



Research Article

A Clinicopathological Review of Colonic Polyps in a Tertiary Hospital in North Central Nigeria

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Abstract

Background: Colorectal polyps, especially adenomas, are known as precursors of colorectal carcinomas. This study was aimed at determining the prevalence and histopathologic characteristics of colonic polyps among Nigerians that underwent colonoscopy at the University of Ilorin Teaching Hospital, Ilorin, Nigeria. The authors also determined the polyp detection rate and adenoma detection rate.

Materials and Methods: This was a hospital-based cross-sectional study of all colonoscopy examinations performed at the University of Ilorin Teaching Hospital, Ilorin from March 2013 to September 2017. The endoscopy register was reviewed, and patients' biodata, indications for colonoscopy and colonoscopic findings were recorded on a proforma. The histopathologic reports of the polyps were also retrieved and their diagnosis confirmed.

Results: A total of 289 patients had colonoscopy carried out on them. The age of the patients ranged from 14 to 90 years with a mean \pm SD of 57.0 ± 15.3 years and a median age of 58 years. There were 178 (61.6%) males and 111 (38.4%) females giving a M:F ratio of 1.6:1. The indications for colonoscopy were rectal bleeding 124 (42.9%); suspected colorectal cancer 67 (23.2%); abdominal pain 22 (7.6%); chronic diarrhea 18 (6.2%); surveillance colonoscopy 12 (4.2%); constipation 11 (3.8%); change in bowel habit 9 (3.1%); occult bleeding 6 (2.1%); others 20 (6.9%). Endoscopic findings were normal findings 89 (30.8%); hemorrhoids 88 (30.4%); colonic polyps 50 (17.3%); diverticulosis 34 (11.8%); rectal cancer 29 (10.0%); colon cancer 24 (8.3%); colitis 19 (6.6%); others 13 (4.5%). The findings were not mutually exclusive. The diagnostic yield was 69.2%. The overall polyp detection rate was 17.3%. Of the 50 patients with polyps, 33 (66.0%) were males ($p = 0.481$). The adenoma detection rate was 4.8%.

Conclusion: The authors conclude that their observed polyp detection rate is consistent with the estimated rates for Africa. Rectal bleeding and adenomatous polyps were the commonest presentation and histopathologic finding, respectively.

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1. Introduction

Worldwide, colorectal cancer (CRC) is the third leading cause of cancer death [1]. It is the third most common cancer in the United States, and African-Americans have the highest incidence rate of CRC among the different races [1]. Previous reports suggest a low incidence of CRC in Africa but recent evidence from most sub-Saharan African countries has shown a sharp rise in the incidence of CRC [2, 3]. Plausible reasons for this rise include the adoption of westernized diet, greater awareness of CRC, improved diagnostic services and better-functioning cancer registries. A polyp is defined as any mass protruding into the lumen of a hollow viscus [4]. Colorectal polyps may be classified by their macroscopic appearance as sessile (flat, arising directly from the mucosal layer) or pedunculated (extending from the mucosa through a fibrovascular stalk) [4]. Colorectal polyps may also be histologically classified as neoplastic or as non-neoplastic (hyperplastic, hamartomatous, or inflammatory). Neoplastic (adenomatous) colorectal polyps are benign tumors that originate from the mucus-secreting colonic epithelial cells [4]. The significance of colorectal polyps, especially the adenomatous polyps, comes from the fact that they are generally accepted to be precursors to CRC. Colon carcinogenesis takes several years through a multistep pathway that includes initial hyperproliferation of normal epithelial cells to formation of adenomas and finally the transition to invasive carcinomas [5]. It is well-known that colonoscopy is considered the gold standard for the detection and prevention of CRC [6]. Among the various diagnostic tools available, colonoscopy enables clinicians to simultaneously screen and prevent CRC by removing cancer predisposing polyps such as adenomatous polyps and serrated polyps, leading to reduction in the incidence and mortality from CRC observed in patients with previous polypectomy [4]. Interruption of adenoma-carcinoma sequence with colonoscopy and polypectomy reduces the incidence of CRC by as much as 90% [7].

