U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ▪ Public Health Service
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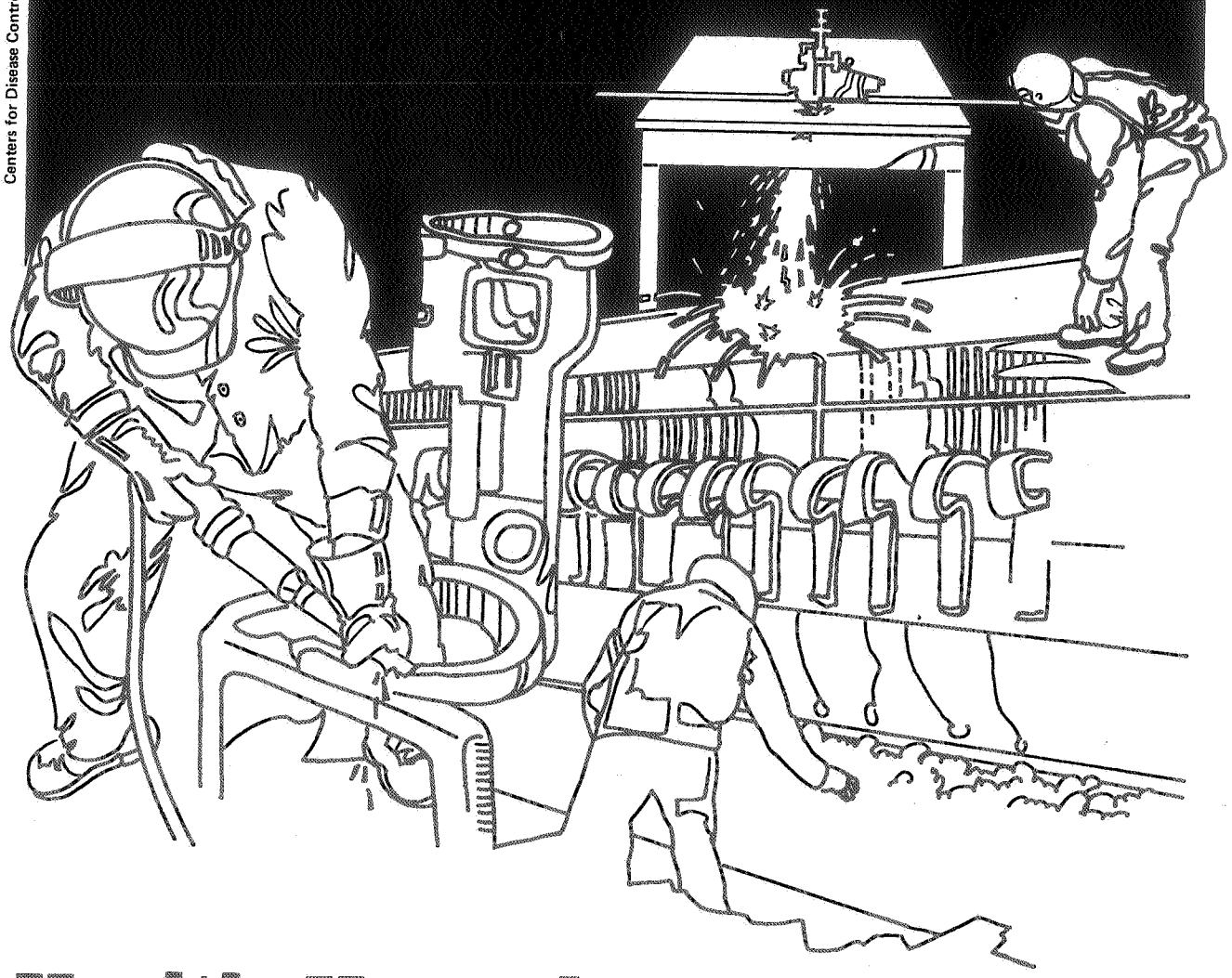
NIOSH



Health Hazard Evaluation Report

HETA 83-425-1500
WESTVIEW PRESS
BOULDER, COLORADO

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

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I. SUMMARY

In August, 1983 the National Institute for Occupational Safety and Health (NIOSH) was requested to evaluate menstrual problems among employees at Westview Press, Boulder, Colorado.

