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# The prevalence and effects of adult attention-deficit/ hyperactivity disorder (ADHD) on the performance of workers: results from the WHO World Mental Health Survey Initiative

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## ABSTRACT

**Objectives:** To estimate the prevalence and workplace consequences of adult attention-deficit/hyperactivity disorder (ADHD).

**Methods:** An ADHD screen was administered to 18–44-year-old respondents in 10 national surveys in the WHO World Mental Health (WMH) Survey Initiative (n = 7075 in paid or self-employment; response rate 45.9–87.7% across countries). Blinded clinical reappraisal interviews were administered in the USA to calibrate the screen. Days out of role were measured using the WHO Disability Assessment Schedule (WHO-DAS). Questions were also asked about ADHD treatment.

**Results:** An average of 3.5% of workers in the 10 countries were estimated to meet DSM-IV criteria for adult ADHD (inter-quartile range: 1.3–4.9%). ADHD was more common among males than females and less common among professionals than other workers. ADHD was associated with a statistically significant 22.1 annual days of excess lost role performance compared to otherwise similar respondents without ADHD. No difference in the magnitude of this effect was found by occupation, education, age, gender or partner status. This effect was most pronounced in Colombia, Italy, Lebanon and the USA. Although only a small minority of workers with ADHD ever received treatment for this condition, higher proportions were treated for comorbid mental/ substance disorders.

**Conclusions:** ADHD is a relatively common condition among working people in the countries studied and is associated with high work impairment in these countries. This impairment, in conjunction with the low treatment rate and the availability of cost-effective therapies, suggests that ADHD would be a good candidate for targeted workplace screening and treatment programs.

Although it is now well known that attention-deficit/hyperactivity disorder (ADHD) often continues into adulthood,[1–3] especially the inattention symptoms,[4 5] adult ADHD has only recently become the focus of clinical attention.[6 7] The same is true of epidemiological research, which has ignored adult ADHD in all but the most recent studies carried out since the development of fully-structured research diagnostic interviews in the early 1980s. Prevalence estimates of adult ADHD were consequently, until recently, based largely on extrapolations from childhood prevalence estimates using information about the proportion of childhood cases that persist into adulthood[4 8–10] or on direct estimation of prevalence in small samples.[11–13] These studies produced adult ADHD prevalence estimates in the range 1–6%, suggested that adult ADHD is often seriously impairing,[14–16] and found that ADHD is more often seen among the unemployed than the employed.[17 18]

An attempt was made to confirm these results with more representative data in the WHO World Mental Health (WMH) Survey Initiative,[19] a series of representative population surveys carried out in 26 countries using a common instrument to assess the prevalence and correlates of mental disorders. An earlier WMH report estimated that the prevalence of DSM-IV adult ADHD is 3.4% (inter-quartile range: 1.2–7.3%) in the 18–44-year-old populations of the 10 WMH countries in which this disorder was assessed.[20] That report also documented high comorbidity and substantial role impairment associated with adult ADHD in these countries.

The current study goes beyond that earlier report to estimate the prevalence of ADHD among working people (either employed or self-employed) and the effects of ADHD on role performance. Previous research on these topics was confined to patients in treatment for adult ADHD.[21 22] The present report, in comparison, considers nationally representative samples of people in the WMH countries in order to present representative data on the burden of ADHD among working people.

## METHODS

### Sample

Adult ADHD was assessed in 10 WMH countries (table 1). Three of these 10 are classified as less developed by the World Bank (Colombia, Lebanon, Mexico). The others are classified as developed.[23] The surveys were conducted face-to-face by trained lay interviewers in multi-stage household probability samples. The weighted average response rate across all countries was 67.9% (range: 45.9–87.7%).

The WMH interview schedule consisted of two parts. All respondents completed part I, which contained core diagnostic assessments. All part I respondents who met criteria for a core disorder plus a probability subsample of others were

