Health, lifestyle and occupational risks in Information Technology workers

D. Lalloo[1], J. Lewsey[2], S. V. Katikireddi[3], E. B. Macdonald[1] and E. Demou[3]

[1]Healthy Working Lives Group, Institute of Health and Wellbeing, University of Glasgow, Glasgow G12 8RZ, UK, [2]Health Economics and Health Technology Assessment, Institute of Health and Wellbeing, University of Glasgow, Glasgow G12 8RZ, UK, [3]MRC/CSO Social and Public Health Sciences Unit, Institute of Health and Wellbeing, University of Glasgow, Glasgow G3 7HR, UK.

Correspondence to: D. Lalloo, Healthy Working Lives Group, Institute of Health and Wellbeing, University of Glasgow, 1 Lilybank Gardens, Glasgow G12 8RZ, UK. Tel: +44 (0) 141 3303559; fax: +44 (0) 141 3305018; e-mail: drushca@hotmail.com

Background	Information technology (IT) and the IT workforce are rapidly expanding with potential occupational health implications. But to date, IT worker health is under-studied and large-scale studies are lacking.
Aims	To investigate health, lifestyle and occupational risk factors of IT workers.
Methods	We evaluated self-reported health, lifestyle and occupational risk factors for IT workers in the UK Biobank database. Using logistic regression, we investigated differences between IT workers and all other employed participants. Regression models were repeated for IT worker subgroups (managers, professionals, technicians) and their respective counterparts within the same Standard Occupational Classification (SOC) major group (functional managers, science and technology professionals, science and technology associate professionals).
Results	Overall, 10 931 (4%) employed participants were IT workers. Compared to all other employed participants, IT workers reported similar overall health, but lower lifestyle risk factors for smoking and obesity. Sedentary work was a substantially higher occupational exposure risk for IT workers compared to all other employed participants (odds ratio [OR] = 5.14, 95% confidence interval [CI]: 4.91–5.39) and their specific SOC group counterparts (managers: OR = 1.83, 95% CI: 1.68–1.99, professionals: OR = 7.18, 95% CI: 6.58–7.82, technicians: OR = 4.48, 95% CI: 3.87–5.17). IT workers were also more likely to engage in computer screen-time outside work than all other employed participants (OR = 1.42, 95% CI: 1.35–1.51).
Conclusions	Improved understanding of health, lifestyle and occupational risk factors from this, the largest to date study of IT worker health, can help inform workplace interventions to mitigate risk, improve health and increase the work participation of this increasingly important and rapidly growing occupational group.
Key words	Behaviours; computer professionals; information technology; lifestyle; occupational health; UK Biobank.

Introduction

Advancement of information technology (IT) has seen a rapid growth in the IT workforce [1], potentially with substantial occupational health (OH) implications. Given their pivotal role in economic and business development globally [2,3] and their increasing size, reliable data and research on this occupational group are essential, to help plan services, meet IT worker needs and establish areas of unmet OH need. To date, robust data and health and well-being research on this occupational group are lacking [2,3].

Defining an IT worker is complex and challenging [2,3]. The Information Technology Association of America (ITAA) uses a broad definition: any skilled worker who performs any function related to IT [3]. In essence, IT workers develop and maintain computer systems, and should be distinguished from other professional groups who use computers as part of their jobs. IT worker roles vary and include: software, hardware and network design and management, data management (storage, administration, retrieval, processing and protection) and helpdesk assistance [2,3]. Big data and artificial intelligence have become important functions

Key learning points

What is already known about this subject:
- The advancement of information technology has seen a rapid growth in the information technology workforce, potentially with substantial occupational health implications, yet there is a paucity of formal research on information technology worker health and well-being, particularly within Europe and North America.
- Most studies to date are small-scale, mainly within a single sector/company, making it hard to assess representability across this varied workforce and have largely neglected risks related to non-communicable diseases, despite their substantial disease burden.

