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The importance of an oncology database in planning melanoma prevention programs

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ABSTRACT

Early detection and early treatment are key to melanoma survival. To organise prevention programs, we need to know the detailed datas of melanoma. Our objective was to assess and understand the epidemiological data of melanoma patients treated at our institution. We investigate whether the available database is suitable for more detailed epidemiological and morphological data analysis; and whether the results can contribute to the design of programs for melanoma prevention and detection. In our study, we retrospectively analyzed data from 636 melanoma patients treated at the Moritz Kaposi General Hospital, based on a unique clinical oncology patient pathway management system (Onkonetwork) database. We analyzed the distribution by sex and age, the subtype of melanoma, localization, tumor thickness, stage, risks, and detection mode. Our results showed that most melanoma cases occurred in women under 40 years and in men aged 60–79 years. There was an increase in the incidence of thin melanomas and a relatively stable incidence of thick melanomas. The study confirmed that the Onkonetwork system serves as a valuable database to support the identification of prevention sites where improvements in early detection, prevention and early treatment of melanoma are needed, tailored to the specific geographical location.

1. Introduction

Melanoma, which starts in melanocytes, is the most serious type of skin cancer. It is less common than basal cell carcinoma (BCC) and squamous cell carcinoma (SCC), but melanoma is more dangerous, as it can metastasize faster if not treated at an early stage. The chance of survival is worse in patients with microsatellites, macroscopic satellites and in-transit metastases than in those without satellite lesions [1] The incidence and prevalence of melanoma have increased in recent decades. The incidence of melanoma increased by 161 % between 1990 and 2017 [2]. Now days, skin melanoma is the 17th most common cancer worldwide with more than 330.000 new cases and almost 60.000 deaths in 2022 [3]. The number of melanoma cases worldwide will reach nearly half a million (466,914) by 2040, a 62 % increase compared to 2018. The number of deaths will rise by 20 % from 60,712 in 2018 to 72,886 in 2025 and will reach 105,904 in 2040, an increase of 74 % [4]. According to the Hungarian National Cancer Registry, nearly 3000 new cases of melanoma are diagnosed in Hungary each year, and 300–400 deaths are attributed to the disease each year.

Melanoma survival is mainly determined by the tumor stage, for which TNM classification is used. For localized melanoma, tumor thickness (Breslow index) and ulceration are considered prognostic factors. For regional lymph node metastasis, the number and type of metastatic lymph nodes determine prognosis. Melanomas are classified as stages I to IV. The importance of knowing the stage is that while the five-year survival rate for stage I is 95.3 %, it is only 10.5 % for stage IV [5,6].

Early detection and early surgery are key. Compared to patients with stage I melanoma who underwent a complete excision within one month (<30 days) of biopsy and diagnosis, those who had 1–2 months (30–59

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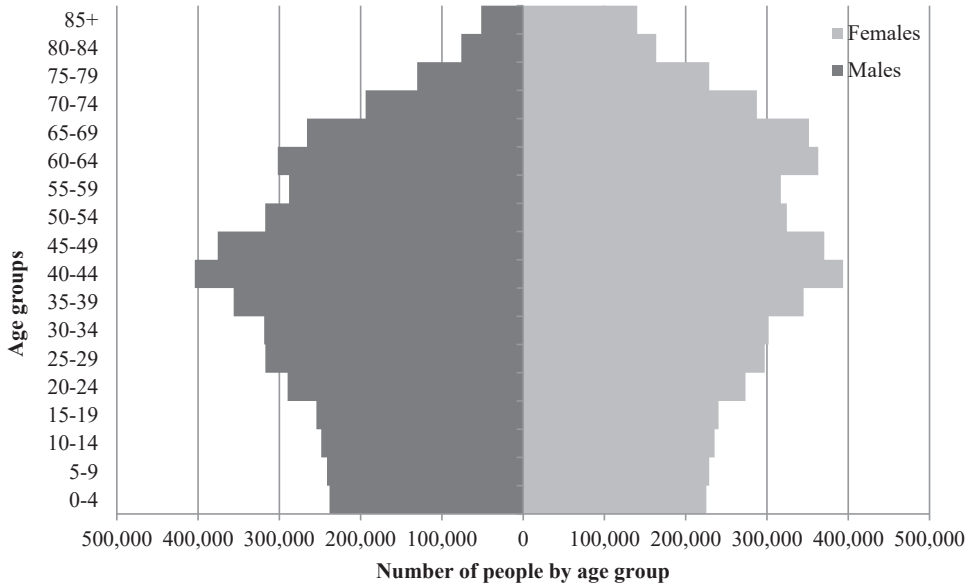

Fig. 1. Average population of Hungary by age groups and sex, 2016–2023 period. Source: Central Statistical Office of Hungary.

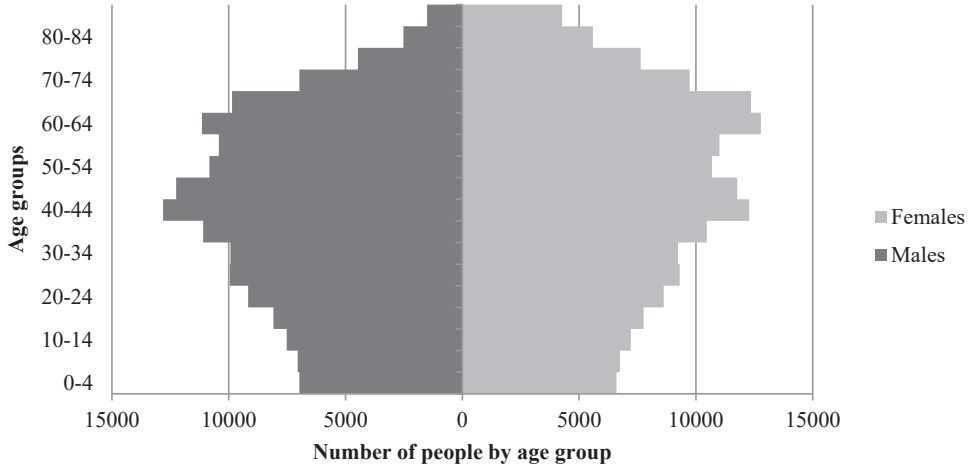

Fig. 2. Average population of Somogy County by age groups and sex, 2016–2023 period. Source: Central Statistical Office of Hungary.

days) to complete excision had a 5 % higher risk of dying from the disease, and those who had a complete excision more than four months later (>119 days) had a 41 % higher risk [7].

