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ORIGINAL RESEARCH ARTICLE

The socioeconomic burden of adult attention-deficit/hyperactivity disorder in Spain

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ABSTRACT

Introduction: The symptoms of attention-deficit/hyperactivity disorder (ADHD) in adults highly interfere with function in multiple dimensions, increasing the economic burden associated with ADHD. The aim of this study was to explore the impact of ADHD in Spanish adults and estimate the associated economic burden within the healthcare, social, economic, and legal domains.

Methods: An economic model was developed from a social perspective using a bottom-up approach, based on the scientific literature and a multidisciplinary expert group.

Results: The cost incurred per diagnosed adult patient with ADHD included an annual cost of €15,652 and a one-time cost of €7,893 (3,035 M€ and 1,531 M€ for Spain, respectively). Regarding the annual cost, 50% was attributed to costs within the economic domain, of which 53% were work-absenteeism-related. Moreover, 28% was attributed to costs within the social domain, of which 74% were substance-abuse-related. Regarding the one-time cost, 52% was attributed to costs within the healthcare domain, of which approximately 50% were hospitalization-related costs. Moreover, 42% was attributed to costs within the legal domain, of which 62% were imprisonment-related costs.

Conclusions: This is the first report on the socioeconomic burden of ADHD in Spanish adults, shedding light on the large burden that adult ADHD poses on the healthcare system and society at large, as symptoms have been shown to impact almost every aspect of life. This is particularly important for undiagnosed/untreated patients with ADHD in Spain, as appropriate treatments have shown positive results in these areas and may reduce its associated socioeconomic burden.

Keywords: adult ADHD, burden of disease, healthcare system, social perspective, substance abuse, work productivity loss

Introduction

Attention-deficit/hyperactivity disorder (ADHD) is a neurodevelopmental disorder characterized by a persistent pattern of inattention, hyperactivity, and/or impulsivity that interferes with functioning or development, with symptoms present before the age of 12, in two or more settings, and not exclusively related to other mental disorders (1). The main characteristics of ADHD encompass symptoms of inattention (e.g., forgetfulness, distractibility, doubtfulness, etc.), hyperactivity (e.g., restlessness, difficulty relaxing, talking too much and too loud, etc.), and impulsivity (e.g., acting without thinking, interrupting others, impatience, etc.), which pose a substantial burden on patients and society at large (2).

Typically diagnosed in early childhood, ADHD is among the most common group of mental disorders in children and adolescents with a worldwide pooled prevalence of 3.4% (3). However, considered a lifespan disorder (2), ADHD may persist

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into adulthood (57.0%-78.2%) as patients continue to meet the criteria for ADHD as adults (4). Accordingly, the worldwide pooled prevalence of adult ADHD has been estimated at 2.8% of the total population (4).

The latest update on ADHD diagnostic criteria specified the need for clear evidence that symptoms interfere with or reduce the quality of social, academic, or occupational functioning (1,2). While children with ADHD present social and academic difficulties, impairments in adults with ADHD extend beyond these areas (1). Specifically, adults with ADHD present social and interpersonal difficulties such as unstable relationships and marital problems leading to separation or divorce; work-related problems such as unemployment and underachievement; and antisocial and criminal behavior leading to arrests, convictions, and/or imprisonment, among others (2,5). Accordingly, a recent systematic review showed that adults incur most of the economic burden associated with ADHD (89.5%) compared to that incurred by children and adolescents (10.5%) (6). In this regard, most ADHD economic burden studies have typically examined only direct costs (medical and nonmedical costs), followed by indirect costs (indirect medical costs, absenteeism, presentism), and a paucity of studies have further captured educational or justice system associated costs, hence underestimating the real economic burden (7). However, particularly for adults, the multidimensional impact of ADHD on function prompts an analysis encompassing a greater number of domains (e.g., healthcare, social, academic, occupational, etc.) to provide a comprehensive description of the economic burden of adult ADHD (2,7).

Impaired functioning associated with ADHD may be prevented or mitigated by an appropriate multimodal treatment (8). Specifically, pharmacological treatment of ADHD (i.e., methylphenidate, lisdexamfetamine, and atomoxetine) has been reported to be both effective and well-tolerated, and has shown a positive impact on important aspects of daily functioning (8). Unfortunately, adult ADHD is often underdiagnosed or misdiagnosed due to the overlap of symptoms with other psychiatric disorders and hence undertreated (9). Moreover, the difficult transition from pediatric to adult healthcare services may compromise treatment continuity (8). These patients continue to show greater healthcare utilization and economic burden compared to those without ADHD (10). Consequently, untreated adult patients with ADHD highly contribute to the overall burden associated with ADHD.