What this study adds:
- Information technology workers have substantially higher exposures to sedentary work than both all other employed UK Biobank participants and comparator groups with similar occupational classifications.
- Compared to all other employed UK Biobank participants, information technology workers had lower levels of lifestyle risk factors for smoking and obesity; but higher computer screen-time outside work.
- This study fills a knowledge gap of risks related to non-communicable diseases in information technology workers.

What impact this may have on practice or policy:
- Improved understanding of health, lifestyle and occupational risk factors of this large and varied information technology worker population can help inform workplace interventions, to mitigate risk, improve health and increase work ability in information technology workers.
- This study sets a benchmark for large-scale information technology worker health studies.

as has information security, particularly with the shift to 'cloud' data storage.

IT jobs are not exclusively located within the IT industry, i.e. the industry that develops and sells IT software, services, systems and devices [3]. Given the rapid integration of IT into business, education, healthcare, industry and homes, IT workers are distributed across multiple sectors (public, private, government, education) and because of this dispersion, identifying and studying this IT worker group has proven difficult [3].

There is a paucity of formal research on IT worker health and well-being. Given the IT industry shift to Asia (due to cost savings and increased workforce availability) [4], IT worker health studies predominantly stem from these countries, where lifestyle, culture and working conditions are different and therefore not generalizable. There are only few European [5–8] and US [9,10] studies, two of these [5,9] briefly addressing health and lifestyle factors and the remainder, evaluating stress/burnout. Most IT worker studies to date are small-scale and limited to employees working in IT companies. They are usually set within a single company or sector, making it hard to assess representability across this varied workforce and they typically focus on three work-related outcomes: musculoskeletal problems, visual strain/fatigue and stress/psychological issues [11–14].

Research has largely neglected risks related to non-communicable diseases (NCDs) among IT workers, despite their substantial disease burden. While it has been surmised that high work stress, sedentary work

and long working hours result in unhealthy behaviours and lifestyle choices [15,16], few IT worker studies have considered health behaviours and lifestyle risk factors [5,9,11,16–18] or evaluated these as outcomes. Many focus on sleep [5,11,18] and are limited to one or two risk factors, with a fuller, broader picture and robust assessment lacking. To our knowledge, there are no large-scale studies, and specifically, no UK-based studies assessing health behaviours and lifestyle factors of this growing workforce.

Improved understanding of occupational risk factors and exposures, even at sector level, can help inform workplace interventions to mitigate risk and reduce NCDs, thereby improving health and work participation. Our aim therefore was to evaluate health, lifestyle and occupational risk factors of IT workers compared with the general working population, other similar comparable occupational groups and within IT worker subgroups, in the UK Biobank.

Methods

We analysed cross-sectional baseline data from the UK Biobank cohort study. Between 2006 and 2010 just over 500 000 participants from the general population aged 40–69 years were recruited into this study. This entailed touch-screen questionnaire completion and face-to-face interviews with physical and biological sample measurements described in detail elsewhere (https://www.ukbiobank.ac.uk/).

Baseline assessment included socio-demographic information (age, sex, ethnicity, socio-economic status using the Townsend score, household annual income, professional qualifications, current employment), self-reported health behaviour and lifestyle data (smoking status, alcohol consumption, physical activity, sleep, self-rated health perception, TV-viewing time, computer screen-time outside work) and physical health measurements (including height, weight, body mass index [BMI]). Employment status was recorded for 99% of participants alongside basic occupational exposure data including: whether the job involves mainly walking or standing, working week duration and work/job satisfaction.

Those 'currently employed' were interviewed by trained Biobank operators to gather job description information including, job title, job tasks and industry type. Following a tree structure algorithm, the operators coded the jobs using the four-digit Standard Occupational Classification (SOC) V.2000. A number (*n* = 18 322) of job descriptions could not be coded via the algorithm. These were subsequently SOC coded using the Computer Assisted Structure COding Tool (CASCOT) described in detail elsewhere [19] and were included in our analyses. Participants not employed were excluded.

