

Association of cervical dysfunction and job strain with ocular symptoms among video display terminal workers in an occupational health program in China: a cross-sectional study

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Abstract

Background

Ocular symptoms are common among workers who use video display terminals, but they are often considered separately from neck-related disability and psychosocial working conditions. We examined ocular symptoms among video display terminal workers in an occupational health program and assessed whether cervical dysfunction and job strain were associated with Ocular Surface Disease Index (OSDI)-defined ocular symptoms.

Methods

This cross-sectional study included workers participating in the 2025 Occupational Health Protection Action program in Shenzhen, China. Questionnaire data were linked with occupational health examination records at the individual level. Ocular symptoms were defined as an OSDI score of 13 or higher, and cervical dysfunction as a Neck Disability Index (NDI) score greater than 4. Multivariable logistic regression was used to estimate associations after adjustment for demographic, occupational, visual, and ocular examination variables. A supplementary model examined NDI total score as a continuous exposure.

Results

Among 664 participants, 389 (58.6%) had OSDI-defined ocular symptoms. Cervical dysfunction was associated with higher odds of ocular symptoms after adjustment for covariates (adjusted odds ratio [aOR], 3.78; 95% confidence interval [CI], 2.65–5.45; $P < 0.001$). Each 0.1-unit increase in the job strain ratio was also associated with higher odds of ocular symptoms (aOR, 1.16; 95% CI, 1.05–1.30; $P = 0.006$). In the supplementary model, each 1-point increase in NDI total score was associated with higher odds of ocular symptoms (aOR, 1.27; 95% CI, 1.20–1.34; $P < 0.001$).

Conclusions

In this occupational health program, ocular symptoms were common among video display terminal workers and were associated with cervical dysfunction and higher job strain. These findings support workplace health approaches that consider visual symptoms together with neck-related disability and psychosocial working conditions. Longitudinal studies with objective ocular assessments are needed to clarify temporal relationships.

Background

Screen-based work has become a routine part of modern employment, and video display terminal (VDT) workers represent a large occupational population with repeated visual and postural demands. Ocular symptoms, including dryness, foreign body sensation, blurred vision, photophobia, and visual fatigue, may affect comfort, productivity, and quality of life. In public health terms, these symptoms are important not only as individual complaints but also as a potentially preventable burden in digitally intensive workplaces [1–4].

Previous studies have linked ocular symptoms in VDT users to screen exposure, reduced blink efficiency, air-conditioned or low-humidity environments, glare, and suboptimal lighting [5–7]. Psychosocial working conditions have also been associated with visual discomfort [8, 9]. However, workplace health programs often assess ocular symptoms, ergonomic complaints, and job stress as separate issues. This may miss the way these conditions cluster in the same workers and work settings.

The overlap between visual and musculoskeletal burden is particularly relevant to VDT work. Screen viewing is commonly accompanied by sustained sitting, forward head posture, and low-level static activation of the neck and shoulder muscles [10]. Ocular symptoms frequently coexist with neck and shoulder complaints in computer users [11]. The association between cervical dysfunction and ocular symptoms therefore deserves attention in occupational health surveillance, especially when both visual and postural demands are present.

Occupational stress is another plausible part of this shared burden. Job strain may accompany sustained visual attention, fewer opportunities for recovery, and increased neck-shoulder tension during computer work [12]. Examining cervical dysfunction and job strain within the same analytic framework may help clarify whether ocular symptoms in VDT workers are better understood as part of a broader workplace health pattern.

Accordingly, this cross-sectional study used questionnaire data linked with occupational health examination records to investigate ocular symptoms among VDT workers in Shenzhen, China. We examined whether cervical dysfunction was associated with OSDI-defined ocular symptoms after adjustment for demographic characteristics, work-related factors, visual acuity, and non-refractive ocular abnormalities, and we assessed job strain as a psychosocial working condition relevant to the same occupational setting.

