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ORIGINAL ARTICLE

# Evaluating the strength of potential misplaced priorities in opportunistic cancer screening practice in Greece

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## Summary

***Purpose:*** *Screening is a significant method for cancer control, nevertheless the implementation of non cost-effective screening tests at national level may constitute a major burden to health economics. The purpose of this study was to determine the cancer screening activities of a large sample of the Hellenic population, in a country with opportunistic screening practice.*

***Methods:*** *A large survey on cancer screening in Greece was organized and conducted by the Panhellenic Association for Continual Medical Research (PACMeR). Screening performance of evidence-based (EB), non-evidence-based (non EB) and of undefined benefit tests was analysed.*

***Results:*** *7001 individuals were analysed. Eighty-eight percent of males and 93% of females stated that they were interested in cancer screening practices. Gynecological cancer screening was performed in the range of 23-38%. Colorectal cancer screening was rarely performed in both genders (1-2%), while non-evidence-based tests were regularly performed (urinalysis 50% and chest radiography 15-18%). Full blood count and PSA measurement were widely accepted (over 45% in both genders and 19.5% in males, respectively). Sociodemographic characteristics did not influence the performance of EB tests in males while females' activities were highly influenced by such parameters.*

***Conclusion:*** *Opportunistic cancer screening in a primary health care system where national guidelines are missing may cause ambiguous results. Reconsideration of health policy in such cases is mandatory.*

**Key words:** cancer, cost-effectiveness, evidence-based, health policy, screening

## Introduction

Cancer is a major public health problem worldwide and the second most common cause of death in Europe. The magnitude of the cancer care cost is impressive. Total cancer-related spending in the US for patients younger than 65 years was estimated at $20.08 billion for 1996-1999 in 2001 dollars [1]. This amount will be even higher in the coming years since more effective but considerably more expensive treatments have already been incorporated in the daily oncological practice. Thus, the need for a better and more reasonable management of cancer spending seems mandatory.

Screening is a significant method for cancer control. For many cancer sites, detection of cancer early in the course of the disease, when treatment is more likely to be successful, improves survival. The survival benefit of screening is strongly documented for breast, colon and cervical cancer [2-6], whereas there is conflicted evidence for other cancers sites [7-9]. The participation of all population in cancer screening programs is of utmost importance since the benefits of a screening program are achieved only if participation is high [10].

Anyhow all medical procedures have a cost and sweeping statements about cost-saving potential of prevention may be overreaching. Studies have concluded that preventing illness can in some cases save money but in other cases can add to health care costs [11]. Con-

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sidering both the worrisome proportion of health care expenses, and specifically imaging costs, are increasing [12], and the potential health and economic consequences of misplaced priorities [11,13], the implementation of non cost-effective screening tests at national level may constitute a major burden to health economics.

In this setting, it is crucial for each nation to assess the actual population coverage of EB, non EB and of undefined benefit screening practices. This will lead to the identification of avoidable expenses and to the development of cost-effective nationwide screening programs. As a matter of fact, in many countries useless tests practice may overcome costs needed for a screening implementation based on cost-effective tests. Anyhow, the inquiring lack of data and related survey studies [13] should not surprise; as suggested by Woolf et al. [14] "for every dollar spent on developing treatments, only one penny is spent to ensure how treatments will reach patients".

There are two main modalities to implement screening policy at national level: the policy of opportunistic screening (largely used worldwide and in USA) which is mainly based on spontaneous screening recommended by general practitioners; and the policy of centralized invitational screening (diffused in north and western Europe) in which early detection procedures are mainly demanded by national/regional screening programs in which the population is periodically invited to undergo predetermined preventive tests [15].

Due to its structure, the policy of opportunistic screening is more fragile and exposed to a higher chance of implementation of screening tests of no benefit. Additionally, considering that the opportunistic screening practice is implemented both in areas with well defined national guidelines for physicians (like USA and Canada), and in areas in which national recommendation for physicians may be less strict or completely absent, we can hypothesise that in the latter areas we have a still higher possibility for under-implementation of useful tests and over-implementation of tests of no evidence.

It seems therefore obvious that in case of opportunistic screening policy, especially in the absence of relative national recommendations, the need to identify and estimate possible avoidable costs is still higher. This means to reveal both which tests will reach the population for screening purposes and the actual population coverage.

In order to estimate the dynamics of screening activities in the Hellenic Health Care System we analysed the screening practices of EB, non EB and of undefined benefit tests among a large population sample in Greece, a country with opportunistic screening practice and without national guidelines.

## Methods

PAcMeR_02 trial is a large survey on cancer screening and preventive practices in Greece which was organized by the PACMeR. PACMeR physicians prepared for the project two medical questionnaires (one for men and one for women) for face-to-face interviews that were used during the research program.

The project was approved by PAcMeR's scientific committee and conformed to the ethical guidelines of the 1975 Declaration of Helsinki. Written informed consent was obtained from all the participants before completing the study questionnaire and the data retrieved were analysed in anonymous and codified form.

### *Population*

The sample consisted of apparently healthy adults able to accompany or visit their relatives while getting healthcare in hospitals and Health Centers in 30 Hellenic provinces. Eligible adults were considered all healthy or apparently healthy individuals (ECOG performance status 0-1) who were visiting the above-mentioned health institutions for reasons not pertaining to personal health. A total number of 7012 Greek individuals were surveyed and answered the questionnaires during a face-to-face interview between 2000 and 2005.