To evaluate the mortality rates associated with melanoma and to implement appropriate prevention strategies, it is necessary to have the TNM data and detailed data on melanoma patients. However, there is no specific melanoma registry in Hungary. Data on melanoma nationally can be obtained from the National Cancer Registry (NCR), the National Health Insurance Fund Management (NEAK), and the Central Statistical Office (KSH), but these data sources do not cover important clinical parameters of the disease. Only the following data are available from the National Cancer Registry: tumor type; year of examination; sex; county. Only incidence data are available from the register. Detailed epidemiological data can be obtained from hospital information systems (HIS) at the local or regional level [8–11].

The permanent population of Hungary on 1 January 2023: 9,804,022 (male: 4,734,246; female: 5,069,776). Since 1981, the population of Hungary has been declining due to low births and high deaths, and its structure is ageing (Fig. 1.). This trend is even more pronounced in Somogy County (Fig. 2.)

The local relevance of the topic is justified by the fact that Somogy county is ranked 12th in terms of melanoma standardised incidence rate per 100,000 inhabitants (19 counties plus Budapest), but its standardised mortality rate (SHH) due to melanoma is much higher than the national average and ranks 2nd in the county ranking [12].

Epidemiological studies on the incidence, demographics and morphology of melanoma can help in the design and implementation of early detection programs.

Despite the popularity of ad hoc melanoma screening events among the population, the basic knowledge of people in the catchment area of our county hospital, which is situated in a rural region of Hungary, on how to prevent and recognize the disease is limited.

There are no national melanoma prevention programs in Hungary. Once a year the Euromelanoma Campaign is usually implemented, apart from that local programs are implemented by hospitals and health care providers. In Kaposvár and Somogy County, the local Prevention and Health Promotion Office organises such programes.

In our study, we retrospectively analyzed data from 636 patients with melanoma treated at the Dermatology Department of the Moritz Kaposi General Hospital in Somogy County between 2016 and 2023, based on a unique clinical oncology patient pathway management system (OnkoNetwork) database [13,14]. The institution has been using

OnkoNetwork, the oncology patient pathway management system used as a database, since October 2015. The design and development of the oncology patient pathway management network can be considered a real paradigm shift in Hungarian oncological care. Similar case management systems exist internationally, while the Kaposvár model was the first in Hungary. The essence of OnkoNetwork is that it provides unified, comprehensive, integrated oncological care based on a protocol system. The main objective is to ensure that patients with suspected oncological diseases are not lost in the care system. Patients should receive diagnosis and treatment within a given timeframe, with priority in the institution's system, thus ensuring early diagnosis and curative therapy. The long-term goals include the development of a valid, prospectively collected oncology database, which allow for real morbidity and mortality analysis, as well as the involvement of cancer screening and the primary care system [15].

The OnkoNetwork system was the subject of a qualitative and quantitative evaluation by the SELFIE project, which is funded by Horizon 2020. The study aimed to provide a qualitative assessment of service delivery, management and governance of the system, the workforce required, funding, technologies used, and medical products, information and research.

The SELFIE study provided the first comprehensive description of the OnkoNetwork program. The study concluded that the OnkoNetwork system provides personalized, quality-assured healthcare services to oncology patients. The system ensures timely treatment of and follow-up for patients in a financially sustainable way. Innovative professional roles for non-physicians and physicians have been introduced, and an IT application supporting oncology patient care has been developed [16].

The aim of our study:

- To assess and understand the epidemiological data on melanoma patients treated at our institution.
- In the absence of a national melanoma database, to investigate whether the database of the Oncology Patient Pathway Management System is suitable for more detailed epidemiological and morphological data analysis.
- To respond quickly and adequately to the needs of the local population.
- In addition to programs for early detection of melanoma, to lay the foundations for the design and implementation of education programs for melanoma prevention.

2. Material and method

Our retrospective analysis was based on the OnkoNetwork oncology patient pathway management system database, which is an integrated subsystem of the Hospital Information System (HIS, Hospital Information System "eMedsolution"). The OnkoNetwork system was implemented in October 2015. The period under review is 1 Januar 2016 to 31 December 2023. The recorded incidence rates are presented in a raw and per 100,000 population, age-standardised format. For the latter, the 2013 EU-27 + EFTA standard population was used as a reference. The age distribution in Somogy County is based on the population figures of the KSH as of 1 January of the given year. We calculated the age group weighted population size in Somogy County and then the weighted melanoma case numbers. Due to the small number of elements, indirect standardisation with 95 % confidence intervals. The incidence were analyzed by year.

In our study, we analyzed data from patients admitted to the Dermatology Department of the Hospital with a diagnosis of melanoma malignant (ICD-10: C43) and melanoma in situ (ICD-10: D03). The study only included data for patients with a regional duty of care. The database includes data on 636 melanoma patients.

Methodology of raw data collection, preparation and cleaning: the OnkoNetwork query interface was used as the database, where the following parameters were set in the first step:

Clinic: full clinic; Date type: oncology case start; Start date (01/01/2016); End date (31/12/2023); Confirmed diagnosis C4300-C4390; D0300-D0390; Case status (both: active and closed).

Data are retrieved in batch CSV file format. With the above settings, we found 757 cases for 731 patients in the entire hospital system. (A patient could have more than one case.) The resulting database was then narrowed down to the cases treated in the Dermatology Department, which resulted in the identification of 669 cases and 636 patients. Data analysis was performed on a patient by patient basis.