All outcome variables were dichotomized into low or high risk based on current clinical and health guidelines, where available (see footnotes 1–4 in Supplementary Material 2). Physical activity was based on the International Physical Activity Questionnaire (IPAQ) short form, converted into metabolic equivalents (MET min/week) and categorized into adequate (≥600 MET min/week) or inadequate (<600 MET min/week) [20]. Implausible values, i.e. total daily physical activity exceeding 24 h, were recorded as missing in our analyses. In the absence of available guidelines for adults, applying evidence on screen-time limits for adolescents and teens [21], total screen-time and its constituent categories (i.e. computer screen-time outside work and TV-viewing time), were dichotomized into ≤2 or >2 h/day.

Descriptive statistics were used to summarize study population characteristics. Logistic regression analyses were undertaken to assess associations between IT worker status (compared to all other employed participants) and health or lifestyle outcomes. Model 0 was unadjusted for all covariates; Model 1 adjusted for potential confounders (age, sex, ethnicity, annual household income and socio-economic deprivation); Model 2 adjusted for both potential confounders (as above in Model 1) and mediators (smoking status, BMI, sleep duration and total screen-time, i.e. computer screen-time outside work plus TV-viewing time, where these were not the dependent variable). These regression models were repeated for the IT worker subgroups of managers, professionals, technicians (with managers as

the reference category). Given potential differences between all other employed participants and the IT worker group, the models were also repeated for more comparable skill levels using the SOC category major group counterparts of functional managers (FMs), science and technology professionals (STPs) and science and technology associate professionals (STAPs), each as the reference categories, respectively.

Analyses were performed using statistical software Stata V14 (StataCorp LP). We analysed separately the study population for which most covariate values were available and then undertook a complete case analysis, which also included covariates with a higher proportion of missing data (i.e. alcohol consumption, physical activity and work/job satisfaction). This study was conducted under generic UK Biobank approval from NHS National Research Ethics service (Ref 11/NW/0382), Application number 17333.

Results

The stages in defining our study population are presented in Figure 1. Of the 287 151 employed participants included in this study, 10 931 (4%) were IT workers (Supplementary Material 1 and 2) (available as Supplementary data at *Occupational Medicine* Online). Over three-quarters (76%) were male, with a median age of 50 years (25th/75th percentile: 45/55) (Supplementary Material 1, column A). The IT workers, as compared to all other employed participants, were more likely to: hold a degree qualification (58% versus 37%), be least socio-economically deprived (52% versus 45%) and have an annual household income in excess of £52 000 (54% versus 31%). Conversely, they were less likely to be troubled with sleeplessness/insomnia compared to all other employed participants (34% versus 27% never/rarely affected, respectively).

IT workers comprised 3698 IT managers, 5756 IT professionals and 1477 IT technicians (1%, 2% and 0.5% of the total employed UK Biobank cohort, respectively)—see Supplementary Material 1, column B. The median age of each subgroup was 50 years (25th/75th percentile: 45/55), 49 years (25th/75th percentile: 44/55) and 51 years (25th/75th percentile: 45/56), respectively, and in all groups the majority were male (76%, 80% and 62%, respectively). A higher proportion of managers were in the least socio-economically deprived category (58% versus 50% of professionals and 46% of technicians), yet a higher proportion of professionals held a degree qualification (63% versus 57% of managers and 38% of technicians).

