

The Effect of Shift Work of Medical and Dental Staff on the Prevalence of Disease and Overweight and Obesity

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Abstract

Overweight and obesity are considered one of the most important health issues in 20 years' it's reached epidemic level and become international public health priority. Obesity and overweight are defined as abnormal or excessive fat accumulation that may impair health, considered to be preventable disease, we should know the contributing factors that lead to be able to reduce its burden and prevented effectively there is will knowing risk factors like age, gender, reduce physical activities, increase food intake, socioeconomic factors, education, marital status and medical conditions and medication on the other hand there is risk factor that are not well known such as shift work. The health complication of irregular shift working hours and night shift rise many epidemiological studies to investigate the association between health impact and shift work, as result of wide number of researches that have been published and found link connected shift work with many health problem such as various type of cancer like breast cancer, prostate, endometrial and colon cancer, shift work have been classified recently as probable carcinogenic by international agency for research on cancer. Night shift schedules contributed to cardiovascular and coronary heart diseases, gastrointestinal disease, increasing the risk of type II diabetes. Dose shift work consider as risk factor for overweight and obesity. In this review we will answer to this question through several studies hopefully will give new dimension to scientists and public health worker for preventing overweight and obesity, which eventually reduce the burden of health cost and reduce several kinds of diseases.

Keywords: Body mass index; Body weight; Overweight; Obesity; Health behavior; Night work; Occupation; Shift work; Rotating shift work; Physical activity; Food intake; Sleep duration; Work environment; Health consequences

Introduction

Obesity and overweight have become important health issues; it reached epidemic level and become an international public health priority. In several part of the world prevalence of obesity is increasing, much evidence shows that main causes of co-morbidities that may lead to mortality, is overweight and obesity WHO 2010 reported that 2.8 million people die each year from overweight and obesity 2.3% of global daily are also caused by overweight and obesity [1]. According to World Health Organization (WHO) obesity identified as epidemic in USA 35.7 in 2009 it was 35.1 in 2000, in UK was 32.8 in 2009 33.9 in KSA in 2009 42.1 in 2009 while it was 36.9% in 2005.

The complication of obesity includes cardiovascular diseases, such as ischemic heart disease and congestive cardiac disease, type II diabetes which consider normal complication of obesity, hypertension [2-5], higher risks of obstetric and neonatal complications menstrual regulation and Polycystic Ovarian Syndrome (PCOS) and infertility, central sleep apnea, obstructive sleep apnea, asthma is respiratory complications that occur in obese people [3,4]. And various cancers such as prostate cancer in males, in female ovarian, breast, cervical, gastrointestinal system complications fatty liver disease, Gastro Esophageal Reflux Disease (GERD) and hernia. Musculoskeletal system also effected by obesity, they may develop osteoarthritis low back pain, immobility, obese individual suffer from many psychological problem such as depression, low self-esteem, body dimorphic disorder and social stigmatization limitation in life task performance and functional activities which is linked to disability and many other important health problem [5,6].

Another burden of obesity is the health cost wish appear to be increased dramatically associating with the continue grow of overweight and obesity. A prospective estimation in US and UK of the trend of obesity and associated health problem for 2030 indicated that there will increase of medical cost of obesity by \$ 48-66 billion/year in US and 2.9-2 billion Euro in UK, this increase is a result of 65 million more obese in US and 11 more in UK, which lead to 6-8.5 additional cases of diabetes, cases of cancer will be more by 492,000-669,000 new cases additional 5.7-7.3 cases of heart disease [7].

The cost of obesity is not limited to the medical and health cost, it effect the individual yearly productivity due to premature mortality (reduction in QALYs), the estimation of annual productivity lost in US is between 3.38 billion and 6.36 billion (\$79 to \$132 per obese individual).

Obesity and overweight are defined as abnormal or excessive fat accumulation that may impair health, considered to be preventable disease, we should know the contributing factors that lead to be able to reduce its burden and prevented effectively, there is will knowing risk factors like age, gender, reduce physical activities, increase food intake, socioeconomic factors, education, marital status and medical conditions and medication on the other hand there is risk factor that are not well known such as shift work [8,9].

