


Spring 5-2019

ASSESSING THE RELATIONSHIP BETWEEN UNIVERSITY ENVIRONMENTAL HEALTH AND SAFETY PROGRAM RESOURCING AND ULTIMATE OUTCOMES

JASON R. SHYU

UTHealth School of Public Health

Follow this and additional works at: https://digitalcommons.library.tmc.edu/uthsph_dissertsopen

 Part of the [Community Psychology Commons](#), [Health Psychology Commons](#), and the [Public Health Commons](#)

Recommended Citation

SHYU, JASON R., "ASSESSING THE RELATIONSHIP BETWEEN UNIVERSITY ENVIRONMENTAL HEALTH AND SAFETY PROGRAM RESOURCING AND ULTIMATE OUTCOMES" (2019). *UT School of Public Health Dissertations (Open Access)*. 83.

https://digitalcommons.library.tmc.edu/uthsph_dissertsopen/83

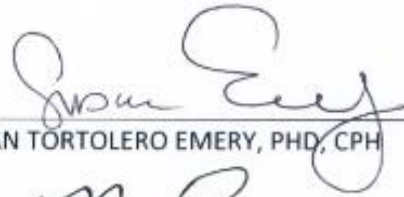
This is brought to you for free and open access by the School of Public Health at DigitalCommons@TMC. It has been accepted for inclusion in UT School of Public Health Dissertations (Open Access) by an authorized administrator of DigitalCommons@TMC. For more information, please contact nha.huynh@library.tmc.edu.

ASSESSING THE RELATIONSHIP BETWEEN UNIVERSITY ENVIRONMENTAL HEALTH AND
SAFETY PROGRAM RESOURCING AND ULTIMATE OUTCOMES

by

JASON R. SHYU, BA

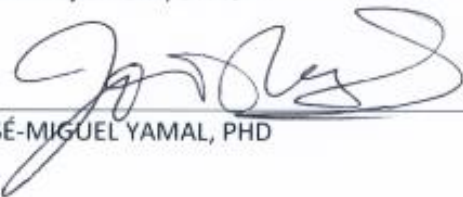
APPROVED:



SUSAN TORTOLERO EMERY, PHD, CPH



ROBERT J. EMERY, DrPH



JOSÉ-MIGUEL YAMAL, PHD

Copyright
by
Jason R. Shyu, BA, MS
2019

ACKNOWLEDGEMENTS

I am exceedingly grateful for all the help, advice, and patience of my advisors and committee. I have learned so much during this entire process, and without their guidance and support, this would not have been possible.

ASSESSING THE RELATIONSHIP BETWEEN UNIVERSITY ENVIRONMENTAL HEALTH AND
SAFETY PROGRAM RESOURCING AND ULTIMATE OUTCOMES

by

JASON SHYU
BA, RICE UNIVERSITY, 2017

Presented to the Faculty of The University of Texas

School of Public Health

in Partial Fulfillment

of the Requirements

for the Degree of

MASTER OF SCIENCE

THE UNIVERSITY OF TEXAS
SCHOOL OF PUBLIC HEALTH
Houston, Texas
May 2019

ASSESSING THE RELATIONSHIP BETWEEN UNIVERSITY ENVIRONMENTAL HEALTH AND
SAFETY PROGRAM RESOURCING AND ULTIMATE OUTCOMES

Jason Shyu, BA, MS
The University of Texas
School of Public Health, 2019

Thesis Chair: Robert J. Emery, DrPH

College and university campuses contain a diverse set of potential health and safety risks mixed with a population that is equally varied. Such a combination requires effective risk management programs adapted to address these challenges. Methods currently exist to predict risk financing premiums and institutional risk control resources (inputs), but there are no models addressing relationships to final Environment Health & Safety (EHS) program outcomes (outcomes such as injuries or illnesses).

Publicly available data obtained from the University of Texas System Office of Risk Management describing their 14 campuses was combined with publicly available data from the National Science Foundation to produce a model assessing the relationship between EHS resourcing inputs and EHS program outcomes. EHS program outcomes were represented by the outcome variable of workers' compensation insurance modifiers and were compared to resourcing variables such as number of EHS full time employees, total net assignable square footage, research net assignable square footage, and research &

development expenditure. When assessed individually, all resourcing variables revealed a negative linear relationship with the outcome variable (lower experience modifiers being indicative of better outcome performance). When using a multivariable stepwise estimation regression, all input variables were eliminated from the model except for research and development expenditure that presented the same negative correlation.

The results of this exploratory study suggest that increased EHS resourcing is associated with improved EHS program outcomes. However, the limited sample size affected the statistical significance of the regression models and resulting interpretation. Future opportunities should be taken advantage of by other university systems to expand upon these preliminary findings and validate the observed correlations.

TABLE OF CONTENTS

| | |
|------------------------------------|-----|
| List of Tables | i |
| List of Figures | ii |
| List of Appendices | iii |
| Background | 1 |
| EHS Program Inputs | 1 |
| EHS Program Outputs | 3 |
| Public Health Significance | 5 |
| Specific Aim and Hypothesis: | 7 |
| Methods | 8 |
| Study Design/Setting | 8 |
| Outcome Variable | 9 |
| Input Variables | 9 |
| Data Collection | 11 |
| Data Analysis | 12 |
| Results | 13 |
| Discussion | 15 |
| Conclusion | 17 |
| Appendices | 24 |
| References | 28 |

LIST OF TABLES

| | |
|---|----|
| Table 1: Table of Data Collected From The National Science Foundation Website and Requested From The University of Texas System Office of Risk Management Department..... | 18 |
| Table 2: Individual and Multiple Regression Results Table | 19 |

LIST OF FIGURES

| | |
|---|----|
| Figure 1: Workers' Compensation Insurance Experience Modifier (XPM) vs. Full-Time Employees (FTE) Linear Regression Plot | 20 |
| Figure 2: Workers' Compensation Insurance Experience Modifier (XPM) vs. Total Net Assignable Square Footage (TNASF) Linear Regression Plot | 21 |
| Figure 3: Workers' Compensation Insurance Experience Modifier (XPM) vs. Research Net Assignable Square Footage (RSF) Linear Regression Plot | 22 |
| Figure 4: Workers' Compensation Insurance Experience Modifier (XPM) vs. Research & Development Expenditure (RDE) Linear Regression Plot | 23 |

LIST OF APPENDICES

| | |
|--|----|
| Appendix A: Thesis Proposal Approval Letter..... | 24 |
| Appendix B: Publication Guidelines (Journal of Environmental Health) | 25 |

BACKGROUND

A recurrent question amongst many organizations is: “what amount of resources should be allocated to prevent an accident or injury?” This vital question drives the budgeting decisions for Environmental Health and Safety (EHS) departments across the country and is a persistent and inherent issue for public health practice. Decision-makers are constantly challenged by the balancing of resource expenditures for adequate preventative measures with meeting the needs of other business demands. Taking the time to evaluate the relationship between institutional EHS resource inputs and the resulting safety performance outcomes can provide valuable insights that can aid institutional leadership and other stakeholders in determining program-wide resource allocation.