While the socioeconomic burden of children and adolescents with ADHD in Spain has been previously studied (11), we are unaware of any previous study on the socioeconomic burden of adult ADHD in Spain (7). Given that childhood-onset ADHD may persist into adulthood (4) and enhance the socioeconomic burden of ADHD (7), this should be studied in detail across relevant domains. Therefore, the aims of the present study were to identify the most relevant impacts of ADHD in the adult population of Spain and to estimate their associated burden within the healthcare, social, economic, and legal domains.

Methods

The burden of adult ADHD in Spain was estimated through an economic model developed from a social perspective using a bottom-up approach and divided into four domains (Fig. 1).

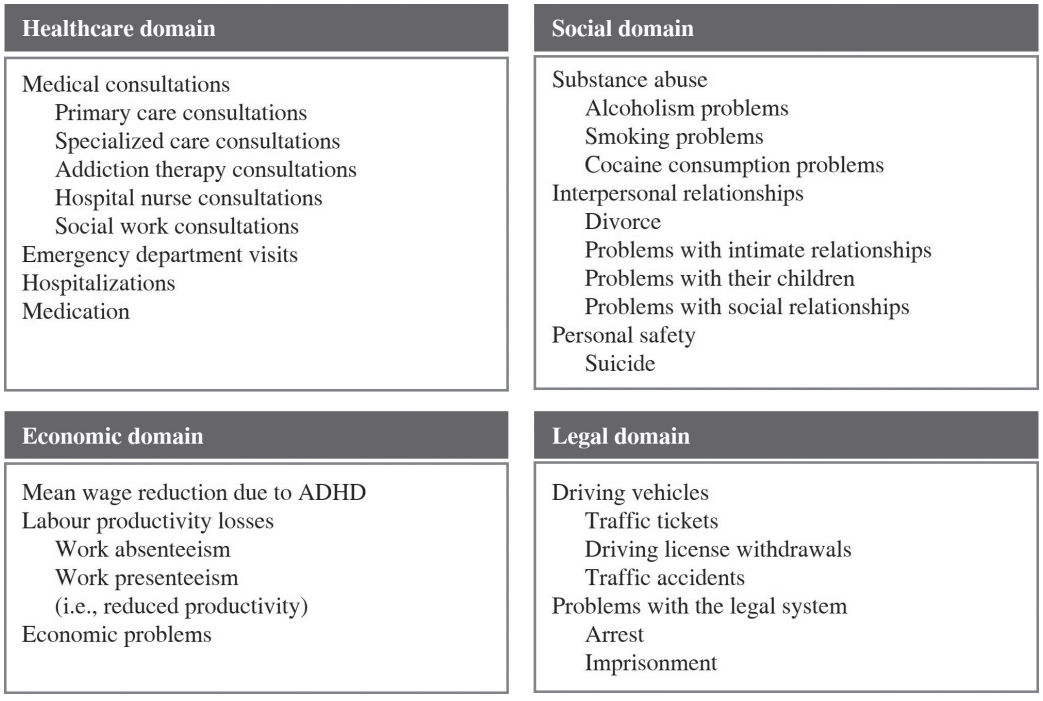

FIGURE 1 - Study domains and associated variables. ADHD = attention-deficit/hyperactivity disorder.

Data sources

Relevant data regarding the prevalence of adult ADHD in Spain and its impact on the healthcare, social, economic, and legal domains were obtained from the scientific literature using the PubMed search engine and selected based on their representation of Spain or any of its regions, or, otherwise, on study methodology. Thereafter, an Advisory Board of a multidisciplinary group of experts on ADHD, including a hospital psychiatric department chief, a prison health service physician, a hospital psychiatric department psychologist, a mental health service social worker, the director of the ADHD association of patients, and a former hospital manager and psychiatrist, was convened to agree on which of the presented data points were to be included in the socioeconomic model. Whenever experts considered that a data point was not representative of the Spanish adult population with ADHD and/or no alternative data point was available in the scientific literature, especially regarding healthcare resource consumption, assumptions were made.