During preparation, we excluded from the analysis patients who were admitted to the OnkoNetwork system with suspected melanoma but whose histology confirmed other malignant skin cancers or benign processes.

The Hospital's coverage is in Somogy County, which means the data is representative of the county's population. Patients in the aera come to our hospital from all over the county because of the central referral role of the hospital.

According to Central Statistical Office, the population of Hungary is about 9.7 million. (on 1st of January, 2016: 9.830.485; on 1st of January, 2023: 9.599.744). There are 19 County in Hungary. The population of Somogy county is approximately 300.000. (population based on data as of 1 January in 2016: 321,221; in 2023: 295,316)

We carried out descriptive statistical analyses of histological and clinical characteristics of all melanomas using information from the Onkonetwork database. The database includes patient sex, age, melanoma localization, morphology, subtype, Breslow index, Clark invasion level, ulceration, TNM classification, and clinical stage classification. The analysis took into account that the AJCC 7th edition used for the TNM definition was replaced by the AJCC 8th edition at the beginning of 2018. Among other things, AJCC 8 changed the definitions of T1a and T1b. Prior to 2018, AJCC 7 defined T1a melanomas as having a Breslow thickness of up to 1 mm and not containing mitoses or ulceration. In the 8th edition of the AJCC, T1a includes melanomas < 0.8 mm thick without ulceration, and T1b includes melanomas with or without ulceration of 0.8–1.0 mm thick and with ulceration of less than 0.8 mm [17].

Data analysis and descriptive statistics were performed using the IBM SPSS version 25. statistical software. ANOVA test and Chi-square test were performed for comparative analyses. To map and understand the patients/patient groups, we also analyzed the data by stage.

In addition to epidemiological and morbidity data, the database contains a wealth of data on individual and family risk, melanoma detection, and disease pathways. To map and understand our patients and patient groups, we also analyzed the data by tumor stage. We looked at the mode of detection, which we narrowed down to three categories: 1. highlighted at screening, 2. presented to a dermatologist with a suspicious lesion or complaint, and 3. suspicious lesion discovered as a finding.

In our research, we assessed which risk factors we could analyze in OnkoNetwork and deliberated using them to determine which risk group our melanoma patients belonged to. During the study period, two of the risk factors were recorded in the OnkoNetwork database: a family history of melanoma and exposure to sunlight radiation. Information on the number of moles, skin type, and freckling could only have been obtained from the anamnesis as part of the electronic patient record, but due to incomplete data, this could not be analyzed.

With reference to the regulations of Moritz Kaposi General Hospital for research subject to authorisation and notification, the reference number of the local authorisation for research is IG/02011-000/2018. The research was conducted with the approval of the Institutional Ethics Committee of the Hospital. The local committee performs its duties in accordance with ICH-GCP standards. The Onkonetwork system and the data stored in it is an integral part of the Hospital's Electronic Information System, classified as security class 5 according to Act L of 2013 on the electronic information security of state and municipal bodies, the highest possible security level at present. In view of the

Table 1
Descriptive analysis of melanoma patients in Moritz Kaposi General Hospital.

a: Descriptive analysis of melanoma patients in Moritz Kaposi General Hospital, crude data.

Descriptive analysis of melanoma patients, crude data									
Patients	**2016** N = 78	**2017** N = 61	**2018** N = 104	**2019** N = 77	**2020** N = 70	**2021** N = 77	**2022** N = 87	**2023** N = 82	**Total** N = 636
Sex N (%)									
Male	36 (46,2)	28 (45,9)	50 (48,1)	34 (44,2)	36 (51,4)	35 (45,5)	39 (44,8)	45 (54,9)	303 (47,6)
Female	42 (53,8)	33 (54,1)	54 (51,9)	43 (55,8)	34 (48,6)	42 (54,5)	48 (55,2)	37 (45,1)	333 (52,4)
Age Group N (%)									
< 40	8 (10,3)	5 (8,2)	20 (19,2)	7 (9,1)	6 (8,6)	7 (9,1)	6 (6,9)	7 (8,5)	66 (10,4)
40–59	17 (21,8)	16 (26,2)	26 (25)	19 (24,7)	12 (17,1)	26 (33,8)	24 (27,6)	25 (30,5)	165 (25,9)
60–79	41 (52,6)	33 (54,1)	50 (48,1)	44 (57,1)	39 (55,7)	34 (44,2)	44 (50,6)	40 (48,8)	325 (51,1)
≥ 80	12 (15,4)	7 (11,5)	8 (7,7)	7 (9,1)	13 (18,6)	10 (13)	13 (14,9)	10 (12,2)	80 (12,6)
Age (year) average±SD	64 ± 15,4	64 ± 14,3	58 ± 17,9	62 ± 14,8	66 ± 16,4	61 ± 16,1	63 ± 15,5	61 ± 15	62 ± 15,9

SD = standard deviation

b: Descriptive analysis of melanoma patients in Moritz Kaposi General Hospital, standardized data

Descriptive analysis of melanoma patients, standardized data								
Cases	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Somogy weighted case numbers	N = 75,7	N = 60,6	N = 101,7	N = 72,1	N = 67,8	N = 73,3	N = 81,6	N = 76,1
adjusted incidence rate per 100,000*	23,6 [15,4 to 35,7]	18,9 [11,4 to 29,7]	31,7 [21,9 to 45,2]	22,4 [13,8 to 33,3]	21,1 [13–32.1]	22,8 [14,6 to 34,5]	25,4 [16,2 to 36,9]	23,7 [15,4 to 35,7]

* Standard population: EU-27+ EFTA standard population with 95 % confidence interval.