Ninety-two physicians employed in primary care activities were involved in the study, 87 of them as interviewers and 5 as data managers and quality control personnel. Data storing was assured by SESy, a dedicated database tailored to population-based cross-sectional surveys for cancer prevention and screening assessment [16-18]. Analysis was performed separately by gender.

### *Definitions and outcomes*

*EB tests:* For males, EB screening tests included fecal occult blood test (FOBT) and sigmoidoscopy/colonoscopy (SIG/COL); for females Pap test (PAP), clinical breast examination (CBE), mammography (MRX), FOBT and SIG/COL.

*non-EB tests:* For males chest x-ray (CXR), urinalysis, testicular examination (TESTIC) and transrectal ultrasound (TRUS) were included, while for females self breast examination (SBE), breast ultrasound (USB), CXR and urinalysis.

*Undefined evidence (UE) tests:* Full blood count (FBC), skin examination (SKIN), digital rectal examination (DRE) were included for both genders and PSA for males.

We considered a test as performed for "screening purpose" only if it was practiced for check-up in asymptomatic individuals within the following intervals:

1) 2 years for CBE, MRX, USB, SBE, PSA, TRUS, TESTIC, DRE, SKIN, FOBT
2) 3 years for PAP test
3) 5 years for SIG/COL

Tests performed in other time intervals or in any setting different form asymptomatic control were defined as "occasional/control tests".

Consequently, we investigated the frequency a test was performed. The percent of population stating that performed the test periodically every year or in 1-2 years was investigated. This is the case for all the tests except SBE where medical advice for the period of less than 2 years and for 3-5 years was assessed. In case of sigmoidoscopy and colonoscopy time intervals of less than 5 years and 5-10 years were considered.

In order to better clarify the impact of non EB and UE tests on overall test performance, we analysed the proportion of tests performed by each individual in 3 screening performance settings defined as follows:

1) Indiscriminate performance of tests for cancer screening purpose (any test)
2) Performance of any test except non EB ones
3) Performance of EB test only

*Subgroup analysis*

Trying to investigate possible relationships between the proportion of tests performed in the 3 screening settings and sociodemographic parameters, subgroup analysis was performed according to age, obesity, educational, smoking and drinking patterns, community and geographical distribution, profession, family status, number of children and cancer family history.

*Statistical analysis*

Statistical analysis of data was based on Pearson's $x^2$ analysis and Fisher's exact test. The results are presented as mean values ± standard deviations. A probability value of less than 1% was considered significant (p-value <0.01) to reduce possible biases due to multitest analyses.

## Results

From August 2000 to January 2005, 7012 surveyed individuals entered the database and 7001 presented data available for analyses (3364 males and 3637 females). The population characteristics are reported in Table 1 while the performance rates for each screening tests and the related performance frequency are reported in Table 2. Of the population analysed, 88% of males and 93% of females declared to be interested in cancer screening practices.

**Table 1.** Population characteristics

| *Characteristics* | *Subgroups Categories* | *Males (n=3364) %* | *Females (n=3637) %* |
|---|---|---|---|
| Age (years) | ≤ 49 | 4.1 | 29.2 |
| | 50-59 | 32.8 | 26.8 |
| | 60-69 | 32.3 | 25.6 |
| | ≥ 70 | 30.8 | 18.4 |
| BMI | < 24.9 | 25.7 | 32.3 |
| | 25-29 | 54.3 | 44.0 |
| | ≥ 30 | 20.0 | 23.7 |
| Education | Compulsory | 59.3 | 60.5 |
| | Higher education | 40.7 | 39.5 |
| Community | Urban | 43.0 | 46.2 |
| | Non urban | 57.0 | 53.8 |
| Land type | Mainland | 74.7 | 71.8 |
| | Aegean islands | 1.4 | 1.5 |
| | Ionian islands | 3.9 | 7.1 |
| | Crete | 20.0 | 19.5 |
| No. of children | 0 | 6.6 | 7.9 |
| | 1-2 | 60.0 | 61.6 |
| | ≥ 3 | 33.4 | 30.5 |
| Family status | Married | 92.3 | 87.7 |
| | Not married | 7.7 | 12.3 |
| Profession | Craftsmen | 11.6 | 3.1 |
| | Clerks | 18.6 | 20.5 |
| | Freelance prof. | 12.6 | 5.0 |
| | Scientists | 3.6 | 1.7 |
| | Farmers | 25.2 | 10.5 |
| | Housewives | 0.0 | 46.5 |
| | Pensioners | 21.7 | 10.0 |
| | Other | 6.6 | 2.8 |
| Alcohol | No | 37.8 | 81.8 |
| | Consumers | 57.4 | 17.8 |
| | Ex-consumers | 4.7 | 0.4 |
| Smoking | No | 41.1 | 75.9 |
| | Smokers | 38.9 | 21.1 |
| | Ex-smokers | 20.0 | 3.0 |
| Smoking quantity | NA+ No smokers | 44.8 | 77.4 |
| | Up to 1 pack | 7.9 | 7.2 |
| | 1-2 packs | 27.3 | 12.2 |
| | > 2 packs | 20.0 | 3.2 |
| Cancer family history | Positive | 29.7 | 36.4 |
| | Negative | 70.3 | 63.6 |