Population

Estimates of the burden of diagnosed and undiagnosed ADHD were based on prevalence data. Accordingly, to estimate the burden of diagnosed adult ADHD in Spain, a 0.5% prevalence was used (12). Moreover, to estimate the burden of undiagnosed adult ADHD in Spain, the difference between the estimated prevalence of adult ADHD in Spain (3.3%) (4) and the prevalence of diagnosed adult ADHD in Spain (0.5%) was used, yielding a prevalence of 2.8%. Applied to the adult population of Spain (≥18 years) on July 1, 2019 (13), it was estimated that, at the time, there were 1,279,861 adults with ADHD in Spain, of which 193,918 were diagnosed (15%) and 1,085,943 were undiagnosed (85%).

Costs

The economic model included two types of costs, one-time and recurrent annual costs, given the characteristics of the first, which are timely and lack an annual frequency. Costs are of tangible and/or intangible nature, the latter of which were estimated from financial proxies (e.g., willingness to pay for an effective alcoholism therapy). Overall, healthcare costs were estimated by multiplying the number of annual resources consumed by their unit costs, while the remaining costs were estimated by further applying prevalence reference data (e.g., multiplying the prevalence of addictions in patients with ADHD by the number of annual addiction therapy consultations and their unit cost). Estimates of the healthcare burden associated with ADHD medication were based on the cost of treating an average patient with each one of the active agents used to treat ADHD and their market share (14), considering that between 10.0% and 27.3% of adult patients with ADHD are undergoing treatment (based on estimates by the Advisory Committee and Takeda, respectively). For each active agent, the presentations with the maximum daily dose as detailed in their summary of product characteristics were selected (15-17), and among them, the ones with the lowest cost per mg (retail price + taxes) (18). Moreover, costs associated with labor productivity were estimated using the human-capital method, by which work time lost as a result of illness is valued at the market wage. A detailed description of the variables and unit costs included in the socioeconomic model has been provided in Tables 1 and 2.

Unit costs were obtained from the median rates for health services published in the official bulletins of the Spanish Autonomous Communities, official statistics (published by the Spanish National Institute of Statistics and the Spanish Ministry of Health, Consumer Affairs, and Social Welfare), the scientific literature, and market prices. Prices were updated to 2019 Euro according to the corresponding general or medical Consumer Price Index (19), except for medication costs, which were obtained on September 10, 2020, from the medication database of the General Council of Official Associations of Pharmacists.

Results are presented as mean costs per adult patient with ADHD and total costs of ADHD within domains, broken down into one-time costs and recurrent annual costs. Moreover, to estimate the burden of ADHD on the healthcare system, the analysis was broken down into three distinct time periods to account for differences in resource consumption: diagnosis, post-diagnosis follow-up (first year), and post-diagnosis long-term follow-up (following years). While the diagnosis time period and the first year after diagnosis incurred one-time costs, the following years were associated with recurrent annual costs. Results are also presented as total costs of adult ADHD in Spain, which were obtained by multiplying the mean cost per patient by the prevalence of diagnosed and/or undiagnosed ADHD according to the bottom-up method (4,13). Given the lack of studies on the consumption of healthcare resources by undiagnosed adults with ADHD, the one-time and annual total cost of undiagnosed ADHD was obtained by excluding healthcare costs from the one-time and annual cost per adult patient diagnosed with ADHD and applying such costs to the estimated number of undiagnosed adults with ADHD.

Sensitivity analysis

A sensitivity analysis on assumption-based data points was carried out to account for worst and best-case scenarios, relative to a reference scenario (Tabs 1 and 2).

Results

Overall, the total cost incurred per adult patient diagnosed with ADHD included an annual cost of €15,652 and a one-time cost of €7,893. On the one hand, the annual cost was mainly attributed to costs within the economic domain (49.80%), followed by the social domain (28.35%), the healthcare domain (21.70%), and the legal domain (0.15%). On the other hand, the one-time cost was mainly attributed to costs within the healthcare domain, which accounted for those associated with diagnosis and the first year of post-diagnosis follow-up (52.08%), followed by the legal domain (42.45%), and the social domain (5.46%). Applied to the number of

TABLE 1 - Variables included in the socioeconomic model according to domains: diagnosis and post-diagnosis (first year)

