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Paper-Based versus Mobile Apps for Colorectal Cancer Screening in COVID-19 Pandemic Setting

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ABSTRACT

***Background**: The incidence of colorectal cancer (CRC) in Asia has kept increasing in the last decade. The morbidity and mortality for CRC can be reduced with early detection; however, mass CRC screening with imaging modalities such as colonoscopy, CT scan, or MRI is unfeasible in developing countries such as Indonesia. Asia Pacific Colorectal Screening (APCS) is utilized to stratify individual CRC risk. Online screening via mobile application is an alternative method to ensure the continuity of community screening without risking COVID-19 transmission. **Objective**: We conducted a descriptive study to evaluate CRC risk using APCS in two different villages. **Methods**: This is a cross-sectional study involving 925 and 207 subjects in 2019 and 2020, respectively. The APCS survey in 2019 was done before COVID-19 pandemic with paper-based questionnaires and direct assessment by door-to-door approach. Meanwhile, the APCS survey in 2020 was done during COVID-19 pandemic using website and mobile apps available for Android and iOS. We gathered participants' characteristics and the APCS score in both groups and tabulated them. **Results**: In 2019, out of 925 subjects; 472 (51%) have been classified in average risk of CRC, 370 (40%) have been classified in moderate risk of CRC, and 83 (9%) have been classified in high risk of CRC. In 2020, out of 207 subjects; 106 (51.2%) have been classified in average risk of CRC, 86 (41.5%) have been classified in moderate risk of CRC, and 15 (7.3%) have been classified in high risk of CRC. **Conclusion**: Although there was a decrease in the participation of the screening program with mobile application in the pandemic era compared with paper-based questionnaires before the pandemic era, online screening using APCS in mobile applications is a preferred alternative for an effective screening method in this pandemic and possibly in the future in Indonesia.*

***Keyword**: APCS, colorectal cancer screening, COVID-19 pandemic, mobile apps, public health service.*

INTRODUCTION

Colorectal cancer (CRC) or colorectal adenocarcinoma arises from glandular epithelial cells of the large intestine due to mutation of genes that allows abnormal growth. This abnormally growing mass is usually benign at first but can evolve into a more malignant mass and thus becomes a carcinoma (Rawla, Sunkara and Barsouk, 2019). CRC is still one main concern because the incidence of CRC in the world keeps increasing, especially in many developing countries. CRC is one of the most diagnosed cancers and it is also the third deadliest cancer. In 2018, there were 1.8 million new cases of CRC which makes up 11% of all cancer cases in the world (Fitzmaurice et al, 2017) Although CRC is more commonly found in North America and Europe population, the incidence of CRC has markedly increased in

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Asia population in the past decade. The increasing incidence is influenced by the "western" way of life which involves red meat, alcohol, and tobacco consumption (Makassari, 2017; Kemenkes RI, 2018).

The successes in the prevention of CRC become the main factor to control CRC incidence as low as possible and prevent high rates of mortality. In developing countries, screening and early detection of CRC is always recommended not only for symptomatic patients, but for asymptomatic populations as well. However, mass screening is very limited in developing countries due to funding problems and financial situation of the general population (Arnold et al, 2017).

CRC can be screened earlier by various methods to allow identification of the disease. There are two commonly accepted methods for CRC screening: fecal occult blood test (FOBT) and visual examination. FOBT allows detection of hemoglobin or blood matters in feces as neoplasia tends to have frail vascular structure which results in minor hemorrhages. Meanwhile, visual examination via colonoscopy and flexible sigmoidoscopy allows direct observation on anatomical structure inside intestinal lumen (Rawla, Sunkara and Barsouk, 2019).

Asia Pacific Colorectal Screening (APCS) is an instrument to identify risk of colorectal neoplasia based on four criteria: age, gender, history of colorectal malignancy in family, and history of smoking. This instrument is made for the Asia region which specifically targets areas limited in both resources and funding to CRC screening. This instrument may help physicians to determine individuals to be prioritized to get CRC screening in asymptomatic populations. Some studies have already proven the association between APCS scoring result and CRC screening result (FOBT and colonoscopy method).

