Trends in use of acupuncture among adults in Taiwan from 2002 to 2011: A nationwide population-based study

Mei-Yao Wu¹, Yu-Chen Lee¹,², Cheng-Li Lin³, Ming-Cheng Huang¹,⁴, Mao-Feng Sun¹,⁴, Hung-Rong Yen¹,⁴,⁵,⁶,⁷,⁸*

¹ Department of Chinese Medicine, China Medical University Hospital, Taichung, Taiwan, ² Graduate Institute of Acupuncture Science, College of Chinese Medicine, China Medical University, Taichung, Taiwan, ³ Management Office for Health Data, China Medical University Hospital, Taichung, Taiwan, ⁴ Graduate Institute of Chinese Medicine, School of Chinese Medicine, College of Chinese Medicine, China Medical University, Taichung, Taiwan, ⁵ Research Center for Traditional Chinese Medicine, Department of Medical Research, China Medical University Hospital, Taichung, Taiwan, ⁶ Research Center for Chinese Herbal Medicine, China Medical University, Taichung, Taiwan, ⁷ Department of Biotechnology, Asia University, Taichung, Taiwan, ⁸ Chinese Medicine Research Center, China Medical University, Taichung, Taiwan

* hungrongyen@gmail.com

Abstract

In recent years, acupuncture has gained in popularity worldwide. However, recent epidemiological studies are lacking. We conducted this study to investigate the trends in acupuncture utilization among adults in Taiwan from 2002 to 2011. We analyzed data from the Longitudinal Health Insurance Database 2000 (LHID 2000), which contains all original claims data for 1 million beneficiaries randomly sampled from the registry of all beneficiaries enrolled in the National Health Insurance (NHI) program in 2000. The one-year prevalence of acupuncture use among adults increased from 7.98% in 2002 to 10.9% in 2011. Acupuncture use significantly increased yearly (incidence rate ratio = 1.04, 95% CI = 1.03–1.05, p < 0.001). Patients who were female, were middle-aged, resided in highly urbanized areas and suffered from injury or disorders of the musculoskeletal system were prone to more frequent acupuncture use. Our study revealed that the utilization of acupuncture became increasingly popular in Taiwan from 2002 to 2011. Our findings may provide useful information for clinical practice and research as well as for health policy decision making.

Introduction

An increasing number of patients worldwide have become interested in complementary and alternative medicine (CAM) in recent years [1]. Of the different types of CAM, traditional Chinese medicine (TCM) has been well defined as an ancient medical system by the National Center for Complementary and Integrative Health (NCCIH, U.S.A.) [2]. The trends in TCM utilization have also increased gradually in Taiwan, and more than 28% of Taiwanese consulted a TCM service in 2010 [3].

Acupuncture, one of the treatment approaches in TCM, has been widely used in Asian [4–6] and Western countries [7–10]. It has been included in the clinical practice guidelines for the treatment of pain-related diseases [11, 12]. For example, the American College of Physicians

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and the American Pain Society recommended acupuncture as a non-pharmacological treatment method for low back pain [13]. Acupuncture has been practiced not only in local clinics but also in most teaching hospitals and medical centers in Taiwan [5]. In a previous Taiwanese study, more than 6% of subjects had received acupuncture in 2002 [5].

The National Health Insurance (NHI) program was established in 1995 in Taiwan, and more than 99% of the population were enrolled in the NHI program by the end of 2010 [3]. The NHI program covers not only Western medical services but also ambulatory care in TCM. All claims data from the NHI program are collected in the National Health Insurance Research Database (NHIRD), and researchers can use these datasets to evaluate the utilization of TCM for various diseases such as allergies [14, 15], musculoskeletal diseases [16–18], metabolic disorders [19, 20], gynecologic diseases [21], pediatric diseases [2], geriatric disorders [22] and cancer [23, 24]. De-identified demographic characteristics (e.g., sex, date of birth, occupation and place of residence) and clinical information (e.g., diagnosis, management and treatment) are also provided in the database. This nationwide database is highly reliable, which reduces the potential for sampling bias [25].

