Endale Tefera, Ali Dawed, Hayat Ahmed, Etsegenet Gedlu. *Ethiop Med J, 2021, Vol. 59, No. 2*

ORIGINAL ARTICLE

CARDIAC AUSCULTATION SKILLS AMONG PEDIATRIC RESIDENTS

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ABSTRACT

Background*: Recent studies from different settings have demonstrated suboptimal proficiency in cardiac auscultation skills among pediatrics and internal medicine residents.*
Objectives*: This study reports proficiency in cardiac auscultation skills among a sample of residents in the Department of Pediatrics & Child Health, School of Medicine, Addis Ababa University.*
Methods*: Findings of five pediatric cardiac conditions: ventricular septal defect, atrial septal defect, patent ductus arteriosus, pulmonary valve stenosis and aortic valve regurgitation were selected and programmed on mannequins. After obtaining consent, residents were asked to auscultate the mannequins and write down their findings.*
Results: Twenty-nine residents participated in the study. Seventeen (58.6%) were in their 1st year of training, 7 (24.1%) were in their 2nd year of training and 5 (17.3%) were in their 3rd year. The mean percentage score for all residents and all cardiac lesions was 31 ± 13% (range, 21 – 71%). Ventricular Septal Defect was the most accurately identified lesion with a mean score of 70 ± 24% (range, 0 – 100%). Aortic regurgitation was the least accurately identified lesion with a mean score of 21 ± 20% (range, 0 – 67%). Year 3 residents significantly outperformed year I residents in accurately identifying findings of Atrial Septal Defect (p= .006). The overall mean rank scores for all cardiac lesions combined by year of residency were 13.24, 12.21 and 24.90, for year I, II, and III residents, respectively. Year III residents had significantly better overall mean rank score.
Conclusion*: Auscultation skills among pediatric residents were suboptimal. Therefore, these skills may need to be reinforced and continuously evaluated in our pediatric residency training programs.*
Key words*: cardiac auscultation skills, physical examination, residency training programs, Ethiopia*

INTRODUCTION

Physical examination is one of the most important skills in medical education that contributes considerably to physician-patient interaction and is also an important contributor to accurate clinical diagnosis (1,2). Bedside teaching is the most important track towards proficiency in medical history taking and physical examination including cardiac auscultation (3,4). However, owing to several factors, bedside teaching has progressively deteriorated (4).

Along with it, cardiac auscultation skills have also deteriorated, with some putting the blame on extreme reliance on technology, declining bedside teaching due to various reasons, and faulty training of teachers (5-9). Recent studies from different settings have demonstrated suboptimal proficiency in cardiac auscultation skills (5,10,11). Even though there are studies that evaluated auscultation skills in residents recruited to different clinical specialty programs in other parts of the world, there are no studies at least to our knowledge that evaluated proficiency in this important skill, in pediatric residency programs in sub-Saharan settings.

There are a number of challenges and gaps, specific to our situation and similar Sub-Saharan settings. Prior to the availability of mannequins, teaching aids available for this purpose in the low-income countries were scarce. The number of trained cardiologists and dedicated cardiology training units in many of the medical schools is limited. These and other related factors may contribute to suboptimal proficiency, not just to auscultation skills but clinical skills in general.

At the same time, our practice mainly relies on history taking and thorough physical examination to arrive at a logical diagnosis, as imaging and laboratory facilities are not always readily available.

This study reports proficiency in cardiac auscultation skills among a sample of residents in the Department of Pediatrics & Child Health, School of Medicine, Addis Ababa University, Addis Ababa, Ethiopia.

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METHODS

Study design and setting

This is a cross-sectional study that was conducted in the Simulation Unit of School of Medicine, Addis Ababa University, using programmed mannequins. The study period was between January 18 and 30, 2016.

Study participants

There were total of 62 residents (33 in year 1, 18 in year 2 and 11 in year 3) in the department though not all were available at the same point in time, owing to assignments out of the main hospital and being on annual and research leave absences. The population of residents is generally a finite population and if we calculated a sample size and adjust it with finite population correction factor (as we are sampling >5% of the population without replacement), a sample of 29 may not be so small (12). Those who were available at the time of the study were asked for consent.

