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Participation of Colorectal Cancer (CRC) Screening: A Systematic Review of the Association among Socio-Economic Inequalities, Physical Activities, Dietary Patterns and Familiar History of Cancer in Rural-Urban Areas

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Abstract:-Participation in Colorectal cancer (CRC) screening have linked to socio-economic inequalities, physical activities, dietary patterns, and familiar history of cancer. Especially, CRC screening was more likely to furious of rural-urban areas. The aims to identify and up to date in participation of CRC screening for an association between socio-economic inequalities, physical activities, dietary patterns and familiar history of cancer in rural-urban areas. Methods: This search was online to eligibility criteria comes from full-text of *GOOGLE SCOLAR, CROSSREF, Science Direct, Pub Med, and COCHRANE* base on risk factors studied in literature reviews concern that identified obstacle and facilitators between socio-economic inequalities, physical activities, dietary patterns and familiar history of cancers in rural-urban areas period of 1998 to 2018. Data extraction and quality assessment used two reviewers. The data analysis has conducted on the obtained, by using the STATA package systematically reviewed to forest plot, Odd Ratio (OR), 95% confidence interval (95%CI) and P-value. Results: The systematic reviews revealed that Socio-economic inequalities, Physical activity, Dietary patterns and Family history of cancer were significantly associated with the participation of CRC screening with random effect model score showing of OR: 1.69,(95%CI: 1.02 –2.99), OR: 1.68; (95 % CI: 1.01 – 3.74), and OR: 1.46; (95 % CI: 1.08 – 1.58) respectively. Our results also revealed a significant association of age, gender, marital status, occupation level, education level, household income, physical activity, and family history of cancer exposure associated with CRC screening with P-values less than 0.05. Conclusions: Obstacle and facilitators in participation in CRC screening have repeated reported. Understanding those risk factors are the first steps to possibly modify the specific risk factors to adherence in participating in CRC screening in rural-urban areas.

Keywords:- *Colorectal Cancer Screening, Socio-economic Risk, Lifestyle Risk Factors, Dietary Patterns in Rural and Urban.*

I. INTRODUCTION

The colorectal cancer (CRC) is the third most common cancer in men and the second in women worldwide, approximately 55% of cases arising in the more developed parts of the world [16]. Especially, CRC incidence is rarely seen in developing countries; on the other hand, high CRC incidence has been reported in developed countries in North America, United Kingdom, Australia, Korea and Japan. While CRC mortality and incidence rates in the United States are continuously decreasing, the CRC incidence rates in Asia are increasing, particularly Korea and Japan [17-21]. This can be explained by the change of Asian behaviors influenced by Western lifestyle acquisition e.g. preserved dietary consumption [24].

Moreover, CRC was the most in populations Asian than in non-Asian countries. Of this has been a rapidly arise from incidences rate of CRC in individual level and area-level for instance; socioeconomic inequalities in health may have an impact on stage distribution at presentation, public awareness in health such as smoking, obesity, lack of physical activity, dietary pattern and lifestyle by education programs increase [26-28]. In addition, the GLOBLOCAN reported incident rate and mortality rate of CRC was high level in male and have been vary in developing countries such as Thailand, The Philippine, Vietnam, Laos, Cambodia, Myanmar and Indonesia. Previous studies showed that socio- economic status (SES) of areas-individual level was varied by socio-economic inequalities in cancer relevant outcomes such as geography, age group, gender, marital status, household income, number person in household, occupation level, and facilities ownership [32]. Recently studies have shown that socio-economic inequalities in participation of CRC screening for provider and clients have been the most affects among opportunities, decrease modalities and stage of CRC, especially in rural-urban areas. [33-37]. In addition, it appears that mediation pathway affects modifiers which are closely related to cancer development and outcomes such as smoking status, alcohol consumption, body mass index (BMI), physical activities, underlying issue, family history of cancer,

dietary pattern and these can be reduced the accessibility to health care system which is a barrier to early detection of cancer.

Several studies to represent adherence CRC screening guideline was published much attention has shown that given to investigate factors associated with CRC screening participation test [38]. In 2009, lifestyle factors and colorectal cancer risk was published in systematically review of association with leisure-time physical activity [39].Moreover, publish systematically reviewing of CRC screening participants. In 2015, these begin on female, younger participants, low level of education, low household income, ethnic minorities and not having a marry were the most frequently reported barriers [40]. Nevertheless, to our knowledge no systematic reviews have been published up to date identifying the association to CRC screening with no limitations of rural-urban areas. Furthermore, no studies up to date have evaluated the risk factors associated among CRC screenings, Socio-economic risk and Lifestyle risk factors in rural-urban areas. Therefore, this study aims to identify and up to date systematic reviews on the daily activities for instance; Socio-economic inequalities, , Lifestyle risk factors, Dietary pattern, Physical activity and Family history of cancer which could early detect, early prevention to human life in terms of their association with increased participation of CRC screening in rural-urban areas [41, 42].

II. METHODOLOGY

Data were collects by using inclusion and exclusions criteria and data analyzes by using the PRISMA-P 2015 checklists. This study was database complex in participation of CRC screenings in rural-urban areas, which covered the period 1999 - 2018 based on project HE622216 were submitted and approved by the Khon Kean University Ethical review committee for research in Human and Social science (group2) base on the declaration of Helsinki and the ICH good clinic practice guidelines.