To date, only a few studies have addressed questions about the trends in utilization of acupuncture. Some studies have only reported acupuncture usage in specific diseases [26], whereas others were conducted decades ago. For example, a previous study described the demographics and patterns of acupuncture use in Taiwan from 1996 to 2002 [5]. To understand the trends in acupuncture use in Taiwan, we conducted this nationwide population-based study to investigate the utilization of acupuncture from 2002 to 2011.

Materials and methods

Data source
We accessed the Longitudinal Health Insurance Database 2000 (LHID2000) from the National Health Research Institutes, Taiwan. The LHID2000 contains all of the original claims data for 1 million beneficiaries who were randomly sampled from the registry of all beneficiaries enrolled in the NHI program in 2000, and these randomly sampled 1 million individuals were followed longitudinally through 2011 according to their personal identification numbers. The included individuals were removed from the cohort until death or withdrawal from the NHI program. The beneficiary characteristics, including age, geographic region, and place of residence, are updated each year. De-identified demographic data on sex, date of birth, residence and occupation as well as medical records of clinical visits, hospitalizations, diagnosis codes and treatment codes were all included in the datasets.

Study samples
We analyzed adult acupuncture users by the treatment codes, which included manual acupuncture (B41, B42, B80-B84, B90-B94, P27041, P31103, P32103 and P33031), electroacupuncture (B43, B44, B86-89 and P33032) and complex acupuncture (B45 and B46). The NHI defines “complex acupuncture” as acupuncture treatment for patients with specific disorders, such as cerebral vascular disease, spinal cord injury, cancer and psychiatric disorders, which require more effort to treat. The diagnosis codes in the LHID2000 were consistent with the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) [27].

Study variables
Sex, age, level of urbanization and geographic region were chosen as independent variables to explore their effects on acupuncture utilization. Of the 1 million beneficiaries, adults older
than 20 years were included in this study. Acupuncture users were categorized into 7 sub-
groups according to age: 20 to 29, 30 to 39, 40 to 49, 50 to 59, 60 to 69, 70 to 79 and ≥80 years
old. There were 6 geographic regions assessed, including Taipei and the Northern, Central,
Southern, Kao-Ping and Eastern regions of Taiwan. Residence areas were grouped into 4 levels
of urbanization based on population density (people/km$^2$), the ratio of elderly persons, the
ratio of people with different educational levels, the ratio of agricultural workers and the num-
ber of physicians per 100,000 persons [28]. The highest degree of urbanization was level 1, and
the lowest was level 4.

Statistical analysis
The demographic characteristics and medical record data were analyzed by SAS statistical soft-
ware (version 9.4 for Windows; SAS Institute, Inc., Cary, NC, USA). The data analysis com-
prised descriptive statistics of the demographic characteristics of acupuncture users. The
percentage of acupuncture users by different demographic factors was calculated as the num-
ber of acupuncture users dividing by the sampled enrollees by different demographic factors.
Logistic regression analysis was used to investigate the change in the utilization rate of acu-
puncture over time. Generalized estimating equation (GEE) method was used to determine
the statistically significant of the trend of acupuncture usage in the follow-up period.

Ethical consideration
All names and identification numbers of enrollees and names of medical facilities included in
the NHIRD dataset for this study were encrypted using a random alphanumeric series to protect
the privacy of the subjects and adhere to ethical considerations. None of the research members
could identify any enrollee or facility from the dataset (https://nhird.nhri.org.tw/en/). This
study was approved by the Research Ethics Committee of China Medical University and Hospi-
tal (CMUH104-REC2-115) and the National Health Research Institutes, which maintain and
manage the NHI database.

