RESEARCH ARTICLE

Association of occupational exposures and work characteristics with the occurrence of gastrointestinal disorders

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Abstract

Background: Work is a daily activity with various conditions, exposures, and habits that may affect health either positively or negatively. Aim of this study was to investigate the relationship between occupational factors and conditions, and the occurrence of gastrointestinal disorders.

Methods: We enrolled in this study a sample of 891 consecutive individuals, who were examined by standard colonoscopy and gastroscopy and interviewed regarding their working conditions and exposures. Consecutively, data were statistically analyzed to explore possible associations.

Results: Peptic ulcer diagnosis was associated with reports of muscle pain/headache [odds ratio (OR): 3.656, 95 % confidence interval (95% CI): 1.898-7.043], with working in shifts (OR: 2.463, 95% CI: 1.058-5.731), and with the presence of occupational stress (OR: 2.283, 95% CI: 1.162-4.486). Gastritis was associated with muscle pain/headache (OR: 2.258, 95% CI: 1.096-4.652), shift work (OR: 3.535, 95% CI: 1.345-9.29), occupational stress (OR: 2.182, 95% CI: 1.072-4.444), and sedentary work (OR 0.275 lower risk 95% CI: 0.113-0.671). Ulcerative colitis was associated with muscle pain/headache (OR: 6.211, 95% CI: 2.162-17.840) and occupational stress (OR: 6.418, 95% CI: 2.243-18.361), while Crohn's disease diagnosis with muscle pain/headache (OR: 3.554, 95% CI: 1.628-7.759), frequent ordering food at work (OR: 4.928, 95% CI: 2.3-10.559), occupational stress (OR: 3.023, 95% CI: 1.413-6.469), work with intense physical activity (OR: 0.665 lower risk, 95% CI: 0.252-0.758). Colon cancer diagnosis was associated with frequent ordering food at work (OR: 2.739, 95% CI: 1.268-5.916) and occupational stress (OR: 3.175, 95% CI: 1.384-7.286), while stomach cancer diagnosis with ordering food at work (OR: 2.794, 95% CI: 1.154-6.763) and exposure to dust (OR: 5.650, 95% CI: 1.551-20.582). Finally, presence of polyps was associated with ordering food at work (OR: 2.154, 95% CI: 1.135-4.091), and constipation with ordering food at work (OR: 2.869, 95% CI: 1.451-5.672), occupational stress (OR: 2.112, 95% CI: 1.097-4.066), and occupational noise (OR: 0.248, 95% CI: 0.084-0.737).

Conclusion: The incidence of the gastrointestinal diseases is affected by occupational exposures and related lifestyle habits. HIPPOKRATIA 2017, 21(2): 74-79.

Keywords: Gastrointestinal disorders, occupational exposures, work conditions, occupational stress, peptic ulcer, peptic cancer

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Introduction

Work is a significant daily activity that affects in multiple ways life and health of working populations. It has been previously documented that specific exposures in the occupational setting, such as rotating schedules, occupational stress, change of dietary habits, sedentary job conditions, extreme temperature conditions, exposure to dust and noise may be related, among others, to the occurrence of gastrointestinal diseases; however, literature investigating the relationship between occupational exposure and the occurrence of gastrointestinal diseases is scarce.

As previously reported, certain gastrointestinal disorders, namely ulcer, and gastritis, are frequent among shift workers[1,2], while there are only a few recent studies investigating the relationship with other types of

gastrointestinal disease such as inflammatory bowel disease[3,4]. Likewise, occupational stress seems to be associated strongly with the occurrence of ulcer and gastritis[5], through the enhancement of colonization of the stomach by Helicobacter pylori[6]. On the other hand, there is no bibliographic documentation of the relationship between occupational stress and peptic cancer, while studies that investigate the relationship between occupational stress and inflammatory bowel disease do not show clear results, investigating stress generally without focusing on occupational stress[7,8].

Regular long-term physical activity and shorted sedentary work seem to protect against colon cancer[9] and inflammatory bowel disease (IBD)[10]. However, these conditions can be associated with higher risk of peptic ulcer[11]. Heavy physical work, poor ergonomics in the workplace, occupational stress, and noise may also affect the incidence of peptic ulcer, gastritis, and inflammatory bowel disease through increased consumption of non-steroidal anti-inflammatory medications for treating related skeletal muscle pain and headache.