A. Search criteria

Using participation of CRC screening was to detect the association between Socio-economic inequalities, Lifestyle risk factors, Dietary pattern, Physical activity and Family history of cancer in world. The searched online were forms *GOOGLE SCOLAR, CROSS REF, Science Direct, Pub Med, and COCHRANE* to identify the relevant publications (Figure 1). We used of the three keywords, “Rural urban inequalities” AND “colorectal cancer” AND “screening” to search on the websites of the databases as mentioned above.

B. Selection criteria

This study were of the domain name, population and setting used identifies come from participation of CRC screenings in rural- urban areas in World of Socio-economic inequalities, Lifestyle risk factors, Dietary pattern, Physical activity and Family history of cancer base on website. We used to the criteria for selecting the article including our study based on these items; the period of 1998 to 2018, only database complex will be included, the incidences, mortalities and risk factors of CRC screening data designs are available. Of those, including the full-text based on English published article online had to be available.

C. Data extraction and quality assessment

The study design of this part was used of systematic reviews for conducting the system of searching, selecting, reviewing and finding. Those are a pilot study that we will define the database of CRC screenings, socio-economic risk and lifestyle risk factors in rural and urban areas base on website online. Also, we will use two reviewers; one from the Faculty of Human and Social Science and another from the Faculty of Medicine, Khon Kaen University. Two main points will be considered, including “Domain name” and “Database complexes”. If all reviewers agree with the same way regarding the all keywords, the database complexes were included and reviewed. If disagreement have been discussed and decided by research teams.

To sum up variables come from each study were recorded; first: domain name/country, second: publication years, third: number of rural-urban areas in the study, fourth: the country where the study was performed, fifth: data collection, sixth: primary outcome measurements, other outcomes measurement, by using data analysis e.g. odd ratios (OR), ninety-five percentage confidence intervals (95%CI) and P-value respectively see in **table 1-8.**

D. Statistic analysis

This study was a technique of statistics for attempt to collect all relevant in a systematic review by using the ten rural- urban studies reporting association among CRC screening, Socio-economic risk, Lifestyle risk factors and six rural- urban studies reporting association for tobacco habits and alcohol consumption, respectively. Firstly, those were to summarize of author’s, Socio-economic inequalities risks, Lifestyle risk factors, Dietary pattern, Physical activity and Family history of cancer data report have shown that domain name to represent of primary outcome. Secondly, those were to determine of CRC screening among risk factors relevant or these have shown that univariate data of association among outcomes included Socio-economic inequalities risks, lifestyle risk factors and family history of cancer. Thirdly, those were statistical modifiable and risk factors among was the studies included in the systematic review was evaluated using P-value statistics for rural-urban areas. Fourthly, those were to representing up to date from Socio-economic inequalities risks, lifestyle risk factors and family history of cancer, respectively by using STATA package. Finally, those were to estimation of important publication bias were executed by using forest plot, in which the standard error of OR of each study was forest plotted against its OR. An asymmetrical plot suggests possible publication bias. All statistical analyses were performed using STATA Software version 10. A P-value <0.05 was considered statistically significant.

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III. RESULTS

A. Literature Search

The studies included in this systematic review to shown that an identification of relevant studies to processing in Figure 1. The characteristics of the selected studies are sum up in Tables 1 and 8. All of the articles included in this study were published the period of 1998 to 2018. Only studies with rural-urban areas design were included in this review due to the lack of cohort studies on the risk factor of CRC screening in rural-urban areas.

During the literature search we were able to identify three hundred and seventy-one (371) journal articles related to CRC screening risk that were published the period of 1998 to 2018. Two hundred and fourthly-nine journal articles out of the 371 met the specific criteria for inclusion in our study while additional one hundred and twenty-one relevant journal articles were discovered from the reference domains of the chosen articles making it a total about nineteen journal articles reviewed of this study.