	Variable	Best scenario	Reference scenario	Worst scenario	Resource/financial proxy	Unit cost (€, 2019 Euro)	Cost typology
Healthcare domain	**Diagnosis**						
	Medical consultations						
	Number of specialized care consultations (27)	3.8	3.8	3.8	First specialized care consultation‡	151.8	One-time
	Post-diagnosis (first year)						
	Medical consultations						
	Number of annual primary care consultations†	6.0	7.0	8.0	Follow-up consultation with a primary care physician‡	50.1	One-time
	Number of annual psychiatric consultations†	4.0	5.0	6.0	Follow-up specialized care consultation‡	88.3	One-time
	Number of annual addiction therapy consultations†§	12.0	12.0	12.0	Follow-up specialized care consultation‡	88.3	One-time
	Number of annual hospital nurse consultations†¶	1.0	1.0	1.0	Hospital nurse consultation‡	42.0	One-time
	Number of annual social work consultations†	1.0	1.0	1.0	Social work consultation‡	36.3	One-time
	Medication						
	Maximum daily adult methylphenidate dose (mg) (16)	80.0	80.0	80.0	Cost per mg of methylphenidate (retail price + taxes) (16,18)	0.03403	One-time
	Maximum daily adult atomoxetine dose (mg) (17)	100.0	100.0	100.0	Cost per mg of atomoxetine (retail price + taxes) (17,18)	0.02603	One-time
	Maximum daily adult lisdexamfetamine dose (mg) (15)	70.0	70.0	70.0	Cost per mg of lisdexamfetamine (retail price + taxes) (15,18)	0.05553	One-time
	ED visits and hospitalizations						
	Patients visiting the ED in the last 6 months# (28)	30.2%	30.2%	30.2%	Hospital ED visit‡	182.2	One-time
	Patients hospitalized in the last 6 months# (28)	26.0%	26.0%	26.0%	Hospitalization (29)	3,509.7	One-time

All variables refer specifically to patients with ADHD.
ADHD = attention-deficit/hyperactivity disorder; ED = emergency department.
†Advisory board.
‡Median rates for health services published in the official bulletins of the Spanish Autonomous Communities.
§Applies to the percentage of ADHD patients with addiction.
¶Applies to the percentage of patients undergoing treatment with stimulant medication who present with high blood pressure.
#Two annual consumptions were assumed for this resource.

TABLE 2 - Variables included in the socioeconomic model according to domains: post-diagnosis (following years)

	Variable	Best scenario	Reference scenario	Worst scenario	Resource/financial proxy	Unit cost (€, 2019 Euro)	Cost typology
Healthcare domain	***Medical consultations***						
	Number of annual primary care consultations[†]	4.0	5.0	6.0	Follow-up consultation with a primary care physician[‡]	50.1	Recurrent
	Number of annual psychiatric consultations[†]	4.0	5.0	6.0	Follow-up specialized care consultation[‡]	88.3	Recurrent
	Number of annual addiction therapy consultations[†§]	12.0	12.0	12.0	Follow-up specialized care consultation[‡]	88.3	Recurrent
	Medication						
	Maximum daily adult methylphenidate dose (mg) (16)	80.0	80.0	80.0	Cost per mg of methylphenidate (retail price + taxes) (16,18)	0.03403	Recurrent
	Maximum daily adult atomoxetine dose (mg) (17)	100.0	100.0	100.0	Cost per mg of atomoxetine (retail price + taxes) (17,18)	0.02603	Recurrent
	Maximum daily adult lisdexamfetamine dose (mg) (15)	70.0	70.0	70.0	Cost per mg of lisdexamfetamine (retail price + taxes) (15,18)	0.05553	Recurrent
	ED visits and hospitalizations						
	Patients visiting the ED in the last 6 months[¶] (28)	30.2%	30.2%	30.2%	Hospital ED visit[‡]	182.2	Recurrent
	Patients hospitalized in the last 6 months[¶] (28)	26.0%	26.0%	26.0%	Hospitalization (29)	3,509.7	Recurrent
Social domain	***Substance abuse***						
	Patients who were ever alcoholics (28)	19.6%	19.6%	19.6%	Annual WTP for a 100% effective alcoholism treatment[#]	4,800.0	Recurrent
					→ *Patients' annual WTP[#]* (30)	*1,200.0*	
					→ *Caregivers' annual WTP[#]* (30)	*3,600.0*	
	Patients who smoke (28)	48.3%	48.3%	48.3%	Annual cost for treating a patient with COPD[#] (31)	4,245.2	Recurrent
	Patients who consume cocaine (32)	20.8%	20.8%	20.8%	Annual cost for addiction rehabilitation treatment[#] (33)	1,456.2	Recurrent
	Interpersonal relationships						
	Patients who are divorced (32)	8.9%	8.9%	8.9%	Cost of a contentious divorce[#]	4,840.0	One-time
					→ *Cost of a contentious divorce for the patient[#]* (34)	*2,420.0*	
					→ *Cost of a contentious divorce for the partner[#]* (34)	*2,420.0*	
	Patients with intimate relationship problems (35)	59.0%	59.0%	59.0%	Cost of 14 psychotherapy sessions (couple's therapy)[‡#] (36)	1,236.2	Recurrent
	Patients who have problems with their children (35)	15.0%	15.0%	15.0%	Cost of six psychotherapy sessions (family therapy)[‡#]	529.8	Recurrent
	Patients with social relationship problems (28)	63.2%	63.2%	63.2%	Cost of six psychotherapy sessions (individual therapy)[‡#]	529.8	Recurrent
	Personal safety						
	Odds ratio of suicide vs. non-ADHD (37)	2.5	5.9	14.3	Social and work-related cost of suicide per person (38)	618.1	One-time