The logistic regression analyses in Supplementary Material 3 (available as Supplementary data at *Occupational Medicine* Online). were based on 252 932 individuals (88% of the total employed participants) and
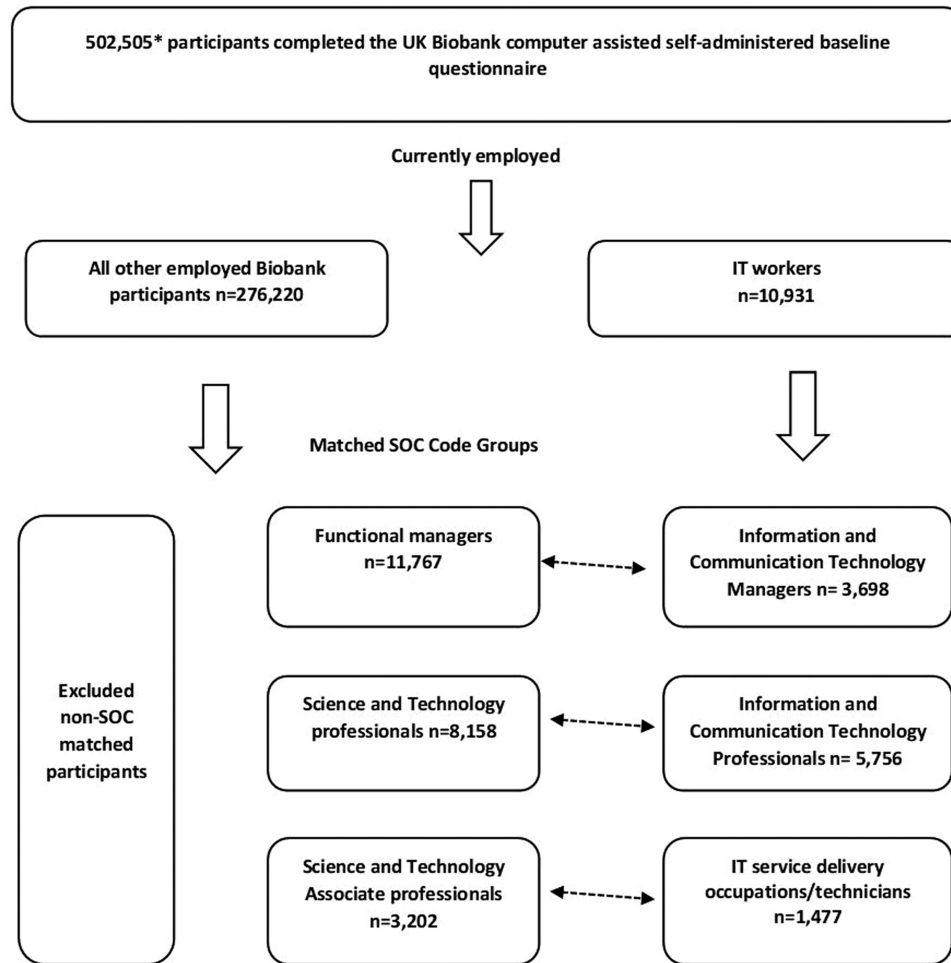
Figure 1. Flow chart of the selection process.

in Figure 2/Table S1 (available as Supplementary data at *Occupational Medicine* Online) were based on 14 363 FMs, 12 797 STPs and 4172 STAPs (93%, 92%, 89% of employed participants in these respective SOC trees).

IT workers were less likely to be previous/current smokers compared to all other employed participants even after adjustment (Model 2: odds ratio [OR] = 0.85, 95% confidence interval [CI]: 0.82–0.89) (Supplementary Material 3, column A). IT professionals were less likely to be previous/current smokers compared to IT managers (Model 2: OR = 0.86, 95% CI: 0.78–0.94) (Supplementary Material 3, column B).

After adjustment, IT workers had a reduced risk of a BMI in excess of recommended guidelines (Model 2: OR = 0.89, 95% CI: 0.86–0.93), compared to all other employed participants (Supplementary Material 3, column A). IT professionals were less likely than IT managers to have an excessive BMI (Model 2: OR = 0.79, 95% CI: 0.72–0.87) (Supplementary Material 3, column B).

For sleep duration, no substantial differences were seen between IT workers and all other employed participants, even after adjustment (Supplementary Material 3, column A). IT professionals were less likely (Model 2: OR = 0.84, 95% CI: 0.76–0.93) to have inadequate sleep than IT managers (Supplementary Material 3, column B).

