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Epidemiological trends in skin cancer

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ABSTRACT Skin cancer, including melanoma and non-melanoma skin cancer (NMSC), represents the most common type of malignancy in the white population. The incidence rate of melanoma is increasing worldwide, while the associated mortality remains stable, or is slightly decreasing. On the other hand, the incidence for NMSC varies widely, with the highest rates reported in Australia.

In the current review, we highlight recent global trends in epidemiology of skin cancer. We discuss controversial issues raised in current epidemiological data, we analyze the most important risk factors associated with the development of melanoma and NMSC and the impact of skin cancer on health care services. Furthermore, we underline the pressing need for improved registration policies, especially for NMSC, and lastly, we refer to the ongoing primary and secondary prevention strategies and their outcomes so far.

Introduction

Epidemiology, translated from Greek, literally means "the study of population." The main aims of epidemiology include the description of disease patterns in human populations, as well as the identification of causes of diseases. Epidemiology provides essential data for the management, evaluation and planning of services for prevention, control and therapeutic management of diseases [1].

Skin cancer represents the most common group of malignant neoplasms in the white population. The incidence rate of melanoma and non-melanoma skin cancer (NMSC) is increasing worldwide [2]. Therefore, studying and understanding their current epidemiological trends is considered crucial in order to achieve early and adequate control of the disease.

Melanoma

Melanoma is much more common in whites than in other ethnic groups. Overall, the lifetime risk of developing melanoma is about 2.4% in Caucasians, 0.1% in Blacks, and 0.5% in Hispanics [3]. The risk of melanoma increases with age. The average age at the time of diagnosis is about 60. Melanoma is approximately 1.5 times more frequent in males than females. It has been shown that the incidence rate does not significantly differ until the age of 40, however, after age 75, the incidence becomes almost three times higher in males compared to females [4,5]. In addition, the frequency of its occurrence is closely associated with the constitutive color of the skin and depends on the geographical zone [6].

Cumulative epidemiologic data from Europe [7-10], Canada [11] and the United States [12-14] indicate a continuous and dramatic increase in incidence during the last decades. The highest incidence rates have been reported in New Zealand with 50 cases per 100,000 persons and Australia with 48 cases per 100,000 persons (59 for males and 39 for females in 2011), followed by the US (21.6 new cases per year per 100,000 in 2012) and Europe (13.2 and 13.1 new cases per year, per 100,000 for men and women, respectively) [15-17].

The wide variation in incidence rates is not observed only among different continents. Data from the European Cancer Observatory suggest significant variability among European countries, too. Scandinavian countries (especially Sweden, with an estimated incidence of 23.9 in 2012), Switzerland and Great Britain report the highest rates (>16.9 per 100,000 for 2012), whilst the Balkan countries, Moldova and Bosnia and Herzegovina, are standing at the lower incidence levels (<5.3 per 100,000 for 2012) [17].

The latter deviation is not only associated with the different risk factors characterizing different European populations. It may also be connected to weaknesses or discrepancies in the national registration systems among different countries. As an example, in Austria the reports by the National Cancer Registry showed that there was an underestimation of the true melanoma burden. The observed divergence is not surprising, given that private practice and non-hospital-based pathology laboratories are not legally obliged to report cancer cases in Austria [18].

The Melanoma Epidemic: Is It Real?

As described above, the continuous increase of melanoma incidence is supported by several epidemiologic data from different countries. However, the real nature of this increase has become a controversial issue [19]. Specifically, the issue in question is whether the incidence increase should be interpreted as a real melanoma "epidemic," or if it represents the result of intense screening [20,21], improved diagnostic ability of clinicians, increased biopsies [22], or changes in histologic criteria [23] that allow us to diagnose melanomas that previously remained unrecognized. The controversy deepens by the recently introduced concept of "overdiagnosis" in cancer, which refers to the increased sensitivity of diagnostic techniques to detect "cancers" that would otherwise not progress enough to cause significant morbidity or death.

In the melanoma family, the subtype that could fit the concept of "overdiagnosis" is melanoma in situ, since one could argue that some of these melanomas, especially those developing in elderly individuals, would not have the time to invade the dermis and acquire a metastatic potential. This argument might be supported by data suggesting that some melanomas (mainly—but not exclusively—of the lentigo maligna subtype) grow very slowly and might need years or even decades to become invasive.