Results
Adults older than 20 years who were included in the 1 million beneficiaries of the LHID2000
dataset were included in this study. The valid beneficiaries were 677,7542 in 2002 and 732,466
in 2011 (Table 1). The proportion of acupuncture users increased significantly from 7.98% in
2002 to 10.9% in 2011. The analysis of generalized estimating equation revealed that acupunc-
ture use increased significantly with year (incidence rate ratio = 1.04, 95% CI = 1.03–1.05,
p<0.0001, data not shown). The number of total acupuncture visits in one year increased from
132,522 in 2002 to 176,538 in 2011. There was no significant difference in the average visit
times of acupuncture users from 2.45 in 2002 to 2.22 in 2011.

Our data revealed that female acupuncture users increased from 8.96% in 2002 to 12.0% in
2011, where male acupuncture users increased from 7.02% in 2002 to 9.66% in 2011. The per-
centages of acupuncture users in female to those in male in every year ranged from 1.24:1 to
1.31:1 between 2002 and 2011. Residents in low urbanization areas (level 4) were less likely to
receive acupuncture. Acupuncture users of different urbanized residences all increased from
2002 to 2011.

The highest percentage of acupuncture users were in the 50–59 y/o age group (9.69%), fol-
lowed by the 40–49 y/o and 60–69 y/o groups (Table 2). In the old age group, including
patients more than 80 y/o, the proportion of acupuncture users was only 4.9%. However, these
patients had a higher average number of visits than the other groups.
More patients received acupuncture in TCM clinics than in hospitals (Table 3). There were 6 regional divisions considered, including Taipei and the Northern, Central, Southern, Kaoping, and Eastern divisions. The percentages of acupuncture users were highest in the Central branch bureau and lowest in the Southern branch bureau.

Table 4 provides the different disease categories as reasons for receiving acupuncture treatment by different age groups. The top two disease categories leading to acupuncture visits were injury (50.6%) and diseases of the musculoskeletal system and connective tissue (41.8%). Patients suffering from stroke, including cerebral infarction and intracerebral hemorrhage, were the largest population among those receiving complex acupuncture (Table 5).

**Discussion**

Our study revealed that the one-year prevalence of acupuncture use in Taiwan increased from 7.98% in 2002 to 10.9% in 2011, with the yearly incidence rate ratio of 1.04. Women had a higher acupuncture utilization rate than men, and middle-aged groups were the most likely to receive acupuncture. Of the six regions, the percentage of one-year acupuncture users was highest in Central branch bureau. Injury and diseases of the musculoskeletal system and connective tissue were the major reason that patients received acupuncture. Patients suffering from stroke represented the largest proportion of those receiving complex acupuncture.

**Table 1. Number of patients and visits among acupuncture users from 2002–2011 in Taiwan.**

| Year | Valid beneficiaries | Acupuncture users |
|------|---------------------|-------------------|
|      | Total number (%)    | Female (%)        | Male (%)         | Urbanization |
|      |                     |                   |                  | Level 1 | Level 2 | Level 3 | Level 4 | New subjects (%) | Total visits |
| 2002 | 677752              | 54106 (7.98)      | 30136 (8.96)     | 23970 (7.02) | 18535 (8.92) | 15830 (7.97) | 9893 (7.98) | 9848 (6.68) | 35944 (66.4) | 132522       |
| 2003 | 683220              | 55967 (8.19)      | 31256 (9.20)     | 24711 (7.19) | 18928 (9.03) | 16527 (8.24) | 10321 (8.26) | 10191 (6.88) | 30334 (54.2) | 142635       |
| 2004 | 688815              | 58120 (8.44)      | 32866 (9.59)     | 25254 (7.30) | 19315 (9.14) | 17319 (8.55) | 10765 (8.55) | 10721 (7.19) | 27388 (47.1) | 139478       |
| 2005 | 697144              | 55768 (8.00)      | 31296 (9.01)     | 24472 (7.00) | 18373 (8.60) | 16624 (8.10) | 10378 (8.13) | 10393 (6.90) | 22450 (40.3) | 131372       |
| 2006 | 703958              | 55069 (7.82)      | 30839 (8.78)     | 24230 (6.87) | 18664 (8.65) | 16337 (7.88) | 9926 (7.68)  | 10142 (6.68) | 20014 (36.3) | 121376       |
| 2007 | 710048              | 57253 (8.06)      | 32302 (9.10)     | 24951 (7.03) | 19407 (8.93) | 16965 (8.10) | 10271 (7.87) | 10610 (6.94) | 19079 (33.3) | 124680       |
| 2008 | 716391              | 60529 (8.45)      | 34143 (9.52)     | 26386 (7.38) | 20463 (9.34) | 18022 (8.52) | 11005 (8.35) | 11039 (7.18) | 18942 (31.3) | 131324       |
| 2009 | 721504              | 71416 (9.90)      | 40310 (11.1)     | 31106 (8.65) | 24177 (11.0) | 21340 (10.0) | 13113 (9.86) | 12786 (8.27) | 21878 (30.6) | 159299       |
| 2010 | 727666              | 78735 (10.8)      | 43859 (12.0)     | 34876 (9.63) | 26973 (12.1) | 23370 (10.9) | 14881 (11.1) | 13511 (8.68) | 22909 (29.1) | 171313       |
| 2011 | 732446              | 79336 (10.9)      | 44362 (12.0)     | 35174 (9.66) | 27220 (12.2) | 23465 (10.8) | 14981 (11.0) | 13870 (8.86) | 20246 (25.5) | 176538       |

