Abstract

Previous studies have documented significant international variations in colorectal cancer rates. However, these studies were limited because they were based on old data or examined only incidence or mortality data. In this article, the colorectal cancer burden and patterns worldwide are described using the most recently updated cancer incidence and mortality data available from the International Agency for Research on Cancer (IARC). The authors provide 5-year (1998–2002), age-standardized colorectal cancer incidence rates for select cancer registries in IARC's *Cancer Incidence in Five Continents*, and trends in age-standardized death rates by single calendar year for select countries in the World Health Organization mortality database. In addition, available information regarding worldwide colorectal cancer screening initiatives are presented. The highest colorectal cancer incidence rates in 1998–2002 were observed in registries from North America, Oceania, and Europe, including Eastern European countries. These high rates are most likely the result of increases in risk factors associated with “Westernization,” such as obesity and physical inactivity. In contrast, the lowest colorectal cancer incidence rates were observed from registries in Asia, Africa, and South America. Colorectal cancer mortality rates have declined in many longstanding as well as newly economically developed countries; however, they continue to increase in some low-resource countries of South America and Eastern Europe. Various screening options for colorectal cancer are available and further international consideration of targeted screening programs and/or recommendations could help alleviate the burden of colorectal cancer worldwide.

Introduction

Colorectal cancer is the fourth most common cancer in men and the third most common cancer in women worldwide, and significant international variations in the distribution of colorectal cancer have been observed. Risk factors for colorectal cancer include obesity, a diet low in fruits and vegetables, physical inactivity, and smoking, and as such it was once a disease primarily observed in longstanding developed nations whose populations typically exhibit these factors. However, in recent years, high colorectal cancer rates have been reported in newly developed countries around the globe in which the risk was once low. The goals of this article are to describe global colorectal cancer incidence and mortality patterns using the most recent data available from the International Agency for Research on Cancer (IARC) and to provide information concerning colorectal cancer screening initiatives worldwide.

Data Sources and Methods

Cancer incidence data are collected by population-based cancer registries across the globe, which cover national populations or, more commonly, regions within nations. These cancer incidence data are compiled and provided by the IARC in volumes I to IX of *Cancer Incidence in Five Continents* (CI5). The most recent volume of CI5...
(volume IX) includes data from 225 registries in 60 countries and covers approximately 11% of the world population.9 We used data from volume IX of CI5 to display cross-sectional, aggregated colorectal cancer incidence rates for 1998–2002 for select registries. Many countries had multiple registries included in CI5; however, we restricted our presentation of the data to 2 registries per country: those with the highest and those with the lowest rates. In addition, when available, aggregates of local registries or national registries were used instead of local registries (eg, the United States and Canada). Colorectal cancer incidence data were coded according to the 10th edition of the International Classification of Diseases for Oncology (ICD-O) (C18–C21).

Mortality data are collected in all economically developed countries and some economically transitioning countries. These data, covering approximately 30% of the world population, are abstracted from death certificates and compiled in a World Health Organization mortality database, and are available to the public at the IARC website.11 The quality of mortality data vary by country, with a high accuracy of underlying cause of death noted in longstanding, economically developed countries and a lower accuracy reported in newly developed or economically transitioning countries. We used single-year mortality data to examine trends in age-standardized colorectal cancer death rates for 29 select countries with long-term mortality data using joinpoint regression analysis, which involves fitting a series of joined straight lines on a logarithmic scale to the trends in the annual age-standardized rates. The method is described in detail elsewhere.12 The resulting trends of varying time periods were described by annual percent change (APC) (ie, the slope of the line segment).12 In describing mortality trends, the terms “increase” or “decrease” were used when the APC was statistically significant (P < .05); otherwise the term “stable” was used. Countries included in the trend analysis had at least 10 continuous years of mortality data of varying length during the time period 1985 and 2005. The majority of countries had data available for all 20 years. Colorectal cancer mortality data were coded according to the ICD edition in use at the time of death (153–154 in ICD-9 or C18–C21 in ICD-10).

Although there are differences in the etiologies and epidemiology of colon and rectal cancer, we chose to study both together to account for variances in classification that sometimes occur with tumors diagnosed at the rectosigmoid junction. All incidence and mortality rates include cancers of the colon, rectum, and anus, and we will refer to these cancers collectively as colorectal cancer. Cancer of the anus is not routinely combined with cancers of the colon and rectum in US cancer statistics, but is combined in international cancer statistics. However, anal cancer is a rare disease. For example, in the United States in 2006, the incidence rate (per 100,000) for anal cancer was 1.5 compared with 45.9 for colon and rectal cancer.13 All colorectal cancer rates were age-standardized to the 1960 world standard population to compare data across countries with different age compositions.