It has been shown that workers being several hours away from home are more prone to adopt a diet based on take-out food (containing higher amounts of meat, fat, salt, spices, additives, etc.) which has been associated with all types of gastrointestinal disorders[12-16]. Furthermore, there is still an insufficient number of studies investigating the relationship between environmental conditions at work, such as noise[17] or exposure to extreme temperature conditions[18] or dust[19] with the occurrence of gastrointestinal diseases. The limited number of published studies investigating the relationship between occupational exposures and the occurrence of gastrointestinal disease was the challenge that this study aimed to answer. More specifically, this study attempts to illustrate any possible correlation between various occupational exposures and the occurrence of a wide variety of gastrointestinal diseases.

Material and Methods

The study protocol was approved by the Ethics Committee of the Democritus University of Alexandroupolis (decision No: 116/04-02-2013). Our study sample comprised consecutive individuals, who attended between January 2014 and December 2015 the Endoscopy Unit of our Institution, which serves as a referral center for the Region of Eastern Macedonia and Thrace, in order to be examined for gastrointestinal disorders. All participants provided written informed consent. To overcome a possible bias against participation, it was made clear that confidentiality would be maintained and that their participation would not affect in any way the medical treatment provided by the Unit's medical staff. Primary exclusion criteria were the following: Long-term unemployment, retirement or exclusive homemaker occupation. Based on the endoscopic diagnosis, individuals were classified into the following eight groups: peptic ulcer, gastritis, Crohn's disease, ulcerative colitis, colon cancer, stomach cancer, constipation, and polyps. Individuals with normal endoscopic findings served as the control group.

For statistical analysis, descriptive statistics were initially calculated. For differences between groups, t-test or chi-squared (χ^2) test was used to examine continuous or categorical variables, respectively. To explore the relationship between several independent or predictor variables and a dependent or criterion variable, a multiple logistic regression model was created for each disorder, with each different disease as the dependent variable, while the work conditions and exposures were the independent variables.

As independent variables for occupational exposure, the following were considered: 1. presence or absence of sedentary work (investigating whether the job of the participant was primarily a sedentary-office job white collar or a blue collar job); 2. Presence or absence of shift work; 3. Presence or absence of work-related skeletal muscle pain/headache occurring more than two times per week and disappearing during vacation, necessitating the frequent use of anti-inflammatory medication; 4. Presence or absence of eating take-out instead of home cooked meals; 5. Presence of occupational stress, defined as score ≥21 in the Workplace Stress Scale (52.1 % of participants had score ≥21); 6. Presence or absence of occupational noise, indicated by reports for subjective hearing disturbance and working in a job where noise is a recognized occupational hazard; 7. Presence or absence of exposure to occupational dust, i.e., working in a job where dust is a recognized occupational hazard; 8. Presence or absence of exposure to high working place temperature [according to American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs) for heat exposure]; 9. Presence or absence of exposure to low temperature (according to ACGIH TLVs for cold exposure).

For confounding parameters, caffeine intake was measured in caffeine units (one cup of coffee is one unit of caffeine, one cup of tea is ½ unit of caffeine); smoking was measured in pack-years, and alcohol intake was measured in alcohol units per week.

In the regression analysis, all possible exposure data were entered into different models created with each examined disease as the dependent variable in order to provide a reliable measurement of occupational exposures impact.

The analysis was conducted with the Statistical Package for the Social Sciences (SPSS) software, version 17 (SPSS Inc., Chicago, IL, USA). For all analyses, a p-value <0.05 was considered statistically significant.

Results

The study included a representative sample of individuals belonging to all professional groups, according to the Greek Statistical classification of occupations (STEP-92) (Table 1). During the study period, 809 individuals were diagnosed with the following eight gastrointestinal disorders: peptic ulcer 155 (19.2 %), gastritis 102 (12.6

Table 1: The 891 consecutive individuals who underwent endoscopic examination and were enrolled in the study, per professional group.

	number	percent (%)
Armed forces	47	5.3
State Legislators	2	0.2
Persons exercising scientific, artistic and related professions	134	15.0
Technologists, technical assistants	74	8.3
Office staff	121	13.6
Service workers and vendors	124	13.9
Agriculture & Livestock	171	19.2
skilled artisans	60	6.7
Operators of industrial plants, machinery and drivers	66	7.4
Unskilled workers	92	10.3
Total	891	100.0

%), Crohn's disease 106 (13.1 %), ulcerative colitis 46 (5.7 %), colon cancer 119 (14.7 %), stomach cancer 58 (7.2 %), constipation 127 (15.7 %), and polyps 126 (15.6 %). There were also 82 individuals, in whom clinical and endoscopic findings were normal and were used as a control group. There was no statistically significant difference between patients and controls regarding age (50.3 ± 10.6 vs 49.6 ± 11.1 years, p =0.629), and gender [patients: 465 (57.5 %) males, 344 (42.5 %) females vs controls: 48 (58.5 %) males, 34 (41.5 %) females; p =0.475].