## Original article

**Table 1** Sample design characteristics

| Country | Survey name* | Design overview† | Field dates | Sample size‡ | | Response rate§ |
|---|---|---|---|---|---|---|
| | | | | (n₁) | (n₂) | |
| Belgium | ESEMeD | Stratified multistage clustered probability sample of individuals residing in households from the national register of Belgium residents. NR | 2001–2 | (15) | (486) | 50.6 |
| Colombia | NSMH | Stratified multistage clustered area probability sample of household residents in all urban areas of the country (approximately 73% of the total national population) | 2003 | (22) | (1731) | 87.7 |
| France | ESEMeD | Stratified multistage clustered sample of working telephone numbers merged with a reverse directory (for listed numbers). Initial recruitment was by telephone, with supplemental in-person recruitment in households with listed numbers. NR | 2001–2 | (39) | (727) | 45.9 |
| Germany | ESEMeD | Stratified multistage clustered probability sample of individuals from community resident registries. NR | 2002–3 | (19) | (621) | 57.8 |
| Italy | ESEMeD | Stratified multistage clustered probability sample of individuals from municipality resident registries. NR | 2001–2 | (32) | (853) | 71.3 |
| Lebanon | LEBANON | Stratified multistage clustered area probability sample of household residents. NR | 2002–3 | (5) | (595) | 70.0 |
| Mexico | M-NCS | Stratified multistage clustered area probability sample of household residents in all urban areas of the country (approximately 75% of the total national population) | 2001–2 | (27) | (1736) | 76.6 |
| Netherlands | ESEMeD | Stratified multistage clustered probability sample of individuals residing in households that are listed in municipal postal registries. NR | 2002–3 | (22) | (516) | 56.4 |
| Spain | ESEMeD | Stratified multistage clustered area probability sample of household residents. NR | 2001–2 | (16) | (960) | 78.6 |
| USA | NCS-R | Stratified multistage clustered area probability sample of household residents. NR | 2002–3 | (139) | (3197) | 70.9 |

*ESEMeD, The European Study of the Epidemiology of Mental Disorders; LEBANON, Lebanese Evaluation of the Burden of Ailments and Needs of the Nation; M-NCS, The Mexico National Comorbidity Survey; NCS-R, The US National Comorbidity Survey Replication; NR, nationally representative; NSMH, The Colombian National Study of Mental Health.
†Most WMH surveys are based on stratified multistage clustered area probability household samples in which samples of areas equivalent to counties in the UK were selected in the first stage followed by one or more subsequent stages of geographic sampling (eg, towns within counties, blocks within towns, households within blocks) to arrive at a sample of households, in each of which a listing of household members was created and one or two people were selected from this listing to be interviewed. No substitution was allowed when the originally sampled household resident could not be interviewed. These household samples were selected from census area data in all countries other than France (where telephone directories were used to select households) and the Netherlands (where postal registries were used to select households). Several WMH surveys (Belgium, Germany, Italy) used municipal resident registries to select respondents without listing households. Eight of the 10 WMH surveys considered here are based on nationally representative (NR) household samples, while the two others are based on nationally representative household samples in urbanised areas (Colombia, Mexico).
‡ADHD was assessed only among respondents the age range 18–44 in the part II sample of each survey. Our focus is on the subsample of these respondents who were employed at the time of interview. The respondents within this subsample who were classified as meeting criteria for DSM-IV adult ADHD are reported in the column labelled n₁, while the total subsample of employed part II respondents in the age range 18–44 are reported in the column labelled n₂.
§The response rate is calculated as the ratio of the number of households in which an interview was completed to the number of households originally sampled, excluding from the denominator households known not to be eligible either because they were vacant at the time of initial contact or because the residents were unable to speak the designated languages of the survey.

administered part II, which assessed disorders of secondary interest and a wide range of correlates. Adult ADHD was assessed in part II. The part II sample was weighted to adjust for the under-sampling of respondents who did not screen positive for any part II disorders, making the weighted part II sample representative of the full population.

As one requirement for a diagnosis of ADHD is symptom onset in childhood, it was necessary to ask respondents to provide retrospective reports about their childhood symptoms of inattention and impulsivity. Based on concerns that the accuracy of these reports might be especially low among elderly respondents, the assessment of ADHD was limited to respondents in the age range 18–44. A total of 11 422 respondents in this age range were screened across the 10 surveys.

The WMH interview schedule and all other study materials were translated using standardised WHO translation and back-translation protocols and are posted at www.hcp.med.harvard.edu/wmh. Consistent interviewer training and quality control procedures were used in all surveys. Procedures for informed consent, which was obtained in all countries before beginning interviews, as well as for protecting human subjects, were approved and monitored for compliance by the Institutional Review Boards of the organisations coordinating the surveys in each country.