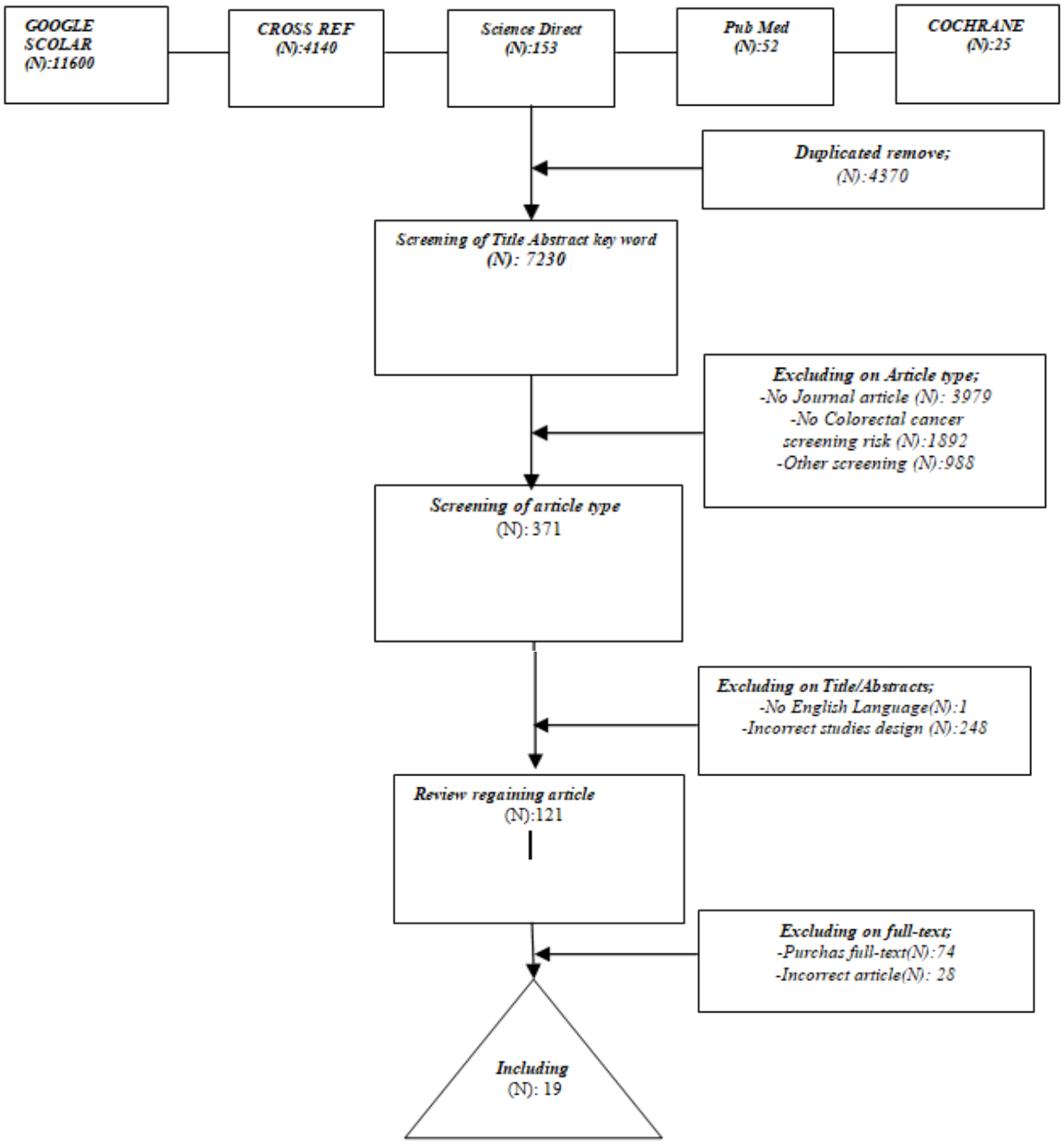

Fig 1:- Identification of relevant studies for the incidences, mortalities and risk factors in participation of CRC screening in rural-urban areas come from *GOOGLE SCOLAR, CROSS REF, Science Direct, Pub Med,* and *COCHRANE* databases. Search date Dec 9, 2019.

B. Evident for risk factors of CRC Screening

The summary was primary outcome base on risk factors of CRC screening in rural-urban areas are domain name that see in Table 1. Several methods were used to get for associated among Socio-economic inequalities; (e.g. age groups, gender, marital status, geographic, occupation level, household income, education level, health status, physicians discussed,), Dietary patterns; (e.g. vegetable and fruit, energy food or drink), Lifestyle risk factors; (e.g. smoking status, alcohol consumption, physical activity, Family history of cancer and Underlying issues) articles were identified. Those was screened and trimmed to 19 relevant publications. Owing to differences in measurement of study risk factors and adjustment for Other confounding risk factors, the systematic reviews were only conducted for smoking status, alcohol consumption and physical activity.

C. Socio-economic inequalities factors

Several studies have shown that up to date ofSocio-economic inequalities factorsfor example;age groups, gender, marital status, geographic, occupation level, household income, education level, health status, health insurance and physicians discussed relating to participation of CRC screening that see in table 2. Moreover, the systematic reviews had shown that significant for forest plot (Figure 2).

D. Dietary factors

Various rural-urban areas studies judge the relationship of dietary pattern these allude to consumption of energy food or drink, vegetable and fruit with participation of CRC screening in rural-urban areas as shown in Table 3. Due to different measurement strategy of the exposure pattern in each study, it was not possible to conduct a systematic review to obtain a summary OR for the relationship of energy food or drink, vegetable and fruit with participation of CRC screening in rural-urban areas. Our result revealed that three out of nineteen studies that reported the relationship of vegetable and fruit with participation of CRC screening in rural-urban areas. Of the four studies that reported the relationship between dietary patterns and participation of CRC screening, only, three studies of vegetable and fruit consumption were found to have significant relationship. For the energy food or drink and participation of CRC screening in rural-urban areas, the only one study reported has statistically non-significant relationship.

The systematic reviews for vegetables and fruit consumption and energy food or drink (ever consumed versus never consumed) are shown in Table 1. The relationship between vegetables and fruit consumption, energy food or drink and participation of CRC screening in rural-urban areas was statistically significant in the random effect model (OR=1.76; 95% CI=0.19-2.31) but with a large statistical heterogeneity (I^2=88%; P<0.01) between the tree rural-urban areas studies included in the systematic reviews. Based on the funnel plot, there is no visual indication of publication bias Figure 3.