The reported prevalence of colonic polyps varies widely between different geographical areas. It was estimated that 30% of the Western population have colonic polyps, whereas lower rates (10–15%) were noted in Africa [8, 9]. Recent studies in Nigeria and other sub-Saharan African countries have reported different prevalence rates of colonic polyps that appear to suggest that their occurrence in these countries may not be rare as previously noted [10–17]. Results from previous studies have also shown that colonic polyps are more common in men than in women and increase in frequency with increasing age in most of these studies.

Although reports are scanty from sub-Saharan Africa in general, recent studies note rising incidence of CRC and prevalence rates of colonic polyps among Africans. In Nigeria, most of the available scanty reports are from the southern region, reports are rare from the northern region. Accruing data about the prevalence of colonic polyps may help direct public health policies and resource allocation for prevention of CRC. This study, therefore, aimed to determine the prevalence, distribution and histopathological characteristic of colonic polyps among Nigerians who underwent colonoscopy at a tertiary health facility in North-central Nigeria.

2. Materials and Methods

Study design: This was a hospital-based retrospective study.

Study methods: A retrospective analysis of prospectively collected data was performed using clinical information from the endoscopy logs and pathology database system of University of Ilorin Teaching Hospital, Ilorin, Nigeria. All consecutive patients who had polyps diagnosed at colonoscopy over a 4 year and half year period (March 2013–September 2017) were included. The study cohort comprised patients who were referred from the Medical, Surgical, and General Out-patient Clinics of the hospital, surrounding secondary and private health facilities in the state as well as patients referred from neighboring states. Patients who had incomplete procedure due to any cause were excluded from the cohort. The research was approved by the Ethics and Research Committee of the University of Ilorin Teaching Hospital. Informed consent was obtained from all patients prior to the procedure. Analgesia was provided to all the patients by giving intravenous tramadol 100mg and conscious sedation was given when required by using intravenous midazolam (mean dose 2.5 mg). The colonoscopies were performed using an Olympus CF-180 Evis Exera II colonoscope. All polyps identified during colonoscopy were either biopsied or removed endoscopically and submitted for histopathology. The location of the polyp(s) was defined as recto-sigmoid (rectum and sigmoid colon) and proximal colon (from caecum to descending colon) on the assumption that sigmoidoscopy usually does not reach beyond the sigmoid-descending colon junction [18]. The number of polyps – whether the polyps were single or multiple – was noted; the gross appearance of the polyp was classified as either sessile or pedunculated.

Definition of terms: Polyp detection rate (PDR) was defined as the number of colonoscopies in which one or more polyps were detected, biopsied, and sent for histology, divided by the total number of colonoscopies that was carried out. Adenoma detection

rate (ADR) as defined as the number of polyps that were histologically diagnosed as adenomatous taken as a proportion of the total number of colonoscopies.

3. Statistical Analysis

Data analyzed include patients' biodata, indications for colonoscopy, colonoscopic findings, presence of polyps, histopathological characteristics of the polyps as well as the PDR and ADR. Patients were stratified by age into two groups (Age ≤ 50 and > 50 years). Categorical variables were expressed as numbers and percentages. Chi-square or Fisher's exact test, where appropriate, was used for the analysis of categorical variables. Continuous variables were expressed as means and standard deviation or medians, as appropriate. All analyses were performed using SPSS version 17.0 (SPSS INC, Chicago, IL, USA). A two-tailed $P < 0.05$ was considered as statistically significant.

4. Results

Over the study period, 289 patients met the inclusion criteria for the study. There were 178 males (61.6%); giving a male to female ratio of 1.6:1. Their ages ranged from 14 to 90 years (mean = 57.3 years) with the highest frequency of 69 (23.9%) observed in the 61–70 years age group (Table 1). There was no statistically significant difference in the ages of both sexes. Only 50 patients had colonic polyps. The overall PDR in the study group was 17.3%. Thirty-seven (74.0%) patients were above 50 years ($p = 0.16$). There were 33 (66.0%) males and 17 (34.0%) females with colonic polyps in the study population ($p = 0.481$). Eight (16.0%) of the patients with colonic polyps had co-existing colorectal mass at colonoscopy ($p = 0.638$). Twenty-seven (54.0%) patients were referred as a result of hematochezia, 7 (14.0%) for suspicion of CRC, 4 (8.0%) for abdominal pain, and 3 (6.0%) for routine screening. Other referral diagnosis included chronic diarrhea, constipation, and change in bowel habit. There was no statistical difference in the referral diagnoses of patients ($p = 0.588$).