### Adult ADHD

The retrospective assessment of childhood ADHD in the WMH surveys was carried out as part of a larger assessment of diverse mental disorders using version 3.0 of the WHO Composite International Diagnostic Interview (CIDI 3.0).[24] The CIDI module that assessed ADHD was based on questions originally developed in the Diagnostic Interview Schedule for DSM-IV (DIS).[25] Respondents classified retrospectively as having met full ADHD criteria in childhood were then asked a single question about whether they continued to have any current problems with attention or hyperactivity/impulsivity. As described in more detail elsewhere,[20] a clinical reappraisal interview of these respondents was carried out in a probability subsample of respondents in the WMH sample in the USA,[26] using the Adult ADHD Clinical Diagnostic Scale (ACDS) v 1.2,[27 28] a semi-structured interview that includes the ADHD Rating Scale (ADHD-RS)[29] for childhood ADHD and an adaptation of the ADHD-RS to assess current adult ADHD. The ADHD-RS has been used in clinical trials of adult ADHD.[30 31] As detailed elsewhere,[26] a strong association (with an area under the receiver operating characteristic curve of 0.86) was found between the questions about ADHD in the main survey and the clinical diagnoses. Based on this result, a transformation rule was developed to convert responses to the CIDI ADHD symptom-recency questions into a predicted probability of adult ADHD

for each respondent in the larger samples. This predicted probability was then transformed to a dichotomous case classification by drawing from the binomial distribution separately for each respondent based on their predicted probability. This dichotomous case measure is the outcome used in the current report. As noted below, appropriate statistical techniques were used to adjust estimates of prevalence and significance for the fact that the outcome measures were generated from predicted probability distributions rather than measured directly.

### Socio-demographics, role performance and service use

The main focus of analysis was the prevalence and correlates of ADHD. We examined the associations of ADHD with socio-demographic variables, several measures of role performance, and responses to several questions about treatment. The socio-demographic variables included gender, age (18–29, 30–44), education (low, low-medium, high-medium, high), partner status (married or cohabitating versus never married or previously married, the latter including separated, divorced and widowed) and broad occupational category (professional, white collar technical, service, blue collar). The education categories were different for each country and were designed to divide the population into rough quartiles. The occupation categories were based on the International Labour Organization International Standard Classification of Occupations (ISCO) (see http://www.ilo.org/public/english/bureau/stat/isco/).

Role performance was assessed using the WHO Disability Assessment Schedule (WHO-DAS),[32] a battery that includes questions about number of days out of role and quantity/quality of role performance in the 30 days before interview. Days out of role were assessed with the question: "Beginning yesterday and going back 30 days, how many days out of the past 30 were you totally unable to work or carry out your normal activities?". Decreased quantity of work was assessed with the question: "How many days out of the past 30 were you able to work and carry out your normal activities, but had to cut down on what you did or not get as much done as usual?". Decreased quality of work was assessed with the question: "How many days out of the past 30 did you cut back on the quality of your work or how carefully you worked?". Responses to the three questions were analysed separately and together in a summary measure of overall role performance. The summary measure was created by counting each day out of role as 1 and each day of decreased quantity/quality of work as ½ day of lost performance. The summary measure was truncated at 30 in the uncommon case where the sum exceeded 30.

We asked about treatment of ADHD as well as more general questions about treatment of any emotional problem. Comparison of the two types of responses allowed us to pinpoint people with ADHD who had received treatment for co-occurring emotional problems but not for ADHD.

### Analysis methods

As noted above, a prediction equation estimated in the clinical re-appraisal sample was used to generate a probability of DSM-IV adult ADHD for each respondent who was administered the ADHD section in the CIDI. The method of multiple imputation (MI)[33] was used to convert these predicted probabilities into dichotomous diagnostic classifications and to adjust significance tests for the fact that the predicted clinical diagnoses are imperfectly related to actual clinical diagnoses. This method is discussed in more detail elsewhere.[26] Simple subgroup comparisons of prevalence were used to study socio-demographic correlates of ADHD in an MI logistic regression framework where a dichotomous measure of estimated ADHD was used as the dependent variable. Logits were exponentiated and are reported here as odds ratios for ease of interpretation. MI linear regression analysis was used to estimate associations of ADHD with lost role performance. In this approach, the dichotomous measure of ADHD was used as an independent variable to predict each of the role performance measures with controls for age, gender, education and occupation. The coefficients for the regression of work performance on ADHD in these models can be interpreted as the incrementally higher number of days of impaired role performance in the past 30 days associated with ADHD. These estimates were annualised by multiplying them by 12 (ie, the number of months in a year). These individual-level annualised estimates were projected to the total civilian labour force of each country by multiplying the individual-level coefficients by the ADHD prevalence estimate and the size of the labour force in that country.

All analyses were carried out on weighted data, so that all estimates presented here can be interpreted as the estimates for the general population of the different countries. Part I respondents in each survey were weighted to adjust for differential probabilities of selection within and between households and to match sample distributions to population distributions on socio-demographic and geographic variables. The part II sample was additionally weighted for the under-sampling of part I respondents without core disorders. Significance tests were estimated using the Taylor series linearisation method,[34] a design-based method implemented in SUDAAN v 8.01 (Research Triangle Institute, Research Triangle Park, NC) in order to adjust for this weighting as well as to adjust for the fact that the vast majority of the WMH country-specific sampling designs used geographic clustering. All significance tests used two-sided Wald $\chi^2$ tests based on design-corrected MI variance-covariance matrices.