BMI: body mass index, NA: not assessed

Overall, 38% of the reviewed population received medical consultation in the last 2 years. Gynecological cancer screening was performed in the range of 23-38% for MRX and PAP test, respectively. These rates are lower when we consider the frequency they were performed (18.5% for MRX and 36% for PAP test). Colorectal cancer screening was rarely performed in both genders with both SOBT and SIG/COL being in the range of 1-2%. Non EB were highly performed: urinalysis (50% of the

**Table 2.** Performance rates of tests in different settings and performance frequency of screening tests

| *Gender* | *Test* | *Setting* | *Last test %* | *Frequency (years)* | *Individuals %* |
|---|---|---|---|---|---|
| ♀ | Medical consultation | Never done | 7.5 | < | 45.9 |
| | | Any cause | 43.4 | 1-2 | 7.4 |
| | | Screening | 37.9 | | |
| ♀ | PAP | Never done | 27.5 | < 1 | 27.7 |
| | | Any cause | 60.5 | 1-2 | 8.1 |
| | | Screening | 39.6 | | |
| ♀ | MRX | Never done | 54.7 | < 1 | 10.3 |
| | | Any cause | 32.3 | 1-2 | 8.2 |
| | | Screening | 22.8 | | |
| ♀ | CBE | Never done | 46.0 | < 1 | 16.3 |
| | | Any cause | 38.2 | 1-2 | 5.2 |
| | | Screening | 27.9 | | |
| ♀ | FOBT | Never done | 88.4 | < 1 | 0.6 |
| | | Any cause | 3.1 | 1-2 | 0.3 |
| | | Screening | 1.4 | | |
| ♀ | SIG/COL | Never done | 90.1 | < 5 | 0.9 |
| | | Any cause | 1.5 | 5-10 | 1.6 |
| | | Screening | 1.2 | | |
| ♀ | Urine | Never done | 6.2 | < 1 | 45.3 |
| | | Any cause | 60.3 | 1-2 | 6.5 |
| | | Screening | 52.3 | | |
| ♀ | CXR | Never done | 17.2 | < 1 | 7.3 |
| | | Any cause | 27.9 | 1-2 | 2.2 |
| | | Screening | 15.0 | | |
| ♀ | SBE | No | 37.1 | M. Adv. < 2 | 28.3 |
| | | Any cause | 39.7 | M. Adv. 3-5 | 55.6 |
| | | Regularly | 38.1 | | |
| ♀ | FBC | Never done | 1.7 | < 1 | 60.5 |
| | | Any cause | 51.3 | 1-2 | 6.5 |
| | | Screening | 46.7 | | |
| ♀ | USB | Never done | 81.6 | < 1 | 4.1 |
| | | Any cause | 10.7 | 1-2 | 2.1 |
| | | Screening | 7.6 | | |
| ♀ | Skin | Never done | 75.1 | < 1 | 2.2 |
| | | Any cause | 2.2 | 1-2 | 1.1 |
| | | Screening | 1.5 | | |
| ♀ | DRE | Never done | 84.6 | < 1 | 1.6 |
| | | Any cause | 4.0 | 1-2 | 0.5 |
| | | Screening | 2.3 | | |
| ♂ | Medical consultation | Never done | 9.4 | < 1 | 42.0 |
| | | Any cause | 42.8 | 1-2 | 7.4 |
| | | Screening | 37.8 | | |
| ♂ | FOBT | Never done | 90.0 | < 1 | 0.7 |
| | | Any cause | 3.3 | 1-2 | 0.4 |
| | | Screening | 1.6 | | |
| ♂ | SIG/COL | Never done | 90.5 | < 5 | 1.0 |
| | | Any cause | 2.0 | 5-10 | 2.0 |
| | | Screening | 1.7 | | |
| ♂ | Urine | Never done | 10.1 | < 1 | 40.8 |
| | | Any cause | 56.3 | 1-2 | 6.6 |
| | | Screening | 48.6 | | |
| ♂ | CXR | Never done | 14.5 | < 1 | 8.9 |
| | | Any cause | 29.7 | 1-2 | 3.6 |
| | | Screening | 17.8 | | |

*Continued on next page*

| *Gender* | *Test* | *Setting* | *Last test %* | *Frequency (years)* | *Individuals %* |
|---|---|---|---|---|---|
| ♂ | TRUS | Never done | 73.1 | < 1 | 5.5 |
| | | Any cause | 11.6 | 1-2 | 1.4 |
| | | Screening | 8.9 | | |
| ♂ | FBC | Never done | 3.7 | < 1 | 55.0 |
| | | Any cause | 52.7 | 1-2 | 6.4 |
| | | Screening | 47.1 | | |
| ♂ | PSA | Never done | 61.0 | < 1 | 13.7 |
| | | Any cause | 23.5 | 1-2 | 2.7 |
| | | Screening | 19.5 | | |
| ♂ | Testicular | Never done | 82.5 | < 1 | 2.2 |
| | | Any cause | 8.4 | 1-2 | 0.8 |
| | | Screening | 6.4 | | |
| ♂ | Skin | Never done | 81.1 | < 1 | 1.4 |
| | | Any cause | 2.3 | 1-2 | 0.7 |
| | | Screening | 1.2 | | |
| ♂ | DRE | Never done | 65.7 | < 1 | 4.7 |
| | | Any cause | 11.2 | 1-2 | 1.6 |
| | | Screening | 7.3 | | |