Data collection tools and procedures

A senior Pediatric cardiologist (consultant) from outside the university hospital, who was not involved in the mentorship of residents, conducted the assessment. Those who consented were asked to perform cardiac auscultation on PAT Basic Pediatric Auscultation Trainer (Simulaids, Inc, NY, USA) and Physiko Physical Assessment Model (Kyoto Kagaku, Kyoto, Japan). These are mannequins with computer programmed simulated murmurs, with the murmurs localized to the specific locations on the precordium of the mannequin, where corresponding real-time murmurs on a patient's precordium would have been auscultated.

Auscultation findings of five common pediatric cardiac conditions: ventricular septal defect (VSD), atrial septal defect (ASD), patent ductus arteriosus (PDA), pulmonary valve stenosis (PS) and aortic valve regurgitation (AR) were selected and programmed on the mannequins. The consultant explained the procedure for the auscultation to the participants. Participants would have considered the mannequins as simulated patients and all steps and findings would be reported as in a real patient. Each participant was given 3 minutes for each simulated cardiac lesion. Study participants were asked to auscultate and write the type of murmur they heard, timing of the murmur, location and other associated auscultation findings and make logical conclusions as to the diagnosis of the cardiac lesions.

Scoring

A score of 1 was given for each key finding that a participant had identified correctly with the total score adding up to 14.

The scoring system is shown in table 1.

Statistical analysis

Data were entered into SPSS version 20 (IBM Corp. Armonk, NY, USA) and analyzed. Numerical variables were reported as mean ± standard deviation. Kruskal-Wallis test followed by post hoc pairwise comparison was used to compare mean rank scores between residents by year of postgraduate training. This nonparametric test was selected due to the small sample size and non-normal distribution of the data. Statistical significance was set at.05.

RESULTS

A total of 29 residents participated in the study. Out of the 29 residents, 17 (58.6%) were in their 1st year of training, 7 (24.1%) were in their 2nd year of training and 5 (17.3%) were in their 3rd/final year of training. The mean percentage score for all residents and all cardiac lesions was 31 ± 13% (range, 21 – 71%). VSD was the most accurately identified lesion with a mean score of 70 ± 24% (range, 0 – 100%). Aortic regurgitation was the least accurately identified lesion, with a mean score of 21 ± 20% (range, 0 – 67%). The most correctly picked auscultation finding was pansystolic murmur of VSD whereas only two participants picked splitting of the second heart sound in ASD. None of the participants picked Austin flint murmur in aortic regurgitation. Mean scores for each of the cardiac lesions by year of postgraduate training are shown in figure 1.

Year 3 residents significantly outperformed year I residents in accurately identifying findings of ASD (p= .006). The overall mean rank scores for all cardiac lesions combined by year of residency were 13.24, 12.21 and 24.90, for year I, II, and III residents, respectively. Accordingly, year III residents performed significantly better on the overall rank score compared to year I and II residents, (p= .013 and p= .022, respectively). There was no statistically significant difference detected in the mean rank score between year I and year II residents either in the individual cardiac lesions or the overall score. The comparative performances of the 3 groups of residents by individual cardiac lesions and overall mean rank scores are shown in table 2.

Table 1: The key findings scored for each lesion and corresponding scores

Diagnosis	Features (score)
Ventricular Septal Defect (VSD)	Pansystolic murmur on the left lower sternal border (1) Correct diagnosis (1)
Atrial Septal Defect (ASD)	Fixed split of S2 (1) Systolic ejection murmur at the left upper sternal border (1) Mid-diastolic rumble at tricuspid area (1) Correct diagnosis (1)
Patent Ductus Arteriosus (PDA)	Continuous/machinery murmur at left upper sternal border/left in-fraclavicular area (1) Correct diagnosis (1)
Pulmonary valve Stenosis (PS)	Systolic ejection click (1) Systolic ejection murmur at left upper sternal border (1) Correct diagnosis (1)
Aortic regurgitation (12)	Diastolic murmur over the left 3rd intercostal space (1) Austin-flint murmur at apex (1) Correct diagnosis (1)