It is a fact that recent society is moving toward a pattern of 24 hours working day, as result shift work become basic work schedule in any institution that provide continues essential services such as police departments ambulance officers fire brigades and hospital. According to that need the number of shift worker have been increased [10]. Those shift work adapt them self's to live differently they become the hidden solders to keep the society alive and valuable through 24 h of the day [11].

The health complication of irregular shift working hours and night shift rise many epidemiological studies to investigate the association between health impact and shift work as result of wide number of researches that have been published and found link connected shift work with many health problem such as various type of cancer like breast cancer prostate endometrial and colon cancer shift work have been classified recently as probable carcinogenic by international agency for research on cancer [12-23]. Night shift schedules contributed to cardiovascular and coronary heart diseases (23 m, 24 m, 25 in population) gastrointestinal disease increase the risk of type II diabetes [24,25].

Dose shift work considered as risk factor for overweight and obesity. The answer to this question will give new dimension to scientists and public health worker for preventing overweight and obesity, which eventually reduce the burden of health cost and reduce several kind of disease [26].

Shift work is defined as work performed primarily outside typical daytime hours and includes evening shifts, rotating shifts, irregular shifts and flexitime. It has been identified as one of the factors that may have an impact on being overweight and/or obese and research findings suggest that shift work may increase the likelihood of being overweight and/or obese by at least 39%, despite the potentially serious health consequences, research on underweight has been limited, perhaps reflecting the comparatively lower prevalence of being underweight in the population. Obesity rates have increased threefold or more since 1980 in some areas of North America, the United Kingdom, Eastern Europe, the Middle East, the Pacific Islands, Australia and China.

Literature Review

In this literature review we will investigate the association between shift work and overweight and obesity through reviewing several studies that provide strong evidence linking shift work with overweight and obesity there is cross sectional studies that conclude this association and insight more in causal relationship through longitudinal studies that explore the effect of shift work as exposure factor lead to overweight obesity and finally we will investigate the causes behind this risk to clarify the link between shift work and weight gain [27-32].

Geliebter, et al. reported that late shift worker gain more weight than the day shift worker in New York hospital, on 85 nurses and security personal with 4.3 kg of mean weight gain in shift worker compared with 0.9 kg mean weight gain in day shift group this was result of analyzing questioner that contain change in weight with adjustment of age year of shift work and smoking statues in addition his study examine the sleep duration of participant since they start the job and found that shift worker have more napping time than day shift worker however there was no significant different in current BMI [33]. A study done by Parkes, et al., on 1574 British male industry worker, according to shift work schedule they were divided in 787 day shifts worker versus 787 day night rotation worker, the participant include different types of job and different level of education aged 29.9-55 years old they were asked about shift pattern height, weight, educational level, smoking habits and years of shift work duration. The study result conclude that there was significant increase in body mass index among shift worker and that increase was associated with increase of duration of shift work and age [34-37].

In Malaysia study conducted to examine the association between socio demographic and life style as factor associated with being overweight and obese on total 1612 female working in factory, the outcome is to measure body mass index and the exposures measure was age, level of education, rotating shift work, ethnic, income and exercise. The result reported that shift work is associated significantly with being overweight, there was increase of BMI in women working rotating shift by 57.6%, 73 of overweight women reported inadequate exercise 57.8% was higher educated [23].

In Sweden Karlsson, et al. investigate the relationship between shift work and metabolic syndrome and focus in obesity in his cross sectional survey of 27.485 individuals in Sweden intervention program the subject include blue collar and professionals drawn from broad population base they were divided in four groups according to the age 30-50 and 60 years old and questioned about diet, physical activities, working conditions they go through clinical assessment on the metabolic syndrome that defined her as obesity, hypertension and dyslipidemia. The result reported that night shift worker is commonly have two and more metabolic factor and have increase prevalence of obesity by 1,4 odds ratio increase of the age were associated with increase the gap of obesity [24].