EHS Program Inputs

Due to the fact that EHS programs focus on preventing injuries and illnesses and maintaining safety regulatory compliance, institution-wide measures regarding resource needs were frequently left unrecorded (Farrar, 1987). Although statistical studies have been performed to assess the optimization of resources for specific safety interventions (Oyewole & Haight, 2009; Haight, Thomas, Smith, Bulfin Jr., & Hopkins, 2001), the literature is largely void of documented attempts to quantitatively discern resource predictors for entire EHS programs regarding outcomes for a variety of industries outside of certain attempted anecdotal efforts within the college and university sector.

Only after higher education institutions began to allocate funding based on performance-based metrics rather than historical spending levels, did attention shift towards identifying relevant drivers of cost and resources for EHS programs (Frølich & Klitkou, 2006). Specifically, this swing in focus resulted in the development of quantitative models that allowed key decision-makers to assess and predict EHS costs as they do other institutional expenditures (Vellani, Emery, & Parker, 2012). However, despite this work, EHS financial modeling tools remained narrow in scope (Veltri & Ramsay, 2009, Bhushan & Leigh, 2011). Most models evaluated the cost of specific safety interventions and were incapable of determining overall costs of a health and safety program.

Focusing on universities in particular, a previous literature review noted that academic institutions tend to be overlooked as a significant target for occupational health prevention policies and that it is particularly important for academic institutions to evaluate whether or not institutional needs are being met by their occupational health programs (Venables & Allender, 2006). Linking organizational measures and safety measures would allow leadership to make appropriate EHS resource and staffing decisions (Jallon, Imbeau, & de Marcellis-Warin, 2011). Specifically, identifying statistically relevant quantitative predictors of program costs would allow EHS professionals to better connect with decision-makers regarding future budgeting (Veltri, Dance & Nave, 2003, Adams, 2002).

Recent work by Brown (2014), noted that institutional expenditures and campus characteristics are statistically significant candidates for the desired predictors for EHS

staffing and EHS expenditures based off of prior studies on institutional efficiency and effectiveness by Powell, Gilleland, and Pearson (2012). The results of Brown's work specifically noted that TNASF and total institutional expenditures were positively correlated with EHS staffing and budgeting. Furthermore, classification under the Carnegie Classification system or as members of the Association of Academic Health Centers was positively associated with EHS staffing and expenditures given its impact on the health and safety considerations of the institution and therefore its EHS staffing and resourcing (Carnegie Foundation for the Advancement of Teaching, 2013, Emery et al., 1998).

Taking this concept further, Brown (2014) conducted an analysis of 118 U.S. colleges and universities EHS programs to predict EHS program inputs using institutional characteristics. The study indicated that the key factors that determined EHS resourcing were total institutional expenditures and total institutional net assignable square feet. These results represented "the first time that a predictive model, based on empirical data, allow[ed] for the objective estimation ... of EHS staffing and program resourcing" (Brown, 2014).

EHS Program Outputs

Broadly speaking, the outputs of EHS programs are primarily the reported number of injuries and illnesses along with compliance with safety regulations as assessed by regulatory inspections. However, there are variations in recorded outputs by individual institutions. The University of Texas Health Science Center at Houston's Safety, Health,

Environment, and Risk Management department maintains four key performance indicators as evaluable metrics: losses (personnel and property), compliance (external and internal inspection results), finances (what the department costs and generates financially), and client satisfaction (SHERM, 2018). For the purposes of this pilot study, the focus will be on personnel losses given that the category encompasses the health and wellbeing of employees, residents, and students. The focus is specifically on employee events as these are directly related to Workers' Compensation Insurance program impacts.

The University of Texas Health Science Center at Houston's EHS program quantitatively measures losses via three measures: number of first reports of injury (of all individuals), employee injury and illness rate, and employee workers' compensation insurance experience modifier (SHERM, 2018). Of the three aforementioned metrics, workers' compensation insurance experience modifier is the most unique given its usage and how it is calculated. In short, experience modifiers are multiplier scores applied to the premiums that organizations pay for workers' compensation (self-insured systems operate under the same model). Depending on a wide variety of performance factors, calculated experience modifiers will fluctuate and overall institutional and individual costs will change accordingly. For EHS departments specifically, they are also important because they are derived from the frequency and severity of reported injuries or illnesses as well as institutional factors such as loss history and protective features (Major 2007, Bouska 1989,

Everett & Thompson 1995). As such, workers' compensation insurance experience modifiers also serve as a broad measure of EHS program performance.

Public Health Significance

Worksite injuries and illnesses are a significant public health issue due to the amount of time spent at work and the sheer volume of individuals involved. The U.S. Department of Health and Human Services' Healthy People 2020 ten year agenda setting report lists occupational safety and health as an included objective given people can spend a quarter of their life commuting or working (U.S. DHHS 2013). In 2015, there were over 150 million people in the U.S. workforce (U.S. Bureau of Labor Statistics 2010). Of the 150 million workers, 4 million nonfatal workplace injuries and illnesses occurred and 4690 fatal injuries did occur (U.S. Bureau of Labor Statistics 2010). These figures are potentially higher than presented given that they do not include non-employees (students, visitors, patients, etc.).

The college and university setting in particular is a unique workplace given the variety of health safety risks that are present. Broadly speaking, risks are typically categorized into four categories: physical, chemical, biological, and radiological. The frequent presence of all four in college and university environments presents a challenge in comparison to the average workplace in the management of injury and illness risk (Emery et al., 1998). For example, a single university research lab can contain open flames,

compressed gases, chemicals, biological samples, and radiation sources – a total of four risk types in one location (DeRoos, 1977).

Narrowing the focus down to this study's population at risk, colleges and universities employ approximately 3.9 million employees across 10,000 locations across the country (U.S. Bureau of Labor Statistics 2010). In addition to nearly 3.0% of the U.S. workforce, U.S. colleges and universities enrolled 21.0 million students in 2015 (U.S. Department of Education 2016a). Across the higher education sector, an aggregate total of roughly 25 million employees and students is a sizeable population that cannot be ignored. This number also does not include the wide variety of frequent visitors that pass through campuses on a daily basis. Consequently, college and university campuses present a uniquely diverse set of risks compounded by a large and varied population.

According to the Department of Human Health and Services, workplaces and academic institutions are determinants of health that contribute to the overall health of the population (U.S. DHHS 2013). Environmental Health and Safety programs help improve and maintain a safe working and learning environment for university and college students. In fact, EHS programs reduce injury and illness costs by 20-40% at any worksite (OSHA, 2013). Clarifying the precise relationship between EHS resource inputs and EHS program outputs supports existing efforts to efficiently and effectively fund health and safety departments.

Specific Aim and Hypothesis:

Beyond the general goal of improving the impact of EHS departments and programs, this study seeks to provide context to the existing literature's examination of EHS inputs and associated outcomes. Specifically, the intention of this study is to explore the relationship between EHS resourcing and safety program performance in a limited capacity:

Specific Aim: Using a limited publicly available dataset, evaluate the relationship between reported EHS resource inputs (staffing, research square footage, total net assignable square footage, and research & development expenditure) at each University of Texas component (n = 14) and their reported workers compensation insurance experience modifiers (an aggregate score based off of safety performance metrics).

Hypothesis: Campuses demonstrating greater EHS resource inputs will exhibit a statistically significant lower workers compensation insurance experience modifier (indicating a better performance) as compared to campuses that report fewer resource inputs.