Twenty-three patients (46.0%) had polyps located proximal to the sigmoid colon, whereas 22 (44.0%) had polyps located at the recto-sigmoid region of the colon. Five (10.0%) patients had multiple polyps involving both segments. Twelve (24.0%) patients had pedunculated morphology, 36 (72.0%) had sessile morphology, whereas 2 (4.0%) had a combination of the two morphologies. The endoscopic images of two of the morphologic types found among the study cohort are shown in Figures 1(a) and (b). More than half of the polyps located in the recto-sigmoid region of the colon

TABLE 1: Age and gender distribution of the patients.

Variable	Frequency	Percent
Sex		
Male	178	61.6
Female	111	38.4
Ratio (Male:Female)	1.6:1	
Age group (years)		
≤ 20	1	0.4
21-30	15	5.2
31-40	27	9.3
41-50	57	19.7
51-60	67	23.2
61-70	69	23.9
71-80	37	12.8
81-90	16	5.5
Total	289	100.0

(63.6%) were found in the rectum. Twenty seven polyps were located proximal to the sigmoid colon in patients above 50 years compared to 5 polyps in those aged 50 years or younger ($p = 0.099$). The histopathology results of 39 patients were available for analysis, whereas other results were missing. Fourteen (35.9%) of these had adenomatous polyps; 12 (30.8%) patients each had inflammatory polyps and hyperplastic polyps; 1 (2.6%) had malignant polyp. The ADR for our cohort was 4.8. Of the patients with adenomatous polyps, two patients had Familial adenomatous polyposis (FAP) as they had more than 100 adenomatous polyps though genetic study was not conducted (see Figure 1(c)). Their ages were 45 and 49 years. Both patients had co-existing colonic cancer; one had surgery followed by chemotherapy, whereas the other was lost to follow-up. Seven (58.3%) of the remaining 12 patients with adenomatous polyps had tubular adenomas, 4 patients (33.3%) had tubulovillous adenoma, and 1 (8.4%) patient had Peutz-Jegher's polyp with adenomatous change (see Figures 2(a) and (b)).

5. Discussion

The prevalence of colorectal polyps varies widely among different populations. Colorectal polyps are believed to be rare among black Africans [19]. Recent data from Nigeria and other sub-Saharan African countries suggest that they may not be as rare as previously reported though the prevalence rates are still relatively low when compared to the rates reported among Caucasians and Asians [10-17]. Over a period

