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DISSERTATION

**Tanning pattern and sun protective behavior of students
of Poznan University of Medical Sciences**

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1 Abstrakt

Obwohl UV-Strahlung der Hauptrisikofaktor für Hautkrebst ist, ist das Sonnenbaden und gebräunte Haut weiterhin sehr beliebt. Dieses Bewusstsein und ein gutes Sonnenschutzverhalten sind fundamental für die Hautkrebsvorsorge.

Das Ziel dieser Arbeit war die Untersuchung der Unterschiede in Sonnen- und Sonnenschutzverhalten, Wissensunterschiede in Bezug auf UV Strahlung und Wirkungsweise von Sonnenschutzprodukten, Erfahrung mit Sonnenbrand und Wissensunterschiede zum Sonnenschutz bei den Medizinstudenten, der Medizinischen Universität in Poznan (Polen), mit Hilfe eines Fragebogens.

Auf Grund der Tatsache, dass die Studenten dieser Universität unterschiedlicher Herkunft sind und verschiedenen ethnischen Gruppen angehören, bilden sie eine einzigartige Untersuchungsgruppe, an der man verschiedene Vorurteile der ethnischen Gruppen untersuchen kann.

Der Fragebogen wurde in elektronischer- und Papierform an die Studenten verteilt, es wurden 718 Fragebögen beantwortet.

Frauen hatten ein größeres Wissen als Männer. Besseres Wissen stand in Zusammenhang mit einem riskanteren Sonnenverhalten. Skandinavier hatten ein größeres Wissen über UV-Strahlung und Sonnenschutzprodukte im Vergleich zu den anderen Gruppen.

Frauen waren mehr um ihre Hautbräune besorgt und sonnten sich deshalb mehr als Männer, was gleichzeitig ihr Hautkrebsrisiko erhöhte.

Der Wunsch der Skandinavier nach einer gebräunten Haut war größer als die Angst vor den Risiken der Sonnenstrahlung. Ostasiaten bevorzugten eine blasse Haut, sodass sie sich kaum absichtlich UV-Strahlung aussetzen. Frauen, mit dem Wunsch nach sonnengebräunter Haut, besuchten öfter Sonnenbänke, sonnten sich länger und vermieden absichtlich Sonnenmilch um den Bräunungseffekt zu verstärken.

Männer benutzten seltener als Frauen Sonnenmilch, jedoch bei dessen Benutzung griffen Sie zu höheren Sonnenschutzfaktoren. Skandinavier zeigten das riskanteste Sonnenverhalten und Ostasiaten das am wenigsten riskante.

Frauen gaben die meisten Sonnenbrände an, hervorgerufen auf Grund beabsichtigter Exposition durch UV-Strahlen. Skandinavier gaben die höchste Anzahl von Sonnenbränden auf Grund von natürlicher und künstlicher UV Strahlung an. Je geringer die Anzahl von Sonnenbränden, in der Kindheit der Studenten war, desto weniger kam es zu Sonnenbränden im späteren Leben.

Die Aufklärung und das Bewusstsein über die Risiken der UV Strahlung sind erste Schritte in der Hautkrebsvorsorge, jedoch sind diese alleine insuffizient.

In der Zukunft sollte dem Sonnenverhalten und dem Wunsch nach gebräunter Haut mehr Beachtung geschenkt werden, um das Vorkommen von Hautkrebs zu senken.

2 Abstract

Although UV radiation is a major risk factor of skin cancer, tanning and tanned skin appearance is still very popular. Awareness and good sun protective behavior are crucial in preventing skin cancer.

The aim of this study was to investigate by a questionnaire the differences in tanning habits and solar protection, knowledge of solar radiation and effectiveness of sunscreen products, attitude towards sunscreen products application, experience with sunburns and the knowledge about solar prevention of medical students of the Poznan University of Medical Sciences in Poznan/ Poland. Based on the fact that students of this University are of different nationalities and different ethnicities, they create a unique opportunity to verify certain stereotypic notions about ethnic groups. The questionnaire was distributed in electronical and paper forms among students, 718 questionnaires were returned.

Females were more knowledgeable than males. Better knowledge correlated with more risky tanning behavior. Scandinavians were better educated about UVR risks and sunscreen products than other groups.

Females were more concerned about their skin tone and therefore tanned more than males, being a group of increased risk for skin cancer. Scandinavians' desire to have a tanned appearance was bigger than fear of tanning hazards. East Asians preferred light skin tone to tanned appearance, so their attitude towards tanning was negative. Females chasing the desire to get a "sun kissed skin" appearance visited tanning studios more often, tanned longer and deliberately avoided using sunscreens to accelerate the effect. Males used sunscreens less often than females, but when they did, they used those with higher SPF. Scandinavians reported the most risky behavior pattern and East Asians the least risky one. Females reported higher number of sunburns due to intentional UVR exposure. Scandinavians reported the highest number of sunburns resulting from exposure to both natural and artificial radiation sources. The lower the number of sunburns during childhood, the less likely the students were to experience sunburns in their later life.

Knowledge and awareness are the first step in prevention of skin cancer but they are not sufficient. For the future, attention should be greatly focused on peoples' attitude and desire to tan to prevent the skin cancer numbers from rising.

3 Introduction

3.1 History and Development of Tanning Culture

Skin color builds a foundation for socially constructed definitions of health, attractiveness and social status. Although the idea is universal around the world, the ideal "skin tone pattern" differs endemically. Caucasians seek tanned skin appearance while Asians tend to pursue pale look.

The cause of this discrepancy is deeply rooted in cultural norms and history. Over centuries skin color had an impact on how a person was perceived by others. During medieval times in Europe, tanned members of the society were recognized as workers and peasants, who had to stay in the sun during work. The aristocrats, on the other hand, avoided sun, and therefore kept a pale look as a symbol of wealth and beauty. Examples of this are seen from the Bible through Renaissance to the "Snow White" fairy tale of the Grimm Brothers. In Asia the aesthetic beauty norms even manifested in Japanese language and Chinese poetry. In the past centuries, a lot of techniques were used to achieve and maintain pallor - the use of parasols, white face powders and bleaching products to name just a few.

Due to the industrialization in the USA and Europe at the beginning of 20th century, pale skin appearance was associated with factory workers, deprived of sunlight. The perception of tan switched. Tanned skin was perceived from then on as a symbol of higher social status of people who were able to spend leisure time at the seaside, playing tennis or golf. In the early 1920s Coco Chanel created a cultural norm that "a golden tan is the index of chic" when she was photographed on a yacht with a bronzed tan. Since then women began critically to compare themselves to the ideal images shown in media of what is considered as "beauty" and often found themselves inadequate or unworthy [1].

3.2 Prevalence and Correlates of Tanning

3.2.1 Who Tans?

An alarming number of people expose themselves to harmful ultraviolet radiation in an effort to tan their skin [2] and the use of indoor tanning devices continues to rise,

with the target costumers being young adult females [3, 4]. From 1988 to 2007 the number of American adults reporting using indoor tanning facilities increased from 1% to 27% [5]. The typical sunbed user is a 17 - 30 years old female, who tends to lead a comparatively unhealthy lifestyle [6]. Sunbeds in Germany are used at least once in life by every second 18–45 year-old, and every fifth is a regular user [7] which is noticeably more frequent than in most other nations [4, 8-10]. Among tanners younger than 50 years, the following features have been identified: being female, being white, having a higher education level, having a moderate to high skin tanning ability, reporting more than one sunburn incidence in the previous year, and not staying in the shade when outside [4]. High sun exposure is especially of concern among teenagers who spend more time outdoors and whose sun protection behavior is less pronounced. [11 12]. Younger tanners' (aged 11-18) use of tanning studios was associated with factors such as: positive attitudes toward a tan, permission from a parent or guardian to use indoor tanning devices, and parent who used indoor tanning devices himself. [13] It has been shown in Germany and Italy that people of higher socioeconomic status tend to tan more than others. [14 15]

3.2.2 Who is at Highest Risk of Developing Cancer?

To define people who are at the highest risk of experiencing serious adverse effects of chronic UV radiation exposure, one would describe Caucasians who burn easily and tan poorly (skin phototype I and II) [16], with family or personal history of skin cancer [17], in addition to phenotypic characteristics such as light colored eyes (i.e. blue), blonde or red hair color and a tendency to freckle [18]. History of blistering sunburn between 15 and 20 years of age is also significantly associated with increased risk [19], as is low educational level [20], but this last factor is not consistent among various studies [21]. It is crucial to remember that regular tanners (who usually belong to a darker skin phototype) are at the highest risk of all groups. They tan at frequent intervals with a mean of 70 times per year, start tanning at the youngest age, have firm intentions of continuing tanning, as well as positive attitudes toward tan and indoor tanning, and on top of all, have a strong positive mood component to their tanning [22].

3.2.3 Adolescents and UV

Extended sun exposure during childhood supposedly increases the probability of skin cancer later in life [23, 24] and has been identified as key period in the etiology of

melanoma in adulthood [25], probably because young skin is particularly sensitive to UV radiation [26]. In addition adolescents' refusal to use skin protection is due to fashion trends and peer pressure. Young people (aged 13-19 years) are likely to stay in the sun for extended periods of time [27].

The relative risk of the three main types of skin cancer is increased as a result of severe sunburns experienced between the ages of 15 and 20 years [28-30]. First contact with indoor tanning before 35 years of age was linked with 75% increase in risk of developing melanoma.

When enrolling even younger population, a recent report by Ting et al. [30] studying 1518 dermatologic patients, among whom there were 79 cases of malignant melanoma, found that previous use of tanning beds was associated with higher risk of developing malignant melanoma and importantly this risk was particularly pronounced among females aged 45 years or younger [31, 32].

As it has been shown that young adults have the lowest probability of change in behavior [27, 33, 34], educational efforts should focus mainly on younger students [34].

3.2.4 Correlates of Tanning

Most studies provide evidence that females tan more often than males. Also younger individuals tend to spend more time in the sun compared to their older peers. Caucasians are the primary target of the indoor tanning industry, as they make up the biggest group of tanners. There is no clear association between education, income and tanning. Geographical location also has its impact on attitude towards tanning. Especially being an inhabitant of the northern regions of Europe and North America predisposes to tanning, especially indoors, which was proven by multiple studies. In addition, there is a higher tendency towards artificial light tanning in cities than in rural areas. Positive family history, or individual experience of skin cancer is negatively correlated with the prevalence of tanning. There has been strong evidence that social norms have significant influence on promoting tanning among individuals who have close friends, relatives, or parents who also engage in tanning activities.

3.3 Motivations for Tanning and Tanning Dependence

3.3.1 Reasons for Tanning

Several studies asked tanners about their motivation for tanning. Respondents reported a desire to achieve an attractive tan and relaxation [10, 35] A small group

reported using indoor tanning devices to get a pre-vacation tan [36]. Tanning addiction can be suspected based on the study, which shows that the feeling of relaxation and health was less often reported by first-time users (44% vs. 14%). Furthermore, it has been shown that adolescents who agree that tanning improves their mood are more likely to self-report difficulty in quitting tanning [37].

A consistent finding in the literature concludes that the central reason for deliberate UV exposure is the positive effect it has on skin appearance [38, 39]. Men find tanned women more attractive and healthy, this is why women who are single try to enhance their looks in order to find a mate. A study by Banerjee et al. has found that tanned individuals are perceived more approachable romantically and friendly [40]. Men and women who are in a stable relationship tend to tan less than their single counterparts, probably due to higher body satisfaction.

A fallacy that tan provides protection against UV rays exists. It is worth knowing that sun protection factor (SPF) provided by tan is approximately 2 – 3 [41]. In fact tanned skin appearance already is a sign of UV damage to skin cells and their DNA [1].

As it was mentioned in paragraph 1.1, tanned skin correlates with higher socioeconomic status in today's society. Due to the growing travel industry the idea of a year-round tan was promoted, and bringing tan from vacation as a souvenir was valued. Those who could not afford vacation in a tropical paradise, and therefore were not able to achieve a tan outside holiday season, pursued other methods. Indoor tanning seemed to be a perfect solution for the lower social class. It was the most similar to tanning in the sun, and was advertised as having fewer side effects than most of other substitute methods like the use of mixture of baby oil with iodine, rubbing skin with salt, and wearing aluminum reflectors.

3.3.2 Role of Media

According to Robinson et al., people in the United States gain most of their skin cancer information through media [42]. Despite hard evidence that tanning brings along serious health risks, the social image of looking more attractive with a tan remains embedded in our culture [43]. Media play an important part presenting tanned individuals as healthy and attractive, which helps to establish sociocultural beliefs about what is thought to be healthy appearance [44, 45]. On top of it, popular television programs targeting younger audience, glamorize indoor tanning [46]. When women realize they do not fit the ideal feminine image, feelings of shame often

emerge. That is what motivates young women to engage in activities aiming to achieve their glorified pattern. 1960s introduced a new genre of Hollywood films, where young attractive actresses and muscular actors were advertising the easy and carefree life at the beach, having fun in the sun. Along came the bikini revolution, turning the regular one-piece swimsuit into a promiscuous, two-piece beachwear. Furthermore, celebrities such as Jane Fonda and Brigitte Bardot promoted the image of a golden-skinned girl. Also colorful fashion magazines (i.e. Vogue) promoted sun tanning by pro-tan-articles and advertisements of tanning products with the use of tanned models [47].

The idea of attractive tan was groomed in the girls' childhood even by the toy industry, with tanned Barbie doll lines, which were often carefully named (i.e. Sun Gold Malibu Barbie) [48].

The results of Jackson [49] and Aiken's intervention focusing on changing normative perceptions of the attractiveness of being tanned, suggest that increasing the attractiveness of pale skin appearance may be effective in producing sun protective behavioral change.

3.3.3 Tanning Dependence

Use of indoor tanning devices carries features of addictive behavior. Many adolescents who regularly tan indoors report having difficulty altering this habit [37]. Experiments have also shown that UV light is a reinforcing stimulus that causes endorphin release [50, 51].

For a certain group of tanners, indoor tanning may represent a form of body dysmorphic disorder (BDD), which is defined as a preoccupation with a perceived defect in appearance causing clinically significant impairment [52]. It has been confirmed that females who are less satisfied with their appearance tan more [47]. These individuals may be motivated to tan their skin due to a preoccupation with an imagined defect in appearance (either of being too pale or of not being tanned enough). Also seasonal affective disorder (SAD), a syndrome that refers to a pattern of major depressive episodes, which occurs in conjunction with the change of seasons, may be the reason why affected individuals visit tanning studios. The most common form of SAD is 'winter depression' type, which often starts in the autumn and is treated with light therapy [53]. Therefore, it is possible that these individuals utilize indoor tanning for its mood-enhancing properties and it could perhaps be seen as a form of self-medication [54].

3.4 Fallacies and Controversies of Tanning Behavior Among Different Ethnic Groups

As tanned skin appearance has been recognized for years as more attractive than pale complexion, a belief has emerged among people that “sun kissed skin” is equal to healthy look. Also, some evidence suggests that vitamin D, which is synthesized in the skin through sun light exposure, has positive effect on human body and prevents the onset of many potentially dangerous diseases, when in fact only a minimal amount of UV radiation is needed for proper vitamin D synthesis. The tanning industry advocates advertise both of those above facts as advantages of indoor tanning, which creates a belief that tanning is safe and healthy [55]. It has to be underlined that UVB is essential to proper vitamin D synthesis in the skin. Indoor tanning light sources offer mainly UVA radiation, and thus do not contribute to vitamin D synthesis [56].

There is also another false belief that indoor tanning is safer than tanning in the sun [57]. This also is supported by distributors of artificial tanning products and is simply untrue. The evidence suggests that indoor tanning is often more addictive and easier to overdose than tanning in the sun. The light bulbs used in the tanning beds are of high power and sometimes even fail to comply with safety regulations making them potentially dangerous to use.

A common belief is that a pre-vacation tanning studio visit helps acquire a protective tan, which allows the tanner to spend more time in the sun. It is believed to protect tanners against sunburns from summer sunlight. Once again promoters of tanning suggest that tan is necessarily required for a healthy vacation and provides natural protection against skin cancer. Nothing could be more wrong. We are now aware that tan is a symptom of cell DNA damage and there is no such thing as a healthy tan.

3.5 Biological Effects of Ultraviolet Radiation in Humans and Process of Skin Tanning

Exposure to ultraviolet (UV) light from the sun is associated with a spectrum of biological effects of both healthy and harmful nature in the skin.

In order to better address the effects that UV exposure brings to human skin, its spectrum has been divided into ranges called UVC (from 100 nm to 290 nm wavelength range), UVB (from 290 nm to 320 nm wavelength range) and UVA (from 320 nm to 400 nm wavelength range) [58]. 90% of the UVB radiation is absorbed in the epidermis, mainly in the corneal layer and is responsible for carcinogenic

processes. UVA radiation reaches reticular and papillary layer of the dermis and has influence on genetic material and may induce immunosuppression[59].

Sunburns are acute inflammatory cutaneous reactions due to overexposure to sunlight. It is crucial to understand that every erythema due to sunlight exposure is pathologic and should be avoided. Usually UVB is responsible for eliciting erythema. Intermittent and intense sun exposure has been shown to increase the risk of melanoma and basal cell carcinoma (BCC), while chronic exposure to sun appears to influence squamous cell carcinoma (SCC) formation [60].

The molecular basis for the above processes is the fact that UV irradiation causes DNA damage. In the past UVB was considered the only carcinogenic part of the solar spectrum, through which the generation of cyclobutane pyrimidine dimers (CPD) occurs. They present as cytosine (C)→ thymidine (T) and CC→TT mutations, also known as UVB fingerprint mutations [61]. Recent evidence suggests that radiation in the UVA range can also trigger DNA damage via CPD formation and C→T mutations [62, 63]. UVB also induces immunosuppression (which promotes neoplastic cells to grow) by compromising Langerhans cells activity.

To prevent neoplastic processes, basic repair mechanisms try to excise the damaged DNA fragments, inhibit DNA replication and block cells from progressing into mitotic state [64]. Also induction of various cytokines damages epidermal cells and can influence the dermal layer of the skin.

If all the above mechanisms fail, then the cell has also a form of self control and can be driven into the apoptotic pathway [65]. UV radiation induces production and accumulation of phosphoprotein p53 in the cell. p53 is a tumor suppressor gene that helps to repair DNA damage. The key role of p53 in this mechanism is to sustain the cell in G1 phase of the cell cycle to give it more time for DNA repair or starting the cell's elimination by way of apoptosis. These apoptotic cells if present in the epidermis are called sunburn cells.

Loss of function of p53 (as sunlight-induced p53 mutations have been found in sun-exposed skin [66]) leads to aberrant cell growth and cancer. A connection between p53 and UV-induced hyperpigmentation was elucidated by Cui et al. [67]. p53 was found to act as a UV sensor/effector for tanning. In response to UV radiation, melanocytes produce melanin pigment, resulting in hyperpigmentation. p53 promotes cutaneous pigmentation following UV radiation by direct transcriptional activation of proopiomelanocortin (POMC). As a dye - melanin has a protective role in absorption

of free radicals induced by UV radiation. POMC is a gene, which encodes alpha melanocyte stimulating hormone (α -MSH), adrenocorticotrophic hormone (ACTH) and β -endorphin. The transcription of these genes occurs in sun-exposed keratinocytes, which leads to an increased release of the encoded proteins. The alpha-melanocyte-stimulating hormone signals to melanocytes via the melanocortin 1 receptor (MC1R) which initiates melanogenesis, melanocytic differentiation and melanosome transfer to keratinocytes [68].

Facts that further support a relationship between tanning and damaging UV radiation effects are: a) many SCC and BCC cancer cells show mutations in p53 gene, causing transcription of incompetent p53 protein; and b) deficiency of p53 protein is associated with inability to tan. Therefore tanners who would like to keep their tanned skin appearance would be subject to unnecessary, repeated, UV-induced DNA damage [1].

3.5.1 The ABCDE Rule as an Early Indicator of Malignant Melanoma

The risk of malignant transformation of nevi can be estimated by this simple rule. Therefore the following features are important to be assessed: asymmetric shape of the nevus (A), irregular borders (B), variation of color (C), diameter (D) more than 6 mm and their evolving over time (E). All of those could be a sign of malignant potential [69].

3.5.2 The Fitzpatrick's Phototyping Scale

In 1975 Thomas Fitzpatrick developed a scale to better assess skin types of his patients. He divided them into 6 categories, and gave a written description to all of them concerning skin color and the incidence of sunburns and tanning on sunlight exposure. [70]

Table 1 Fitzpatrick's Skin Phototype Scale

<i>Skin type</i>	<i>Skin color</i>	<i>Characteristics</i>
I	White; very fair; red or blond hair; blue eyes; freckles	Always burns, never tans
II	White; fair; red or blond hair; blue, hazel, or green eyes	Usually burns, tans with difficulty
III	Cream white; fair with any eye or hair color; very common	Sometimes mild burn, gradually tans
IV	Brown; typical Mediterranean Caucasian skin	Rarely burns, tans readily
V	Dark Brown; mid-eastern skin types	Very rarely burns, tans very easily
VI	Black;	Never burns, tans very easily

3.6 Skin Cancer and Other Health Hazards of Tanning

Scarring, freckles and nevi formation are direct consequences of acute erythematous reactions caused by UVB radiation, which is also responsible for melanogenesis in form of increasing number of melanosomes. Ultraviolet radiation (UVR) is responsible for cataract formation and premature skin aging [71]. Consequences of repeated sunlight exposure are very serious i.e. photoaging, actinic keratosis (AK), non-melanoma skin cancer, and melanoma to name the most important ones [72]. Sunlight exposure is thought to be responsible for about 65% of cases of skin cancers worldwide [73]. The link is stronger when patients report history of sunburns [74]. Among the risk factors that contribute to the occurrence of skin lesions, family history of skin cancer is most commonly reported. UV rays, in addition to facilitating genetic mutations, have an immunosuppressive effect on the skin cells [75].