Information regarding international colorectal cancer screening initiatives was based on a literature review. The majority of the data were obtained from the International Colorectal Cancer Screening Network (ICRCNS) through an article published by Benson et al.14

Results

Colorectal Cancer Incidence

Colorectal cancer incidence rates vary markedly worldwide, with rates per 100,000 among males in the time period 1998–2002 reported to range from 4.1 in India (Karunagappally) to 59.1 in the Czech Republic. Among females, these rates ranged from 3.6 in India (Karunagappally) to 39.5 in New Zealand. The majority of registries with the highest incidence rates of colorectal cancer were located in Europe, North America, and Oceania. In contrast, the lowest rates were observed from registries in Asia, Africa, and South America.

Notably, colorectal cancer rates (1998–2002) among males in the Czech Republic, Japan, and Slovakia (Fig. 1) have exceeded the peak incidence rates observed in longstanding, developed nations such as New Zealand, Australia, and the United States, which previously reported the highest colorectal cancer incidence rates worldwide.3 Although data regarding risk factors for colorectal cancer are limited in many parts of the world, high colorectal cancer rates in newly developed or economically transitioning countries such as the Czech Republic and Slovakia and some others in Eastern Europe are most likely the result of the increased prevalence of obesity associated with “Westernization,” including the consumption of high-calorie–dense foods.
and physical inactivity. In addition, elevated smoking prevalence as indicated by lung cancer mortality rates (which were noted to have peaked later and at a higher rate in the Czech Republic and Slovakia compared with longstanding, economically developed countries such as the United States) may play a role in the elevated colorectal cancer rates reported in these countries.

Although the majority of the highest colorectal cancer incidence rates among males were observed in Europe, North America, and Oceania, select registries in Asia also recorded high rates in Japan, Singapore, and Israel. Increases in colorectal cancer incidence rates have been observed in these 3 countries in recent years, and are most likely due to environmental or lifestyle factors. In Japan, a developed country with one of the strongest economies worldwide, the high incidence of colorectal cancer, particularly among males, is most likely due to modifications in dietary intake. Energy intake gradually increased and then remained constant in Japan after World War II, mainly as a result of the increased intake of Western-type foods, which has contributed to increased obesity in Japan.

Among females, the highest colorectal cancer incidence rates were observed in New Zealand, Australia (Tasmania), and Israel (Fig. 1). New Zealand and Australia, in addition to many other longstanding developed nations in Europe and North America, have historically had high incidence rates of colorectal cancer that are most likely the result of behaviors associated with urbanization. However, colorectal cancer incidence rates in recent years among females have declined in New Zealand and stabilized in Australia (Tasmania), but have continued to increase in Israel. High colorectal cancer rates among females were also observed in the Asian registries of Japan and Singapore, although rates

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**FIGURE 1.** Registries with the Highest Age-Standardized Colorectal Cancer Incidence Rates by Sex, 1998–2002. UK indicates United Kingdom; USA, United States of America; NPCR, National Program of Cancer Registries. Source: Cancer Incidence in Five Continents.
for females are substantially lower than those for males in these and other registries. The lower rates observed among females compared with males may be related to differences in risk behaviors associated with colorectal cancer, such as smoking, and the differing effect of obesity in men and women. In many countries, the regular uptake of smoking among women lags 20 to 30 years behind that of men.

Among both males and females, the lowest rates of colorectal cancer incidence were observed for registries in India (Nagpur, Poona, and Karunagappally), Oman, Egypt (Gharbiah), Algeria (Setif), and Pakistan (South Karachi) (Fig. 2). In these economically developing regions of the world, low colorectal cancer incidence rates may reflect a lower prevalence of known risk factors.