For the purposes of this study, reported EHS resource inputs were collected from the 2017 fiscal year and compared to reported workers' compensation insurance experience modifiers from the 2018 fiscal year. Collecting data from sequential years is important in assessing whether EHS resource inputs would have an impact on workers' compensation insurance experience modifiers given that the modifier scores are set on a rolling three year average of past performance.

METHODS

Study Design/Setting

The study utilizes a cross-sectional ecological design to examine existing university characteristic data collected directly from the University of Texas System Office of Risk Management department and National Science Foundation (NSF). This information, in addition to reported campus workers' compensation insurance experience modifiers, was combined to examine the relationship between university EHS resource inputs and outcome performance from the 2017 fiscal year.

All variables were explicitly chosen given their accessibility as publicly available data. Furthermore, publicly available data would be open to the validation of reviewers and offer the opportunity for future expansion of the study to other school systems using the standardized definitions of the publicly available metrics.

Due to the limits of data availability and access, campus eligibility was limited to institutions within the University of Texas System. Therefore, a total of 14 institutions were included in the study. These include the University of Texas academic campuses in Arlington, Austin, Dallas, El Paso, Permian Basin, Rio Grande Valley, San Antonio, Tyler along with the health focused campuses UT Southwestern Medical Center in Dallas, UT Medical Branch in Galveston, UT Health Science Center (UTHSC) in Houston, UTHSC in San Antonio, UT MD Anderson Cancer Center, and UTHSC in Tyler.

Outcome Variable

Workers' Compensation Insurance Experience Modifier: Workers' compensation experience modifiers are a multiplier adjustment of the university's premium for worker's compensation based on the losses the insurer experiences. As such, lower experience modifiers indicate better performance, whereas higher modifiers imply the opposite. The multiplier values are based on headcount, payroll, and employee injury frequency compared to a three year rolling industry average. Workers' compensation experience modifiers are updated every fiscal year using data provided by the institution from the previous year. Reported workers' compensation experience modifier is a continuous variable that served as a representation of the performance of The University of Texas System EHS departments with regards to employee safety. Workers' compensation experience modifiers are reported annually in The University of Texas System Risk Management Annual Report made publicly available on The University of Texas System Administration Website.

Input Variables

EHS Full-time Equivalent (FTE) Staff: EHS full-time equivalent employees equal the number of EHS employees on full-time schedules plus the number of employees on part-time schedules converted to a full-time basis. This included technical, managerial, and directorial staff that support EHS function in addition to administrative support staff. Staff outside the EHS unit were included, but only if they had devoted half-time or greater (≥ 0.5)

FTE) to safety functions based on a standard 40 hour work week. Similarly, contractors were also only included if onsite time was half-time or greater (≥ 0.5 FTE) (Brown, 2014). FTE numbers are collected annually by The University of Texas System Office of Risk Management department and were available on request.

Total Institutional Net Assignable Square Feet (NASF): Total institutional net assignable area is reported as “Net Usable Area” and is defined by the National Center for Education Statistics Postsecondary Education Facilities Inventory and Classification Manual (FICM) 2006. Total institutional NASF specifically refers to the total area of a building assigned or designated to an occupant or specific use or necessary for the building’s general operation. Net usable area is calculated by adding the Net Assignable Area and the Non-assignable Area. The space subdivisions of the 10 assignable major space use categories and the 3 non-assignable space categories defined in the National Center for Education Statistics FICM should be included (U.S. Department of Education 2006). Total NASF numbers are collected annually by The University of Texas System Office of Risk Management department and were available on request.

Research Net Assignable Square Feet (NASF): Research net assignable area is defined by the National Science Foundation Fiscal Year Survey of Science and Engineering Research Facilities. Science and engineering research facilities include the following research areas within a building for which they are separately budgeted and accounted: “agricultural sciences and natural resources sciences, biological and biomedical sciences, computer and

information sciences, engineering, health and clinical sciences, mathematics and statistics, physical sciences, psychology, social sciences, and other science and engineering fields” (NSF 2017). Survey data on research NASF is made publicly available by the National Center for Science and Engineering Statistics on the National Science Foundation Website.

Research and Development Expenditure (RDE): Research and development expenditure is collected by the National Science Foundation Fiscal Year Survey of Higher Education Research and Development. RDE is equal to the reported monetary values by the institutions responding to the survey. Institutions reporting less than \$150,000 in RDE were not included in the final published survey data. Survey data on RDE is made publicly available by the National Center for Science and Engineering Statistics on the National Science Foundation Website.

Data Collection

The most recent published workers’ compensation insurance experience modifier values were collected from The University of Texas System Risk Management Annual Report for the 2018 Fiscal Year.

The TNASF and number of EHS FTE for each institution is a continuous variable obtained directly upon request from the University of Texas Risk Management department and is also reported to the Campus Safety, Health, and Environmental Management Association (CSHEMA). For the purposes of this study, TNASF and EHS FTE numbers for the 2017 fiscal year were requested and collected. Requested FTE numbers for the 2017 fiscal

year were the only set of variables with missing values due to a component campus failing to report the information (Table 1).

The final two variables, research NASF and RDE, were collected from the National Science Foundation's 2017 Fiscal Year Iteration of the Survey of Science and Engineering Research Facilities and Higher Education Research and Development surveys respectively. Both are continuous variables public accessible from the National Science Foundation's website.

The difference in collection year for the outcome variable and input variables was an explicit choice given the method by which workers' compensation insurance experience modifiers are calculated. Ideally, data on the outcome variable would be available for a specific year and compared to the input variables for a specific year. However, because workers' compensation insurance experience modifiers are set on a three year rolling average, such was not the case for this undertaking.

Data Analysis

The aforementioned variables were coded by campus and input into STATA for analysis. The primary goal was to assess whether increased input (in the form of higher RSF, TNASF, and staffing numbers) was associated with lower outcomes (employee injuries represented via lower insurance premium modifiers). Associations between each input variable and the outcome variable were assessed using simple linear regression.

After examining the individual relationships, a multivariable linear regression was applied to investigate the relationship between all the input variables and the outcome variable using a stepwise approach. During this stage of the process, total and research NASF was converted into a composite variable “percentage of total research square footage.” Given that research NASF is a subset of total NASF, calculating what percentage of total was research was done in an attempt to reduce potential multicollinearity.

For both regressions, the diagnostics regarding normality and variance of the error terms were performed via Q-Q plots and residual plots.

RESULTS

For each individual linear regression model, the associations between the input variables and outcome variable were negative (Table 2). In order of coefficient magnitude, RDE was the largest (-0.099), followed by research NASF (-0.049), total NASF (-0.002), and EHS FTE (-0.001). In evaluating the fit of the regression models, the R-squared values of the FTE, research NASF, and RDE models were relatively consistent (0.23, 0.22, and 0.24 respectively). Total NASF was the only outlier with an R-squared value of 0.07. The p-values for the models follow a similar trend with similar values for FTE, research NASF, and RDE (0.10, 0.09, and 0.07) and a significantly different value for total NASF (0.36).

The multivariable regression performed via stepwise backward-selection estimation produced a final model with only RDE as the remaining variable with a coefficient of -0.098. FTE and the composite variable percent research NASF, were removed at p-values of 0.74

and 0.53 respectively. RDE remained in the model with a p-value of 0.085. In terms of fit, the results of the stepwise estimation presented an R-squared value similar to most of the individual models at 0.25.