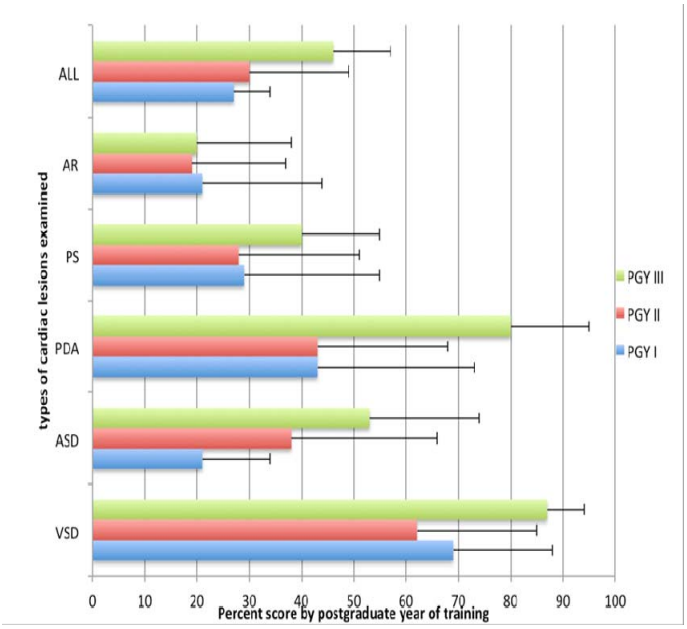

Figure 1: Mean performance scores for residents by post-graduate year of training and type of cardiac lesion

VSD-ventricular septal defect; ASD-atrial septal defect; PDA-patent ductus arteriosus; PS-pulmonary valve stenosis; AR-aortic valve regurgitation; PGY-postgraduate year

Table 2: Comparative performance of resident groups by postgraduate year of training and cardiac lesions examined

Cardiac lesions examined	Postgraduate year	Mean rank score	p-value
Ventricular septal defect (VSD)	I	14.97	
	II	12.07	.307
	III	19.20	
Atrial septal defect (ASD)	I	12.47	.008*
	II	14.00	
	III	25.00	
	Pairwise comparison	I – II	1.000
		I – III	.006*
		II – III	.054
Patent ductus arteriosus (PDA)	I	13.26	.071
	II	14.00	
	III	22.30	
Pulmonary valve stenosis (PS)	I	14.18	.484
	II	14.43	
	III	18.60	
Aortic regurgitation (12)	I	15.09	
	II	14.71	.994
	III	15.10	
Overall mean rank score	I	13.24	
	II	12.21	.010
	III	24.90	
	Pairwise comparison	I – II	1.00
		I – III	.013*
		II – III	.022*

*Statistically significant difference in mean rank score at α=0.05

DISCUSSION

The overall score achieved for skills in cardiac auscultation in our group of Pediatric residents is remarkably suboptimal. Though several studies from different corners of the world have shown similar findings (5,10,11,13-15), the implication of our study results is worrying due to the peculiarities pertaining to Sub-Saharan settings. In the developed world, the widespread availability of echocardiography may to some extent, compensate for the deficiency in physical examination skills. However, in resource-limited settings, like in Sub-Saharan Africa, echocardiography is usually unavailable or available only in teaching institutions or bigger public or private hospitals. Trained manpower performing echocardiography is also generally scarce. Once residents complete their training and are assigned to regional or district hospitals, their access to echocardiography is limited. Under many circumstances, patient evaluation, diagnosis and management is solely based on thorough history and physical examination. Therefore, there is no substitute to high-level proficiency in physical examination, including cardiac auscultation skills in most settings in Sub-Saharan Africa, including Ethiopia.