3.6.1 UV Light and Skin Cancer

It is only a matter of time when more serious changes take place in a chronically overexposed skin. Premalignant changes that are generated mostly by UVB radiation present as AK, also called solar or senile keratosis. This process may progress into non-melanoma skin cancers, either (SCC) or BCC and, as tested by Karagas et al, indoor tanning does contribute significantly to the risk of developing SCC and BCC [76]. The most common is BCC, which accounts for approximately three quarters of skin cancers, grows slowly and rarely gives distant metastases. SCC is responsible

for approximately 10,000 cases per year and rarely affects those under 60 years of age. Lastly, cutaneous malignant melanoma, with about 4000 cases in the United Kingdom each year, accounts for about 75% of all skin cancer deaths [77].

3.6.2 Indoor Tanning

Apart from the sun, indoor tanning facilities (also called 'sun-beds', 'tanning booths', 'tanning salons', 'tanning parlors', 'solariums' and 'cancer grills') are the most important and increasingly frequent sources of UVR in developed countries [78], as indoor tanning has become increasingly popular over the past decades [31]. In the USA, for example, almost 30 million individuals tan indoors every year, including 2.3 million adolescents [26, 79].

Tanning devices emit mainly UVA, with less than 5% in the UVB radiation range [80]. The use of tanning beds has been linked with numerous adverse health effects, such as acute sunburn [22, 81], photo induced medication reactions, polymorphous light eruption, atypical melanocytic lesions, skin fragility and blistering, suppression of cutaneous DNA repair and immune function, ocular disorders [82], increased risk of melanoma and increased risk of developing SCC [78]. Despite these ill effects, popularity of recreational tanning remains unshaken and the artificial UV light devices have become a billion-dollar enterprise [82].

3.6.3 Skin Cancer Incidence Worldwide

Skin cancer is the most commonly diagnosed cancer in Australia, and causes significant mortality and morbidity [83]. Furthermore, incidence rates of non-melanoma skin cancers continue to rise in this country [84]. Nevertheless, the increasing mortality rate attributed to melanoma still remains a matter of great importance [19, 85].

Over the last half century, there has been an increase in UV light exposure in western populations, and in Sweden the annual incidence of malignant melanoma has risen from 8.2 to 27.3 cases per 100 000 inhabitants, when comparing data from 1970 and 2006 [86]. In Greece, documentation from the *Euromelanoma* prevention campaign has shown the incidence of skin cancer to be increasing, although the incidence is not as high as in other northern European countries [87, 88]

3.7 Sun Protective Behavior and Prevention of Skin Cancer

3.7.1 Tanners' Knowledge of Tanning Hazards

Although adolescents have high levels of knowledge about the risk of skin cancer, it

often does not translate into behavior [89-92]. Frequent tanners are more knowledgeable about skin cancer risks than non-frequent tanners are [93-94]. It appears that other factors may contribute to people's tanning behavior, as increased knowledge of the risk of skin cancer alone may not be sufficient to bring about a behavioral change [94-96].

This incongruence could be explained, in part, by a belief that suntan is healthy and enhances one's appearance [97] as it has been shown that young people perceive that a person with tanned skin looks younger, sexier and thinner [98]. For some young people, the positive beliefs associated with tanned skin have been shown to outweigh the potential risk of developing melanoma in the future [99].

Casual sunbed users often show considerable lack of knowledge about risks of artificial UV radiation. They tend to be less informed about the risks of sunbathing than non-users. They are also more convinced that tanning in sunbeds provides them with a 'healthier' type of tan and therefore on average underestimate the health risks of indoor tanning [6].

3.7.2 Sunscreen Products Usage

The use of photo protectors as an effective protection measure has been widely discussed in the literature and is recommended for the prevention of all skin neoplasms [100]. Evidence suggests that the majority of skin cancers are preventable and it has been tested on a sample of immunocompromised patients, that the daily use of sunscreen products prevented BCC, SCC and AK formation [101].

The following measures are recommended to reduce skin cancer risk: application of broad spectrum sunscreens with SPF of 15+; reapplication of sunscreen after 1.5–2 h of exposure or after swimming and perspiring; avoidance of sunlight during midday hours; use of protective clothing such as wide-brimmed hats, long-sleeved shirts and long shorts or pants; and remaining in shade. It is clear that among young children, parents and caregivers must play an active role, either directly or indirectly, in providing and facilitating sun protection.

The rate of sun protection reported by adolescents is poor. Only about 20% of adolescents wear protective clothing, and only about 30% apply sunscreen consistently when out in the sun [102]. Adolescents who frequently used sunscreen were more convinced of its advantages and they also experienced more emotional regret after sunburns. Infrequent users, on the other hand, were more convinced of

disadvantages, such as sunscreen use being greasy and preventing the development of a nice tan [20].

3.7.3 Differences Between Opposite Genders in Sun Protective Behavior

There appears to be gender and age differences regarding how students protect themselves from the sun. Girls are generally more knowledgeable and have more positive attitudes towards sun protection than boys but they prefer a darker tan [103]. The use of sunscreen by females is reported significantly more frequently than that by males. Females also report staying in the shade more than males and are also more likely to report wearing of sunglasses 'usually/always'. In contrast, males are more likely than females to report wearing a hat. In contrast to usual hat-wearing behavior, reported use of maximum SPF sunscreen when out in the sun was higher among female students (73%) than male students (54%), with this gender difference consistent across the year levels [104]. Social norms and attitudes are more important determinants of sunscreen use, with cosmetic motives such as desire for a tan competing with health-related beliefs about cancer prevention [96, 105]. Generalization that females appear to be selecting sun-protection behaviors which fit into their socialization, such as using a sunscreen which is similar to the use of make-up, or moisturizers, or other skin care products, may be hypothesized. Currently, there are a number of make-up or moisturizing products on the market that include a SPF 15+ sunscreen, which protect from UVB, but provide a poor UVA radiation filter. Similarly, males probably wear caps more as a fashion statement than for protection from the sun. [104]

3.7.4 Parental Influence on Sun Protective Behavior

Parents are primarily responsible for their children's sun exposure during early childhood [106]. Several studies have shown that parents are aware of the benefits of sun protection, yet do not routinely engage in sun-protective behavior for their children [107]. They are slightly more likely to protect them while at the beach or on vacation than while at home [108]. However, during adolescence individuals become increasingly responsible for their own sun exposure behaviors.

3.7.5 Social Influence on Sun Protective Behavior

Positive social influence on sunscreen use among both parents and friends is greater among frequent than infrequent users [20]. In the case of sun protection, for example, perceived peer norms may include the estimated number of friends who

use sunscreen when out in the sun during summer. The larger the estimated number of friends who use sunscreen, the higher the perceived need to conform to the norm [109].

3.7.6 Education as a Factor Influencing Sun Protective Behavior

A survey conducted among students showed that students from wealthier and more educated backgrounds were more likely to use sun protection, and those from wealthier backgrounds also held stronger belief in the importance of sunscreen use [110].

Physicians also have to be aware of psychological mechanisms that may influence behavior of patients that use sunscreen. Patients tend to have a false belief that the use of sunscreen might allow them to stay in the sun longer. Despite using a sunblock, prolonged sunlight exposure still carries the risks of potentially carcinogenic UVA radiation and increases the risk of melanoma [111].

3.7.7 Early Prevention Methods Aimed at Reducing Skin Cancer Incidence

It was previously thought that reducing sun exposure through protective measures, especially during childhood, could reduce total UVR exposure by more than 50% and could reduce the lifetime incidence of non-melanoma skin cancer by 78% [112]. Stern obtained the theoretical results of his study by using a mathematical model and came to the conclusion that one receives 80% of a lifetime dose by the age of 18. Further examination of study results gathered by Stern et al. led to the conclusion that the above data was calculated on wrong assumptions. After careful analysis Godar et al. concluded that individuals rarely get 25% of a lifetime UV dose by the age of 18 [113]. These findings support the theory that UV exposure pattern is linear and radiation-induced damage should be avoided continuously and equally during lifetime. Based on this information it seems natural that the primary intervention effort should be to decrease UVR exposure in childhood and adolescence. This can be done by either banning tanning studios for minors, or educating parents about risks of UV light exposure. In the USA there are now at least 29 states with legislation regulating tanning salons in compliance with World Health Organization (WHO).

Most prevention programs focus on educational interventions directed towards increasing the knowledge of parents and children about the dangers of sunlight overexposure. Schools have a great potential for reaching and educating teenagers about skin cancer prevention [13]. Unfortunately, studies have shown that even after

the goal of having a better knowledge has been achieved, especially among adolescents and young adults, tanning behavior and attitudes often remain unchanged [94, 95].

Education might still not be enough to change tanners' behavior. People who are at the highest risk of experiencing adverse effects of UV radiation exposure should be the first group to be aware of the benefits of sun protection, disadvantages of sunbathing and advantages of sunscreen barriers and, as multiple studies show, this group is well aware of that [49, 114].

The role of the media is crucial in changing attitudes toward tanning among adolescents. It is unlikely that this age group will change their behavior unless they perceive the shift in sun protection as normative adult behavior or as acceptable to peers. Achieving this may involve changing basic concepts such as the beliefs regarding the attractiveness of tan [115].

3.7.8 National Campaigns and Their Effect on Sun Protective Behavior

The current findings and those of previous studies suggest that a multiple strategy approach is necessary for the development of an appropriate sun protection education campaign. It would need to encourage adaptive behaviors by emphasizing the risk of skin cancer associated with sunburn and by lowering the perceived attractiveness of suntanned skin. The aims of these campaigns are to reduce the incidence, morbidity and mortality of skin cancer by changing attitudes and behaviors, as well as controlling existing disease [116]. A reduction in skin cancer incidence would have a direct effect on health system cost savings for the government [117].

Mid-1980s marked the beginning of educational campaigns in the United States of America, starting with the "Fry Now, Pay Later" campaign, launched by the American Cancer Society in 1985. Now there are a lot of such campaigns warning society of the sunbathing hazards, for instance the New Zealand Ministry of Health and The New Zealand Cancer Control Trust 2002 [118], the Sun-smart America Curriculum 2004 [119], The Transtheoretical Model 2003 in Sweden [120, 121], Slip, Slop, Slap (Slip on a shirt, Slop on sunscreen and Slap on a hat) 1980 and Sunny Days, Healthy Ways, 2005 in the USA [85, 121, 122], the Australian Sun-smart [116], (2000) and Euromelanoma (2003) in Europe [81, 123]. The main goal of these campaigns, which is consistent with WHO [124] and Center for Disease Control (CDC) [125] guidelines, is to increase awareness of the risks of prolonged sun exposure and to educate the

public about protective measures.

A large influence on public awareness of skin cancer in the USA was achieved after President Ronald Regan, who was known to suffer from multiple basal cell malignancies, had promoted the National Skin Cancer Prevention and Detection Week [48].

Although public education concerning skin cancer has increased in recent years, the number of college students who engage in tanning activities has risen. [47]

Against this background, the tanning patterns and sun protective behavior of students of Poznan University of Medical Sciences was investigated.

4 The Aim of the Study

The present study had several goals.

- The first goal was to investigate differences in tanning habits and solar protection in various ethnic groups of medical students of Poznan University of Medical Sciences.
- The second aim was to check their knowledge of solar radiation and effectiveness of sunscreen products.
- The third aim was to find out their attitude towards sunscreen product application.
- The fourth aim was to investigate how important tanned skin appearance is for them. Focusing on the ethnic and nationality mixture, those different groups are compared to one another, trying to find out similarities or differences in behaviour and preferences.
- By conducting this research, a history of sunburn cases was collected.
- On top of it, this research explores students' awareness of solar radiation hazards and the risk of getting skin cancer.
- Nevertheless, their source of knowledge about the need of solar prevention is estimated, at the same time checking if public skin cancer prevention campaigns exist in their countries.

An additional goal of this work was to verify certain stereotypic statements about ethnic groups. Assumptions, which were based on stereotypes about each ethnic group examined were made. The survey helped to prove or disprove their accuracy.

Statements verified in this study:

Statement 1: Scandinavian students with skin type II visit tanning studios more often in comparison to East Asian students with skin type II.

Statement 2: East Asian students prefer not to be tanned, so that they do not visit tanning studios or tan in the sun as often as other students.

Statement 3: East Asian students use more sunscreens with higher SPF (30 or more) than other students.

Statement 4: Parents with a higher education level (university) educate their children about sun protection at home.

Statement 5: Students who experienced sunburn (those who answered positively questions no. 11 and 12) are those who do not know what effect UVR has on their skin.

Statement 6: Students who like to be tanned would risk getting sunburnt to be tanned.

Statement 7: More North American students with skin types II and III would risk getting sunburnt to be tanned than students from Eastern Europe with skin types II and III.

Statement 8: Students who like to be tanned tan in the midday sun and visit tanning studios.

Statement 9: Students who like to be tanned get sunburnt more often after tanning studio visits than after tanning in the sun.

Statement 10: Students who get sunburnt in the sun are those with skin type II and III.

Statement 11: Students who did not experience sunburn in their childhood were educated about sun protection at home.

Statement 12: Students who did not experience sunburn in their childhood get less frequent sunburns as adults.

Statement 13: Students who use sunscreen products to increase the time they can spend in the sun are those who get sunburnt.

Statement 14: Students who check themselves for skin changes visit tanning studios.

Statement 15: Those students who had a mole removed by a doctor use tanning studios and tan under natural sun.

Statement 16: North American students with skin type II and III get more sunburnt than Eastern European students with skin type II and III

Statement 17: Students who were not sunburnt during childhood have national campaigns in their country informing about sun protection.

Statement 18: Students who get burnt in the sun do not use sunscreen products.

Hypotheses concerning: gender, ethnic groups and national campaigns, were stated and their significance is presented in paragraph 4.7.

5 Material and methods

5.1 Study Population

The study was performed during the academic year 2010/2011 at Poznan University of Medical Sciences, situated in Poland, which has Polish and an English division department. The total number of foreign medical students who participated in the survey, including various nationalities and different ethnicities was 1011. Participants were divided into groups according to geographic regions. This resulted in the creation of one group each of students from North America, Eastern Asia, Scandinavia, Eastern Europe and a mixed group consisting of students who did not fulfill the criterion of the groups mentioned above.

In autumn 2010 the questionnaire was sent in an electronic form to the students of the English and Polish divisions. Due to the inadequate response rate (n=241 out of 1011) we prepared the questionnaire in paper form and continued the study in spring 2011. Foreign and Polish 1st and 2nd year students were asked to complete the questionnaire during lectures. Students who had answered the electronic questionnaire were asked not to answer it the second time. The total number of students taking part in the study rose from 241 to 718.

Table 2. Distribution of students broken down by ethnic group regarding the method of participation

Ethnic Group	Internet	Paper	Total
North American ¹	50	68	118
Eastern Asian ²	32	37	69
Scandinavian ³	55	69	124
Eastern European ⁴	71	266	337
Mixed group ⁵	24	27	51
Total	232	467	699

¹ USA, Canada

² Taiwanese, Korean, Chinese

³ Norwegian, Swedish, Danish

⁴ Polish, Russian, Ukrainian

⁵ Afghan, African, Australian, Bangladeshi, British, Colombian, Dominican, East Indian, French, German, Greek, Indian, Iraqi, Jamaican, Mongolian, New Zealander, Nigerian, Pakistani, Persian, Saudi Arabian, Syrian, Sri Lankan

**(19 students did not specify their nationality)*

Most of the participants (72%) identified themselves as Caucasian, 13% as Asian, 3% as Indian, 2% as Arab, 1% as African, 0.3% as African-American, 0.1% as South African and 6% as others.

Unfortunately not all the questions were answered by all students. Value “n” is given for every question and refers to the total number of given responses.

The study was approved by the ethics committee of Poznan University of Medical Sciences (No. 883/2011).

5.2 Questionnaire

The multiple-choice questionnaire, which is attached as paragraph 6. consisted of 6 parts: **demographic** questions, questions testing the students' **knowledge** of UV radiation risks, questions assessing their **attitude** towards tanning, questions concerning their tanning **behaviour** and sun protection, questions regarding their **experience** with sunburns in the past and questions related to **education** about solar damage and sun protection.

5.2.1 Demography

The demographic part (first part of the questionnaires) consisted of questions about age, gender, ethnic group, nationality, self-assessment based on written description of skin type according to Fitzpatrick classification of sensitivity to sun exposure (skin type I: very white, always burns; skin type II : light white, burns easily; skin type III: dark white, might burn; skin type IV: tans easily, uncommon burns; skin type V: darker, never burns; skin type VI: dark, never burns) [70], affiliation to faculty (Polish or English division), current educational level, parents' educational level, family history of skin cancer or presence of own skin cancer history.

5.2.2 Knowledge

The knowledge testing part (questions 1 through 4) contained questions about the relation of UV radiation and its hazards and the effects of using sun screen products. The students had to answer which part of the UV radiation causes sunburn and which causes skin aging. Questions referring to sunscreens were about the effectiveness of their radiation blocking properties, their ability to prevent sunburns, skin cancer, skin aging or if they reversed signs of aging and what did SPF in sunscreen products refer to.

5.2.3 Attitude Towards Tanning

The third part (questions 5,6) concentrated on students' attitude towards tanning and their preferences of tanned skin appearance. Students were asked how they liked themselves the most (tanned, not tanned, do not care, or if they were already naturally dark enough). There was also a question if they would risk getting sunburnt just to be tanned.

5.2.4 Tanning Behavior

The behaviour part (questions 7-10, 16-18) had questions about personal tanning practice (natural sun, midday sun, tanning studio, tanning time) and attitude towards sunscreen use (do you use sunscreens, when do you reapply sunscreens, which sun protective factor do you use or why don't you use it).

5.2.5 Experience with Sunburns in the Past

The fifth part of the survey (questions 11-15) focused on students' experience. Students were asked about their past history of sunburns, specifically last summer and in childhood and in which circumstances they experienced one.

5.2.6 Education About Solar Damage and Sun Protection

The last part of the questionnaire (question 19-22) concerned students' skin cancer prevention. Students were asked about main sources of information (home, physician, school, medical school, national campaigns or other) from which they gathered knowledge about sun protection and solar damage and their UV radiation hazards awareness based on their responses to questions on checking nevi for changes or even getting moles removed.

5.3 Statistical Analysis

For statistical analysis "Statistica 9.0" software was used. Students' responses were analysed statistically using the Chi-square test for dichotomous variables and $r \times c$ variables, with Fischer or Yates correction. For hypotheses comparing different (5) ethnic groups, Pearson's Chi-square test was used. All results with statistical significance of $p < 0.05$ were considered significant.

6 Results

6.1 Demography

6.1.1 Gender

The sample consisted of 718 medical students with the age ranging from 17 to 36 years ($M=22,4$, $SD=2,86$). Three students did not specify their gender.

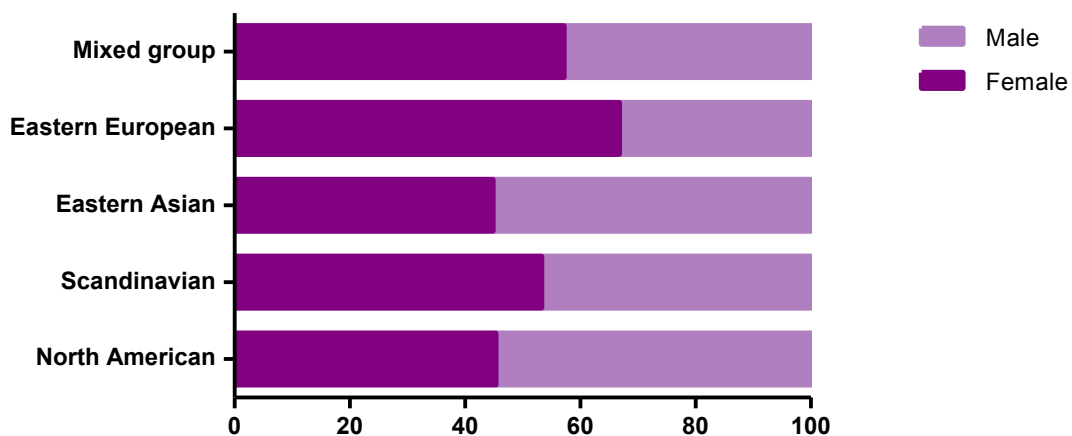


Figure 1. Gender distribution among ethnic groups (n=715, 3 answers missing)

6.1.2 Skin Type

Focusing on the gender the skin type distribution was as follows:

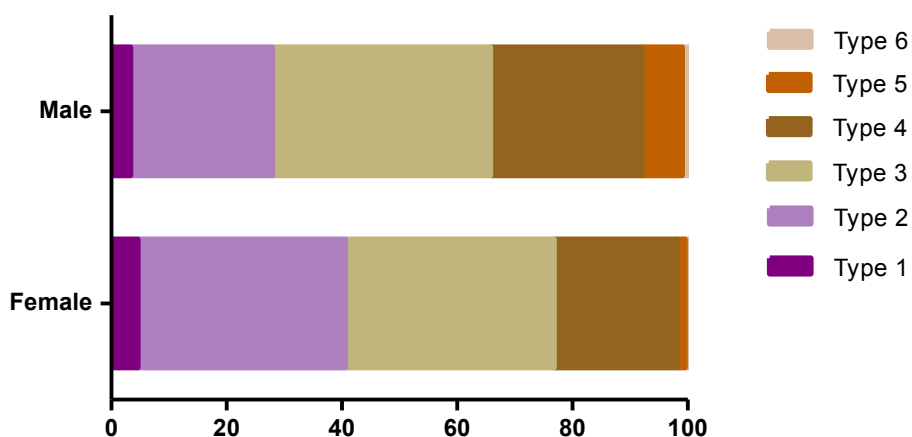


Figure 2. Gender distribution among ethnic groups (n=715, 3 answers missing)

Among ethnic groups the skin type distribution was as follows:

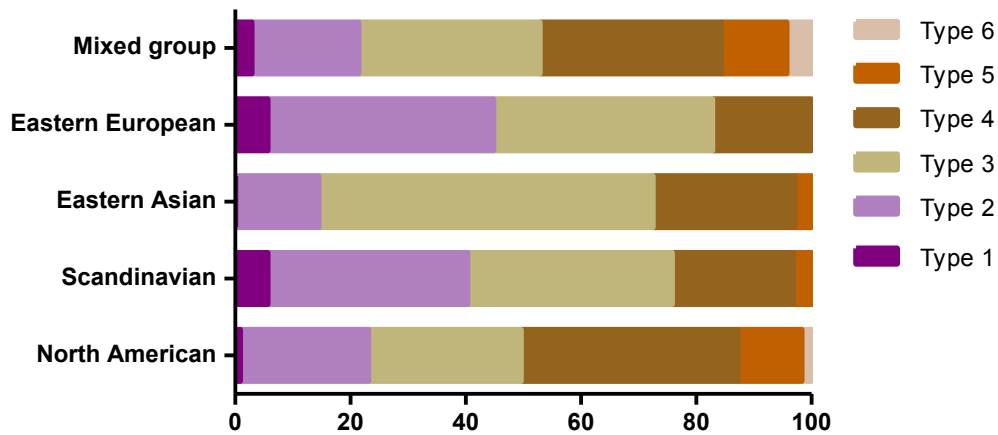


Figure 3. Skin type distribution among ethnic groups (n=702, 16 answers missing)

6.1.3 Students' Level of Education

The following results were collected about the students' level of education:

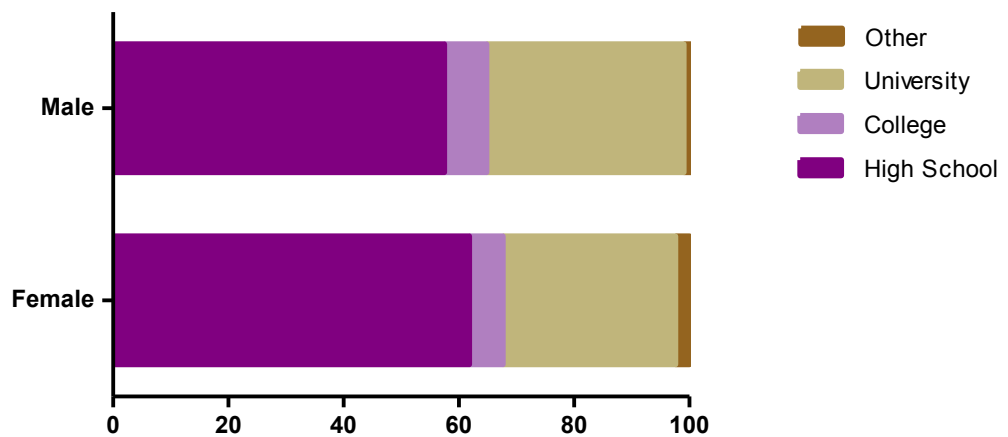


Figure 4. Students' level of education (n=713, 5 answers missing)

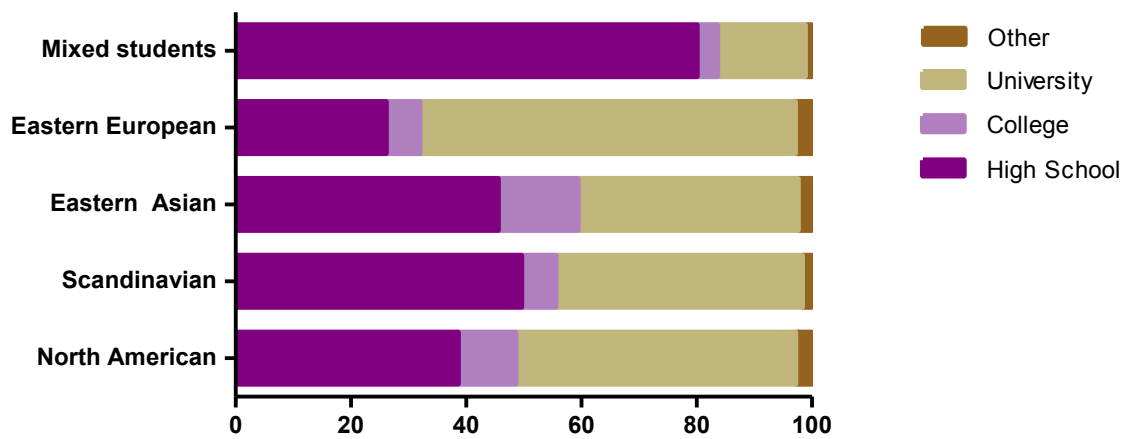


Figure 5. Educational level of students broken down by ethnic group (n=714, 4 answers missing)

6.1.4 Students' Parents' Level of Education

Asking about educational level of students' parents the following results were given:

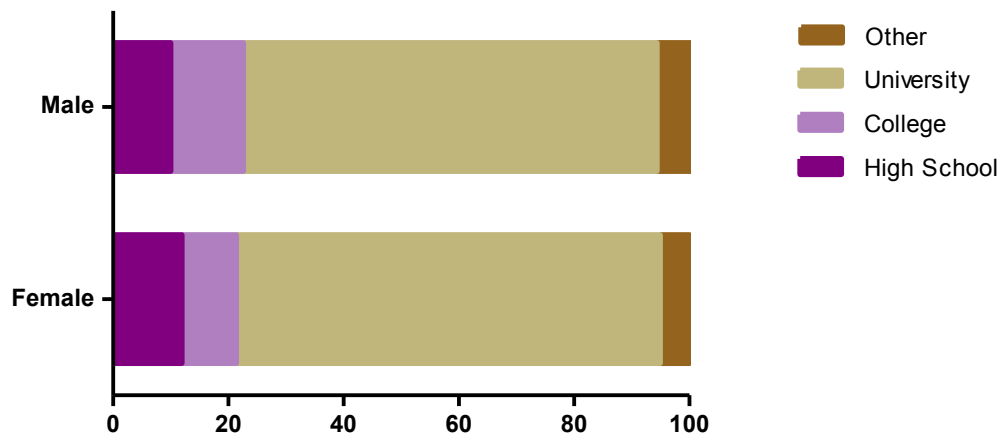


Figure 6. Educational level of students' parents (n=713, 5 answers missing)

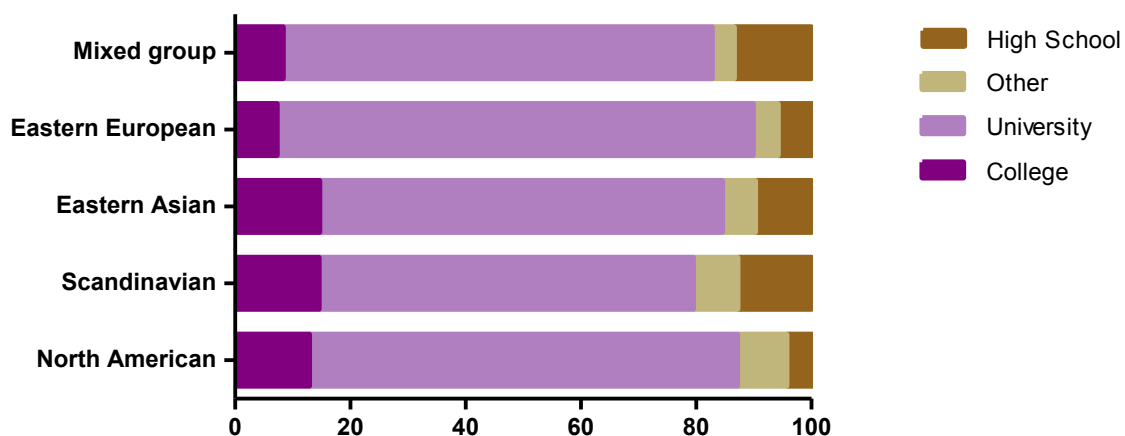


Figure 7. Educational level of students' parents broken down by ethnic group (n=715, 3 answers missing)

6.1.5 Family History of Skin Cancer

The majority of students reported that there was no family history of skin cancer. Most cases were reported within the Scandinavian group.

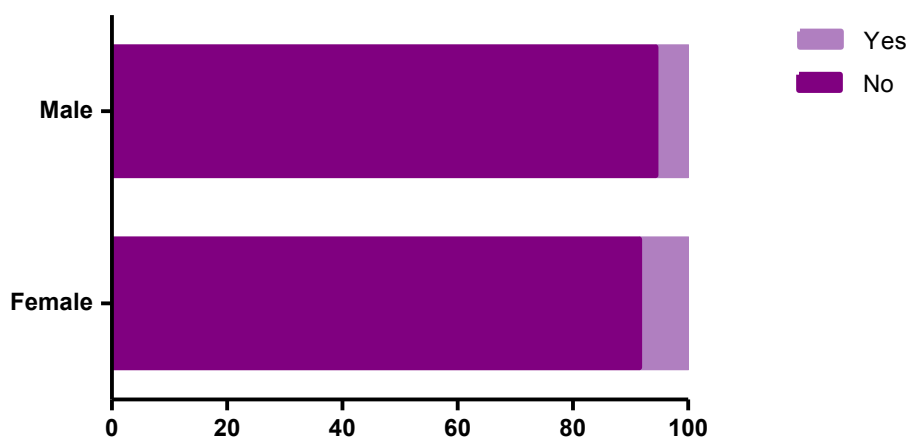


Figure 8. Family history of skin cancer broken down by gender (n= 714, 4 answers missing)

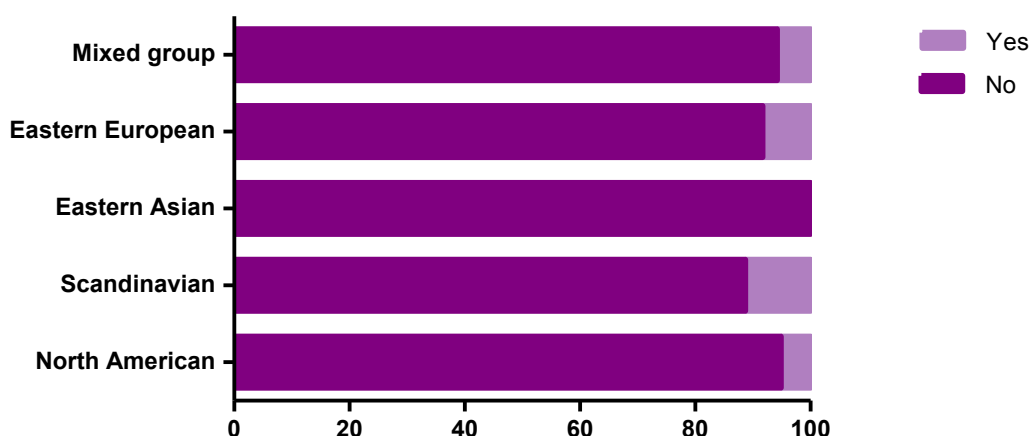


Figure 9. Family history of skin cancer among ethnic groups (n= 716, 2 answers missing)

6.1.6 Personal History of Skin Cancer

Majority of students did not have skin cancer. Just a few students admitted having a positive history of skin cancer. There were more females than males in this group. Among the ethnic groups, the North American students gave the greatest number of affirmative answers.

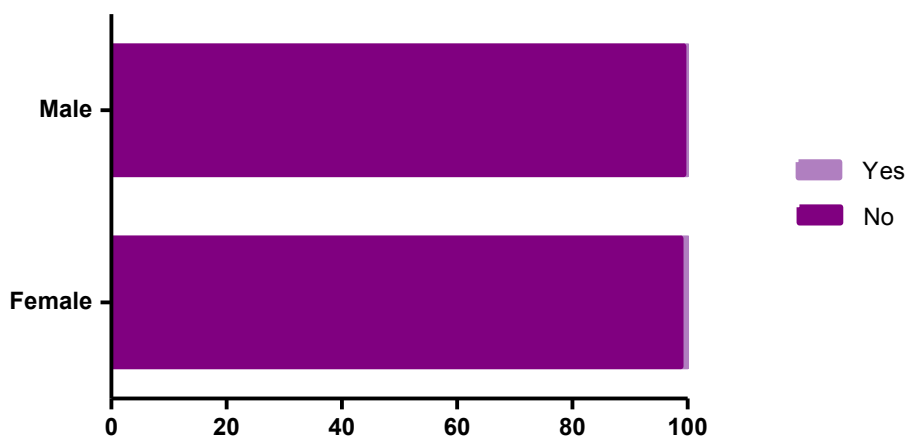


Figure 10. Personal history of skin cancer between genders (n= 712, 6 answers missing)

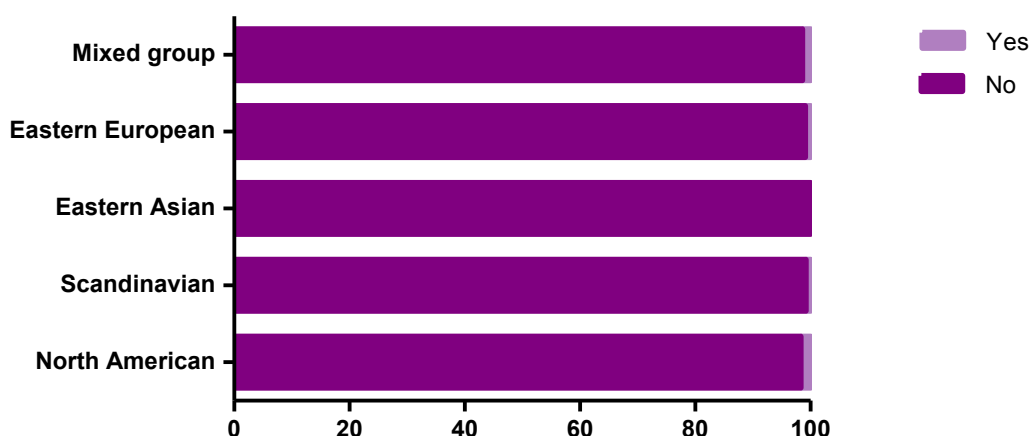


Figure 11. Personal history of skin cancer among ethnic groups (n=714, 4 answers missing)

6.2 Knowledge

6.2.1 Sunscreen Effectiveness

Students' knowledge about sunscreens was examined by two questions. In the first question (question no.1 of the questionnaire which is attached in the appendix) the students were expected to estimate the effectiveness of sunscreens. Most students were sure that sunscreens are effective in preventing sunburns.

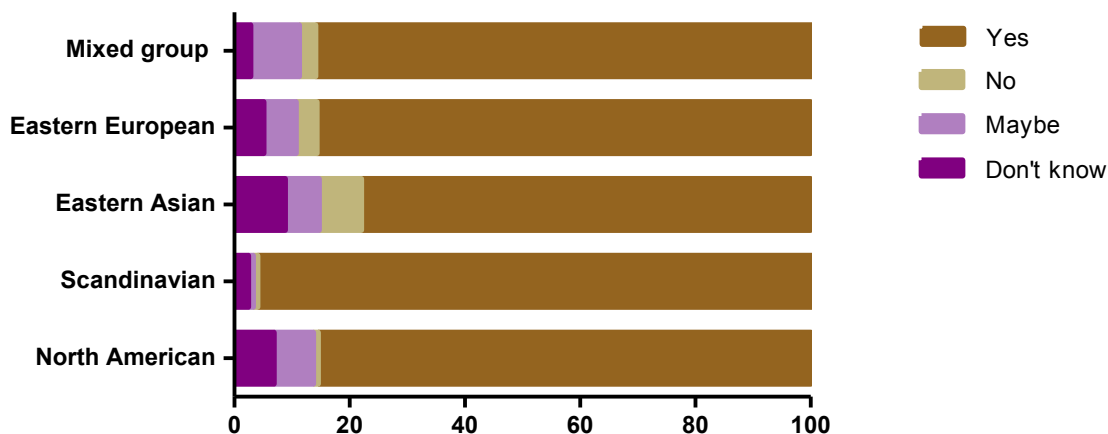


Figure 12. Sunscreen effectiveness in preventing sunburns (n= 716, 2 answers missing)

Majority of students were positive about sunscreens being effective in preventing skin cancer.

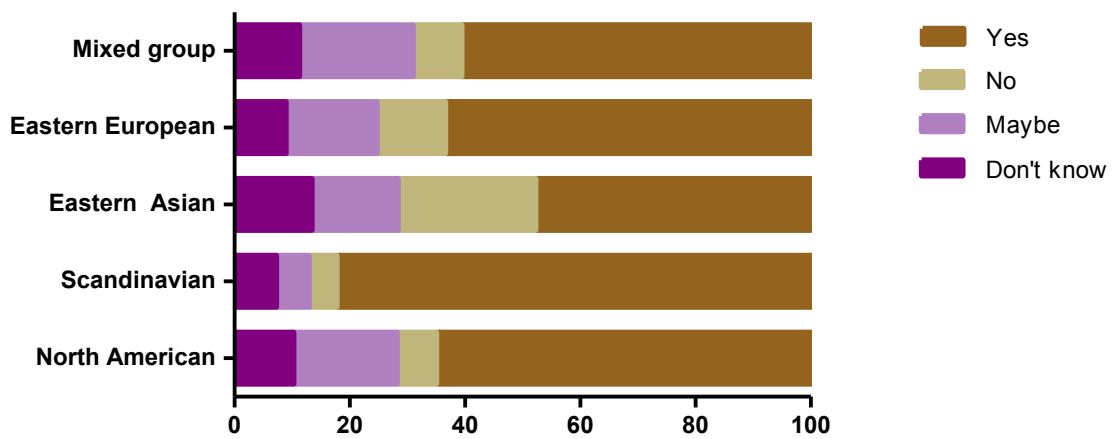


Figure 13. Sunscreen effectiveness in preventing skin cancer (n= 715, 3 answers missing)

The majority of students gave a positive answer when asked if sunscreens were effective in preventing skin from aging.

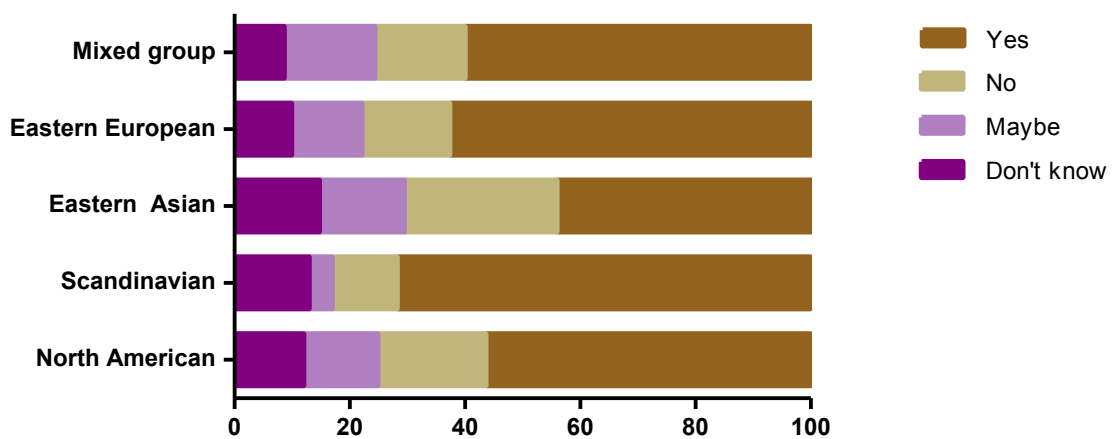


Figure 14. Sunscreen effectiveness in preventing skin from aging (n=714, 4 answers missing)

Following answers were given when asked if sunscreens were effective in reversing signs of aging:

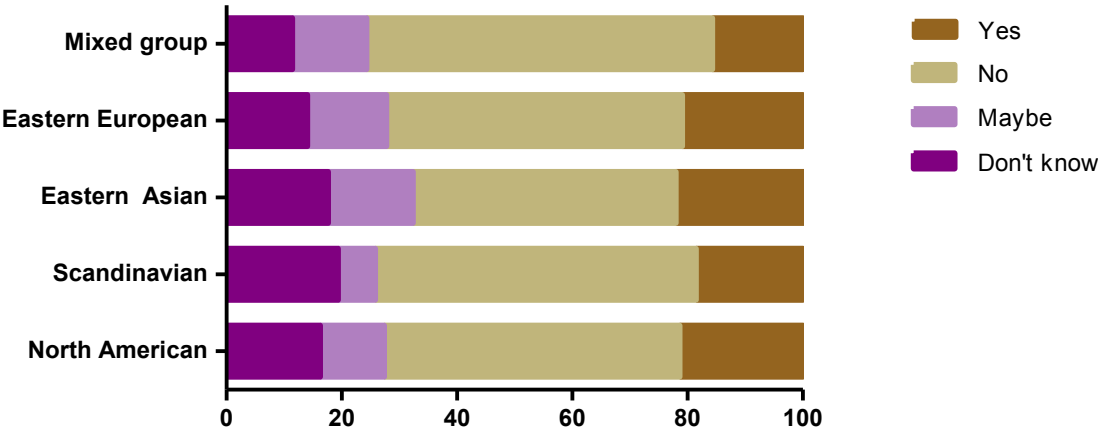


Figure 15. Sunscreen effectiveness reversing signs of aging (n=714, 4 answers missing)

6.2.2 SPF

In the second question (question no. 4) the students had to establish what SPF (sun protective factor) measures. Most of the students chose UVA and UVB as an answer.