E. Lifestyle factors Smoking status

Nineteen rural-urbans areas studies that examined the relationship between smoking status and participation of CRC screening in World were studied (Table 3). Of the 19 studies, only five (26.32%) reported that smoking significantly increased the risk for developing in participation of CRC screening. The systematic reviews results obtained from our forest plot in Figure 4 show significant (OR=1.89; 95% CI=1.49-2.38) relationship of CRC screening with smoking, but with large heterogeneity (I^2=93%; P<0.01) as shown in Figure 7. the equation as a graphic and insert it into the text after your paper is styled.

F. Alcohol consumption

The relationship between alcohol consumption and CRC screening in World were evaluated from ten rural-urban areas studies as shown in Table 6. Only four out of the ten studies reported alcohol significantly increased the risk factors of CRC screening. The systematic reviews result obtained from our forest plot in Figure 5 show significant (OR=1.42, 95% CI=1.23-1.65) relationship of CRC screening with alcohol consumption but with low heterogeneity (I^2=36%, P=0.14) as shown in Table 8.

G. Physical Activities factors

Table 4 shows the results of the systematic reviews for Risk Factors Studies on the relationship between participation of CRC screening and Physical Activities of p-value: <0.001 that has strongest of variable used to all available of risk factors in participation of CRC screening in rural-urban areas.

H. Family history of cancer

Of these five in nineteen study for family history of cancer used to represent in Participation of CRC screening that performances have effect of p-value: <0.001. However, those are the only, father mother sister and brother with Participation of CRC screening in rural-urban areas (table 5).

IV. DISCUSSIONS

Overall, the systematic reviews strongly that have been association between participation of CRC screening among Socio-economic inequalities Dietary pattern Physical activity Familiar history of cancer. Especially, the systematic reviews have shown that association between the participation of CRC screening in FIT test in rural-urban areas with random effect model score showing of *OR: 1.69 ,(95%CI: 1.02 –2.99), OR: 1.68; (95 % CI: 1.01 – 3.74), and OR: 1.46; (95 % CI: 1.08 – 1.58)* respectively. Moreover, forest plots to represent the vegetable and fruit consumption suggests that significant of (OR=1.76; 95% CI=0.19-2.31) but with a large statistical heterogeneity (I^2=88%; P<0.01) between the three rural-urban areas studies, Smoking status show significant of (OR=1.89; 95% CI=1.49-2.38) relationship of CRC screening with smoking, but with large heterogeneity (I^2=92%; P<0.01) Alcohol consumption to show significant of (OR=1.42, 95% CI=1.23-1.65) relationship of CRC screening with alcohol consumption but with low heterogeneity (I^2=36%, P=0.14) respectively.

Therefore, up to date on method of variables used; the socio-economic inequalities for instances household income base on 1-5 quintiles was novel technique to determining of participation of CRC screening [11, 43]. Also, physical

discussions, health insurance and health status suggested that the effort in formation of non-participation. Of those via the early detection early prevention and primary health care systems such as general physical or health technicians and others non-health technician [11]. The dietary pattern variables to only, energy food or drink and vegetable and fruit consumption have been risked factors in participation of CRC screening [1, 9, 44]. The lifestyle risk factors, physical activity and familiar history of cancer have still to get the associates with participation of CRC screening in rural-urban areas[9, 45-47].

Limitation

This study has been lowered, still in participation of CRC screening in rural-urban areas that will be justifiable with several others. If there is a selected some few suggest that performance includes the risk factors with participation of CRC screening in rural-urban areas

Conflicts of Interest

Non-conflict of interest exists among the authors.

Table1. To sum up of the Rural-Urban areas Studies on the Risk Factors Contributed to Colorectal Cancer Screening

Domain name /Country	**Cohorts**	**Data collection method**	**Outcome measured**	**Odd Ratio estimates (OR), Ninety-five percentage confidences interval (95% CI)**
(Heo *et al.*, 2004)[4] / -	250 Rural and Urban	Survey	Overweight, Obesity	$OR_{Overweight}$ =1.15; (CI= 1.02 – 1.31) $OR_{Obesity}$ =1.21; (CI= 1.09 – 1.35)
(Rosen *et al.*, 2004)[6]/ United States	52,886 Rural and Urbans	Interview Telephone Survey	BMI, Gender	OR_{BMI} =2.00; (CI= -3.80 – 0.10) OR_{gender} =3.70; (CI=-6.20–1.10)
(O'Malley *et al.*, 2005) [8]/ United States	9,985 Rural, Urbans	Personal interview	Age groups, Gender High school, >high school, household income, Geography, health status, physicians discussed	$OR_{Age\ groups}$ =0.86; (CI=0.79 – 0.93) OR_{gender} =0.87; (CI=0.79–1.97) $OR \leq_{High\ school}$ = 1.23; (CI= 1.12 – 1.36) $OR >_{High\ school}$ = 1.79; (CI= 1.55 – 2.07) $OR_{household\ income}$ = 1.30; (CI=1.17 – 1.45) $OR_{Geography}$ = 1.12; (CI= 0.97 – 1.31) $OR_{health\ status}$ =1.08; (CI=0.95–1.24) $OR_{physicians\ discussed}$=1.47; (CI=1.31–1.64)
(Wardle Jane, 2005) [15] / United Kingdoms	5,468 Rural and Urbans	Questionnaire	Family history, Deprivation index, Gender, marital status Occupation level health status, physicians discussed	$OR_{Family\ history}$ = 1.83; (CI= 1.48–2.25) OR_{most} = 0.45; (CI=0.39–0.52) OR_{gender} = 1.53; (CI=1.34–1.75) $OR_{marital\ status}$ =0.68; (CI=0.58–0.79) OR_{Work} = 1.28; (CI=1.13–1.47) $OR_{health\ status}$ =0.73; (CI=0.66–0.80) $OR_{physicians\ discussed}$=0.72; (CI=0.62–0.83)

