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Healthcare resource use and indirect costs associated with migraine in Italy: results from the *My Migraine Voice* survey

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ABSTRACT

Aims: To evaluate the healthcare resource use (HRU) and cost of lost productivity due to migraine among Italians with ≥4 monthly migraine days (MMDs), with a focus on those with ≥2 prior preventive treatment failures (TFs).

Materials and methods: Data from Italian participants from the *My Migraine Voice* survey were used to assess migraine-related HRU and migraine's impact on work productivity and daily activities using the Work Productivity and Activity Impairment questionnaire. The mean, annualized cost of lost productivity was estimated using the Human Capital Approach and extrapolated to employed Italian population with ≥4 MMDs to calculate the overall migraine-related indirect cost burden in Italy.

Results: Data of 420 participants, enrolled between September 2017 and February 2018, were analyzed (mean age: 38.5 years, 81.2% women, 37.8% with ≥2 TF). During a 6-month period, 57.6% of participants visited general practitioners (mean visits: 4.5), 31.9% neurologists (mean visits: 2.6), and 26.4% headache specialists (mean visits: 2.8). Overall, 32.0% of participants had ≥1 emergency room visit (mean visits: 2.8) and 15.0% had ≥1 hospitalization (mean visits: 2.9) because of migraine in the past 12 months. Participants who were employed ($N = 215$) reported 15.5% absenteeism, 45.3% presenteeism, 53.8% overall work impairment, and 52.6% activity impairment. The mean annualized indirect cost was estimated to be €14,368. The annual indirect cost burden was estimated to be €7.6 billion for the employed Italian population with ≥4 MMDs. The impact of migraine was particularly high among the ≥2 TF subgroups on all parameters. The indirect cost was estimated to be €15,881 (€5,007 attributed to absenteeism).

Conclusion: Migraine-related HRU and indirect costs are high among individuals with ≥4 MMDs (particularly those with ≥2 TF). There is a need for more effective treatments and better management of migraines to reduce the functional and economic burden among this difficult-to-treat population.

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Introduction

Migraine is a debilitating neurological disorder that affects approximately 10% of the adult population globally[1]. It is the second leading cause of disability and accounts for 5.6% of all years lived with disability (YLDs) worldwide[2,3]. Migraine imposes an immense societal burden and is a leading cause of YLDs in the age group of 15–49 years—the most productive years of an individual's personal, social, and professional development[2]. In Italy, the estimated prevalence of migraine ranges from 11.6% (point prevalence)[4] to 13.7% (one-year prevalence)[5], and is the second leading cause of YLDs[3].

Migraine has been found to cause a large economic impact owing to the direct and indirect expenses associated with it[6–15]. While direct costs include resource use and the expenditures incurred for medically managing the disease, indirect costs include losses (e.g. income, productivity, caregiver's time etc.) and any additional expenditures that would otherwise not be incurred (child care, home care etc.). In Europe, the annual cost associated with migraine ranged from €18 to €27 billion in 2010[9,16]. Italy-specific cost estimates are limited. In 2010, a nationwide cross-sectional study (The Eurolight study) estimated an overall, per-patient annual cost of €1034 (inclusive of direct and indirect costs)[10]. More recently, a tertiary headache center-based study estimated that the direct, per-patient annual cost of treating migraine was €1482[14]. In terms of chronicity, the direct cost because of chronic migraine (CM) ranges from €2037 to €2648[13,14,17], and that of episodic migraine (EM), from €427 to €828[13,14,17]. While these costs may vary owing to differences in study designs, sample sizes, and costing time periods, these studies suggest that substantial costs are incurred because of migraine in Europe, including Italy. Recent studies have suggested that higher proportions of persons with migraines

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make visits to a healthcare provider (HCP) or an emergency room (ER) compared with those without migraine[6,17,18], and accrue 2 – 3 times more HCP and ER visits and hospitalizations[17,18].

Finally, migraine results in a substantial loss of productive time and incurs additional related costs. Moreover, people with migraines have significantly higher absenteeism (absence from work) and presenteeism (present at work while sick, therefore with reduced productivity) than their matched healthy controls[6,19]. In Europe, working individuals with migraines are estimated to lose between 27.6 days[20] and 28.8 days[18] annually to migraine. Furthermore, between 70% and 93%[7,9,10,21] of all migraine-associated costs in Europe are indirect, with lost productivity being the largest cost driver[7,10,21].