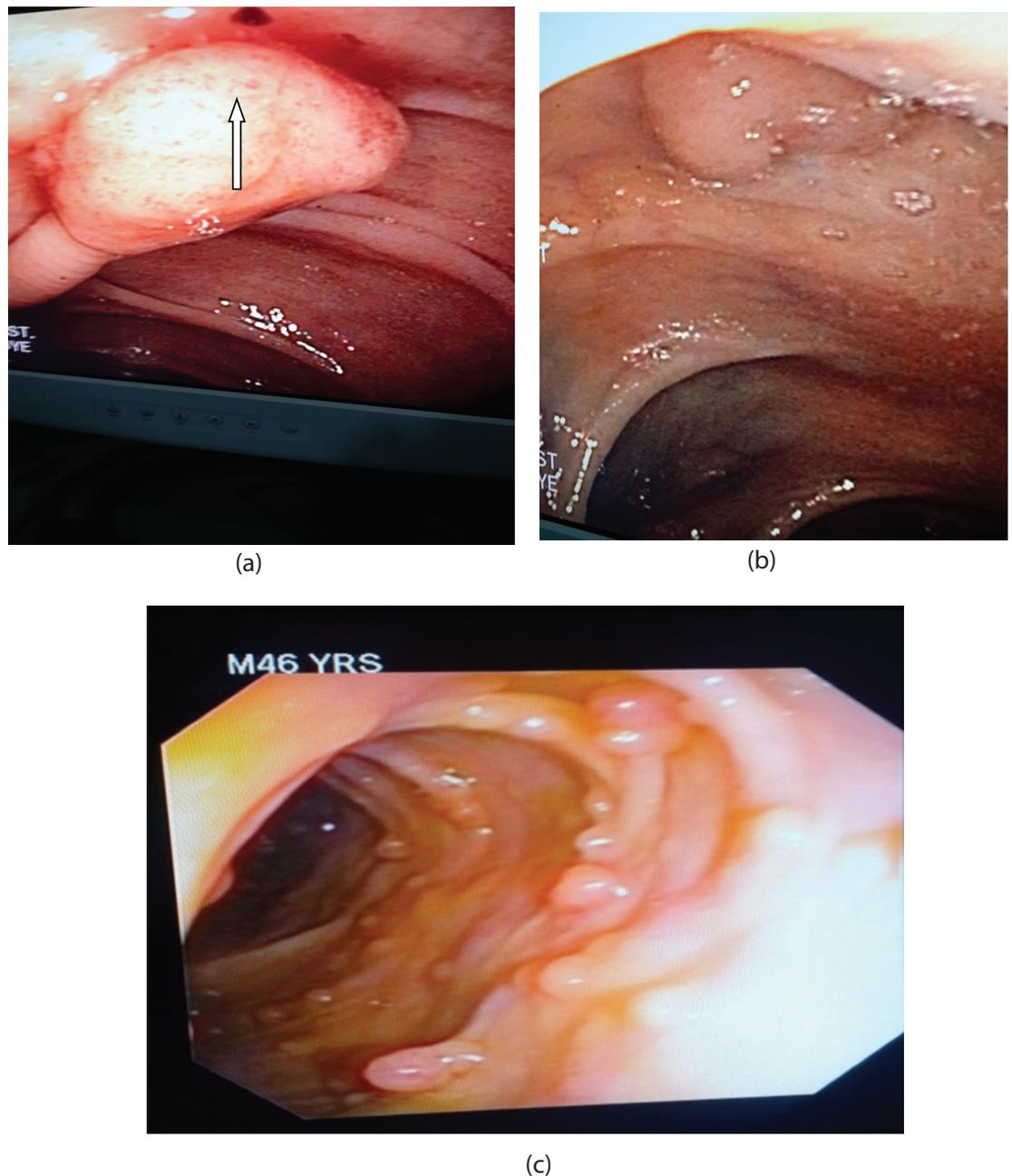


Figure 1: (a): A pedunculated polyp with its stalk. (b): A sessile polyp with a broad base. (c): Familial Adenomatous Polyposis with hundreds of polyps.

of 4 years, a total of 50 of the 289 patients who underwent colonoscopy in our center had colorectal polyps giving a prevalence rate of 17.3%. This PDR of 17.3% is similar to the 15.5% earlier obtained by Olokoba et al. in a hospital-based cross-sectional study of the indications and findings at colonoscopy carried out at the Endoscopy unit of Crescent hospital, a privately owned specialist hospital in Ilorin, from January 2010 to May, 2012 [14]. It is, however, higher than the PDR of 10.2% obtained in Jos, Plateau State, which is also located in the North Central region of Nigeria [15]. The observed