**Colorectal Cancer Mortality**

Mortality trend analyses for select countries have demonstrated that colorectal cancer mortality decreased in both males and females in 13 of the 29 countries considered in this analysis. These decreases were largely confined to longstanding, economically developed nations such as the United States, Australia, New Zealand, and the majority of Western Europe, including Austria, France, Germany, Ireland, and the United Kingdom (Tables 1 and 2) (Fig. 3). However, colorectal cancer mortality trends have also decreased in some Asian and Eastern European countries in which incidence rates are among the highest worldwide. In Japan, death rates decreased by 0.9% per year from 1996 through 2005 in men and by 5.0% per year from 1992 through 2005 in women (Table 3). Similarly, in the Czech Republic, in which death rates were the second highest in 2005 among both males and females (Table 4), rates decreased by 1.0% per year from 1994 through 2005 in men and by 1.2% per year from 1988 through 2005 in women (Table 2). In addition to these 13 countries in which decreasing colorectal cancer mortality rates were noted among males and females, 4 addi-
tional countries recorded decreasing mortality rates among females only, including Latvia, Slovakia, South Africa, and Spain. The decreasing mortality rates may reflect improvements in colorectal cancer treatments that increase survival\textsuperscript{23,24} or possibly earlier detection due to opportunistic screening or symptom recognition.

Increasing trends in colorectal cancer mortality rates during the most recent time period were observed among both males and females for 6 of the 29 countries examined. These increases were observed in all South American countries examined (Mexico, Brazil, Chile, and Ecuador), as well as 2 Eastern European countries (Romania and Russia) (Fig. 3). In Romania, for example, colorectal cancer mortality rates increased 2.9\% per year among males from 1985 through 2005 and 1.5\% per year among females during the same time period (Table 2). Although mortality rates for males and females in Russia were high and those for Romania were intermediate, mortality rates in the South American countries in 2005 were among the lowest of all countries examined (Table 4). In addition to these 6 countries, colorectal cancer mortality rates increased among males only in 5 countries including China, Croatia, Kazakhstan, Latvia, and Spain, and among females only in Korea. In fact, the largest observed increase in colorectal cancer deaths among all countries examined occurred in Korean females, in whom rates increased 10.2\% per year from 1985 through 2005 and 3.8\% per year from 1994 through 2005, although rates still remained relatively low (7.5 per 100,000) in the most recent year examined (2005). Colorectal cancer mortality rates among Korean males stabilized during the most recent time period (2002–2005) after increasing 7.2\% per year from 1985 through 2002 (Table 3).

### TABLE 1. Colorectal Cancer Mortality Rate Trends with Joinpoint Analyses for 1985 Through 2005 for Select Countries in the Americas and Oceania by Sex—WHO Mortality Database

| Country                  | Sex | Years    | APC   | Years    | APC   | Years    | APC   |
|--------------------------|-----|----------|-------|----------|-------|----------|-------|
| **North America**        |     |          |       |          |       |          |       |
| Canada                   | Male| 1985-2004| -1.10*|          |       |          |       |
| Canada                   | Female| 1985-1993| -2.71*| 1993-2004| -1.07*|          |       |
| **US**                   |     |          |       |          |       |          |       |
| US                       | Male| 1985-2002| -1.61*| 2002-2005| -4.19*|          |       |
| US                       | Female| 1985-2001| -1.71*| 2001-2005| -3.90*|          |       |
| **Central and South America** |     |          |       |          |       |          |       |
| Mexico                   | Male| 1985-2005| 1.48* |          |       |          |       |
| Mexico                   | Female| 1985-2005| 0.87* |          |       |          |       |
| Brazil                   | Male| 1985-2004| 1.96* |          |       |          |       |
| Brazil                   | Female| 1985-1992| 0.63  | 1992-2004| 1.72* |          |       |
| Chile                    | Male| 1985-2005| 1.18* |          |       |          |       |
| Chile                    | Female| 1985-2005| 0.55* |          |       |          |       |
| Ecuador                  | Male| 1985-2005| 1.05* |          |       |          |       |
| Ecuador                  | Female| 1985-2005| 1.01* |          |       |          |       |
| **Oceania**              |     |          |       |          |       |          |       |
| Australia                | Male| 1985-2000| -1.48*| 2000-2003| -6.12*|          |       |
| Australia                | Female| 1985-2003| -2.33*|          |       |          |       |
| New Zealand              | Male| 1985-1987| -6.69 | 1987-1992| 2.27  | 1992-2004| -2.68*|
| New Zealand              | Female| 1985-2004| -1.90*|          |       |          |       |

WHO indicates World Health Organization; APC, annual percent change; US, United States.