A multiple logistic regression model was used to test the effect of the occupational parameters in each type of gastrointestinal disease; smoking habit (mean: 16.46 pack-years), alcohol use (mean: 4.97 alcohol units per week), and caffeine intake (mean: 1.96 caffeine units per day) were also entered in each model (Table 2).

A higher risk of peptic ulcer was associated with the presence of work-related skeletal muscle pain/headache: [odds ratio (OR): 3.656, 95 % confidence Intervals (95% CI): 1.898-7.043], with occupational stress (OR: 2.283, 95% CI: 1.162-4.486), with shift work (OR: 2.463, 95% CI: 1.058-5.731) (Table 3).

A higher risk of gastritis was associated with work-related skeletal muscle pain and headache (OR: 2.258, 95% CI: 1.096-4.652), with shift work (OR: 3.535, 95% CI: 1.345-9.29), and with occupational stress (OR: 2.182, 95% CI: 1.072-4.444). Having a sedentary job was associated with reduced risk of gastritis (OR: 0.275, 95% CI: 0.113-0.671) (Table 3).

Ulcerative colitis was positively associated with skeletal muscle pain/headache (OR: 6.211, 95% CI: 2.162-17.840) and with occupational stress (OR 6.418 95% CI: 2.243-18.361) (Table 3). Higher odds were found for Crohn's disease to be associated with skeletal muscle pain and headache at work (OR: 3.554, 95% CI: 1.628-7.759), with occupational stress (OR: 3.023, 95% CI: 1.413-6.469), with eating out instead of home cooked meals (OR: 4.928, 95% CI: 2.3-10.559). On the contrary, work with physical activity was associated with a lower risk of Crohn's disease (OR: 0.665, 95% CI: 0.252-0.758) (Table 3).

Constipation was found to be significantly associated with eating out instead of home cooked meals (OR: 2.869, 95% CI: 1.451-5.672) and with occupational stress (OR: 2.112, 95% CI: 1.097-4.066). The occupational noise was associated with a lower risk of constipation (OR: 0.248, 95% CI: 0.084-0.737) (Table 4).

Occupational exposure to dust was added as a variable to the models for colon cancer, stomach cancer, and polyps, since previous literature reported that occupational exposure to dust might be associated with peptic cancer[19]. Higher colon cancer risk was associated with eating out instead of home cooked meals (OR: 2.739, 95% CI: 1.268-5.916) and with occupational stress (OR: 3.175, 95% CI: 1.384-7.286) (Table 4). Stomach cancer risk was positively correlated with occupational exposure to dust (OR: 5.650, 95% CI: 1.551-20.582) and also eating take-out instead of home cooked meals (OR: 2.794, 95% CI: 1.154-6.763) (Table 4). Polyp presence was significantly associated with eating out instead of home cooked meals due to work (OR: 2.154, 95% CI: 1.135-4.091) (Table 4).

Discussion

Investigating the relationship between occupational exposure and gastrointestinal disease is an interesting but still unexplored field of research as the number of relevant studies is limited and occupational conditions are dynamic and continuously evolving, affecting the results of such observational studies and creating a constant need for repeating them frequently.

Our results have shown that shift work is strongly associated with the occurrence of peptic ulcer and gastritis, a finding in line with the existing literature[2]. Our study confirmed the results of a recent report on the lack of statistically significant correlation of shift work with stomach cancer[20] but did not confirm the results of other recent studies showing that shift work and shift work's sleep disturbances may increase the risk of colorectal cancer[21]. Additionally, there was not any statistically significant correlation found between shift work and inflammatory

Table 2: Caffeine, alcohol, and smoke consumption of the 891 consecutive individuals who were enrolled in the study.