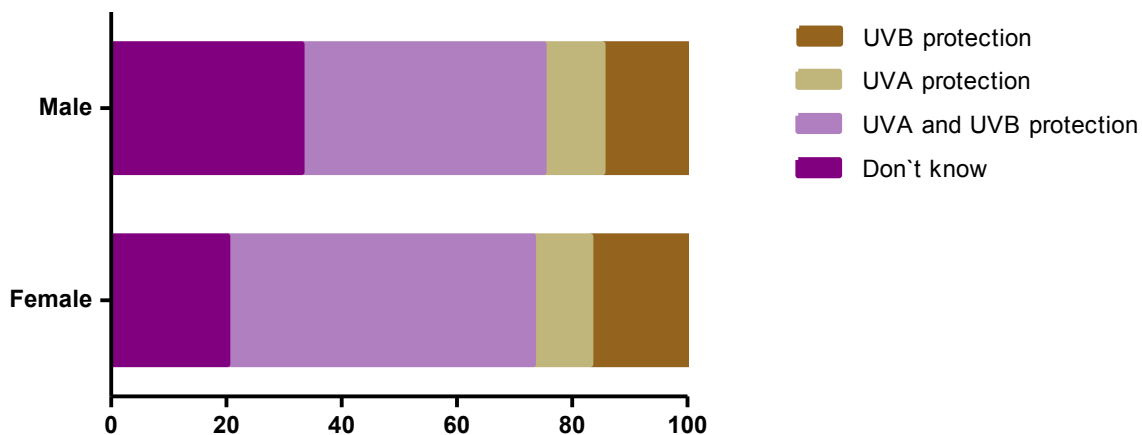


Figure 16. Students answers to the question "What is sun protective factor (SPF) a measure of?" (regarding genders) (n= 704,14 answers missing)

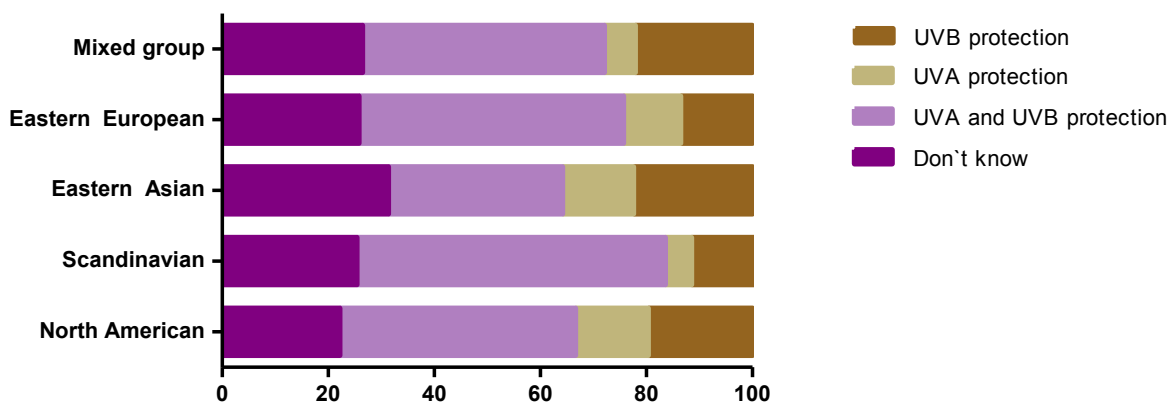


Figure 17. Students answers to the question "What is sun protective factor (SPF) a measure of?" (among ethnic group) (n=707, 11 answers missing)

6.2.3 UV Radiation

The knowledge about UV radiation was also estimated by two questions. The first one (question no.2) asked about UV radiation part that causes sunburns. The following answers were collected:

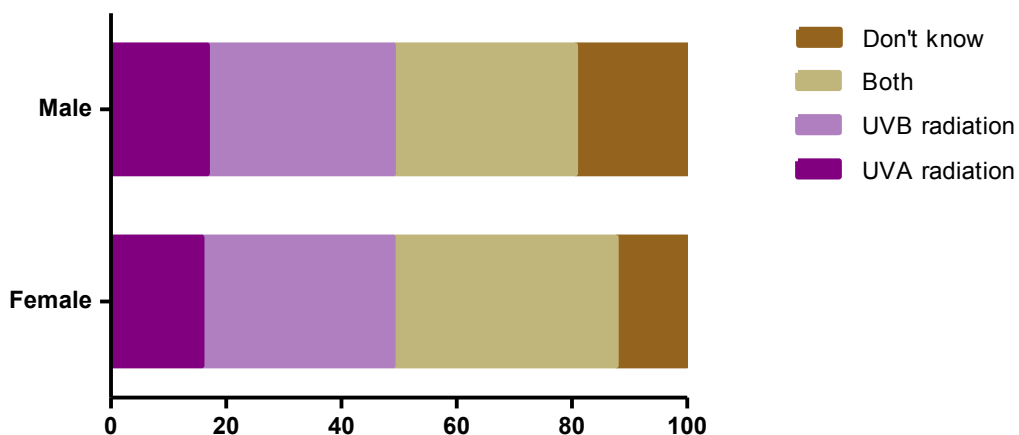


Figure 18. Students' answers regarding the question "Which part of the UV radiation causes sunburns?" (between genders) (n=707, 11 answers missing)

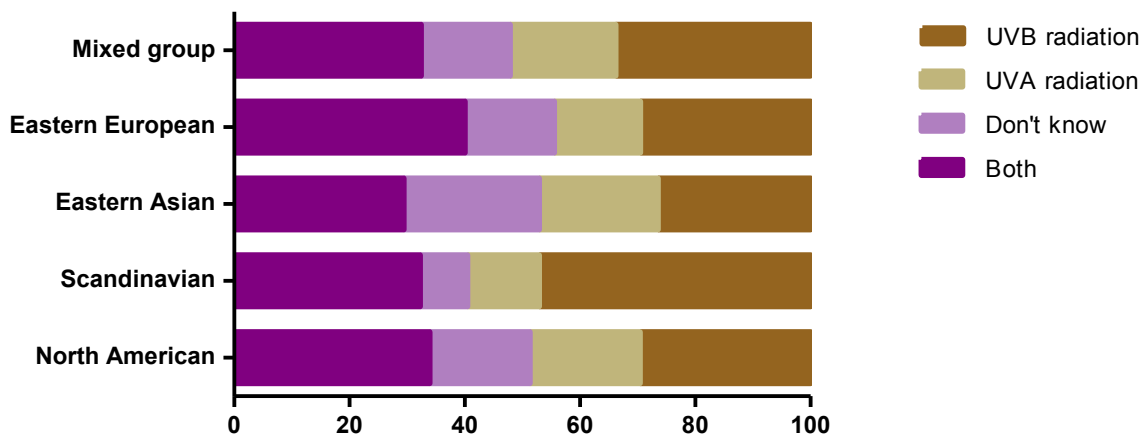


Figure 19. Students' answers regarding the question "Which part of the UV radiation causes sunburns?" (among ethnic groups) (n=710, 8 answers missing)

When asked which part of UV radiation causes skin aging (question no. 3), respondents answered similarly. Most of them picked UVA and UVB.

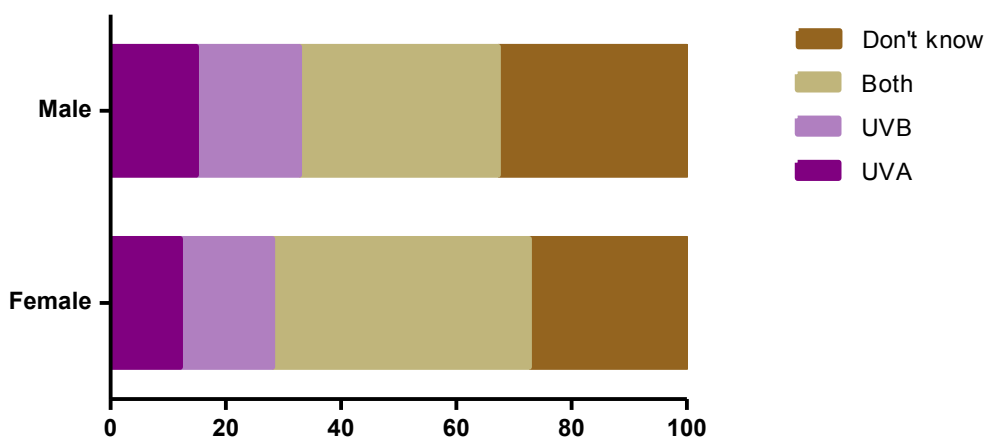


Figure 20. Students' answers as to which part of the UV radiation causes skin aging (broken down by gender) (n=709, 9 answers missing)

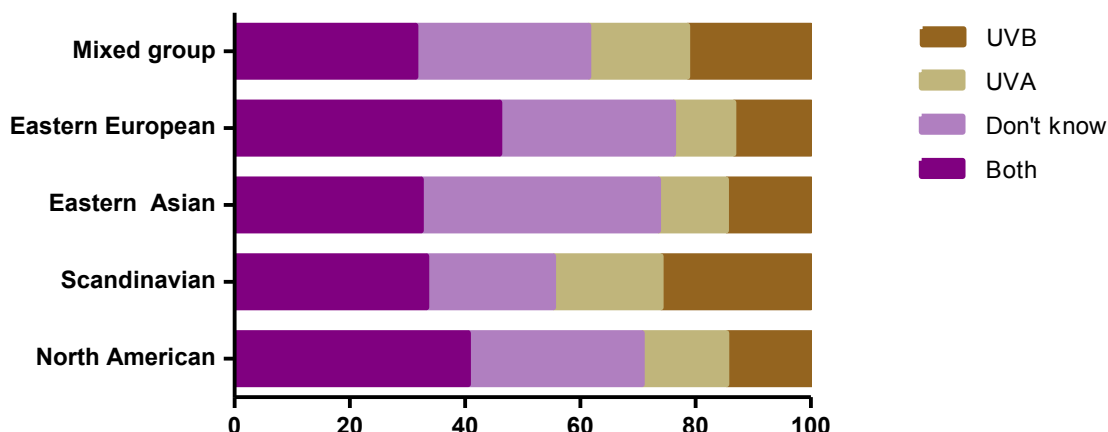


Figure 21. Students' answers as to which part of the UV radiation causes skin aging (broken down by ethnic group) (n=712, 6 answers missing)

6.3 Attitude Towards Tanning

In order to estimate the students' attitude towards tanning and their preferences of tanned skin appearance, two questions were asked. When asked how the students like themselves the most (question no. 5), majority of females liked themselves when they were tanned, the same answer was given by the majority of the students of the ethnic groups. Only the Eastern Asian students were the ones who in majority liked themselves the most when they were not tanned.

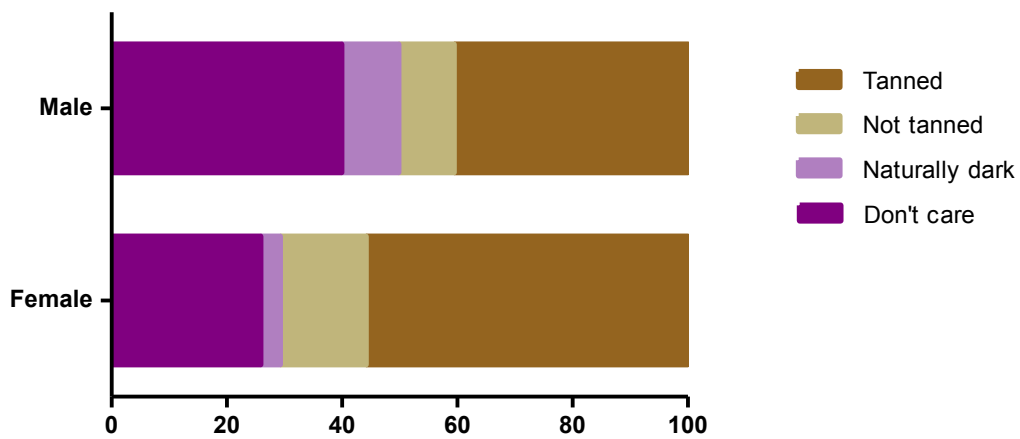


Figure 22. Students answers to the question “How do you like yourself most?” (broken down by gender) (n=703,15 answers missing)

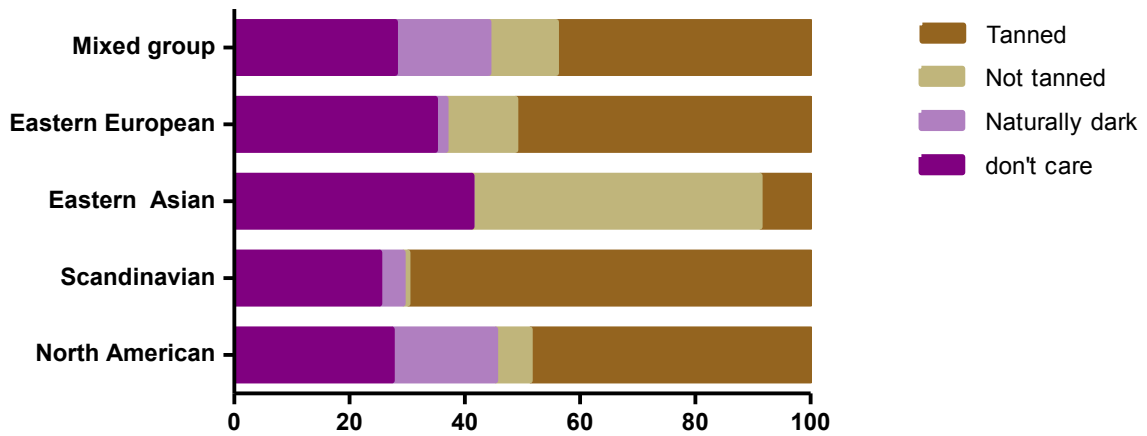


Figure 23. Students answers to the question “How do you like yourself most?” (broken down by ethnic group) (n= 706, 12 answers missing)

The second question the students were asked to answer was if they would take the risk of getting sunburnt just to be tanned (question no. 6). One-third of students, consisting of more females than males, affirmed that they would take this risk. Focusing on the ethnic groups, most affirmative answers were given by the Scandinavian students.

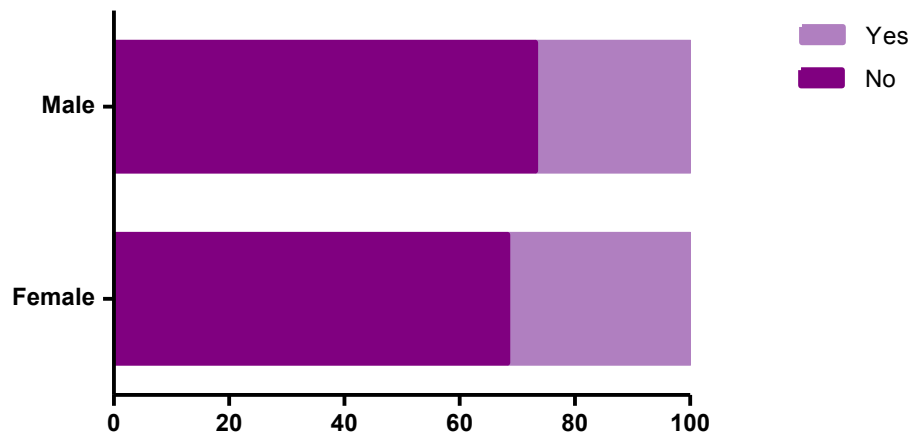


Figure 24. Students answers to the question “Would you take the risk to get sunburnt just to be tanned?” (broken down by gender) (n=704, 14 answers missing)

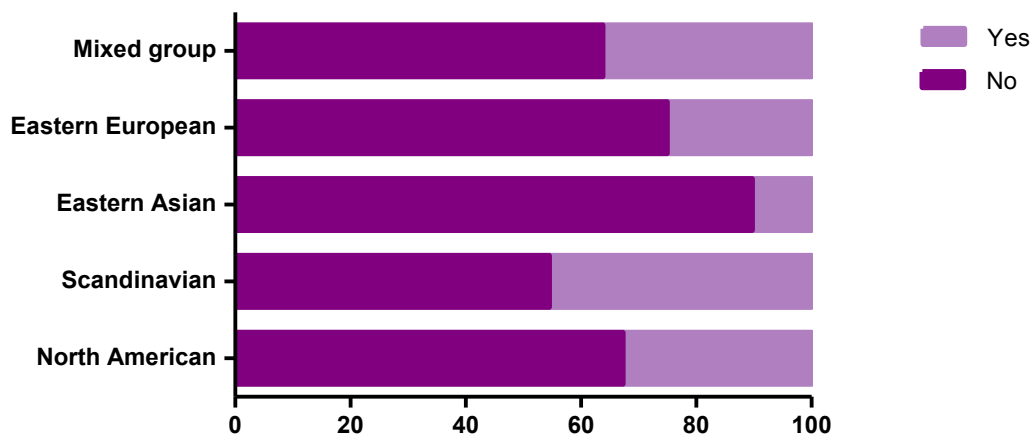


Figure 25. Students answers to the question “Would you take the risk to get sunburnt just to be tanned?” (broken down by ethnicity) (n=704, 14 answers missing)

6.4 Tanning Behavior

Most of the participants answered that they tanned in natural sun light. The majority of them did it for less than 3 hours per day. The results show that more than a half of the surveyed tanned in the midday sun.

6.4.1 Tanning in the Sunlight

The majority of both male and female students answered that they tan in the sun (question no. 7). Regarding the ethnic groups, the majority gave an affirmative answer with the exception of the Eastern Asian students, who said that they avoided tanning in the sun.

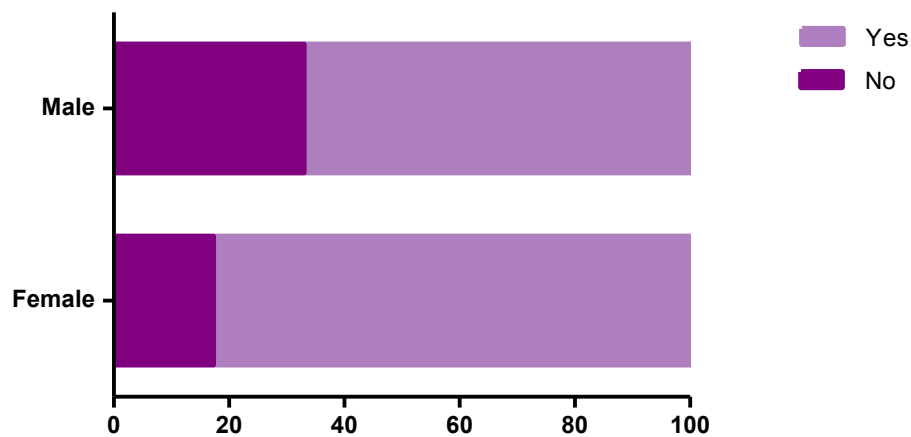


Figure 26. Students answers to the question “Do you tan in the sun?” regarding genders (n=705, 13 answers missing)

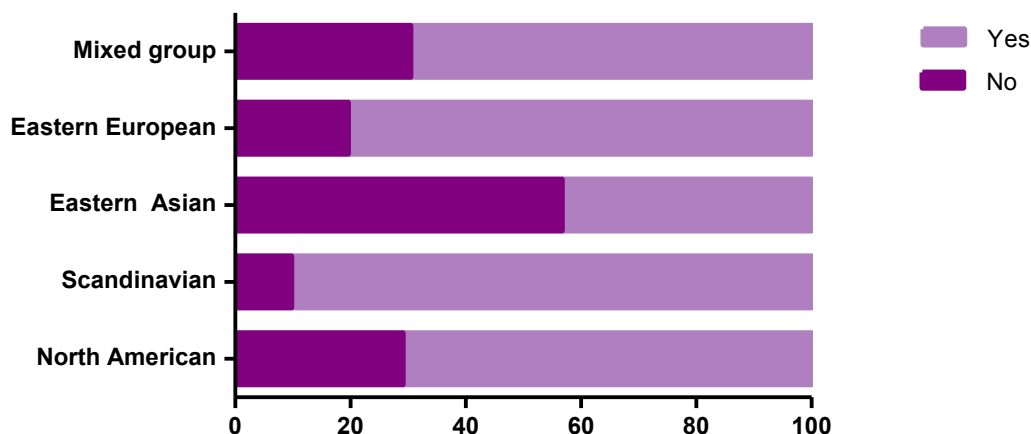


Figure 27. Students answers to the question “Do you tan in the sun?” among ethnic groups (n=708, 10 answers missing)

When asked about the time of tanning in the sun, the majority reported a daily tanning time of less than 3 hours (question no. 7).

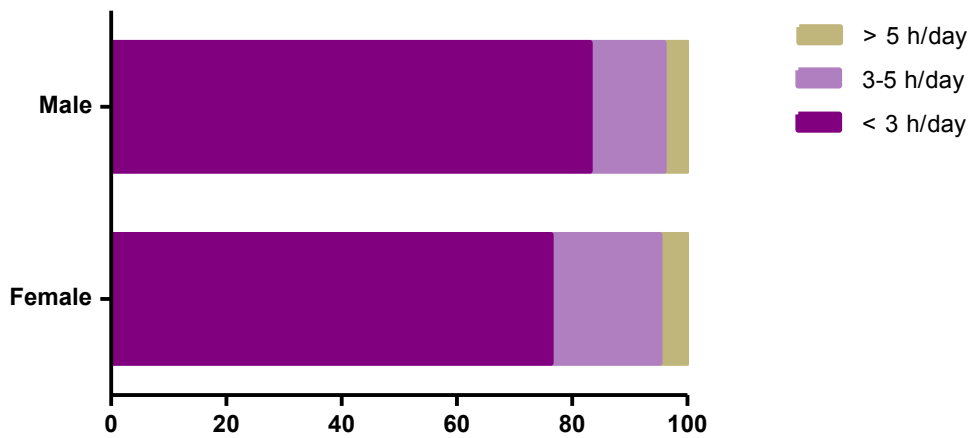


Figure 28. Amount of time students spent tanning in the sun regarding genders (n=528, 9 answers missing)

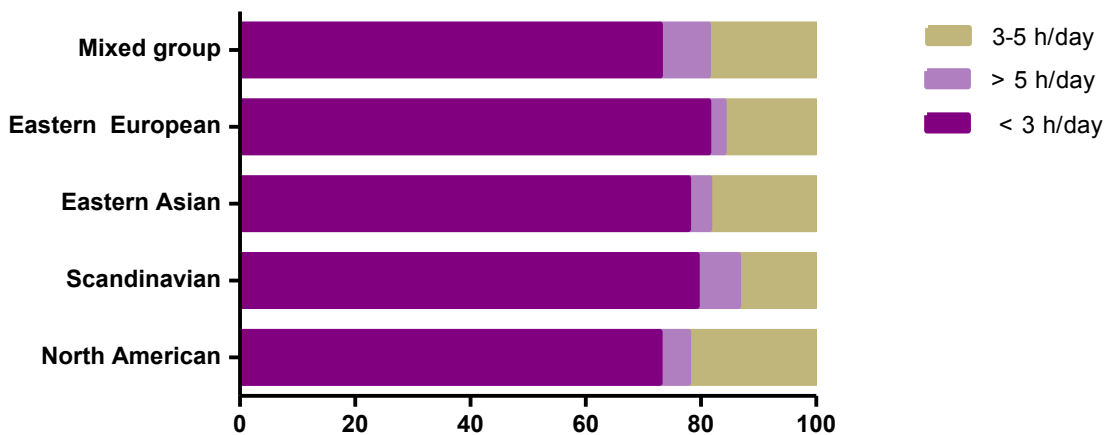


Figure 29. Amount of time students spent tanning in the sun among ethnic groups (n=529, 8 answers missing)

The majority of students gave an affirmative answer to the question regarding tanning in the midday sun (question no. 8), with exception of the Eastern Asian students, who mostly denied such behavior.