*The APC was statistically different from 0.
TABLE 2. Colorectal Cancer Mortality Rate Trends with Joinpoint Analyses for 1985 Through 2005 for Select Countries in Europe by Sex—WHO Mortality Database

| Country     | Male Years | Male APC | Female Years | Female APC |
|-------------|------------|----------|--------------|------------|
| Eastern Europe |            |          |              |            |
| Czech Republic | 1986-1994 | 0.90*    | 1994-2005 | -1.01*     |
| Slovenia     | 1985-1996 | 2.94*    | 1996-2005 | -0.88      |
| Slovakia     | 1992-1995 | 4.13*    |            |            |
| Russia       | 1985-1993 | 2.31*    | 1993-1996 | -0.95      |
| Estonia      | 1985-2005 | 0.48     |              |            |
| Romania      | 1985-2005 | 2.94*    |              |            |
| Latvia       | 1985-2005 | 0.61*    |              |            |
| Western Europe |        |          |              |            |
| Austria      | 1985-1993 | 0.89     | 1993-2005 | -2.80*     |
| Croatia      | 1985-2005 | 2.04*    |              |            |
| France       | 1985-2005 | -1.20*   |              |            |
| Germany      | 1985-1994 | 0.37     | 1994-2005 | -1.97*     |

* indicates a statistically significant trend.
colorectal cancer screening programs and interventions to reduce the effects of lifestyle and dietary changes that accompany urbanization.

In the remaining 2 countries examined (Estonia and Slovenia), colorectal cancer mortality trends stabilized in both men and women.

Colorectal Cancer Screening

The presence or absence of colorectal cancer screening programs is an important consideration when evaluating the colorectal cancer burden worldwide, because screening may increase colorectal cancer incidence in the short term through the increased detection of prevalent cases and reduce the incidence of colorectal cancer in the long term through the removal of precancerous polyps. Thus, over time, screening lowers colorectal cancer mortality by reducing the incidence and/or by detecting tumors at earlier stages, which then have better prognoses. In fact, the increased use of screening has been cited as one of the most important factors responsible for the recent decline in colorectal cancer rates in the United States.

Internationally, the chosen modality of colorectal cancer screening varies, and it is likely that the cost and availability of diagnostic resources are the leading factors influencing program design. Although colonoscopy may be considered the “gold standard” for colorectal cancer screening, it requires a skilled examiner, involves greater cost, and is less convenient to the patient. As such, a population-based colorectal cancer screening program based on colonoscopy is more resource-intensive and less feasible in most countries, and not at all practical in low-resource countries. Therefore, although less sensitive than structural examinations, the fecal occult blood test (FOBT), which is inexpensive and easy to perform, is a more feasible colorectal cancer screening option in many areas of the world.

In the United States, current screening recommendations for the detection of adenomatous polyps and colorectal cancer in adults with average risk (those aged 50 years and older) include either annual stool testing with a high-sensitivity guaiac- or immunochemical-based test, periodic stool DNA testing, flexible sigmoidoscopy every 5 years, colonoscopy every 10 years, double-contrast barium enema every 5 years, or computed tomographic colonography every 5 years. The structural examinations are invasive procedures that require bowel preparations and are associated with various levels of risk. Therefore, in cases in which resources are not available or patients are not willing to adhere to structural examination requirements, annual FOBTs, including guaiac-based tests (gFOBT) and fecal immunochemical tests (FIT), are recommended. Although gFOBT, the most commonly used stool blood test, has been shown to reduce colorectal cancer mortality by up to 33%, it is less sensitive than structural examinations and less effective for the prevention of colorectal cancer.

**TABLE 2. (Continued)**

| Country | Trend 1 Years | Trend 1 APC | Trend 2 Years | Trend 2 APC | Trend 3 Years | Trend 3 APC | Trend 4 Years | Trend 4 APC |
|---------|---------------|-------------|---------------|-------------|---------------|-------------|---------------|-------------|
| Ireland | Male 1985-2005 | -1.26*      |               |             |               |             |               |             |
|         | Female 1985-2005 | -2.40*    |               |             |               |             |               |             |
| Spain   | Male 1985-1995 | 3.79*       | 1995-2005     | 0.69*       |               |             |               |             |
|         | Female 1985-1996 | 1.69*     | 1996-2005     | -1.09*      |               |             |               |             |
| UK      | Male 1985-1991 | -0.22       | 1991-2005     | -2.32*      |               |             |               |             |
|         | Female 1985-1992 | -1.67*    | 1992-2001     | -3.63*      | 2001-2005     | -1.18*      |               |             |

WHO indicates World Health Organization; APC, annual percent change; UK, United Kingdom.

