Instructional Multiple Binaural Stethoscope

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Abstract - *The stethoscope is an acoustic medical device for auscultation where human ear plays significant part. Long before doctors practiced immediate auscultation meaning placing ear directly on patient's body by Salinsky (1990), then monaural introduced by Laennec; later binaural, Comins's invention and Cammann developed further. Several decades numerous innovations made predominantly over chestpiece some had drawbacks. Dr Littman introduced teaching stethoscope with two headset and researcher utilized as prior art.Experimental research method used and the study aimed to determine accuracy and measurement of speed of the device in terms of systolic and diastolic blood pressure and acceptability of user. The subjects were 19 clients and 27 nursing students, government /private registered nurses. The device are comparable to single binaural stethoscope in accuracy performance; speed of sound, former is slightly higher than the latter but still considered as normal; the device are acceptable to users; the utility model have no significant difference in accuracy performance and speed measurements of systolic and diastolic. The utility model may be tried in any acoustic activities and may be pilot tested to the Universities animal science courses, veterinary medicine other Colleges of Nursing and all health allied courses.*

Keywords:*acoustic stethoscope , multiple binaural, monaural.*

INTRODUCTION

A human ear plays an integral part in any acoustic procedures. The stethoscope is an acoustic medical device for auscultation, or listening to the internal sounds of the human body as well as animal sounds. Stethoscope and sphygmomanometer are commonly used for measurements of blood pressure

In the past doctors usually practiced immediate auscultation which means by placing ear directly on patient's body Salinsky [1]. This method as cited by Sterne [2] has drawbacks to the user they cannot pinpoint where the sound is coming, because of the extraneous sounds coming from elsewhere.

Rene TheophileHyacinthe Laennec invented the first stethoscope in 1816, he was a flute maker and a player that is why his invention was designed like a flute having no finger holes and made of wood. It is a monaural device meaning only used by one ear as cited by Bause[3]. The drawbacks still haunt the doctors in using the monaural device because there is still one ear open to their surroundings; they had to learn to concentrate hard in order to focus on hearing what they needed through their instrument. Despite of many comments about monaural there were a lot of versions, styles, creative innovations made, Salinsky[1]. An Irishman, Nicholas Comins designed the first binaural stethoscope in 1829. It was made of brass tubes connected by movable joints with coiled silk inside the joints to give an airtight seal but several drawbacks were identified until the advent of Dr. George Cammann's invention in 1852 where once authority said, " he perfected the design of the instrument" and which became a standard during their time as stated by Duffin[4], a medical historian. Several decades after, many were introduced particularly focused on the chestpiece modification like the invention of phonocardiograph by Eithnoven in 1924 is an audion tube made successful amplification of heart sounds, but the resulting sounds were so altered in character that doctors would have had to re-learn their listening techniques as according to Sterne [2]. In 1948, J. Scott Butterworth and Charles Poindexter both physician, was dissatisfied with the methods of teaching students on how to interpret sounds of the human hearts leading to the invention of a multiple channel electronic stethoscope it has an amplifier constructed that is connected to a multiple stethophones for the entire students to have a full effect but it is too expensive and it is battery operated and has a background noise sometimes

affects the sound transmission as stated by Ananthi [5].

Early 1960s Dr. David Littmann, created a new stethoscope that was lighter than previous models and had improved acoustics as cited by Duffin[4]. The two headsets is another modification made by Littman that serve as prior art of the researcher, where teacher and student simultaneously listens to sounds they are assessing. The utility model introduced by Daniel Grady a multiple channel shutoff valve housing made up of plastic connectors and having three sound receiving sensors serve the researcher the idea of making a three way port where the three headsets where connected[6].

CMO No. 14 s. 2009 Art. VII Instructional Standards under Section 15 the Related Learning Experience (RLE) is composed of Clinical and Skills Laboratory. The RLE in the skills laboratory were procedures to be done before the students will be exposed in the clinical area the procedures depending on the year level of nursing students for them to develop skills and their competencies [7].