Despite evidence consistently suggesting higher cost because of lost productivity[7,10,11,22–26], only a few studies have been conducted to explore this aspect in Europe[7,10], especially in Italy[15]. Furthermore, higher migraine frequency is associated with an increased economic burden[17,18] and is also a predictor of lost productive time[27,28]. The preventive treatment paradigm of migraine involves repurposed drugs as the first choice of therapy and the novel, migraine-specific preventive treatment (Calcitonin gene-related peptide inhibitors) is recommended only among those with ≥4 monthly migraine days (MMDs) who have already failed ≥2 prior preventive treatments[29,30]. Yet, real-world economic burden in this subgroup remains largely unexplored in Italy, leaving scope for research. Our study used data from the Italian cohort of the *My Migraine Voice* survey and evaluated the healthcare resource use (HRU), work impairment, and cost of lost productivity in participants with ≥4 MMDs, with a focus on those who failed prior preventive treatment.

Methods

Study design and participants

My Migraine Voice was a large cross-sectional study spanning 31 countries globally, including Italy[18]. For the Italian study, participants were enrolled between September 2017 and February 2018. The participants were all adults with self-reported migraine, who were screened for eligibility using a series of questions based on the International Classification of Headache Disorders, third edition (ICHD III) criteria[31]. Furthermore, participants who experienced at least ≥4 MMDs in the preceding 3 months were considered eligible for the survey. Finally, the second set of screener criteria, with predetermined quotas, were applied to participants reporting a history of preventive medication use (Figure 1) to create subsets of participants who had taken and failed prior preventive treatments. Moreover, participants who reported changing their preventive medication for any reason, at least once, were defined as having had a preventive treatment failure (TF).

Participants were recruited through patients' and consumers' panels in GFK's (now Ipsos Healthcare) network and *via* patients' support groups, where available. All participants provided consent before their participation in the survey and received compensation in the form of vouchers upon completing the survey. They were able to respond to the questionnaire in their local language. Data confidentiality and participant anonymity were maintained throughout the study. A detailed description of the MMV survey's methodology has been published elsewhere[18].

Demographics and migraine characteristics

Survey participants provided data on their sociodemographic characteristics, such as age, sex, employment status, family status (whether single, married/partnered, divorced/separated, and if they had children), and disability support. In addition, they were asked to provide details of their medical history, including MMDs, time since migraine diagnosis, coexisting conditions and treatments taken to manage migraine. Recall periods of questions varied from 3 and 6 months to 12 months and no time limit, depending on the nature of the question.

Outcomes assessed

Healthcare resource use

Data on HRU included visits to general practitioners (GPs), neurologists, headache specialists, and pharmacists in the 6

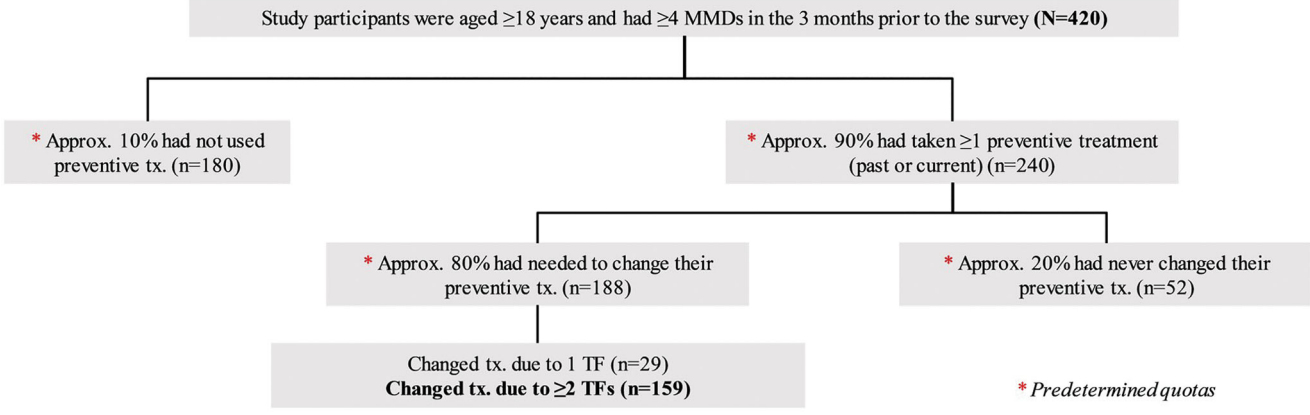

Figure 1. Inclusion and screener criteria for study participants. Abbreviations. tx, treatment; MMDs, monthly migraine days.

months preceding the survey, and ER and hospital admissions in the 12 months preceding the survey. All questions related to HRU were migraine-specific and began with "In relation to your migraine….". Participants were asked to provide information on any investigative procedures, such as brain scans (e.g. magnetic resonance imaging and computed tomography scans), performed for their migraine. In addition to the overall cohort, HRU was separately assessed for those with ≥2 TF. HRU questions had either 6-month, 12-month or no time-limit recall periods, depending on the kind of resource used.

