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IMPACT OF DIABETES MELLITUS ON WORK PRODUCTIVITY IN CONSTRUCTION INDUSTRY

By

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Abstract

Introduction: Diabetes Mellitus (DM) is the eleventh most important cause of premature mortality in Egypt and is one of the most prevalent and costly chronic disease conditions in Egypt, it is associated with a profound negative impact on workers' productivity. Aim of Work: To assess the impact of diabetes on the productivity of the workers in construction industry. **Materials and Methods:** A case-control study was conducted among 34 diabetic workers in construction industry and 34 healthy workers from the same site. Health and performance questionnaire (HPQ) was used. In addition, some questions about socio-demographic characteristics, medical and occupational characteristics. Investigations were done including: fasting and post prandial blood sugar, HbA1c, liver and renal functions, body mass index (weight / hight) were calculated, 34 workers were chosen as a control group and were matched for socio demographic and occupational characteristics. **Results:** work days lost due to DM/month ranging from 0-12 and partial loss of work days due to DM/month was 0-3 ,a statistically significant difference between diabetics and controls (where controls were better than diabetic workers) regarding work performance of an average worker, total score of work performance and percentage of total score ($P<0.05$). There was no statistically significant difference between subjective and objective assessment regarding work evaluation last year or last monthly evaluation ($P>0.05$). There was no significant difference between mean value of days lost due to DM and that of days lost due to other reasons ($P>0.05$). **Conclusion:** our results provide evidence for a negative impact of diabetes on work productivity among construction workers in Egypt due to increased time loss, increased absenteeism (either partial or total work days loss), yet, the increased performance by the diabetic workers compensated for that loss. Further

studies are recommended to explore the consequences of diabetes on work place and to suggest the interventions.

Key words: Diabetes Mellitus, work productivity, construction industry, work performance, body mass index.

Introduction

Chronic disease is a stressful condition that imposes a different life style on the patients, with subsequent changes in daily activities, feeding habits, work performance and even family life. One of the most widely spread chronic diseases is Diabetes Mellitus (DM) particularly type (2) and it is the eleventh most important cause of premature mortality in Egypt, and is responsible for 2.4% of all years of life lost (YLL).also, DM is the sixth most important cause of disability burden in Egypt (National Centre of Health and Population, 2004).

Worldwide the prevalence of diabetes among adults (aged 20-79 years) was 6.4%, affecting 285 million adults in 2010, and will increase to 7.7% and 439 million adults by 2030. Between 2010 and 2030, there will be a 69% increase in numbers of adults with diabetes in developing countries and 20% increase in developed countries (Shaw et al., 2010).

Construction industry is one of the industries that have a vast number of job varieties, ranging from sedentary office works to various field activities like building, painting, scaffolding, plumbing, electrical and electro-mechanical works, excavation, vocational driving, steel fixing, carpeting and many others. The nature of construction industry is also transient both in place and in time. Workers finish a job at one place, for a certain period of time, and then start another job at another place and have a nature that could be totally different from the first job (Weeks, 2011).

Construction workers include about 5 to 10% of the workforce in industrialized countries. Workers in construction industry are exposed to many hazards: physical (atmospheric conditions, vibration, illumination, and dust), chemical (through direct contact or inhalation) or ergonomic, and those factors affect both white and blue collar employees. Also, the transient nature of construction industry and the increased

risks of harmful exposures, together with the tight time schedules of project delivering dates, collectively put workers at all levels under continuous stress (Roto, 2011).

There is an evidence that Diabetes Mellitus which affects workers, employees and society not only by reducing employment but also by contributing to work loss and health-related work limitations for those who remain employed (Kaan et al., 2005).

Aim of Work: To assess the impact of diabetes on the productivity of the workers in construction industry.

Materials and Methods

I-Technical design:

Type of study: Case control study

Site of study: Big Construction site in New Cairo.

Time of study: The field work was carried out during the period from the beginning of August 2013 to the 30thof November 2014.

Subjects: Diabetic workers in construction industry.