PAP: Papanicolaou test, MRX: Mammography, CBE: Clinical Breast Examination, FOBT: Fecal Occult Blood Test, SIG/COL: sigmoidoscopy/colonoscopy, CXR: chest x-ray, SBE: Self Breast Examination, FBC: Fool Blood Count, USB: Breast Ultrasound, DRE: Digital Rectal Examination, M. Adv: medical advice

population performed and repeated it in the last 2 years) and CXR (15-18% of the population). The rest of non-cost effective tests were performed in less than 10% of the surveyed population. Considering UE tests, FBC was regularly performed in both genders, PSA was widely accepted as screening tool in men (19.5%), while skin examination was rarely performed.

When we tried to assess the overall impact of non EB and UE tests on overall test performance, by analysing the proportion of tests performed by each individual in the 3 above-defined screening performance settings the results were quite interesting (Table 3 and 4).

In the first setting (indiscriminate performance) the proportion of men who never underwent any screening test was 34.7%, while the proportion of those who underwent 1-3 tests, 4-6 tests and 7-10 tests was 54.5, 9.9 and 0.9%, respectively. When non EB tests were excluded (second setting), the rate of men who never underwent a screening test increased up to 45%. The proportion of men who performed 1-3 tests was steady (53.9%), while the proportion of individuals who performed 4-8 tests was decreased to 1%. Finally, when only EB screening tests were included, the rate of individuals who never underwent EB test was 97.3%, while only 2.7% of men performed 1-3 EB tests. The results concerning the EB screening tests were not influenced by sociodemographic parameters, while the first 2 groups were highly influenced by such factors (Table 3).

The same analysis in indiscriminate performance setting for females revealed that 18.1% of women had never undergone any screening test, while the rate of women who underwent 1-3 tests, 4-6 tests and 7-10 tests were 52.3, 25.9 and 3.7%, respectively. With the exclusion of non EB screening tests, the proportion of women who never underwent screening test raised to 32.6%, while the proportion of those who underwent 1-3 tests remained almost the same (56.9%). When only EB tests were included, the proportion of women with no test raised more (52%), while at the same time there was a decrease in the proportion of women who underwent 1-3 and 4-5 EB tests (47.3 and 0.7%, respectively). Contrary to men, subgroup analysis revealed that there were different screening practices between the various groups of women. Thus, younger women of lower body mass index (BMI), of higher educational status, scientists, clerks and freelance professionals, women living in mainland and in urban communities, married with 1-2 sons, smokers of 1-2 packs per day seemed to perform more frequently EB tests (Table 4).

## Discussion

To the best of our knowledge, this study is the first that tried to estimate the proportion of performance of no benefit tests during opportunistic screening practice in an country without national guidelines. A worrisome implementation of avoidable tests was identified. This is of extreme importance since the implementation of a non cost-effective screening test at national level may