(Sewitch *et al.*, 2007) [7]/ Canada	16,791 Rural, Urbans	Survey	Age groups, Gender, household income, Occupation level, Geography, Vegetable and Fruit, smoking status, physicians discussed, Underlying issues, Physical activity,	$OR_{Age\ groups}$ =0.71; (CI=0.57–0.88) OR_{gender} =0.93; (CI=0.79–1.10) $OR_{household\ income}$ = 0.82; (CI=0.72 – 0.93) $OR_{Geography}$ = 0.61; (CI= 0.37 – 0.99) $OR_{smoking\ status}$ =0.85; (CI=0.65–1.11) $OR_{Vegetable\ and\ Fruit}$ =1.05; (CI=1.03–1.06) $OR_{Underlying\ issues}$ =1.32; (CI=1.11–1.57) $OR_{Physical\ act}$= 2.68; (CI=1.77–4.04) OR_{Work} = 0.73; (CI=0.62–0.87)
(McLafferty *et al.*, 2009) [3]/ United States	3,283 Rural, 20,672 Urbans	Personal interview	Geography	OR = 0.84
(Choi *et al.*, 2010) [10] / South Korea	3,699 Rural, Urbans	Survey, Personal interview	Age groups, marital status, high school, household income, health status, smoking status,	$OR_{Age\ groups}$ =1.38; (CI=1.12 – 1.70) OR_{gender} =0.84; (CI=0.64–1.11) $OR_{>High\ school}$ = 1.00; (CI= 0.80 – 1.24) $OR_{household\ income}$ = 1.11; (CI=0.83 – 1.49) $OR_{smoking\ status}$ =1.25; (CI=0.92–1.69) $OR_{health\ status}$ =1.41; (CI=1.01–1.96)
(Myong *et al.*, 2012) [14]/ South Korea	820 Rural, 1802Urbans	Interview survey	Age groups, marital status, High school, >high school, household income, health status, smoking status, Underlying issues, Geography	$OR_{Age\ groups}$ = 1.81; (CI=1.54 – 2.14) $OR_{marital\ status}$ =1.43; (CI=1.23–1.66) $OR_{\leq High\ school}$ = 1.29; (CI= 1.09 – 1.53) $OR_{>High\ school}$ = 1.53; (CI= 1.23 – 1.91) $OR_{household\ income}$ = 1.29; (CI=1.07 – 1.56) $OR_{health\ status}$ =1.38; (CI=1.21–1.58) $OR_{smoking\ status}$ =1.35; (CI=1.43–1.60) $OR_{Underlying\ issues}$ =1.41; (CI=1.22–1.62) $OR_{Geography}$ = 1.16; (CI=1.02–1.32)
(Ponce *et al.*, 2012)[2]/ United States	1,174 Rural and 460,000Urbans	Interview telephone Survey	Family history, Age groups, physicians discussed, household income, High school, Geography, Underlying issues,	$OR_{Family\ history}$ = 0.28; (CI= 0.11 - 0.60) $OR_{Age\ groups}$ = 1.13; (CI= 1.07 - 1.19) $OR_{physicians\ discussed}$ = 0.33; (CI=0.17–0.63) $OR_{household\ income}$ = 0.49; (CI=0.17 – 0.90) $OR_{High\ school}$ = 1.01; (CI= 0.34 – 3.25) $OR_{Geography}$ = 1.36; (CI= 0.84 –