(*Continued*)

TABLE 2 - (*Continued*)

	Variable	Best scenario	Reference scenario	Worst scenario	Resource/financial proxy	Unit cost (€, 2019 Euro)	Cost typology
Economic domain	Mean wage reduction compared with non-ADHD[††] (39)	20.0%	20.0%	20.0%	Annual earnings per employee in Spain (40)	24,197.6	Recurrent
	Labor productivity losses						
	Absenteeism as annual days on work leave[††] (41)	33.6	33.6	33.6	Earnings per day of work (42)	123.8	Recurrent
	Percentage of patients with work presenteeism[††] (28)	45.8%	45.8%	45.8%	Annual cost of presenteeism[‡‡] (43)	1,950.5	Recurrent
	→ Daily effective work minutes lost (43)	15.0	30.0	45.0			
	Economic problems						
	Patients with economic problems (35)	49.0%	49.0%	49.0%	Interest cost linked to personal loans (9% interest rate)[#] (44)	545.9	Recurrent
Legal domain	***Driving vehicles***						
	Patients with >1 traffic ticket in the last 12 months (27)	17.6%	17.6%	17.6%	Cost of a speeding ticket (45)	132.0	Recurrent
	Mean number of driving license withdrawals (46)	1.1	1.1	1.1	Cost of a driving license withdrawal	998.5	One-time
					→ *Very serious speeding ticket + 6-point withdrawal* (47)	*600.0*	
					→ *Driving license recovery course* (48)	*398.5*	
	Patients involved in traffic accidents while driving (27)	18.5%	18.5%	18.5%	Annual insurance cost increase for traffic accidents[#] (49,50)	110.2	One-time
	Problems with the legal system						
	Patients who have ever been arrested	37.0% (51)	42.0%*	47.0% (52)	Cost of legal counsel for criminal detainee assistance[#] (53)	350.0	One-time
	Patients who have ever been imprisoned	3.5% (41)	9.2%*	15.0% (52)	Cost per day per inmate (54)	61.8	One-time

All variables refer specifically to patients with ADHD.
ADHD = attention-deficit/hyperactivity disorder; COPD = chronic obstructive pulmonary disease; ED = emergency department; WTP = willingness to pay.
*Average of best- and worst-case scenarios.
[†]Advisory board.
[‡]Median rates for health services published in the official bulletins of the Spanish Autonomous Communities.
[§]Applies to the percentage of ADHD patients with addiction.
[¶]Two annual consumptions were assumed for this resource.
[#]Financial proxy.
[††]Applies to the percentage of patients with ADHD who are currently employed.
[‡‡]Cost subject to best- and worst-case scenario of daily effective work minutes lost in patients with ADHD.

TABLE 3 - Average cost per patient (€ 2019), total cost (M€ 2019), and relative cost (%) according to domains and type of cost

Domains/type of cost	Cost per patient (€, 2019 Euro)	Total cost† (M€, 2019 Euro)	Relative cost (%)
Healthcare burden			
Recurrent annual cost	3,395.83	658.51	21.70
One-time cost‡	4,110.88	797.17	52.08
Social burden			
Recurrent annual cost	4,437.80	860.57	28.35
One-time cost	430.99	83.58	5.46
Economic burden			
Recurrent annual cost	7,794.79	1,511.55	49.80
One-time cost	0.00	0.00	0.00
Legal burden			
Recurrent annual cost	23.23	4.51	0.15
One-time cost	3,350.84	649.79	42.45
Total cost			
Recurrent annual cost	15,651.66	3,035.14	100
One-time cost	7,892.71	1,530.54	100

ADHD = attention-deficit/hyperactivity disorder; M€ = million Euros.
†Cost per patient applied to the prevalence of diagnosed adult patients with ADHD.
‡Includes costs associated with the diagnosis and the first-year post-diagnosis.

adult patients diagnosed with ADHD in Spain, the estimated costs would yield a total annual cost of €3,035 million and a one-time cost of €1,531 million (Tab. 3).