Methods

Study design and participants

This cross-sectional study was conducted among video display terminal (VDT) workers participating in the Occupational Health Protection Action program in Shenzhen, China. Participants were recruited from managerial and office-based positions in more than 20 technology enterprises and traditional manufacturing companies in Shenzhen, China. Typical job types included research and design, managerial work, office-based white-collar work, technical drawing, and computer programming. The

study was organized at the company level and conducted in parallel with routine occupational health examinations. Questionnaire completion was voluntary and performed after informed consent was obtained. Eligible participants were defined as VDT workers who performed screen-based work for at least 4 hours per workday and had worked in their current position for at least 1 year. Workers with less than 4 hours of VDT work per workday or job tenure of less than 1 year were excluded. The study sample was determined by the number of eligible workers who participated in the Occupational Health Protection Action program during the study period.

A total of 818 workers participated in the study. Questionnaire and occupational health examination records were linked at the individual level. Of the 818 participants, 42 did not respond to the questionnaire, and 91 questionnaire records could not be validly linked because some questionnaires were completed using unreal names or phone numbers. As a result, 685 participants had successfully linked questionnaire and examination records. Among these linked participants, 21 were excluded because key examination items required for the present analysis were unavailable, including 7 without height and weight measurements for body mass index calculation and 14 without visual acuity and ophthalmic examination data required for visual and ocular covariates. The final complete-case analysis included 664 participants. The main analysis used a complete-case approach. Because some questionnaires were completed with invalid or non-matching identifiers, some questionnaire and examination records could not be successfully linked. The study was approved by the Ethical Review Committee of the Shenzhen Prevention and Treatment Center for Occupational Diseases (LL2020-34), and all participants provided informed consent. The study was conducted in accordance with the Declaration of Helsinki. This cross-sectional study was reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement.

Data collection

Questionnaire data were collected using the 2025 Health Survey for VDT Workers, which included modules on demographic characteristics, occupational factors, sedentary behavior, ocular symptoms, cervical function, disease history, and occupational stress. The overall questionnaire was developed for the 2025 Occupational Health Protection Action program and has not been published as a standalone instrument; an English translation of the study-specific questionnaire items used in the present analysis is provided in Supplementary File 1. The questionnaire recorded weekly work hours, daily computer use, self-reported workplace lighting condition, and daily sedentary time. Ocular symptoms were assessed using the published Ocular Surface Disease Index (OSDI), and cervical dysfunction was assessed using the published Neck Disability Index (NDI). Occupational stress was assessed using the published 22-item Job Content Questionnaire (JCQ-22). Routine occupational health examination records provided height, weight, visual acuity, and ophthalmic examination findings.

Outcome definition

The primary outcome was OSDI-defined ocular symptoms [13]. The OSDI includes 12 items covering ocular symptoms, vision-related function, and environmental triggers during the previous week. Item responses were coded according to the standard OSDI scoring system, and responses indicating that the participant had not performed the relevant activity or had not been in the relevant environment during the previous week were treated as not applicable. The total OSDI score was calculated as:

OSDI total score = (sum of item scores × 25) / number of items answered

Yielding a score range of 0 to 100, with higher scores indicating more severe ocular symptoms. In the main analysis, OSDI-defined ocular symptoms were defined as an OSDI score ≥ 13 , and OSDI < 13 served as the reference category.

Exposure definition

The primary exposure was cervical dysfunction assessed using the Neck Disability Index [14]. The NDI consists of 10 items covering pain intensity, personal care, lifting, reading, headache, concentration, work, sleep, driving, and recreation, with each item scored from 0 to 5. Higher total scores indicate greater cervical disability. For participants who selected “I do not drive or rarely drive,” the driving item was treated as non-applicable and coded as missing for scoring purposes. In such cases, the NDI total score was derived from the completed items and standardized to the conventional 0–50 scale when necessary. In the main analysis, participants with an NDI score > 4 were classified as having cervical dysfunction, whereas those with NDI ≤ 4 were classified as having no cervical dysfunction. This operational cut-point was based on the conventional NDI interpretation ranges proposed by the original developers, in which scores of 0–4 indicate no disability and scores of 5–14 indicate mild disability [14].