Impact on work productivity

All participants were asked questions regarding their professional lives, including their employment status and how migraine affected their professional lives. In addition, the validated Work Productivity and Activity Impairment Questionnaire (WPAI)[32] adapted for migraine (WPAI:Migraine), was used to evaluate the impact of migraine on work productivity and daily activity. Since its questions are not disease or occupation-specific, the instrument can be adapted and generalized across different diseases and occupations with ease[33]. Thus, the WPAI is a recommended instrument for use in assessing migraine-specific productivity losses at workplace[34,35].

WPAI:Migraine outcomes are expressed as impairment percentages, with higher numbers indicating greater impairment and less productivity, that is, worse outcomes. The 6-item questionnaire measures work absenteeism (reduction in working time), presenteeism (reduction in productivity while working), overall work impairment (absenteeism + presenteeism), and daily activity impairment during the past 7 days[32]. The instrument covers questions on current employment status (Q1), number of hours missed because of migraine (Q2), number of hours missed owing to other reasons (Q3), number of hours actually worked (Q4), and the degree to which migraine affected productivity while working (Q5) and regular/non-work activities (Q6). Q5 and Q6 are evaluated using a numeric rating scale (from 0 = no effect to 10 = migraine completely prevented me from working/doing my daily activities).

Only study participants who reported being employed responded to this questionnaire ($n = 243$). After excluding participants with missing or inconsistent data ($n = 28$), 215 employed participants were included in the analysis.

Cost of lost productivity due to migraine

The cost of lost productivity due to migraine was estimated using the Human Capital Approach (HCA) that estimates lost productivity as the expected or potential earnings lost due to a disease or disorder, where 1 hour of lost productivity is valued as 1 hour of an individual's compensation[36]. Using individual patient data, the percentage overall work impairment score was multiplied by employee compensation to calculate the total cost of lost productivity. Similarly, percentage absenteeism and presenteeism were multiplied by daily employee compensation (at risk) to calculate the cost of absenteeism and presenteeism. These costs were then annualized assuming 230 working days (46 working weeks).

The latest gender-specific daily wage rates for Italy (men: €126.8, women: €119.0; the year 2014) were used for the estimation of absenteeism. These were calculated based on hourly wage rates sourced from the International Labour Organization's (ILO) database, assuming eight working hours per day[37]. For presenteeism, the absenteeism cost was subtracted from total daily compensation to calculate the remaining daily compensation at risk (i.e. total daily compensation – [% absenteeism X total daily compensation]). It may be noted that the cost associated with presenteeism was not taken as a fraction of total hours lost. This is because the WPAI directly evaluates the degree of impairment with which the productivity is affected while working by using a numeric rating scale, with a rating of 10 implying "migraine completely prevented me from working". Finally, the population size of employees with ≥4 MMDs in Italy was estimated based on published estimates provided in Table 1 and was multiplied by the mean cost to estimate the total indirect cost for the Italian population.

Data analyses

Patient and disease characteristics and HRU were analyzed descriptively. Continuous measures were summarized as means and standard deviations, and categorical measures were summarized as counts and percentages. The HRU data were analyzed using the IBM Statistics 24 and the SPSS software. The cost of lost productivity was estimated using descriptive statistics in Microsoft Excel.

Results

Demographics and migraine characteristics

This study included 420 participants, with a mean age of 38.5 years. Overall, 81.2% of participants were women, and 57.9% were employed at the time of the survey. Most participants were married or had a partner, and 58.1% had children. Notably, 45.5% of participants reported a family history of migraine.

Most of the study participants (84.1%) had a confirmed medical diagnosis of migraine. The study cohort included individuals who had migraine ranging from less than a year to over 20 years. Almost half of the participants had eight or more migraine days per month, and on average, participants had migraine for 9 days per month during the 3 months preceding the survey. At the time of the survey, 57.1% of the participants were using preventive medication for migraine. Furthermore, insomnia, anxiety, chronic back pain, and obesity were the most prevalent coexisting conditions.