Another study support this result was done by Di lorenzo in Italy (Apulia), his study was to examine the impact of shift work on cardiovascular risk and metabolic factors among male

workers in chemical industry in 2003, 319 subjects were randomly selected with five years' work duration and no impaired glucose tolerance and indication of diabetes as inclusion criteria. His outcome was BMI and waist to hip ratio measurement, total cholesterol level (SBP), (DPB) exposure measurement was 8 h shift work that divided into two groups, day shift worker and three regular rotating shift. He concluded that three rotating shift have higher prevalence of obesity 20% compared with day shift 9.7%, and rotating shift work is significantly associated with increase of BMI, the BMI of shift worker was 20.2–40.7 kg/m² compared with 19.8–35 kg/m² of day shift worker however there was no difference in WHR in the day work group and rotating shift group [25]. While in other study done by Nakamura, et al. reported that two shift and three shift workers have higher Abdominal to Hip girth Ratio (AHR) than day workers and no differences in BMI, after adjustment of age, drinking and snacking, exercise and smoking [26]. In third study that uses both body mass index and waist hip ratio suggested that both BMI and WHR were associated with shift work the study done on 6,676 workers male and female in metal factory the purpose of the study is to examine the relationship work characteristics and body mass index and waist hip ratio [27].

In Milan in Italy retrospective longitudinal study conducted to investigate the relationship between metabolic and cardiovascular risk factors permanent night work all subjects who had worked between 1976 and 2007 in night shifts as motor sweepers delivery truck drivers and hand sweeper were compared with subjects who work day shift and worker who transfer from day shift to night shift for the same jobs socioeconomic status and educational level were controlled on the fact of homogeneous of the groups. After adjustment of age, lifestyle and job the result was significant increase in BMI among night shift worker and increase in prevalence of obesity compared with day shift worker for the worker who transfer from day shift to night shift there was increase in BMI associated with the night shift working period [28].

Across sectional study on 689 female nurses drawn from the work and health in Finnish hospital personnel project that work either three shift schedule permanent day shift and permanent night shift his study was to investigate the associations between health habits and shift work two of his outcome measurement was overweight and sedentary lifestyle the result suggested that shift workers more overweight by OR: 1.54, 95% (CI: 1.06–2.25) than day workers and this difference increase with age. There was no significant difference in sedentary life style in the groups [29].

Lee Di, et al. in his study evaluate the effect of working hours and sleep duration of shift worker on the increase of body mass index. With total number of 346 participants mainly male the number of female was 59. He found that the BMI was significantly higher in shift worker compared with day worker and it is associated with increase of working hours and less sleep duration [30]. The strength of this study is that it examines the sleep duration and working hours as contributing factor for increasing the BMI [31].

More recent cross sectional sub study done to evaluate the effect of shift work on unhealthy weight among midwives and

nurses data was from nurse and midwives e-cohort study the subject included in the study was 2494 female midwives or/and nurses who work in Australia, United Kingdom and New Zealand there were asked about their life style that include alcohol consumption, diet quality, smoking and physical activities the shift work exposure day shift work with and without weekend and shift work rotating three shift including night shift. The result of the study reported that prevalence of overweight and obesity was more in shift worker the shift worker are 1.15 times more likely to be overweight and to be obese 1.14 times more than day and physical activities was lower among shift worker.

One of the latest studies that investigate weight gain increase among nurses with shift work in relation to duration and age and investigate the sleep duration the subject study were nurses working in public hospital of (548 nurses) working day shift and night shift 52.7% of night shift worker reported increase in their weight last year. However; the result concludes that nurses working at night are more likely to have increase in their weight gain with years of work and age with no significant difference in current body mass index the result of this study was similar to Geliebter, et al. finding. The interesting thing in this study is that sleep duration is not affected by night shift since the subject who works at night shift in this study reported more sleeping hours than day shift worker. In contrast cross sectional study suggested that there was significant differences in sleep duration and quality between day worker and shift worker in way that shift worker have reduction in their sleeping duration and quality with more naptime frequency and increase the BMI among night shift worker however, it doesn't show higher weight change in night shift worker this study was conducted to investigate the prevalence of weight change and obesity in night shift worker and its relation with sleep pattern on 84 nurses they were divided in two groups night shift group (from 7:00 am to 7:00 pm) and day shift group that include two shift (7:00 am to 1:00 am) or from (1:00 am to 7:00 pm), in this study the author investigate physical activities and he conclude that as the frequency of physical activities decrease per week the body mass index increases [32].