				2.19) $OR_{Underlying\ issues}$ =1.05; (CI=0.87–1.26)
(Anderson *et al.*, 2013) [12]/ United State	1,178 Rural, 3,082Urbans	Surveys and Questionnaires	Age groups, marital status, High school, >high school household income, health status, Family history, Geography	$OR_{Age\ groups}$ = 2.19; (CI=1.73 – 2.78) $OR_{marital\ status}$ =0.78; (CI=0.63–0.96) $OR_{\leq High\ school}$ = 0.65; (CI= 0.51 – 0.81) $OR_{>High\ school}$ = 0.63; (CI= 0.51 – 0.78) $OR_{household\ income}$ = 0.63; (CI=0.46 – 0.85) $OR_{health\ status}$ =0.59; (CI=0.42–0.85) $OR_{Family\ history}$ =1.17; (CI=0.76–1.80) $OR_{Geography}$ = 0.65; (CI=0.53–0.79)
(Bostean *et al.*, 2013)[1] / United States	12,603 Rural, Urbans	Survey	Smoking status, physical Activity, Alcohol, Consumption, BMI Vegetable and Fruit, Energy drinking Family history	$OR_{smoking\ status}$ =0.88; (CI=0.43–0.96) $OR_{physical}$ act=0.81; (CI=0.43–1.99) $OR_{Alcohol}$ =1.05; (CI=1.03–2.82) OR_{BMI} =0.82; (CI=0.65–0.96) $OR_{Vegetable\ and\ Fruit}$ =0.97; (CI=0.81–0.99) $OR_{Energy\ drinking}$=1.01; (CI=0.92–1.59) $OR_{Family\ history}$ = 0.97; (CI= 0.11 - 0.98)
(Hui *et al.*, 2013)[13] / United States	212 Rural, 481 Urbans	Questionnaire	Gender,>high school household income, Occupation level, Physical activity, Geography	OR_{gender} = 2.27; (CI=0.75 – 1.46) $OR_{>High\ school}$ = 1.34; (CI= 0.98 – 1.84) $OR_{household\ income}$ = 1.13; (CI=0.80 – 1.58) OR_{Work} = 0.98; (CI=0.71–1.35) $OR_{Physical\ act}$= 1.25; (CI=0.78–1.89) $OR_{Geography}$ = 1.99; (CI=1.09–3.63)
(Wong *et al.*, 2013)[30] / Singapore	1,763 Rural and Urbans	Personal interview	Gender	OR_{gender} = 0.79; (CI= 0.50–1.25)
(Hughes *et al.*, 2015)[5]/ United States	200 Rural, 193 Urbans	Surveys mailed	Geography gender, physicians discussed	$OR_{Geography}$ = 0.40; (CI= 0.22 – 0.75) OR_{gender} = 2.27; (CI=1.10 – 4.75) $OR_{physicians\ discussed}$ =3.92; (CI=1.72–8.93)
(Taheri-Kharameh *et al.*, 2015) [22]/ Iran	24 Rural, 166 Urbans	Questionnaire	Aged groups, Gender, high school, Marital status, Occupation level,Family history,	$OR_{aged\ group}$ = 1.01; (CI=0.97 – 1.05) OR_{gender}=3.52; (CI=1.03–11.94) $OR_{>High\ school}$ =1.07; (CI=0.74–1.56) $OR_{marital\ status}$ =0.96; (CI=0.66–1.37)

				OR_{work} =0.88; (CI=0.60–1.28) $OR_{Family\ history}$=1.13; (CI=0.38–3.29)
(Lopez-Torres Hidalgo *et al.*, 2016)[23]/ Spain	73 Rural, 100 Urbans	Interviewed	Invitation to letter Telephone, Health status	OR_{letter} = 2.32; (CI=1.23 – 2.37) $OR_{telephone}$= 4.38; (CI=2.38 – 8.07) $OR_{health\ status}$= 1.19; (CI=1.05 – 1.36)
(Kelly *et al.*, 2017)[25]/ France	1,222 Rural, Urbans	Interviewed	Occupation level, Household income, high school, Occupation Level, Health insurance	OR_{work}= 0.72; (CI=0.46 – 2.05) $OR_{household\ inc}$= 0.62; (CI=0.62 – 1.29) $OR_{>High\ school}$ =1.25; (CI=0.81 – 1.25) $OR_{health\ ins}$= 1.06; (CI=0.69 – 1.54)
(Molina-Barceló *et al.*, 2018) [31]/ Spain	141 Rural, 643 Urbans	Interview Telephone Survey	Gender, Aged groups high school, Geography, physicians discussed	OR_{gender} = 1.52; (CI=1.06 – 2.19) $OR_{Age\ groups}$ = 1.64; (CI=1.14 – 2.36) $OR_{>High\ school}$ = 1.26; (CI= 0.85 – 1.87) $OR_{Geography}$ = 0.67; (CI=0.41–1.08) $OR_{physicians\ discussed}$ =1.64; (CI=1.05–2.55)
(Stevens *et al.*, 2018)[9]/ United Kingdom	774 Rural, Urbans	-	Smoking status, physical Activity, Alcohol Consumption, Vegetable and Fruit,	$OR_{smoking\ status}$ =0.45; (CI=0.29–0.68) $OR_{physicalact}$=0.75; (CI=0.49–1.99) $OR_{Alcohol}$ =0.71; (CI=0.53–1.15) $OR_{Vegetable\ and\ Fruit}$ =1.70; (CI=1.14–2.55)

Table2. Rural-Urban Studies on the Association of CRC with Socio-economic inequalities risk factors

Risk Factors	**Study**	**Exposure**	**P-value**
Aged groups	(McLafferty& Wang, 2009; Ponce *et al.*, 2012) [2, 3]	<50 ≥50	<0.001
Genders	(Hughes *et al.*, 2015)[5]	Male Female	0.05
Household income	(von Euler-Chelpin *et al.*, 2010) [11]	Quintile 1-5	<0.001
Marital status	(Ponce *et al.*, 2012)[2]	Marital Single, widows, divorce	<0.001
Education level	(Lopez-Torres Hidalgo *et al.*, 2016)[23]	No or Primary education Secondary education or higher	0.578
	(Choi *et al.*, 2010) [10]	≤ High school >High school	0.984
Occupation level	(Kelly *et al.*, 2017)[25]	Manager Farmer Self-employees Professional Employees Manual worker Other	0.372

Household income	(Anderson *et al.*, 2013) [12]	Poor ventilated house	0.0032
Physical discussions	(Molina-Barceló *et al.*, 2018) [31]	NO Yes	<0.05
Health status	(Sewitch *et al.*, 2007) [7]	Fair/poor good Excellent /very good	- 0.044 0.007
Health insurance	(Kelly *et al.*, 2017) [25]	Yes No	<0.05