≥2 Treatment failures subgroup

Approximately 38% of the participants ($n = 159$) had failed at least two or more prior preventive treatments (≥2 TF subgroup). The demographic profile of this subgroup was similar to that of the overall cohort. However, this subgroup

Table 1. Estimates used for assessing the cost of lost productivity in Italy.

Part 1: Selection of participants for the WPAI analysis	
All participants with ≥4 MMDs[#], *N*	420
Participants who responded to the questionnaire (i.e. those who were employed), *n*	243
Participants excluded from the analysis	28
Participants with missing data[*]	*21*
Participants with inconsistent data[**]	*6*
Outlier[***]	*1*
Employed participants included in the analysis	**215**
Part 2: Estimation of adult employed individuals with migraine (≥4 MMDs) in Italy	
Italy's population (aged 18–67 years)[38]	39,289,119
Prevalence of migraine in Italy, *n* (%)[4]	4,557,538 (11.6%)
Rate of migraine diagnosis, *n* (%)[39]	1,781,997 (39.1%)
Migraine participants with ≥4 MHDs, *n* (%)$[40]	843,954 (47.4%)
Employment rate in Italy, *n* (%)[41]	525,783 (62.3%)
Total estimated employees with migraine in Italy	**525,783**

[#]Based on participants' self-reported data.
[*]Data for Q4 (number of hours worked) were missing for 21 participants and the exact number of hours at risk could not be calculated for these patients.
[**]Six participants incorrectly reported the degree of impairment while working, even if they reported a number of hours worked as "zero" (of which two participants reported 100% absenteeism owing to migraine).
[***]One participant was excluded because they reported >168 hours lost, which is not feasible.
[$]The estimated prevalence of migraine in Italy, taken from the NHWS, is based on MHDs, which includes MMDs.
Abbreviations. MHD, monthly headache days; MMD, monthly migraine days; NHWS, national health and wellness survey; WPAI, Work Productivity and Activity Impairment questionnaire.

Table 2. Demographic and disease characteristics of the Italian cohort of the *My Migraine Voice* survey population.

Variables	All participants (*N* = 420)	≥2 TF subgroup (*n* = 159)
Female, *n*	341 (81.2%)	129 (81.1%)
Age, mean (years)	38.5	40.6
Currently employed, *n*	243 (57.9%)	93 (58.5%)
Full time	138 (32.9%)	53 (33.3%)
Part time	64 (15.2%)	22 (13.8%)
Self-employed	41 (9.8%)	18 (11.3%)
Having a family history of migraine, *n* (%)	189 (45.0%)	82 (51.6%)
Having children, *n* (%)	244 (58.1%)	97 (61.0%)
Receiving disability allowance for migraine, *n* (%)	17 (4.0%)	13 (8.2%)
Medical diagnosis of migraine, *n* (%)	353 (84.1%)	151 (95.0%)
MMDs (in preceding 3 months), mean (SD)	9.0 (4.6)	10.4 (4.9)
Participants by MMDs, %		
4–7 MMDs	219 (52.1%)	61 (38.4%)
≥8 MMDs	201 (47.9%)	98 (61.6%)
Time affected by migraine, *n* (%)		
<1 year	20 (4.8%)	4 (2.5%)
1–5 years	110 (26.2%)	27 (17.0%)
6–10 years	85 (20.2%)	36 (22.6%)
11–15 years	52 (12.4%)	22 (13.8%)
16–20 years	55 (13.1%)	23 (14.5%)
≥21 years	98 (23.3%)	47 (29. 6%)
On preventive treatment for migraine at time of survey, *n* (%)	240 (57.1%)	159 (100%)
Most prevalent coexisting conditions, *n* (%)		
Insomnia/sleep disorder	106 (25.2%)	59 (37.1%)
Anxiety	106 (25.2%)	49 (30.8%)
Chronic back pain	85 (20.2%)	40 (25.1%)
Obesity/overweight	85 (20.2%)	40 (25.1%)
Allergies	72 (17.1%)	32 (20.1%)

Abbreviations. MMD, monthly migraine days; SD, standard deviation; TF, treatment failure.

consisted of slightly older participants, most of whom were employed and had children. Approximately 8% of the participants in this subgroup had been on disability support owing to migraine. Ninety-five percent of the participants with ≥2 TFs had a medical diagnosis of migraine and over half of them (61.6%) experienced migraine for eight or more days per month. All of them reported being on preventive medication at the time of the survey (Table 2).