## RESULTS

### Prevalence

As previously reported,[20] the MI prevalence estimate (standard error in parentheses) of current DSM-IV adult ADHD pooled across all 10 of the participating WMH surveys is 3.4% (0.4) (table 2). The prevalence estimate among workers, in comparison, is 3.5% (0.4) compared to 3.3% (0.5) among other respondents. In the total sample, and in all countries except the USA, estimated prevalence does not differ significantly between workers and other respondents. In the USA, the estimated prevalence of ADHD is significantly lower among workers than other respondents (4.5% vs 7.2%, $\chi^2_1 = 5.5$, $p = 0.021$).

### Socio-demographic correlates

For all the countries combined, the prevalence of ADHD among workers differs significantly by gender and occupation, but not for age, education or partner status (table 3). ADHD is more common among males than females, with an odds ratio (OR) of 1.7. ADHD is less common among professionals than other workers, with the elevated ORs of the other occupational groups relative to professionals ranging between 1.7 (service workers) and 3.0 (white collar technical workers).

Interaction analyses found no significant between-country differences in the associations of ADHD with either age or

**Table 2** Multiply imputed prevalence estimates of current DSM-IV ADHD among respondents aged 18–44, by employment status

| | Overall | | | Employed or self-employed | | | All other respondents | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | % | (SE) | (n) | % | (SE) | (n) | % | (SE) | (n) | χ²§ | p Value |
| Belgium | 4.1 | (1.5) | (486) | 3.7 | (1.5) | (347) | 4.8 | (2.5) | (139) | 0.0 | 0.86 |
| Colombia | 1.9† | (0.5) | (1731) | 1.9† | (0.6) | (790) | 1.9† | (0.6) | (941) | 0.0 | 0.92 |
| France | 7.3‡ | (1.8) | (727) | 6.3 | (1.7) | (533) | 10.0 | (3.6) | (194) | 0.9 | 0.35 |
| Germany | 3.1 | (0.8) | (621) | 3.5 | (1.1) | (432) | 2.1 | (0.8) | (189) | 1.2 | 0.28 |
| Italy | 2.8 | (0.6) | (853) | 3.4 | (0.7) | (569) | 1.6† | (0.7) | (284) | 2.7 | 0.10 |
| Lebanon | 1.8† | (0.7) | (595) | 0.9† | (0.5) | (305) | 2.8 | (1.4) | (290) | 2.9 | 0.09 |
| Mexico | 1.9† | (0.4) | (1736) | 2.4 | (0.7) | (749) | 1.5† | (0.4) | (987) | 1.0 | 0.32 |
| Netherlands | 5.0 | (1.6) | (516) | 4.9 | (1.9) | (389) | 5.3 | (2.8) | (127) | 0.1 | 0.79 |
| Spain | 1.2† | (0.6) | (960) | 1.3 | (0.6) | (574) | 1.0† | (0.8) | (386) | 0.2 | 0.63 |
| USA | 5.2 | (0.6) | (3197) | 4.5* | (0.7) | (2387) | 7.2‡ | (1.2) | (810) | 5.5 | 0.021 |
| Total | 3.4 | (0.4) | (11 422) | 3.5 | (0.4) | (7075) | 3.3 | (0.5) | (4347) | 0.0 | 0.99 |

*Significant difference in prevalence between employed and not employed at the 0.05 level, two-sided test.
†The upper end of the 95% confidence interval of this estimate is below the prevalence estimate for the total sample.
‡The lower end of the 95% confidence interval of this estimate is above the prevalence estimate for the total sample.
§The prevalence estimate for the USA here is somewhat different from the estimate given in a previous report[17] because a somewhat different imputation equation was used in the analyses reported here in order to be consistent with the equation used in the other WMH countries.
ADHD, attention-defecit/hyperactivity disorder; SE, standard error.

gender, but did find significant differences in the associations of ADHD with education (p = 0.008), occupation (p = 0.009) and partner status (p = 0.030). Inspection showed that the interaction involving education is due exclusively to respondents in the lowest two education categories having a very low estimated prevalence of ADHD in Colombia. The interaction involving occupation is due to white collar technical workers having an exceptionally high estimated prevalence in the USA and blue collar workers having a high estimated prevalence in France and Spain. Occupation is unrelated to ADHD in the other countries. Finally, the interaction involving partner status is due to previously married people having a high estimated prevalence in the Netherlands and never married people having a high estimated prevalence in the USA.