*The APC was statistically different from 0.
because it is less sensitive in detecting precancerous polyps.\textsuperscript{32} To the best of our knowledge, annual or biannual FOBT is currently the only screening method supported by evidence from prospective randomized clinical trials.\textsuperscript{34,35}

Country-specific colorectal cancer screening guidelines, recommendations, and screening programs vary greatly worldwide. The ICRCSN was established in 2003 and has documented organized screening initiatives and pilot projects that began before 2004 (Table 5).\textsuperscript{14} The majority of countries that have national screening programs in place are using FOBT (Czech Republic, Israel, and Japan), although Poland and Germany\textsuperscript{36} have initiated colorectal cancer screening with colonoscopy. A recent study of colorectal cancer screening in Europe also indicated that the United Kingdom and France have been in the process of rolling out national screening programs using FOBT over the past several years.\textsuperscript{36} However, at this time, the majority of colorectal cancer screening initiatives are not national screening programs but rather recommendations and/or guidelines with opportunistic screening available. What is in place in many North American and European countries are ongoing regional colorectal cancer research studies and/or pilot screening programs intended to evaluate the potential for implementing screening.\textsuperscript{14,37,38} These studies and pilot programs use a variety of screening tests alone or in combination. Italy was reported to have the largest number of studies/programs, with 8 underway that used various combinations of FOBT, colonoscopy, and flexible sigmoidoscopy.\textsuperscript{14} These pilot programs were precursors to a national campaign for colorectal cancer screening that was launched in 2005 and was expected to have involvement from all regions of Italy by 2009.\textsuperscript{36} Other European and North American countries with documented colorectal cancer screening research studies and/or pilot programs include the United States, Canada, Belgium, Denmark, France, Norway, Spain, Switzerland, and the United Kingdom (Table 5). Information regarding colorectal cancer screening programs in South America is scarce, although 1 pilot study currently underway in Uruguay using FIT with follow-up colonoscopy for patients with positive test results reported high adherence and detection rates for colorectal cancer in the study population.\textsuperscript{39}

Although nationally organized screening programs are limited to only a few countries, policies and other programs can still effectively support the availability and use of colorectal cancer screening. In the United States for example, colorectal cancer screening for persons aged 65 years and older is covered by Medicare,\textsuperscript{40} the majority of states have legislation in place to ensure private health insurance coverage for colorectal cancer screening,\textsuperscript{40} and government-sponsored demonstration programs focus on colorectal cancer screening for low-income persons with inadequate health insurance.\textsuperscript{41} In addition, a measure called the Healthcare Effectiveness Data and Information Set (HEDIS) can help employers evaluate health plans’ colorectal cancer screening performance, and is widely regarded as a stimulus to health plans to increase colorectal cancer screening rates.\textsuperscript{42} These and other policies/programs most likely influenced the trend in colorectal cancer mortality rates (Figure 3).

**FIGURE 3.** Trends in Colorectal Cancer Mortality Rates for Select Countries in Males, 1985 Through 2005. Source: World Health Organization Mortality Database. Available at: http://www-dep.iarc.fr/. Accessed December 15, 2008.
the high rate of adoption of colorectal cancer screening in the United States and may have contributed to the low and decreasing colorectal cancer mortality rates noted in the country as well.

To the best of our knowledge, Japan is the only country in the Western Pacific region with a longstanding colorectal cancer screening program in place. Japan incorporated colorectal cancer screening using FOBT into its public health policy in 1992 and this in part may have contributed to the increase in colorectal cancer incidence rates noted in Japanese registries in the mid to late 1990s.\textsuperscript{43,44} National guidelines are available in Australia, Korea, and Singapore,\textsuperscript{45} and research studies and/or pilot programs for colorectal cancer screening have been implemented in Australia, Hong Kong, and Taiwan.\textsuperscript{14} Taiwan is the only country in the region with