One of activities to be learned by Level 1 or First Year students is Vital signs taking. One of which in the vital signs activity is the blood pressure taking,withthe use of stethoscope and sphygmomanometer. This procedure will be first demonstrated by the Clinical instructor then the student will demonstrate after. The instructor has to evaluate the accuracy and competency performance of the students, but this return demonstration is usually done one by one with the instructor observing and rechecking their performance. This procedure noted as time consuming, and possibility to develop skin bruises or marks to client for repeated blood pressure taking, and distressing on the part of the client as well.

Hence, the development of multiple binaural stethoscopes inspired the researcher. Two students and one instructor can able to use the device simultaneously for comparison or synchronization of data taken. The said device is composed of three headsets or multiple binaural stethoscopes connected with a three-way metal port adapter having an angle of separation at about 45 degrees and comprise of common vertex being connected to one end of the flexible tubing and the other end to the tunable chest piece.

OBJECTIVES OF THE STUDY

This study aims to determine the audibility performance of the instructional multiple binaural stethoscope versus single binaural stethoscope in terms of accuracy, speed, in determining systolic/diastolic and acceptability by the user. And also able to determine the significant difference between the instructional multiple binaural stethoscope from single binaural stethoscope in systolic/diastolic performance.

METHODS

Research Design

Experimental research method was used by the researcher in this study. Itdetermine the accuracy and measurement of speed of multiple binaural stethoscopes in terms of systolic and diastolic blood pressure.

Subjects of the Study

The subjects of the study were 19 clients and 27 student nurses of PSU-IN and registered nurses in private and government hospitals. The participants are those patients confined in the government and private hospitals in the province and handled by the registered nurses, while in the skills laboratory the graduating students are the ones performing the procedure and some acted as patient.

Procedure

Materials needed are the single binaural stethoscope, multiple binaural stethoscope, pen, piece of paper, lap clock and sphygmomanometer with gauge meter. The instructor first makes use of the single binaural stethoscope (pink color as control) to client to take the initial blood pressure by inflating the sphygmomanometer when reaching 200 mm Hg in the gauge meter (or it depends on the researcher's reference as common indicator), then ready the lap clock releasing 5 to 7 mm per second once heard the first sound then click the lap clock and then resume and continue releasing until the last sound heard then click again the lap clock record the blood pressure taken and note time of systolic and diastolic.

Assign two students to take charge of other available stethoscope and do same thing what the instructor did with the first stethoscope and follow instruction accordingly. Then compare the data taken from the control group (pink colored stethoscope) to the multiple binaural stethoscopes. Interview guide was used to determine the acceptability by the user.

Treatment of the study

The data gathered were subject through tabulation for the analysis. Most of the problems were answered using statistical tools.For problem (1), about the performance of multiple binaural stethoscopes on accuracy measurement of systolic and diastolic mean were employed. The computed mean were described using the range of values below. The created ranges of values below were based on the performance of single binaural stethoscope mean and standard deviation performance.

The given scale was used to interpret the Binaural Stethoscope Accuracy Performance: Very Accurate (VA): 0σ - $\pm 0.99\sigma$; Accurate (A): $\pm 1.00\sigma - \pm 1.99\sigma$; Moderately Accurate (MA): $\pm 2.00\sigma - \pm 2.99\sigma$; Not Accurate (NA): $\pm 3.00\sigma above\ or\ below$. The given scale was used to interpret the Single Binaural Stethoscope Speed Performance:Normal: 0σ - $\pm 0.99\sigma$; Moderately Fast or slow: $\pm 1.00\sigma - \pm 1.99\sigma$; Fast or Slow: $\pm 2.00\sigma - \pm 2.99\sigma$; Very Fast or Slow: $\pm 3.00\sigma above or below$.

For the speed performance of multiple binaural stethoscopes harmonic mean were employed. The computed mean were described using the range of values below. Again, the created ranges of values below were based on the performance of single binaural stethoscope harmonic mean speed and standard deviation performance.

For Problem (2), Analysis of Variance (ANOVA) and Kruskal Wallis were employed, because multiple binaural stethoscopes is composed of three parts and the performance of each part in terms of measurement accuracy and speed of the multiple binaural stethoscope were compared to each other and to the single binaural stethoscope performance.