Table3. Risk Factors Studies on the Association of CRC screening with Dietary patterns (heterogeneity: I^2=88%; P<0.01)

Risk Factors	**Study**	**Exposure**	**P-value**
Vegetable and Fruit	(Bostean *et al.*, 2013) [1]	yes or no	0.08
	(Stevens *et al.*, 2018)[9]	Response or no	0.05
	(Sewitch *et al.*, 2007)[7]	yes or no	0.001
Energy food or drink	(Bostean *et al.*, 2013) [1]	yes or no	0.08

Table 4. Risk Factors Studies on the Association of CRC screening with Physical Activities

Risk Factors	**Study**		**P-value**
Physical Activities	(Bostean *et al.*, 2013) [1]		<<0.01
	(Sewitch *et al.*, 2007) [7]		0.001
	(Hui *et al.*, 2013) [13]		0.040

Table5. Risk factors Studies on the Association of CRC screening with Family history of cancer

Risk Factors	**Study**	**P-value**
Family History	(Bostean *et al.*, 2013) [1]	< 0.01
	(Ponce *et al.*, 2012) [2]	<0.05
	(McLafferty& Wang, 2009) [3]	<0.05
	(Taheri-Kharameh *et al.*, 2015) [22]	0.82
	(Wardle *et al.*, 2005) [29]	<0.05