## ADHD and role performance

ADHD is significantly related to overall role performance in the total sample, with an annualised individual-level regression coefficient of 22.1 days out of role (reference: subjects without ADHD) (table 4). Days out of role and reduced quantity/quality of role performance are all statistically significant in the combined data. Workers with ADHD have an average excess 8.4 days out of role, 21.7 days of decreased work quantity and 13.6 days of decreased work quality. Projections of individual-level effects to the civilian labour force yields an estimate that 143.8 million lost days of productivity associated with ADHD occur each year in these countries.

No significant interactions were found in the total sample between ADHD and any socio-demographics in predicting total role performance. However, statistically significant differences were found across countries (p = 0.044), with the strongest associations in Colombia, France, Italy, Lebanon and the USA.

It is noteworthy that no controls for comorbidity were introduced into these analyses on days out of role, despite our previous analyses documenting high comorbidity between ADHD and other DSM-IV disorders.[20] The reasoning was that ADHD is temporally primary to the vast majority of comorbid disorders, meaning that any attenuation of the associations between ADHD and role performance due to controlling for comorbid disorders would indicate mediation (ie, ADHD leading to secondary disorders that, in turn, cause decrements in role performance) rather than spuriousness (ie, control

variables causing both ADHD and decrements in role performance, with ADHD playing no causal role). Nevertheless, it is instructive to investigate the extent to which such controls attenuate the ADHD–impairment associations. The analyses carried out to produce the results in table 4 were consequently repeated with controls for the other DSM-IV mental/substance disorders in the WMH surveys. The significant individual-level association (standard error in parentheses) between ADHD and overall role performance in the total sample remained significant, but decreased from 22.1 (4.8) days per year to 15.8 (4.7) days per year with the introduction of these controls, meaning that most of the days out of role could be attributed to ADHD and not to the disorders co-occurring with ADHD.

## Role performance versus work performance

As noted in the section on measures, the WHO-DAS measures decrements in role performance rather than work performance. It is also possible that respondents counted some regularly scheduled days off work as having role impairment if they had difficulty with household chores or other normal activities because of problems with their physical or mental health. We investigated this issue by reanalysing the US data, where workers were administered both the WHO-DAS and the WHO Health and Work Performance Questionnaire (HPQ) assessment of work performance. In the original analysis (table 4), the overall annualised association between ADHD and days out of role in the USA was 28.3 (8.4) days. In the analysis with the HPQ substituted for the WHO-DAS as the outcome, the annualised association between ADHD and days out of work was 33.5 (10.1) days. The fact that the latter is higher than the former was unexpected. To the extent that the same pattern would hold in other WMH countries, the WHO-DAS analyses reported above yielded estimates of the associations between ADHD and role performance that were conservative relative to work performance.

## Treatment

Respondents who screened positive for current ADHD were asked whether they received any professional treatment for their problems with concentration, inattention or impulsivity at any time in the 12 months before the interview. Very few respondents reported receiving such treatment (table 5). Indeed,

**Table 3** Associations of socio-demographic variables with multiply imputed estimates of DSM-IV ADHD among employed or self-employed respondents aged 18–44 (n = 7075)

| | Prevalence† | | | | | |
|---|---|---|---|---|---|---|
| | % | (SE) | OR* (95% CI) | $\chi^2$ | df | p Value |
| Gender | | | | | | |
| Male | 4.2 | (0.6) | 1.7* (1.1 to 2.0) | 8.6 | 1 | 0.003 |
| Female | 2.5 | (0.4) | 1.0 | | | |
| Age | | | | | | |
| 18–29 | 3.8 | (0.5) | 1.0 | 0.1 | 1 | 0.73 |
| 30–44 | 3.2 | (0.5) | 0.9 (0.7 to 1.3) | | | |
| Education‡ | | | | | | |
| Low | 4.7 | (1.0) | 1.3 (0.8 to 2.3) | 4.0 | 3 | 0.26 |
| Low-medium | 4.5 | (0.7) | 1.3 (0.8 to 2.1) | | | |
| High-medium | 3.2 | (0.5) | 1.0 (0.6 to 1.5) | | | |
| High | 1.8 | (0.4) | 1.0 | | | |
| Partner status | | | | | | |
| Married/cohabitating | 3.1 | (0.5) | 1.0 | 2.9 | 2 | 0.23 |
| Separated/widowed/divorced | 4.1 | (0.9) | 1.4 (0.9 to 2.1) | | | |
| Never married | 4.0 | (0.5) | 1.3 (0.9 to 1.8) | | | |
| Occupation | | | | | | |
| Professional | 1.7 | (0.4) | 1.0 | 13.9 | 3 | 0.003 |
| White collar technical | 5.8 | (1.3) | 3.0* (1.7 to 5.5) | | | |
| Service | 2.9 | (0.4) | 1.7* (1.0 to 3.0) | | | |
| Blue collar | 4.0 | (0.6) | 2.0* (1.1 to 2.0) | | | |