Healthcare resource use

Overall sample

During the 6 months before the survey, approximately 60% of the participants visited a GP, 31.9% visited a neurologist, 26.4% visited a headache specialist, and 20.2% visited a pharmacist at least once for migraine. Among participants with at least one migraine-related visit to the respective HCPs, the mean number of visits to GPs, neurologists, and headache specialists during the preceding 6 months were

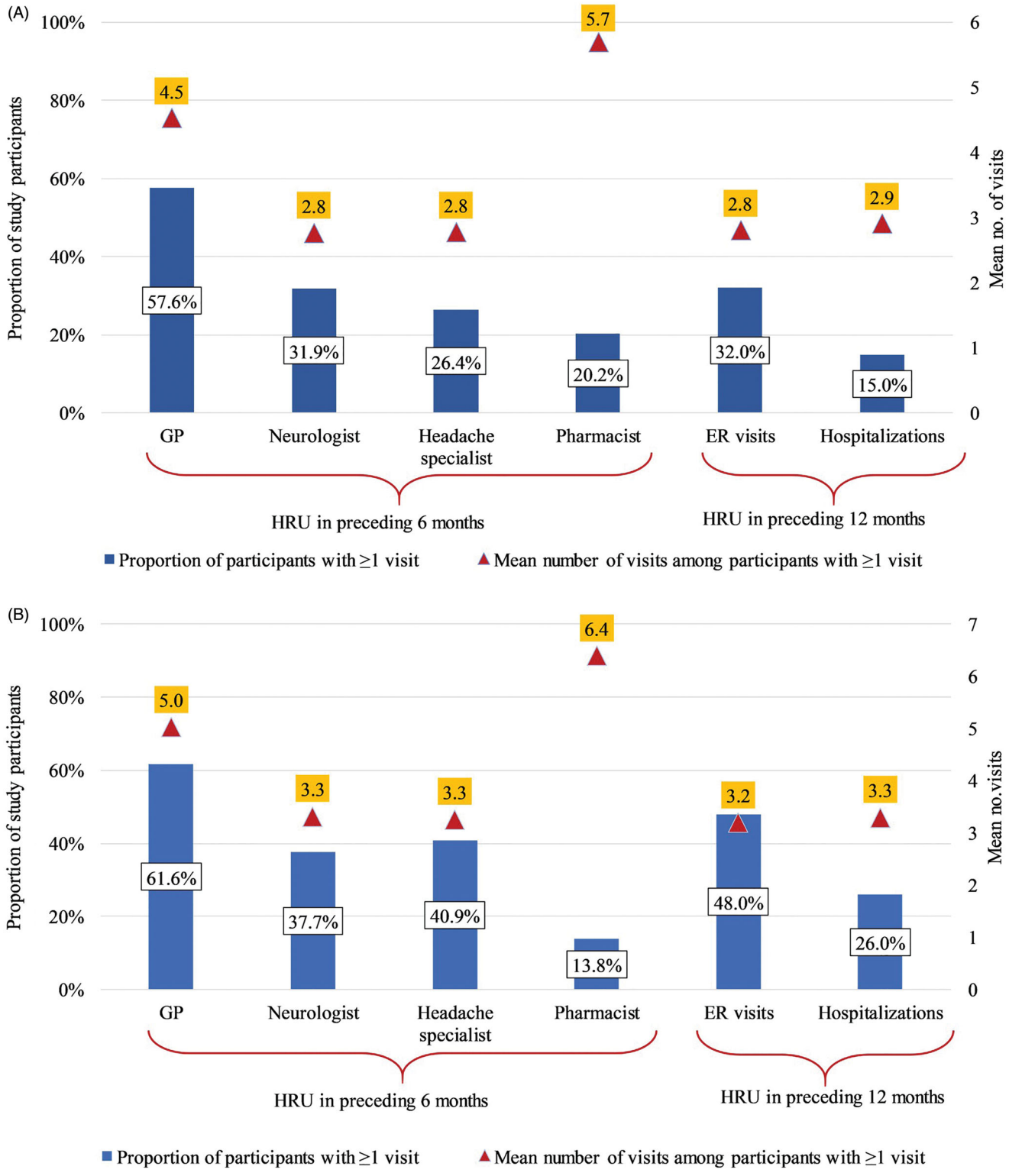

Figure 2. (A) Healthcare resource use among study participants ($N = 420$). (B) Healthcare resource use ≥2 TF subgroup (159). Abbreviations. ER, emergency room; GP, general practitioner; HRU, healthcare resource use; TF, treatment failure.