Indeed, very recent epidemiological studies indicate that melanoma in situ, with an annual increase of 9.5%, occupies a disproportionately high percentage of the overall melanoma increase. However, the combined melanoma incidence (including both invasive and in situ melanoma) was also found to increase by 2.6% per year [20], justifying that the incidence increase also considers tumors with metastatic potential.

From the dermatopathologic point of view, this is not surprising, since there are studies suggesting a current trend towards reclassification of prior non-malignant diagnoses as melanoma [21].

Furthermore, in a population-based study correlating number of skin biopsies and incidence of melanoma, the investigators noted that there was an in parallel increase during a 15-year period, suggesting that the melanoma "epidemic" is possibly attributed to scrutiny and increased number of biopsies, too [21].

On the other hand, studies exploring the incidence of melanoma based on tumor thickness and demographic factors have suggested that increased screening and biopsy alone cannot account for the dramatic increase in the incidence. The authors' chief argument is that incidence increases independently of socioeconomic status, which functions as a surrogate marker for access to care and screening [24]. The latter suggestion is in agreement with the findings of Shaikh et al. In their study they used a validated imputation method for missing thickness data, in order to characterize melanoma thickness and survival trends among men and women in the Surveillance Epidemiology and End Results (9 registries included) between 1989-2009. According to their results, an increasing incidence was observed in all thickness groups. In addition, thickness increased in T3/T4 tumors, and nodular melanomas. These observations coupled together "suggest that the melanoma epidemic is real and not simply an artifact of increased detection pressure of earlier-stage T1/T2 lesions" [25].

What Does the Future Hold Concerning Melanoma Incidence?

Whiteman et al used age-period cohort models to describe current trends and project future incidence rates. They analyzed three decades of registry data (1982-2011) from six populations with moderate-to-high melanoma incidence (US Whites, United Kingdom, Sweden, Norway, Australia, New Zealand). Statistical analysis showed that melanoma rates in the US, UK, Sweden and Norway increased more than 3% annually. Future projections indicate that the rates will keep on rising until at least 2022. On the other hand, in Australia melanoma incidence has been declining since 2005, whilst in New Zealand, even though it is currently increasing, it is expected to decline soon. In regards with the number of new melanoma cases, it is estimated that they will rise in all the studied populations because of the increasing longevity and the high age-specific rate of melanoma in the elderly. The latter highlights the rigorous need for adequate melanoma control [26].

Non-Melanoma Skin Cancer or Keratinocyte Carcinomas

Under the umbrella of NMSC we describe all the non-melanoma malignant neoplasms affecting the skin. However, especially epidemiologically, the term NMSC practically refers to keratinocyte carcinomas, namely basal (BCC) and squamous cell carcinoma (SCC), since they account for the 99% of the tumors in this group [27].

The incidence of NMSC is 18-20 times higher than that of melanoma [28]. However, compared to melanoma, the epidemiology of NMSC is understudied. There are significant limitations in the investigation of NMSC incidence, mainly attributed to its marked geographic variability, as well as to the fact that large cancer registries usually exclude NMSC from their records, or the records are incomplete. Even secondary data analyses are rather limited [29]. The low mortality rate together with the practical difficulties in ascertaining the large number of cases may represent possible reasons for this gap in NMSC recording.

Indeed, the metastatic potential and mortality rates of NMSC are low. The incidence of metastatic BCC and SCC ranges between 0.00281-0.05% and 0.5-16%, respectively, whilst the age-adjusted mortality rate is estimated to be 0.12 per 100,000 for BCC and 0.3 per 100,000 for SCC [30-32]. However, despite its relatively low malignant potential, NMSC is associated with a remarkable morbidity and substantial cost [33,34].

The lack of national cancer registries for NMSC restricts our ability to estimate and establish definite and comparable incidence rates. Looking at the map of keratinocyte carcinomas, it is evident that the worldwide incidence varies widely. Australia is by far at the top of the rate, with more than 1,000 per 100,000 person-years for BCC (2,448/100.000, 2011), followed by Europe (129.3 in men, and 90.8 in women per 100,000 person-years, European standard) and the US (450 per 100.000 person-years, 2010). Prevalence was estimated to be 2.0% (2002), 1.4% and 0.7%, for Australia, Europe and the US, respectively [35,2].