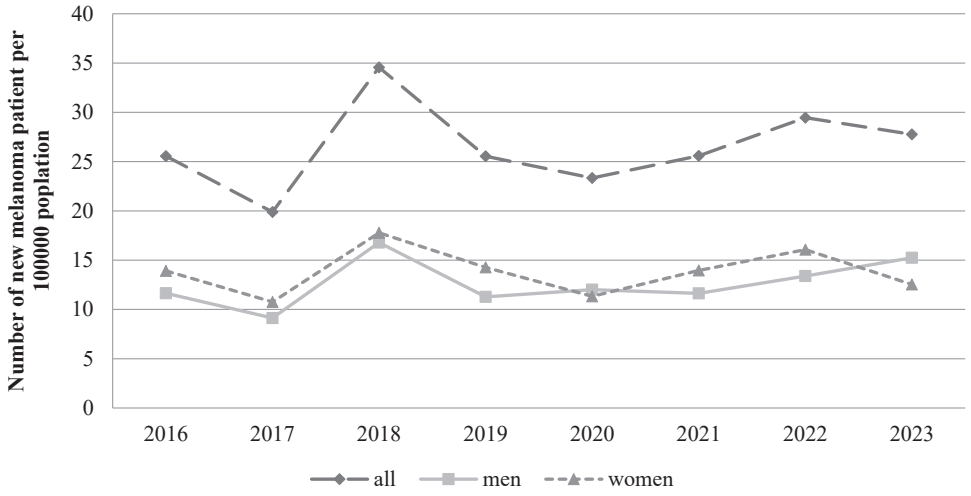

Fig. 3. Melanoma crude incidence per 100,000 population in the Moritz Kaposi General Hospital, between 2016 and 2023, n = 636.

importance of the protection of health data, it is implemented through the data protection provisions of the General Data Protection Regulation 2016/679 of the European Parliament and of the Council (GDPR), which is directly applicable in the EU Member States.

3. Results

In our study, data from a total of 636 patients diagnosed with malignant melanomas were analyzed (Table 1a). An average of 80 new melanoma patients were diagnosed each year, with the only outlier being in 2018, when several local campaigns and screening programs were implemented and 104 new melanoma patients we diagnosed.

The overall incidence over the full study period was 20.322/100,000 inhabitant-years. Gender distribution of melanoma cases was balanced (male). 303 (47,6 %) Male and 333 (52,4 %) female. There was no significant difference between the number of men and women registered per year, with a similar incidence of melanoma each year for both sexes (Fig. 3).

We have calculated the crude prevalence of melanoma patients per 100,000 inhabitants of Somogy County. We observed an increasing trend in the prevalence of our melanoma patients over the period under study, with nearly constant incidence values. The incidence value in 2018 was significantly higher compared to other years. (Fig. 4)

The recorded incidence rates are presented in a raw and per 100,000 population, age-standardised format; 31,7/100,000. (Fig. 5)

However, there was a significant difference in the proportion of women and men in the under-40 category ($p = 0.008$). Women were significantly more affected in the young age group. In the 60–79 age group, however, the ratio of women to men was reversed, with a significant difference in favor of men. (Fig. 6). Most patients were in the 60–79 age group. The average age of patients was lowest in 2018 when all years were considered.

In terms of location, the incidence of melanoma in males was markedly higher on the trunk (167; 55.1 %), followed by the head and neck region (61; 20,1 %). In females, melanoma localization predominated in the lower limbs (108; 32.4 %), followed by the trunk (90; 27 %), and then the upper limbs (75; 22,5 %). Overall, in both sexes, melanoma is most common on the trunk (257; 40.4 %) (Fig. 7).

When analyzed by the Breslow index (aggregate data), the prevalence of clinically thin melanomas, i.e. less than 1 mm, was the highest (231; 36,3 %), followed by melanomas of intermediate thickness, i.e. between 1 and 4 mm (170; 26,7 %), and then in situ melanomas (133;

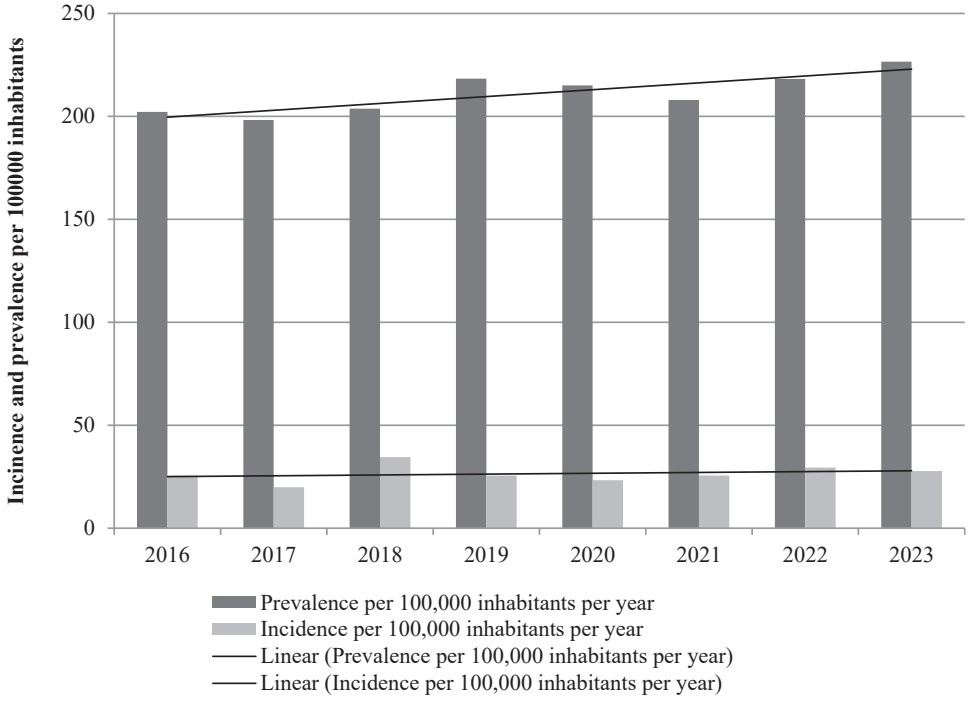

Fig. 4. Melanoma crude prevalence and incidence per 100,000 population, between 2016 and 2023(case/population of Somogy County).