### TABLE 3. Colorectal Cancer Mortality Rate Trends with Joinpoint Analyses for 1985 Through 2005 for Select Countries in Asia and Africa by Sex—WHO Mortality Database

| JOINTPOINT ANALYSES | TREND 1 | TREND 2 |
|---------------------|---------|---------|
|                     | YEARS   | APC     | YEARS   | APC     |
| **Asia**            |         |         |         |         |
| China (Hong Kong)   |         |         |         |         |
| Male                | 1985-2005 | 0.78*   | 1998-2005 | -1.98 |
| Female              | 1985-1998 | 0.90    | 1998-2005 | -1.98 |
| Japan               |         |         |         |         |
| Male                | 1985-1996 | 2.09*   | 1996-2005 | -0.86* |
| Female              | 1985-1992 | 1.28*   | 1992-2005 | -5.00* |
| Singapore           |         |         |         |         |
| Male                | 1985-2005 | -1.61*  | 1998-2005 | -4.36* |
| Female              | 1985-1998 | -0.99   | 1998-2005 | -4.36* |
| Korea               |         |         |         |         |
| Male                | 1985-2002 | 7.16*   | 2002-2005 | 1.79   |
| Female              | 1985-1994 | 10.21*  | 1994-2005 | 3.77*  |
| Israel              |         |         |         |         |
| Male                | 1985-1995 | 2.46*   | 1995-2004 | -1.77* |
| Female              | 1985-1992 | 1.28*   | 1992-2004 | -0.50* |
| Kazakhstan          |         |         |         |         |
| Male                | 1985-2005 | 0.59*   |          |         |
| Female              | 1985-2005 | 0.08    |          |         |
| **Africa**          |         |         |         |         |
| South Africa        |         |         |         |         |
| Male                | 1993-2005 | -0.08   |          |         |
| Female              | 1993-2005 | -1.41*  |          |         |

WHO indicates World Health Organization; APC, annual percent change.
*The APC was statistically different from 0.

### TABLE 4. Age–Standardized Colorectal Cancer Mortality Rates for Select Countries by Sex, Ranked in Descending Order—WHO Mortality Database, 2005*

| MALES | FEMALES |
|-------|---------|
| RANK  | COUNTRY | RATE  | RANK  | COUNTRY | RATE  |
| 1     | Slovakia | 30.8  | 1     | New Zealand | 15.3 |
| 2     | Czech Republic | 30.0  | 2     | Czech Republic | 14.1 |
| 3     | Croatia | 25.0  | 3     | Slovakia | 13.4 |
| 4     | Slovenia | 21.0  | 4     | Russia | 12.7 |
| 5     | Estonia | 20.2  | 5     | Croatia | 12.0 |
| 6     | Russia | 19.4  | 6     | Latvia | 11.8 |
| 7     | Latvia | 19.2  | 7     | Slovenia | 11.7 |
| 8     | New Zealand | 18.3  | 8     | Estonia | 10.9 |
| 9     | Ireland | 17.7  | 9     | Israel | 10.6 |
| 10    | Spain | 17.5  | 10    | Ireland | 10.6 |
| 11    | Germany | 16.9  | 11    | China (Hong Kong) | 10.5 |
| 12    | China (Hong Kong) | 16.8  | 12    | Austria | 10.2 |
| 13    | Austria | 16.3  | 13    | Singapore | 9.9 |
| 14    | Japan | 15.8  | 14    | Japan | 9.6 |
| 15    | Romania | 15.6  | 15    | Canada | 9.6 |
| 16    | Australia | 15.2  | 16    | Italy | 9.2 |
| 17    | France | 14.8  | 17    | Romania | 9.1 |
| 18    | UK | 14.8  | 18    | UK | 9.1 |
| 19    | Canada | 14.8  | 19    | Austria | 9.0 |
| 20    | Israel | 14.5  | 20    | Spain | 9.0 |
| 21    | Korea | 12.7  | 21    | France | 8.7 |
| 22    | Singapore | 12.6  | 22    | Kazakhstan | 8.5 |
| 23    | Kazakhstan | 12.1  | 23    | US | 8.1 |
| 24    | US | 11.9  | 24    | Korea | 7.5 |
| 25    | Brazil | 9.5  | 25    | South Africa | 4.5 |
| 26    | Mexico | 4.0  | 26    | Ecuador | 3.5 |
| 27    | Ecuador | 3.4  | 27    | Mexico | 3.4 |