Moreover, undiagnosed patients with ADHD were estimated to incur at least a total annual cost of €13,309 million and a one-time cost of €4,107 million.

Healthcare burden

The estimated cost per adult patient with ADHD to establish a diagnosis amounted to €577, increased up to €3,534 in the first year following diagnosis, and slightly decreased to €3,396 per year during the following years. Costs associated with hospitalizations accounted for approximately 50% of the burden on the healthcare system for both the first and the following post-diagnosis years (Fig. 2A).

Social burden

The estimated cost per adult patient with ADHD within the social domain amounted to an annual cost of €4,438 and a one-time cost of €431. Costs associated with substance abuse accounted for 74.23% of the annual social burden, specifically those associated with smoking (46.20%) and alcoholism (21.20%). In addition, problems with intimate relationships accounted for 16.44% of the social burden. Moreover, the cost of a divorce at any given time in the patients' life further contributed to the overall social burden (Fig. 2B).

Economic burden

The estimated cost per adult patient with ADHD within the economic domain amounted to an annual cost of €7,795, of which 53.35% were costs associated with work absenteeism, followed by wage reductions with respect to those without ADHD (31.76%) and work presenteeism (11.46%). One-time costs were not identified within this domain (Fig. 2C).

Legal burden

The estimated cost per adult patient with ADHD within the legal domain amounted to an annual cost of €23 associated with traffic tickets. Most importantly, one-time costs amounted to €3,351, of which 62.23% were associated with imprisonment and 32.78% with driving license withdrawals at any given time in the patients' life (Fig. 2D).

Sensitivity analysis

Overall, the results of the sensitivity analysis showed that recurrent annual costs associated with diagnosed adults with ADHD could vary up to 6%, while one-time costs could vary up to 21% with respect to the reference scenario. More specifically, one-time costs associated with the legal domain could vary up to 39% with respect to the reference scenario (Tab. 4). This large variation within the legal system was primarily associated with variations in the percentage of patients with ADHD who have ever been imprisoned (3.5%