Total numbers of acupuncture users means total numbers of different acupuncture users in each year.

% of female (male) acupuncture users means the percentage of female acupuncture users in female (male) beneficiaries in each year.

% of acupuncture users in the different urbanization levels means the percentage of acupuncture users in the beneficiaries of each urbanized area.

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**Table 2. Age-specific prevalence of acupuncture users during 10 years from 2002–2011 in Taiwan.**

| Age (years) | Number of total population | Number of acupuncture users (%) | Number of acupuncture visits (visits/subject) |
|-------------|----------------------------|---------------------------------|---------------------------------------------|
| ≥80         | 238059                     | 11691 (4.91)                   | 39390 (3.37)                               |
| 70–79       | 478273                     | 37573 (7.86)                   | 118704 (3.16)                              |
| 60–69       | 681064                     | 61437 (9.02)                   | 163406 (2.66)                              |
| 50–59       | 1208056                    | 117005 (9.69)                  | 278441 (2.38)                              |
| 40–49       | 1533355                    | 142171 (9.27)                  | 317716 (2.23)                              |
| 30–39       | 1534700                    | 135803 (8.85)                  | 282865 (2.08)                              |
| 20–29       | 1385437                    | 120819 (8.72)                  | 231815 (1.92)                              |

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Table 3. Service volumes of the acupuncture by facility type and region from 2002–2011 in Taiwan.