*Significantly different from the contrast category at the 0.05 level, two-sided test. †The prevalence of ADHD among respondents in each of the socio-demographic categories. ‡See the text for a definition of the education categories.
ADHD, attention-defecit/hyperactivity disorder; SE, standard error.

it was only in the Netherlands, where 2.7% of estimated cases reported receiving such treatment, and in the USA, where 12.6% did so, that any respondents estimated to have ADHD reported any treatment for the symptoms of ADHD. However, with the exceptions of Lebanon and Mexico, considerably more of the respondents with ADHD reported receiving treatment for some other emotional problems in the same time period. The proportion of these cases in treatment (other than in Lebanon and Mexico, where none were receiving treatment) is in the range between 3.5% (Belgium) and 9.6% (Colombia) in six of the other countries and much higher in the Netherlands (21.3%) and the USA (43.4%).

## DISCUSSION
Several limitations are noteworthy. First, DSM-IV criteria for ADHD were developed with children in mind and offer only limited guidance regarding adult diagnosis. Clinical studies make it clear that symptoms of ADHD are more heterogeneous and subtle in adults,[35][36] leading some researchers to suggest that assessment of adult ADHD might require an increase in the variety of symptoms assessed,[37] a reduction in the severity threshold,[38] or a reduction in the DSM-IV six-of-nine symptom requirement.[39] To the extent that such changes would lead to a more valid assessment, our estimates of prevalence and related impairment would be conservative.

**Table 4** Annualised associations between multiply imputed DSM-IV ADHD and lost role performance among employed or self-employed respondents aged 18–44†

| | Individual level | | | | | | | | National level (in million of days) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Absenteeism | | Quantity | | Quality | | Total | | Absenteeism | | Quantity | | Quality | | Total | | |
| | Days | (SE) | Days | (SE) | Days | (SE) | Days | (SE) | Days | (SE) | Days | (SE) | Days | (SE) | Days | (SE) | (n) |
| Belgium | 10.8 | (15.1) | 18.3 | (28.9) | 9.4 | (9.4) | 16.5 | (23.8) | 1.1 | (1.6) | 1.9 | (3.0) | 1.0 | (1.0) | 1.7 | (2.5) | (347) |
| Colombia | 21.9* | (9.4) | 14.3 | (9.9) | 13.0 | (9.6) | 29.4* | (11.9) | 6.2* | (2.7) | 4.1 | (2.8) | 3.7 | (2.7) | 8.3* | (3.4) | (790) |
| France | −1.0 | (3.9) | 24.9 | (27.7) | 20.1 | (12.9) | 20.1 | (17.5) | −1.0 | (4.0) | 25.5 | (28.3) | 20.6 | (13.2) | 20.6 | (17.9) | (533) |
| Germany | 13.3 | (14.4) | −3.6 | (4.9) | 3.9 | (4.6) | 13.6 | (14.6) | 10.6 | (11.5) | −2.8 | (3.9) | 3.1 | (3.7) | 10.8 | (11.6) | (432) |
| Italy | 7.7 | (9.5) | 25.6* | (12.6) | 6.4 | (6.8) | 22.2 | (13.9) | 4.0 | (5.0) | 13.4* | (6.6) | 3.3 | (3.6) | 11.6 | (7.2) | (569) |
| Lebanon | 5.8 | (9.8) | 30.7 | (26.8) | −4.1 | (4.0) | 19.4 | (13.3) | 0.1 | (0.1) | 0.4 | (0.4) | −0.1 | (0.1) | 0.3 | (0.2) | (305) |
| Mexico | 5.0 | (4.8) | 5.5 | (6.9) | −0.9 | (1.0) | 6.1 | (6.7) | 2.4 | (2.3) | 2.6 | (3.3) | −0.4 | (0.5) | 2.9 | (3.2) | (749) |
| Netherlands | −8.8 | (14.2) | −37.3 | (16.8) | −8.2 | (4.7) | −28.4 | (15.8) | −2.2 | (3.5) | −9.3* | (4.2) | −2.0 | (1.2) | −7.0 | (3.9) | (389) |
| Spain | −2.8 | (2.5) | 3.5 | (8.8) | 7.5 | (7.8) | 1.1 | (8.1) | −0.4 | (0.3) | 0.5 | (1.2) | 1.0 | (1.0) | 0.1 | (1.1) | (574) |
| USA | 10.0* | (4.6) | 29.1* | (9.0) | 20.6* | (5.9) | 28.3* | (8.4) | 37.0* | (16.9) | 107.5* | (33.4) | 76.1* | (21.9) | 104.7* | (31.2) | (2387) |
| All countries | 8.4* | (2.7) | 21.7* | (5.6) | 13.6* | (3.2) | 22.1* | (4.8) | 54.8* | (17.7) | 141.3* | (36.7) | 88.6* | (20.9) | 143.8* | (31.5) | (7075) |