Sampling:

- Diabetic patients were selected between about one thousand construction workers, in a big construction project in New Cairo; the sample included diabetic patients with Type 1 or Type 2 Diabetes Mellitus. The selection was according to our inclusion criteria; those suffering from hypertension or any other chronic illness were excluded.

Size of Study group: All Diabetics who accepted to participate were included. The total number of workers who agreed to fill the questionnaire was 34 persons, a similar number of normal persons of the same work place matched according to socio demographic, occupational and BMI data were chosen as control.

II-Consent

- An informed written consent was obtained from all workers before participation; it included data about aim of the work, study design, site, time, subject and tool. They were informed that all collected data will be confidential and used for scientific purposes only. They were informed also that no invasive or painful techniques will be carried upon them.

III- Ethical approval

An approval from The Research Ethics Committee in Benha, faculty of medicine was obtained before conduction of this work

Tools of data collection:

1-Questionnaire

- A structured anonymous questionnaire sheet was used to collect data; it was translated to Arabic language to be easily understood by the workers and was administered by personal interviewing.
- The questionnaire was adopted and modified according to WHO HPQ (Health and performance questionnaire) and it was validated by previous studies (Kessler et al. 2004) and it was revised by four academic professors to assess its content and construction validity.
- The questionnaire points were explained to each candidate in the face to face interview to make-clear every point because of the educational and cultural variability of the sample.
- It took about10 minutes from each worker to fill the questionnaire which includes data about the following topics:
  - **Personal and socio-demographic data of workers:** gender, age, education, marital status, special Habits.
  - **Medical history:** about diabetes: commencement and duration of present illness, course of the disease, medications, compliance to treatment. Family history. History of complications.
  - **Investigation:** fasting and post prandial blood sugar, HbA1c, liver and renal functions, body mass index (weight / hight).
  - **Occupational history:** Job description, years of experience, work hours/week, over time work hours.
  - **Work performance during illness as:** Absence due to illness, work hours lost, work performance during illness (due to diabetes and or its complications) in the past 28

days and the past year, work performance compared to that of the best worker (an average worker) in the same job given a grade on a scale from Zero (least performance) to ten (best performance) (Kesseler, 2004). Performance evaluation was made by the participants themselves (self- evaluation of performance) and also by their direct supervisors (direct supervisor's- evaluation) in order to reduce bias at this point. By personal interview of the researcher with the worker and his supervisors.

III - Administrative design:

An official permission was obtained to conduct this study from the head of medical department of the construction company where the study was made.

IV -Statistical design:

The collected data were tabulated and analyzed using the Statistical Package for Social Science (SPSS) .Categorical data were expressed as number and percentage; Continuous variables were expressed as mean and standard deviation. Chi-square test or Fishers exact test, student "t" test, Man Whitney U test, Wilcoxon test, Spearman's correlation coefficient (rho) and multiple linear regression analysis were the used tests of significance. The accepted level of significance in this work was 0.05.

Results

The socio-demographic criteria of the studied sample:

The study included 34 diabetic patients and 34 healthy workers as a control group, the ages ranged from 25-63 years. The mean body mass index (BMI) was on the overweight side for both groups. The educational level of the studied group was: 24% were illiterate, 2% received primary education, and 6% preparatory, 48% secondary and 20% received university education. About 88% were married and 50% were smokers. Comparing both groups regarding socio-demographic characters revealed non-significant difference ($P>0.05$ for all parameters).

Occupational and medical history of the studied sample:

The occupational history of the studied sample revealed that 13% of

them had white collar jobs and 87% had blue collar jobs. 27% had permanent jobs (monthly paid according to a contract) and 73% workers were casuals (receive payments on daily basis), 82% had a work experience of more than 10 years while 18% who had a work experience of less than 10 years. The work hours/week ranged between 48-97 hours. Regarding medical history of the diabetic group, this work declared that the mean age of onset of D.M. was 41years of age (ranges from 14 – 55 years), the mean duration of diabetes ranged between 0.9 - 21 years. 38% were type 1 diabetics and 62% were type 2. 44% received Insulin as a treatment, 47.0% received oral medications and 12% only followed a diet control. In 82% of the diabetics, the diabetic current status was controlled and 18% were uncontrolled. 77% suffered from diabetic complications and 32% had no complications. The results also revealed that 18% suffered diabetic keto-acidosis; all were transferred to hospital and properly managed and 27% suffered from hypoglycemia. Diabetic retinopathy affect 9% of them as proved by fundus examinations, 45% suffered from peripheral neuropathy, 15% had to be absent work due to their complications and 85% did not. Also, there was no significant difference between mean value of days lost due to DM (0.88±2.33) and that of days lost due to other reasons(0.56±0.705) ($P>0.05$).

Laboratory findings among the studied groups:

Table 1: Comparison between diabetics and control regarding Lab investigation.

	Diabetic group(34)		Control group(34)		t test	P value
	Mean± SD	Range	Mean± SD	Range		
Fasting blood sugar	190.59±77.97	89-480	85.71±6.9	76-104	7.81	0.001**
Post prandial blood sugar	242.7±66.95	123-400	98.97±10.97	73-120	12.35	0.001**
Glycated Hemoglobin	7.66±2.15(7)	5-11	5.65±0.66(13)	4-6.1	3.16	0.005**
Creatinine	0.83±0.21	0-1.4	0.95±0.15	0.6-1.3	2.62	0.011 *
Albumin	4.26±0.32	3.5-5.1	4.15±0.66	0.8-5	0.863	0.391
Bilirubin	0.64±0.34	0-1	0.87±0.76	0.5-5.1	1.66	0.102

**: Highly significant *: Significant

In (table 1) we compare between the diabetic group and the control group in lab investigation where the only significant difference ($P<0.05$) was found between the 2 groups in the blood sugar denominators as fasting blood sugar, post – prandial blood sugar and glycosylated hemoglobin. Renal function tests were statistically significantly high among control group but liver function tests did not show any significant variation between the diabetic group and the control group.

Work performance among the studied groups:

Table 2: Comparison between diabetics and control regarding work performance

	Diabetic group(34)		Control group(34)		t test	P value
	Mean± SD	Range	Mean± SD	Range		
Work hours requested by the employer	63.5±9.4	48-97	67.65±12.76	48-97	1.53	0.132
Total work hours/week	64.82±8.25	48-97	68.68±11.47	48-97	1.59	0.117
Work days lost due to DM/month	1.015±2.38	0-12	0.0	0-0	-	-
Working days lost due to other reasons/month	0.56±0.705	0-3	0.32±0.59	0-2	Z= 1.53	0.126
Partial loss of work days due to DM/month	0.69±1.0	0-3	0.0	0-0	-	-
Partial loss of work days due to other reasons/month	0.21±0.73	0-4	0.09±0.38	0-2	Z=0.835	0.403
Total no of work hours/ month	267.38±40.83	179-388	245.62±39.85	150-324	2.22	0.03*
Work performance of an average worker	7.56±1.05	5-10	8.27±0.88	7-10	3.02	0.004**
Self-evaluation of performance last year	7.47±1.4	5-10	7.79±1.15	5-10	1.04	0.301
Self-evaluation of performance last month	7.5±1.503	4-10	7.76±1.499	5-10	0.727	0.47
Direct supervisor's evaluation of performance for last year	7.32±1.51	4-10	7.68±1.49	5-10	0.969	0.336
Direct supervisor's evaluation of performance for last month	7.35±1.63	3-10	7.68±1.49	5-10	0.854	0.396
Total score(max. score=50)	37.82±6.11	24-49	40.94±5.06	28-48	2.29	0.025*
Total score percentage	75.65±12.21	48-98	81.88±10.11	56-96	2.29	0.025*

**: Highly significant *: Significant

Table 2 shows a statistically significant difference between diabetics and controls (where controls were better than diabetic workers) as regard work performance of an average worker, total score of work performance and percentage of total score ($P<0.05$ for them all). Regarding mean values of total no of work hours/Month it was (267.38 ± 40.83) for diabetic and (245.62 ± 39.85) for non-diabetic the difference was statistically significant.

