INTRODUCTION
To avoid complications during surgical and radiological procedures, the anatomical knowledge of vermiform appendix is prime importance. The Vermiform appendix is blind ended tube associated with caecum with varying in length (commonly 6-9 cm). The appendix lies in the right iliac fossa and its base is situated one third of the way up the line joining the right anterior superior iliac spine to the umbilicus (McBurney’s point).

Vermiform appendix is not a useless organ. As age advances the weight of appendix decreases due to decreasing number of lymphatic nodules with replacement by connective tissue. Appendix has irregular lumen due to lymphoid nodules and mucosal glands range from 42-130 in number at different age groups. The histological differentiation of vermiform appendix shows that it is a specialized organ. At different age groups the circular, longitudinal muscular layers and sub mucosa varies in thickness considerably.

It has been observed that wall thickness and size of lymphoid nodules between normal and inflamed appendix have significant differences. Although it is helpful but not conclusive to diagnose negative appendicitis by ultra sound and C T scan findings.

Figure-1. Normal appendix (Transverse section) Ultra-sound picture
MATERIAL AND METHODS
Total forty negative appendectomy/normal appendices (removed along with other abdominal operations) specimens, were included in this study. It was conducted at IIMC Rawalpindi from January 2014 to March 2015.

According to age, these specimens were arranged in four equal groups. Ten specimens were included in each group i.e. Group A, B, C, D. The age difference between each group was 15 years. The age range in the last group was extended due to less availability of specimens i.e. from 46 to 74 years. In all groups, only middle parts of appendices specimens’ slides were included after standard tissue staining. The various parameters i.e. wall thickness, lumen size and lymphoid nodules were measured in micron meters under the light microscope after calibration.

Data Analysis
ANOVA and Tukey- hoc tests were used to compare the differences in the wall thickness, and lumen size between four age groups. The p value of < 0.05 is significant.

RESULTS
A sample of total 40 specimens, age of the participants ranging from 6 to 74 years, were prepared and analyzed for the study. Mean age of the sample was 32.4 ± 19.8 years. There were 29 (72.5%) males and 11 (27.5%) females.

The wall thickness (serosa to mucosa), lumen size of vermiform appendix were measured under light microscope. Mean lumen size and mean wall thickness of middle part of appendix was then added for comparison between the groups.

The mean lumen size in group A was 228.5 ± 77.5 µm, in group B was 129.6 ± 59.5 µm. In group C was 112.8 ± 34.7 µm and in group D, the mean lumen size was 73.9 ± 34.3 µm. The mean luminal size was greatest in group A (228.5µm). The maximum luminal size was also observed in group A. ANOVA reported a highly significant difference between the four groups (p < 0.01).

On applying ANOVA, a highly significant difference was found between the four age groups (p < 0.01).

DISCUSSION
In our study negative appendicectomy specimens were included. In other countries, most studies had been conducted on postmortem appendix specimens.

In our study, the mean luminal size of group A (0-15 years) is greatest of all the groups. The luminal diameter is greater in a group (0-20 years) in females in a Bangladesh study.11
HISTOMORPHOMETRIC STUDY OF VERMIFORM APPENDIX

**Figure-4. Photomicrograph of appendix of group C showing wall thickness H&E stain. X 100**

**Figure-5. Photomicrograph of appendix of group C showing lumen H&E stain. X 100**

**Figure-6. Photomicrograph of appendix of group D (74years) showing wall thickness and lumen H&E stain. X 100**

**Graph-1. Comparison of mean lumen size and mean wall thickness between different age groups**

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Age Group</th>
<th>Mean Difference</th>
<th>P-Value</th>
<th>Mean Lumen Size ± SD (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth - 15 Years</td>
<td>16 Years - 30 Years</td>
<td>98.90</td>
<td>.001</td>
<td>228.5 ± 77.5</td>
</tr>
<tr>
<td></td>
<td>31 Years - 45 Years</td>
<td>115.70</td>
<td>.000</td>
<td>129.6 ± 59.5</td>
</tr>
<tr>
<td></td>
<td>46 Years - 74 Years</td>
<td>154.60</td>
<td>.000</td>
<td>112.8 ± 34.7</td>
</tr>
<tr>
<td>16 Years - 30 Years</td>
<td>Birth - 15 Years</td>
<td>-98.90</td>
<td>.001</td>
<td>73.9 ± 34.3</td>
</tr>
<tr>
<td></td>
<td>31 Years - 45 Years</td>
<td>16.80</td>
<td>.901</td>
<td></td>
</tr>
<tr>
<td></td>
<td>46 Years - 74 Years</td>
<td>55.70</td>
<td>.122</td>
<td></td>
</tr>
<tr>
<td>31 Years - 45 Years</td>
<td>Birth - 15 Years</td>
<td>-115.70</td>
<td>.000</td>
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<td></td>
<td>16 Years - 30 Years</td>
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<td></td>
<td>46 Years - 74 Years</td>
<td>38.90</td>
<td>.396</td>
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<td>46 Years - 74 Years</td>
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</tbody>
</table>

Table-I. Mean lumen size of vermiform appendix in all age groups
In our study, the specimens were sectioned and stained at three levels i.e. base, middle and tip, but only middle component was included in this study. The lumen sizes of above components of specimen were variable. This was also observed in a study of Shgabu, Umar and Singh in Nigeria.\textsuperscript{12} There is inverse relationship between lumen size and wall thickness in our study irrespective of lymphoid nodules diameter. In a Shugaba and also Gupta G. study, the wall thickness increased with decreased lumen size when the diameter of the lymphoid nodules increased\textsuperscript{12,13}

Overall total of mean wall thickness and mean lumen size were closer in various age groups irrespective of diameter of lymphoid nodules. This is due to quantity of the fatty tissue increased as the age advanced.

In many adults, the normal structure of the appendix is lost and appendage is filled with fibrous scar tissue as written in a text book of histology.\textsuperscript{14}

It is observed that after 15 years, there is progressive atrophy of lymphoid tissue proceeded concomitantly with fibrosis of wall and partial or complete obliterations of the lumen.\textsuperscript{15} In our study the lumen size was well recognized in the specimens even at ages of 60-74 year.

In postmortem specimens of vermiform appendix at Mayo Clinic\textsuperscript{16} the earliest total obliteration of lumen occurred at age of 12 year. In one study of autopsy group that high incidence of fibrosis suggested that this is an age related change.\textsuperscript{17}

### CONCLUSION

In this study, there was some inverse relationship between lumen size and wall thickness. The lymphoid nodules were present even at the age of 74 years. There is no much effect on the overall thickness of the wall even if the mean lymphoid nodule and lumen size were decreased with the advancing age.
RECOMMENDATIONS
For a better understanding of histomorphometric studies the larger samples of vermiform appendix should be examined. For connective tissue contents at different age groups the Masson Trichrome stain may be used. In younger age group, the fibrosis of wall and the obliteration of the lumen of vermiform appendix may be further evaluated.

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REFERENCES