The models produced by the simple and multivariable linear regression methods suggest that there is a visible negative association between each EHS input variable of interest and the insurance experience modifiers of University of Texas system campuses (Figures 1-5). Increases in FTE, research NASF, total NASF, and RDE were linked to decreases in insurance experience modifier magnitude. Specifically, the regression models predict that for every increase in EHS FTE, insurance modifiers would decrease by 0.001. Every million dollar increase in RDE was related to a 0.099 drop in modifier score. There was a substantial difference in impact of research NASF when compared to total NASF. For each million square footage increase in research and total NASF, there was a 0.049 and 0.002 drop in experience modifier respectively.

When aggregating all the input variables using a multivariable stepwise estimation, the only variable to remain after elimination was RDE – the variable with the lowest p-value when running individual simple linear regression. The resulting model coefficient suggests that for every additional million dollars spent on research and development would reduce insurance experience modifiers by 0.098.

However, across the board, none of the models presented R-squared values above 0.25. Especially the total NASF regression model which presented an R-squared value

significantly lower than the rest (0.07 compared to 0.22-0.25). Furthermore, none of the p-values for any model were below a significance level of 0.05. As such, it is difficult to reject the null and accept nearly all of the produced models. In particular, the regression model for total NASF had an unacceptably high p-value. The remaining input variables produced coefficients with p-values under a significance level of 0.10, making them more tolerable in comparison.

DISCUSSION

The results of this pilot study provide evidence that support the initial hypothesis in a limited capacity. The observed negative correlation between EHS FTE, total NASF, research NASF, and RDE reflected the intuitive initial assumption that campuses with more personnel and resources allocated for risk management would result in a more effective program. In addition to the individual associations, taking all the variables into account using a multivariable regression produced the same outcome. As such, a broader interpretation of the results imply that increased EHS resourcing and higher campus characteristics values were linked with improved EHS program outcomes and performance.

Taking a closer look at the coefficients, total NASF was the least statistically significant regression model. This is particularly important given previous work indicating that total NASF served as an important predictor for EHS resourcing (Brown, 2014). This observation suggests that characteristics predicting EHS resourcing are not necessarily the same as variables that would correlate with the success of those EHS programs.

A potential explanation of this disparity in variable significance could be the much broader scope of total NASF in comparison to the other three input variables. Our designated outcome variable and analytical focus revolved around employees due to the nature of workers' compensation insurance modifier calculations. Total NASF is a resource not closely tied to employees in particular especially when compared with EHS FTE, research NASF, and RDE.

A more generalizable explanation of this reflection lies in the division between resource allocation and application. Variables that predict funding and resources dedicated to EHS departments do not necessarily reflect the efficiency and effectiveness of their usage in programs. As such, further research assessing variables associated with EHS outcomes would require a different perspective from the current literature's economic resourcing approach.

However, it is important to note the limited sample size of the study. The small available pool of data reduces the ability to draw meaningful conclusions from all of the regression analyses – the multivariable model in particular. Further, the high p-values and low R-squared values of the models indicate that the models should not be relied upon for precise predictions. Extrapolating beyond trends and direction of association would not be appropriate given the exploratory nature of the study.

As such, increasing the number of participating schools should be the focus for future studies. Improving the overall sample size would address the statistical difficulties

present in this study. In addition, assessing campuses from a variety of school systems would improve the generalizability of the results.

The final limitation of the study lies in the representative nature of the chosen outcome variable. Workers' compensation insurance experience modifiers reflect the performance of the campus given the factors involved in their calculation and are significant for economic reasons. However, the variable specifically focuses on employee outcomes out of the entire population at risk at the higher education setting. Furthermore, it serves as an indirect evaluation of the true outcomes of interest: injury frequency, severity, etc.

CONCLUSION

Although not statistically conclusive, this exploratory analysis suggests that increased EHS program resourcing is correlated with improved outcome measures as defined by workers' compensation insurance experience modifiers. Despite limitations present in the form of restricted sample size and data accessibility, this work still presents an opportunity for other university systems to replicate the study, expand upon the approach, and corroborate findings.

Table 1: Table of Data Collected From The National Science Foundation Website and Requested From The University of Texas System Office of Risk Management Department

| Component Campus | EHS Full-Time Employees (EHS FTE) | Total Net Assignable Square Footage (TNASF) (1 million sq. ft) | Research Net Assignable Square Footage (RSF) (1 million sq. ft.) | Research & Development Expenditures (RDE) (1 million dollars) | Workers' Compensation Experience Modifier (XPM) |
|---------------------------------|-----------------------------------|--|--|---|---|
| A | 18 | 6.669858 | 0.463 | 0.097197 | 0.2 |
| B | 32 | 26.338962 | 1.375 | 0.652187 | 0.128 |
| C | 9 | 7.030064 | 0.529 | 0.113205 | 0.103 |
| D | 16 | 5.212732 | 0.28 | 0.094565 | 0.244 |
| E | 2 | 1.386304 | 0.224 | 0.001152 | 0.106 |
| F | 13 | 4.366685 | 0.082 | 0.0295 | 0.141 |
| G | 28.3 | 5.381645 | 0.254 | 0.070163 | 0.16 |
| H | 4 | 1.606218 | 0.033 | 0.001837 | 0.087 |
| I | 45 | 13.072083 | 1.197 | 0.461797 | 0.097 |
| J | * | 8.832387 | 0.442 | 0.185106 | 0.163 |
| K | 30 | 6.622914 | 0.459 | 0.24606 | 0.078 |
| L | 8 | 4.861207 | 0.613 | 0.192557 | 0.14 |
| M | 88 | 15.740978 | 1.687 | 0.888029 | 0.044 |
| N | 1 | 0.866389 | 0.051 | 0.016292 | 0.185 |
| <i>* Indicates missing data</i> | | | | | |

Table 2: Individual and Multiple Regression Results Table

| Individual Regression Models | | | | |
|--|--------------------|----------------|---------|----------------|
| Independent Variable | Parameter Estimate | Standard Error | p-value | R ² |
| EHS Full-Time Employees (FTE) | -0.001 | 0.0006 | 0.1 | 0.226 |
| Total Net Assignable Square Footage (TNASF) | -0.002 | 0.0022 | 0.362 | 0.07 |
| Research Net Assignable Square Footage (RSF) | -0.049 | 0.0266 | 0.093 | 0.218 |
| Research & Development Expenditure (RDE) | -0.099 | 0.0502 | 0.072 | 0.244 |
| Multiple Regression Model | | | | |
| Research & Development Expenditure (RDE) | -0.098 | 0.0518 | 0.085 | 0.245 |

Figure 1: Workers' Compensation Insurance Experience Modifier (XPM) vs. Full-Time Employees (FTE) Linear Regression Plot