Niedhammer, et al. in his longitudinal study found existing evidence of relation between shift work and weight gain. In the data, weight gain of nurses who work at night shift were 5 kg and more over the second five years from the 10 years observation period of the study, there was no differences in the first five years, his study was done on French nurses population total of 469 female nurses the main purpose of the study is evaluate the prevalence of weight gain and overweight in relation to night work. The follow up lost in the first five years (1985) 5% where in the second five years (1990) he lost 16% the group were divided according to work schedule controlled group include nurses working permanent morning and evening shift and other group was permanent night shift and alternating morning, evening and night shift work. The controlled confounders was age, birth during observation period BMI at baseline, smoking and sport activities the BMI measurement was taken twice in each five year period the result of the study demonstrate that overweight prevalence was associated with shift work in 1980 with OR: 3.3, 95% CI, in the period between 1995 to 1990 and after adjustment of confounders more nurses

reported more weight gain in night shift than nurses in day shift with (>5 kg, OR:1.9, 95% CI: 1.0 3.6; >7 kg, OR:2.9, 95% CI:1.2 6.9) physical activities in 1985 and 1990 observation periods were collected from self-administered questionnaires, van Amelsvoort, et al. in his prospective longitudinal study to assess the relationship BMI and duration of shift work the data was collected among 337 male and female from ongoing cohort study with five year observation period after adjustment was done for age, smoking, educational level and physical activities the shift worker wear working alternating shift schedule including night shift the result conclude positive relationship between duration of shift work and increase of waist hip ratio and body mass index in rang of 0.12 kg per year in shift worker [33,34].

The other recent study conducted in Japan is retrospective cohort study to investigate the effect of shift work as risk factor for obesity the subject were either day worker or rotating shift worker of three shifts the result demonstrate that the risk of shift work on obesity become obvious after 10 years the study reported 3319 cases of obesity from 9912 male employee with RR 1.14, 95% CI 1,1 to 1,28 [35]. Suwasnsso in his study, investigate the effect of alternating shift work on weight gain in male Japanese workers compared to day work through prospective longitudinal study. They follow up period was 14 years from 1991 to 2005. The enrolled subject is a total of 7,254 subjects, that included 2,926 alternating shift workers and 4,328 day workers there was no drop out reported the subject included are those attending annual health examination the shift work exposure was three continuous clockwise rotating shift schedule (five days on and two off, five evening on and one off and five night on and two off) permanent night worker and irregular shift worker wear excluded in this study, the main outcome was body mass index measured by professionals, and the controlled confounder is age BMI measurement regular exercise m smoking and alcohol consumption the study reported a significant increase of BMI and weight change among rotating shift worker after one year of the observation period, food intake was not included in statistical module because they did not observe it in the beginning however at the end of the study they observe that shift worker eat more meal than day shift worker in this study there was no effect of age in increasing BMI. Absence of habitual exercise were significantly higher in shift workers compared to day workers, however physical activity do not treated as individual confounder instead the result was adjusted with it [36].

Another prospective cohort study with 10 years follow up to investigate the effect of shift work on change in parameter related to metabolic disturbance the study population was 1529 blue collar worker in Japanese factory age 19-49 years the participants were classified to four groups according to questioner for work schedule to describe the occupation exposure the first group was day-day workers (have fixed day time work) group two shift-day worker (those who was night work in 1993 and transfer to day shift work during observation period) group three day-shift worker (those who have fixed day time in 1993 and transfer in shift work during observation period, group four shift-shift worker (fixed shift work) the measurement was the change in BMI using anthropometric

measurement divided in to two period every five years with two measurement and blood pressure serum cholesterol in the period and health related behavior at baseline 1993 to end point 2003) and compare it among those groups the nutrition intake was measured through self-administrated diet history questioner in 2003 alcohol intake was calculated in 2003. The result from this study after age-adjustment was the following increase in BMI for group three (day-shift) with significant change compared to day-day worker and shift to day worker large increase among shift to shift worker compared to day-day worker. No significant change in blood pressure, smoking, alcohol and cholesterol level where food intake was lowest in day-day shift worker there was significant difference among the group in the total calorie at the end point intake the highest number of calories was seen among (shift-shift) consumed followed by (day-shift). Shift worker in the study regression analysis was used to analyze the relation between changes in parameter after 10-years follow up according to this result the study consider shift work to be risk factor for overweight, they assess the food intake and underestimate the physical activity [37].