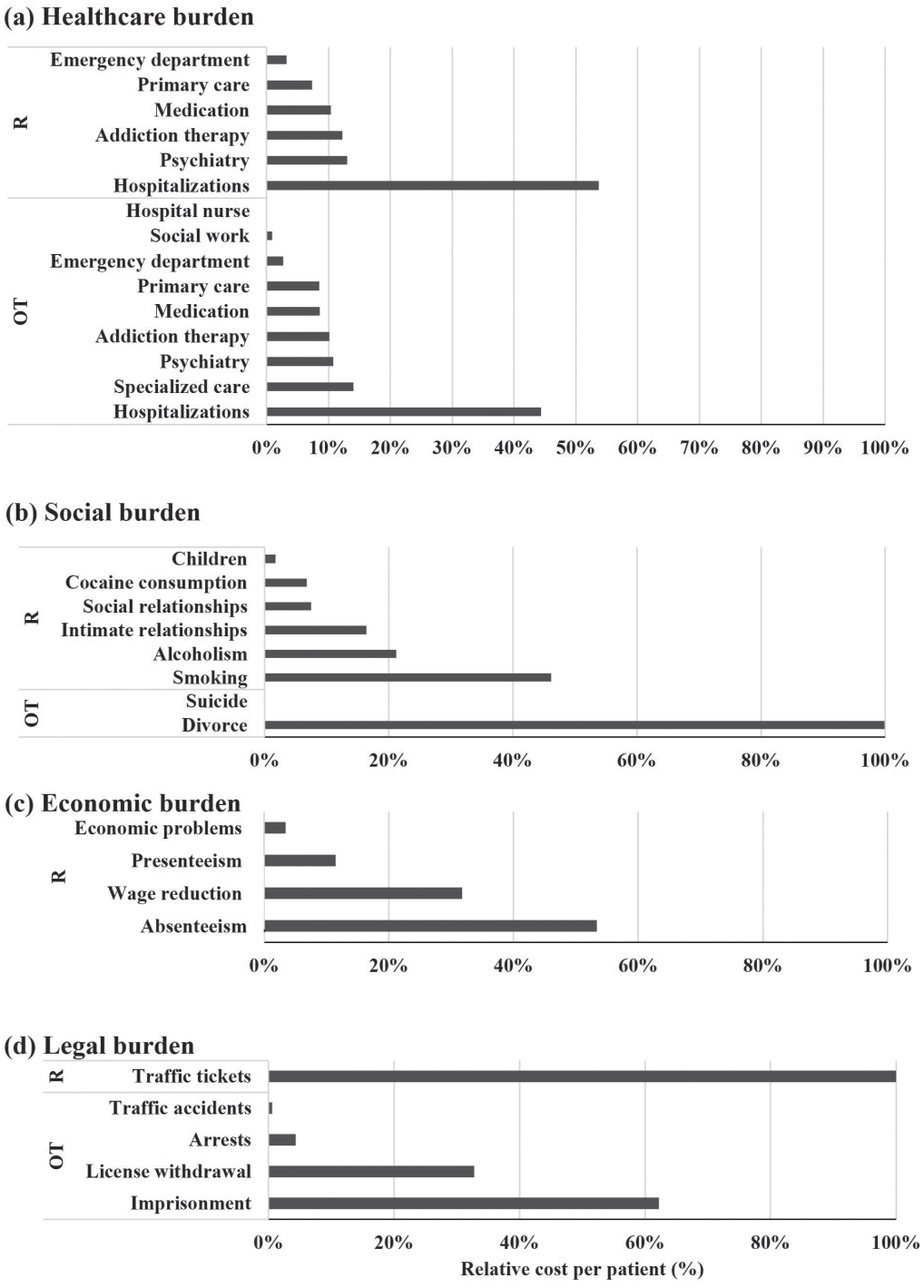

FIGURE 2 - Relative costs per patient (%) with respect to total one-time (OT) or recurrent (R) total cost within the healthcare (A), social (B), economic (C), and legal (D) domains.

to 15%). Moreover, the mean cost per day of imprisonment depends on the number of years that the patient spends in prison, which could further increase variability.

This is the first report on the socioeconomic burden of adult ADHD in Spain (7). The results highlight a large socioeconomic impact, which was estimated to incur an annual cost of €15,652 and a one-time cost of €7,893 per adult patient diagnosed with ADHD (€3,035 million and €1,531 million for Spain, respectively). Given the large rates of adult ADHD underdiagnosis, estimated at 2.8% (4), the socioeconomic impact is expected to be much higher (at least €13,309 million and €4,107 million, respectively). These results are not easily comparable to previous studies on the economic burden of ADHD. A recent systematic review on the global

TABLE 4 - Best- and worst-case scenarios for the average cost per patient (€ 2019) and total cost (M€ 2019) according to domains and type of cost

Domains/type of cost	Cost per patient (€, 2019 Euro)		Total cost† (M€, 2019 Euro)	
	Best-case Scenario	Worst-case Scenario	Best-case Scenario	Worst-case Scenario
Healthcare burden				
Recurrent annual cost	3,093.32	3,698.35	599.85	717.18
One-time cost‡	3,806.94	4,415.68	738.24	856.28
Social burden				
Recurrent annual cost	4,437.80	4,437.80	860.57	860.57
One-time cost	430.81	431.62	83.54	83.70
Economic burden				
Recurrent annual cost	7,147.29	8,442.29	1,385.99	1,637.12
One-time cost	0.00	0.00	0.00	0.00
Legal burden				
Recurrent annual cost	23.23	23.23	4.51	4.51
One-time cost	2,033.50	4,668.18	394.33	905.25
Total cost				
Recurrent annual cost	14,701.64	16,601.68	2,850.92	3,219.37
One-time cost	6,271.25	9,515.48	1,216.11	1,845.23

ADHD = attention-deficit/hyperactivity disorder; M€ = million Euros.
†Cost per patient applied to the prevalence of diagnosed adult patients with ADHD.
‡Includes costs associated with the diagnosis and the first-year post-diagnosis.

economic burden of ADHD reported a large variability across countries possibly associated with differences in healthcare systems, resource utilization, cost components, populations, and data sources (7). Therefore, any comparisons with previous studies should be interpreted with caution.