**Table 3.** Impact of non-EB and UE tests on overall test performance and sociodemographic subgroup analysis in males

| *Subgroups* | *Categories* | *No. Screen test per patient (all tests included)* | | | | | *No. Screen test per patient (non-evidence based tests excluded)* | | | | *No. Screen test per patient (evidence-based tests only)* | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *None %* | *1-3 %* | *4-6 %* | *7-10 %* | *p-value* | *None %* | *1-3 %* | *4-8 %* | *p-value* | *None %* | *1-3 %* | *p-value* |
| All | | 34.7 | 54.5 | 9.9 | 0.9 | | 45.1 | 53.9 | 1.0 | | 97.3 | 2.7 | |
| Age (years) | ≤49 | 44.9 | 50.0 | 5.1 | 0.0 | | 51.4 | 48.5 | 0.0 | | 97.8 | 2.8 | |
| | 50-59 | 35.3 | 54.5 | 9.7 | 0.5 | 0.0415 | 45.0 | 54.0 | 1.0 | 0.7383 | 97.3 | 2.7 | 0.8822 |
| | 60-69 | 35.2 | 52.9 | 10.4 | 1.2 | | 45.2 | 53.8 | 1.0 | | 97.6 | 2.4 | |
| | ≥70 | 32.0 | 56.8 | 10.1 | 1.1 | | 44.4 | 54.6 | 1.0 | | 97.1 | 2.9 | |
| BMI | ≤24.9 | 37.2 | 54.32 | 8.01 | 0.5 | | 47.2 | 52.1 | 0.7 | | 97.6 | 2.4 | |
| | 25-29 | 35.2 | 53.51 | 10.1 | 1.1 | 0.0730 | 44.8 | 53.9 | 1.3 | 0.1613 | 97.0 | 2.9 | 0.4462 |
| | ≥30 | 31.7 | 55.52 | 12.0 | 0.8 | | 42.9 | 56.6 | 0.5 | | 97.9 | 2.1 | |
| Education | Compulsory | 38.8 | 53.1 | 7.4 | 0.8 | | 50.0 | 49.2 | 0.8 | | 97.7 | 2.3 | |
| | Higher | 29.1 | 56.3 | 13.5 | 1.1 | <0.0001 | 38.4 | 60.3 | 1.3 | <0.0001 | 96.8 | 3.2 | 0.1204 |
| Profession | Clerks | 30.9 | 56.4 | 11.9 | 0.8 | | 41.2 | 57.8 | 1.0 | | 97.3 | 2.7 | |
| | Freelance prof. | 34.0 | 57.5 | 7.7 | 0.7 | <0.0001 | 45.5 | 53.3 | 1.8 | <0.0001 | 98.4 | 1.6 | 0.1010 |
| | Farmers | 42.4 | 50.6 | 6.2 | 0.7 | | 45.3 | 45.3 | 0.7 | | 98.1 | 1.9 | |
| | Craftsmen | 40.8 | 51.3 | 7.4 | 0.5 | | 50.2 | 49.2 | 0.5 | | 97.2 | 2.8 | |
| | Scientists | 26.0 | 58.0 | 15.1 | 0.8 | | 35.3 | 63.9 | 0.8 | | 96.6 | 3.4 | |
| | Pensioners | 17.9 | 56.8 | 12.9 | 1.5 | | 38.8 | 59.7 | 1.5 | | 95.9 | 4.1 | |
| | Others | 31.9 | 53.5 | 14.2 | 0.4 | | 40.3 | 59.3 | 0.4 | | 98.2 | 1.7 | |
| Community | Urban | 33.6 | 54.5 | 10.9 | 1.0 | | 42.5 | 56.2 | 1.2 | | 97.4 | 2.6 | |
| | Non urban | 35.6 | 54.4 | 9.1 | 0.8 | 0.2702 | 47.2 | 52.0 | 0.7 | 0.0113 | 97.2 | 2.8 | 0.7137 |
| Land type | Mainland | 31.7 | 56.9 | 10.4 | 1.0 | | 42.2 | 57.9 | 1.1 | | 97.3 | 2.7 | |
| | Aegean islands | 54.3 | 30.4 | 15.2 | 0.0 | <0.0001 | 58.7 | 41.3 | 0.0 | <0.0001 | 95.6 | 4.3 | 0.1597 |
| | Ionian islands | 36.1 | 52.3 | 10.8 | 0.8 | | 49.2 | 50.0 | 0.8 | | 95.4 | 4.6 | |
| | Crete | 45.0 | 47.5 | 7.0 | 0.4 | | 55.2 | 44.2 | 0.6 | | 98.3 | 1.6 | |
| Children | No | 36.4 | 50.0 | 12.1 | 1.4 | | 50.0 | 48.1 | 1.9 | | 96.3 | 3.7 | |
| | 1-2 | 33.0 | 55.5 | 10.8 | 0.8 | 0.0632 | 42.5 | 56.6 | 0.9 | 0.0080 | 97.4 | 2.6 | 0.5993 |
| | ≥3 | 36.5 | 54.6 | 7.9 | 0.9 | 0.0632 | 48.1 | 51.0 | 0.9 | | 97.3 | 2.7 | |
| Family status | Married | 34.1 | 55.1 | 9.9 | 0.8 | | 44.6 | 54.5 | 0.9 | | 97.3 | 2.7 | |
| | Other | 42.4 | 47.5 | 8.9 | 1.2 | 0.0503 | 52.1 | 46.7 | 1.2 | 0.0550 | 97.3 | 2.7 | 0.9532 |
| Alcohol | Absteiners | 30.8 | 57.0 | 11.0 | 1.1 | | 42.3 | 56.4 | 1.3 | | 97.1 | 2.9 | |
| | Consumers | 36.9 | 52.9 | 9.4 | 0.8 | 0.0079 | 46.1 | 53.1 | 0.8 | 0.0582 | 97.5 | 2.5 | 0.6432 |
| | Ex consumers | 31.2 | 61.1 | 7.6 | 0.0 | | 49.0 | 51.0 | 0.0 | | 98.1 | 1.9 | |
| Ethanol (gr) | 0 | 33.9 | 54.7 | 10.5 | 0.9 | | 45.5 | 53.5 | 1.0 | | 97.2 | 2.8 | |
| | ≤39 | 34.8 | 55.1 | 8.8 | 1.2 | 0.0819 | 44.7 | 54.4 | 0.8 | 0.3972 | 97.7 | 2.3 | 0.7858 |
| | ≥40 | 42.8 | 48.3 | 8.5 | 0.4 | | 51.3 | 48.0 | 0.7 | 0.3972 | 97.4 | 2.6 | |
| Smoking | No smokers | 29.3 | 56.1 | 13.2 | 1.3 | | 40.0 | 58.8 | 1.2 | | 96.6 | 3.4 | |
| | Smokers | 41.7 | 36.0 | 6.9 | 0.7 | <0.0001 | 50.7 | 48.4 | 0.7 | <0.0001 | 97.8 | 2.2 | 0.0971 |
| | Ex-smokers | 30.5 | 60.1 | 9.1 | 0.3 | | 43.5 | 55.6 | 0.9 | | 97.9 | 2.1 | |
| Smoking quantity (packs daily) | No + NA | 30.4 | 55.5 | 12.9 | 1.2 | | 41.5 | 57.3 | 1.3 | | 96.7 | 3.3 | |
| | < 1 | 28.8 | 62.1 | 8.7 | 0.4 | <0.0001 | 40.1 | 59.1 | 0.8 | 0.0002 | 97.0 | 3.0 | 0.1165 |
| | 1-2 | 38.7 | 52.8 | 7.9 | 0.5 | | 48.7 | 50.5 | 0.8 | | 98.1 | 1.8 | |
| | > 2 | 41.6 | 51.3 | 6.4 | 0.7 | | 51.0 | 48.4 | 0.6 | | 97.9 | 2.1 | |
| Cancer family history | Negative | 35.6 | 54.3 | 9.3 | 0.7 | | 45.9 | 53.3 | 0.8 | | 97.6 | 2.4 | |
| | Positive | 32.6 | 54.9 | 11.2 | 1.2 | 0.0908 | 43.6 | 55.2 | 1.2 | 0.2926 | 96.7 | 3.3 | 0.1346 |