| Year | Accreditation level of hospital | Location of medical institution |
|------|---------------------------------|---------------------------------|
|      | Hospital | Clinic | Taipei branch bureau | Northern branch bureau | Central branch bureau | Southern branch bureau | Kao-Ping branch bureau | Eastern branch bureau | Others* |
| 2002 | 2913     | 51193  | 253848 (7.33) | 21655 (8.53) | 91505 (5.51) | 5511 (6.02) | 120646 (12.0) | 14426 (12.9) | 94373 (5.09) | 5093 (5.40) | 102080 (12.0) | 6164 (6.04) | 11960 (12.57) | 1275 (10.5) | 3340 (0) |
| 2003 | 2766     | 53201  | 25855 (8.40) | 21491 (8.40) | 91779 (6.06) | 605 (6.61) | 121992 (11.9) | 14459 (11.9) | 95114 (5.57) | 5575 (5.84) | 13095 (6.86) | 7073 (6.86) | 11987 (12.1) | 1322 (11.0) | 3398 (0) |
| 2004 | 3160     | 54960  | 257802 (8.28) | 21339 (8.28) | 92333 (6.82) | 6286 (7.39) | 123307 (12.4) | 15307 (12.4) | 95887 (6.85) | 5865 (6.12) | 103991 (7.15) | 7439 (7.15) | 12036 (11.2) | 1344 (11.2) | 3459 (0) |
| 2005 | 2966     | 52802  | 260793 (7.74) | 20183 (7.74) | 93536 (6.10) | 6810 (7.28) | 125170 (11.5) | 14445 (11.5) | 96900 (5.76) | 5769 (5.95) | 105112 (6.85) | 7200 (6.85) | 12100 (11.3) | 1361 (11.3) | 3533 (0) |
| 2006 | 2932     | 52137  | 263132 (7.70) | 20275 (7.70) | 94948 (6.90) | 6907 (7.31) | 126682 (10.8) | 13780 (10.8) | 97972 (5.72) | 5728 (5.86) | 105964 (6.60) | 7050 (6.60) | 12135 (11.0) | 1329 (11.0) | 3575 (0) |
| 2007 | 2940     | 54313  | 265483 (8.06) | 21389 (8.06) | 95311 (7.27) | 7279 (7.64) | 128117 (11.0) | 14135 (11.0) | 99593 (6.71) | 6171 (6.26) | 106750 (6.60) | 7050 (6.60) | 12183 (10.1) | 1229 (10.1) | 3611 (0) |
| 2008 | 2955     | 57574  | 267726 (8.46) | 22650 (8.46) | 96274 (8.09) | 8091 (8.40) | 129414 (11.2) | 14551 (11.2) | 99468 (6.32) | 6321 (6.35) | 107684 (7.23) | 7766 (7.23) | 12192 (9.27) | 1130 (9.27) | 3633 (0) |
| 2009 | 3209     | 68207  | 269531 (10.1) | 27109 (10.1) | 96948 (10.05) | 10051 (10.4) | 130608 (12.5) | 16379 (12.5) | 100158 (7.09) | 7098 (7.09) | 108368 (8.57) | 9291 (8.57) | 12206 (12.2) | 1488 (12.2) | 3685 (0) |
| 2010 | 3128     | 75607  | 271797 (11.5) | 31127 (11.5) | 97957 (10.45) | 10445 (10.7) | 131909 (13.0) | 17150 (13.0) | 100842 (7.33) | 7335 (7.27) | 109158 (10.2) | 11166 (10.2) | 12277 (12.3) | 1512 (12.3) | 3726 (0) |
| 2011 | 3078     | 76458  | 273301 (11.6) | 31717 (11.6) | 98837 (10.16) | 10169 (10.3) | 133041 (12.9) | 17188 (12.9) | 101416 (7.08) | 7087 (6.99) | 109766 (10.2) | 11013 (10.2) | 12332 (12.7) | 1567 (12.7) | 3753 (79) (21.2) |

N: numbers of beneficiaries; n: numbers of acupuncture users.

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A previous study on the characteristics of acupuncture users in Taiwan demonstrated that the ratio of acupuncture users was fairly stable during the first few years of the establishment of the NHI program (from 6% in 1996 to 6.2% in 2002) [29]. However, our study revealed that from 2002 to 2011, acupuncture utilization increased further from 7.98% to 10.9%, which was

Table 4. Frequency distribution of acupuncture users by disease categories and age groups from 2002–2011 in Taiwan.