Although APCS is easily understandable and practiced, there is no published record of the use of APCS in Indonesia. We aimed to record and inform the use of APCS by conducting the mass screening of colorectal cancer risk in rural areas of Yogyakarta in Indonesia.

METHODS

This research was a cross-sectional study. The data were collected from screening and education events in the October to December 2019 (before COVID-19 pandemic) and other screening events from August to December 2020 (during COVID-19 pandemic).

Data collection in 2019 was carried out before the COVID-19 pandemic by paper-based questionnaires and a door-to-door direct assessment. We implemented a direct method by visiting the designated villages and giving education about CRC, as well as instructions about CRC screening using APCS paper-based translated to Bahasa Indonesia **(Figure 1)**. A local health promoter was trained by the research team to assist us in a door-to-door approach for recruiting more participants to fill the survey form.

The program in 2020 was carried out during the COVID-19 pandemic so that the data collection was taken using the websites and mobile applications available on Android and iOS. We created a mobile app, "3D Kanker Kolorektal," which provides education on CRC and self-screening with APCS questionnaire. The link for this Android (https://play.google.com/store/apps/details?id=com.deteksi.kolorektal.apps) and iOS (https://apps.apple.com/id/app/deteksi-dini-kanker-kolorektal/id1570965326) application **(Figure 2)** was distributed to various chat groups and the local health promoter to further encourage people to use the application, also a website to supplement the education material from : https://webkolo.klinikbedahdigestif.com. All of the survey forms, educational material, as well as our social media can be accessed through https://linktree.com/tumorususindonesia **(Figure 3)**. The participants of this study were randomly selected by public health promoters.

We gathered additional information outside the APCS questionnaire on subjects' characteristics comprising of highest education level achieved, body weight and height, as well as history of illness and other comorbidities. Since this was a descriptive study, we collected all the data and tabulated them into Microsoft Excel sheets. There was no statistical analysis done for this study.

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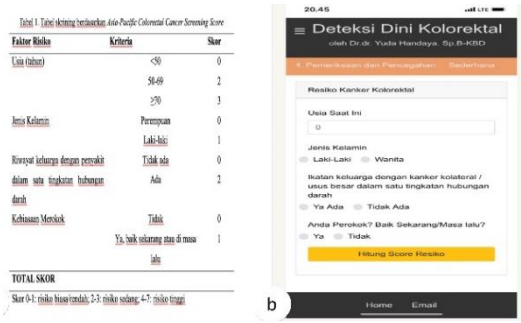

Figure 1. APCS translated to Bahasa Indonesia: (A) paper-based. (B) application-based.

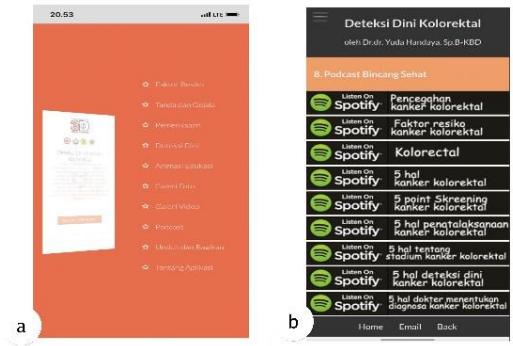

Figure 2. Mobile application feature (A) main menu (B) podcast menu directed to Spotify

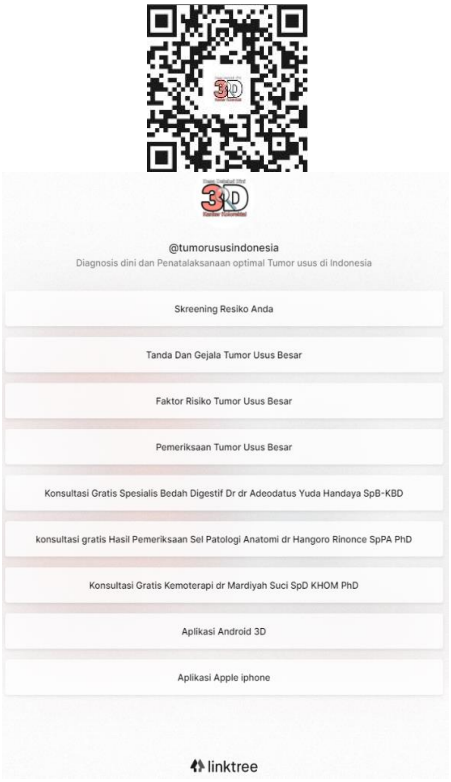

Figure 3. Scannable QR barcode that will direct user to our Linktree to ease access to our content and sources of information