Covariates

Covariates were selected a priori based on subject-matter relevance and potential confounding and were prespecified to align with the primary analytic model [15–16]. These included age (years), sex, body mass index (BMI, kg/m²), weekly work hours (h/week), daily computer use (h/day), workplace lighting condition, sedentary time (h/day), job strain ratio, worse-eye visual acuity, and a proxy indicator of non-refractive ocular abnormalities.

Age, BMI, weekly work hours, daily computer use, sedentary time, and job strain ratio were analyzed as continuous variables. Sex was coded as female or male, with female as the reference category. Workplace lighting condition was categorized as appropriate, insufficient, or excessive, with appropriate lighting as the reference category.

Worse-eye visual acuity was defined as the lower value of the two eyes. For participants not wearing glasses, the recorded value represented uncorrected visual acuity; for those wearing glasses, the recorded value represented corrected visual acuity [17]. The proxy indicator of non-refractive ocular

abnormalities was defined as positive if any abnormality of the external eye/conjunctiva/cornea, lens, or fundus was recorded on examination, and negative otherwise [18].

Occupational stress was operationalized using the JCQ demand/control ratio [19], calculated as demand/control $\times 9/5$, with higher values indicating greater job strain. For regression analyses, the job strain ratio was rescaled so that the reported OR corresponded to each 0.1-unit increase.

Statistical analysis

The main analysis used a complete-case approach. Participants with missing data on the outcome, exposure, or covariates included in the primary model were excluded from the main analysis. Participant characteristics were summarized according to OSDI-defined ocular symptom status (OSDI < 13 vs OSDI ≥ 13). Continuous variables were presented as mean $\pm$ standard deviation (SD), and categorical variables were presented as number (%). Between-group comparisons were performed using independent-samples t tests for continuous variables and chi-square tests for categorical variables.

Univariable logistic regression was first used to estimate crude associations between each candidate variable and OSDI-defined ocular symptoms. Multivariable logistic regression was then used to estimate adjusted odds ratios (aORs) and 95% confidence intervals (CIs) for the association between cervical dysfunction and OSDI-defined ocular symptoms after adjustment for age, sex, BMI, weekly work hours, daily computer use, workplace lighting condition, sedentary time, job strain ratio, worse-eye visual acuity, and non-refractive ocular abnormalities.

As a supplementary analysis, the binary cervical dysfunction variable was replaced by continuous NDI total score in an otherwise similar multivariable logistic regression model to examine the robustness of the findings. All tests were two-sided, and a P value < 0.05 was considered statistically significant. Statistical analyses were performed using R software (version 4.5.2).

Results

Participant characteristics

A total of 818 workers participated in the study, of whom 685 had successfully linked questionnaire and examination records. Among these linked participants, 21 lacked key examination items required for the present analysis; therefore, the final complete-case analysis included 664 participants. The derivation of the analytic sample is shown in Fig. 1. The main loss before analysis arose from incomplete completion of required examination items, non-response to the questionnaire, and unsuccessful record linkage due to the use of unreal names or phone numbers in some questionnaires.

Among the 664 participants included in the main analysis, 389 (58.6%) had OSDI-defined ocular symptoms. Compared with participants with OSDI < 13, those with OSDI ≥ 13 had a higher prevalence

of cervical dysfunction, a higher job strain ratio, longer weekly work hours, longer sedentary time, and a higher proportion of women. Other baseline characteristics were broadly comparable between groups.

