Figure: (5). Correlation of HA and SGA year 2022

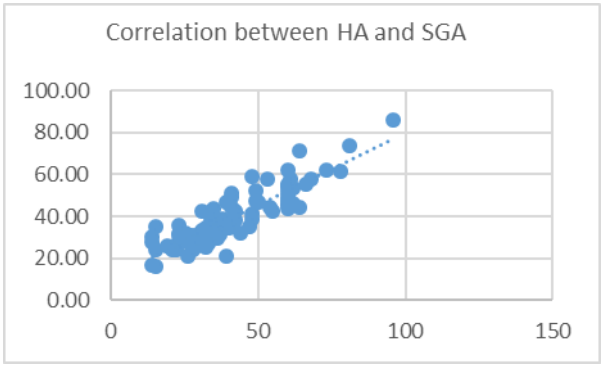

Figure: (6). Correlation of HA and SGA year 2023

The r value of 0.73119 indicates a high positive correlation between RLE 2 and SGA, similar to the HA-SGA relationship for 2021. The r value of 0.41556 suggests a low positive correlation, similar to the weaker HA-RLE 2 relationship observed in this batch. The r value of 0.54078 in 2023 denotes a moderate positive correlation, indicating a somewhat stronger relationship compared to 2022 but not as strong as 2021 (Table 5).

Table:(5). Correlation between RLE 2 and SGA

Batch	r	p-value	Interpretation
2021	0.73119	<0.00001	High
2022	0.41556	0.000057	Low
2023	0.54078	<0.00001	Moderate

Batch 2021 recorded the highest r in terms of the correlations between RLE 2 and SGA. The scatter plot in Figure 7 appears smoother than those in Figures 8 and 9.

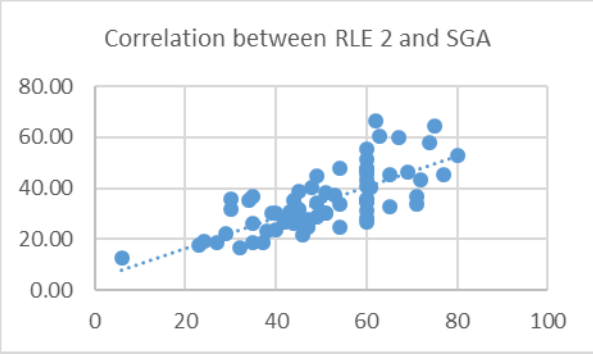

Figure: (7). Correlation of RLE 2 and SGA year 2021

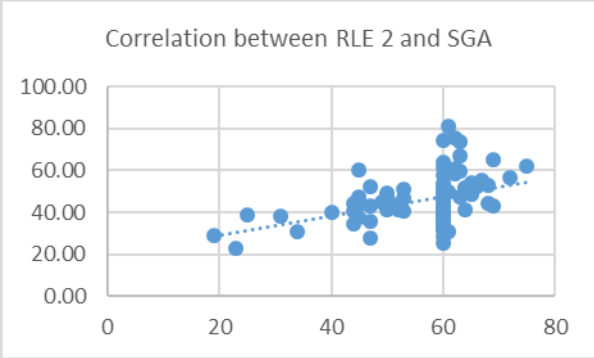

Figure: (8). Correlation of RLE 2 and SGA year 2022

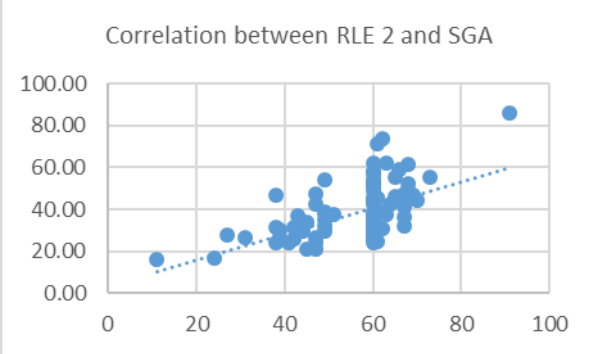

Figure: (9). Correlation of RLE 2 and SGA year 2023

DISCUSSION

As predicted by the theory, The results of the study support the statement that good HA performance would imply better RLE 2 performance. This outcome shows that HA training leads to improved preparedness for practice. A similar finding in the study by (Oducado et al., 2019) demonstrated a high correlation between theoretical classroom instructions and RLE among nursing students. The study emphasized sound theoretical instruction, and its positive correlation with stu-

dents' performance in their RLE involvement was revealed as a form of education model. The study also stressed the need for good pedagogy in HA. Instructors who use active learning and allow learners to practice what they learned by applying it in clinical settings increase the connection between theoretical knowledge and performance (Oducado et al., 2019).