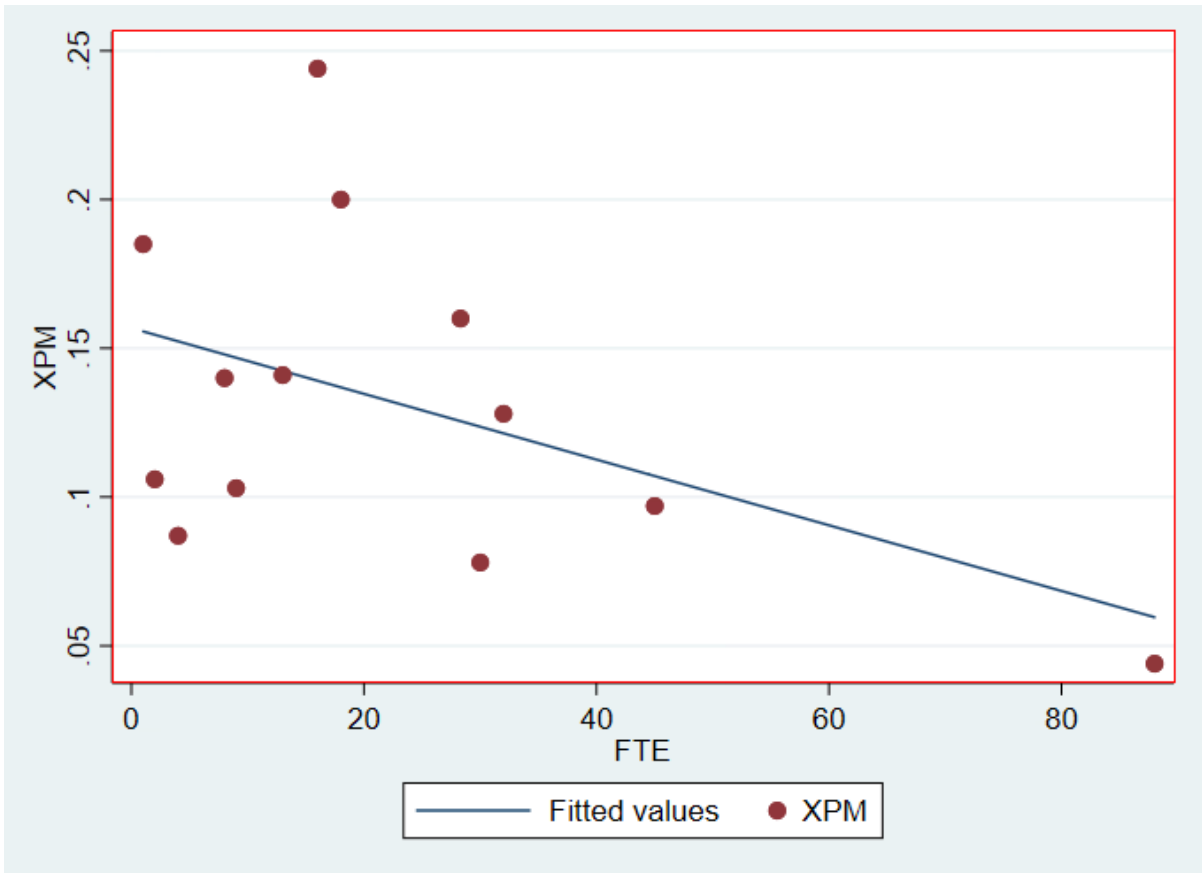


Figure 2: Workers' Compensation Insurance Experience Modifier (XPM) vs. Total Net Assignable Square Footage (TNASF) Linear Regression Plot

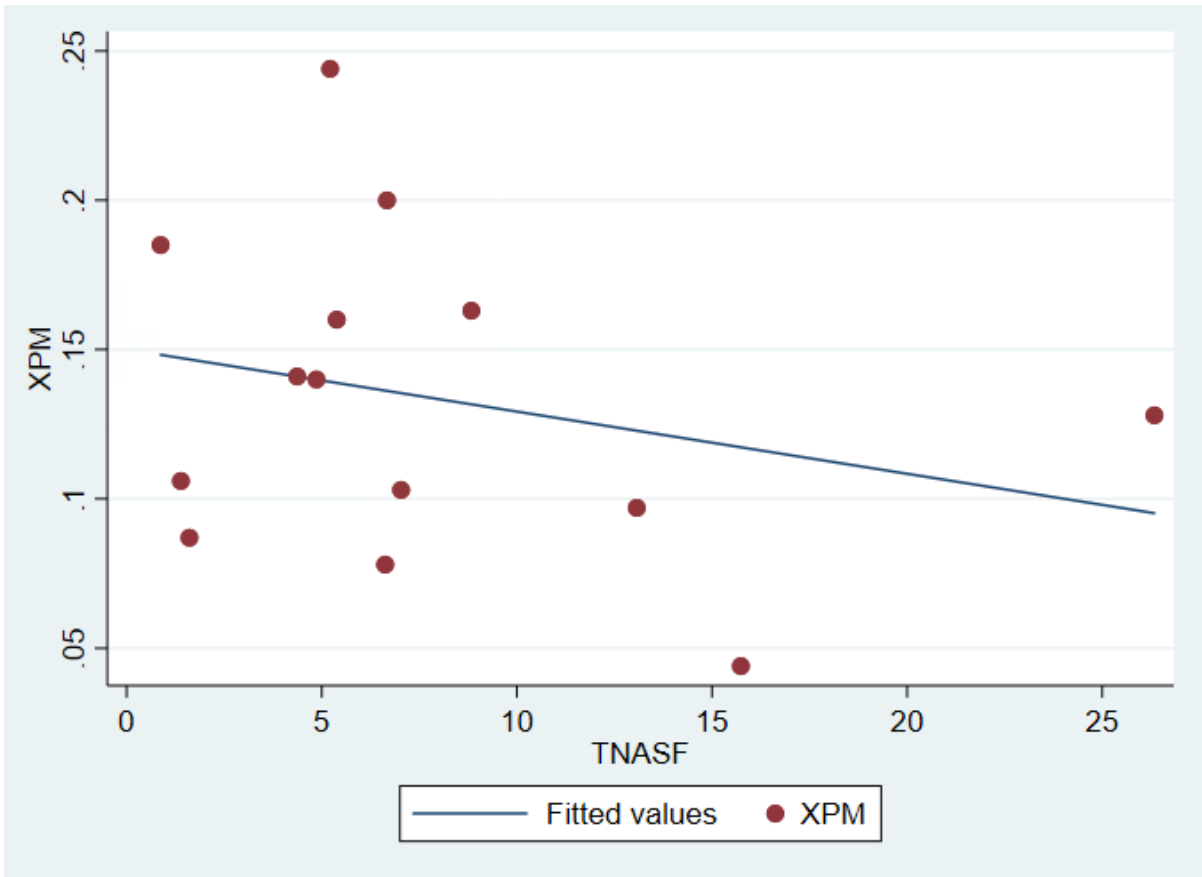


Figure 3: Workers' Compensation Insurance Experience Modifier (XPM) vs. Research Net Assignable Square Footage (RSF) Linear Regression Plot