IT workers were more likely to engage in >2 h/day of computer screen-time outside work compared to all other employed participants (Model 2: OR = 1.42, 95% CI: 1.35–1.51). IT professionals (Model 2: OR = 1.52, 95% CI: 1.37–1.69) and technicians (Model 2: OR = 1.75, 95% CI: 1.42–2.15) were more likely to engage in >2 h/day of computer screen-time outside work than their respective STP and STAP counterparts, although no substantive differences were seen for IT managers (Figure 2).

The odds of IT worker's jobs being sedentary were over five times compared to all other
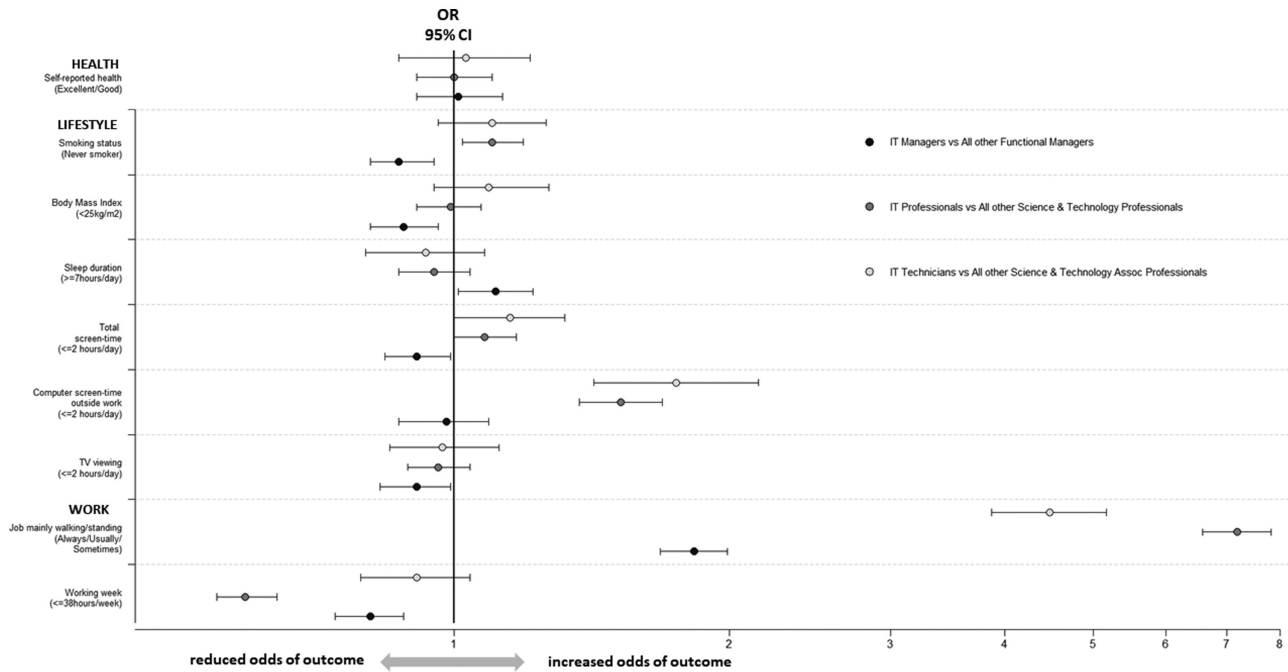
Figure 2. Multivariable logistic regression Model 2 (adjusted for potential confounders and mediators) of IT subgroups versus similar occupations within their SOC tree (functional Managers, science and technology Professionals, science and technology associate Professionals). Model 0: unadjusted and Model 1: adjusted for potential confounders, are included in Table S1 (available as Supplementary data at *Occupational Medicine* Online).