The associations between shift work and increase of weight gain have been evidenced in most of the previous studies the concluded result suggested that shift work is risk factor for overweight and obesity; however most of the studies was limited either in its cross sectional design methodology dealing with confounders and outcome measurement. The limitation of previous study can be seen in many aspect such as exposure was taken differently, which may affect the accuracy of the result few studies examined the role of working hours and schedule on body mass index in the other hand there was no information about shift work schedule, duration, frequency and pattern other studies or no specific information on day works schedule nevertheless some studies excluded permanent night shift worker and irregular shift worker from his study.

Another limitation of those studies was selection bias in Parkes, et al. study the participant were employee that have to have standard requirement on mental health and physical level in way make their health statues favorable and different than general population in other study we have voluntary participants which consider bias selection, in way that the subject volunteered may have greater health consequences. In Di Lorenzo in addition to the small sample size, selection bias could be considered since only blue collar male worker are included in the study which my limited generals ability due to their different social economic statues than white blue collar and other professionals.

Another selection bias seen in nature of work of participant as nurses and midwives make them in higher educational level in Kivimaki, et al. study there was large number of study participants that were recruited and involvement of female participants only and there was drop out from work subject wear less healthy and this may affect the evaluations of association. Another study have differences in the type of work job between day shift worker and rotating shift worker where night worker have another job which may affect their body mass index through increase stress, unhealthy food intake and lack of

ability to do any physical activities. Or day shift worker have different job and working hours blues the small sample size in some longitudinal studies there was lost in follow up participant where 33% lost in the follow up in the both first and second duration of the 10 years observation period which consider possible confounder and the non-responded may not be healthy as responded and they may leave the work for health reasons and there was no follow up for night shift duration possible bias in Van Amelosvoort, et al. from the 65% response rate and different occupation and job strain, payment, spare time and among participant in day shift and shift worker and some participant refuse to answer all the questions. Suwasno, et al. included subjects who attended annual health examinations during the observation period. In some longitudinal studies there was no clear information about the participant schedule-D changes during the observation period we cannot roll out the bias due to drop out which was 16% during the observation period.

Confounding factor was taken differently in the all of the previews studies for example in some studies food assessment as confounder was not taken in to account and exercise or physical activity was not adjusted and under estimates which may affect the result in other study physical activity was evaluated at the end of the observation period using a self-administered physical activity questionnaires they didn't assess the change in physical activity during the observation period. There was different in measurement used for weight change in some study there wear relying on participant in recording weigh by self-report which affect the accuracy of weight measurement. Physical activities, food assessment and sleep duration wear not account as confiding factor Parker, et al. study or there was no reporting in the odds ratios. Where Most of the studies did not investigate sleep duration as contributing factor.

The causal relationship between shift work and weight gain is complex correlation from one side shift work as exposure have different definition duration and pattern and from the other side there is multiple contributing factor for overweight and obesity which make it difficult to come up with definite causal relationship. The question needed to be answered is what make shift work different than day work to become risk factor for overweight and obesity.

The knowing predisposing factor for weight gain mainly due lack of balance between food intake and physical activity associated with another important contributing factors like age, gender, marital status, socioeconomic status, hormones, sleep duration, genetic back ground, educational level and lifestyle.

From all the previous studies the reason making shift work increases the risk of overweight and obesity is still unraveled and not definite. All of this factor can affect night shift worker and day shift worker the difference is night shift worker due to their alteration of life style and continues disruption of circadian rhythm are more likely to be more effected by those predisposing factors.

Different possible causal factors have been mentioned directly or indirectly in those studies and some factors have been taken into account in all of the studies like age, gender, educational

level, socioeconomic status and medical history and shift work have no influence on those factors as result they don't provide causal relationship between shift work and increase of overweight and obesity while other important factors that can be affected by shift work like duration of shift work physical activity, food assessment and sleep duration have been under estimated and taken differently in the previous studies.

Some studies evaluate the positive causal relationship between duration of shift work on n the weight gain in some study there was significant change in body weight after one year of the observation period while others found this a positive relationship after five years of study period in one study the result concluded that shift work become obvious risk factor for obesity after 10 years. A few studies examined the role of working hours schedule on body mass index Biggi N, et al. found that permanent 6 h night workers have higher body mass index when compared with day shift worker, Di Lorenzo, et al. reported the same association with 8 hours rotating shift worker while Parkes, et al. concluded increase of BMI among worker that exposed to continues shift work is significantly greater than day worker.