Participants	Caffeine units per day (mean)	Alcohol units per week (mean)	Smoking pack years (mean)
Peptic ulcer	1.10	6.89	18.19
Gastritis	2.12	4.36	10.73
Ulcerative colitis	1.87	4.35	13.87
Crohn's disease group	1.78	3.87	12.66
Colon cancer	1.91	8.30	24.84
Stomach cancer	1.86	5.05	16.14
Polyps	1.93	4.32	20.65
Constipation	1.93	4.32	20.65
Healthy control group	2.05	3.37	16.66

Table 3: Multiple logistic regression models created with each examined disease as the dependent variable to test the effect of the occupational parameters, smoking habit, alcohol, and caffeine intake in peptic ulcer, gastritis, ulcerative colitis, and Crohn's disease.

	patients with peptic ulcer			patients with gastritis			patients with ulcerative colitis			patients with Crohn's disease		
	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p
Sedentary work (white collar job)	0.426	0.176-1.029	0.058	0.275	0.113-0.671	0.005						
Work-related skeletal muscle pain/headache	3.656	1.898-7.043	0.000	2.258	1.096-4.652	0.027	6.211	2.162-17.840	0.001	3.554	1.628-7.759	0.001
Shift work	2.463	1.058-5.731	0.037	3.535	1.345-9.290	0.010	0.559	0.132-2.368	0.430	1.216	0.442-3.347	0.705
Eating take-out instead home cooked meals	1.436	0.740-2.786	0.284	0.542	0.241-1.219	0.139	2.745	0.988-7.631	0.053	4.928	2.300-10.559	0.000
Occupational stress	2.283	1.162-4.486	0.017	2.182	1.072-4.440	0.031	6.418	2.243-18.361	0.001	3.023	1.413-6.469	0.004
Smoking (pack-years)	0.990	0.969-1.010	0.321	0.969	0.946-0.993	0.010	0.986	0.960-1.014	0.328	0.975	0.950-1.000	0.046
Work with physical activity (blue collar job)							0.424	0.107-1.682	0.222	0.665	0.252-0.758	0.041
Alcohol (alcohol units per week)	1.128	1.043-1.221	0.003	1.154	1.033-1.290	0.011	1.203	1.036-1.398	0.016	1.130	1.016-1.256	0.025
Occupational noise	0.756	0.303-1.887	0.549	0.738	0.262-2.078	0.565	0.650	0.151-2.785	0.561	0.301	0.090-1.005	0.057
High workplace temperature	2.308	0.355-14.992	0.381	0.863	0.060-12.497	0.914	1.589	0.119-21.170	0.726	1.651	0.300-9.094	0.565
Low workplace temperature	0.487	0.068-3.479	0.473	1.108	0.075-16.421	0.941	0.362	0.024-5.387	0.460	1.329	0.238-7.409	0.745
Caffeine intake (caffeine units per day)	0.858	0.600-1.227	0.402	0.941	0.619-1.431	0.777	0.534	0.291-0.978	0.042	0.438	0.270-0.710	0.001
Constant	1.814		0.526	4.466		0.111	0.563		0.694	1.748		0.585

OR: odds ratio, 95% CI: 95 % confidence intervals.

bowel disease diagnosed, although sleep disturbances generally appear to be associated with the occurrence of these diseases[3,22].

Occupational stress has been previously reported to be associated with an increased risk of developing a peptic ulcer and gastritis[5,6,23], and this has been confirmed by our results. The relationship of occupational stress with the gastrointestinal malignancies has not been fully elucidated. Studies on this topic are sparse and warrant further exploration. Research on colorectal cancer shows conflicting results[24] while there seems to be some link between stress and stomach cancer[25]. Our research found

Table 4: Multiple logistic regression models created with each examined disease as the dependent variable to test the effect of the occupational parameters, smoking habit, alcohol, and caffeine intake in constipation, colon cancer, stomach cancer, and polyps.