employed participants, even after adjustment (Model 2: OR = 5.14, 95% CI: 4.91–5.39) (Supplementary Material 3, column A). Across all models and attenuated after adjustment, the odds of IT professional's jobs being sedentary were almost two times that of IT managers (Model 2: OR = 1.84, 95% CI: 1.65–2.04). Conversely, IT technician's jobs were less sedentary compared to IT managers (Model 2: OR = 0.75, 95% CI: 0.65–0.87) (Supplementary Material 3, column B). Across all models and with attenuation after adjustment for managers and professionals, the odds of IT manager's jobs being sedentary were approximately two times (Model 2: OR = 1.83, 95% CI: 1.68–1.99); IT professional's jobs were over seven times (Model 2: OR = 7.18, 95% CI: 6.58–7.82); and IT technician's jobs were over four times (Model 2: OR = 4.48, 95% CI: 3.87–5.17), that of their respective FM, STP and STAP counterparts (Figure 2).

IT workers were less likely to work beyond the average working week (Model 2: OR = 0.80, 95% CI: 0.77–0.84) compared to all other employed participants (Supplementary Material 3, column A). IT professionals (Model 2: OR = 0.45, 95% CI: 0.41–0.50) and technicians (Model 2: OR = 0.42, 95% CI: 0.37–0.49) were substantially less likely to work beyond the average working week compared to IT managers (Supplementary Material 3, column B). IT managers (Model 2: OR = 0.81, 95% CI: 0.74–0.88) and IT professionals (Model 2: OR = 0.59, 95% CI: 0.55–0.64) were both less likely to work beyond the average

working week compared to their respective counterparts (Figure 2).

All other associations are shown in Supplementary Material 3, Figure 2 and Table S1 (available as Supplementary data at *Occupational Medicine* Online). Although alcohol, physical activity and work/job satisfaction were variables limited by a high proportion of missing data, and the results therefore to be considered with caution, we observed the following findings for these outcomes (analyses were based on 34 278 individuals, i.e. 12% of the total employed participants).

For alcohol consumption, after adjustment, no differences were found for IT workers compared to all other employed participants or across IT worker subgroups (Table S2, columns A and B, available as Supplementary data at *Occupational Medicine* Online).

Across all three models an increased risk (Model 2: OR = 1.26, 95% CI: 1.11–1.43) of inadequate physical activity in IT workers compared to all other employed Biobank participants was observed. No differences were found across IT worker subgroups (Table S2, columns A and B, available as Supplementary data at *Occupational Medicine* Online).

Across all three models an increased likelihood of IT workers being unhappy in their work/jobs (Model 2: OR = 1.67, 95% CI: 1.45–1.93) compared to all other employed Biobank participants was observed. No differences were found across IT worker subgroups (Table S2, columns A and B, available as Supplementary data at *Occupational Medicine* Online).

Discussion

In this, the largest to date study of IT worker health, IT workers have substantially higher exposures to sedentary work than both all other employed participants (five times the odds) and their SOC group counterparts (approximately two, seven and four times the odds, for managers, professionals and technicians, respectively). IT workers reported similar overall health, but lower lifestyle risk factors for smoking and obesity. IT professionals are less likely to have lifestyle risks of smoking, obesity and inadequate sleep than IT managers yet conversely, their jobs are substantially more sedentary. IT technicians' jobs are less sedentary compared to IT managers. This is likely related to their technical services support role, which can be peripatetic, responding to helpdesk calls, particularly for those not working in IT companies.

This UK-based study is substantially larger than any previously published studies examining IT worker health and well-being. It has a large range and rich characterization of variables. In contrast to other studies, it is not restricted to a specific IT company. With recruitment from the general working population, it includes IT workers working in different IT companies and those employed out with IT companies (across various organizations/sectors), thereby providing a broader and more generalizable overview of IT worker health and well-being. Additionally, it fills a knowledge gap of risks related to NCDs in IT workers.