During the last 30 years, the incidence of SCC has been rising 3–10% per year [29]. For the same period, it is estimated that BCC incidence rate has risen between 20-80% in the US [29]. BCC is more common than SCC, with a standardized ratio being roughly 4:1.2 [6]. The risk for development of a keratinocyte carcinoma increases with age [2]. With regards to the gender, there is a slight male predilection, which also increases with age [2]. Concerning lifetime risk of developing a NMSC (for a child born in l994 in Rhode Island, USA), it was estimated to be 28-33% for BCC and 7-11% for SCC [2].

The most well recognized exogenous factor implicated in the pathogenesis of NMSC is the ultraviolet radiation (UVR). In Western societies, tan-seeking behavior, including sunbathing and indoor tanning, outdoor activities without adequate sun protection, clothing style and ozone depletion are among the parameters contributing to the increased UVR-exposure [2].

Future Projections About NMSC: Why Should We Worry?

Future expectations, as reported by the Dutch National Institute for Public Health and the Environment, suggest a possible increase in the overall number of extra cancer cases related to environmental factors and increased UVR by 2060 [36].

Apart from environmental changes, another crucial reason for a further future increase of the NMSC incidence is the prolonged life expectancy. Data from the Population Division of the Department of Economic and Social Affairs of the United Nations underline that population ageing, as recorded since 1950, is unprecedented, and it is estimated that within the next four decades, will be even more rapid. By 2050, it is expected that 32% of the world population will be above the age of 60. Given the predilection of keratinocyte cancers for the elderly, it is reasonable that NMSC will follow this age increase [37].

Besides the the UV exposure and the increased life expectancy, other possible reasons contributing to the incidence increase during the last decades of life may include improved registration procedures and improved diagnostic tools [6].

The Economic Burden of NMSC

Increasing incidence together with high prevalence translates into significantly higher costs, which has become a considerable economic burden for public health services. The quantifiable financial cost consists of the direct costs, resulting from medical care, and indirect costs, associated to loss of potential life-years and productivity [38]. In Australia (population: 23.13 million), the estimated total cost, including diagnosis, therapeutic management and histopathology, reached $511 million in 2010, and it is projected to increase up to $703 million by 2015 [39].

Similarly, in the US (population: 318.9 million), the estimated total annual expenditure for NMSCs' medical care reached $650 million [40]. Concerning cost efficacy of different care settings, Mudigonda et al found out that physician-office settings are characterized by the lowest cost per episode of care and represent the most popular choice of care. The latter is in agreement with data in the recent literature that evaluated the financial burden of BCC and reported higher costs in the hospital compared to physician-office treatment setting. In the same study, investigators concluded that in descending order, cost of different treatment modalities is as follows: radiotherapy, Mohs surgery, standard excision, destruction (electrodessication and curettage, cryotherapy), imiquimod and 5-fluoruracil [41]. This information is essential, since it indicates that investment in optimization of the already existing, and development of new, physician-office based treatments is clinically relevant and may contribute to the control of the overall cost.

NMSC: Risk Factors

Elaboration of efficient prevention strategies requires good knowledge of the risk factors. Regarding NMSC, these are divided into personal and environmental. Age, gender and genetic susceptibility are the most dominant risk factors of the former group, while UVR exposure represents the most dominant environmental risk factor [38]. The incidence of SCC increases more rapidly with age than BCC. In younger ages, the incidence of NMSC is similar for both sexes; however after the age of 45, men develop keratinocyte carcinomas 2-3 times more frequently than women. Genetic susceptibility is mainly attributed to the melanin content of the skin and ability to tan [6].

While SCC is strongly related to long-term, cumulative sun exposure [42], the relationship between exposure to UVR and the risk of BCC is more complex. It seems that a history of excessive/intermittent sun exposure and sunburn in childhood and adolescence are responsible for its development [43]. This observation is also in agreement with findings from histopathological studies, investigating the association of SCC and BCC with sun-damage alterations in the perilesional skin. According to their results, presence of actinic damage at the perilesional skin is five times more frequent in SCC than in BCC [44].

A very worrisome finding in epidemiological studies is the substantial increase of BCC among younger women. This has raised concerns about the role of sunbathing and indoor tanning behaviors, which may contribute to this increase [45]. Indeed, despite the intense warnings of the harmful effects of indoor tanning, there are studies reporting that in Western countries it is very common, especially among young individuals [46]. These findings contribute to the growing body of evidence on the harm of indoor tanning and on the support of public health campaigns and regulation to reduce exposure and alter this modifiable risk factor [47].