Table 1
Characteristics of participants included in the main analysis according to OSDI-defined ocular symptoms (N = 664)

Variables	Level	Total (N = 664)	OSDI < 13 (n = 275)	OSDI ≥ 13 (n = 389)	P value
Continuous variables					
Age, years	-	34.98 ± 8.26	35.19 ± 8.31	34.83 ± 8.23	0.579
BMI, kg/m ²	-	23.77 ± 3.79	23.88 ± 3.57	23.69 ± 3.94	0.519
Weekly work hours, h/week	-	44.28 ± 5.36	43.75 ± 5.10	44.66 ± 5.51	0.028
Daily computer use, h/day	-	7.27 ± 1.96	7.21 ± 1.98	7.32 ± 1.95	0.484
Sedentary time, h/day	-	7.48 ± 3.56	7.12 ± 3.55	7.73 ± 3.54	0.031
Job strain ratio (D/C × 9/5)	-	0.97 ± 0.18	0.93 ± 0.14	1.00 ± 0.20	< 0.001
Worse-eye visual acuity	-	0.78 ± 0.27	0.80 ± 0.28	0.76 ± 0.27	0.082
Categorical variables					
Sex	Female	287 (43.2%)	98 (35.6%)	189 (48.6%)	0.001
	Male	377 (56.8%)	177 (64.4%)	200 (51.4%)	
Lighting condition	Appropriate	591 (89.0%)	250 (90.9%)	341 (87.7%)	0.070
	Insufficient	32 (4.8%)	7 (2.5%)	25 (6.4%)	
	Excessive	41 (6.2%)	18 (6.5%)	23 (5.9%)	
Cervical dysfunction	No	391 (58.9%)	215 (78.2%)	176 (45.2%)	< 0.001
	Yes	273 (41.1%)	60 (21.8%)	213 (54.8%)	
Non-refractive ocular abnormality	No	637 (95.9%)	265 (96.4%)	372 (95.6%)	0.786
	Yes	27 (4.1%)	10 (3.6%)	17 (4.4%)	

Univariable associations

In univariable logistic regression, cervical dysfunction, weekly work hours, sedentary time, job strain, and insufficient lighting were positively associated with OSDI-defined ocular symptoms, whereas male sex was associated with lower odds. Age, BMI, daily computer use, worse-eye visual acuity, and non-refractive ocular abnormalities were not significantly associated with the outcome.

Table 2
Univariable logistic regression analysis of factors associated with OSDI-defined ocular symptoms (OSDI ≥ 13) in the main analytic sample (N = 664)

Variable	Level	OR (95% CI)	P value
Cervical dysfunction	Yes vs No	4.34 (3.07, 6.18)	< 0.001
Age, years	Per 1-year increase	0.99 (0.98, 1.01)	0.577
Sex	Male vs Female	0.59 (0.43, 0.80)	0.001
BMI, kg/m ²	Per 1-unit increase	0.99 (0.95, 1.03)	0.526
Weekly work hours, h/week	Per 1-hour/week increase	1.03 (1.00, 1.06)	0.031
Daily computer use, h/day	Per 1-hour/day increase	1.03 (0.95, 1.11)	0.482
Lighting condition	Insufficient vs Appropriate	2.62 (1.17, 6.65)	0.027
	Excessive vs Appropriate	0.94 (0.50, 1.79)	0.841
Sedentary time, h/day	Per 1-hour/day increase	1.05 (1.00, 1.10)	0.032
Job strain ratio (D/C $\times$ 9/5)	Per 0.1-unit increase	1.28 (1.16, 1.43)	< 0.001
Worse-eye visual acuity	Per 1-unit increase	0.60 (0.33, 1.06)	0.081
Non-refractive ocular abnormality	Yes vs No	1.21 (0.56, 2.78)	0.638

Multivariable analysis

After adjustment for demographic, occupational, visual, and ocular examination variables, cervical dysfunction remained independently associated with higher odds of OSDI-defined ocular symptoms (aOR = 3.78, 95% CI: 2.65–5.45, $P < 0.001$). Each 0.1-unit increase in the job strain ratio was independently associated with higher odds of OSDI-defined ocular symptoms (aOR = 1.16, 95% CI: 1.05–1.30, $P = 0.006$). Insufficient lighting showed a positive but non-significant association.