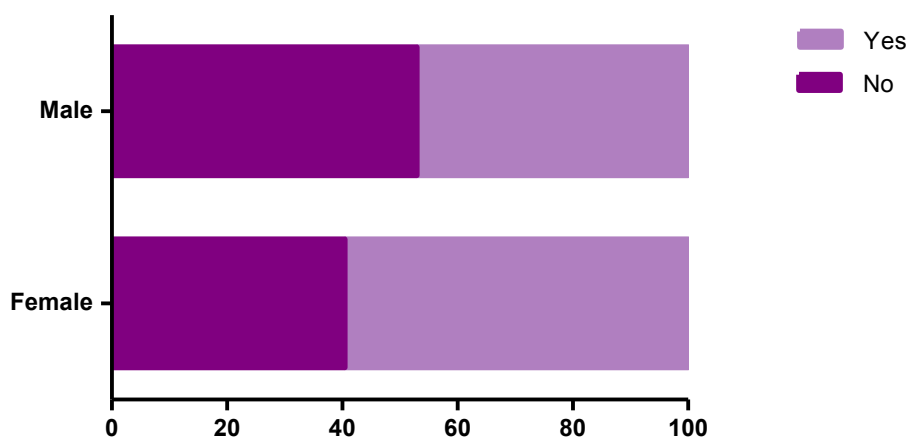


Figure 30. Students answers regarding tanning in the midday sun (11 AM- 3 PM) between genders (n=701,17 answers missing)

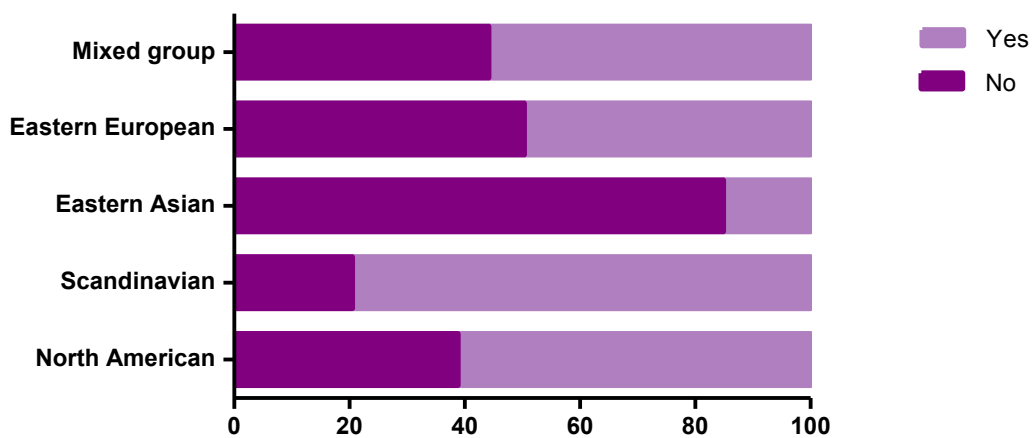


Figure 31. Students answers regarding tanning in the midday sun (11 AM- 3 PM) among ethnic groups (n=704,14 answers missing)

6.4.2 Tanning in the Tanning Studio

One third of participants tan in the tanning studio, with the predominance of females (question no.9). Among the ethnic groups the majority students were positive about the artificial light, only Eastern Asian students gave the fewest affirmative answers.

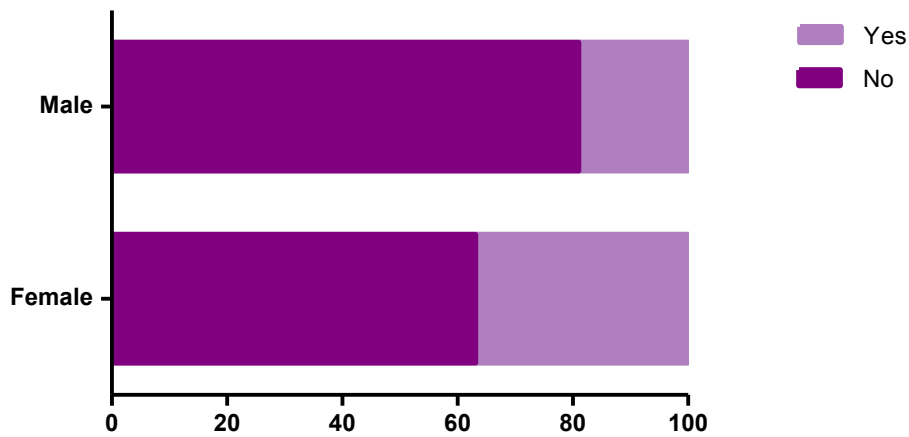


Figure 32. Students answers to the question “Do you visit tanning studios?” regarding gender(n=706)

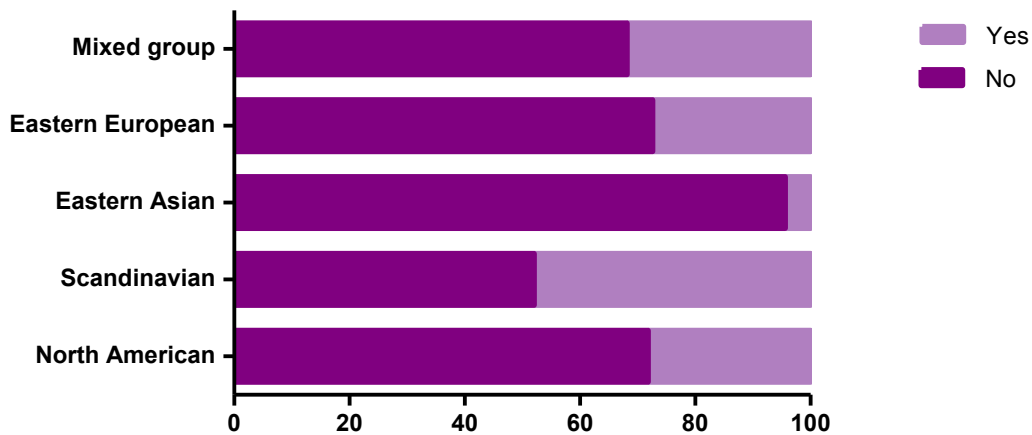


Figure 33. Students answers to the question “Do you visit tanning studios?” regarding ethnicity (n=706)

The majority of students tan rarely and the distribution is equal among females and males. Scandinavian students were the ones who tanned regularly most.

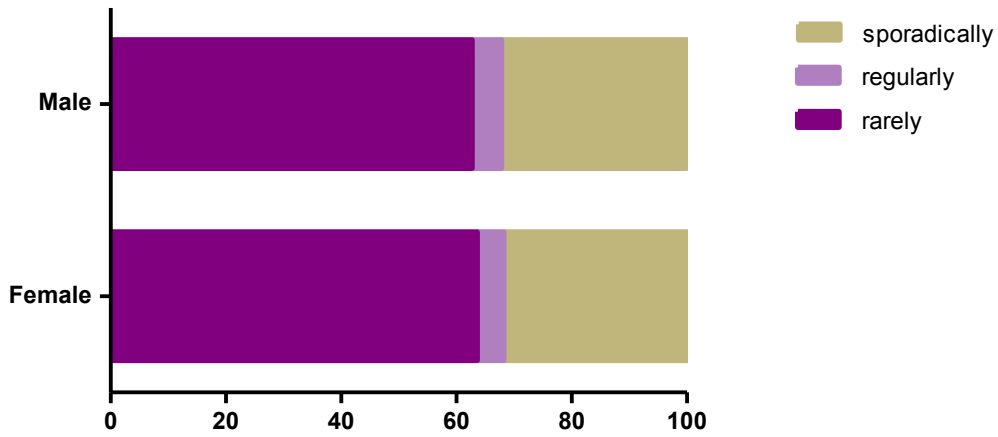


Figure 34. Frequency of tanning studio visits (regarding genders) (n=208)

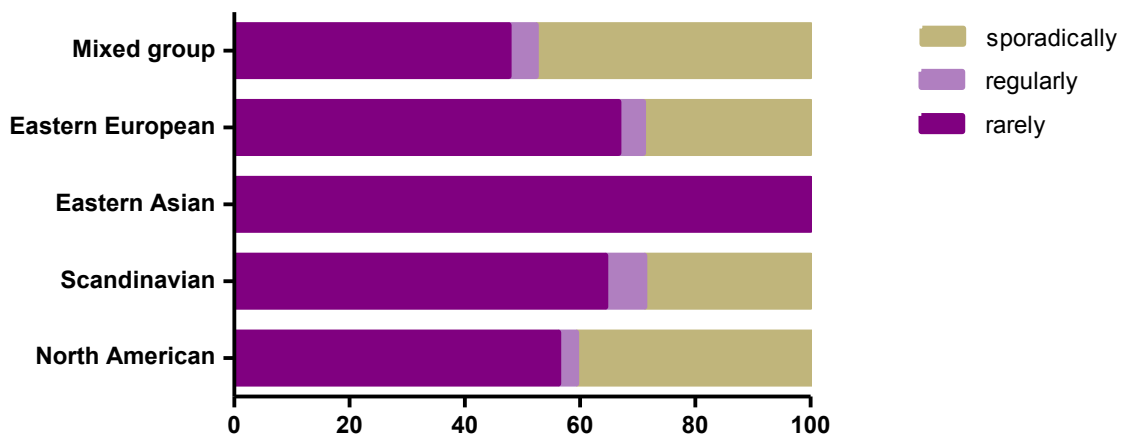


Figure 35. Frequency of tanning studio visits (regarding ethnic groups)(n=208)

When asked about the time spent in the solarium (question no. 10) most students answered they tanned between 5-10 minutes. Scandinavian students were the ones who tanned the longest.

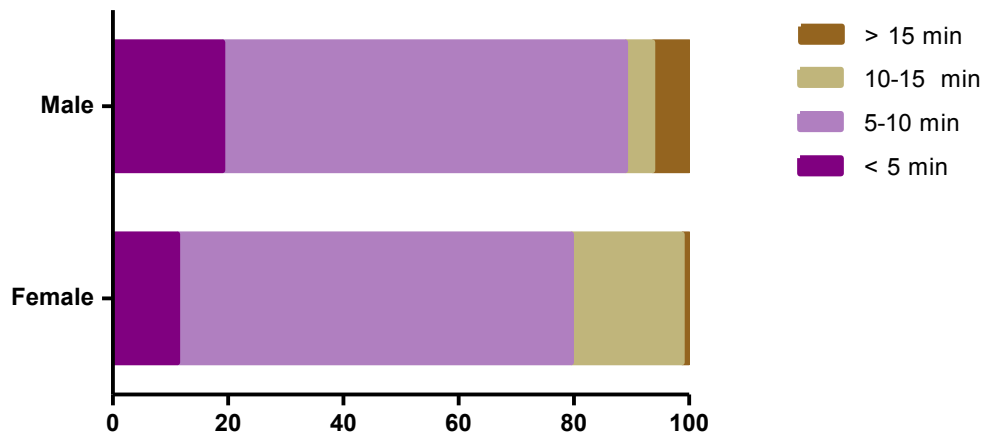


Figure 36. Amount of time spent tanning in a tanning studio (regarding gender) (n=208)

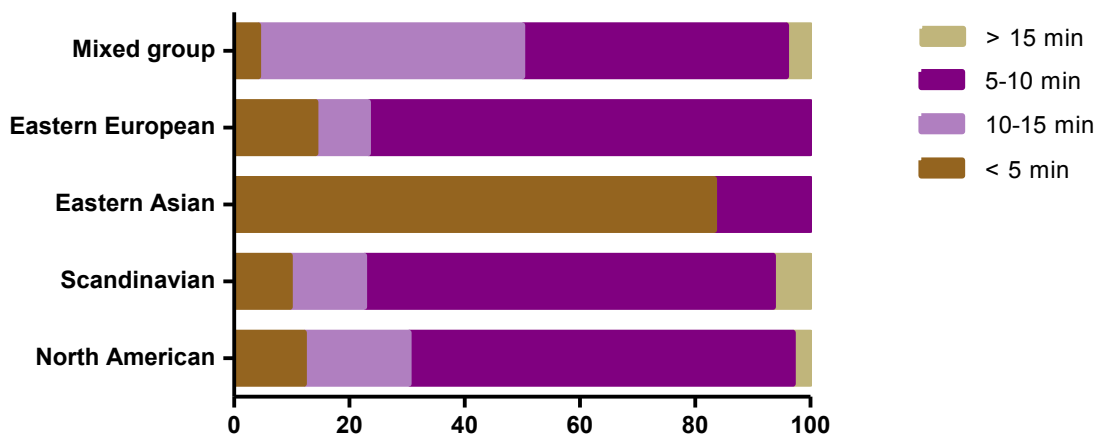


Figure 37. Amount of time spent tanning in a tanning studio (among ethnic groups) (n=208)

6.4.3 Sunscreen Use

6.4.3.1 SPF Most Commonly Used

In general, almost all students claimed to use sunscreens while tanning (question no.17) Sunscreen products with the sun SPF 15-30 were the most popular. Among Eastern Asian students the most popular SPF was 50+.

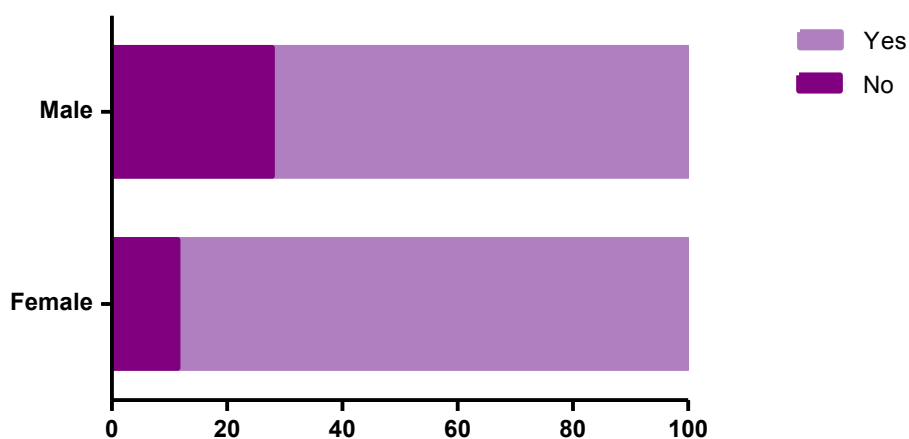


Figure 38. Students' answers regarding sunscreen use while tanning (between genders) (n=686, 32 answers missing)

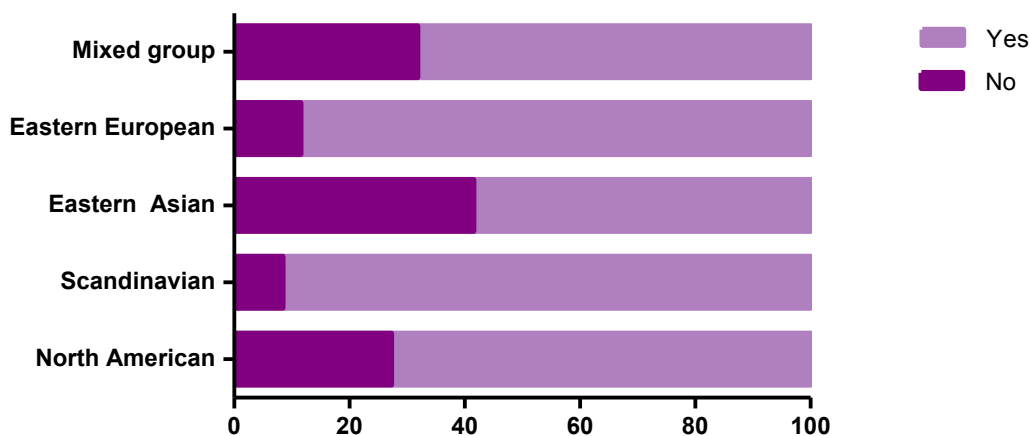


Figure 39. Students' answers regarding sunscreen use while tanning (among ethnic groups) (n=689, 29 answers missing)

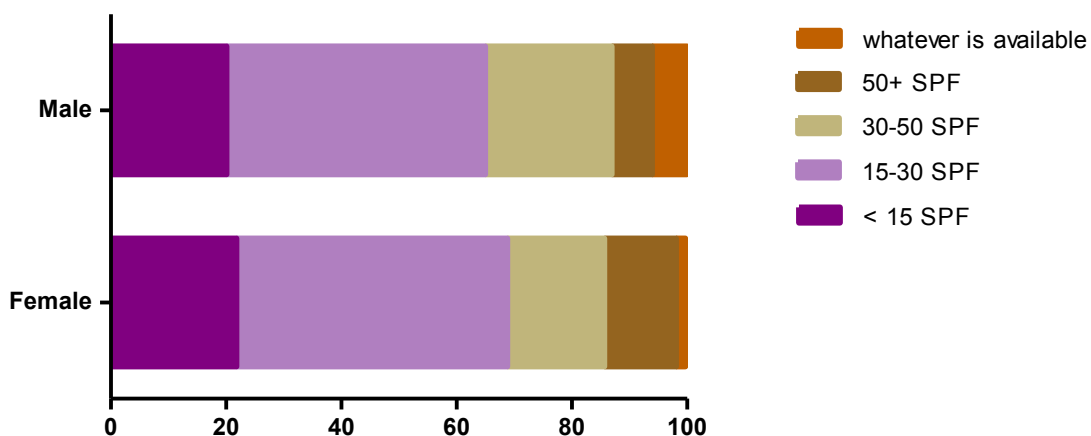


Figure 40. Students' answers regarding the question "Which SPF do you apply?" (between genders) (n=561)

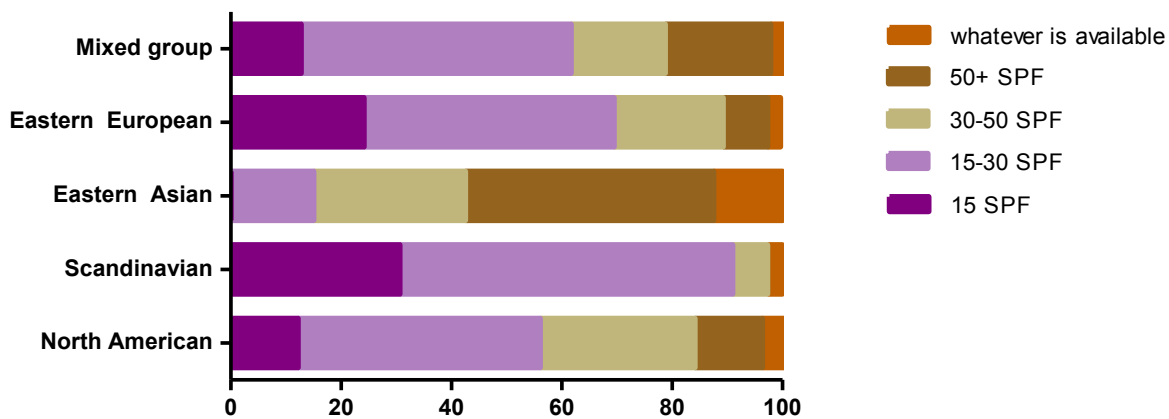


Figure 41. Students' answers regarding the question "Which SPF do you apply?" (among ethnic groups) (n= 563)

6.4.3.2 Reasons Given for not Using Sunscreens

Nearly one fifth of students admitted not using sunscreen while tanning. Forgetting it was the most common reason among males and females, as well as among the ethnic groups. The wish to tan was the most popular answer among Scandinavian and North American students.

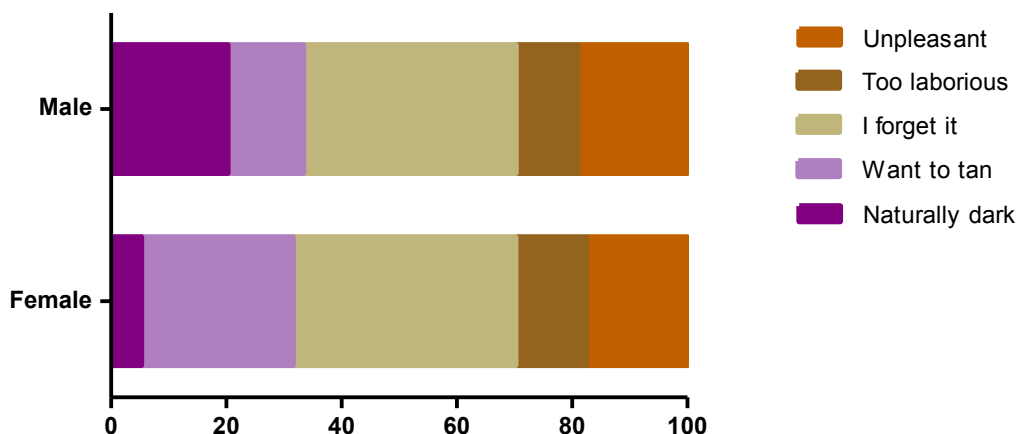


Figure 42. Students' answers to the question: "What prevents you from applying sunscreens?" (regarding genders) (n=125)

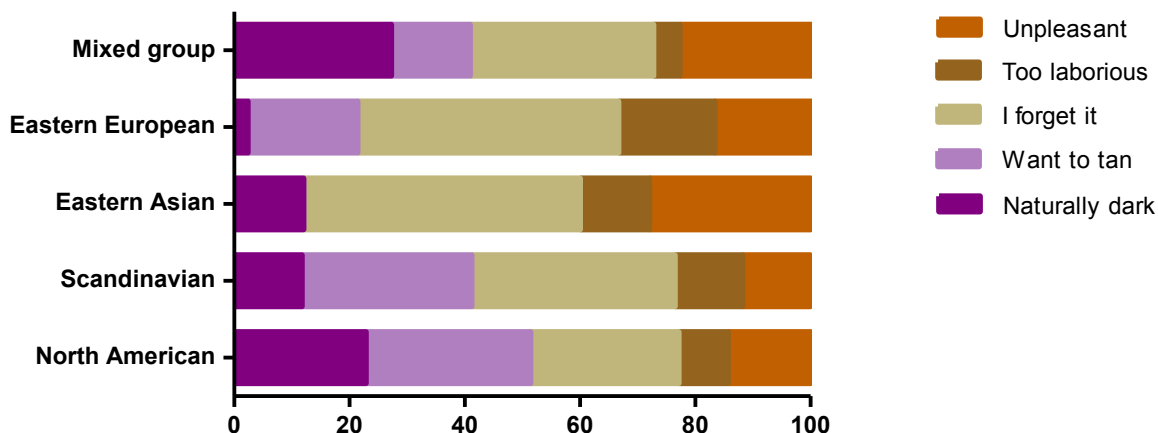


Figure 43. Students' answers to the question: "What prevents you from applying sunscreens?" (among ethnic groups) (n=126)

6.4.3.3 Situations When Sunscreen is Used

Asked about the situations when they applied sunscreen products in the spring and summer (question no.18), half of the student answered they did so when they planned to stay outdoors in the sun for a longer time. It can be seen from the figure 44. that more males than females never used sunscreens, and that more females than males used sunscreen products on a daily basis. More North American students

never used sunscreen products and more Eastern Asian students used them every day compared to other groups.