4.5, 2.8, and 2.8, respectively. Notably, visits to the pharmacist accounted for the largest number of visits made to any HCP (5.7 visits). During the preceding 1 year, 32.0% of participants had at least one migraine-related ER visit and approximately one-sixth (15%) were hospitalized at least once because of migraine. On average, there were approximately 2.8 migraine-related ER visits and 2.9 hospitalizations among these participants (Figure 2(A)).

In terms of medical tests, the resource use of brain scans was high. On average, participants received a mean number

of three brain scans in their lifetime pertaining to their migraine. Approximately 64% of the overall cohort had undergone at least one brain scan.

≥2 Treatment failures subgroup

Approximately 40% of participants in this subgroup had at least one migraine-related visit to a specialist during the preceding 6 months (Figure 2(B)). On average, the subgroup made five visits to GPs, 3.3 visits to neurologists and 3.3 visits to headache specialists. Furthermore, almost half of the participants (48%) made at least one migraine-related ER visit and 26% were hospitalized due to migraine during the preceding 1 year.

Impact on professional life and work productivity

Overall sample

Most participants (68%) reported that migraine had negatively affected their professional lives. Among participants whose employers were aware of their illness, 26.7% reported receiving support from them. In the preceding month, participants had lost an average of 5.3 days of work, of which 2.8 days were availed as paid sick leave.

Work impairment owing to migraine was high among survey participants who were employed ($n = 215$). On average, participants had lost 15.5% of work time because of absenteeism and 45.3% due to presenteeism. This resulted in 53.8% of time lost to overall work impairment (includes absenteeism and presenteeism). In addition, 52.6% of time was lost to impairment in daily activities. The migraine-related mean cost of lost productivity was €14,368 per year. Approximately 70% of these costs were due to presenteeism (Figure 3(A)). When extrapolated to the employed Italian population with ≥4 MMDs, the annualized cost of lost productivity was estimated to be €7.6 billion.

≥2 Treatment failures subgroup

A substantial impact of migraine was observed in participants with ≥2 TFs, with eight out of 10 participants reporting that migraine had negatively affected their professional lives. In the preceding month alone, they had lost an average of 6.5 days from work, including 3.6 days of paid sick leave.

The migraine-related mean cost of lost productivity was €15,881 per year among participants with ≥2 TFs ($n = 84$), the majority of which (€10,874) was owing to presenteeism (Figure 3(B)).

Discussion

The HRU, work impairment, and cost of lost productivity were found to be high among the study participants, with presenteeism being the major cost driver. These measures were particularly high among the ≥2 TF subgroup, suggesting that treatment failure among individuals with migraine might increase the overall disease burden.

In terms of HRU, the mean number of visits to pharmacists was the highest among all HCPs in our study. This finding is similar to results from the Italian sample of the International Burden of Migraine Study (IBMS), where pharmacy visits were found to be a major cost driver[17]. This finding was probably because, in Italy, a vast majority of drugs are only dispensed *via* retail pharmacies[42]. In addition, our study participants had a high migraine attack frequency (≥4 MMDs), presumably making them more likely to try more medications than those with lower migraine frequency[43], leading to a higher number of visits to pharmacists.

Although several studies have explored the productivity loss and its cost-value, the estimates vary widely owing to differences in study methods, particularly costing time periods, wage rates, components of productivity loss, and the methods adopted to collect productivity loss data[7,10,11,15,21–26,44–48]. Despite these variations, presenteeism was noted to be the largest contributor of productive time loss[11,15,22,23] and the single largest driver of these costs associated with lost productivity[7,10,21,24–26]. Our study indicates that 74% of the cost of lost productivity is attributed to presenteeism, which is similar to the results of these studies.

To our knowledge, there is only one other study that has estimated the cost of lost productivity using an Italian sample of people with migraine[15]. Similar to our study, Nica et al. used a cross-sectional study design and the HCA for cost estimation. However, our cost estimates were comparatively higher, possibly due to major differences in the methodologies of the two studies. We used the WPAI:Migraine questionnaire in our study for evaluating the productive time lost, whereas Nica *et al.* used a set of questions to elicit responses from respondents on the number of days lost due to migraine. The WPAI:Migraine provides an output for absenteeism and presenteeism separately and limited our sample to those participants who were employed at the time of the survey. Although both studies used Italy's gender-specific wage rates for cost estimation, Nica et al. additionally used employment class-specific wage rates. Despite these differences, results of both studies indicated that time lost to presenteeism was over twice the time lost to absenteeism.