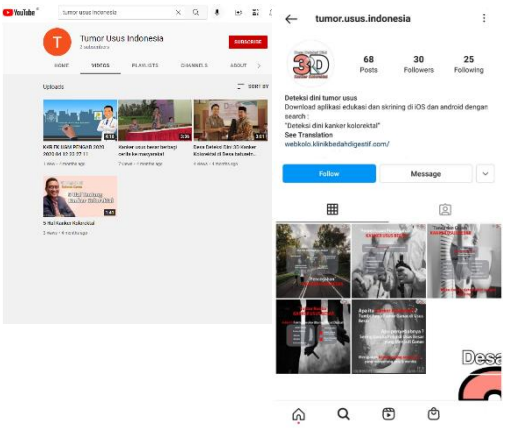

Figure 4. Online source of information using social media platforms such as YouTube and Instagram.

RESULTS AND DISCUSSION

We collected the data from 925 subjects in Baturetno village for the program in 2019 and 207 subjects in Bangunjiwo village for the program in 2020. We tabulated them and the details can be found below.

There was a great disparity in the number of recipients between the two periods of the program. The first year of our survey, we successfully gathered 925 subjects while, in the second year, we only gathered 207 subjects **(Figure 3).** Moreover, in 2019, we gathered an adequate number of subjects for each age group: 539 subjects were <50 years old, 354 subjects were between 50-69 years old, and 30 subjects were 70 years old and above. Meanwhile, in 2020, we gathered fewer number of subjects to represent each age group: 185 subjects were <50 years old, 22 subjects were between 50-69 years old and none of the subjects was 70 years old and above.

In 2019, the number of female subjects was higher than male subjects which was 694 and 231, respectively. However, in 2020, the number of female subjects was fewer than the number of female subjects, which were 72 and 135, respectively.

Most of the participants in both surveys had a tertiary level of education. The participants in 2019 generally had a lower average of education level with 33.4% participants in primary and secondary level of education and 17.4% having university level of education. On the other hand, participants in 2020 had a higher average of education level with 8.7% in primary and secondary level of

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education and 38.6% having university level of education.

Table 1. Baseline characteristics.

		2019	2020
Subjects (n)		925	207
Age group	<50	539 (58.3%)	185 (89.4%)
	50-70	354 (-)	22 (10.6%)
	>70	30 (3.2%)	0 (0%)
Sex	Male	231 (25.0%)	135 (65.2%)
	Female	694 (75.0%)	72 (34.8%)
Highest level of education achieved	Primary	188 (20.3%)	4 (1.9 %)
	Secondary	121 (13.1%)	14 (6.8%)
	Tertiary	422 (45.6%)	109 (52.7%)
	University	161 (17.4%)	80 (38.6%)
Family history of malignancy	Present	39 (4.2%)	9 (4.3%)
	Absent	886 (95.8%)	198 (95.7%)
Smoking	Yes	164 (17.7%)	73 (35.3%)
	No	761 (82.3%)	134 (64.7%)

In 2019, out of 925 subjects that we analyzed, 472 subjects (51%) were classified in average risk of CRC, 370 subjects (40%) in moderate risk, and 83 subjects (9%) in high risk. In 2020, out of 207 subjects that we analyzed, 106 subjects (51.2%) were classified in average risk of CRC, 86 (41.5%) subjects in moderate risk, and 15 subjects (7.3%) in high risk.

Table 2. The distribution of CRC risk derived from screening programs using APCS in 2019 and 2020.