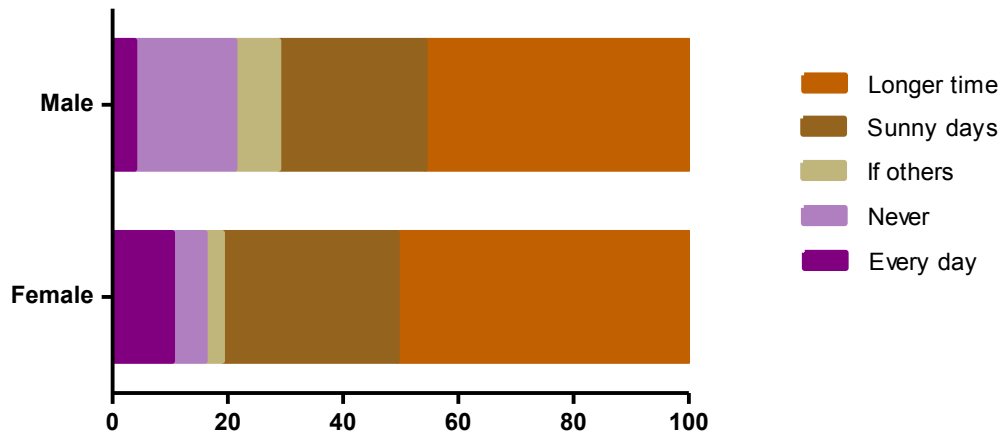


Figure 44. Students' answers regarding the question "Do you apply sunscreens in the spring and summer?" (broken down by gender) (n=693, 25 answers missing)

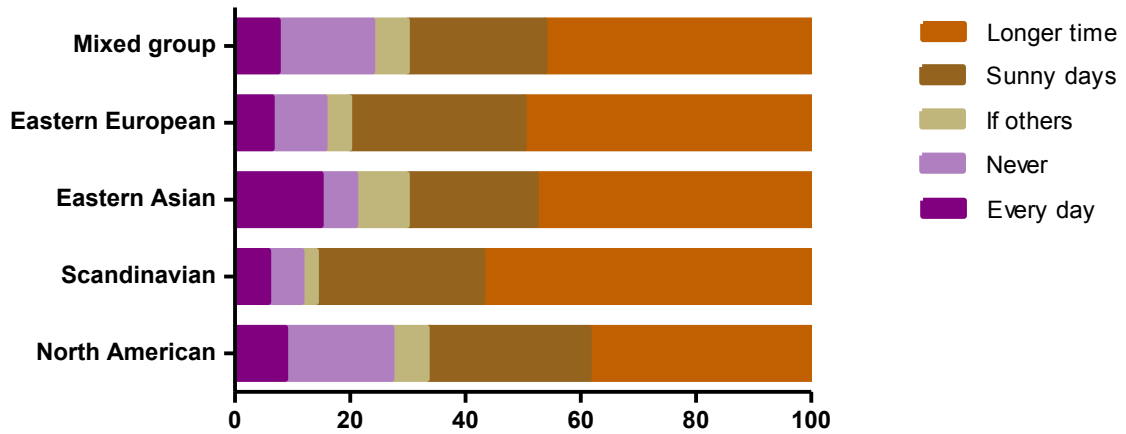


Figure 45. Students' answers regarding the question "Do you apply sunscreens in the spring and summer?" (among ethnic groups) (n=696, 22 answers missing)

6.5 Experience with Sunburns in the Past

More than a half of the students admitted getting sunburnt in the sun (question no. 15) compared to one third of those who experienced a sunburn after a tanning studio visit (question no. 17).

6.5.1 Sunburns in the Sun

While comparing males and females it could be noticed that more females than males got sunburnt in the sun. The majority of Scandinavians reported getting burnt in the sun.

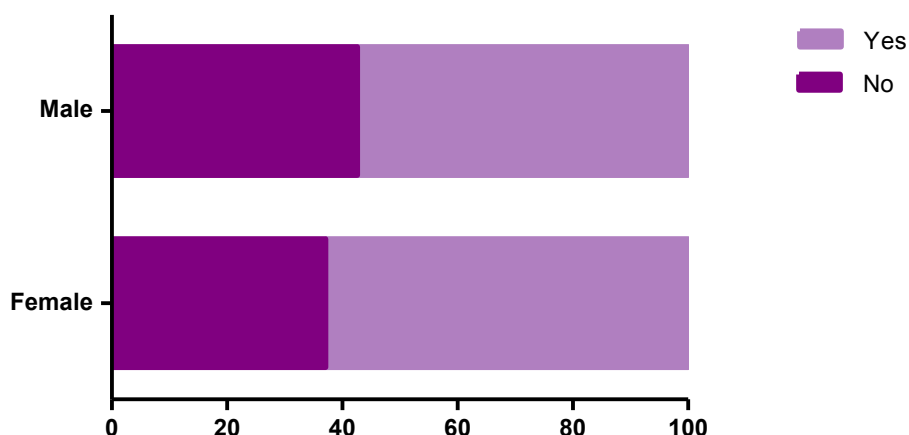


Figure 46. Students' answers to question "Do you get sunburnt in the sun?" (broken down by gender) (n= 698, 20 answers missing)

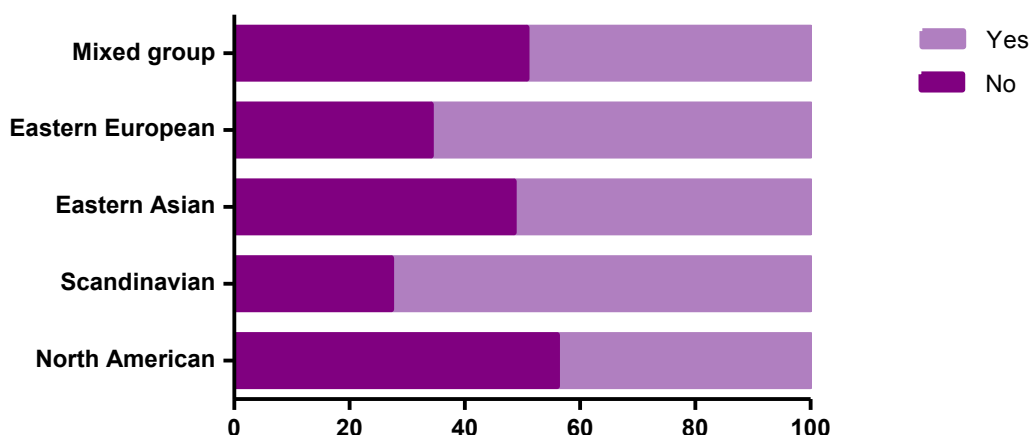


Figure 47. Students' answers to question "Do you get sunburnt in the sun?" (among ethnic groups) (n=701, 17 answers missing)

6.5.2 Sunburns in Tanning Studios

More females than males admitted getting burnt in the tanning studio. Most positive answers were given by the Scandinavian students and the fewest by the Eastern Asian group.

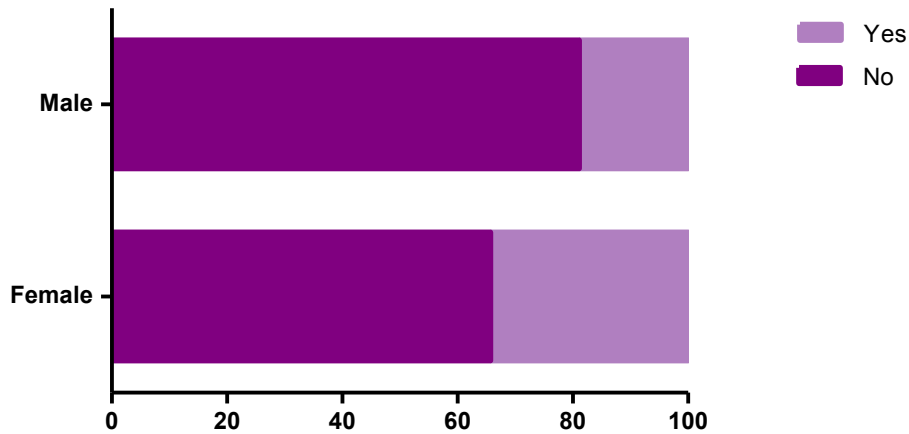


Figure 48. Students' answers to the question "Did you ever experience a sunburn after a tanning studio visit?" regarding genders (n=521)

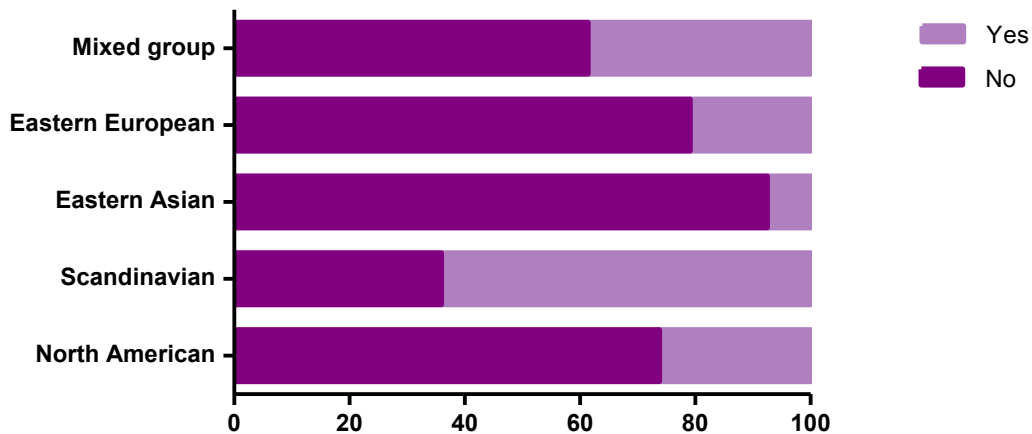


Figure 49. Students' answers to the question "Did you ever experience a sunburn after a tanning studio visit?" among ethnic groups (n=523)

6.5.3 Sunburns in Childhood

The allocation of students experiencing sunburn in their childhood (before 10 years of age) (question no. 13) was almost equal among males and females. Scandinavians reported the highest number of sunburns experienced in childhood.

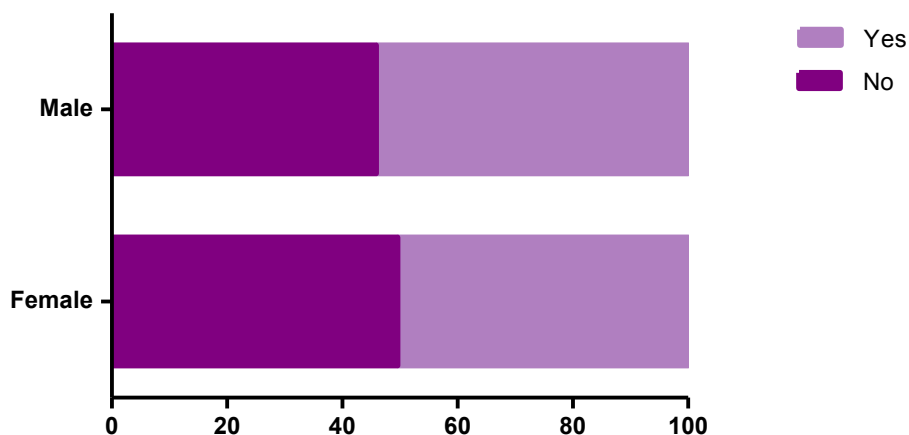


Figure 50. Students' answers to question "Did you experience a sunburns in your childhood (before 10 years of age) ?" among genders (n=586, 132 answers missing)

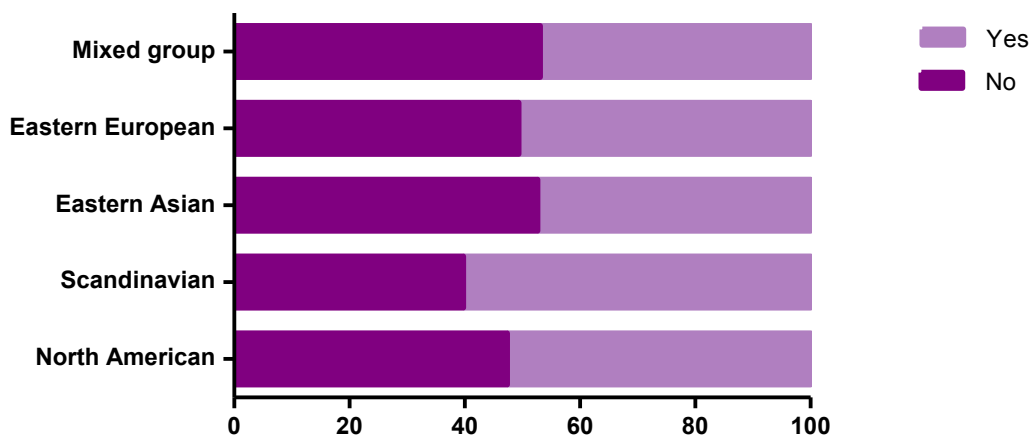


Figure 51. Students' answers to question "Did you experience a sunburns in your childhood (before 10 years of age) ?" among ethnic groups (n=588, 130 answers missing)

6.5.4 Sunburns and Activities

Almost half of the students experienced their worst sunburn while on the beach (question no.14). A quarter of participants had the worst sunburn while tanning. More females than males got burnt during tanning. In the ethnic groups, water sports and outdoor activities were the most frequent answers.

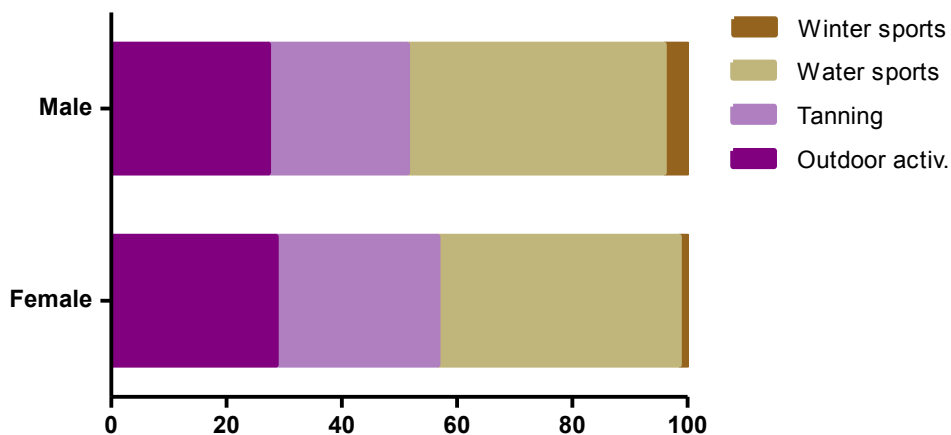


Figure 52. Students' answers to the question "When did you experience your worst sunburn?" regarding genders (n=566,152 answers missing)

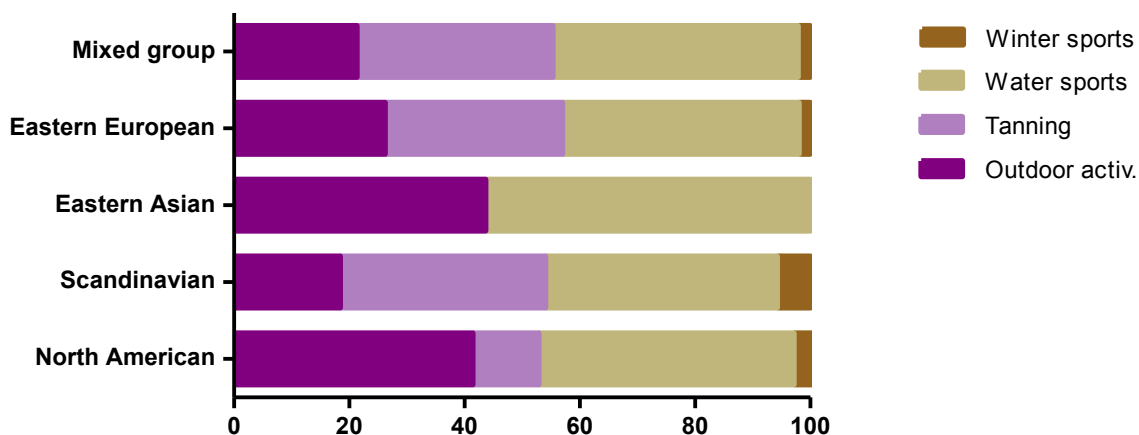


Figure 53. Students' answers to the question "When did you experience your worst sunburn?" among ethnic groups (n=568,150 answers missing)

6.5.5 Sunburns Experienced Last Summer

Being asked about getting sunburnt during last summer (question no.15), the majority of all participants answered in the negative and one-third in the positive. In the affirmative subgroup (n=173), most had experienced just one sunburn.

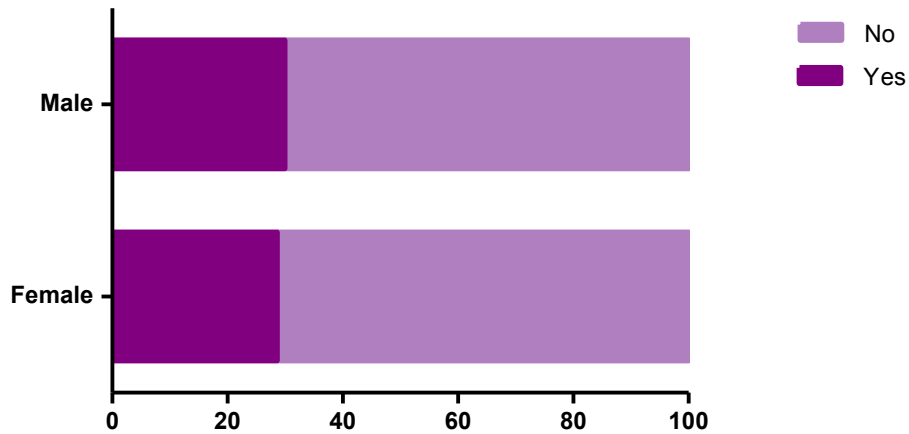


Figure 54. Students' answers regarding a sunburn last summer (among genders) (n= 594, 124 answers missing)

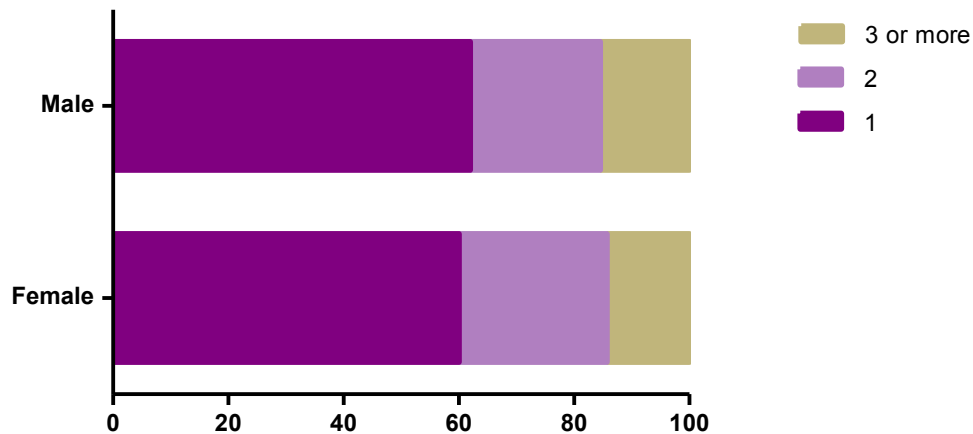


Figure 55. Students' answers regarding the amount of sunburns last summer (among genders) (n=173)

Regarding ethnic groups Scandinavians admitted the highest frequency and the highest number of sunburns.