Table 3

Multivariable logistic regression analysis of factors associated with OSDI-defined ocular symptoms (OSDI ≥ 13) in the main analytic sample (N = 664)

Variable	Level	Adjusted OR (95% CI)	P value
Cervical dysfunction	Yes vs No	3.78 (2.65, 5.45)	< 0.001
Age, years	Per 1-year increase	1.00 (0.98, 1.02)	0.975
Sex	Male vs Female	0.70 (0.49, 1.01)	0.060
BMI, kg/m ²	Per 1-unit increase	1.01 (0.97, 1.06)	0.567
Weekly work hours, h/week	Per 1-hour/week increase	1.02 (0.99, 1.05)	0.267
Daily computer use, h/day	Per 1-hour/day increase	1.01 (0.91, 1.12)	0.900
Lighting condition	Insufficient vs Appropriate	2.31 (0.96, 6.19)	0.075
	Excessive vs Appropriate	0.70 (0.35, 1.43)	0.326
Sedentary time, h/day	Per 1-hour/day increase	1.04 (0.99, 1.11)	0.136
Job strain ratio (D/C $\times$ 9/5)	Per 0.1-unit increase	1.16 (1.05, 1.30)	0.006
Worse-eye visual acuity	Per 1-unit increase	0.70 (0.37, 1.32)	0.273
Non-refractive ocular abnormality	Yes vs No	1.35 (0.57, 3.32)	0.498

Supplementary analysis for robustness using continuous NDI total score

As a supplementary analysis to assess the robustness of the main findings to an alternative parameterization of NDI, we replaced the binary cervical dysfunction variable with continuous NDI total score in an otherwise similar multivariable model. The results were consistent with the main analysis: each 1-point increase in NDI total score was associated with higher odds of OSDI-defined ocular symptoms (aOR = 1.27, 95% CI: 1.20–1.34, $P < 0.001$).

Table 4

Multivariable logistic regression analysis using continuous NDI total score as the exposure for OSDI-defined ocular symptoms (OSDI ≥ 13)

Variable	Level	Adjusted OR (95% CI)	P value
NDI total score	Per 1-point increase	1.27 (1.20, 1.34)	< 0.001
Age, years	Per 1-year increase	1.00 (0.98, 1.02)	0.901
Sex	Male vs Female	0.78 (0.54, 1.13)	0.186
BMI, kg/m ²	Per 1-unit increase	1.02 (0.97, 1.07)	0.538
Weekly work hours, h/week	Per 1-hour/week increase	1.02 (0.98, 1.05)	0.359
Daily computer use, h/day	Per 1-hour/day increase	1.00 (0.90, 1.11)	0.995
Lighting condition	Insufficient vs Appropriate	1.88 (0.76, 5.14)	0.189
	Excessive vs Appropriate	0.68 (0.33, 1.40)	0.292
Sedentary time, h/day	Per 1-hour/day increase	1.04 (0.98, 1.11)	0.183
Job strain ratio (D/C $\times$ 9/5)	Per 0.1-unit increase	1.13 (1.02, 1.27)	0.029
Worse-eye visual acuity	Per 1-unit increase	0.69 (0.36, 1.33)	0.271
Non-refractive ocular abnormality	Yes vs No	1.52 (0.64, 3.77)	0.351

Discussion

Principal findings

In this cross-sectional study of VDT workers participating in an occupational health program, ocular symptoms were common. Cervical dysfunction was strongly associated with OSDI-defined ocular symptoms after adjustment for demographic, occupational, visual, and ocular examination variables. Job strain ratio also remained associated with ocular symptoms in the adjusted model. The supplementary analysis using continuous NDI total score showed a similar direction of association, suggesting that the eye-neck association was not driven solely by the chosen dichotomous NDI cut-point.