Our study is unique because it estimated the cost of lost productivity among individuals with migraine who also had TF. While presenteeism was the major contributor of lost productivity and associated cost, absenteeism among those with ≥2 TFs was particularly high too. Because absenteeism may cause direct pay cuts for working individuals, particularly those who are self-employed, it would substantially increase the existing burden of individuals with migraine falling in this category.

Our study had some inherent limitations because of its cross-sectional design. It comprised individuals with ≥4 MMDs who had access to the internet. A recruitment bias might have affected the estimates owing to the presence of differences between the survey participants and the overall population with migraine. Moreover, because the study relied on self-reported data, recall and response biases are possible and difficult to account for. However, to minimize

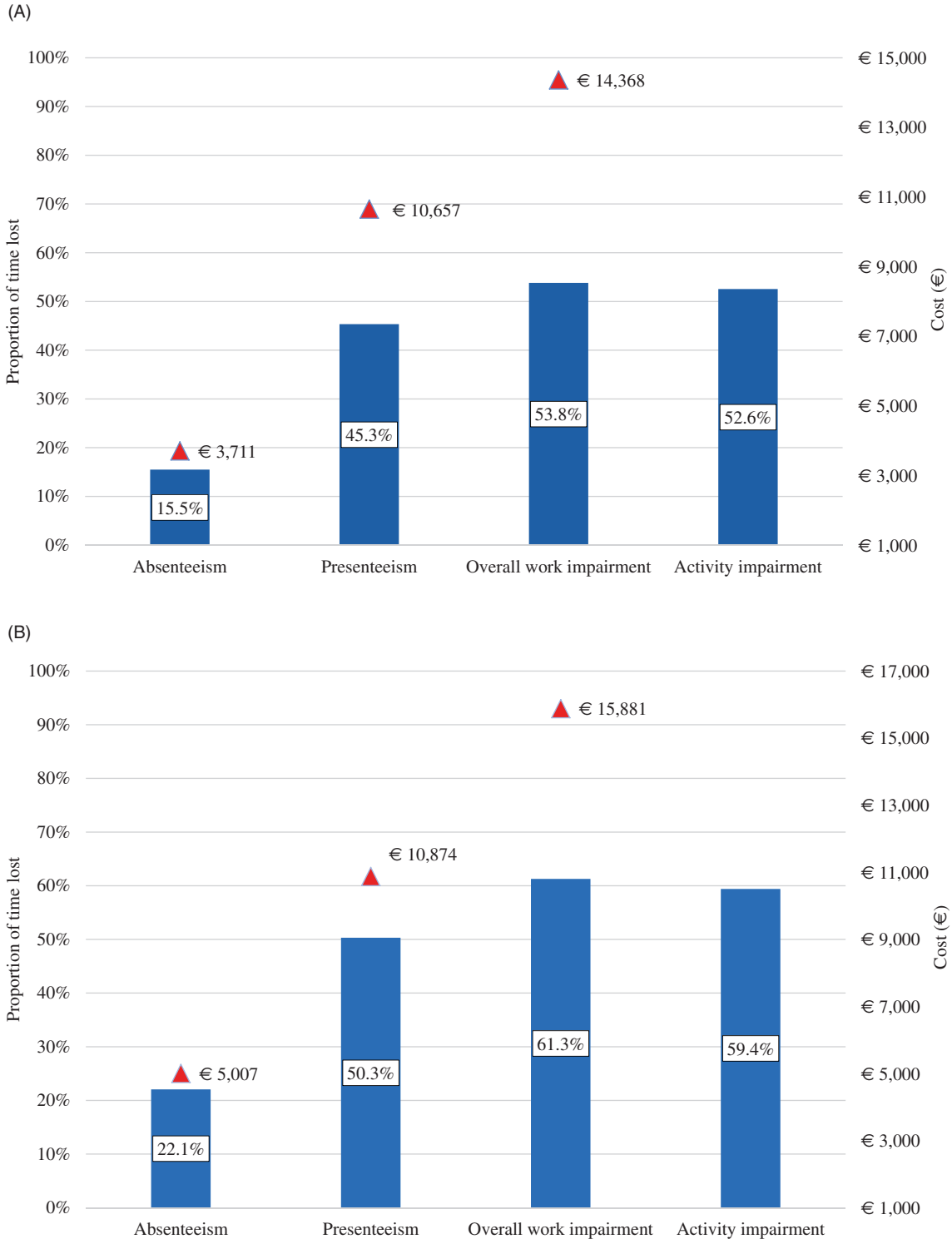

Figure 3. (A) Work productivity and activity impairment and associated costs among study participants ($n = 215$). The WPAI instrument was administered to 215 participants who were employed at the time of the survey. (B) Work productivity and activity impairment, and associated costs among the ≥2 TF subgroup of participants ($n = 84$). The WPAI instrument was administered to 84 participants who were employed at the time of the survey. Abbreviation. TF: treatment failure.

recall bias, while at the same time allow for a more longitudinal information, the survey included 3-month, 6-month, 12-month and no time-specific recall periods depending on the nature of the question.