BMI: body mass index, NA: not assessed

constitute a major burden to health economics. Thereafter, despite that in certain settings preventing illness can save money, our study clearly evidenced that uncontrolled opportunistic screening can notably add to health care costs without any additional health benefit.

Inquiringly, despite the potential health and economic consequences of misplaced priorities [11,13], there are only few studies in medical literature exploring how and especially which tests will reach patients for screening purpose [13]. This is of major importance

**Table 4.** Impact of non-EB and UE tests on overall test performance and sociodemographic subgroup analysis in females

| *Subgroups* | *Categories* | *No. Screen test per patient (all tests included)* | | | | | *No. Screen test per patient (non-evidence based tests excluded)* | | | | *No. Screen test per patient (evidence-based tests only)* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *None %* | *1-3 %* | *4-6 %* | *7-10 %* | *p-value* | *none %* | *1-3 %* | *4-8 %* | *p-value* | *none %* | *1-3 %* | *4-5 %* | *p-value* |
| All | any | 18.1 | 52.3 | 25.9 | 3.7 | | 32.6 | 56.9 | 10.5 | | 52.0 | 47.3 | 0.7 | |
| Age (years) | ≤49 | 12.0 | 48.5 | 33.8 | 5.7 | | 22.3 | 62.9 | 14.83 | | 32.6 | 67.14 | 0.3 | |
| | 50-59 | 14.5 | 47.0 | 33.6 | 4.8 | | 27.4 | 58.1 | 14.51 | | 42.0 | 56.7 | 1.3 | |
| | 60-69 | 22.7 | 56.0 | 19.1 | 2.2 | | 40.0 | 53.3 | 6.79 | | 64.2 | 35.2 | 0.5 | |
| | ≥70 | 26.7 | 60.7 | 11.7 | 0.9 | <0.0001 | 46.8 | 50.3 | 2.85 | <0.0001 | 80.8 | 18.5 | 0.7 | <0.0001 |
| BMI | ≤24.9 | 16.3 | 51.2 | 28.1 | 4.3 | | 29.6 | 58.0 | 12.45 | | 47.15 | 52.2 | 0.7 | |
| | 25-29 | 18.3 | 52.1 | 26.2 | 3.3 | | 32.2 | 57.4 | 10.34 | | 52.2 | 47.3 | 0.8 | |
| | ≥30 | 20.0 | 54.5 | 22.1 | 3.4 | 0.0538 | 36.6 | 53.5 | 9.87 | 0.0161 | 57.9 | 41.4 | 0.6 | 0.0003 |
| Education | Compulsory | 22.3 | 56.4 | 19.6 | 1.7 | | 39.7 | 53.8 | 7.09 | | 61.9 | 37.4 | 0.7 | |
| | Higher | 11.9 | 46.3 | 35.8 | 6.6 | <0.0001 | 22.6 | 61.5 | 15.98 | <0.0001 | 37.1 | 62.1 | 0.8 | <0.0001 |
| Profession | Clerks | 12.9 | 45.4 | 34.4 | 7.2 | | 22.2 | 62.5 | 15.28 | | 34.3 | 64.8 | 0.8 | |
| | Freelance prof. | 14.3 | 46.7 | 35.2 | 3.8 | | 23.6 | 63.2 | 13.18 | | 38.5 | 60.2 | 1.1 | |
| | Farmers | 26.8 | 55.3 | 16.6 | 1.3 | | 42.6 | 50.5 | 6.84 | | 66.6 | 33.2 | 0.3 | |
| | Craftsmen | 15.9 | 49.6 | 31.9 | 2.6 | | 27.4 | 60.4 | 12.39 | | 50.4 | 48.7 | 0.9 | |
| | Scientists | 4.9 | 42.6 | 47.5 | 4.9 | | 19.7 | 59.0 | 21.31 | | 31.1 | 68.8 | 0.0 | |
| | Housewives | 18.0 | 56.2 | 22.8 | 2.9 | | 35.1 | 55.9 | 9.05 | | 56.5 | 42.5 | 1.0 | |
| | Others | 23.1 | 50.9 | 23.3 | 2.8 | <0.0001 | 38.4 | 53.2 | 8.41 | <0.0001 | 60.6 | 39.4 | 0.0 | <0.0001 |
| Community | Urban | 17.0 | 50.0 | 28.8 | 4.7 | | 31.2 | 56.4 | 12.37 | | 48.0 | 51.4 | 0.6 | |