| Diagnosis (ICD-9-CM range) | Acupuncture, n (%) | Age |
|----------------------------|--------------------|-----|
| All                        | 8160624 (100.00)   |     |
| 20–39 (%)                  | 3031150 (37.00)    |     |
| 40–59 (%)                  | 3630624 (44.50)    |     |
| ≥60 (%)                    | 1498850 (18.50)    |     |
| Injury and poisoning (800–999) | 6744878 (41.80)    |     |
| Diseases of the Musculoskeletal System and Connective Tissue (710–739) | 1698062 (34.50)    |     |
| Diseases of the Circulatory System (390–459) | 2949757 (41.30)    |     |
| Diseases of the Nervous System and Sense Organs (320–389) | 175667 (10.90)     |     |
| Symptoms, Signs, and Ill-Defined Conditions (780–799) | 40811 (0.83)       |     |
| Diseases of the Respiratory System (460–519) | 135128 (1.93)      |     |
| Diseases of the Genitourinary System (580–629) | 135128 (1.93)      |     |
| Mental Disorders (290–319) | 151205 (41.30)     |     |
| Diseases of the Digestive System (520–579) | 151205 (41.30)     |     |
| Neoplasms (140–239)        | 151205 (41.30)     |     |
| Endocrine, Nutritional, and Metabolic Diseases, and Immunity Disorders (240–279) | 135128 (1.93)      |     |
| Diseases of the Skin and Subcutaneous Tissue (680–709) | 23272 (0.32)       |     |
| Infectious and Parasitic Diseases (001–139) | 22272 (0.32)       |     |
| Diseases of the Blood and Blood-Forming Organs (280–289) | 11581 (0.22)       |     |
| Complications of Pregnancy, Childbirth, and the Puerperium (630–676) | 7874 (0.21)        |     |

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consistent with the increasing trend in overall TCM users in Taiwan (from 26.59% in 2000 to 28.66% in 2010) [3]. The percentage of acupuncture usage in Taiwan was higher than that in Japan (6.7% in 2006) [4], Australia (3.4% in 2011) [30], the U.S.A. (1.5% in 2007) [9], the UK (1.6% in 2004) [31] and South Korea (7.4%) [6]. Although acupuncture has become more popular in Asian countries, the proportion of Taiwanese acupuncture users was still lower than the proportion of overall TCM users in Taiwan. This might be due to the wide acceptance of Chinese herbal medicine in Taiwan. TCM theories such as Yin and Yang as well as Chinese herbal medicine are part of life and Chinese culture. For example, several herbs are commonly used to promote health in Taiwanese communities [32]. In addition, Chinese herbal medicine is also reimbursed by NHI policy and is thus easily affordable by the general public.

Acupuncture users were mainly enrollees in the middle-aged groups, which is similar to the findings of previous reports on acupuncture users in Taiwan [5], Australia [8] and the U.S.A. [33]. In accordance with previous studies in Taiwan [5], Japan [4], the UK [34] and Australia [30], our study revealed a female predominance among acupuncture users. Residents in highly urbanized areas usually utilized TCM more than those in less urbanized areas [35].

The most common diseases among patients receiving acupuncture treatment in Taiwan were injury and disorders of the musculoskeletal system and connective tissue, which is similar to the results in Japan [4] and Australia [8]. According to TCM theory, these disorders are considered to represent Qi stagnation and blood stasis in terms of TCM diagnoses. Acupuncture is usually considered to move qi and remove blood stasis quicker than Chinese herbal medicine [36]. Previous studies among osteoarthritis [37] and fibromyalgia [38] patients also provided substantial evidence supporting the beneficial effects of acupuncture in these disorders.

Patients with circulatory disorders, including cardiovascular disease and cerebrovascular disorders, also received acupuncture. The proportion of acupuncture users among stroke patients in Taiwan was 17% in 2008 [26]. A retrospective cohort study revealed that acupuncture lowered the rate of recurrent stroke in patients with ischemic stroke [39]. Furthermore, a previous study found that ischemic stroke patients experienced increased cerebral blood flow when they received acupuncture treatment [40]. The NHIA launched a Pilot Scheme for Health Policy in Stroke Adjuvant Acupuncture Therapy (HPSAAT) in 2006 to support the health care of stroke patients [41]. In addition to outpatient clinical consultations, the inpatient treatment of stroke patients in acute and subacute stages with acupuncture has been reimbursable by the NHIA since 2006. The implementation of this pilot scheme in the NHI policy has also promoted the utilization and integration of acupuncture treatment in stroke patients.