Table 3: Comparison between subjective & objective assessment of work performance among the diabetic group only.

(Worker's self-assessment Versus Supervisor's assessment)

	Subjective assessment		Objective assessment		Paired t test	P value
	Mean ± SD	Range	Mean ± SD	Range		
Work evaluation last year	7.47±1.4	5-10	7.32±1.51	4-10	0.796	0.432
Last monthly evaluation	7.5±1.503	4-10	7.35±1.63	3-10	1.3	0.201

Table 3 shows that there was no statistically significant difference between subjective and objective assessment regarding work evaluation last year or Last monthly evaluation ($P>0.05$).

Table 4: Correlation between score of evaluation and some studied variables

Score of evaluation	rho test	P value
Age	0.011	0.95
Duration of DM	-0.343	0.047 *
Fasting blood sugar	-0.452	0.007 **
Post prandial blood sugar	-0.394	0.023 *
Glycated Hemoglobin	-0.908	0.005 **
creatinine	-0.369	0.032 *
Albumin	0.094	0.599
Bilirubin	-0.085	0.632

**: Highly significant *: Significant

This table demonstrates that there was a significant (P<0.05) negative correlation between the score of evaluation of diabetic workers and duration of DM, FBS, PP, glycated Hb and creatinine levels.

Table 5: Stepwise multiple linear regression analysis for the predictors of the worker's score of evaluation.

Score of evaluation	â	P value	95% CI
Duration of DM	-0.342	0.061	-0.791-0.944
Fasting blood sugar	-0.238	0.24	-0.567-0.999
Post prandial blood sugar	-0.274	0.163	-0.649-0.99
Glycated hemoglobin (the most predictor)	-0.908	0.005	(-2.93)-(-0.897)
Creatinine	0.202	0.452	0.384-0.634

Table 5 shows that Glycated hemoglobin (Hb A1c) was the significant predictor (P<0.05)

Discussion

Lost productivity at work is an important concern for employees, employers, and society. Moreover, the complications related to diabetes are a major cause of disability, reduced quality of life, and death .Employees with diabetes may stop working prematurely and may experience unemployment, which could translate into a reduction in earned income and savings and loss of self-esteem. For employers too, lost productivity due to absenteeism, presenteeism, and early retirement is an important economic issue (Breton et al., 2013).

Our calculations were based only on the work hours lost and absenteeism from work to evaluate productivity, and that goes with the nature of construction industry in Egypt, where production is evaluated mainly by work hours needed to finish a given task and where the dates of work accomplishment are solid, mandatory and economically effective.

The results revealed that there was a significant time loss in the diabetics group when compared to the control group we found that the number of days lost from work/month due to diabetes ranging from (0-12) and partial loss of work days/month due to diabetes ranged from (0-3).

Our results were in consistent with previous studies (De Backer et al., 2006 and Vamos et al., 2009); they found that individuals with diabetes had significantly more absences from work than those without diabetes (odds ratio ranged between 1.51 and 3.3).

Other four studies, found that individuals with diabetes had between 0.90 and 5.7 more days lost in the previous year than individuals without diabetes (Mayfield et al., 1999, Cawley et al., 2008, Fu et al., 2009 and Tunceli et al., 2005).

Also our results were in agreement with(Krstović-Spremo et al., 2014) who conducted a cross sectional survey to examine the impact of diabetes mellitus on the ability to work in , they found that patients with diabetes mellitus experienced more difficulties in performing work or other activities over the past 4 weeks. Eleven percent of patients with diabetes mellitus were constrained to perform work or other activities “all the time”.