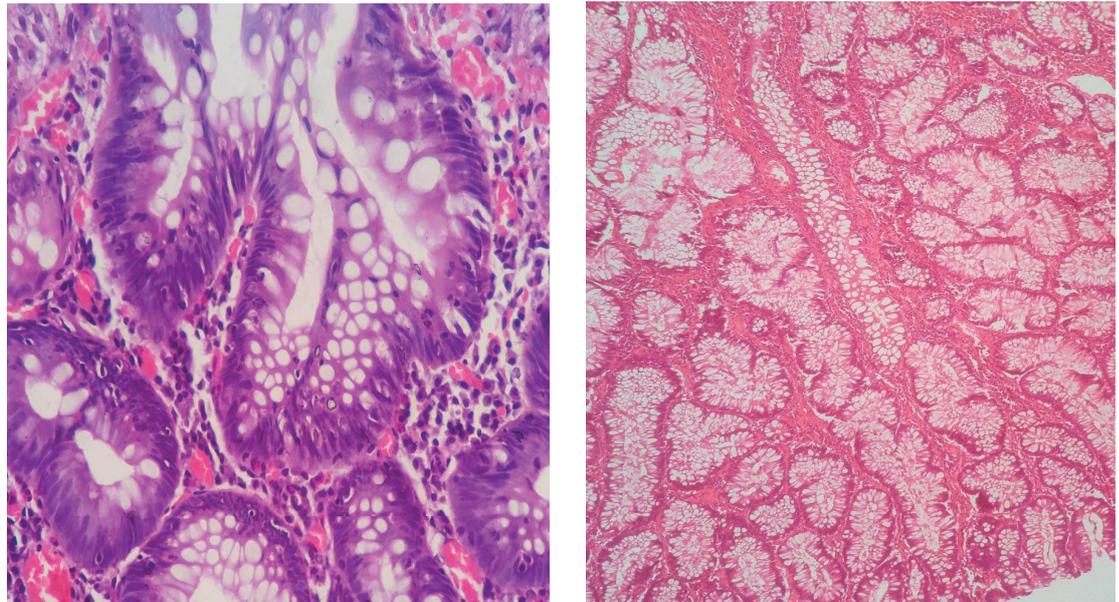


Figure 2: (a): Photomicrograph of tubulovillous adenoma polyp. (b): Photomicrograph of Peutz-Jegher.

difference may be due to the fact that on average the patients in the Jos study were more than a decade younger than the participants in our study and the smaller size of their study population. Our observed prevalence rate is similar to the rate of 16.2% obtained by Alatisie et al. in Ile-Ife, South Western, Nigeria [11]. In Ado-Ekiti, South-western region of Nigeria, the prevalence of polyps was 14.7% among patients with lower GI bleeding. The differences in the patient selection, geographical location, and sample size (289 versus 68) may account for the difference in the observed prevalence rate [12]. Oluyemi et al. and Onyekwere et al. in Lagos, South-western Nigeria obtained PDR of 11.2% and 6.8%, respectively [10, 13]. A PDR of 1.0% was obtained by Obonna et al. in Ondo, South-western Nigeria [16]. It is, however, lower than the rate of 20.8% obtained in Saudi Arabia [20]. The PDR in East Azerbaijan, Iran, was 14.4% [21]. An overall PDR of 23.5% and 42.0% was observed in two other studies from Iran [22, 23]. These prevalence rates from Africa and the Middle East are much lower than the rates reported in Europe and the United States. Some of the reported PDR from the latter include 35.5%, 45.8%, and 49.0% from France, Spain, and the United States, respectively [24–26]. Our ADR of 4.8% is the same as that obtained in Lagos, lower than the 6.8% obtained in Ile-Ife but higher than 2.9% obtained in Ghana [10, 11, 17]. These ADRs from African countries are, however, much lower than the 17.7%, 19.4%, and 31.0% obtained in France, Germany, and the United States, respectively [24, 26, 27]. Several factors have been identified to influence PDR and ADR. These include personal or family history of polyps and/or CRC, the use of split-dose bowel preparation, documentation of withdrawal time, and overall procedure time, patients’

gender and age (over 50), alcohol and cigarette-smoking history, issuance of annual performance report cards especially among physicians with low ADR < 25%, the level of Endoscopist's experience and expertise, differences in exclusion criteria, the quality of the endoscopic devices, and the time of the day that the procedure was done [28–34]. This study also showed that close to half of the polyps (46.0%) were found proximal to the sigmoid colon. The implication of this is that perhaps almost 50% of the polyps may be missed if flexible sigmoidoscopy is used to evaluate patients in our environment. This is more than the 33.3%, 22.2%, and 38.0% that was reported in Ile-Ife, Lagos, and the United States [10, 11, 35]. Colonoscopy rather than sigmoidoscopy may thus be a preferred screening tool in our environment. In this study, we found more polyps in patients older than 50 years compared to those aged 50 years or younger but the difference was not statistically significant. In addition, more right-sided polyps were recorded in the patients above 50 years of age. This study did not find any association between age and the location of polyps that is similar to the finding in Ile-Ife but contrast with a previous study that showed that incidence of right sided polyps increased with increasing age [11, 36]. In concordance with previous studies, we found that more males had polyps than females. Though the reasons for low polyp rate in women are not known, factors such as the protective role of oestrogen, decreased secondary bile acid production, and decreased serum levels of insulin-like growth factors in women have been suggested as plausible reasons [37–40]. We did not find any statistical relationship between sex and location of the polyps. The commonest indication for colonoscopy among the patients with polyps was hematochezia, a similar finding to previous studies [10, 11, 41]. It, however, contrasts with the finding of abdominal pain as the commonest presentation in Iran [21].