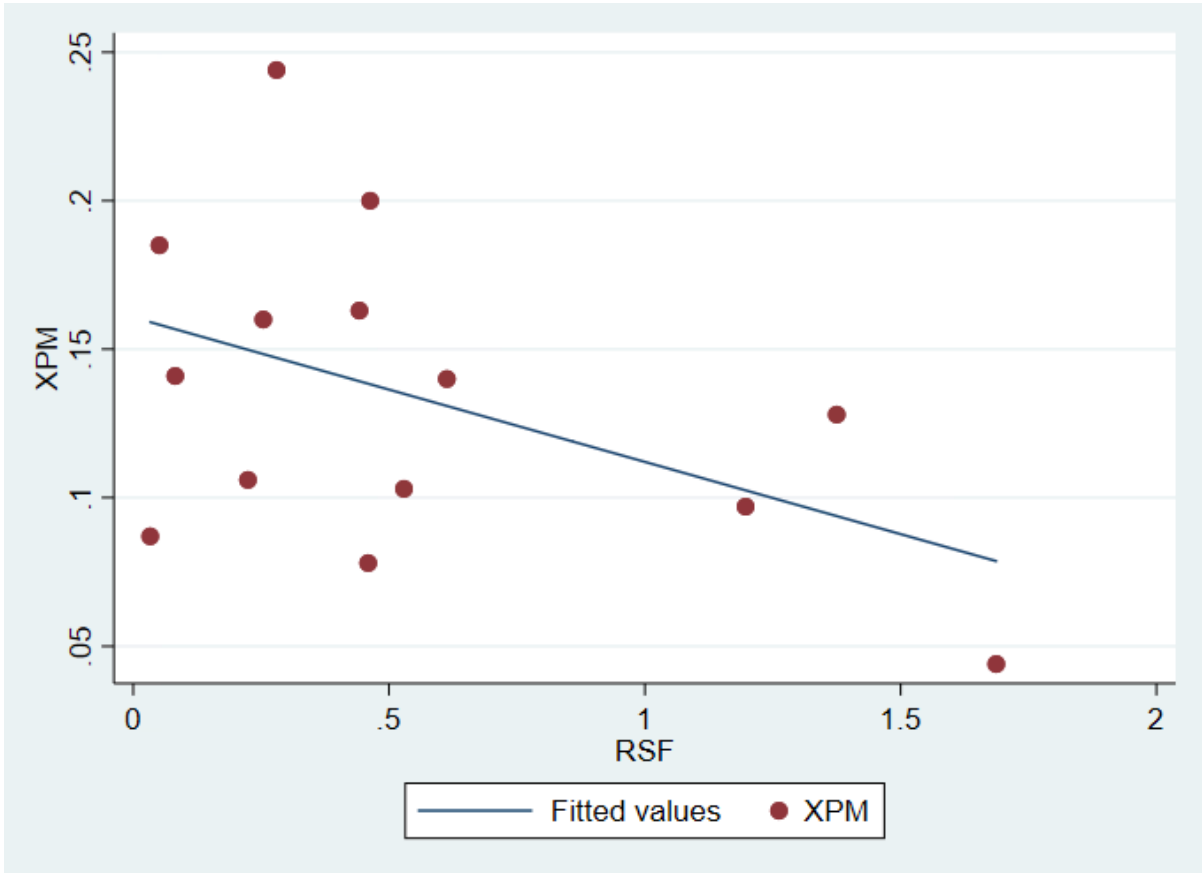
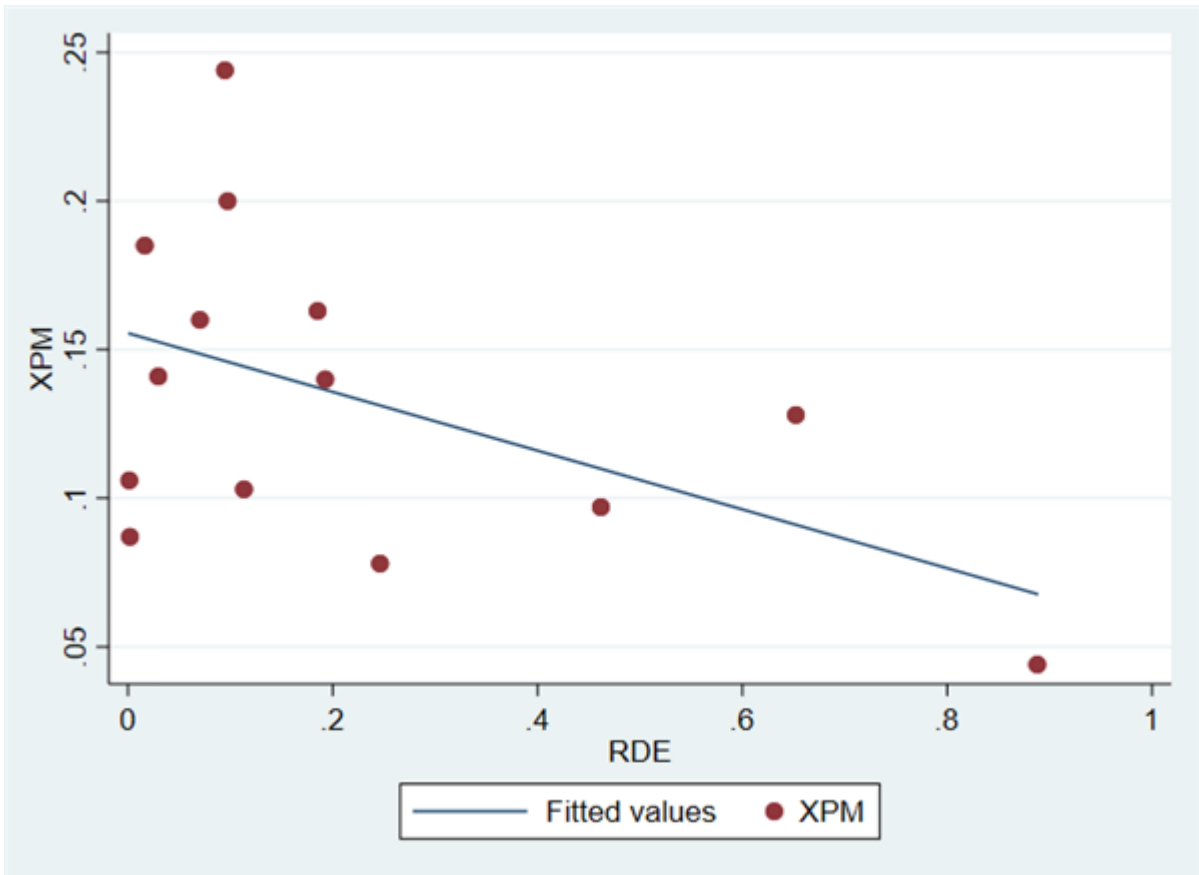


Figure 4: Workers' Compensation Insurance Experience Modifier (XPM) vs. Research & Development Expenditure (RDE) Linear Regression Plot



APPENDICES

Appendix A: Thesis Proposal Approval Letter



Office of Academic Affairs and Student Services

MEMORANDUM

TO: Jason Shyu

FROM: Nesh Aqrawi
Assistant Director for Academic Affairs

RE: Thesis Proposal

DATE: December 21, 2018

TITLE: Assessing the Relationship Between UT System Environmental Health and Safety Program Resourcing and Outcomes

Your proposal has been reviewed and approved by The University of Texas School of Public Health at Houston, Office of Academic Affairs and Student Services. Your proposal is exempt from review by The University of Texas Health Science Center at Houston (UTHealth) Committee for the Protection of Human Subjects. You may proceed with your research.

Cc: Susan Tortolero Emery, PhD
Robert Emery, DrPH
Jose-Miguel Yamal, PhD

713.500.9064 Phone
P.O. Box 20186
Houston, Texas 77225
www.sph.utb.edu

Appendix B: Publication Guidelines (Journal of Environmental Health)

About *Professional Safety*

Professional Safety is ASSP's flagship peer-reviewed journal and our top-ranked member benefit. Each monthly issue delivers the latest technical knowledge in occupational safety and health (OSH) — developed through evidence-based information and on-the-job experience.