Overall, the estimated total annual cost per adult patient diagnosed with ADHD in Spain was above previous reports ranging between $US 831 (€536) to $US 20,538 (€13,247) per person (7,20). Moreover, the present study included one-time costs that increased the overall burden of adult ADHD in Spain, providing a more holistic estimate of costs. However, while previous studies on the economic burden of ADHD have typically focused on only one aspect of cost (e.g., healthcare costs) (7), the present study examined the burden of adult ADHD from a multidimensional perspective, estimating costs incurred within the healthcare, social, economic, and legal domains. Particularly important for adults with ADHD, this multidimensional analysis provides a more comprehensive description of the burden and may prevent the underestimation of costs (2,7). However, it should be noted that overestimation of costs was also prevented by taking a conservative approach within the analysis (e.g., costs that could possibly be incurred by undiagnosed adults with ADHD were not quantified, such as healthcare costs derived from traffic accidents, fights, or drug consumption).

The results of previous studies that considered costs within four major domains (direct costs, indirect costs, education system costs, and justice system costs) closely resembled those reported in the present study. Accordingly, an annual cost per person of $US 20,538.95, of which 72% was attributed to work-related productivity costs, has been previously reported (7). Moreover, Sciberras et al (21) reported an annual cost per person of $US 15,664 of which 81% was attributed to work-related productivity costs. Though the latter estimated costs across the lifespan, the majority of costs were associated with adulthood (21). As the results of these studies, the estimated annual cost per patient in the present study was mainly attributed to work-related productivity costs within the economic domain (i.e., costs associated with mean wage reductions compared to non-ADHD, absenteeism, and presenteeism). However, only 45% of published studies on the economic burden of ADHD have captured indirect costs (i.e., work-related productivity) (7).

On the other hand, healthcare costs have been widely studied within economic burden studies (7). In this domain, the present study estimated an annual cost of €3,395.83 (21% of the total annual costs) and a one-time cost of €4,110.88 (52% of the total one-time costs) per patient diagnosed with ADHD. The latter included all medical consultations leading to diagnosis and those of the first-year post-diagnosis follow-up, contributing to the large one-time healthcare costs. However, these costs may be compensated with an appropriate treatment, which may have an impact on costs within

other domains. Moreover, medication was estimated to be only 10% of the annual healthcare costs. This is particularly important for undiagnosed (i.e., untreated) adults, which accounts for 85% of adult patients with ADHD in Spain (4,13). In this regard, previous studies have shown that appropriate medication may reduce the risk of substance abuse (22,23), criminality (24), traffic accidents (25), and suicide attempts (26) in patients with ADHD, which may positively impact work-related productivity and other economic and/or legal issues.

However, the results of this study should be interpreted with caution given its limitations. First of all, the estimated burden of adult ADHD applies specifically to Spain and is therefore not representative of other countries. Within the healthcare domain, the large variability reported for the management of ADHD across regions of Spain may infer a large variability of costs as well. However, the present study did not include an interregion analysis of costs, which should be considered in future studies. Notwithstanding, a reasonable range for the consumption of healthcare resources was included in the sensitivity analysis to account for this variability. Moreover, healthcare costs incurred were mainly associated with ADHD follow-up and treatment and as such were only applied to adult patients with an ADHD diagnosis (0.5%) (12) for the estimation of total costs. Therefore, total costs incurred by adults with ADHD who are yet to be diagnosed and treated were underestimated, as the healthcare domain was not accounted for in these patients. Accordingly, future studies are encouraged to estimate the burden of adult ADHD before and after diagnosis, as it was not possible in the present study given the lack of scientific literature on the matter. Moreover, future studies should consider ADHD as a lifespan disorder in which any action taken during initial stages may drastically affect the course of the disorder and its burden (8).

Conclusions

The present study highlights the large burden that adult ADHD poses on the healthcare system and society at large. In contrast to childhood ADHD, symptoms in adulthood result in very serious consequences for the patients and society at large. The impact of ADHD encompasses almost every aspect of adult life, including social (e.g., substance abuse), work-related (e.g., productivity loss), and legal aspects (e.g., criminality). This is particularly important for undiagnosed patients with ADHD as appropriate treatments have shown positive results in these areas and may therefore reduce its associated socioeconomic burden. Accordingly, strategies that promote an early diagnosis and treatment should be implemented. The results of the present study can be used to inform policy and practice to help reduce the large burden of adult ADHD.

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