Differences in food intake and quality between shift workers and day time workers may give possible explanation of the association between shift work and increase in body mass index, due to the fact that shift work could change the eating habits of worker however some of the previous epidemiological studies have demonstrate differences in the notational intake. Geliebter, et al. reported change in eating habits among nurses working night and evening shift work. Sauwasno, et al. at the end of his observational period suggested that shift worker eat more meals than day worker, while others demonstrate indirect link for increase unhealthy food intake due to increases of smoking pattern among shift worker compared with day worker another study result also show that high number of calories and energy intake among shift worker in Japanese factory those three studies have been reported change in food quality but they did not adjust food assessment as possible confounder in their studies. A study reported that there was no different in food quality among day and shift worker wear they both reported high quality of food intake by 61.5%. During the rest of the studies eating habits were not taken into account and not been adjusted.

In the previous studies, some studies reported decrease in exercise level among shift worker while others reported the absences of leisure activity among shift worker much more than day worker despite the fact that these studies underestimate the physical activity as confounder. Morikawa, et al. suggested in his study that worker who shift from day shift to night shift have reported the lowest level of physical activity during his observation period of the study. The same result was concluded in where the author suggested that lower odds of overweight are observed in women with adequate exercises. Some studies suggested that increase of body mass index associated with decrease of physical activity among shift worker.

Discussion

The reports from literature of shift work generally demonstrate that employees who engaged with shift work don't have time for physical activities and as result they have less activity level. In the previous limited studies that assess physical activity as confounder the founding subjected that whenever we have increase in body mass index we will found decrease in level of physical activity except for one study that reported increase in physical activity level among shift worker by 52.6% compared with day worker. In similar result other study reported that body mass index is associated positively with increase of physical activity.

Sleep duration is another factor may affect weight gain in shift worker many studies have given positive relationship between lower sleep duration and overweight and obesity. It was conformed that shift work affect negatively quality duration and difficulty in sleeping and lack of sleeping leads to change in endocrine and metabolism function which can cause hormonal disparity that leads weight gain and effect feeding control.

The studies that provide significant association between shift work and increase of body mass index sleep duration as confounder factor was underestimated however some have been reported that shift worker have low quality of sleep and difficulty in falling to sleep and more napping time among shift worker and suggestion that shift worker have less sleep duration than day shift worker have been mentioned while others conclude that wearer no different in sleep duration among day and shift worker nevertheless two studies suggested that shift worker have more sleep duration than day shift worker.

Those different results make it difficult to conform that sleep duration is casual factor for increase overweight among shift worker and reflect the need for more longitudinal studies to investigate this factor.

Many evidence have proven the shift work is risk factor for increasing overweigh and obesity due to the limitation of longitudinal studies and existing limitation in sample population methodology and dealing with confounders a definite causal relationship between shift work and increase in body mass index is not clear and the mechanism behind this association is unknown. We notice that the important contributing factors to overweight and obesity such as physical activity food intake and sleep duration which consider factors that influence by shift work are not taken as permeating factors even more they are not consider as confounding factors need to be adjusted in many of the studies.

Conclusion

Obesity and overweight is crucial health issue due to its morbidity and mortality impact as well as social and economic impact and its increasing trend make it in the top priorities of scientists, public health worker and government. Highlighting any factor that may contribute to increase overweight and obesity should be taken seriously to reduce the burden of this disease. The result of several epidemiological studies evidence that shift work is possible risk factor for increasing body mass

index and as result it is consider as contributing factor for overweight and obesity, however, there is limited number of studies explain the causal relationship and they failed to give definite behind this mechanism more longitudinal and clinical trial studies should be conducted to investigate more on causal relationship physical activities, food intake sleep duration and shift work duration need to be taken more seriously in future studies.

In Saudi Arabia we should start exploring this correlation and provide evidence based studies to influence more researches to insight more to clear the factors that makes shift work a risk factor for overweight and obesity.

Important steps should be taken to develop effective strategies to improve work environment, policies should implement guideline for each institution that shift work is part of its schedule, those guidelines should cover physical activities, healthier food better sleep quality and increase awareness among employee not only for weight control but it's appropriate for any working population in work place.

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