WHO indicates World Health Organization; UK, United Kingdom; US, United States.
*Rates for Brazil, Canada, Israel, and New Zealand are for 2004 and those for Australia are for 2003.
| COUNTRY        | INITIATIVE TYPE | MODALITY | NAME OF INITIATIVE | REGION(S) | TARGET POPULATION | AGE RANGE, YEARS | TARGET POPULATION | FUNDING SOURCE | YEAR ACTIVITY BEGAN |
|---------------|----------------|----------|--------------------|-----------|-------------------|------------------|-------------------|----------------|---------------------|
| Belgium       | Research       | FS       | Screening for CRC  | All       | HMO members       | 50-75            | 10,000            | S              | 1993                |
| Czech Republic| Program        | FOBT     | National Program of Screening for CRC | All | Population visiting FP | 50-+ | 3,700,000 | CG, HI | 2001 |
| Denmark       | Research       | FOBT     | Randomized Study of Screening for CRC with FOBT | Funen | Resident population | 45-75 | 140,000 | PC, CG | 1985 |
| France        | Research       | FOBT     | Burgundy Study     | Burgundy, Saône-et-Loire | Resident population | 45-74 | 155,000 | CG, HI | 1988 |
|               | Pilot          | FOBT     | National Program for CRC | 22 Départements | Resident population | 50-74 | 4,500,000 | CG, HI | 2003 |
| Israel        | Program        | FOBT     | CHS National CRC Screening Program | All | HMO members | 50-74 | 700,000 | HMO | 1993 |
| Italy         | Research       | FS       | SCORE              | Arezzo, Biella, Genova, Milan, Rimini, Turin | Volunteers | 55-64 | 256,000 | PC | 1995 |
|               | Pilot          | FOBT     | SCORE 2            | Biella, Florence, Milan, Rimini, Turin | Resident population | 55-64 | 122,000 | LG, PC | 1999 |
| Program       | FOBT           | NHS Funded Regional Screening Program | Tuscany | Residential population of 7 local health units | 50-70 | 969,000 | LG | 2000 |
| Program       | FOBT           | NHS Funded Regional Screening Program | Veneto | Resident population of 4 local health units | 50-69 | 173,000 | LG | 2002 |
| Research      | FOBT TC        | Accademia Multidisciplinare Oncologia Digestiva (AMOD) | 65 FP centers within 9 regions | FP patients | 55-64 | 98,992 | PC | 2002 |
| Program       | FS             | Un’occhiata ti salva la vita | Veneto | Residential population of 1 local health unit | 60 | 5000 | LG | 2003 |
| Research      | FOBT TC        | SCORE 3  | Biella, Florence, Milan, Rimini, Turin, Verona | Resident population | 55-64 | 122,000 | LG, PC | 2003 |
| Program       | FOBT           | NHS Funded Regional Screening Program (Prevenzione Serena) | Turin, Novara | Resident population | 58 | 17,900 | LG | 2003 |
|               | FS             | NHS Funded Regional Screening Program (Prevenzione Serena) | Turin | Resident population | 59-69 | 125,000 | LG | 2004 |
| Norway        | Research       | FS only FOBT | NORCCAP-1 | Oslo, Telemark | Resident population | 50-64 | 100,000 | CG, PC | 1999 |
| Poland        | Program        | TC       | Colonoscopic CRC Screening | All | FP patients | 50-65 | 6,500,000 | CG | 2000 |
| COUNTRY       | INITIATIVE TYPE | MODALITY | NAME OF INITIATIVE                      | REGION(S)                        | TARGET POPULATION | AGE RANGE, YEARS | TARGET POPULATION | FUNDING SOURCE | YEAR ACTIVITY BEGAN |
|--------------|----------------|----------|----------------------------------------|----------------------------------|--------------------|-----------------|-------------------|-----------------|---------------------|
| Spain        | Pilot          | FOBT     | Catalan CRC Pilot Screening Programme  | Catalonia, l’Hospitalet          | Resident population| 50-69           | 69,000            | LG              | 2000                |
| Research     | FOBT           |          | Sigmoidoscopy Screening Research Project| Catalonia, Vilafrańca del Penedés | Resident population| 50-69           | 4726              | LG              | 2004                |
|              | FS             |          | Sigmoidoscopy Screening Research Project| Catalonia, Vilafrańca del Penedés | Resident population| 50-69           | 2023              | LG              | 2004                |
| Switzerland  | Research       | FOBT     | —                                      | Glarus, Vallée du Joux, Uri      | Resident population| 50-80           | 20,000            | O               | 2000 F              |
| UK           | Research       | FOBT     | The Nottingham CRC Screening Trial     | Nottingham, England              | FP patients        | 45-74           | 153,000*          | CG              | 1981                |
| Research     | FS             |          | UK FS Screening Trial                  | 14 areas in England, Scotland, and Wales | FP patients        | 55-64           | 376,000           | CG, PC          | 1996                |
| Pilot        | FOBT           |          | The UK Pilot of CRC Screening         | England (3 areas) and northeast Scotland (2 areas) | Resident population| 50-69           | 476,000           | CG              | 2000                |
| Research     | FS             |          | Nurses Led FS Screening Study          | Harrow, North London             | FP patients        | 60-64           | 500               | PC              | 2003                |
| The Americas |               |          |                                        |                                  |                    |                 |                   |                 |                     |
| Canada       | Program        | FS       | Colon Cancer Detection Clinic          | Ontario                          | FP patients        | 50+             | 500,000           | HI              | 1999                |
| Pilot        | FOBT           |          | Ontario FOBT Pilot Study               | Ontario                          | 6 regions of FP patients, public health units | 50-75           | 440,000           | LG              | 2004                |
| US           | Research       | FS       | PLCO Cancer Screening Trial            | 10 states                        | 10 clinical centers| 55-74           | 154,000           | CG              | 1993                |
| Program      | FS             |          | CoCaP (Kaiser Permanente)              | Northern California              | HMO members        | 50+             | 500,000           | CG, HMO, O       | 1994                |
| Pilot        | FOBT           |          | FOBT in Veterans Affairs               | All                              | Veterans Affairs patients | 50+             | 30,000            | CG              | 2000                |
| Research     | TC             |          | National Colonoscopy Study (Phase I)   | 3 states                         | HMO members, wellness clinic, resident population | 50-64           | 975,000           | CG              | 2000                |
| Western Pacific |           |          |                                        |                                  |                    |                 |                   |                 |                     |
| Australia    | Pilot          | FS       | FS for CRC in Average-Risk Subjects    | Fremantle, Western Australia     | Resident suburban population | 55-64           | 80,000            | LG              | 1995                |
| Research     | FOBT           |          | Relative performance and acceptability of FOBT types | Adelaide, South Australia | Southern residential population | 50+             | 100,000           | CG, PC, O         | 1997                |
| Pilot        | FOBT           |          | The Australian Bowel Cancer Screening Pilot | Melbourne, Victoria; Adelaide, South Australia; MacKay, Queensland | Resident population | 55-74           | 57,000            | LG, CG           | 2002                |
free mass colorectal cancer screening available under its national health insurance program.\textsuperscript{45} In contrast, most Asian countries have very little governmental support for colorectal cancer screening and lack any kind of colorectal cancer screening initiative, including screening guidelines (eg, Brunei, China, India, Indonesia, Malaysia, the Philippines, Thailand, and Vietnam).\textsuperscript{45}