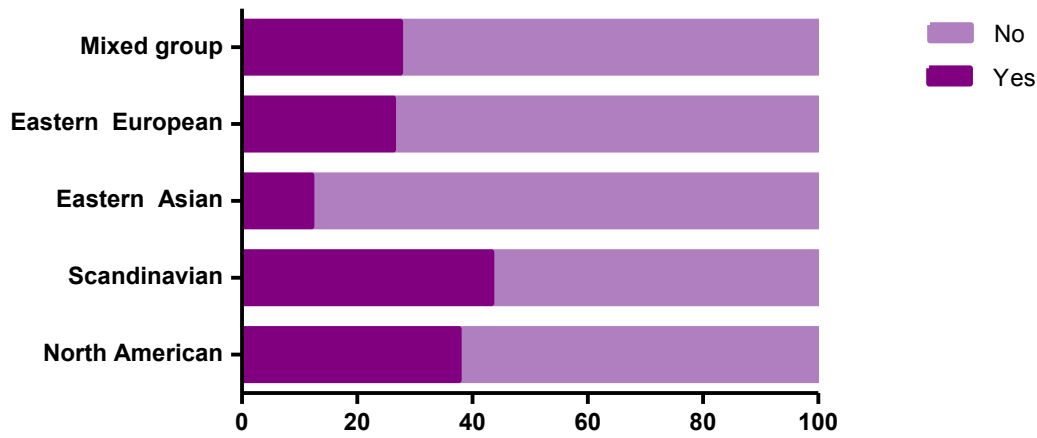


Figure 56. Students' answers regarding a sunburn last summer (among ethnic groups) (n= 596, 122 answers missing)

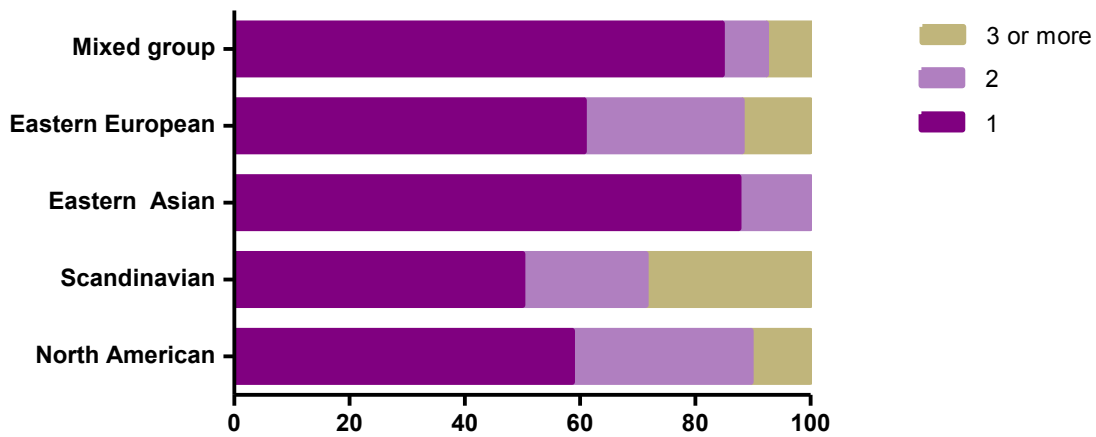


Figure 57. Students' answers regarding the amount of sunburns last summer (among ethnic groups) (n=173)

6.6 Education About Solar Radiation Damage and Sun Protection

6.6.1 Moles

Many students do check themselves for skin changes, like new moles or changing moles (question no.19). Some students reported having moles removed by a physician (question no.20).

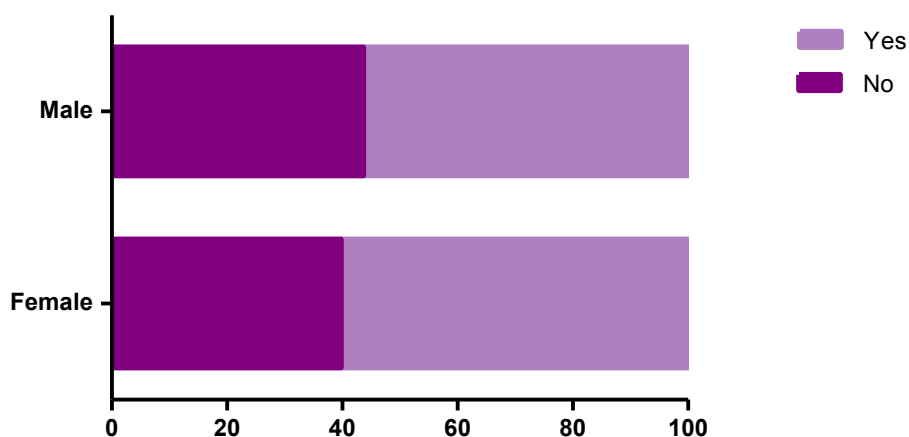


Figure 58. Students' answers to the question "Do you check yourself for skin changes, like new moles or changing moles?" (regarding genders) (n=696, 22 answers missing)

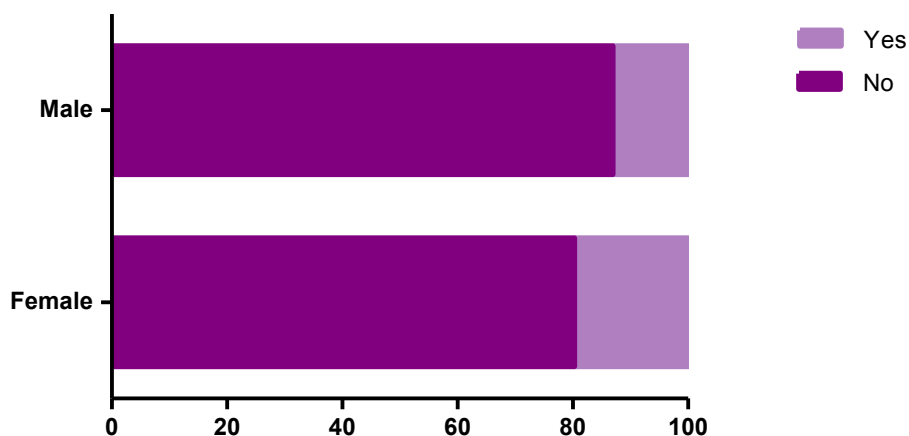


Figure 59. Students' answers to the question "Have any moles been removed by a physician?" (regarding genders) (n=691, 27 answers missing)

Within the ethnic groups, most students did check their skin for new moles, only Eastern Asian students denied doing it in the majority. The Scandinavian group reported the highest number of students who had moles removed by a physician.

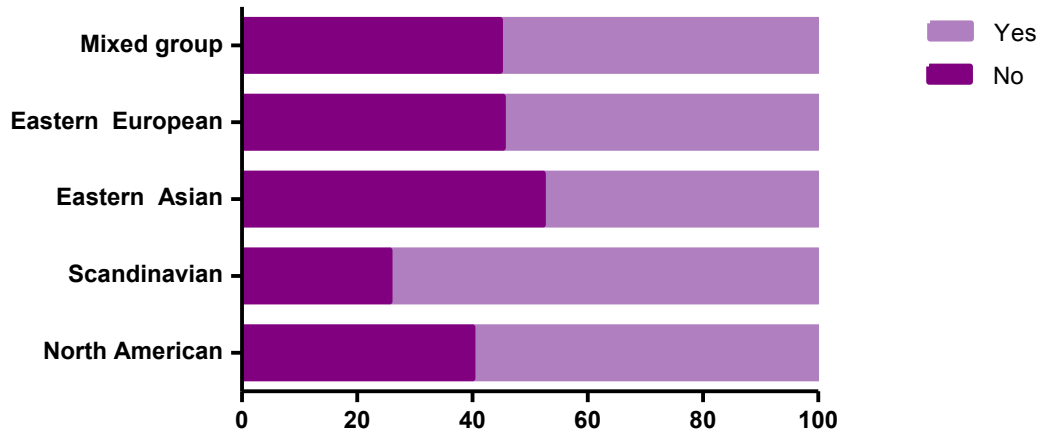


Figure 60. Students' answers to the question "Do you check yourself for skin changes, like new moles or changing moles?" (among ethnic groups) (n=699, 19 answers missing)

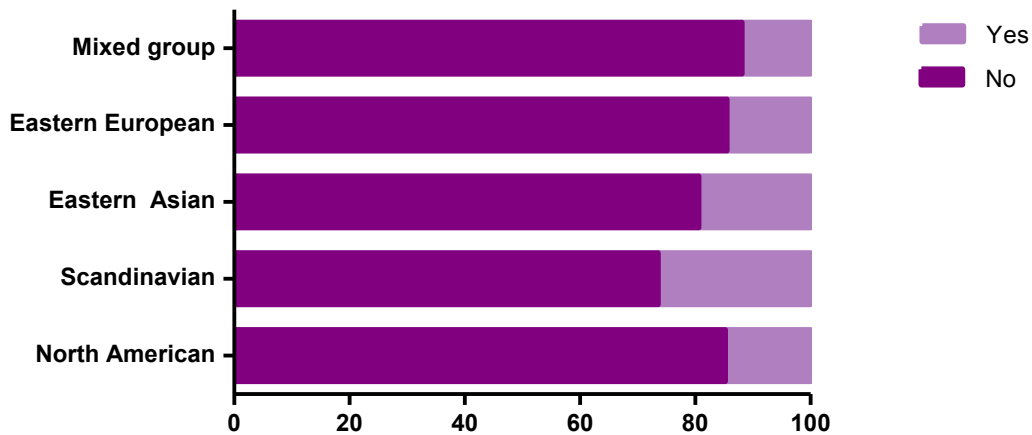


Figure 61. Students' answers to the question "Have any moles been removed by a physician?" (among ethnic groups) (n=694, 24 answers missing)

6.6.2 Sources of Information on Sun Protection

More than half of the interviewees were informed about sun protection at home (question no.21). Just a few students reported a physician as the source of the information. Similar results were collected within the ethnic groups.

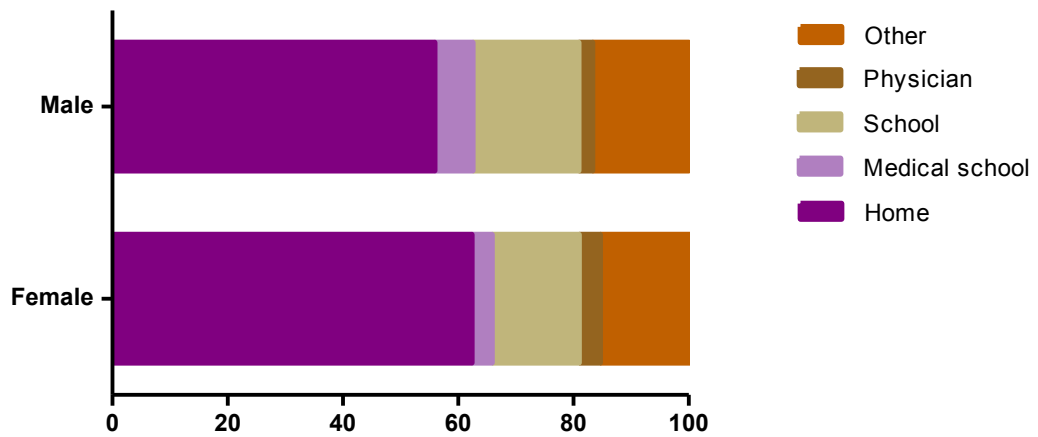


Figure 62. Students' answers to the question "Where have you been informed about sun protection?" (regarding genders) (n=692, 26 answers missing)

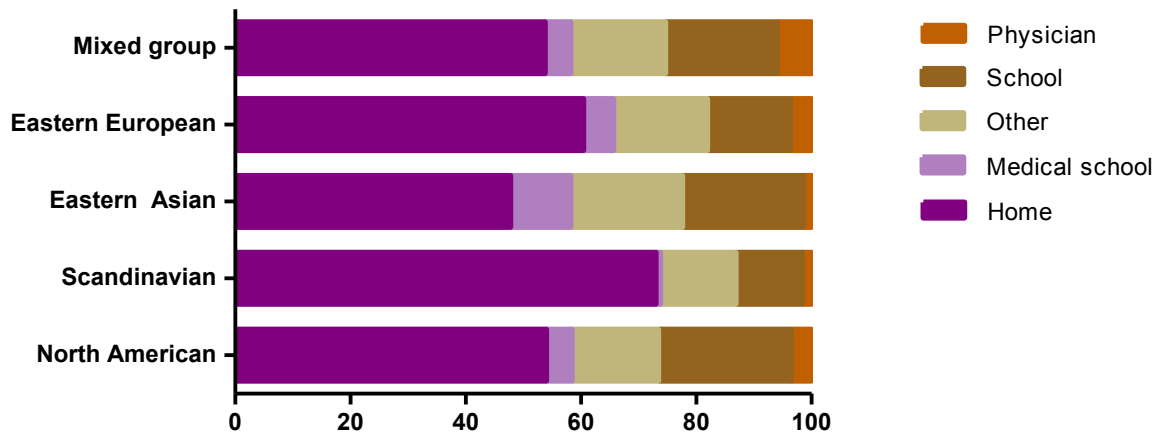


Figure 63. Students answers to the question "Where have you been informed about sun protection?" (regarding ethnic groups) (n=695, 23 answers missing)

6.6.3 National Campaigns

Students were asked if there were any national campaigns (posters, brochures, TV commercials) for public education on sun protection and solar damage in their countries (question no.22). The majority of the respondents answered in the affirmative. The highest frequency of such campaigns was reported by East Asian students.

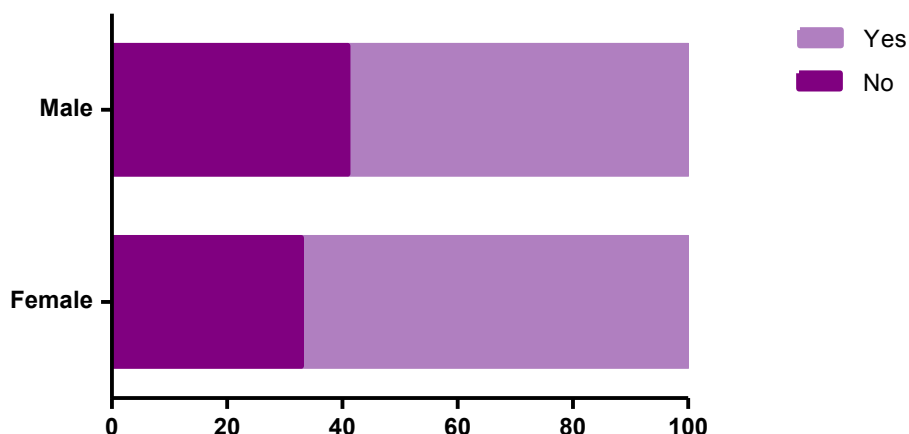


Figure 64. Students' answers regarding campaigns in their countries between genders (n= 693, 25 answers missing)

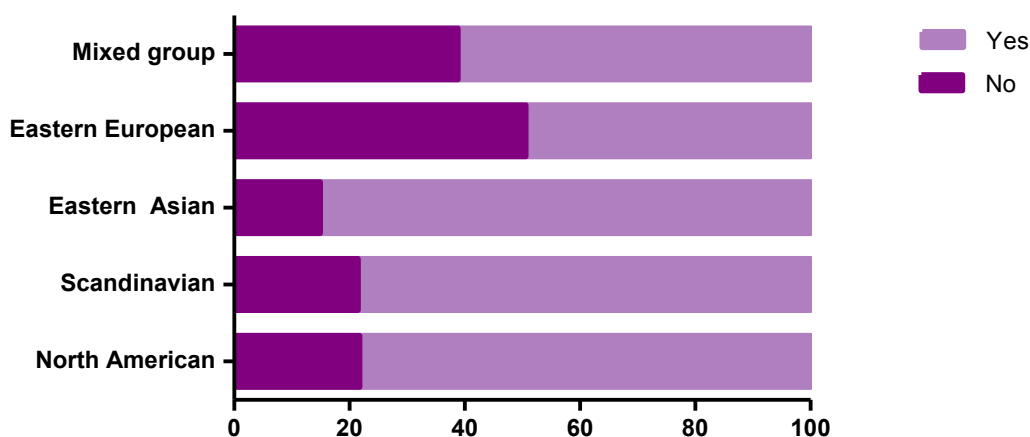


Figure 65. Students' answers regarding campaigns in their countries among ethnic groups (n= 696, 22 answers missing)

6.7 Hypotheses

The table 3. shows the statistical significance for hypotheses tested in this study.

Table 3: Significance of the statements

No	Hypotheses	Statistical significance (p)
1.	Scandinavian students visit tanning studios more in comparison to Eastern Asian students.	0.0001
2.	Eastern Asian students prefer not to be tanned, so they do not visit tanning studios or tan in the sun as often as other students.	0.0001
3.	Eastern Asian students use more sunscreens with higher SPF (30 or more) than other students.	<0.0001
4.	Parents with a higher educational level (university) educate their children about sun protection at home.	0.003
5.	Students who get sunburnt (in the sun or tanning studios) are those who do not know how UV radiation works.	>0.05
6.	Students, who like to be tanned would risk getting sunburnt to be tanned	0.0001
7.	More North American students with skin type II and III would risk getting sunburn to be tanned than students from Eastern Europe with skin type II and III.	0.0254
8.	Students who like to be tanned tan in the midday sun and visit tanning studios.	0.048
9.	Students who like to be tanned get more often sunburnt after tanning studio visits than after tanning in the sun.	>0.05
10.	Students who get sunburnt in the sun are those with skin type II and III.	0.032
11.	Students who did not experience sunburns in their childhood were educated about sun protection at home.	0.52
12.	Students who did not experience sunburns in their childhood get less frequent sunburns as adults.	0.008
13.	Students who use sunscreen products to increase the time they can spend in the sun are those who get sunburnt.	0.1
14.	Students who check themselves for skin changes visit tanning studios.	0.022
15.	Those students who had a mole removed by a physician use tanning studios and tan in the sun.	0.0006
16.	North American students with skin type II and III get more sunburnt than Eastern European students with skin type II and III.	0.71
17.	Students who did not get sunburnt during childhood have national campaigns informing about sun protection in their country.	0.0002
18.	Students who get burnt in the sun do not use sunscreen products.	0.0001
Hypotheses concerning gender		
19.	More females than males think that sunscreens are effective in preventing sunburns.	0.0047
20.	More females than males think that sunscreens are effective in preventing skin from aging.	0.0001
21.	More females than males like themselves the most being tanned.	<0.0001
22.	More females than males tan under in the sun.	<0.0001
23.	More females than males tan in the midday sun (11 AM- 3 PM)	0.0011
24.	More females than males visit tanning studios.	0.0001
25.	More females than males experienced a sunburn after a tanning studio visit.	0.0014
26.	More females than males use sunscreens while tanning.	<0.0001
27.	More females than males have experienced sunburn after a tanning studio visit.	0.0001
28.	More females than males reapply sunscreens while tanning.	0.04
29.	More females than males report willingness to tan as reason not to apply sunscreens while tanning.	0.469

30.	More females than males had a mole removed by a doctor.	0.2
Hypotheses concerning ethnic groups		
31.	More Scandinavian students in comparison to Eastern Asian students knew that sunscreens are effective in preventing sunburns.	0.006
32.	More Scandinavian students in comparison to Eastern Asian students knew that sunscreens are effective in preventing skin cancer.	<0.0001
33.	More Scandinavian students than Eastern Asian students knew that sunscreens are effective in preventing skin from aging.	0.0035
34.	More Scandinavian students than Eastern Asian students knew that UVB is the radiation that causes sunburns.	0.005
35.	More Scandinavian students than Eastern Asian students like themselves the most when they are tanned.	<0.0001
36.	More Scandinavian students than Eastern Asian students would take the risk to get sunburnt just to be tanned.	<0.0001
37.	More Scandinavian students than Eastern Asian students tan in the sun.	<0.0001
38.	More Scandinavian students than Eastern Asian students visit tanning studios.	<0.0001
39.	More Scandinavian students than Eastern Asian students tan more than 5 minutes in tanning studios.	<0.0001
40.	More Scandinavian students than Eastern Asian students get burnt in the sun.	<0.0001
41.	More Scandinavian students than Eastern Asian students experienced a sunburn after a tanning studio visit.	<0.0001
42.	More Scandinavian students in comparison to Eastern Asian students had a sunburn this summer.	0.0003
43.	More Scandinavian students in comparison to Eastern Asian students use sunscreens while tanning.	<0.0001
44.	More Scandinavian students than Eastern Asian students use sunscreens with low SPF.	<0.0001
45.	More Scandinavian students in comparison to Eastern Asian students do not use sunscreens while tanning because they want to tan.	0.0449
46.	Scandinavian students in comparison to Eastern Asian students check themselves for skin changes, like new moles or changing moles.	0.0012
47.	Eastern Asian students in comparison to Eastern European students had more moles removed by a doctor.	0.0262
48.	More Eastern Asian students than Eastern European students have national campaigns in their countries.	<0.0001
Hypotheses concerning national campaigns on sun protection		
49.	More students of the English program have national campaigns in their countries in comparison to Polish program students.	<0.0001
50.	Students who reported presence of national educational campaigns knew that sunscreens are effective in preventing skin from aging more often than those who did not report the presence of such campaigns.	0.0036
51.	Students who reported the presence of educational campaigns in their countries know that UVB radiation causes sunburns.	0.0114
52.	Students who reported national campaigns promoting sun protection in their countries visit tanning studios less frequently than students who did not report such campaigns.	0.0411
53.	Students who reported the presence of national campaigns in their countries did not get sunburnt last summer.	0.0067
54.	Students who reported the presence of national campaigns in their countries check themselves more frequently for skin changes, such as moles or changing moles in comparison to students who did not report such campaigns.	<0.0001

7 Discussion

Poznan University of Medical Sciences offers a rare chance to investigate an ethnically diverse group of students from all over the world. These conditions allowed us to conduct parallel comparison of East Asian, North American, Scandinavian and Eastern European students.

The comparison was divided into 5 main parts, each concerning a separate topic: knowledge about theory of tanning, attitudes towards tanning, tanning behaviors, sunscreen use and tanning experiences. For each part, a comparison between ethnic groups and genders was performed.

7.1 Knowledge

Questions concerning the effectiveness of sunscreen products (sunscreen's ability to prevent sunburns, skin from aging, skin cancer) were answered correctly by more females. This data may indicate that females had better knowledge about UV radiation protection than males. This data agrees with the findings of Wang and Dusza, who surveyed the healthy population of New Jersey [126]. Also, Douglas et al. reported significant differences in knowledge between genders in the population of 21-year-old New Zealanders [127].