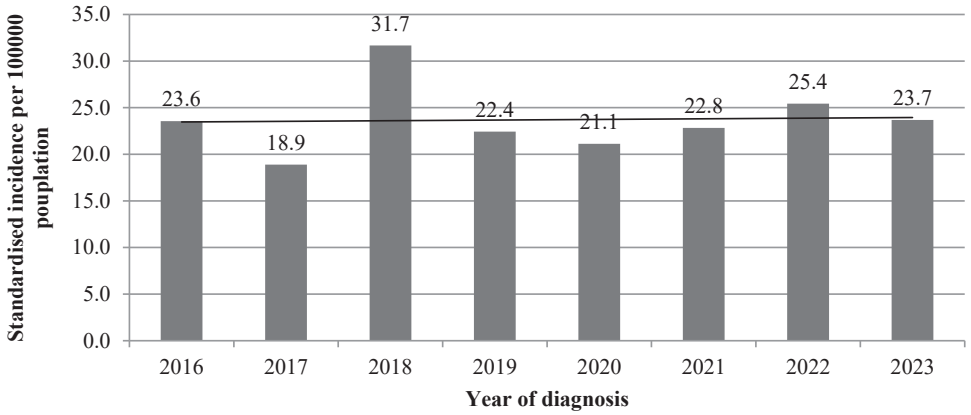

Fig. 5. Standardised incidence of melanoma in Somogy county per 100,000 inhabitants. Standard: EU-27+ EFTA standard population.

20,9 %). Clinically thick melanoma occurred in 94; 14,8 % of cases. No data 8 (1,3 %)

Breslow score was statistically significantly different across calendar years in ANOVA test, with statistically significant difference between years 2016–2018 and 2016–2023 in Tukey post hoc test. When calendar years with none, low intensity (<300 screened subjects per year) and higher intensity of the screening programme were pooled, the ANOVA test revealed statistically significantly higher Breslow melanoma width in years with low intensity screening versus high intensity screening ($p = 0.0000459$). Interestingly, in years without screening programme, melanoma width was also significantly higher than in years with low intensity screening ($p = 0.0052870$). (Fig. 8)

Looking at the Clark invasion level, the highest proportion of histological findings was Clark IV (176; 27,7 %). The incidence of Clark III (133; 20,9 %) and Clark I (132; 20,8 %) was almost identical. Clark V level occurred in 46 cases (7,2 %).

Based on the TNM classification, most melanomas were classified as T1a (< 0.8 mm without ulceration) (191; 30,0 %), followed by in situ (Tis) tumors (133; 20,9 %). The classification by clinical stage was also similar, with most melanomas classified as Stage IA (185; 29,1 %), followed by Stage 0 (132; 20,8 %) (Table 2.)

Histologically, according to the subtype of melanoma, 344; 54 % were superficially spreading melanomas, 127; 20 % nodular melanomas, 66; 10 % *lentigo maligna* melanomas, 14; 2 % acral-lentiginous melanomas, and 17; 3 % other (naevoid, spitzoid, amelanotic type) melanomas. 61; 10 % of melanomas were not otherwise specified (NOS) (Fig. 9).

Based on the stage distribution, melanoma patients were studied in eight groups, taking into account age, sex, location, subtype of melanoma, mode of detection, and individual risk. Stage IA had the lowest mean age of patients (57 years). The highest mean age was in stage IIC (71 years).

In terms of location, in situ, melanomas were most frequent in the head and neck region (48 or 7.5 %), and from stage IA onwards, melanomas were most frequent uniformly on the trunk. In terms of subtype, the proportion of superficial spreading melanomas (SSM) was highest in stage IA (143; 22,48 %), with nodular melanomas (NM) occurring most frequently in stages IIB, IV, and IIC. Most Lentigo maligna melanomas

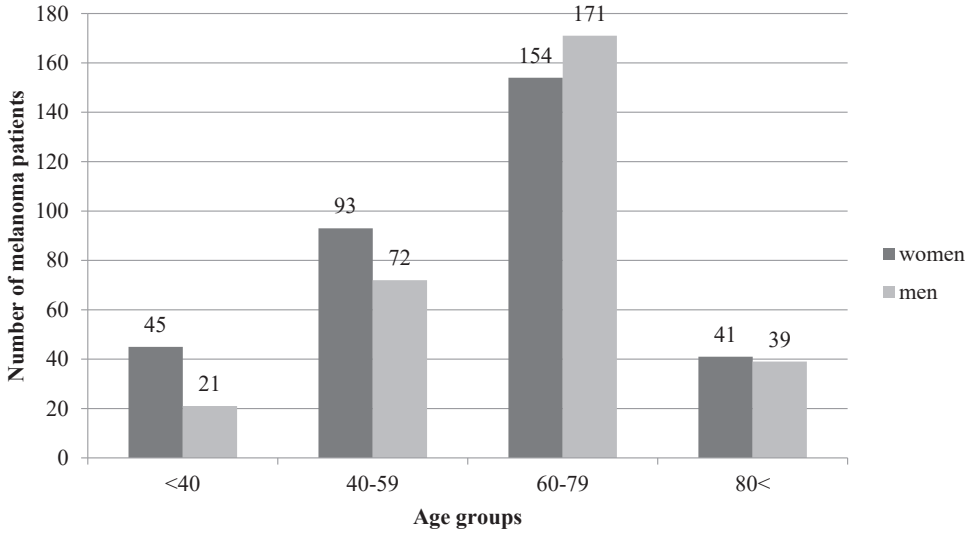

Fig. 6. Age and sex distribution of melanoma patients between 2016 and 2023, n = 636.