The results provide interesting information on the correlation between HA, RLE 2, and SGA among the three batches.

1. Variable relationship between HA and RLE 2: In contrast to the stable connection between the HA-SGA, the relation between HA and RLE 2 is more diverse. The correlation of the 2021 batch is moderately positive, with a value of 0.61970, whereas those of 2022 and 2023 are relatively weaker, with values of 0.48243 and 0.42996, respectively. This could mean that although HA performance somehow contributes to RLE 2, other factors are more likely to have a greater influence on this course.
2. Consistent strong correlation between HA and SGA: The most outstanding result was the distribution of a significant positive correlation between HA and SGA for all batches ($r > 0.86$ and $p<0.00001$). This indicates that the performance in HA, a theoretical basis, is a fundamental factor affecting overall success. The results conform with the function of the fundamental classes, which are aimed at establishing the knowledge and skills to improve and succeed in further classes.
3. Varying correlations between RLE 2 and SGA: As with HA-RLE 2, the link between RLE 2 and SGA appears to be highly variable. On the other hand, the first batch in the list, batch 2021, again has the strongest positive correlation $r = 0.73119$, while batch 2022 has the weakest $r = 0.41556$, and batch 2023 has a moderate correlation $r = 0.540780$. This implies that RLE 2 increases overall academic standing. However, the effect differs in batches.

The differences in course delivery or structural design between batches may account for some of the variations observed. Adaptations are expected to eventually consider the flaws of previous versions of the curriculum and try to cover them (Al Nozha & Fadel, 2017). Nevertheless, in practice, much depends on the modification type and its implementation scope, as such factors can impact how students perceive their general learning environment and education.

As a result, other factors concerning student demographics, learning styles, and perhaps even previous knowledge in each batch may also affect their performance as well as the observed correlations. Knowing students' learning style preferences is critical for success but their influence on achievement is limited therefore further research should be conducted (Hernández-Torrano, et al., 2017). A study done by (Hernández-Torrano et al., 2017) showed that visual and sequential learning styles are preferred by students. These preferences may be influenced by the demographics of the students, as well as the teaching styles of educators. Another piece of evidence illustrates the clinical supervisory role of nursing faculty that significantly contributes to developing skills in students and promotes the achievement of their career goals (Gumabay, 2017), which proves an educator's significance for students.

It is also possible that factors beyond the courses themselves, such as major life events, economic conditions (Tortorelli et al., 2022), and even the campus environment, could impact student performance and relations among classes.

Furthermore, detailed analysis may focus on the exact changes in curriculum, teaching practices, or learner characteristics that might help to pinpoint these differences across batches. The inclusion of student feedback or interview responses can also provide useful information about the experience of every course and how they measure the relationships between them. In addition, exploring the in-

fluence of factors outside the courses could provide broader knowledge about students' performance.

Limitations and Future Research:

The limitations of this study are the retrospective nature and confounding variables such as individual student motivation before experience. Further studies can use a longitudinal design to follow individual student development and describe the characteristics that make one successful at RLE 2. Furthermore, qualitative research on student accounts of the link between HA and RLE 2 might yield other useful information.

This study offers the potential to provide specific insights into the link between HA and RLE 2 at Tobruk University.

- Better design and sequencing of courses to ensure that students are sufficiently prepared for RLEs.
- The development of targeted interventions that would be used to support students who struggle in either the HA course or RLE 2.
- Better assessment methods for theory and practice in the nursing field of education.

Analyzing the specific causes for different relationships, deep knowledge of factors affecting student success in HA, RLE 2, and general academic performance will be obtained. Additional data points, such as specific RLE 2 skills assessments or student demographics, may provide a more refined analysis of the relationships identified.

CONCLUSION

In this study, Tobruk University nursing students' HA scores were studied in relation to their RLE 2 results. This understanding can provide evidence for use in curriculum development and improving students' foundations for clinical practice which contributes to better patient care.

The findings of this study provide empirical support for a positive relationship between HA performances, and the ability to perform laboratory skills in RLE 2. The design and implementation of the curriculum, as well as the advocacy of teaching techniques for HA, also, can also help nursing programs prepare students to be ready for the challenges and rewards that clinical practice entails.