| | Non urban | 19.0 | 54.3 | 23.4 | 3.3 | 0.0006 | 33.8 | 57.3 | 8.95 | 0.0026 | 55.4 | 43.7 | 0.9 | <0.0001 |
| Land type | Mainland | 17.3 | 51.2 | 27.7 | 3.81 | | 30.8 | 57.9 | 11.27 | | 49.2 | 50.1 | 0.7 | |
| | Aegean Islands | 14.5 | 54.5 | 21.8 | 9.1 | | 23.6 | 65.4 | 10.91 | | 40.0 | 58.2 | 1.8 | |
| | Ionian Islands | 12.8 | 66.9 | 18.7 | 1.6 | | 39.7 | 56.4 | 3.89 | | 68.5 | 31.1 | 0.4 | |
| | Crete | 23.1 | 51.5 | 22.1 | 3.4 | <0.0001 | 37.3 | 52.8 | 9.90 | <0.0001 | 57.4 | 41.9 | 0.7 | <0.0001 |
| Children | No | 19.6 | 54.3 | 24.5 | 3.6 | | 32.4 | 59.0 | 8.63 | | 56.1 | 42.8 | 1.1 | |
| | 1-2 | 16.5 | 51.4 | 28.1 | 3.9 | | 30.1 | 58.0 | 11.96 | | 48.8 | 50.3 | 0.8 | |
| | ≥3 | 21.4 | 53.9 | 21.5 | 3.1 | 0.0004 | 37.9 | 53.8 | 8.25 | <0.0001 | 57.4 | 42.1 | 0.6 | <0.0001 |
| Family status | Married | 17.7 | 52.1 | 26.5 | 3.8 | | 32.3 | 57.0 | 10.77 | | 50.7 | 48.5 | 0.8 | |
| | Other | 20.4 | 54.8 | 21.5 | 3.4 | 0.1111 | 34.6 | 55.9 | 9.50 | 0.5136 | 60.9 | 38.7 | 0.4 | 0.0003 |
| Alcohol | Absteiners | 18.6 | 52.4 | 25.3 | 3.7 | | 33.1 | 56.3 | 10.63 | | 53.4 | 45.9 | 0.7 | |
| | Consumers | 14.3 | 53.4 | 28.7 | 3.6 | | 30.0 | 59.8 | 10.20 | | 45.7 | 53.5 | 0.8 | |
| | Ex consumers | 13.3 | 46.8 | 33.3 | 6.7 | 0.1757 | 26.7 | 60.0 | 13.33 | 0.5459 | 60.0 | 40.0 | 0.0 | 0.0114 |
| Ethanol (gr) | 0 | 18.6 | 51.9 | 25.8 | 3.7 | | 32.8 | 56.7 | 10.48 | | 52.5 | 46.7 | 0.7 | |
| | ≤39 | 15.1 | 55.4 | 25.8 | 3.7 | | 32.4 | 57.7 | 9.94 | | 48.9 | 50.6 | 0.6 | |
| | ≥40 | 10.0 | 40.0 | 50.0 | 0.0 | 0.3933 | 10.0 | 80.0 | 10.00 | 0.6095 | 30.0 | 70.0 | 0.0 | 0.4030 |
| Smoking | Non smokers | 18.9 | 54.3 | 23.7 | 3.8 | | 34.1 | 56.2 | 9.58 | | 55.7 | 43.6 | 0.7 | |
| | Smokers | 14.6 | 46.0 | 33.9 | 5.4 | | 26.9 | 58.9 | 14.23 | | 40.0 | 59.2 | 0.8 | |
| | Ex smokers | 12.0 | 54.6 | 29.6 | 3.7 | <0.0001 | 29.6 | 60.2 | 10.19 | <0.0001 | 44.4 | 55.6 | 0.0 | <0.0001 |
| Smoking quantity (packs daily) | No + NA | 19.1 | 53.1 | 23.9 | 3.2 | | 34.1 | 56.3 | 9.61 | | 55.3 | 44.0 | 0.75 | |
| | < 1 | 10.3 | 51.7 | 32.7 | 5.3 | | 24.7 | 60.8 | 14.45 | | 39.9 | 59.7 | 0.4 | |
| | 1-2 | 14.9 | 44.9 | 34.5 | 5.6 | | 27.5 | 59.4 | 13.09 | | 40.4 | 58.7 | 0.9 | |
| | > 2 | 22.6 | 47.0 | 27.0 | 3.5 | <0.0001 | 33.0 | 53.0 | 13.91 | 0.0011 | 45.2 | 53.9 | 0.9 | <0.0001 |
| Cancer family history | Negative | 19.0 | 51.3 | 26.0 | 3.7 | | 33.4 | 56.2 | 10.35 | | 52.9 | 46.3 | 0.8 | |
| | Positive | 16.4 | 54.1 | 25.8 | 3.7 | 0.2338 | 31.1 | 58.1 | 10.85 | 0.3532 | 50.4 | 49.0 | 0.6 | 0.2586 |

BMI: body mass index, NA: not assessed

considering that the policy of opportunistic screening is the most common form of screening implementation worldwide (north and eastern Europe excluded). Indeed, due to its structure, the policy of opportunistic screening is fragile and exposed to a higher possibility for recommendation of tests of no value and this may be still worse in the absence of strict national guidelines.