*Significant at the 0.05 level, two-sided test.
†Estimates are based on linear regression equations in which the role performance outcomes are regressed on a dummy predictor variable that distinguishes workers estimated to have ADHD from all other workers, controlling for age, gender, education and occupation.
ADHD, attention-defecit/hyperactivity disorder; SE, standard error.

Second, adult ADHD was diagnosed based entirely on adult respondent self-report. Childhood ADHD is diagnosed largely from parent and teacher reports because children with ADHD have notoriously little insight into their symptoms.[40] However, use of informants is much more difficult for adults, making it necessary to rely on self-report.[36] Methodological studies comparing adult self-reports versus informant reports of adult ADHD symptoms document the same general pattern of under-estimation as in child self-reports,[41 42] suggesting that prevalence is probably under-estimated here.

Third, the MI imputation model used to estimate ADHD in this study was based on a clinical assessment carried out only in the USA. We have no way to confirm whether the calibration is as accurate in other countries. This is especially problematic given that little research on adult ADHD has been conducted outside the USA, making it unclear if the same markers apply in other countries. Given the centrality of this issue, it is important for structured assessment of adult ADHD to be expanded for use in future surveys and for the validity of these assessments to be evaluated in clinical reappraisal studies outside the USA.

Within the context of these limitations, our results show adult ADHD to be a fairly common disorder in the labour force associated with substantial lost role performance. Our finding that the prevalence of ADHD is generally as high among workers as others was unexpected based on previous clinical research that has generally found patients with ADHD to have a high unemployment rate.[18] However, disaggregation found that unemployed respondents have a higher prevalence of ADHD (5.5%) than working people (3.5%), while homemakers (1.9%) and students (2.2%) have the lowest rates.[20]

The finding that adult ADHD is significantly more prevalent among male than female workers is consistent with much previous general population research.[18] The finding that ADHD is less prevalent among professionals than other workers is not surprising given that ADHD interferes with cognitive perfor-mance and might create a selection bias against success in professional work. The finding that ADHD is not related to age in the range considered here (ie, 18–29 vs 30–44) extends the broader finding that ADHD does not spontaneously remit in early adulthood.[17]

The finding that adult ADHD appears to be somewhat more prevalent in developed than developing countries could reflect the fact that the notion of a "deficit" existing in attentiveness has to be defined in relation to the level of environment demands on attention. A deficit exists only when demands exceed the person's abilities. It might be that high environ-mental demands for attentiveness are more common in the workplaces of developed countries, leading to the higher recognition of adult ADHD in those countries. However, this possibility is only a speculation that should be confirmed with objective cognitive tests before it is accepted as true.

The key finding of the paper is that adult ADHD is associated with significant decrements in role performance. This finding is broadly consistent with much clinical evidence[28] and with evidence from neuropsychological studies.[43] However, the magnitude of the associations found here are quite large in relation to comparable estimates reported in the literature for other chronic physical and mental disorders.[44–46]

It is noteworthy that we found more than half the days out of role associated with ADHD to be due to reduced quantity/quality of role performance rather than to days out of role. This is important from an employer perspective because many employers consider some number of days out of work (typically 1 per month) part of the cost of doing business and have mechanisms to reduce financial losses due to larger numbers of absence days (eg, caps on paid sick days, disability insurance). However, employers typically expect their workers to be working when they are on the job. To find that most ADHD-related lost role performance occurs on days in role, then, is both striking and disturbing from an employer perspective.

Although we found statistically significant differences in ADHD prevalence across occupation, no between-occupation difference were found in the association between ADHD and role performance. Specifications involving other demographic variables were also generally not significant. These results suggest that the adverse effects of ADHD are widespread rather than concentrated among workers in jobs where high concen-tration is critical for success. The unusual finding that the association between ADHD and role performance is positive in the Netherlands is consequently difficult to explain and might be due to the low number of respondents or low estimated prevalence of ADHD in the Netherlands.