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REFERENCES

Abbott, M. R., Fankhauser, K., & Nininger, J. (2023). Top-Ranked Nursing Programs: Curricula Content Analysis. *Journal of Nursing Education*, 62(4), 233-235.

Adib-Hajbaghery, M., & Safa, A. (2013). Nurses' evaluation of their use and mastery in health assessment skills: selected Iran's hospitals, *Nursing and Midwifery Studies*, 2(3), 39.

Akinoglu, O. (2017). Pre-Service Teachers' Metaphorical Perceptions Regarding the Concept of Curriculum. *International Journal of Instruction*, 10(2), 263-278.

Al Nozha, O. M., & Fadel, H. T. (2017). Student perception of the educational environment in regular and bridging nursing programs in Saudi Arabia using the Dundee Ready Educational Environment Measure. *Annals of Saudi Medicine*, 37(3), 225-231.

Alaban, A. G., Buran-Omar, A. P., & Abduraji, S. T. (2023). Acceptability of the Proposed Competency-Based Curriculum and Instruction Model to Further Improve the Quality of Nursing Education. *International Journal of Instruction*, 16(2).

Arkan, B., Ordin, Y., & Yılmaz, D. (2018). Undergraduate nursing students' experience related to their clinical learning environment and factors affecting their clinical learning process. *Nurse education in practice*, 29, 127-132.

Buhat-Mendoza, D. G., Mendoza, J. N. B., & Ampaguey, J. O. (2018). From Skills Laboratory to Hospital Duty: Nursing Students Efficacy in Vital Signs and Parenteral Drug Admin at Tobruk University. *IOSR Journal of Nursing and Health Science (IOSR-JNHS)*, 7(2), 41-47.

Egilsdottir, H. Ö., Byermoen, K. R., Moen, A., & Eide, H. (2019). Revitalizing physical assessment in undergraduate nursing education, what skills are important to learn, and how are these skills applied during clinical rotation? A cohort study. *BMC Nursing*, *18*, 1-11.

Gumabay, E. (2017). Caring behaviors of clinical instructors during nursing students' related learning experience: a basis for enhancing student-mentor relationship. *Asia Pacific Journal of Multidisciplinary Research*, 5(1).

Hernández-Torrano, D., Ali, S., & Chan, C. K. (2017). First-year medical students' learning style preferences and their correlation with performance in different subjects within the medical course. *BMC Medical Education*, 17, 1-7.

Jarvis, C. (2023). Physical examination and health assessment-Canadian E-book. *Elsevier Health Sciences.*

Koukourikos, K., Tsaloglidou, A., Kourkouta, L., Papathanasiou, I. V., Iliadis, C., Fratzana, A., & Panagiotou, A. (2021). Simulation in clinical nursing education. *Acta Informatica Medica*, *29*(1), 15.

Landeen, J., Carr, D., Culver, K., Martin, L., Matthew-Maich, N., Noesgaard, C., & Beney-Gadsby, L. (2016). The impact of curricular changes on BSCN students' clinical learning outcomes. Nurse Education in Practice, 21, 51-58.

McDonald, C. (2023). *Qualitative Study: Storytelling for Complex Concepts and Critical Thinking. Nurse Educators' Experience* (Doctoral dissertation, Capella University).

Mikkonen, K., Elo, S., Kuivila, H. M., Tuomikoski, A. M., & Kääriäinen, M. (2016). Culturally and linguistically diverse healthcare students' experiences of learning in a clinical environment:

A systematic review of qualitative studies. *International journal of nursing studies*, *54*, 173-187.

Oducado, R. M., Amboy, M. K. Q., Penuela, A. C., & Belo-Delariarte, R. G. (2019). Correlation between theoretical classroom instruction and related learning experiences: Evidence from a Philippine nursing university. *International Journal of Scientific & Technology Research*, 8(12), 3666-3670.

Tan, M. W., Lim, F. P., Ling Siew, A., Levett-Jones, T., Chua, W. L., & Liaw, S. Y. (2021). Why are physical assessment skills not practiced? A systematic review with implications for nursing education. *Nurse Education Today*, *99*, 104759.

Tortorelli, M., Trigo, T. R., Bolibio, R., de Freitas, C. C. S., Ribeiro, F. G., de Lucia, M. C. S., & Fráguas, R. (2022). The Association of Life Events Outside the Workplace and Burnout: A Cross-Sectional Study on Nursing Assistants. *International Journal of Environmental Research and Public Health*, 19(15), 9342.