On August 22, 1983, NIOSH conducted an initial industrial hygiene survey with an initial medical visit on September 2, 1983. On September 20-22, 1983, ninety-three (93) percent of the 73 current employees were interviewed regarding general and menstrual symptoms as they might relate to work or other factors. An industrial hygiene survey was also performed in the print shop on November 9, 1983 to evaluate exposures to perchloroethylene and petroleum naphtha. Levels of perchloroethylene ranged from less than 0.01 mg/m^3 to 107 mg/m^3. Levels of petroleum naphtha ranged from less than 0.01 mg/m^3 to 118 mg/m^3. These levels are well below the evaluation criteria. NIOSH regards perchloroethylene as a potential carcinogen and recommends controlling exposures to the lowest feasible level.

Statistical evaluation of the 68 questionnaires showed headaches to be the most frequent symptom (23.5%). Upper respiratory symptoms were also noted (18.7%). Menstrual symptoms which were temporally plausible were diverse and not widely reported (2.3-13.6% by department). There were no chemical or physical agents found present in the building to account for the workers° health problems.

On the basis of environmental data and personal interviews, NIOSH concluded that a potential health hazard to perchloroethylene exposure in the print shop did exist at the time of this evaluation. Recommendations reducing levels of perchloroethylene are included in this report.

KEYWORDS: SIC 2731, printing, perchloroethylene, petroleum naphtha

II. INTRODUCTION

In August, 1983, the National Institute for Occupational Safety and Health (NIOSH) was requested to evaluate menstrual problems among employees at Westview Press, Boulder, Colorado.

Environmental investigations were conducted on August 22, and November 9, 1983. Medical evaluations were conducted on September 2, 1983 and on September 20-22, 1983. Management was informed of the medical and environmental results in a letter sent in February, 1984.

III. BACKGROUND

Westview Press is a book publishing company located in Boulder, Colorado. The company edits, composes, prints and assembles postgraduate level books on various types of research. The complaints that led to this evaluation came from various female employees who were experiencing menstrual symptoms. A complete walk-through evaluation did not show an occupational exposure that could be causing such symptoms. Workers were not exposed to environmental extremes and except in the manufacturing (printing) warehouse departments, did not stand while working. Due to the complex and diverse complaints, a complete industrial hygiene and medical evaluation was planned.

IV. ENVIRONMENTAL DESIGN AND METHODS

A. Environmental

The only area in this facility where chemicals are used is in the printing department. Perchloroethylene and petroleum naphtha are used to clean various printing inks from the printing machines. Eight personnel and one general room air samples were taken on organic vapor charcoal sampling tubes and analyzed according to NIOSH physical and chemical method (P & Cam 127).

B Medical - Epidemiological

After having a tour of the plant on the initial visit, the NIOSH physician individually interviewed 10 workers who were having medical problems. An additional three women were contacted by telephone following the first visit (a worker, an ex-worker, and a worker in an office in the same building as Westview Press). The NIOSH industrial hygienist talked informally to the workers in the print shop and adjacent areas. Because several of the women had menstrual or reproductive problems and it was unclear if there was any relationship to the work environment, arrangements were made to have an epidemiologic study of the total work force with the help of a NIOSH epidemiologist from Cincinnati, Ohio.

For the epidemiologic study, a confidential questionnaire including a job description, work history, smoking history, menstrual history, reproductive history, a list of recent symptoms, and an assessment of job and home stress was administered individually to all available workers by either the NIOSH epidemiologist or the NIOSH physician. The question for the list of symptoms was "During the past 6 months have you had any of the following symptoms?". The symptoms covered dermatologic, respiratory, neurologic and

menstrual problems. If present, onset, frequency, and changes in severity were determined. The existence of pre-existing medical conditions was also elicited. The number of workers participating by department is given in Table I. Overall, 68 out of 73 employees (93%) participated.

V. EVALUATION CRITERIA

A. Environmental

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is important to note, however, that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

Three sources of criteria used to assess the workroom concentrations of the chemicals were (1) recommended Threshold Limit Values (TLVs) and their supporting documentation as set forth by the American Conference of Governmental Industrial Hygienists (ACGIH), 1984, (2) the NIOSH criteria for a recommended standards, and (3) the Occupational Safety and Health Administration (OSHA) standards (29 CFR 1910.1000), July 1980.

	Permissible Exposure Limits 8-Hour Time-Weighted Exposure Basis
Perchloroethylene	LFL (NIOSH) 335 mg/m^3 (ACGIH) 678 mg/m^3 (OSHA)
Petroleum Naphtha	*350 mg/m^3 (NIOSH)

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mg/M^3 = milligrams of substance per cubic meter of air.
LFL = Lowest Feasible Level (due to its carcinogenic potential)
* = no standard or criteria has been established; this value is for varnish makers' and painters' naphtha which is a type of petroleum naphtha.