The need for mass colorectal cancer screening in the economically developing countries of Asia, South America, and Africa is occasionally questioned given the lower rates of colorectal cancer, the substantial burden of communicable diseases, and the limited resources in these areas.\textsuperscript{46} However, because colorectal cancer mortality rates are increasing in many economically developing countries, particularly those that are transitioning to Western lifestyles or have aging populations, consideration of implementing targeted screening for colorectal cancer is likely to increase over time.

Conclusions

Worldwide, colorectal cancer incidence rates are highest in the registries of newly economically developed countries such as the Czech Republic and Slovakia in Eastern Europe, and also remain high in longstanding, economically developed countries such as Japan and Australia as well as the majority of registries in Western Europe and North America. Decreasing colorectal cancer mortality rates, most likely due to colorectal cancer screening and/or improved treatment, have been observed in a large number of countries examined; however, increases in mortality rates are still occurring in countries that may have more limited resources, including Mexico and Brazil in South America and Romania and Russia in Eastern Europe, compared with longstanding, economically developed countries.

The current study was limited by data availability, because incidence data are not available for all countries and in most instances are only region-specific. Although mortality data are more complete, it is possible that the increasing mortality trends noted in some countries could be the result of improvements in death certification systems or data abstraction.

The increasing prevalence of obesity and decreasing physical activity in many parts of the world, resulting from “Westernization,” will likely continue to contribute to the growing international colorectal cancer burden if these behaviors are not modified. In addition, as people continue to live longer, colorectal cancer will become an even greater public health problem worldwide. Colorectal cancer screening has been proven to greatly reduce mortality and in some instances may prevent the onset of disease through the removal of precancerous polyps. The variety of existing screening tests makes colorectal cancer screening accessible for most countries, and therefore, greater international consideration of targeted screening programs and/or screening recommendations could help to alleviate the burden of colorectal cancer worldwide.
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