A limitation of this study is that some of the data on histology of colonic polyps were missing thus the ADR may be higher than the 4.8 recorded in this study. In conclusion, we found that the PDR of 17.3% from our facility is consistent with the estimated polyp prevalence of 10.0–15.0% in Africa. Near half of the polyps were located proximal to the sigmoid colon with the implication that these would have been missed if flexible sigmoidoscopy alone was employed in evaluating our patients. Males and older ages may benefit more from colonoscopy in our population.

Conflict of Interest

The authors declare no conflict of interest.

Authors' Contribution

- Study concept and design: Dr. M. O. Bojuwoye
- Collection of data: Dr. M. O. Bojuwoye, Dr. A. A. Adeyeye, Dr. O. O. K. Ibrahim, Dr. K. C. Okonkwo, Dr. A. M. Aliyu
- Analysis and interpretation of data: Dr. M. O. Bojuwoye, Dr. S. O. Agodirin, Dr. J. A. Ogunmodede, Dr. A. B. Olokoba and Dr. O. A. Ogunlaja
- Draft and revision: Dr. M. O. Bojuwoye, Dr. A. B. Olokoba, Dr. O. A. Ogunlaja, Dr. S. O. Agodirin, Dr. O. O. K. Ibrahim.
- Final approval of manuscript by all the authors.

References

- [1] Siegel, R. L., Miller, K. D., and Jemal, A. (2017). Cancer statistics. *CA: A Cancer Journal for Clinicians*, vol. 67, pp. 7–30.
- [2] Irabor, D. O., Arowolo, A., and Afolabi, A. A. (2010). Colon and rectal cancer in Ibadan, Nigeria: An update. *Colorectal Disease*, vol. 12, pp. 43–49.
- [3] Adesanya, A. A. and da Rocha-Afodu, J. T. (2000). Colorectal cancer in Lagos: A critical review of 100 cases. *The Nigerian Postgraduate Medical Journal*, vol. 7, pp. 129–136.
- [4] Shussman, N. and Wexner, S. D. (2014). Colorectal polyps and polyposis syndromes. *Gastroenterology Report*, vol. 2, no. 1, pp. 1–15.
- [5] Kinzler, K. W. and Vogelstein, B. (1996). Lessons from hereditary colorectal cancer. *Cell*, vol. 87, no. 2, pp. 159–170.
- [6] Zippi, M., Hong, W., Crispino, P., et al. (2017). New device to implement the adenoma detection rate. *World Journal of Clinical Cases*, vol. 5, no. 7, pp. 258–263. Epub 2017/08/12.
- [7] Winawer, S. J., Zauber, A. G., O'Brien, M. J., et al. (1993). Randomized comparison of surveillance intervals after colonoscopic removal of newly diagnosed adenomatous polyps. The national polyp study workgroup. *The New England Journal of Medicine*, vol. 328, pp. 901–906.
- [8] Segal, I. (1998). Rarity of colorectal adenomas in the African black population. *European Journal of Cancer Prevention*, vol. 7, pp. 387–391.
- [9] Segal, I., Cooke, S. A., Hamilton, D. G., et al. (1981). Polyps and colorectal cancer in South African Blacks. *Gut*, vol. 22, pp. 653–657.