B. Epidemiologic

For a symptom to be considered potentially work-related, it needed to be temporally plausible. This means that its onset occurred after the subject began work at Westview, or the severity of a pre-existing symptom worsened since having begun work at Westview. Only these temporally plausible symptoms are given in this report. The chi square and Student's t-test (2 tailed) were used in the statistical analysis. Probabilities (p) of chance occurrence of 0.05 or less were considered statistically significant.

C. Toxicological

Perchloroethylene--NIOSH recommends that perchloroethylene be handled in the workplace as if it were a human carcinogen. This recommendation is based on the National Cancer Institute (NCI) indicating that perchloroethylene caused liver cancer in laboratory mice. Substances that cause cancer in experimental animals must be considered to pose a potential cancer risk to man. Other than perchloroethylene's carcinogenic potential, it is toxic to liver and kidneys of humans. There is also central nervous system depression as experienced by: vertigo, impaired memory, confusion, fatigue, drowsiness, irritability, loss of appetite, nausea and vomiting.

Metabolism of tetrachloroethylene is slow. It is deposited in fatty tissues and has a biologic half-life in man of approximately six days.[1]

Petroleum Naphtha--The petroleum distillate used in the printing industry includes the distillate that distills between 95 degrees and 175 degrees Centigrade. These are chiefly aliphatic hydrocarbons chiefly of C_7 - C_{10} series. The composition may vary widely since any one of several fractions within this boiling range may be used.

Depression of the central nervous system is one of the symptoms of exposure. Prolonged exposure causes irritation to mucous membranes, skin irritation, and defatting dermatitis. Liver and kidney damage can occur if excessive exposure is long term.

This product should be used under well ventilated conditions. If airborne concentrations are high (excess of 200 mg/m^3, or the action level), local exhaust ventilation should be used. For short exposure a respirator may be used.[2]

VI. RESULTS AND DISCUSSION

A. Environmental

On November 9, 1983, eight breathing zone and one general room air sample were collected in the print shop (located on the bottom floor) for perchloroethylene and petroleum naphtha. These solvents represented the only chemical exposures in the facility. Results of these air samples showed perchloroethylene levels of less than 0.01 mg/m^3 to 107 mg/m^3 and petroleum naphtha ranged from less than 0.01 mg/m^3 to 118 mg/m^3. These levels of perchloroethylene are below the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) of 335 mg/m^3 and the Occupational Safety and Health Administration Standard of 350 mg/m^3. However, due to perchloroethylene's carcinogenic potential, levels should be reduced as low as possible. The evaluation criteria for petroleum naphtha was not exceeded and exposures were not a health hazard. All results were discussed with the requestor in February, 1984.

B. Epidemiologic

Table III gives the prevalence of each individual symptom and Table IV presents the number of workers, by department, who reported at least one symptom from a particular category. Included is a listing of the number of workers who reported at least one symptom from any of the four categories. Chi square statistical testing for each symptom category showed no significant differences when each department was compared to all other departments. The executive and editorial departments reported the highest symptom frequencies of any departments (3 of 4 - 75%, and 12 of 17 - 71% respectively), yet did not show statistically significant differences from the other departments. (Overall 36 of 68 - 53% - of workers reported symptoms.) Grouping departments together by their location in the building also failed to show any statistically significant differences. No clustering of individual symptoms was observed when examined by department.

Headaches were the most frequently reported symptom (23.5%). A large number of workers spend the majority of their day reading, editing, or typesetting manuscripts. People who perform this kind of work can put great strain on their eyes. Headache is a common symptom of eye strain. It can also relate to stress. The 16 workers complaining of headaches had a mean job stress rating of 3.4 ± 1.0 compared to those without headaches whose mean rating was 2.8 ± 1.2. This difference did not quite reach statistical significance.

Upper respiratory symptoms (sneezing - 20.6%; itchy, watery eyes - 19.1%; running or stuffy nose - 14.7%) were also widespread. Many of the workers reported that their symptoms became more pronounced in the late spring. No factor or work process within the plant changed at that time. Given that Spring 1983 was unusually wet in

Colorado, many of these symptoms may have been due to vegetation-related allergies. The itchy, watery eyes could also be a symptom of eye strain (see the previous paragraph).

Menstrual symptoms were diverse, and not widely reported (2.3-13.6%). Those changes which were reported were subtle and of various types (i.e., 13.6% reported decreased flow, 11.4% an increased flow). These changes in a woman's menstrual period are not uncommon.[3,4] Although menstrual changes have been reported due to chemical exposures or standing for long periods of time[5], in this workplace no occupational relationship is suspected other than a possible relation to job stress. The women with menstrual symptoms had a mean job stress rating of 3.5 + 1.2 compared to menstruating women without menstrual symptoms whose mean rating was 2.7 + 1.0. The difference gave a t value of 2.492 and a statistical significance p value of 0.02.