The journal also publishes articles that describe industry best practices and share advances in consensus standards developments.



Target Audience

Professional Safety articles aim to provide new information and best practices to OSH professionals. The more than 37,000 members who read the journal are spread across a broad range of industries in the U.S. and around the globe.

Peer-Reviewed Manuscripts: Key Expectations

ASSP's Editorial Review Board evaluates the content ultimately published as peer-reviewed content in the journal. As a potential author, we encourage you to focus on these five areas when developing a manuscript for peer-reviewed feature consideration:

1. **Topic:** *Professional Safety* readership crosses a broad spectrum of experience and education. Focus on timely, leading-edge topics. If you cover basic/fundamental topics, strive to advance and expand on information available elsewhere.
2. **Depth:** Cover your topic in sufficient depth. Draft an article that is not be too narrow, broad or complex, keeping in mind that ASSP membership covers the full career spectrum from students and young professionals to seasoned OSH leaders. Strive for balance in your presentation rather than trying to oversell or denigrate any perspective. If your article is targeting a particular audience (e.g., novice, experienced), please indicate that when submitting your manuscript.
3. **Timeliness:** Include current statistics and reflect current accepted or emerging practices. While we ask that references be relatively current, older references that offer historic perspective or are relevant to current practices often remain appropriate.
4. **Purpose:** Present information that adds to or advances the profession's knowledge base. Avoid promoting or advertising specific products, services or individuals as it detracts from the objectivity and credibility of the information present.
5. **Applicability:** Present information and sound practices that are easily extractable and applicable. Lessons learned/how-to applicability is particularly relevant.



Submission Guidelines for Peer-Reviewed Manuscripts

Carefully follow the following guidelines to submit a manuscript for review by the journal's Editorial Review Board. Doing so lends credibility to you as an author and supports your position as a qualified expert on your topic. Submit all documents related to your manuscript to [PSJ's editorial staff](#).

Word Count Guideline

- 2,500 to 3,000 words (preferred), not including illustrations

Format

- MS Word
- Include no author identifiers in the main article (e.g., byline, headers/footers, bios) to help preserve the blind-peer-review process.
- Provide author contact and biographical information, including degrees held, granting institution(s) and designations held, in a separate document.
- Use double-space setting and set all margins to 1 inch.
- Number pages consecutively, including a number on the first page.
- Include a Key Takeaways summary consisting of two or three short bulleted sentences that highlight what you will cover and what readers will learn.
- Provide an effective introduction and solid conclusion.
- Use subheads throughout to help readers move through the article and connect key concepts.

References

- Document all quotes, facts and figures according to [APA style](#). Doing so lends credibility to the article and provides readers with information to locate sources and conduct further research.
- Support statements and opinions with facts and viable references. Be sure to indicate when statements reflect your opinion as the author and avoid over generalizations.
- Reflect the depth of information available on your topic via the references quoted/cited.

Graphics and Visual Content

- Figures and tables are not required, but add interest. Carefully chosen and well-prepared figures, such as diagrams and photos, can greatly enhance an article.
- Strive to be sure these elements clarify and expand on key points or technical issues.
- Provide clear, easy-to-read, high-quality figures/charts/images for highest reproduction quality in print. Always provide captions and credits.
- Illustrations (photos, graphs, charts) should be clear and concise, easy-to-read and self-explanatory, and they should be appropriately referenced.

Author Agreement

Professional Safety authors must sign a transfer of copyright agreement, which assigns ASSP rights to the article but also outlines author permissions for using the content.

[Download the agreement](#)

Peer-Review Process

The peer-review process typically takes at least 60 days. We will notify you to confirm that we have received your submission and indicate whether it will be submitted to the Editorial Review Board. If selected for peer review, we will share with you review comments and an indication of the submission's status. The Editorial Review Board's primary focus is to offer comments that will improve your article and get it published.

If your article is accepted for publication, when submitting the revision, please:

- Highlight all changes made to manuscript (e.g., use the track changes feature in Word).
- Save charts, graphs, tables/figures or other electronically created images as separate files (not embedded files). Indicate the software and version used, and include raw data for all graphs and charts so these items can be recreated to match journal presentation style.
- Submit only high-resolution (300 dpi) digital photos. Acceptable formats include TIF, EPS and JPG.
- Send a copy of the final manuscript with changes highlighted and any graphics files to [PSJ editorial staff](#).
- Submit a signed copyright agreement that allows PSJ to publish the article. The author retains the right to use the material in other books, presentations, etc. Contact [PSJ staff](#) with any questions regarding this requirement.

Professional Safety reserves the right to edit all manuscripts to be published in order to improve clarity and style. *Professional Safety* is copyrighted by ASSP. Published articles may not be published elsewhere without written permission of ASSP and the author(s).

[I have some questions](#)

Contribute Other Articles and News to *Professional Safety*

Professional Safety welcomes the submission articles that don't meet the criteria for peer-reviewed manuscripts — including event announcements, new product information and general news stories of interest to occupational safety and health professionals. Send your submissions to [PSJ editorial staff](#).

- **Best Practices Articles:** Practical information, ideas and suggestions that readers can immediately apply in their workplaces and readily share with coworkers. (Suggested length: 1,200 to 1,800 words)
- **Leading Thoughts Articles:** General or safety-specific leadership guidance, advice or tips. (Suggested length: 800 to 1,200 words)
- **Checkpoints Articles:** Discussion of the fundamentals of a specific safety practice. (Suggested length: 600 to 800 words)
- **Vantage Point Articles:** A forum for sharing ideas and opinions in order to encourage and stimulate critical thinking, discussion and debate on matters of concern to the OSH profession. (Suggested length: up to 1,800 words)

Tone and style for these articles: Most articles for the journal are written in the third person. In other words, authors does not speak directly to readers. Instead of using "you" statements (e.g., "You can . . .") use universal language (e.g., "OSH managers can . . ."). In addition, these articles cannot promote a specific product, association or company. They should be informational – that is, they should be idea- and concept-focused rather than product- or company-focused.

When submitting these types of article, please sign and submit a transfer of copyright agreement, which assigns ASSP rights to the article but also outlines author permissions for using the content.

[Download author agreement](#)

- **Worth Reading Reviews:** Reviews of current literature, book or other publication of interest to OSH professionals. Discuss the book within the context of personal experience. Interested in volunteering to review a book? [Tell us your area of interest](#).

[Download book review guidelines](#)

- **Reader Forum Letters:** Reader commentary on stories, features and news reported in the journal.
- **Event Announcements:** Provide event date and location, sponsoring company and contact phone, e-mail and URL. Please send information at least three months in advance of the event.
- **News Items:** These may be included in the Safety Matters section of the journal. Please include contact information for follow-up questions.
- **Product Pulse Items:** Provide product releases, high-resolution digital images and contact information for follow-up questions.

REFERENCES

- Adams, S.J. (2002). Financial management concepts: making the bottom-line case for safety. *Professional Safety*, August 2002, 23-26.
- Behm, M., Veltri, A., & Kleinsorge, K., (2004). The cost of safety: cost analysis model helps build business case for safety. *Professional Safety*, April 2004, 22-29.
- Bhushan, A. & Leigh, J.P. (2011). National trends in occupational injuries before and after 1992 and predictors of workers' compensation costs. *Public Health Reports*, 126, 625-634.
- Bouska, A. 1989. Exposure Base Revisited. *Proceedings of Casualty Actuarial Society*, LXXVI, pp. 1-23.
- Brown, Bruce J. et al. *An Empirical Model for Estimating Environmental Health and Safety Program Resourcing for Colleges and Universities* . 2014.
- Brownson, R. C., Baker, E. A., Left, T. L., Gillespie, K. N., & True, W. R. (2011). *Evidence-based public health*. Oxford University Press, New York, New York, USA.
- Bush, V. (1945). Science: The endless frontier. *Transactions of the Kansas Academy of Science* (1903), 231-264.