Melanoma and NMSC: Prevention Strategies

Prevention strategies are divided twofold: primarily to encourage behavioral changes to lower subsequent skin cancer risk, and secondarily, to enhance early detection. Primary prevention is considered efficient when it succeeds in reducing incidence over the years. To achieve this goal it must be focused on interventions that reduce sun exposure, reinforce the use of adequate sun protection and discourage intensive tanning [47].

Approaching different age groups is sometimes tricky. As an example, it seems that in teen girls emphasizing the risk-to-appearance, by correlating sun damage and premature wrinkling, works better, while in teen boys, shifting the emphasis from long-term risk of NMSC to protection of painful burns is more efficient [48]. Stratification of the parents as models of sun protection is also efficient. Introduction of sun protection policy guidelines for primary/secondary schools is also a promising policy [49].

Implementation of mass media campaigns for public education is considered a significant intervention for achieving behavioral modification. The benefit-cost ratio of three skin cancer campaigns held in Australia between 2006-2013 was found to be 3.85, meaning that for every $1 invested, there is a return of $3.85. Based on this finding, the authors concluded that public education in mass media campaigns are beneficial, taking into account the likelihood of resulting reduced morbidity, mortality and economic burden of skin cancer [50].

On the other hand, the aim of secondary prevention is to reduce morbidity and mortality, mainly through early recognition of skin cancer. Some big steps towards early diagnosis include screening of the high-risk population, skin self-examination with the assistance of a partner, as well as physicians' surveillance [51,52]. The benefits of dermatoscopy [53] and total body skin examination are well known, especially when we deal with the population at high risk, such as young individuals with many nevi and elderly people with sun damage [54].

Conclusion

Taking into account the worldwide epidemiologic trends of skin cancer, it becomes obvious that there is a rigorous need to control increasing incidence and subsequent socioeconomic burden. Efforts towards this aim include optimization of the registration standards and development of efficient primary and secondary prevention strategies.

References

1. Australasian Epidemiological Association website. http://www.aea.asn.au/about-us/what-is-epidemiology. Accessed June 3, 2016.