Our study had a focus on individuals with ≥2 TF. While we provided a descriptive analysis, the sample size presented a challenge in comparing this subgroup to those with ≤2 TF. The 261 participants who did not fall in the ≥2 TF subgroup included 180 who reported never using preventive treatment, 29 who failed one preventive treatment and 52 who never failed preventive treatment. It would be inappropriate to group these for comparison to the ≥2 TF subgroups and unfeasible to compare them individually. There may also be limitations associated with the estimation of costs. The method used to estimate the cost of lost productivity (HCA) has been criticized for overestimating productivity losses and associated costs

because it considers the patient's perspective and assumes that every hour not worked is an hour lost, until the person's retirement[49]. The WPAI:Migraine outcomes were calculated only for participants who were working at the time of the survey ($N = 215$), which led to the exclusion of participants ($n = 2$) who had missed all work because of migraine. This, in turn, may have caused a slight underestimation of the impact of migraine on absenteeism and a conservative estimate of the associated cost. To estimate the cost of lost productivity, we extrapolated data of 7 days to 1 year, assuming all participants would experience the same impact of migraine throughout the year. This extrapolation could have resulted in slight over-or underestimation of the impact of migraine in terms of cost. On one hand, this assumption could be true for participants with CM because the impact on their work is likely to be consistently high throughout the year owing to the chronicity of migraine. On the other hand, there is also the possibility of some participants not reporting any impact of migraine on their work productivity. Finally, we estimated the total cost of lost productivity based on the total number of diagnosed migraine cases in Italy. However, there may be cases with undiagnosed migraine, which could potentially result in additional disease-related burden and lead to a relatively higher estimate for the cost of lost productivity.

Despite the above limitations, the gender and age proportions of our study participants were similar to those of participants from other large cross-sectional studies across the world[50,51], suggesting that our study cohort was representative of the migraine population worldwide.

This study is among the few studies to have estimated the cost of lost productivity among Italian participants with $\geq$4 MMDs. Moreover, it quantified the HRU and impact on work productivity among individuals with migraine who have failed two or more prior preventive treatments. These participants may be considered difficult-to-treat because they have already exhausted the first- or second-line therapies under the country's standard of care. Hence, this study provides valuable data that are relevant for healthcare providers, payers, and health policy decision-makers.

Conclusions

The results of this study indicate that in Italy, the HRU, impact on professional lives, and work productivity loss and associated costs are high among individuals with a high migraine frequency ($\geq$4 MMDs). In addition, these aspects can be even higher among those with a history of preventive TFs, suggesting that the impact is even greater on difficult-to-treat participants with high migraine frequency. Therefore, further investigation of the economic burden of migraine in this subgroup is essential in enabling the healthcare providers and policymakers to make well-informed decisions about appropriate preventive migraine care.

Transparency

Declaration of funding

This study was funded by Novartis Pharma AG, Basel, Switzerland.

Declaration of financial/other interests

PM has served on the advisory boards of Allergan/Abbvie, Lilly, Novartis, TEVA and Lundbeck, and received speaking honoraria from them. He received royalties from Springer Switzerland and Springer Nature and served as Editor-in-Chief for both, the Journal of Headache and Pain and Springer Nature Comprehensive Clinical Medicine. He served as a European Medicine Agency expert. He is the Immediate Past-President of the European Headache Federation.

Within the prior 24 months, TS has received compensation for serving as a consultant or on an advisory board from Alder, Allergan, Amgen, Biohaven, Click Therapeutics, Eli Lilly, Equinox, Lundbeck, Novartis, Weber and Weber, and XoC. He has received research support from the American Migraine Foundation, Amgen, Henry Jackson Foundation, National Institutes of Health, Patient-Centered Outcomes Research Institute, and the United States Department of Defense. He has received royalties from UpToDate. He holds stock options in Aural Analytics and Nocira.

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Author contributions

All authors contributed to the study concept and design; collection, analysis, and interpretation of data; and were actively involved in the development, review, and final approval of the manuscript. All authors agree to be accountable for all aspects of the work.

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Availability of data and materials

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