The UK Biobank was set up for a broader purpose than specifically evaluating occupational factors, so there is limited OH and exposure information and no sickness absence data. Response rates to the baseline UK Biobank survey are acknowledged to be low (https://www.ukbiobank.ac.uk/), participants are aged ≥40 years and our study included those employed only. Therefore, our results may not be representative of all UK IT workers. Potential selection bias through the recruitment method, recall bias and healthy-worker effect may underestimate the true occupational risks of IT work and the cross-sectional nature of this study is more about describing health needs, rather than establishing causality.

While our results are consistent with the broader literature for some risk factors, there is variance for others. Our findings of less previous/current smoking and higher income levels are in keeping with those of an Indian software industry study [17]. A 1983 US IT professional study [9] which assessed alcohol and smoking precludes comparison with our findings, due to variable heterogeneity and the historical nature of the data. Sleep deficit and sleeplessness/insomnia not identified as substantive factors in our IT population are consistent with a Finnish study [5], where sleep debt and insomnia were not common in their

IT population. A study [11] of Indian and US-based software professionals observed that getting 'good' sleep was the commonest strategy used to manage health and work-related symptoms. Conversely, in another Indian study [18], over half reported insomnia symptoms. A Taiwanese study [16] reported a higher obesity prevalence among IT workers, whereas our study identified a lower comparative obesity risk. A general population review identified limited evidence of a longitudinal relationship between sedentary behaviour and obesity risk in adults [22]. Sedentary behaviour, however, has been identified as a distinct risk factor (independent of physical activity), for multiple adverse health outcomes including: increased all-cause mortality, cardiovascular disease, cancer, diabetes, metabolic syndrome and mental illness [23,24]. Our working week findings are in contrast with Finnish and Japanese studies [5,25], which report excessive working hours in IT employees. Our results could demonstrate differing work cultures and conditions across these countries. This is supported by a study comparing Indian and US employees of the same IT company, with the Indian employees reporting a 10.5-h and the US employees reporting a 7.5-h average working day [11].

While IT has brought us physical activity tracking devices and prompting apps (reminding us to get up and move regularly), our findings highlight that IT workers themselves are not adopting this important health promotion advice. There is a need for interventions focused on reducing sedentary behaviour both within and out with the workplace and for education and awareness among IT workers to minimize sedentary behaviour.

Despite some evidence from our study that IT workers, IT professionals in particular, either intentionally or unintentionally adopt other positive health and lifestyle measures, the overall impact of sedentary behaviour on IT worker health is unclear. Further research on disease incidence (particularly those associated with sedentary behaviour such as cardio-metabolic disease and cancer) in IT workers is needed to evaluate the health impact of this risk factor. The higher computer screen-time outside work among IT workers identified in our study may represent leisure use, but it may also potentially reflect an extension of work beyond the standard working day/hours and merits further research.

This study sets a benchmark for large-scale IT worker health studies. Improved understanding of health, lifestyle and occupational risk factors of this large and mixed IT worker population can help inform workplace interventions to mitigate risk, improve health and increase the work participation of this rapidly growing and under-researched occupational group.

Competing interests

None declared.

References

1. The Office for National Statistics. EMP04: Employment by Occupation. https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/datasets/employmentbyoccupationemp04 (15 August 2020, date last accessed).

2. National Research Council. *Building a Workforce for the Information Economy*. Washington, DC: The National Academies Press, 2001. https://www.nap.edu/catalog/9830/building-a-workforce-for-the-information-economy (15 August 2020, date last accessed).

3. Freeman P, Aspray W. *The Supply of Information Technology Workers in the United States*. Washington, DC: Computing Research Association,1999. https://cra.org/resources/workforce-reports/ (15 August 2020, date last accessed).

4. Computerworld. India to Overtake U.S. on Number of Developers by 2017. 2013. https://www.computerworld.com/article/2483690/it-careers/india-to-overtake-u-s--on-number-of-developers-by-2017.html (15 August 2020, date last accessed).

5. Kivistö M, Härmä M, Sallinen M, Kalimo R. Work-related factors, sleep debt and insomnia in IT professionals. *Occup Med (Lond)* 2008;**58**:138–140.