Our results regarding treatment of ADHD show clearly that adult ADHD is not recognised as a disorder that requires

**Table 5** Twelve-month treatment for emotional problems and more specifically for the symptoms of ADHD among employed or self-employed respondents aged 18–44 with multiply imputed DSM-IV ADHD

| | Treatment for any emotional problem | | | | | | | | | | Treatment for ADHD | | |
| | General medical | | Any mental health | | Human services | | CAM* | | Any treatment for any emotional problems | | | | |
| | % | (SE) | % | (SE) | % | (SE) | % | (SE) | % | (SE) | % | (SE) | (n)† |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Belgium | 2.5 | (5.7) | 3.1 | (7.0) | 0.0 | | 0.0 | | 3.5 | (7.2) | 0.0 | | (15) |
| Colombia | 1.0 | (1.0) | 8.6 | (7.3) | 0.0 | | 2.3 | (2.3) | 9.6 | (7.3) | 0.0 | | (22) |
| France | 2.4 | (1.6) | 4.7 | (2.9) | 0.0 | | 0.0 | | 5.8 | (3.2) | 0.0 | | (39) |
| Germany | 0.0 | | 3.8 | (6.5) | 0.0 | | 0.0 | | 3.8 | (6.5) | 0.0 | | (19) |
| Italy | 6.2 | (3.6) | 3.2 | (2.3) | 0.0 | | 1.6 | (1.6) | 7.8 | (4.0) | 0.0 | | (32) |
| Lebanon | 0.0 | | 0.0 | | 0.0 | | 0.0 | | 0.0 | | 0.0 | | (5) |
| Mexico | 0.0 | | 0.0 | | 0.0 | | 0.0 | | 0.0 | | 0.0 | | (27) |
| Netherlands | 20.2 | (11.8) | 16.9 | (11.8) | 0.0 | | 14.0 | (11.5) | 21.3 | (11.9) | 2.7 | (2.4) | (22) |
| Spain | 4.3 | (3.5) | 4.3 | (3.5) | 0.0 | | 0.0 | | 4.3 | (3.5) | 0.0 | | (16) |
| USA | 20.0 | (3.5) | 23.7 | (5.1) | 9.1 | (1.8) | 10.6 | (2.9) | 43.4 | (5.1) | 12.6 | (3.9) | (139) |

*CAM: complementary and alternative medical treatment (eg, self-help group, chiropractor, faith healer, etc).
†The numbers of respondents with ADHD reported here, when divided by the total numbers of employed respondents in the age range 18–44, which were reported in table 1, do not reproduce the prevalence estimates reported in table 1. This is because the sample sizes reported here are unweighted (ie, they represent the actual numbers of respondents in the various samples), while the prevalence estimates are based on weighted data.
ADHD, attention-deficit/hyperactivity disorder; SE, standard error.

## Main messages

▶ A high proportion of childhood attention-defecit/hyperactivity disorder (ADHD) persists into adulthood.
▶ An average of 3.5% of workers in nationally representative surveys carried out in 10 countries met criteria for current DSM-IV adult ADHD.
▶ Workers with ADHD have an average 8.4 excess sickness absence days per year and even higher annualised average excess numbers of work days associated with reduced work quantity (21.7 days) and quality (13.6 days).
▶ Only a small minority of these workers are treated for ADHD despite evidence that such treatment can be quite effective in improving functioning.

## Policy implications

▶ Attention-defecit/hyperactivity disorder (ADHD) is a good candidate for targeted workplace screening and treatment programs.
▶ Evaluation is needed to determine the extent to which best-practices outreach and treatment interventions would result in improvements in work performance that have a positive return-on-investment from the employer perspective.

treatment in most of the countries studied. A much higher proportion of cases in the USA and the Netherlands could be detected if professionals treating patients with other emotional problems screened for comorbid ADHD, as sizable minorities of ADHD cases in both countries receive treatment for other emotional problems. However, in the other countries only small proportions of ADHD cases receive treatment for any emotional problem.

The above results raise the question whether adult ADHD is a candidate for targeted workplace screening and treatment programs. Short screening scales that are both sensitive and specific for adult ADHD exist.[47 48] It might be cost-effective from the employer perspective to implement workplace screening programs with such a scale to detect and provide treatment for workers with ADHD. The thinking here is that ADHD among workers has non-trivial prevalence, high impairment and a low rate of treatment, whereas cost-effective therapies exist that are related to improvements in some objective aspects of role performance.[49–51] The obvious next step from a public health perspective, given these findings, is to evaluate the extent to which best-practices outreach and treatment would result in improvement in functioning that might have a positive return-on-investment for employers.

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