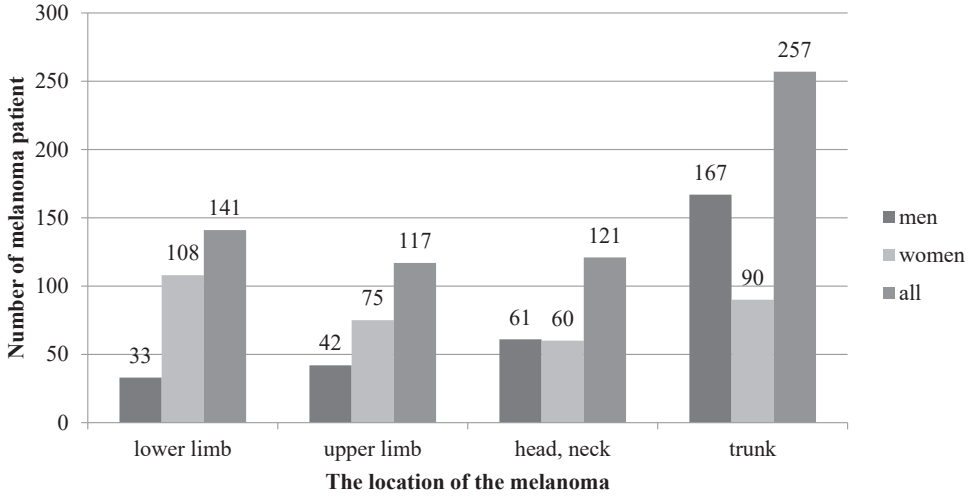

Fig. 7. Melanoma incidence by location and sex, n = 636.

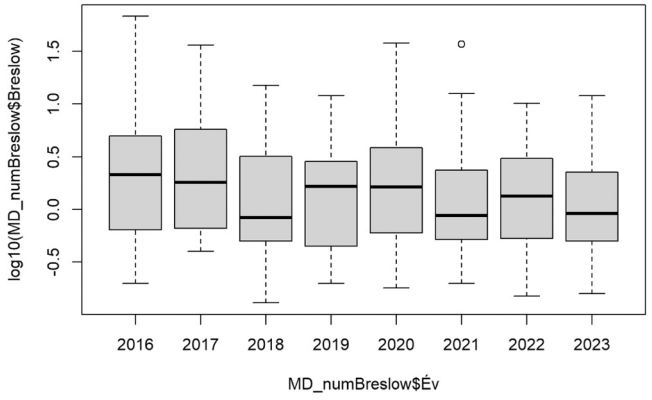

Fig. 8. Breslow thickness in the patients studied. Without in situ melanoma.

(LMM) were in situ melanomas, and non-specified melanomas (NOS) were most common in stages IA and IB.

In terms of the method of detection, 398; 62.5 % of all cases presented to a dermatologist with a suspicious lesion, 73; 11.4 % were detected by screening, and 58; 9.1 % were detected as a secondary finding during the investigation of another disease. In 107; 16.8 % of cases, no indication of the method of detection was found in the anamnesis.

Among the individual risks, pathological solar radiation dominated in 331; 52,0 % of patients, which is in line with the literature. Previous malignant skin cancer (e.g., cc. basocellulare, spinalioma) occurred in 80; 12,6 %; of patients, previous melanoma in 46; 7.2 %, dysplastic nevus in 67; 10 % of patients, and a family history of malignant skin cancer or melanoma in 40; 6.3 % of patients (of which 24; 3.8 % were melanomas). Also, 8.5 % (54) of patients developed a new melanoma during the study period. Among the other risks to patients, chronic disease and/or other cancer were present in 246; 38.6 %, and a family history of cancer affected 278; 43,7 % of melanoma patients.

4. Discussion

Comparing the prevalence of melanoma patients diagnosed and/or treated in the Hospital with the data from the National Cancer Registry, we found that on average 68 % of melanoma patients living in Somogy County were treated in our institution. There are 3 other hospitals in Somogy County where dermatology is also available, but they do not

Table 2
Descriptive analysis of tumors studied, crude dataDescriptive analysis of tumours studied.