- [10] Oluyemi, A., Awolola, N., and Oyedeji, O. (2016). Clinicopathologic review of polyps biopsied at colonoscopy in Lagos, Nigeria. *Pan African Medical Journal (PAMJ)*, vol. 24, p. 333.
- [11] Alatise, O. I., Arigbabu, A. O., Agbakwuru, A. E., et al. (2014). Polyp prevalence at colonoscopy among Nigerians: A prospective observational study. *Nigerian Journal of Clinical Practice On Web*, vol. 17, no. 6, pp. 756–762.
- [12] Ajayi, A. O., Ajayi, E. A., Solomon, O. A., et al. (2014). Lower gastrointestinal bleeding: spectrum of colonoscopy findings from Ado-Ekiti, Nigeria. *International Journal of Medical Sciences*, vol. 6, no. 5, pp. 128–133.
- [13] Onyekwere, C. A., Odiagah, J. N., Ogunleye, O. O., et al. (2013). Colonoscopy practice in Lagos, Nigeria: A report of an audit. *Diagnostic and Therapeutic Endoscopy*. Epub 798651.
- [14] Olokoba, A. B., Obateru, O. A., Bojuwoye, M. O., et al. (2013). Indications and findings at colonoscopy in Ilorin, Nigeria. *Nigerian Medical Journal*, vol. 54, no. 2, pp. 111–114.
- [15] Ismaila, B. O. and Misauno, M. A. (2013). Gastrointestinal endoscopy in Nigeria – A prospective two year audit. *Pan African Medical Journal (PAMJ)*, vol. 14, pp. 22.
- [16] Barret, M., Boustiere, C., Canard, J. M., et al. (2013). Factors associated with adenoma detection rate and diagnosis of polyps and colorectal cancer during colonoscopy in France: Results of a prospective, nationwide survey, M. Katoh (ed.). *PLOS ONE*, vol. 8, no. 7. Epub e68947.
- [17] Dakubo, J., Kumoji, R., Naaeder, S., et al. (2008). Endoscopic evaluation of the colorectum in patients presenting with haematochezia at Korle-bu teaching hospital Accra. *Ghana Medical Journal*, vol. 42, pp. 33–37.
- [18] Painter, J., Saunders, D. B., Bell, G. D., et al. (1999). Depth of insertion at flexible sigmoidoscopy: Implications for colorectal cancer screening and instrument design. *Endoscopy*, vol. 31, pp. 227–231.
- [19] Irabor, D. O. (2011). Colorectal carcinoma: Why is there a lower incidence in Nigerians when compared to caucasians? *Journal of Cancer Epidemiology*, vol. 5.
- [20] Almadi, M. A., Alharbi, O., Azzam, N., et al. (2014). Prevalence and characteristics of colonic polyps and adenomas in 2654 colonoscopies in Saudi Arabia. *Saudi Journal of Gastroenterology*, vol. 20, no. 3, pp. 154–161.
- [21] Bafandeh, Y. and Yazdanpanah, F. (2017). Distribution pattern of colorectal diseases based on 2300 total colonoscopies. *Gastroenterology and Hepatology from Bed to Bench*, vol. 10, no. 2, pp. 90–96.