Another cross-sectional study conducted in USA by (Stewart et al., 2007) including individuals with diabetes with and without neuropathic symptoms; they found that diabetic workers are 18% more likely to lose ≥2 h of work per week due to illness when compared with individuals without diabetes. In fact, 52.0% of individuals with diabetes and neuropathic symptoms lost ≥2 h per week from work due to illness or reduced performance compared with 28.0% of individuals without diabetes. However, no significant difference was found between individuals with diabetes and without neuropathic symptoms and those without diabetes. The total number of days of productivity lost due to illness annually was 26.3 in the group of individuals with diabetes with neuropathic symptoms compared with 11.9 for those with diabetes without neuropathic symptoms and 12.0 for those without diabetes.

Similar to our results (Tunceli et al., 2005) found that diabetes reduced the absolute likelihood of working by 4.4 percentage points for women and7.1 percentage points for men. Although this study did not explicitly measure presenteeism (i.e., reduced productivity while working), they found that diabetes was associated with the presence of work limitations. Diabetes was also associated with increased absenteeism. These findings suggest that diabetes may result in productivity losses for employers.

Herquelot et al., 2011 conducted a prospective cohort on 20,625 employees and identified 506 employees with diabetes and randomly selected 2,530 non diabetic employed control subjects. Participants with diabetes had significantly increased risks of transition from employment to disability [95% CI 1.0–2.9]), retirement [1.5–1.8], and death [3.6–14.6] compared with participants without diabetes. Between 35 and 60 years, each participant with diabetes lost an estimated mean time of 1.1 year in the workforce (95% CI 0.99–1.14) compared with a non-diabetic participant.

The differences in absenteeism in different countries could be attributed to differences in social security coverage modalities that vary across countries in terms of granting sick leave or other

employment benefits (Osterkamp et al., 2007). However, despite differences between social security models, results are generally consistent and attest to the negative consequences of diabetes on ability to work. Individuals with diabetes and or complications related to diabetes had more absenteeism and productivity loss (Stewart et al. 2007 and Vamos et al., 2009).

The mean values of total no of work hours/month was (267.38±40.83) for diabetic and (245.62 ± 39.85) for non-diabetic the difference was statistically significant, because diabetic workers compensate days loss by doing extra work (overtime) to improve their incomes.

Contrary to our results Lavigne et al., 2003 stated that a few of diabetic workers reported working extra hours in order to compensate their reduced productivity.

Minimal researches were studying the effect of diabetes on work performance and work productivity in Egypt. According to the evaluation of work performance of the participants it was made using a work performance evaluation scale ranging from Zero (least performance) to ten (best performance) (Kessler et al,. 2004). According to work performance there was no significant difference between the diabetic group and the control group concerning work performance. This may be due to a psychological element that most of the diabetics stated: that increasing their work activity helped them get rid of the high blood sugar and gave them a sense of well-being and unchanged value and those they enjoyed a good general health just like their non-diabetic colleagues. We observed that the impact of diabetes on productivity was significant but it was compensated by the better work performance.

Limitations: this study has some limitations. First, small sample size larger samples are needed to provide a better assessment of the causes and effects of diabetes on ability-to-work outcomes. Second, diabetes status and ability-to-work data were generally related to memory and workers may forget some data especially when recall periods are long.

Conclusion: our results provide evidence for a negative impact of diabetes on work productivity among

construction workers in Egypt due to increased time loss due to increased absenteeism (either partial or total work days loss), yet, the increased performance by the diabetic workers compensated for that loss .Further studies are recommended to explore the consequences of diabetes on work place and to suggest the interventions.

Recommendations

- Proper workplace health precautions, close supervision, proper choice of jobs, and regular follow up helps prevent or minimize diabetes risks
- Night shifts are better avoided for diabetic workers. If mandatory, proper handling of work-rest schedules, types of medications, availability of a nearby qualified medical facility, and knowledge of the medical condition of the patient by the nearer colleagues to report any abnormalities that might endanger the patient's safety will be highly needed.
- Licensing for vocational driving for diabetics should be reconsidered in the Egyptian law, because of the great harm that might happen if the driver suffers hypoglycemia during driving a truck, a crane or any big vehicle.
- Efficient employer implemented intervention programs to improve the physical health and well-being of their workers with diabetes.

Conflict of interests:

The authors declare that there was no conflicts of interest exist.

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