		2019	2020
APCS CRC Risk	Low	472 (51.0%)	106 (51.2 %)
	Moderate	370 (40.0%)	86 (41.5%)
	High	83 (9.0%)	15 (7.3%)

Figure 5. (A) 2019 education with villager and local health promoter. (B) 2020 only attended with local health promoter

Many factors contribute to a person's risk of developing colorectal cancer. Genetics play an important role in the occurrence of colorectal cancer. Any incidence of colorectal cancer in the family means a higher risk to develop colorectal cancer. People with age 50 or above are at a significantly higher risk of developing colorectal cancer. However, it is still possible for younger people to also get colorectal cancer. The incidence of colorectal cancer may increase in the future because of a newly adopted lifestyle such as smoking, excessive consumption of red meat and processed meat, excessive alcohol consumption, and low fiber consumption. A history of gastrointestinal diseases such as polyps and intestinal inflammation is also a risk factor for colorectal cancer (Rawla, Sunkara and Barsouk, 2019).Therefore, APCS covers one of the few factors mostly associated with colorectal cancer which are age, family history, and smoking history. (Quach et al, 2018; Jiang et al, 2020) By using APCS, we can prioritize individuals with moderate and high risk to get examined as early as possible in hospitals. Individuals with moderate and high risk are eligible for further examination with simple tests such as fecal occult blood test and followed by CT scan or colonoscopy if the result of FOBT is positive. (Jiang et al., 2020)

From the analysis, the number of subjects in the two periods of time differs greatly: 925 in 2019 and 207 in 2020. In 2019, the number of participants was higher because we had a local health promoter who helped us to approach more people directly. This allowed a wider reach to the population to do the APCS screening. Hence, we got several subjects from each age group. Meanwhile, we strongly believe that the significantly lower number of participants in 2020 was influenced by few gadget possessions such as mobile phones, tablets, and computers among the residents.

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The lack of supporting infrastructure makes people who live in rural areas less able to get maximum internet access. In 2019, APJJI launched an independent internet village program so the people in rural areas can access the internet via satellite technology (V-sat). Unfortunately, this program was stopped during the COVID-19 pandemic. Currently there are 12,500 of 82,000 villages in Indonesia that have not been connected to the internet (Buletin APJII, 2021).

Furthermore, the age factor is also a handicap in accessing online information. People aged over 50 years have a very low knowledges of the gadget (Kamal et al, 2021), thus we have very few subjects for the 50-69 years old group and none for the 70 years old and above group.

The difference in the age group may be related with the difference in the highest education level of the people. There were more elderly people participating in the 2019 event than in 2020 and coincidentally there were more people with lower education levels in 2019. We believed that, in such rural areas, many of the elderly have a low education level as compared to the younger ones. In 2019, the survey was done by gathering and approaching the participants individually; therefore, reaching a higher number of elderly participants. In general, low educated people may correlate with low-income level and this was depicted in our survey event in 2020. The correlation between low education and low-income level is also reported in a study done by Nawi Ng et al. which showed that people with low levels of education and socioeconomic status had higher odds of having a poorer quality of life and health. Older people with low educational and socioeconomic status (SES) had 3.4 times higher odds of being in the worst quality of life quintile as compared to people with high education and high SES (Nawi Ng et al., 2010). In 2020, the survey was done via smartphones and gadgets. These low-income people may not have the suitable gadget or smartphones to use the survey application that we created. Therefore, we can see a very low number of participants in 2020 especially in the elderly category and in primary or secondary education level category.

In 2019, the number of female subjects was very high compared to the male subjects. We believed that the disparity between the two genders was caused by the availability of women during the survey. Most women in rural areas are housewives and some of them work from home or close to their houses, while most men tend to work far from home; therefore, there were very few male subjects present at the time of the survey. However, in 2020, the percentage of male subjects was higher than female subjects compared to the previous year. We assumed that, in low financial families, more men possess the gadgets or smartphones to allow them to fill the questionnaire through the mobile apps. In Indonesia's 2020 population census, the population of male is larger than the population of female; however, in Daerah Istimewa Yogyakarta, the number of female was recorded more than the number of male population. The sex ratio at the age of 75 years and over which is 79 indicates that the number of elderly female population is greater than the number of male elderly population (Badan Pusat Statistik,2020). Furthermore, the unemployment rate in Indonesia has increased during COVID-19 pandemic. Central Statistics Agency (BPS) in November 2021 released the fact that the unemployment rate increased tremendously. The data show that there is an increase of 7.46% of unemployment rate in male population as compared to an increase of 6.46% in female population (Ramadani et al., 2022). The increasing male unemployment rate may be one of the factors causing a higher number of male subjects participating in the 2020 survey.