- [22] Asadzadeh, A. H., Nazemalhosseini, M. E., Ashtari, S., et al. (2017). Polyp detection rate and pathological features in patients undergoing a comprehensive colonoscopy screening. *World Journal of Gastrointestinal Pathophysiology*, vol. 8, no. 1, pp. 3–10.
- [23] Delavari, A. R., Mardan, F., Salimzadeh, H., et al. (2014). Characteristics of colorectal polyps and cancer: A Retrospective review of colonoscopy data in Iran. *Middle East Journal of Digestive Diseases*, vol. 6, pp. 144–150.
- [24] Barret, M., Boustiere, C., Canard, J., et al. (2013). Factors associated with adenoma detection rate and diagnosis of polyps and colorectal cancer during colonoscopy in France: Results of a prospective, nationwide survey. *PLoS ONE*, vol. 8, no. 7, e68947.
- [25] Lucendo, A. J., Guagnozzi, D., Angueira, T., et al. (2013). The relationship between proximal and distal colonic adenomas: Is screening sigmoidoscopy enough in the presence of a changing epidemiology? *European Journal of Gastroenterology & Hepatology*, vol. 25, pp. 973–980.
- [26] Boroff, E. S., Gurudu, S. R., Hentz, J. G., et al. (2013). Polyp and adenoma detection rates in the proximal and distal colon. *The American Journal of Gastroenterology*, vol. 108, pp. 993–999.
- [27] Pox, C. P., Altenhofen, L., Brenner, H., et al. (2012). Efficacy of a nationwide screening colonoscopy program for colorectal cancer. *Gastroenterol*, vol. 142, no. 7, pp. 1460–1467.
- [28] Sanaka, M. R., Rai, T., Navaneethan, U., et al. (2016). Adenoma detection rate in high-risk patients differs from that in average-risk patients. *Gastrointestinal Endoscopy*, vol. 83, no. 1, pp. 172–178. Epub 2015/05/31.
- [29] Radaelli, F., Paggi, S., Hassan, C., et al. (2017). Split-dose preparation for colonoscopy increases adenoma detection rate: A randomised controlled trial in an organised screening programme. *Gut*, vol. 66, no. 2, pp. 270–277. Epub 2015/12/15.
- [30] Ricci, E., Hassan, C., Petruzzello, L., et al. (2013). Inter-centre variability of the adenoma detection rate: A prospective, multicentre study. *Digestive and Liver Disease*, vol. 45, no. 12, pp. 1022–1027. Epub 2013/07/03.
- [31] Sey, M. S. L., Liu, A., Asfaha, S., et al. (2017). Performance report cards increase adenoma detection rate. *Endoscopy International Open*, vol. 5, no. 7, pp. E675–E682. Epub 2017/07/12.
- [32] Mehrotra, A., Morris, M., Gourevitch, R. A., et al. (2017). Physician characteristics associated with higher adenoma detection rate. *Gastrointestinal Endoscopy*. Epub 2017/09/04.

- [33] Marcondes, F. O., Dean, K. M., Schoen, R. E., et al. (2015). The impact of exclusion criteria on a physician's adenoma detection rate. *Gastrointestinal Endoscopy*, vol. 82, no. 4, pp. 668–675. Epub 2015/09/20.
- [34] Sanaka, M. R., Deepinder, F., Thota, P. N., et al. (2009). Adenomas are detected more often in morning than in afternoon colonoscopy. *The American Journal of Gastroenterology*, vol. 104, pp. 1659–1664.
- [35] Mehran, A., Jaffe, P., Efron, J., et al. (2003). Screening colonoscopy in the asymptomatic 50-to 59-year-old population. *Surgical Endoscopy*, vol. 17, pp. 1974–1977.
- [36] Okamoto, M., Shiratori, Y., Yamaji, Y., et al. (2002). Relationship between age and site of colorectal cancer based on colonoscopy findings. *Gastrointestinal Endoscopy*, vol. 55, pp. 548–551.
- [37] Issa, J. P., Ottaviano, Y. L., Celano, P., et al. (1994). Methylation of the oestrogen receptor CpG island links ageing and neoplasia in human colon. *Nature Genetics*, vol. 7, pp. 536–540.
- [38] McCashland, T. M., Brand, R., Lyden, E., et al. (2001). CORI Research Project. Gender differences in colorectal polyps and tumors. *The American Journal of Gastroenterology*, vol. 96, pp. 882–886.
- [39] Everson, G. T., McKinley, C., and Kern, F. J. (1991). Mechanisms of gallstone formation in women. Effects of exogenous estrogen (Premarin) and dietary cholesterol on hepatic lipid metabolism. *Journal of Clinical Investigation*, vol. 87, pp. 237–246.
- [40] Foley, E. F., Jazaeri, A. A., Shupnik, M. A., et al. (2000). Selective loss of estrogen receptor beta in malignant human colon. *Cancer Research*, vol. 60, pp. 245–248.
- [41] Nouraie, M., Hosseinkhah, F., Zamanifekri, B., et al. (2010). Clinicopathological features colon polyps from African-Americans. *Digestive Diseases and Sciences*, vol. 55, no. 5, pp. 1442–1449.