Ocular symptom burden in VDT workers

The high proportion of participants with OSDI-defined ocular symptoms in our study is broadly consistent with previous research showing that ocular symptoms are common among VDT users and office workers [1, 20, 21]. However, prevalence estimates vary substantially across studies because of differences in case definition, symptom thresholds, and whether symptom-based or combined symptom-and-sign criteria are used [2, 22]. Therefore, our results should be interpreted primarily in relation to

studies using symptom-oriented definitions, particularly those based on OSDI or similar instruments, rather than compared directly with studies adopting formal clinical diagnostic criteria.

Association between cervical dysfunction and ocular symptoms

The association between cervical dysfunction and ocular symptoms was the most notable finding of the present study. Participants with NDI-defined cervical dysfunction had markedly higher odds of OSDI-defined ocular symptoms. Because the NDI > 4 threshold reflects a categorical interpretation of neck-related disability rather than a diagnosis-specific clinical cut-off for VDT workers, we additionally analyzed continuous NDI total score. The continuous NDI model produced a similar pattern, supporting the robustness of the finding under an alternative exposure specification. A cautious interpretation is that ocular symptoms and neck-related disability may cluster within the same visual-postural work context during prolonged computer work [10, 11, 23].

This association may also reflect broader symptom-reporting and workload patterns rather than a direct local biomechanical pathway. Ocular symptoms may overlap with heightened sensory discomfort, neck-shoulder complaints, and psychosocial strain [24, 25]. Because our data are cross-sectional, the temporal direction of the association cannot be determined. The findings should therefore be viewed as evidence of co-occurrence and correlation within VDT work, not as evidence that cervical dysfunction causes ocular symptoms.

Role of job strain ratio

A higher job strain ratio was another independent correlate of OSDI-defined ocular symptoms in this study. This result is in line with previous studies indicating that psychological stress and adverse psychosocial working conditions may contribute to ocular symptoms [8, 26]. One possible explanation is that high job strain may accompany sustained visual attention, fewer opportunities for recovery, and greater neck-shoulder tension during computer work [9, 27]. Psychosocial strain may also influence the perception and reporting of somatic discomfort, thereby contributing to a higher symptom burden [28]. Taken together, our findings suggest that psychosocial work demands may be relevant to the broader context in which ocular symptoms occur among VDT workers.

Work-related exposures and environmental conditions

In our descriptive and univariable analyses, weekly work hours, sedentary time, and insufficient lighting showed associations with OSDI-defined ocular symptoms. However, these associations were attenuated after multivariable adjustment. This pattern should not be interpreted as evidence that such factors are unimportant. Instead, it may indicate that these exposures cluster within a broader high-demand digital working environment and partly share explanatory pathways with more proximal factors such as job strain and neck-related functional burden.

Previous studies have linked prolonged screen exposure, reduced blink efficiency, air-conditioned or low-humidity environments, glare, and suboptimal illumination to ocular symptoms in office-based workers [29]. Environmental studies have further suggested that reduced humidity, increased temperature, and decreased illumination may adversely affect ocular surface status [7, 30]. These factors may still describe the exposure context of VDT work, but in the present adjusted model they did not show clear independent associations with OSDI-defined ocular symptoms.

Sex differences

Women in our study had a higher proportion of OSDI-defined ocular symptoms in the descriptive analysis, which is consistent with previous literature reporting a greater burden of ocular symptoms among female workers [31]. However, the association was attenuated after multivariable adjustment and was no longer statistically robust. This suggests that the crude sex difference may be partly explained by correlated factors such as occupational stress, symptom burden, work pattern, or coexisting musculoskeletal complaints, rather than by sex alone as an isolated determinant. Future studies may benefit from examining sex-related differences in ocular symptoms together with hormonal, behavioral, ergonomic, and psychosocial factors.