Despite better knowledge, females' tanning behavior was still considered as particularly risky as shown in paragraph 5.3. The discrepancy between knowledge about tanning hazards and behavior might be due to the misconception that just by being aware of the risks, tanners are better protected from their effects.

Choi et al. suggested that emphasizing hazards should be the next step in discouraging adults from visiting tanning studios [128]. Robinson et al. on the other hand, showed that increasing knowledge of UV radiation's hazards did not have any influence on the population's behavior [42]. The number of sunburns due to intentional tanning and the use of sunscreens increased during the period from 1986 to 1996. Robinson suspected that improving preventive knowledge alone would not be enough to implement changes in the population's tanning patterns. Although this observation has been reported by many authors [42, 105, 126] it is crucial to further research the cause of this issue.

When comparing ethnic groups – Scandinavians answered significantly more often correctly than other students to questions concerning knowledge. They knew that sunscreens prevent sunburns, skin aging and that they are effective in preventing skin cancer. This group also gave more correct answers to the question "Which part

of the UV radiation causes sunburns?". This phenomenon is probably due to good health education in Scandinavian countries, although it was Eastern Asians who reported the highest percentage of national campaigns on sunlight protection.

To sum up: Females were more knowledgeable than males. Better knowledge correlated with more risky tanning behavior. Scandinavians were better educated about UVR risks and sunscreen products than other groups.

7.2 Attitude Towards Tanning

7.2.1 Attitude Towards Skin Tone

Statistical differences between genders were clearly visible when asked about attitude towards tanning. When asked "How do you like yourself the most?", females chose the answer "When I am tanned" more often than other answers. Males chose this answer less often, and the difference between the genders was statistically significant. This data showed that females were at higher risk of getting sunburnt because they put a lot of effort in getting a tanned appearance. This is because of a general belief that tanned skin is more attractive, and females try to adapt to the current social norms. Other key factors responsible for the tanning motivation in tanning studios might be related to relaxation, low costs and socialization [129].

The study of Robinson et al. shows that from 1986 to 1996 there was a decline in the attitude that tanned skin looks healthy. However, in 1996 tanned skin was still considered as appearance enhancing, especially by male respondents [42].

7.2.2 Attitude Towards Risk of Getting Sunburnt

One may assume that students who like to be tanned would risk getting sunburnt to be tanned. It turned out that this assumption was correct. This shows how dangerous tanning might be, as it shows signs of addictive behavior. Addiction to indoor tanning was disputed in previous works by Mosher et al. [130 131].

Taking into consideration that most trends come from the USA, especially those referring to the attractiveness, which tanned skin is a part of, it may be assumed that more North American students would try to follow them. This is why it was checked if a difference between North American students and Eastern European students who would take the risk of getting sunburnt just to be tanned existed. This statement was proved to be correct. North Americans were more likely to risk getting sunburnt.

Scandinavian students gave the highest rate of affirmative answers when asked if they would risk getting sunburnt just to be tanned. This risky behavior probably

originates from the Scandinavian attitude towards tanning. This ethnic group stated significantly more often than any other group that they liked themselves the most when they were tanned. On the other hand, only 9% Asians answered the latter question like most of Scandinavians did. The study comparing Chinese and Caucasian populations by Cheng et al. also showed significant differences in attitudes towards tanning between those groups, which are a result of cultural differences. The ideal beauty patterns in those ethnic groups are different and Chinese females think that tanned skin appearance makes them look less attractive [132].

Given that the Eastern Asian beauty norm is light skin, which results from imitating the appearance of preindustrial time European females (pale skin, blond hair, long legs and big blue eyes, the “original Barbie” type) and the fact that Scandinavians desire to be tanned, it was checked if more Scandinavians like themselves more when they were tanned in comparison to Eastern Asian students. It turned out that this assumption is correct. Comparing the tanning habits of these two ethnic groups it was noticed that fewer Eastern Asian students tanned in the natural sunlight and visited tanning studios less frequently. Furthermore it was proved that fewer Eastern Asian students would take the risk of getting burnt just to be tanned in comparison to Scandinavian students. All these results can be attributed to the Eastern Asian beauty norms. Therefore, those students liked themselves most when they were not tanned. Similar conclusions were made by Sahay et Piran who observed highest levels of body satisfaction in light-skinned Asian-Canadians [133]. Other researchers found that lighter skin for Asian women was deemed more attractive and healthy, and more beautiful [134].

To sum up: Females were more concerned about their skin tone and therefore tanned more than males, being a group at increased risk for skin cancer. Scandinavians’ desire to have a tanned appearance was stronger than their fear of tanning hazards. Eastern Asians preferred light skin tone to tanned appearance, so their attitude towards tanning was negative.

7.3 Tanning Behavior

7.3.1 Tanning in the Sunlight and Tanning Studios

More females reported tanning in natural sunlight than males. This answer is tied to attitude towards tanning, i.e. the fact that more women like themselves better when

they are tanned, as described in section 4.3. Also significantly more females than males tanned in the midday sun and visited tanning studios. All of the above indicated that females tended to show more risky behavior, although both genders possessed similar knowledge about the risks of UV radiation exposure and females were even better informed about the effectiveness of sun protection products.

Other researchers did not find any difference in knowledge about UV radiation exposure risks between genders [135]. The gathered data regarding increased risk behavior of females correlated with similar findings from Swedish researchers [136], where females used sunbeds more frequently than males. In the study of Forster et al. [128] males living in big cities visited tanning studios more often than females.

An interesting study by Thieden et al. who developed a model of sun behavior assessment by using personal dosimeters also showed that females received significantly more radiation measured in Standard Erythema Dose (SED) than males [137]. This clinical observation aligns with findings of more risky behavioral patterns reported by females in this study.

It is worth noting that the discrepancies between genders are observed very early in life. Many researchers found differences in attitudes and behavior between boys and girls attending primary schools [102, 138-141]

Females respond to the pressure to fulfill sociological norms by following the group's behavior and adjusting to beauty standards. Nowadays one of the beauty standards includes young, healthy, sun tanned skin appearance, which girls try to achieve by visiting tanning studios. They seem to overdo it to quickly achieve their goal of a "sun kissed skin", thereby putting themselves at risk of skin cancer. Erythema, which is already an early form of skin damage, is not considered as an alarming sign and students exceed the limits of a "harmless" sun exposure. This correlates with the study by Melia et al. where sunburns were more frequently associated with tanning females than males, however males had more sunburns in total [142].

The knowledge that excessive UV radiation is risky and might have negative effects on the skin is present. But this knowledge does not result in behavioral changes because students who check themselves for abnormal moles also visited tanning studios. Even a shocking experience, such as the excision of a mole by a doctor, does not change the tanning behavior.

The statistically significant differences in answers to questions about students' behavior set apart two ethnic groups of extremely different nature. In general

Scandinavians tended to choose most answers reflecting risky behavior. On the other hand, Asians gave answers that reflected risk avoidance.

Based on the fact that Scandinavian countries have less daylight for several months of the year, it could be assumed that many students from those countries would tan a lot and would use tanning studios more often than in other countries. This appears to be the case. 25% of all students from other ethnic groups visit tanning studios, which was significantly less, when compared to 48% students of Scandinavian origin. This is consistent with several studies, which show that indoor tanning is most common among young females in Scandinavia and Minnesota [143].

A circumstance that may explain why North European students visit tanning studios more often is the geographic location, with reduced daylight for half a year. This may result in depressed mood and seasonal depression, which evokes self-therapeutic behavior.

Tanning in the midday sun is considered as high risk behavior because of intense UV radiation, which might have negative effects for the skin, like sunburns. Following students' wish to be tanned, the hypothesis was proposed that students who like to be tanned would be irresponsible in their tanning behavior and would tan in the midday sun and would use the tanning studios. It turned out to be true. This underlines the strong desire to be tanned.

In addition it was assumed that those students who liked to be tanned stayed in the sun long enough to be burnt and that they tanned indoors too long so they got sun induced erythema. Also these groups were compared to see if there were more incidents of sunburns in the indoor tanning group than in the group that tanned in the sun. No significant differences were found, so this assumption turns out to be wrong.

7.3.2 Sunscreen Use

The study revealed that most of responders (80%) used sunscreens while tanning. In contrast, in the study of Koh et al. only a quarter of responders used sunscreens with recommended SPF [144].

In this study, females used sunscreens more often while tanning than males and more females reapplied sunscreens while tanning. Lack of compliance to use sunscreen products by males may derive from prejudged opinion that males using cosmetic products (like sunscreens) may be "metrosexual" or less masculine [79].

This result correlates with the findings of Koh et al. where males, especially those with the lowest level of education, were less frequent sunscreen users [144].

The study by Abroms et al. revealed that females use sunscreens more as a preventive measure and males after getting sunburnt [145].

Female responders, who denied applying sunscreens, when asked for the reason of this omission, reported willingness to get tanned more often than male responders, who gave other reasons. This shows that females deliberately avoided sunscreen products while tanning, because they know these preparations would interfere with the desired effect of tanned skin appearance. Therefore it may be presumed that females possessed knowledge about the mechanism and purpose of sunscreen products. However, this does not translate into a healthy behavior.

These findings are consistent with the study of Autier et al. who found that application of sunscreens with 30 SPF was linked to tanning more in the midday sun and that females who used them increased their sun exposure time [146]. This might suggest that sunscreen itself could be a risk factor for skin cancer due to the wrongly understood protection it provides to users during sun exposure. In addition, they pointed out the desire to enjoy the sun and a safe tan as the reasons for sunscreen use by young tanners.

The study of Robinson et al. revealed that females in comparison to males who both were previously diagnosed with non-melanoma skin cancer, were less compliant with sunscreen use compared to the control group [147]. He suggested that females did not see skin cancer as a problem serious enough to stop tanning.

In the study of Choi et al., females who used sunscreens on a regular basis were less likely to visit tanning studios due to the knowledge that indoor tanning causes skin damage [128]. On the other hand females who did not report regular application of sunscreens were older, less educated and more likely to use tanning studios. Therefore, these females are at higher risk of skin cancer due to their additional exposure to UV radiation and lack of protection on sunny days. This is why future research should investigate the reasons for ineffective sunscreen use by females and males.

In this study more males than females using sunscreen products used sun protection with a high SPF while tanning, but this difference was not significant.

An attempt was made to prove that students who got sunburnt were those whose desire to be tanned was so strong that they used sunscreen products just to increase the amount of time they could spend in the sun. In fact there was no statistical

difference. But it turned out that students who do not use sunscreen products at all got burnt in the sun more often.

Looking at the ethnic groups it can be said that more Scandinavian students than Eastern Asian students used sunscreens while tanning. Also, more Scandinavian students in comparison to Eastern Asian students did not use sunscreens while tanning because they wanted to acquire tanned skin. In addition, Scandinavian students used sunscreens with a low SPF more often than Eastern Asian students. Eastern Asian students used more sunscreen protection with a high SPF (30 or more) in comparison to other students. The statistical difference proves once again that Eastern Asian students either had a good knowledge of the risks of UV radiation, or tried very hard to adjust to their cultural beauty standards.

To sum up: Females driven by the desire to get a "sun kissed skin" appearance visited tanning studios more often, tanned longer and deliberately avoided using sunscreens to accelerate the effect. Males used sunscreens less often than females, but when they did, they used those with higher SPF. Scandinavians reported the most risky behavior pattern and Eastern Asians the least risky behavior pattern.

7.4 Experience with Sunburns in the Past

To verify the clinical importance of the questions from the experience section of the questionnaire, responders were asked if they had ever experienced a sunburn after a tanning studio visit. Females answered "Yes" significantly more often than males visiting tanning studios. This illustrates the fact that females, considering their hazardous attitude and behavior towards tanning, represent a group of increased risk. This is not consistent with the finding of Robinson et al. where more males than females had a higher number of sunburns [148].

Assuming that everybody, despite their skin type and their tanning possibilities, tries to keep up with the beauty norms, this study verified that the students who were at the highest risk of skin damage doing so (those with skin type I and II), were those who reported a higher number of sunburns. This assumption was true.

There was no difference in number of sunburns between students with skin type II and III from North America or Eastern Europe. But more Scandinavian students than Eastern Asian students got burnt in the sunlight and after tanning studio visits. In addition, more Scandinavian students than Eastern Asian students experienced sunburn last summer.

Interestingly, a negative correlation between knowledge about tanning risks and attitude towards tanning appears when considering these ethnic groups. This also emphasizes the stereotypes that Scandinavians tan excessively to have nicely tanned appearance and that Eastern Asian students try to stay as pale as possible avoiding sun exposure.

Sun protection behavior is a matter of knowledge and may be taught in childhood by parents. Therefore, students who did not experience sunburns in their childhood got less frequent sunburns as adults. Interestingly, when students who did not experience sunburns in their childhood were asked if they had been educated about sun protection at home, there was no statistical difference between them and the group that did experience a sunburn in early life. The above findings may suggest that education itself is insufficient to change behavior patterns, but if parents provide an example of proper behavior towards tanning for their children, a lower number of sunburns in childhood is more likely to be achieved.

To sum up: Females reported higher number of sunburns due to intentional UVR exposure. Scandinavians reported the highest number of sunburns resulting from exposure to both natural and artificial light sources. The lower the number of sunburns during childhood, the less likely students were to experience sunburns in their later life.

7.5 Education About Solar Damage and Sun Protection

More females admitted having a mole removed by a doctor than males. This could be a consequence of several separate mechanisms:

- 1) Females tend to find new nevi more often than males, because they pay a lot of attention to how they look.
- 2) Longer and more frequent tanning predisposes to increased formation of new moles [149].
- 3) Females occasionally have skin nevi removed by a physician, primarily for aesthetic reasons. This rarely applies to males.

While comparing ethnic groups it turned out that more Scandinavian students in comparison to Eastern Asian students checked themselves for skin changes, like new moles or changing moles and had more moles removed by physicians. These findings may be a result of excessive sun exposure by Scandinavians desiring a tanned skin.

7.5.1 National Campaigns

An interesting finding is that significantly more females than males reported presence of national public education campaigns on sun protection and solar damage. This might be due to the fact that females are more interested in this subject and the topic is often discussed in women's beauty magazines they read. Other reasons:

1) Campaigns are often addressed to mothers who are supposed to protect their children from UV radiation. That is why females are often main target groups of such campaigns. This can be supported by the finding that students who were not sunburnt during childhood have been informed through national campaigns about sun protection in their country. This correlates also with the results of Abrams where females were advised by their mothers and peers about using sunscreen [145].

2) There is a general trend towards a healthy life style and organic foods, which evokes the need for medical information about avoidable hazards of certain habits.

More students from the English programs than the Polish program reported to have national campaigns in their countries. The fact that public education with the help of campaigns results in better knowledge is shown in this study. Students who had national campaigns in their country knew that sunscreens are effective in preventing skin from aging in comparison to those who did not have them and these students knew that UVB radiation causes sunburns. Furthermore, students with the sun protection promoting campaigns visited tanning studios less frequently and did not experience sunburns last summer. This is why national campaigns which emphasize the hazards of UV radiation should be conducted more often in the future.

The great importance of self-examination, which could help to detect early changes, should be emphasized. This knowledge turns out to be effective because students who had national campaigns in their country did check themselves more often for skin changes like moles or changing moles in comparison to students who did not have such campaigns.

Although 85% of Eastern Asians reported about national campaigns being conducted in their country, which was 6% more than in the Scandinavian ethnic group, their knowledge was worse when compared to that of Scandinavian students, who probably received more health related education during standard school education programs.

More Eastern Asian students reported about national campaigns being conducted in their country than Eastern European students. This might be due to the fact that most

Eastern Asian responders came from Taiwan, which is an island with a tropical climate.

It is crucial to promote education on UV exposure risks. As proven by the Australian model, the media can increase awareness and the likelihood of taking precautions. However, television viewers still desire the tanned appearance [150]. This might be due to the fact that celebrities promote nicely tanned skin. Perhaps in the future, when the knowledge of UV radiation hazards like photoaging becomes more evident, light skin will be the new chic.

To sum up: Females are an easier target for educational campaigns. The existence of national health campaigns on tanning risks was linked to better knowledge and less risky behavior of tanners.

7.6 Summary

Females were more knowledgeable than males. However better knowledge correlated with more risky tanning behavior. Scandinavians were better educated about UVR risks and sunscreen products than other groups.

Females were more concerned about their skin tone and therefore tanned more than males, as a result of which they constitute a group that is at an increased risk for skin cancer. Scandinavians' desire to have a tanned appearance was bigger than their fear of tanning hazards. Eastern Asians preferred a light skin tone to tanned appearance, so their attitude towards tanning was negative.

Females driven by the desire to get a "sun kissed skin" appearance visited tanning studios more often, tanned longer and deliberately avoided using sunscreens to accelerate the effect. Males used sunscreens less often than females, but when they did, they used those with higher SPF. Scandinavians reported the most risky behavior pattern and Eastern Asians the least risky behavior pattern.

Females report higher numbers of sunburns due to intentional UVR exposure. Scandinavians reported the highest number of sunburns resulting from exposure to natural and artificial light sources. The lower the number of sunburns during childhood, the less likely students were to experience sunburns in later life.

Females are an easier target for educational campaigns. The existence of national health campaigns on tanning risks was linked to better knowledge and less risky behavior of tanners.

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9 List of Abbreviations

α -MSH	Alpha melanocyte-stimulating hormone
ACTH	Adrenocorticotrophic hormone
AK	Actinic keratosis
BCC	Basal cell carcinoma
BDD	Body dysmorphic disorder
C	Cytosine
CDC	Center for Disease Control
CPD	Cyclobutane pyrimidine dimers
DNA	Deoxyribonucleic acid
G1	Post mitotic phase
M	Mean
MC1R	Melanocortin 1 receptor
n	Number of examples in a sample
p53	Tumor protein 53
POMC	Proopiomelanocortin
SAD	Seasonal affective disorder
SCC	Squamous cell cancer
SED	Standard erythema dose
SD	Standard deviation
SPF	Sun protection factor
T	Thymine
TV	Television
USA	United States of America
UVA	Ultraviolet A
UVB	Ultraviolet B
UVC	Ultraviolet C
UVR	Ultraviolet radiation
WHO	World Health Organization

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12 Questionnaire

This questionnaire is created especially for students of University of Medical Sciences in Poznan (academic year 2010/2011) in order to research their attitude towards tanning and skin cancer prevention.

We would like you to answer these questions truthfully and according to your knowledge.

Thank you

Sex: female **age:**____ **ethnic group:** Caucasian **Skin Type:** Type 1 (very white, always burns)
 male Asian Type 2 (light white, burns easily)
 African- American Type 3 (darker white, might burns)
Nationality:..... African Type 4 (tans easily, uncommon burns)
 Indian Type 5 (darker, never burns)
 South American Type 6 (dark, never burns)
 Arabic
 Other

You are a student of the: English program Polish program

Have you answered this questionnaire before via email? YES NO

If YES , thank you for taking part in it before. You may stop now.

If NO, please continue.

What is your highest educational degree?

- High School
- College
- University
- other

What is your parents' level of education?

- High School
- College
- University
- other

Do you have a *family* history of skin cancer? yes no

Do you *personally* have / had skin cancer? yes no

1) In your opinion sunscreen is effective at :

- preventing sunburns? yes no do not know maybe
- preventing skin cancer? yes no do not know maybe
- preventing skin from aging? yes no do not know maybe
- reversing signs of aging? yes no do not know maybe

2) Which part of the UV radiation causes sunburns?

- UVA radiation
- UVB radiation
- Both
- Do not know

3) Which part of the UV radiation causes skin aging?

- UVA radiation
- UVB radiation
- Both
- Do not know

4) The sun protection factor (SPF) of sunscreen products is a measure of:

- UVA protection
- UVB protection
- UVA and UVB protection
- Do not know

5) How do you like yourself most?

- I do not care about my tan
- When I am tanned
- When I am not tanned
- My skin is naturally dark

6) Would you take the risk of getting sunburnt just to be tanned?

- Yes
- No

7) Do you tan in the sun?

- Yes
- No

if YES how long?

- less than 3 hours per day
- 3-5 hours per day
- more than 5 hours

8) Do you tan in the midday sun (11 AM - 3 PM)?

- Yes
- No

9) Do you visit tanning studios?

- Yes
- No

if YES, how often?

- regularly
- sporadically
- rarely

10) How long do you tan in a tanning studio?

- Less than 5 minutes
- 5-10 minutes
- more than 10 minutes
- more than 15 minutes

11) Do you get sunburnt in the sun?

- Yes
- No

12) Have you ever experienced a sunburn after a tanning studio visit?

- Yes
- No

13) Did you experience a sunburn in your childhood (before 10 years of age)?

- Yes
- No

14) When did you experience your worst sunburn?

- During water sports
- During tanning
- During outdoor activities (tennis, jogging, etc.)
- During winter sports

15) Did you have a sunburn this summer?

- Yes No

if YES, how many?

- 1
 2
 3

16) When do you reapply sunscreens? (more than one answer is possible)

- After swimming
 To increase the time I can spend in the sun
 After 6 hours in the sun
 When I get sunburnt

17) Do you use sunscreens while tanning?

- Yes No

If YES, which sun protection factor (SPF) do you apply?

- <15 SPF
 15-30 SPF
 30-50 SPF
 50+ SPF
 whatever is available

If NO, what keeps you away from applying sun screens?

- I forget it
 It is too laborious
 Unpleasant sensation (skin sensation, smell)
 Because I want to tan
 Because I am naturally dark

18) When do you apply sunscreens in spring and summer?

- On sunny and hot days
 When I plan to stay outdoors in the sun for a longer time
 Every day despite the weather conditions
 Just if the people I am with are using sun screens
 I never use sunscreens

19) Do check yourself for skin changes, like new moles or changing moles?

- Yes No

20) Have you had any moles removed by a physician?

- Yes No

21) Where were you informed about sun protection?

- at home
 by the physician
 at school
 at medical school
 other

22) Are there in your country any national campaigns (posters, brochures, TV commercials) for public education on sun protection and solar damage?

- Yes No

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14 Curriculum vitae

Mein Lebenslauf wird aus datenschutzrechtlichen Gründen in der elektronischen Version meiner Arbeit nicht veröffentlicht.

15 Eidesstattliche Versicherung

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