Descriptive analysis of tumors studied								
TNM (T)	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Tis: Melanoma in situ	25 (32,1)	11 (18,0)	22 (21,2)	21 (27,3)	12 (17,1)	8 (10,4)	20 (23)	14 (17,1)
T1a: < 0.8 mm without ulceration	16 (20,5)	12 (19,7)	36 (34,6)	17 (22,1)	21 (30,0)	33 (42,9)	25 (28,7)	31 (37,8)
T1b: < 0.8 mm with ulceration, or 0.8–1.0 mm with or without ulceration	4 (5,1)	7 (11,5)	7 (6,7)	3 (3,9)	1 (1,4)	3 (3,9)	3 (3,4)	3 (3,7)
T2a: > 1.0–2.0 mm without ulceration	3 (3,8)	4 (6,6)	9 (8,7)	12 (15,6)	9 (12,9)	5 (6,5)	9 (10,3)	8 (9,8)
T2b: > 1.0–2.0 mm with ulceration	2 (2,6)	1 (1,6)	1 (1,0)	2 (2,6)	3 (4,3)	2 (2,6)	4 (4,6)	4 (4,9)
T3a: > 2.0–4.0 mm without ulceration	4 (5,1)	4 (6,6)	8 (7,7)	3 (3,9)	6 (8,6)	6 (7,8)	6 (6,9)	3 (3,7)
T3b: > 2.0–4.0 mm with ulceration	7 (9,0)	6 (9,8)	7 (6,7)	7 (9,1)	5 (7,1)	7 (9,1)	7 (8,0)	9 (11,0)
T4a: > 4.0 mm without ulceration	2 (2,6)	5 (8,2)	4 (3,8)	1 (1,3)	4 (5,7)	6 (7,8)	6 (6,9)	1 (1,2)
T4b: > 4.0 mm with ulceration	15 (19,2)	10 (16,4)	7 (6,7)	10 (13,0)	9 (12,9)	6 (7,8)	6 (6,9)	5 (6,1)
T0: No evidence of primary tumor	0	0	3 (2,9)	0	0	0	0	1 (1,2)
TX: Primary tumor cannot be assessed (ie, curettaged melanoma)	1 (1,3)	0	1 (1,0)	1 (1,3)	0	1 (1,3)	2 (2,3)	3 (3,7)
AJCC stádium N (%)	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Stage 0	25 (32,1)	10 (16,4)	22 (21,2)	21 (27,3)	12 (17,1)	8 (10,4)	20 (23,0)	14 (17,1)
Stage IA	16 (20,5)	13 (21,3)	31 (29,8)	17 (22,1)	20 (28,6)	32 (41,6)	25 (28,7)	31 (37,8)
Stage IB	6 (7,7)	10 (16,4)	14 (13,5)	15 (19,5)	6 (8,6)	4 (5,2)	11 (12,6)	9 (11,0)
Stage IIA	5 (6,4)	4 (6,6)	7 (6,7)	5 (6,5)	8 (11,4)	7 (9,1)	8 (9,2)	6 (7,3)
Stage IIB	7 (9,0)	10 (16,4)	9 (8,7)	4 (5,2)	6 (8,6)	10 (13,0)	10 (11,5)	10 (12,2)
Stage IIC	6 (7,7)	4 (6,6)	3 (2,9)	4 (5,2)	4 (5,7)	6 (7,8)	4 (4,6)	2 (2,4)
Stage III	4 (5,1)	4 (6,6)	8 (7,7)	4 (5,2)	8 (11,4)	7 (9,1)	5 (5,7)	4 (4,9)
Stage IV	10 (12,8)	5 (8,2)	10 (9,6)	7 (9,1)	6 (8,6)	3 (3,9)	5 (5,7)	6 (7,3)

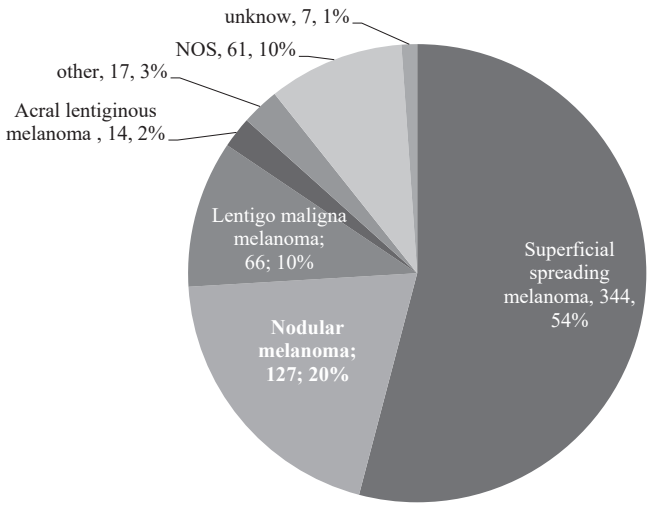

Fig. 9. Melanoma subtypes, n = 636.

provide melanoma care. It is assumed that, due to the free choice of doctors in Hungary, the other melanoma patients, use the National Oncology Centre or the nearby Pécs Melanoma Centre. There was a significant difference in 2018 when 104; 87 % of melanoma patients living in the county were detected and/or treated here. According to the Onkonetwork protocol, patients with suspected melanomas are confirmed or rejected by histological diagnosis within 21 days of entry into the system. Further care is decided by the treating physician and OnkoTeam within 30 days of entry into the system and, if necessary, further treatment is started within 14 days of the OnkoTeam's decision.

Comparing the crude average annual number of new melanoma patients discovered and treated each year (80 patients a year) with data from a national university clinical melanoma center (99.6 patients a year) [9], we find that our hospital treated only 20 % fewer melanoma patients than a large university center. There are currently 5 melanoma centres in Hungary, where melanoma patients receive priority care. Until 2017, the Dermatology Department of our hospital was also a regional melanoma centre. With the introduction of high-value treatments (target therapy, immunotherapy, biological therapy), 5 melanoma centres have been designated nationally to provide these treatments. As this type of melanoma treatment is not performed in the Dermatology Department of our hospital, the "melanoma centre" status has been discontinued, however, due to its central management role, it continues to see a large number of melanoma patients. In terms of gender, the overall proportion of women in our patient population was slightly higher than men, but we found no significant difference between them, so we should pay similar attention to both genders in prevention programs. We plan to conduct further studies in two priority age groups, men aged between 60 and 79 and women under 40, to investigate why melanoma is more common in these two age groups.

The highest proportion of melanomas less than 1 mm in diameter were found in the period studied. Our patient population as a whole was dominated by melanomas between 0 and 4 mm (534; 83,9 %). The proportion of thick melanomas deeper than 4 mm was 94; 14,7 %, which we should pay particular attention to as they are the main cause of melanoma-related deaths. 2018 saw the highest number of newly detected melanomas and the highest number of melanomas below 1 mm and in situ.

In Hungary, there is no national organised program for the prevention and early detection of melanoma. Once a year our country joins the Euromelanoma campaign, where the population can participate in a screening of moles.

As melanoma is not a screenable tumour according to the Wilson-Junger criteria, 'screening' is understood as a program for the early detection of melanoma.

If someone wants to have their skin checked without complaints or symptoms, a so-called 'screening', they can do so in public and private dermatology services or through locally organised prevention programs. There is a great demand from the public for such opportunities, and as health promotion and prevention professionals we need to respond to this demand. Patients with complaints, changes or suspicious skin lesions should continue to report to the Dermatology Department.