Dry skin (a dermatologic symptom) was widely reported but was found to coincide with the person moving to Colorado (an area of generally low humidity) rather than with that person beginning employment at Westview Press. However, two workers in the manufacturing department (33%) did report dermatologic effects which may be work related. Their symptoms were temporally related to their work with inks and solvents, often when they were sweating.

Table V gives the average stress rating given to amount of home stress and of job stress separated by the presence or absence of symptoms. No difference was found in the level of home stress when symptomatics were compared with non-symptomatics. However, a statistically significant difference in job stress was reported, the symptomatics giving a higher rating than did the nonsymptomatics (mean = 3.4 vs. 2.4, t = 4.1232, p = less than 0.001). From the information obtained it is impossible to determine if the stress is a causative factor for some of the symptoms, or if the perception of stressfulness is a result of the person's feeling that his/her health is compromised.

Table VI compares the average age of workers by sex and the presence or absence of symptoms. Table VII does the same by average years at Westview Press. Neither shows significant differences between the two groups. Smoking habits also failed to show significant differences between the groups (16 of 36 - 44% - of symptomatics had ever smoked, 11 of 32 - 34% of non-symptomatics had ever smoked).

The information obtained during the initial interviews was consistent with the findings on the epidemiologic study. Several of the workers remarked on a strong odor of "grape kool-aid" coming from an adjacent plant at times. This was most noticeable outdoors and did not seem to tie in with the problems under study. It was also mentioned that at one time fumes from the darkroom vented into the general work area causing eye and upper respiratory irritation. This had been corrected before this study was requested.

VIII. CONCLUSIONS

Headaches were the most common symptom among those workers who reported symptoms. Possible contributing factors could be eye strain and job stress. The next most common symptoms involved the upper respiratory system. These appeared to be seasonal rather than job related. A number of the women had some problem with their menstrual periods, but these were quite varied and except for a possible relation to job stress, did not seem related to work at Westview Press. Dry skin appeared to be related to the relatively low humidity in Colorado, but two of the workers in manufacturing had skin problems which probably related to exposure to inks and solvents. There did not appear to be any chemical or physical agent present in the building causing the problems the workers were reporting. All industrial hygiene monitoring data was below the OSHA Standard. However, perchloroethylene exposures should be lowered due to its carcinogenic potential.

VIII. RECOMMENDATIONS

1. It is important that people who spend the majority of their day reading, editing, typesetting manuscripts, or similar visual work, be provided with well-lit, low-glare work areas, obtain regular eye examinations, and be given frequent work breaks to rest their eyes.[6]

2. Local exhaust ventilation should be installed over the printing press to lower perchloroethylene exposure.

IX. REFERENCES

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XI. DISTRIBUTION AND AVAILABILITY

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia. Information regarding its availability through NTIS can be obtained from NIOSH, Publications Office, at the Cincinnati address.

Copies of this report have been sent to:

1. Westview Press, Boulder, Colorado
2. U.S. Department of Labor/OSHA - Region VIII.
3. NIOSH - Region VIII.
4. Colorado State Health Department.

For the purpose of informing affected employees, a copy of this report shall be posted in a prominent place accessible to the employees for a period of 30 calendar days.

Westview Press
Boulder, Colorado

September, 1983

TABLE I

Study Participation by Department

Department	People Interviewed	Total Employees In Department	% Interviewed
Bookkeeping	4	4	100 %
Data Processing	3	3	100 %
Editorial	17	17	100 %
Manufacturing	6	6	100 %
Marketing	15	16	94 %
Production	4	4	100 %
Typesetting	9	12	75 %
Warehouse	5	5	100 %
Executives	4	5	80 %
Miscellaneous	1	1	100 %
Totals	68	73	93 %
Female	51	55	93 %
Male	17	18	94 %

Westview Press
Boulder, Colorado

November 9, 1983

TABLE II

Breathing Zone and General Room Air Concentrations
of Perchloroethylene and Petroleum Naphtha (PN)