	patients with constipation			patients with colon cancer			patients with stomach cancer			patients with polyps		
	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p
Work-related skeletal muscle pain/headache	1.488	0.761-2.911	0.245	1.378	0.553-3.437	0.492	1.411	0.625-3.186	0.407	1.003	0.498-2.018	0.994
Shift work	1.387	0.579-3.324	0.463	2.313	0.797-6.714	0.123	1.728	0.574-5.199	0.331	1.583	0.647-3.872	0.314
Eating take-out instead home cooked meals	2.869	1.451-5.672	0.002	2.739	1.268-5.916	0.010	2.794	1.154-6.763	0.023	2.154	1.135-4.091	0.019
Occupational stress	2,112	1.097-4.066	0.025	3.175	1.384-7.286	0.006	1.450	0.642-3.273	0.371	1.786	0.933-3.422	0.080
Smoking (pack-years)	0.985	0.966-1.005	0.153	1.005	0.985-1.026	0.620	0.996	0.977-1.015	0.681	1.000	0.985-1.016	0.964
Work with physical activity (blue collar job)	0.723	0.305-1.715	0.461	1.012	0.326-3.145	0.983	0.427	0.145-1.255	0.122	0.481	0.208-1.113	0.087
Alcohol (alcohol units per week)	1.040	0.955-1.133	0.369	1,353	1.186-1.544	0.000	1.059	0.953-1.176	0.286	1.026	0.933-1.128	0.598
Occupational noise	0.248	0.084-0.737	0.012	0.482	0.139-1.678	0.252	1.282	0.448-3.668	0.644	0.776	0.298-2.023	0.605
High workplace temperature	3.292	0.255-42.525	0.361	5.905	0.508-68.568	0.156	1.436	0.107-19.30	0.785	2.524	0.526-12.11	0.247
Low workplace temperature	0.630	0.050-7.967	0.721	0.163	0.012-2.239	0.175	0.441	0.026-7.468	0.570	0.297	0.056-1.562	0.152
Caffeine intake (caffeine units per day)	0.548	0.370-0.811	0.003	0.320	0.192-0.536	0.000	0.593	0.363-0.969	0.037	0.589	0.396-0.875	0.009
Occupational exposure to dust				2.214	0.526-9.319	0.279	5.650	1.551-20.58	0.009	2.143	0.593-7.742	0.245
Constant	3.401		0.198	0.507		0.579	2.130		0.522	5.638		0.064

OR: odds ratio, 95% CI: 95 % confidence intervals.

that occupational stress leads to higher risk of colon cancer. Additionally, occupational stress was associated with increased risk of inflammatory bowel disease as it has also been recorded in the existing literature[7,8]. Our results also demonstrated a correlation between occupational stress and constipation.

An interesting question is whether there is a correlation between work's nature (white or blue collar job) and the occurrence of gastrointestinal diseases. Having a sedentary white collar job was found to be protective against gastritis while having a blue collar job was found to be protective against Crohn's disease. The current study contributes to the clarification of this issue adding to the limited existing literature which considers inflammation bowel disease as a white collar[10] and gastritis and peptic ulcer[11] as blue collar job diseases. Our study did not show any protective effect of having a blue collar job on gastrointestinal malignancy although physical activity and shorter sitting hours are generally negatively associated with the occurrence of colorectal cancer[9]. The presence of work-related musculoskeletal pain or a headache was associated with an increased risk of gastritis, ulcer, and inflammatory bowel disease regardless of being white or blue collar job.

Lack of sufficient time to prepare home cooked meals can lead to the consumption of high caloric snacks, adopting a diet rich in fat, meat, salt, spices, additives, and salt and deficit in fiber, fruits, and vegetables. Within this rationale, our results showed a positive correlation of the substitution of homemade food due to work with a higher risk of colon cancer, stomach cancer, Crohn's disease, constipation, and polyps.

Occupational exposure to dust was found to be associated with a higher risk of stomach cancer in agreement with the conclusions of a review of English literature on mortality among hard rock miners, granite, and quarry workers[26]. This review also revealed a negative relationship between occupational exposure to dust and the occurrence of colorectal cancer which was not observed in our study. Also, we did not observe any statistically significant relationship between occupational exposure to high temperature and inflammatory bowel disease, as reported by Christine et al[18].

Animal studies have shown that exposure to loud noise leads to reduced serum nitric oxide level (NO) and elevated serum endothelin and gastrin level[17]. However, our study failed to show any statistically significant correlations between occupational noise and ulcer or gastritis. On the other hand, occupational noise was found to affect negatively the incidence of constipation.

There are certain limitations in this study, which, however, do not diminish the value of the reported re-

sults. One might say that the study investigates a set of occupational exposure parameters which may affect the accuracy of the results, compared to studies that isolate the effect of an individual exposure's factor. Its advantage, however, is that its results are exported after weighting/adjustment for a set of exposure parameters, some of which have not yet been thoroughly investigated. Also, these are the real-life working conditions, during which, an individual is co-exposed to combined hazards. Another limitation is that our sample did not derive from the general working population, but from a clinical population, with active occupational history though. We have chosen this recruitment process, taking into consideration the difficulties in applying an invasive examination program to individuals not reporting significant complaints and, thus, not seeking medical help.

In conclusion, occupational conditions and exposures and related lifestyle habits can affect the incidence of gastrointestinal disease and thus it is important to intervene for their prevention. Occupational physicians can have a more active role in promoting safer work practices and cultivating a prevention culture.

Conflict of interest
Authors declare no conflicts of interest. This study received no financial support.

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