Therefore, the observed under-implementation of useful tests and over-implementation of non EB tests should not surprise but should be considered the logical consequence of this health policy. What mainly perturb us was on the one hand the potential worrisome economical burden of this phenomenon and on the other hand the worldwide lack of literature about controlling mechanisms that would have permitted prompt identification of sources of avoidable costs and put into practice relative corrective actions.

Although policy of opportunistic screening in areas with well defined national recommendations and long tradition in primary health care guideline (such as north American and Australian countries) might be related to a substantially better screening implementation [15], the strength of the aforementioned screening practice should be determined.

Many other important implications have been raised from this study. First of all the majority of the interviewed population stated that are interested in performing screening activities. This is a major issue to consider since it means that the population wishes to be screened but this intention is not translated into practice. The barriers resulting from this discrepancy should be investigated in order to increase screening adherence, and interventions to obtain high compliance of recommended tests should be addressed [19].

Regarding the cost-effective tests in females, screening rates for gynecological cancer is undoubtedly higher than colorectal cancer screening, where the results are devastating (Table 2). Nevertheless, even for gynecological cancer the results are not the desired ones. Indeed screening rates of 39% for PAP test, 23% for MRX and 28% for CBE in the last 2 years are not satisfactory. These rates are actually even lower since, in order to have an effective presymptomatic population control screening exams, they should be performed periodically at the right time interval. In this setting the screening rates are even lower if we consider the percentage of the population undergoing the exams periodically in the right time interval, meaning that further effort is necessary to improve the adherence of the population to the right time interval.

Similarly to females, colorectal cancer screening in males is extremely low. These results in both sexes need further evaluation since colorectal cancer is the second most common cause of cancer death in the western societies, although potentially preventable. The unpleasant nature of the exams, the lack of endoscopic facilities and the low recommendation rates by Greek physicians [20] are only few of the reasons to explain these results. Physician's recommendation for screening is a strong predictor of patient's adherence [21 -23] and this is actually missing. Nevertheless these results are not unique for Greece. Indeed, McGregor et al. mentioned low screening rates in Alberta, Canada, even after the release of official guidelines [21], while similar rates were observed in Ontario, Canada [24]. On the contrary, in the United States colorectal cancer screening rates are higher but definitely lower than other widely recommended cancer screening tests [22, 25, 26]. Hence, the need for physician's recommendation for colorectal cancer screening was underlined. Another issue to explain the low rate of colorectal cancer screening is that widespread consensus about the value of screening has been reached only recently. Therefore while American Cancer Society (ACS) has recommended both FOBT and sigmoidoscopy since 1980, the U.S. Preventive Services Task Force (USPSTF) did not recommend these screening tests until 1996 [27, 28]. Moreover, in Europe only FOBT is advised for screening of men and women aged between 50 and 74, while sigmoidoscopy is under investigation [29]. Furthermore, the lack of invitational programmes that could increase population's adherence should be considered, although results from such kind of interventions were not satisfactory with the exception of UK [30-35].

In contrast, in both genders non EB tests are highly performed causing an avoidable economic burden to the health care system. The high rate of urinalysis and CXR is worth mentioning while these results seem to confirm the initial observations of our study [36]. Concerning CXR it seems that the high recommendation rates from physicians [37] is a main cause of population's high performance, a phenomenon encountered worldwide [8]. The need for more oriented education of primary care physicians is mandatory.

The next topic to discuss is the indiscriminate use of tests for screening purposes. In males the real low rate of performing EB tests may explain the notable lack of differences between the various subgroups. Therefore, the already described influence of sociodemographic factors in men's cancer screening could not be revealed in our study [38,39] On the contrary the high rate of performance (over 50%) of 1-3 of tests in the first 2 settings (Table 3) indicates the indiscriminate use of exams for screening. Whether these results are due to physicians' unawareness of guidelines, inaccurate patients' beliefs about cancer [40] or demand of the surveyed population to be examined is a matter of investigation.

Interestingly, there were sociodemographic differences between females' subgroups. Indeed, older women of high BMI, of low educational status, farmers, craftswomen, housewives, women living in the Ionian islands and Crete, in rural communities, unmarried without or with more than 3 children, nonsmokers seem to perform less frequently EB tests. Similar factors with those in our study seem to influence screening behavior worldwide [41-45] with the exception of smoking that was positively correlated with higher screening attitudes. This discrepancy from the already observed evidence [46-48] is worth mentioning and needs further evaluation.

There are some limitations that should be discussed. Population data were derived from a cross-sectional study on a large convenience sample of the Greek healthy adult population. This design has limited internal validation and is sensitive to a variety of biases. Hence, the results can not be generalized for the whole Hellenic or other European countries. The present European health system is inhomogeneous and is strictly dependent on each country's economics. Moreover, this study was performed in a long time period and a time bias could be suspected. However, no interventions to change the performance rates were implemented from the national health care system in this time period. Finally, the study was based on face-to face questionnaire and there could not be validation from medical records. Therefore, the results should be viewed cautiously, especially if we consider the conflicting results concerning the validity of self-reported surveys [49-51].

Despite these limitations it is evident that opportunistic cancer screening in a primary care system where national guidelines are missing may cause ambiguous results. Reconsideration of health policy in such cases is mandatory. Moreover, the identification of subgroups with low performance rates will help us tailor targeted interventions to increase screening rates in these subpopulations.

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