Cancer patients often seek CAM to ameliorate symptoms induced by cancer or the side effects of cancer treatment [24]. Notably, cancer, which was the tenth leading disease category

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Table 5. The top ten diseases of patients received complex acupuncture.

| Diseases | ICD-9     | N = 40028 (%) |
|----------|-----------|---------------|
| Cerebral infarction | 433–434 | 14164 (35.4) |
| Intracerebral hemorrhage | 431–432 | 8962 (22.4) |
| Other cerebrovascular disease | 435–437 | 8276 (20.7) |
| Subarachnoid hemorrhage | 430 | 2828 (7.07) |
| Cancer | 140–208 | 1812 (4.53) |
| Spinal cord injury without evidence of spinal bone injury | 952 | 953 (2.38) |
| Schizophrenia | 295 | 738 (1.84) |
| Manic disorder | 296 | 713 (1.78) |
| Fracture of vertebral column with spinal cord injury | 806 | 497 (1.24) |
| Other diseases of spinal cord | 336 | 318 (0.79) |

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among acupuncture visits in our study, was not in the top 10 disease categories among acupuncture visits in the previous study in Taiwan [5]. The number of cancer patients has increased in recent years, and the acceptability of TCM theory has also been growing. Acupuncture research in the field of oncology has also increased [42]. Current evidence has found that acupuncture is effective in treating the symptoms associated with cancer and cancer treatment. For example, cancer pain was shown to be attenuated through auricular acupuncture [43]. Acupuncture significantly improved joint pain in postmenopausal women with aromatase inhibitor-induced arthralgia [44]. Furthermore, fatigue, anxiety and depression in women with aromatase inhibitor-induced arthralgia were also improved by acupuncture [45]. Complementary TCM treatment approaches for hospitalized cancer patients, including acupuncture, are also covered by the NHI.

There were several limitations to our study. First, detailed information about acupuncture, including the selected acupoints, manipulation and needle retention time, were not provided in this dataset. The detail information could be only provided in the electronic medical records in hospitals but not in the dataset for study from NHIRD. We could only analyze the utilization rate in different population and different disease categories. Another limitation was that the treatment codes recorded in the NHIRD only included manual acupuncture, electroacupuncture and complex acupuncture. Auricular acupuncture, scalp acupuncture and moxibustion were all recorded under the same treatment codes as manual acupuncture. Acupressure may have been recorded as orthopedic manipulation. However, this study still provided the most up-to-date information about the seeking of acupuncture treatment, the associations of demographic data and the trends in acupuncture utilization in Taiwan. The large sample size provided by the NHIRD also minimized selection bias.

Conclusion

This study provides the most up-to-date report on acupuncture utilization among adults in Taiwan. The major characteristics of acupuncture users included being middle-aged, female and a resident of a highly urbanized area and suffering from injury or disorders of the musculoskeletal system and connective tissue. Our findings may provide useful information for clinical practice and acupuncture research as well as for health policy decision making.

Author Contributions

Conceptualization: Mei-Yao Wu, Yu-Chen Lee, Ming-Cheng Huang, Mao-Feng Sun, Hung-Rong Yen.

Data curation: Cheng-Li Lin, Hung-Rong Yen.

Formal analysis: Mei-Yao Wu, Cheng-Li Lin.

Funding acquisition: Hung-Rong Yen.

Investigation: Mei-Yao Wu, Ming-Cheng Huang, Mao-Feng Sun, Hung-Rong Yen.

Methodology: Mei-Yao Wu, Yu-Chen Lee, Cheng-Li Lin, Hung-Rong Yen.

Resources: Cheng-Li Lin.

Software: Cheng-Li Lin.

Supervision: Hung-Rong Yen.

Validation: Hung-Rong Yen.
Visualization: Mei-Yao Wu, Yu-Chen Lee, Cheng-Li Lin, Ming-Cheng Huang, Hung-Rong Yen.

Writing – original draft: Mei-Yao Wu, Hung-Rong Yen.

Writing – review & editing: Hung-Rong Yen.

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