Despite the difference in number of subjects and other criteria, the trend for CRC risk classification was very similar between the 2019 and 2020 period. Although the number of participants did not represent the real proportion of the population, we can at least deduce that the CRC risk in the rural population roughly follows the percentages shown in the result section because the two surveys was done in two different places with two entirely different settings but showing very similar numbers.

From the two events in 2019 and 2020, we realize that online education and screening is not as effective as a live event that is delivered directly. Online-based education and screening discourages low-

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income people from participating due to lack of suitable gadgets and smartphones. Offline events attract more participants and allow them to inquire more information and clarify their confusions directly. On the other hand, online form of surveys and data collection will be much more effective in urban areas due to easier access to smartphone, computers, and stable internet connection as well. The online form of surveys can reach a greater population when done in the city (Nugraha and Susilastuti, 2021).

During the current pandemic situation, we have no permission to organize an offline event as the government has imposed a ban on non-urgent social gatherings and, therefore, an online measure is our only choice to continue the previous year's event.

Paper-based case reports are the most commonly used data collection in field-based research studies. In this approach, the data collected are recorded on paper before being turned into digital. (Ley et al., 2019) This method has several advantages over the automated methods, which is data collection is not limited to a certain place, it is easier to be produced, modified, and implemented. Moreover, the potential of data loss is less compared to the automated data collection (Ahmed et al, 2018). Despite its easy implementation, the paper-based data system has some risk of errors both during data collection and digitization. Alongside an increase in the development and use of computer technology, electronic data collection is increasingly being used for healthcare implementation and research. Electronic data collection has several advantages compared to paper-based collection, including enabling large volumes of data to be collected and stored securely and avoiding the need to carry and store bulky paperwork (Dickinson et al., 2019). Electronic data collection has become a well-accepted alternative compared to paper-based data collection (Ley et al., 2019). This method is effective for data collection during the pandemic due to the restriction of social mobility in which data collection cannot be performed from door-to-door.

Based on a big data review conducted by the Indonesian Central Statistics Agency on the impact of COVID-19, people have begun to reduce their activities to visit public places since the enactment of WFH policy on March 17, 2020. In fact, the mobility has decreased drastically after the official PSBB program was issued on April 10, 2020. The people's activity to retail commerce and recreational places was decreased up to 70%. Moreover, the using of public transportation also decreased by about 79% (BPS, 2020). If possible, a hybrid approach of both online platform and door-to-door approach is the optimal measure for next screening events during this pandemic.

The Asia-Pacific Colorectal Screening (APCS) scoring system has been shown to be highly effective for mass CRC screening purposes. A study in Vietnam has shown that APCS is useful in identifying CRC incidence in people with irritable bowel syndrome, allowing patient stratification for colonoscopy priority (Quach et al., 2018) Furthermore, a study in China proved that APCS is very effective in detecting colorectal neoplasia in outpatient and asymptomatic patients in China where it is not feasible to conduct colonoscopy screening for the whole population at risk (Jiang et al., 2020) However, the APCS scoring system has a major flaw. The screening points overlook many other significant risk factors for CRC such as diabetes, types of diet and exercise habits, alcohol consumption, etc. (He et al., 2019). Based on many studies, people aged 50-75 years old are considered the population with high risk of CRC and, therefore, require an annual screening more than just with APCS but with fecal immunochemical test (FIT). People with present family history of colorectal cancer should undergo the screening earlier, starting from 40 years old of age. In addition to APCS, many studies recommend annual or biannual testing of fecal occult blood test (FOBT) or FIT and, if possible, colonoscopy for a more accurate and effective CRC screening (Rex et al., 2017; Bnard et al., 2018).

CONCLUSION

Through our study, we can conclude that direct approach with paper-based surveys is a more effective way in conducting screening in rural areas. Despite the low participation rate, colorectal cancer screening by using APCS which is integrated in mobile apps, is still proven useful. Mobile apps and other forms

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of online screening may become a preferred alternative for a safe screening method in this pandemic and possibly in the future.

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