Implications for occupational health

From an occupational and public health perspective, the findings support an integrated approach to symptom prevention in VDT workers. Workplace programs that address sustained visual strain, workstation ergonomics, lighting and indoor environmental conditions, recovery breaks, and psychosocial work stress may be more appropriate than eye-only approaches for workers with combined symptom burdens [32]. The observed co-occurrence of ocular symptoms and cervical dysfunction suggests that these issues could be screened and managed together in occupational health practice [11].

Limitations

Several limitations should be acknowledged. First, because of the cross-sectional design, causality and temporal direction cannot be established. It remains unclear whether cervical dysfunction contributes to ocular symptoms, whether ocular discomfort contributes to postural or neck-related complaints, or whether both arise from shared occupational exposures. Second, the main analysis used a complete-case approach, which may have introduced selection bias. Third, both the primary outcome and the main exposure were assessed using self-reported instruments (OSDI and NDI), raising the possibility of common-method bias. Participants with a greater overall symptom burden or heightened symptom perception may have been more likely to report both ocular symptoms and neck-related disability. Fourth, the outcome was based on OSDI-defined symptoms rather than a formal clinical diagnosis of dry eye disease, and symptom-based measures do not necessarily correspond fully with objective ocular surface signs. Fifth, although we adjusted for multiple demographic, occupational, visual, and ocular examination variables, residual confounding remains possible, including from factors such as sleep, medication use, contact lens use, blink behavior, and additional environmental exposures not captured in

the current analysis. Finally, several covariate categories contained relatively few participants, particularly non-refractive ocular abnormalities and lighting subgroups; estimates for these variables should be interpreted cautiously.

Summary

Despite these limitations, this study contributes occupational health evidence from a real-world VDT worker program with linked questionnaire and examination data. The results suggest that ocular symptoms in screen-based work may be better understood when visual, cervical, and psychosocial working conditions are considered together.

Conclusions

In this cross-sectional study of VDT workers, OSDI-defined ocular symptoms were common. NDI-defined cervical dysfunction and higher job strain ratio were associated with higher odds of ocular symptoms after adjustment for demographic, occupational, visual, and ocular examination variables. These findings support workplace health approaches that consider visual symptoms alongside neck-related disability and psychosocial working conditions. Longitudinal studies with objective ocular assessments are needed to clarify temporal relationships.

Abbreviations

VDT, video display terminal;

OSDI, Ocular Surface Disease Index;

NDI, Neck Disability Index;

JCQ, Job Content Questionnaire;

BMI, body mass index;

OR, odds ratio;

aOR, adjusted odds ratio;

CI, confidence interval;

SD, standard deviation;

STROBE, Strengthening the Reporting of Observational Studies in Epidemiology.

Declarations

Ethics approval and consent to participate

The study was approved by the Ethical Review Committee of the Shenzhen Prevention and Treatment Center for Occupational Diseases (LL2020-34). All participants provided informed consent.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Author Contribution

Liuzhuo Zhang contributed to writing the original draft, formal analysis, data curation, and visualization. Yu Hu contributed to methodology and manuscript review and editing. Jiao Bai, Dafeng Lin, Mengli Liu, Dexiang Zhu, Aipin Xiao, Shaofan Weng, Xizhi Wang, and Guangtao Yang contributed to investigation and data curation. Naixing Zhang contributed to conceptualization, methodology, supervision, project administration, and manuscript review and editing. All authors read and approved the final manuscript.

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None

Data Availability

The datasets generated and analyzed during the current study are not publicly available because they contain identifiable occupational health and questionnaire data, but are available from the corresponding author on reasonable request and subject to approval by the relevant ethics committee.