6. Kouvonen A, Toppinen-Tanner S, Kivistö M, Huuhtanen P, Kalimo R. Job characteristics and burnout among aging professionals in information and communications technology. *Psychol Rep* 2005;**97**:505–514.

7. Sonnentag S, Brodbeck FC, Heinbokel T, Stolte W. Stressor-burnout relationship in software development teams. *J Occup Organ Psychol* 1994;**67**:327–341.

8. Salanova M, Peiró J, Schaufeli W. Self-efficacy specificity and burnout among information technology workers: an extension of the job demand-control model. *Eur J Work Organ Psychol* 2002;**11**:1–25.

9. Ivancevich J, Napier H, Wetherbe J. Occupational stress, attitudes, and health problems in the information systems professional. *Commun ACM* 1983;**26**:800–806.

10. Pawlowski S, Kaganer E, Cater J. Focusing the research agenda on burnout in IT: social representations of burnout in the profession. *Eur J Inf Syst* 2007;**16**:612–627.

11. Das R. Occupational health concerns of software professionals and their coping strategies. *Int J Mgmt Res Bus Strat* 2012;**1**:81–85.

12. Pinto B, Ulman S, Assi H. Prevalence of occupational diseases in information technology industries in Goa. *Indian J Occup Environ Med* 2004;**8**:30–33.

13. Sharma AK, Khera S, Khandekar J. Computer related health problems among information technology professionals in Delhi. *Indian J Community Med* 2006;**31**:36–38.

14. Talwar R, Kapoor R, Puri K, Bansal K, Singh S. A study of visual and musculoskeletal health disorders among computer professionals in NCR Delhi. *Indian J Community Med* 2009;**34**:326–328.

15. Priya S, Tilak A. IT industry and health hazards. *J Pharm Res Clin Pract* 2016;**6**:8.

16. Yang SC, Chien KL, Tsai WI, Ho YL, Chen MF. The estimated risk for coronary heart disease and prevalence of dyslipidemia among workers of information technology industries in Taiwan. *Clin Chim Acta* 2011;**412**:569–573.

17. Jha A, Sadhukhan SK, Velusamy S *et al*. Exploring the quality of life (QOL) in the Indian software industry: a public health viewpoint. *Int J Public Health* 2012;**57**:371–381.

18. Zadeh S, Begum K. Association between insomnia and quality of life: an exploratory study among software engineers. *Appl Res Qual Life* 2011;**6**:335.

19. De Matteis S, Jarvis D, Hutchings S *et al*. Occupations associated with COPD risk in the large population-based UK Biobank cohort study. *Occup Environ Med* 2016;**73**:378–384.

20. The World Health Organization. Global Recommendations on Physical Activity for Health. http://apps.who.int/iris/bitstream/10665/44399/1/9789241599979_eng.pdf (15 August 2020, date last accessed).

21. Stiglic N, Viner RM. Effects of screentime on the health and well-being of children and adolescents: a systematic review of reviews. *BMJ Open* 2019;**9**:e023191.

22. Thorp AA, Owen N, Neuhaus M, Dunstan DW. Sedentary behaviors and subsequent health outcomes in adults a systematic review of longitudinal studies, 1996-2011. *Am J Prev Med* 2011;**41**:207–215.

23. Biswas A, Oh PI, Faulkner GE *et al*. Sedentary time and its association with risk for disease incidence, mortality, and hospitalization in adults: a systematic review and meta-analysis. *Ann Intern Med* 2015;**162**:123–132.

24. Teychenne M, Ball K, Salmon J. Sedentary behavior and depression among adults: a review. *Int J Behav Med* 2010;**17**:246–254.

25. Nishikitani M, Nakao M, Karita K, Nomura K, Yano E. Influence of overtime work, sleep duration, and perceived job characteristics on the physical and mental status of software engineers. *Ind Health* 2005;**43**:623–629.