When compared with other studies, the results of our study are more or less similar to studies conducted elsewhere, though there were important differences in sample size and methodology. A study by Gaskin et al involving pediatric and combined pediatric/internal medicine residents, evaluated auscultation skills in 47 of 64 residents on 5 different cardiac lesions (pulmonary stenosis with ejection click, VSD, ASD, PDA and combined aortic stenosis/regurgitation) programmed on a mannequin. The overall accuracy of diagnosis was at 33% whereas the mean score for the lesions was a little above 11 out of possible 19 (10).

The St Claire et al study that compared auscultation skills among internal medicine residents on 3 simulated auscultation findings (mitral regurgitation, mitral stenosis and aortic regurgitation), showed an overall accuracy of 52% (15) but this study is different from our study in an important way, the type of the lesions tested, being the outstanding one. One of the largest studies by Mangione et al (13) recruited 453 internal medicine and family medicine residents and 88 medical students testing them on 12 different cardiac findings. The residents recognized only about 20% of the findings correctly.

The performances of all the three groups of residents in detecting key features of VSD and PDA were better, compared to the other lesions. This is not surprising, as these were the most common lesions with loud murmurs that practitioners encounter in pediatric practice.

In our study, year III residents performed comparatively better in identifying ASD features and in the overall mean rank score. This is in contrast to some other studies that reported year of training had no significant difference in the performance scores (10). This could be explained by the fact that all of the year III residents in our study have had their cardiology rotations.

One finding of interest is that even in those who detected the major murmurs and associated lesions correctly, most of them failed to look for other clues that would help differentiate some of the lesions from other lesions with similar findings. Those included mid systolic click of pulmonary valve stenosis, wide and fixed splitting of second heart sound and tricuspid mid diastolic murmurs that were associated with large ASDs and Austin flint murmur of aortic regurgitation. That may probably be due to the tendency of requesting echocardiograms once a murmur was detected without bothering to conduct further analysis.

Our study findings may serve as a stepping-stone to continuously assess and improve not only cardiac auscultation skills but also other physical examination skills in residency programs. Lots of opportunities exist for residents to improve their examination skills. Those may include the same simulation facilities on which our study was conducted, self-directed auscultation teaching programs (16,17) and other pertinent innovations. A good level of proficiency in cardiac auscultation skills may decrease unnecessary echocardiographic referrals besides helping timely and accurate diagnosis. Therefore, cardiac auscultation skill among general pediatricians should be reinforced, as they are the highest-level physicians caring for children with congenital and acquired heart diseases in many cases. There is no better opportunity than residency training programs as the skills can be assisted by feedback from experienced mentors and echocardiography.

Limitations of the study

Finally, our study had important limitations. First of all, the relative representation of the 2nd year and more significantly, the 3rd year residents was small due to consent issues. Related to the small number of participants in the 2nd and 3rd year groups, the distribution of scores is not expected to follow normality. Due to this limitation, our comparative statistics was worked out with non-parametric tests, making the comparison less accurate.

Secondly, those who consent to such skill studies may probably be those who are more self-confident in their proficiency in the skill under study, which may create bias as to the representativeness of the sample. Thirdly, there could be important differences with the auscultation findings on a Mannequin and a real patient. Findings in a real patient have many variations and complexity, whereas Mannequins are programmed on a more distinct finding.

Conclusion

Cardiac auscultation skills among pediatric residents in our study were suboptimal. Though the proficiency got better as the training year advanced in some cases, the overall assessment showed markedly low scores. Therefore, cardiac auscultation skills will need to be reinforced and evaluated in our pediatric residency training programs, as pediatricians are the highest-level physicians caring for children with congenital and acquired heart diseases in many cases.

In terms of acquiring the basic skill and thought framework, simulations play an important role as they are being used in high-income countries for basic medical education. With all its limitations, we still believe that our study laid a foundation and a framework for well-designed studies. Future studies may be designed as interventional studies, where the initial evaluation is followed by interventional measures and assessment of the impact.

ACKNOWLEDGEMENTS

We would like to thank Sr. Liyuwork Abebe and the School of Medicine for allowing us to use the Simulation Unit for this study. We are also grateful to all study participants for consenting to participate in this study.

Competing of interest

All authors declare no conflict of interest related to the study or publication of this manuscript.

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