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Figures

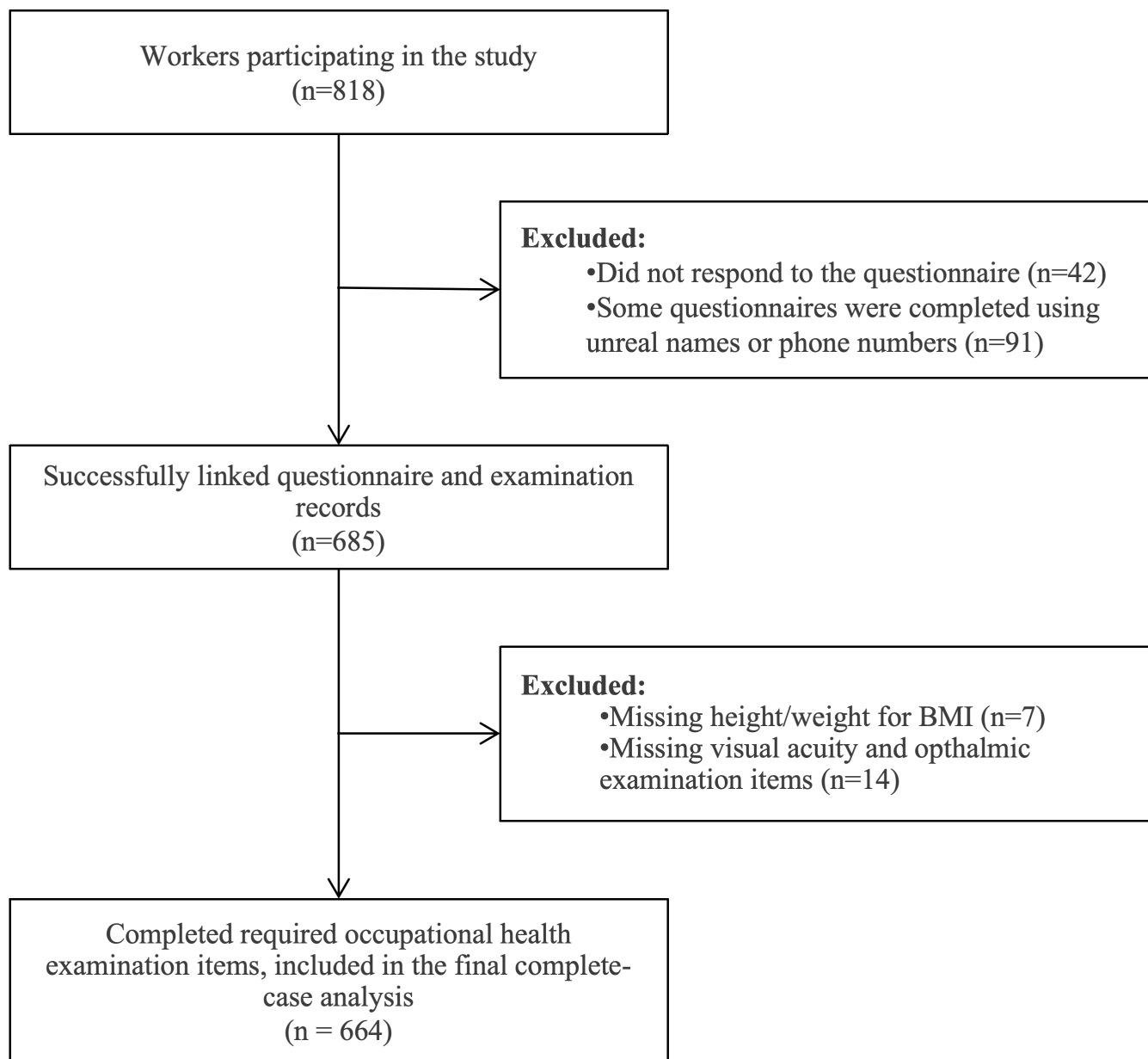


Figure 1

Flow diagram of participant selection and derivation of the final analytic sample.

Supplementary Files

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