2. Leiter U, Eigentler T, Garbe C. Epidemiology of skin cancer. *Adv Exp Med Biol.* 2014;810:120-140.
3. American Cancer Society. http://www.cancer.org/cancer/skincancer-melanoma/detailedguide/melanoma-skin-cancer-key-statistics. Accessed June 3, 2016.
4. Rastrelli M, Tropea S, Rossi C, Alaibac M. Melanoma: epidemiology, risk factors, pathogenesis, diagnosis and classification. *In Vivo.* 2014;28:1005-1011.
5. Chen ST, Geller AC, Tsao H. Update on the epidemiology of melanoma. *Curr Dermatol Rep.* 2013;2:24-34.
6. Leiter U, Garbe C. Epidemiology of melanoma and nonmelanoma skin cancer—the role of sunlight. *Adv Exp Med Biol.* 2008;624:89-103.
7. de Vries E, Coebergh JW. Cutaneous malignant melanoma in Europe. *Eur J Cancer.* 2004;40:2355–2366.
8. Lasithiotakis K, Leiter U, Gorkievicz R, et al. The incidence and mortality of cutaneous melanoma in Southern Germany: trends by anatomic site and pathologic characteristics, 1976 to 2003. *Cancer.* 2006;107:1331–1339.
9. Mansson-Brahme E, Johansson H, Larsson O, Rutqvist L, Ringborg U. Trends in incidence of cutaneous malignant melanoma in a Swedish population 1976–1994. *Acta Oncol.* 2002;41:138–146.
10. Stang A, Pukkala E, Sankila R, Söderman B, Hakulinen T. Time trend analysis of the skin melanoma incidence of Finland from 1953 through 2003 including 16,414 cases. *Int J Cancer.* 2006;119:380–384.
11. Ulmer MJ, Tonita JM, Hull PR. Trends in invasive cutaneous melanoma in Saskatchewan 1970–1999. *J Cutan Med Surg.* 2003;7:433–442.
12. Dennis L. Analysis of the melanoma epidemic, both apparent and real: data from the 1973 through 1994 surveillance, epidemiology, and end results program registry. *Arch Dermatol.* 1999;135:275–280.
13. Geller AC, Miller DR, Annas GD, Demierre MF, Gilchrest BA, Koh HK. Melanoma incidence and mortality among US whites, 1969–1999. *JAMA.* 2002;288:1719–1720.
14. Hall HI, Miller DR, Rogers JD, Bewerse B. Update on the incidence and mortality from melanoma in the United States. *J Am Acad Dermatol.* 1999;40:35–42.
15. Australian Government, Cancer Australia. http://melanoma.canceraustralia.gov.au/. Accessed June 3, 2016.
16. National Cancer Institute, Surveillance Epidemiology, and End Results Program. http://seer.cancer.gov/. European Cancer Observatory http://eco.iarc.fr/eucan. Accessed June 3, 2016.
17. Monshi B, Vujic M, Kivaranovic D, et al. The burden of malignant melanoma—lessons to be learned from Austria. *Eur J Cancer.* 2016;56:45-53.
18. Erickson C, Driscoll MS Melanoma epidemic: facts and controversies. *Clin Dermatol.* 2010;28:281-286.
19. Higgins HW 2nd, Lee KC, Galan A, Leffell DJ. Melanoma in situ: Part I. Epidemiology, screening, and clinical features. *J Am Acad Dermatol.* 2015;73:181-190.
20. Frangos JE, Duncan LM, Piris A, et al. Increased diagnosis of thin superficial spreading melanomas: A 20-year study. *J Am Acad Dermatol.* 2012;67: 387-394.
21. Welch HG, Woloshin S, Schwartz LM. Skin biopsy rates and incidence of melanoma: population based ecological study. *BMJ.* 2005;331:481.
22. Weyers W. The 'epidemic' of melanoma between under- and over-diagnosis. *J Cutan Pathol.* 2012;39:9-16.
23. Linos E, Swetter SM, Cockburn MG, Colditz GA, Clarke CA. Increasing burden of melanoma in the United States. *J Invest Dermatol.* 2009;129: 1666-1674.
24. Shaikh WR, Dusza SW, Weinstock MA, et al. Melanoma thickness and survival trends in the United States, 1989 to 2009. *J Natl Cancer Inst.* 2015;108(1).
25. Whiteman DC, Green AC, Olsen CM. The growing burden of invasive melanoma: projections of incidence rates and numbers of new cases in six susceptible populations to 2031. *J Invest Dermatol.* 2016;136:1161-1171.
26. Karimkhani C, Boyers LN, Dellavalle RP, Weinstock MA. It's time for "keratinocyte carcinoma" to replace the term "nonmelanoma skin cancer." J Am Acad Dermatol. 2015;72: 186-187.
27. Katalinic A, Kunze U, Schäfer T. Epidemiology of cutaneous melanoma and non-melanoma skin cancer in Schleswig-Holstein, Germany: incidence, clinical subtypes, tumour stages and localization (epidemiology of skin cancer). Br J Dermatol 2003;149:1200-1206.
28. Eide MJ, Krajenta R, Johnson D, et al. Identification of patients with nonmelanoma skin cancer using health maintenance organization claims data. Am J Epidemiol. 2010;171:123-128.
29. Wadhera A, Fazio M, Bricca G, Stanton O. Metastatic basal cell carcinoma: A case report and literature review. How accurate is our incidence data? *Dermatol Online J.* 2006;12:7.
30. Soyer HP, Rigel, et al. Actinic keratosis, basal cell carcinoma and squamous cell carcinoma. In: Bolognia JL, Jorizzo JL, Schaffer JV, eds. *Dermatology.* 3rd ed. London, United Kingdom: Elsevier. 2012: 1773-1794.
31. Weinstock MA, Bogaars HA, Ashley M, Litle V, Bilodeau E, Kimmel S. Nonmelanoma skin cancer mortality: a population-based study. *Arch Dermatol.* 1991;127:1194-1197.
32. Rogers H, Weinstock M, Feldman S, Coldiron B. Incidence estimate of nonmelanoma skin cancer (keratinocyte carcinomas) in the U.S. population, 2012. *JAMA Dermatol.* 2015;151:1081-1086.
33. Hay RJ, Johns NE, Williams HC, et al. The global burden of skin disease in 2010: an analysis of the prevalence and impact of skin conditions. *J Invest Dermatol.* 2014;134: 1527-1534.
34. Perera E, Gnaneswaran N, Staines C, Win AK, Sinclair R. Incidence and prevalence of non-melanoma skin cancer in Australia: a systematic review. *Australas J Dermatol.* 2015;56:258-267.
35. van Dijk A, den Outer PN, Slaper H. Climate and Ozone change Effects on Ultraviolet radiation and Risks (COEUR) using and validating earth observation. Rapport 610002001/2008. National Institute for Public Health and the Environment, RIVM. http://www.rivm.nl/dsresource?objectid=rivmp:9586&type=org&disposition=inline&ns_nc=1. Accessed June 3, 2016.
36. United Nations, Department of Economic and Social Affairs, Population Division (2013). *World Population Ageing 2013.* ST/ESA/SER.A/348. http://www.un.org/en/development/desa/population/publications/pdf/ageing/WorldPopulationAgeing2013.pdf. Accessed June 3, 2016.
37. Rigel DS, Robinson JK, Ross MI, Friedman R, Cockerell CJ, Lim H, Stockfleth E, Kirkwood JM, eds. *Cancer of the Skin: Expert Consult.* 2nd ed. Philadelphia, PA: Elsevier Saunders. 2011.
38. Fransen M, Karahalios A, Sharma N, English DR, Giles GG, Sinclair RD. Non-melanoma skin cancer in Australia. *Med J Aust.* 2012;197:565-568.