Low-intensity melanoma screening (<300 screened patients a year) was associated with a significantly thicker (Breslow) melanoma diagnosis than higher-intensity screening ($p = 0.0002$). High screening intensity years had a lower rate of faded melanoma at diagnosis. High and low intensity refers to the frequency of such 'screening programs'.

2018 was the most intensive year for the local melanoma early detection campaign, with three major screening programs and several educational programs. The screening programs were advertised to the general population, with a focus on the population at higher risk of melanoma [18]. In the campaigns, we raised awareness of the risks of melanoma, such as skin type, number of moles and family history of melanoma. Among the education programs, we organized training for

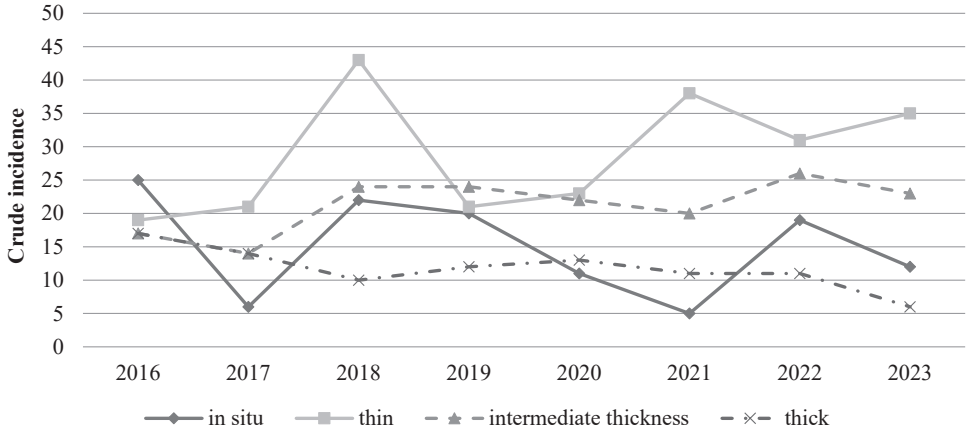

Fig. 10. Incidence of melanoma by clinical thickness and years, n = 615 (21 unknown).

GPs, on how to recognize suspicious signs of melanoma and how to care for patients with melanomas. We also organized lectures on sun protection for young people in secondary school and parents with young children. The other outlier was in the post-covid period 2021–2022, when we also had high rates of melanoma less than 1 mm and in situ melanoma, even though no specific screening campaigns were organized during that time. The increase in the number of melanoma patients screened was likely because group screening campaigns could not be organized during the pandemic, and fewer patients consulted a doctor, but after the restrictions were lifted, patients 'caught up' with screening (Fig. 10)

Although the incidence of thin melanomas has increased over the study period, the incidence of thick melanomas, which is specific to older men and is what sustains mortality [19], is relatively stable and shows only a very slight, non-significant decrease.

In terms of melanoma localization, the results are in line with literature and national studies [9]. The highest proportion of melanomas in men were found on the trunk, while in women they were found on the lower limbs. When both sexes are considered together, the trunk had the highest incidence of melanoma.

The subtype prevalence of melanomas in our patient population is consistent with the types described in the literature, the most common being Superficial spreading melanoma (344; 54 %), Nodular melanoma (127; 20 %), Lentigo maligna melanoma (66; 11 %) and Acral lentiginous melanoma (14; 2.0 %) [19]. The prevalence rates of the subtypes were also in agreement with those reported in the literature, except for Nodular melanoma, which was nearly twice as common among our patients (127;20 %) as in the literature (10–15 %). This rate of occurrence of nodular melanoma will therefore be examined separately later.

Early detection and early treatment are key to melanoma survival [7], so our research also analyzed how melanomas are detected. We found information suggestive of detection in the medical history of 558; 83 % of melanoma patients. Most of our patients (420; 63 %) complained to their dermatologist about a suspicious skin lesion, but this also means that a significant proportion of them did not notice the lesion, did not know what to look out for, or ignored it. Patients who did present with a suspicious lesion also waited an average of 14 months to see a dermatologist with their complaint. Delay on the part of the patient and assessment of knowledge should therefore be given more attention.

In addition to epidemiological and morphological data, knowledge of the target population is essential for planning any prevention intervention.

In the analysis, we found that about 268; 40 % of patients with stage III-IV melanoma have a chronic disease and are likely to see their GP regularly (e.g. for prescriptions). The proportion is similar among patients with earlier stages, with 258; 38.5 % of patients having a chronic disease and therefore regularly seeing their GP. A total of 283; 42 % of our patients also have a family history of cancer. This draws our attention to the need for greater emphasis on oncology vigilance and patient screening in both primary and specialist care. In terms of reaching the general public, an important venue for education could be the waiting rooms of doctors' surgeries, where information and demonstration tools and posters could be used to raise patients' awareness of the skin lesions that are suspicious of melanoma.

5. Summary, conclusions

Onkonetwork was the first oncology patient pathway management system in Hungary, and its other main objective, besides improving patient pathways and patient care, was to build up a database to support future clinical epidemiological research. Our research has shown that Onkonetwork works well as a patient pathway management system because the care of all patients entering the system can be tracked at all levels, all patients receive consistent, protocol-based care and no patient is lost in the system. As a result of the research, improvements have also been made to the melanoma section of the system and a separate melanoma data sheet has been added, which asks for details of the patient's individual and family history and risk factors.

The results obtained from the database have helped us to understand the epidemiological data of our melanoma patients and their detailed characteristics which helps to plan preventive interventions and programs based on these data.

Based on the results, local screening programs will pay particular attention to the older male age group, which has a chronic disease burden. These patients will be targeted through screening programs at GPs' surgeries and specialist clinics. Since April 2023, as planned, once a month, our hospital has been offering a special "screening day" for the population without complaints or symptoms to participate in screening for early detection of melanoma and other skin cancers. In our prevention programs, as part of education, we place the greatest emphasis on sun protection and conscious sunbathing, especially among children, young people, parents with young children, and chronically ill patients.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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