Frequency count and percentage was used to assess the convenience performance of the users.

RESULTS

Table 1. Performance of the Instructional Multiple Binaural Stethoscope According to Systolic Measurement

	Single Binaural Stethoscope	Multiple Binaural Stethoscope		
		Gray	Green	Blue
Mean	113.16	114.21	112.63	112.63
Std. Deviation	12.50	11.21	11.94	11.94
Description		VA	VA	VA
Skewness	-.294	-.176	-.351	-.351
Kurtosis	-.497	-.231	-.281	-.281

The systolic measurement performance of the Instructional Multiple Binaural is almost the same as the single binaural stethoscope. This means that the multiple binaural is an instrument that measures accurately because the means measured are within 1 standard deviation above and below the single binaural stethoscope mean.

The diastolic measurement performance of the Instructional Multiple Binaural is almost the same as the single binaural stethoscope. This means that the multiple binaural is an instrument that measures accurately because the means measured are within 1 standard deviation above and below the single binaural stethoscope mean.

Table 2. Accuracy Performance of the Instructional Multiple Binaural Stethoscope According to Diastolic Measurement

	Single binaural Stethoscope (Pink)	Multiple Binaural Stethoscope		
		Gray	Green	Blue
Mean	75.79	76.31	74.74	74.21
Std. Deviation	9.61	8.95	8.41	9.01
Description	VA	VA	VA	VA
Skewness	.170	-.183	.092	.008
Kurtosis	-.864	-.454	-.283	-.558

Table 3.Performance of the Instructional Multiple Binaural Stethoscope According to Systolic Speed (ss) Measurement

	Pink ss	Grayss	Greenss	Bluess
Harmonic Mean	12.9289	11.5084	12.4421	12.4568
Std. Deviation	3.37035	2.11602	2.96228	2.6603
Descriptive		Normal	Normal	Normal
Skewness	-0.206	0.151	0.916	-0.369
Kurtosis	-0.487	-0.25	.852	-0.649

The systolic speed performance of the Instructional Multiple Binaural Stethoscope slightly lower than the computed mean of the single binaural but within 1 standard deviation below, this implies that the speed of sound in single binaural is slightly slower than the multiple binaural stethoscope. Therefore, it can possibly describe the speed of sound of multiple binaural as normal because of its slight difference in single binaural stethoscope.

Table 4. Performance of the Instructional Multiple Binaural StethoscopeAccording to Diastolic Speed (ds) Measurement

	Pink ds	Grayds	Greends	Blueds
Mean	8.8342	8.8363	8.3258	9.7142
Std. Deviation	2.16782	2.6758	2.37246	3.38932
Description		Normal	Normal	Normal
Skewness	-0.171	1.378	0.111	1.333
Kurtosis	-1.214	4.163	-1.024	2.081

The diastolic speed performance of the Instructional Multiple Binaural Stethoscope is almost the same as the computed mean of single binaural and within 1 standard deviation above and below the mean , this implies that the speed of sound in single binaural is slightly slower than the multiple binaural stethoscope therefore, the speed of sound of multiple binaural is normal because of its slight difference in single binaural stethoscope.

Table 5. Difference on Systolic Speed Measurement between Monaural and Multiple Binaural Stethoscope

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	20.184	3	6.728	.849	.472
Within Groups	570.404	72	7.922		
Total	590.588	75			

The F-value is 0.849 with a P-value of 0.472 which is greater than 0.05. This implies that the distributions of the measured systolic speed(ss) according to type of stethoscope used are the same. The systolic speed of the tubes in the multiple binaural are not significantly differ from each other and also mean that diastolic speed of tubes of both stethoscope are the same.

Table 6. Difference on Diastolic Speed Measurement between Monaural and Multiple Binaural Stethoscope

	Mean Rank	Df	Chi Square	Sig
Pink	39.47	3	1.284	0.733
Gray	37.89			
Green	34.34			
Blue	42.29			

The x-value is 1.284 with a P-value of 0.733 which is greater than 0.05, this implies that the distributions of the measured diastolic speed according to type of stethoscope are the same. The diastolic speed of the tubes in the multiple binaural is not significantly differ from each other.