39. Mudigonda T, Pearce DJ, Yentzer BA, Williford P, Feldman SR. The economic impact of non-melanoma skin cancer: a review. *J Natl Compr Canc Netw.* 2010; 8(8):888-896.
40. Wu X, Elkin EE, Marghoob AA. Burden of basal cell carcinoma in USA. *Future Oncol.* 2015;11:2967-2974.
41. Gallagher RP, Hill GB, Bajdik CD, et al. Sunlight exposure, pigmentation factors, and risk of nonmelanocytic skin cancer. II. Squamous cell carcinoma. *Arch Dermatol.* 1995;131:164-169.
42. Rubin AI, Chen EH, Ratner D. Basal-cell carcinoma. *N Engl J Med.* 2005;353:2262-2269.
43. Apalla Z, Calzavara-Pinton P, Lallas A, et al. Histopathological study of perilesional skin in patients diagnosed with nonmelanoma skin cancer. *Clin Exp Dermatol.* 2016;41:21-25.
44. Flohil S, Seubring I, van Rossum MM, Coebergh JW, de Vries E, Nijsten T. Trends in basal cell carcinoma incidence rates: a 37-year Dutch observational study. *J Invest Dermatol.* 2013;133:913-918.
45. Wehner MR, Chren MM, Nameth D, et al. International prevalence of indoor tanning: a systematic review and meta-analysis. *JAMA Dermatol.* 2014;150:390-400.
46. Wehner MR, Shive ML, Chren MM, Han J, Qureshi AA, Linos E. Indoor tanning and non-melanoma skin cancer: systematic review and meta-analysis. *BMJ.* 2012;345:e5909.
47. Olson AL, Gaffney CA, Starr P, Dietrich AJ. The impact of an appearance-based educational intervention on adolescent intention to use sunscreen. *Health Educ Res.* 2008;23:763-769.
48. Reeder AI, Jopson JA, Gray A. Sun protection policies and practices in New Zealand primary schools. *N Z Med J.* 2012;125:70-82.
49. Doran CM, Ling R, Byrnes J, et al. Benefit Cost Analysis of Three Skin Cancer Public Education Mass-Media Campaigns Implemented in New South Wales, Australia. *PLoS One.* 2016;11:e0147665.
50. Robinson JK, Mallett KA. The duty to inspect the skin and counsel those at risk to develop melanoma. *JAMA.* 2009;301:1702-1704.
51. Weinstock MA, Risica PM, Martin RA, et al. Melanoma early detection with thorough skin self-examination: the "Check It Out" randomized trial. *Am J Prev Med.* 2007;32:517-524.
52. Zalaudek I, Lallas A, Moscarella E, Longo C, Soyer HP, Argenziano G. The dermatologist's stethoscope—traditional and new applications of dermoscopy. *Dermatol Pract Concept.* 2013;3:67-71.
53. Argenziano G, Zalaudek I, Hofmann-Wellenhof R, et al. Total body skin examination for skin cancer screening in patients with focused symptoms. *J Am Acad Dermatol.* 2012;66:212-219.