Sample #	Location/Job	Sampling Time	mg/m^3 Perchloroethylene	PN
1	Supervisor	7:35-10:38	24	31
2	Press Operator	7:55-10:37	107	67
3	Paste-up	9:03-3:50	8	22
4	Camera Platemaking	9:22-4:05	10	31
5	Silk Screening	9:50-1:50	*	*
6	General Room (Print Shop)	9:51-4:06	31	118
7	Supervisor	10:39-4:07	3	10
8	Press Operator	10:38-4:08	48	111
9	Silk Screening	1:51-4:10	17	50
Evaluation Criteria			335(ACGIH)**	350***
Laboratory limit of detection mg/sample			0.01	0.01

* Below laboratory limit of detection
** A possible carcinogen and a safe exposure level has not been established NIOSH recommends the lowest feasible level
*** This is the evaluation criteria for varnish makers' and painters' naphtha, a type of petroleum naphtha

Westview Press
Boulder, Colorado

September, 1983

TABLE III

Percent of Population Reporting Temporally Plausible Symptoms

Symptom	Symptom Type	Number	Percent
Headaches	Neurologic	16	23.5
Sneezing	Respiratory	14	20.6
Itchy, watery eyes	Respiratory	13	19.1
Running or stuffy nose	Respiratory	10	14.7
Decreased menstrual flow	Menstrual	6	13.6 *
Rash	Dermatologic	8	11.8
Dry skin	Dermatologic	8	11.8
Increased menstrual flow	Menstrual	5	11.4 *
Increased menstrual pain or cramping	Menstrual	5	11.4 *
Sore throat	Respiratory	7	10.3
Irregular menstrual periods	Menstrual	4	9.1 *
Increased irritability	Neurologic	6	8.8
Difficulty sleeping	Neurologic	6	8.8
Redness of skin	Dermatologic	5	7.4
Burning/itching skin	Dermatologic	4	5.9
Blurred or double vision	Neurologic	4	5.9
Dizziness	Neurologic	3	4.4
Unusual nervousness	Neurologic	3	4.4
Moodiness	Neurologic	3	4.4
Coughing	Respiratory	2	2.9
Phlegm	Respiratory	2	2.9
Trouble breathing or shortness of breath	Respiratory	2	2.9
Skipping menstrual periods	Menstrual	1	2.3 *
Spotting or mid-cycle bleeding	Menstrual	1	2.3 *
Weak spells	Neurologic	1	1.5
Fainting, blackouts	Neurologic	0	0.0
Tremors, twitching, or loss of muscle coordination	Neurologic	0	0.0

* Women only.

Westview Press
Boulder, Colorado

September, 1983

TABLE IV

People with Potentially Work Related Symptoms by Department

Department	Number	Dermatologic	Respiratory	Neurologic	Menstrual	Any
Bookkeeping	4	0	1	1	0/4	1
Data Processing	3	0	0	0	0/3	0
Editorial	17	4	9	8	5/13	12
Manufacturing	6	3	2	0	0/1	3
Marketing	15	3	4	6	6/13	9
Production	4	0	2	1	1/1	2
Typesetting	9	1	2	2	1/5	3
Warehouse	5	1	3	2	0/1	3
Executives	4	1	3	3	2/3	3
Miscellaneous	1	0	0	0	0/0	0
Totals	68	13	26	23	15/44	36

TABLE V

Stress Rating by Home or Job Related, and by Presence of Symptoms

Status	Number	Home Stress Rating Mean	Home Stress Rating Std. Dev.	Job Stress Rating Mean	Job Stress Rating Std. Dev.
Symptomatic	36	2.6	± 1.1	3.4	± 1.0
Not Symptomatic	32	2.3	± 1.3	2.4	± 1.1
Total	68	2.5	± 1.2	2.9	± 1.2
Student's t-test t =		0.8245		4.1232	
p (2 tailed) =		greater than 0.40		less than 0.001	

Stress Rating

1 = Very Light 2 = Light 3 = Moderate 4 = High 5 = Very High

Westview Press
Boulder, Colorado

September, 1983

TABLE VI

Mean Age with Standard Deviation (S.D.) by Sex and Presence of Symptoms

Sex	Symptomatic			Not Symptomatic			Total		
	Number	Mean Age	S.D.	Number	Mean Age	S.D.	Number	Mean Age	S.D.
Male	11	31.8	± 13.4	6	36.8	± 15.0	17	33.6	± 13.8
Female	25	32.2	± 8.0	26	32.3	± 12.9	51	32.8	± 10.6
Total	36	32.1	± 9.8	32	33.2	± 13.1	68	32.2	± 11.6

TABLE VII

Mean Years at Westview Press by Presence of Symptoms

Status	Number	Mean Years	Standard Deviation
Symptomatic	36	2.6	± 2.2
Not Symptomatic	32	2.1	± 2.0
Total	68	2.3	± 2.1