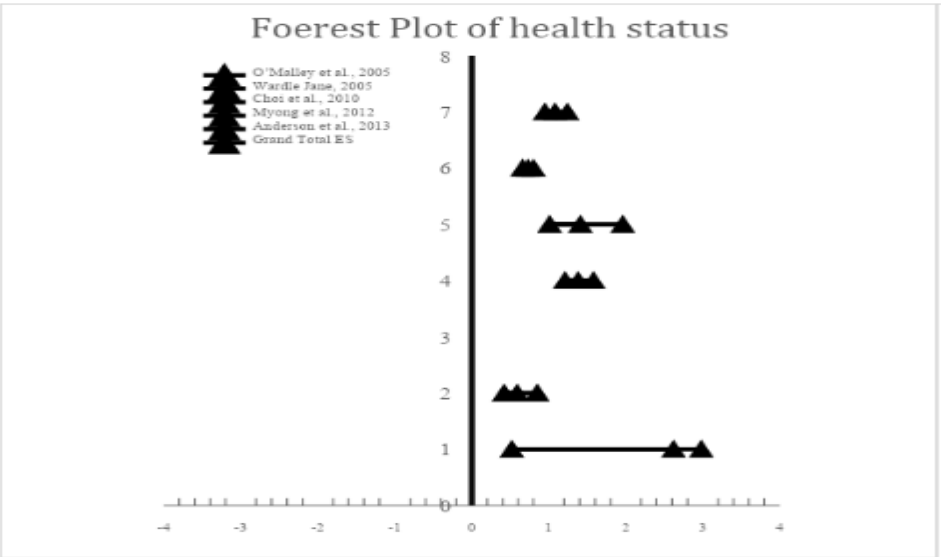

Fig2. Forest plot of health status

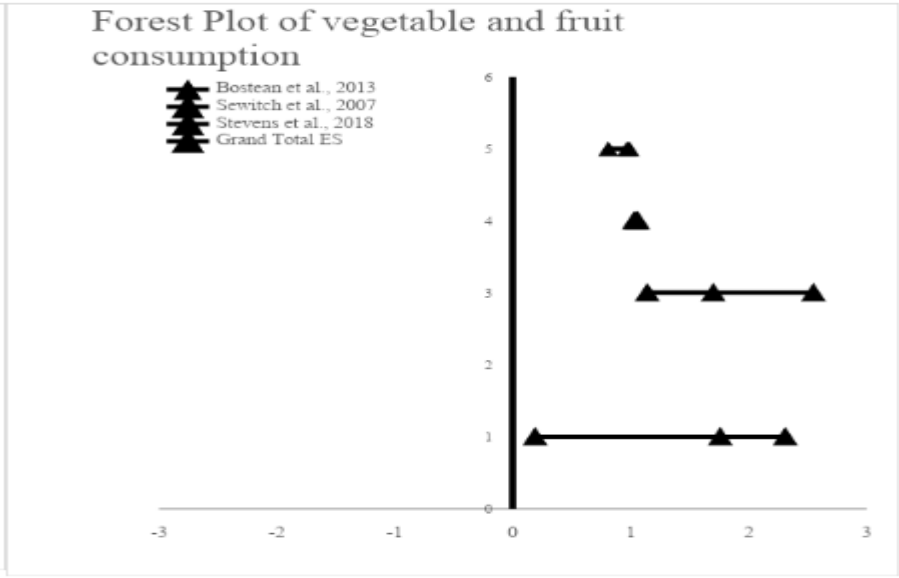

Fig3. Forest plot of vegetable and fruit consumption

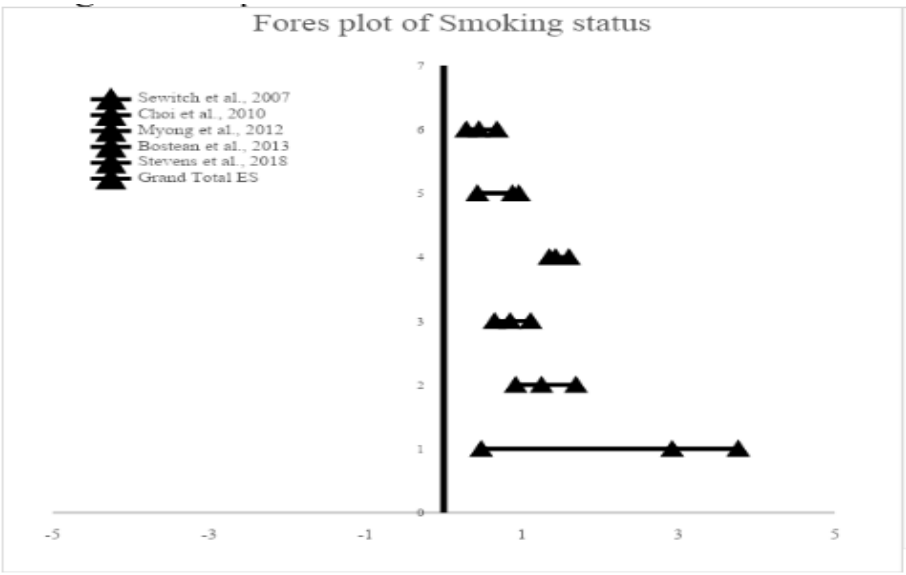

Fig4. Forest plot of Smoking status

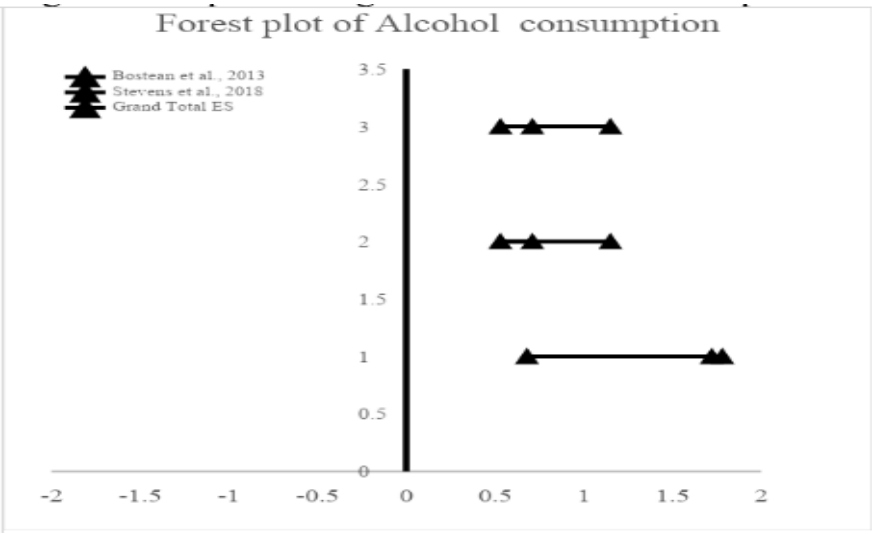

Fig5. Forest plot of Alcohol consumption

Table 6. Rural-Urban areas Studies on CRC screening Association with Tabaco habit (heterogeneity: I^2=93%; P<0.01)

Cohorts	Rural		Urban		OR; (95%CI)
	Rural	Totals	Urban	Totals	
(Sewitch *et al*., 2007)[7]	16,791	17,498	16,791	17,498	0.85; (0.65–1.11)
(Choi et al., 2010) [10]	3,699	4,085	3,699	4,085	1.25; (0.92–1.69)
(Myong et al., 2012) [14]	820	15,103	1,820	15,103	1.35; (1.43–1.60)
(Bostean *et al*., 2013) [1]	12,603	34,912	12,603	34,912	0.88; (0.43–0.96)
(Stevens *et al.*, 2018)[9]	736	774	736	774	0.45; (0.29–0.68)

Table 7. Rural-Urban areas Studies on CRC screening Association with Alcohol Consumption (heterogeneity: I^2=36%, P=0.14)

Cohorts	Rural		Urban		OR; (95%CI)
	Rural	Totals	Urban	Totals	
(Bostean *et al*., 2013) [1]	176	290	170	290	1.09; (0.78-1.52)
(Stevens *et al.*, 2018) [9]	714	774	714	774	0.71; (0.53–1.15)

Table 8. Rural-Urban areas Studies on the Association of CRC heterogeneity shown among the 8 rural-urban areas studies with Sociodemographic factors included in the systematically reviews (I^2=92%; P<0.01).

Risk Factors	Study	Graduated of Groups compared	p-value
Education level	(O'Malley *et al.*, 2005) [8]	>High school ≤Hihg school	0.990
	(Choi *et al.*, 2010) [10]	>High school ≤High school	0.984
	(Myong *et al.*, 2012) [14]	7-9 10-12 ≥ 13	<0.05
	(Ponce *et al.*, 2012) [2]	>High school ≤High school	0.990
	(Anderson *et al.*, 2013) [12]	≤High school High school Some college College graduate Missing/ Unknown	<0.001
	(Hui *et al.*, 2013) [13]	>High school ≤High school	0.064
	(Hughes *et al.*, 2015) [5]	>High school ≤High school	0.023
	(Molina-Barceló *et al.*, 2018) [31]	≤12 years >12 years	<0.001

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