Campus Firewatch. (2013). Fatal Fire Spreadsheet. Available at <http://www.campus-firewatch.com/resources/current-fire-information/fatal-fire-spreadsheet/>.

Center for Campus Fire Safety (2013). Fire Fatality Statistics. Available at <http://www.campusfiresafety.org/firefatalitystatistics>.

DeRoos, RL. (1977) Environmental health and safety in academic settings. *American Journal of Public Health* 67: 851-854.

Edwards, B., Barnes, L., Gibbs, B., & Nguyen, G. (2002). Development of a laser safety hazard evaluation procedures for the research university setting. *Health Physics* 82: S37-S46.

Emery, R. J., Delclos, G., Cooper S. P., & Hardy, R. (1998) Evaluating the relative status of health and safety programs for minority academic and research institutions. *American Industrial Hygiene Association Journal* 59: 882-888.

Everett, J. & Thompson, W. (1995). Experience modification rating for workers' compensation insurance. *Journal of Construction Engineering and Management*, 121(1), 66-79.

Farrar, A. C. (1987). Industrial hygiene and risk management – understanding and promoting a healthy relationship. *American Industrial Hygiene Association Journal* 48(3):A-164-A-169.

Fine, W.T. (1982). Proper staffing of an occupational safety and health office. *Professional Safety*, March 1982, 20-24.

Frølich, N., & Klitkou, A. (2006). Strategic management of higher education institutions: performance funding and research output. Paper submitted to the Conference on Indicators on Science, Technology and Innovation, Special Session on Indicators for strategic management of higher education institutions, Lugano 15th-17th November 2006. (Accessed at <http://www.prime-noe.org/2006-prime-indicators-conference.html>)

Furr, A. K. (2000). *CRC handbook of laboratory safety*, 5th edition. (p.1). Boca Raton, Florida: CRC Press LLC.

Haight, J.M., Thomas, R.E., Smith, L.A., Bulfin, R.L., Hopkins, B.L., (2001). Impact of safety efforts: intervention effectiveness research: phase 2, design, optimization & verification of the loss prevention system & analysis models. *Professional Safety*, June 2001, 33-37.

Head, G.L. & Horn II, S. (1997). *Essentials of Risk Management*. Third edition, volume 1. Malvern, PA: Insurance Institute of America.

Jallon, R., Imbeau, D., de Marcellis-Warin, N. (2011). Development of an indirect-cost calculation model suitable for workplace use. *Journal of Safety Research*, 42(3), 149-164.

Los Alamos Site Office Environment Safety and Health Team. (2005). Staffing analysis: safety and health team oversight requirements: evaluations of multiple models. December 2005, revision 1.0. <http://www.asse.org/practicespecialties/bosc/docs/Alamos-StaffingPaper.pdf>

McAdams, M. T., Kerwin, J. J., Olivo, V., & Goksel, H. A. (2011). National assessment of the occupational safety and health workforce. Retrieved from CDC National Institute for Occupational Safety and Health website: <http://www.cdc.gov/niosh/oshworkforce/#report>

National Science Foundation (2017). Survey of Science and Engineering Research Facilities. Retrieved from: <https://www.nsf.gov/statistics/srvyfacilities/#sd>

Oyewole, S.A. & Haight, J.M. (2009). Making the business case: assessment of safety intervention and optimization of resource allocation. Proceedings of the American Society of Safety Engineers, session 616.

Powell, B.A., Gilleland, D. S. & Pearson, L.C. (2012). Expenditures, efficiency, and effectiveness in U.S. undergraduate higher education: a national benchmark model. *Journal of Higher Education*, 83(1), 102-127.

Safe work in the 21st century: Education and training needs for the next decade's occupational safety and health personnel. (2000). Washington, DC: National Academy Press.

Tabershaw, I.R., & Fuenning, S.I. (1968). Environmental health problems in institutions of higher learning. *Journal of Occupational Medicine* 10: 663 -666.

U.S. Bureau of Labor Statistics (2010). Back to College, September 2010. <http://www.bls.gov/spotlight/2010/college/pdf/college.pdf>.

U.S. Department of Health and Human Services (2013). Health People 2020 Topics & Objectives, Occupational Safety and Health. <http://www.healthypeople.gov/2020/topicsobjectives2020/overview.aspx?topicid=30>.

U.S. Centers for Disease Control and Prevention, National Institute of Occupational Safety and Health. (2013). National occupational research agenda (NORA): National Services Agenda. Retrieved from <http://www.cdc.gov/niosh/nora/sectors/serv/agenda.html>.

U.S. Department of Education, National Center for Education Statistics. (2013). Digest of Education Statistics – 2012 (NCES2014-015). Retrieved from <http://nces.ed.gov/programs/digest/d12/>.

U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System (2011a). IPEDS 12-month enrollment 2009-2010. http://nces.ed.gov/ipeds/surveys/2010/pdf/e12_2010.pdf.

U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System (2011b). IPEDS Finance for Public Institutions Using GASB Reporting Standards. http://nces.ed.gov/ipeds/surveys/2010/pdf/f_1_2010.pdf.

U.S. Department of Education, National Center for Education Statistics (2012b), Integrated Postsecondary Education Data System. IPEDS glossary. <http://nces.ed.gov/ipeds/glossary>.

U.S. Department of Education, National Center for Education Statistics. (2006). Postsecondary Education Facilities Inventory and Classification Manual (FICM): 2006 Edition (NCES 2006-160). Retrieved from <http://nces.ed.gov/pubs2006/2006160.pdf>.

UTHealth Safety, Health, Environment, and Risk Management (2018). FY18 SHERM Metrics-Based Performance Summary.

<https://www.uth.edu/safety/sherm/FY18%20SHERM%20Annual%20Report.ppt>

Vellani, K.H., Emery, R.J., Parker, N. (2012). Staffing benchmarks: a model for determining how many security officers are enough. *Journal of Healthcare Protection Management*, 28(2), 1-11.

Veltri, A., Dance, D., & Nave, M. (2003a). SH&E life-cycle cost model: an internal study from the semiconductor manufacturing industry. *Professional Safety*, June 2003, 23-32.

Veltri, A., Dance, D., & Nave, M. (2003b). SH&E life-cycle cost model: an internal study from the semiconductor manufacturing industry, part 2. *Professional Safety*, June 2003, 30-36.

Veltri, A., Pagell, M., Behm, M., Das, A. (2007). A data-based evaluation of the relationship between occupational safety and operating performance. *Journal of SH&E Research*, 4(1), 1-22.

Veltri, A., Ramsay, J. (2009). Economic analysis: make the business case for SH&E. *Professional Safety*, September 2009, 22-30.

Venables, K. M., & Allender, S. (2006). Occupational health needs of universities: a review with an emphasis on the United Kingdom. *Occupational and Environmental Medicine* 63(3):159-167.