DISCUSSIONS

The table I shows that, the systolic measurement using the single binaural stethoscope has a mean of 113.16 and a standard deviation of 12.50. The systolic means measurement using multiple binaural stethoscopes is almost the same as the single binaural stethoscope. This means that the multiple binaural stethoscopes is an instrument which measure the systolic blood pressure very accurately, because the means measured are within 1 standard deviation above and below the single binaural stethoscope mean. Moreover, the shape of the distributions of the means from single binaural and multiple binaural stethoscope is approximately normal because all of the values under skewness and kurtosis are within the range of -1 to +1.

Table 2 displays that, the systolic measurement using the single binaural stethoscope has a mean of 75.79 and a standard deviation of 9.61. The diastolic means measurement using multiple binaural stethoscopes is almost the same as the single binaural stethoscope. This means that the multiple binaural stethoscopes is an instrument which measure the diastolic blood pressure very accurately, because the means measured are within 1 standard deviation above and below the single binaural stethoscope mean. Moreover, the shape of the distributions of the means from single binaural and multiple binaural stethoscope is approximately normal because all of the values under skewness and kurtosis are within the range of -1 to +1.

The table 3 reveals that, the mean systolic speed of single binaural stethoscope is 12.9289 with and standard deviation of 3.37035. The computed means systolic speed of multiple binaural stethoscope are slightly lower than the computed mean of monaural stethoscope, but within 1 standard deviation below the mean systolic speed of single binaural stethoscope. This implies that the speed of sound in single binaural stethoscope is slightly slower than the speed of sound in multiple binaural stethoscopes.

Therefore, we can possibly describe the speed of sound of multiple binaural as normal, because of its slight difference in the speed of sound of single binaural stethoscope. Moreover, all of the computed value of skewness and kurtosis are less than 1. This

means that the shape of distribution of the speed of sound in monaural and multiple binaural stethoscope are approximately normal.

The table 4 reveals that, the mean diastolic speed of single binaural stethoscope is 8.8342 mm/sec with and standard deviation of 2.16782 mm/sec. The computed means diastolic speed of multiple binaural stethoscope are almost the same as the computed mean of single binaural stethoscope and within 1 standard deviation above and below the mean diastolic speed of single binaural stethoscope. This implies that the speed of sound in single binaural stethoscope is the same as the same as the speed of sound in multiple binaural stethoscopes. Therefore, we can possibly describe the speed of sound of multiple binaural as normal, because of its slight difference to the speed of sound of single binaural stethoscope. Moreover, some of the computed value of skewness and kurtosis are not within the range $[-1,1]$. This means that the shape of distribution of the speed of sound in single binaural and multiple binaural stethoscopes are not normal.

The table 5 shows that, the F-value is 0.849 with a P-value of 0.472 which is greater than 0.05. This implies that the distributions of the measured systolic speed according type of stethoscope used are the same. Also, the systolic speed of the tubes in the multiple binaural stethoscope are not significantly differ from each other. This means that the diastolic speed of tubes of multiple binaural stethoscope is the same as the single binaural stethoscope

The table 6 shows that, the ×-value is 1.284 with a P-value of 0.733 which is greater than 0.05. This implies that the distributions of the measured diastolic speed according to type of stethoscope used are the same. Also, the diastolic speed of the tubes in the multiple binaural are not significantly differ from each other. This means that the diastolic speed of the tubes of multiple binaural stethoscope are the same as the single binaural stethoscope at 95% level of confidence.

CONCLUSIONS

The multiple binaural stethoscope are comparable to single binaural stethoscope in accuracy performance however, the speed of multiple binaural is slightly higher than single binaural but considered normal; The multiple binaural are acceptable by the users and have no significant difference in accuracy and speed performance of systolic and diastolic of blood pressure.

RECOMMENDATION

The instructional multiple binaural may be pilot tested to the campuses in the University offering agricultural programs major in animal science and other University offering Veterinary Medicine, Colleges of Nursing, Midwifery and other Health Allied courses needing this device. Future researchersmay venture into assessing physiologic sounds of the heart, lungs, abdomen emphasizing the rate, rhythm and quality of sounds..

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