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From good sleep to health and to quality of life – a path analysis of determinants of sleep quality of working adults in Abu Dhabi

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Abstract

Background Sleep quality has significant impacts on many aspects of quality of life. Therefore, identifying the association of sleep quality with that quality of life domains could lead to deeper insights for social policymakers and professionals to enhance their understanding of the lives of Abu Dhabi working adults. This research focuses on sleep quality among working people in Abu Dhabi. The direct and indirect associations of sleep quality with various quality-of-life domains such as income and housing, physical and mental health, sport and activities, eating habits and obesity, work-life balance, online hours, and social connections are investigated and discussed.

Methods Data were drawn from 36,515 full-time employees in both public, and private sectors, obtained from the third Abu Dhabi Quality of Life (QoL) survey aimed to cover all community members using online platforms. Informed by international research on sleep quality, preliminary investigation using correlation analysis and simple regression identified many well-being variables deemed necessary for inclusion in the path model. Path analysis was then performed.

Results The final path model produced excellent fit measures. The significant variables directly associated with sleep quality included sleeping hours, social connection, satisfaction with income, satisfaction with residence, subjective physical and mental health, income satisfaction, satisfaction with the surrounding environment, frequency of eating healthy food, work-life balance, and online time. In addition, most variables recorded an indirect association to sleep quality through subjective health.

Conclusions The importance of multidimensional linkages between many well-being factors influencing sleep quality and subjective health is underscored.

Keywords Sleep quality, Working adults, Wellbeing, Quality of life, Path analysis, Abu Dhabi

Introduction

Poor sleep quality is significantly associated with poor quality of life (Lee et al. 2021). In addition, studies have shown that sleep quality influences multiple aspects of quality of life, including health, physical and cognitive functioning, and psychological effects (Cohrdes et al. 2018; Matsui et al. 2021). However, most existing studies on sleep quality were conducted in developed countries, mainly in the US, Europe, and Asia. With a few exceptions (Mahfouz et al. 2020), sleep quality and its

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correlates and determinants are rarely studied in Arab countries.

In Abu Dhabi, the Abu Dhabi Quality of Life (QoL) survey results have led to several empirical research highlighting the significance of understanding various social issues in the Abu Dhabi community (Badri et al. 2021; Badri et al. 2022a; Yang et al. 2021). For example, among the social issues identified, full-time working adults in Abu Dhabi tended to work for long hours and usually slept less than seven hours a day (Abu Dhabi Department of Community Development (ADDCD 2020).

This study examines the role of many quality-of-life variables in influencing the sleep quality of working adults in Abu Dhabi. The research objective is to determine how sleep quality relates to self-rated physical health and how some well-being determinants interact with the two outcomes. The study uses path analysis to estimate the magnitude and significance of hypothesized connections among quality-of-life variables. We will examine the direct association between sleep quality and the various well-being variables in an integrated model. The model will also examine the relationships between the independent variables (sleep hours, housing, social connection, mental health, obesity, sports, online hours, eating healthy, the environment, income, work-life balance, and physical health).

Using data collected through the third cycle of the Abu Dhabi QoL survey, this research contributes to the literature and policymaking in several ways. First, consistent with similar research, it analyzes working adults' sleep quality, more specifically in the Emirate of Abu Dhabi, considering various well-being factors. Second, the study can further our understanding of how certain quality of life indicators associate with sleep quality, providing insights, especially for social policymakers and professionals, to enhance their understanding of the lives of Abu Dhabi's working adults. Third, the results could be used as insider intelligence for creating programs to provide services to enhance working people's happiness.

Literature review

Like nutrition and physical activity, sleeping is a significant determinant of health (Rezaei et al. 2017). Sleep, as an "active, recursive and repetitive mode and disconnection from the physical environment" (Carskadon & Dement 2000), is associated with cognitive functions, reasoning, behaviors, and creative processes (Flo et al. 2014). In addition, enough sleep is an essential bodily weapon for fighting diseases, including infections, metabolism, and diabetes (van Cauter & Knutson 2008). Conversely, poor sleep quality attributes to heart disease, hypertension, and obesity (Kripke et al. 2002).

Research has pointed out the significant impacts of sleep quality on many aspects of quality of life (Rezaei et al. 2017). An abundance of research evidence reveals that poor sleep quality subsequently leads to a decline in health and psychological well-being (Marques et al. 2017; Radek & Kaprelian 2013). Overall, the extant literature has explored the relationships between various aspects of quality of life attributes with sleep quality. Among other factors, these include satisfaction with residence and income (Sandberg et al. 2014; Wu et al. 2018), physical and mental health (Giannotti et al. 2002; Rezaei et al. 2017), eating habits and obesity (Kripke et al. 2002), sport and physical activities (Dubinina et al. 2021; Mahfouz et al. 2020), social connections (Kent et al. 2018; Troxel et al. 2007), the environment (Carskadon & Dement 2000; Gaultney & Collins-Mcneil 2009), time spent online (Cellini et al. 2020; Levenson et al. 2016), as well as work-life balance and sleep duration (Bin 2016; Nakashima et al. 2011).

Many studies address sleep quality by examining sleep duration (Wu et al. 2018). Bin (2016) notes that sleep duration and quality are significant health risk factors. Meta-analyses also confirm the association between sleep duration and hypertension and diabetes (Anothaisintawee et al. 2015). Some longitudinal studies point to the relationship between short sleep duration and worse sleep quality (Kinuhata et al. 2014), which is associated with some subsequent cardiovascular diseases (Mattiasson et al. 1990). The research by Min et al. (2018) concluded that short sleep duration and poor sleep quality might be associated with higher consumption of unhealthier foods. They revealed that lower consumption of fruits, milk, and vegetables tended to be related to poor sleep quality. However, utilizing the Pittsburgh Sleep Quality Index data, Matsui et al. (2021) found that more negative sleep quality, not shorter sleep duration, was associated with a more negative physical quality of life.

Some studies have explored the relationship between housing conditions, sleep quality, and health (Sandberg et al. 2014). Housing quality, including noise and other environmental factors, could negatively affect sleep quality (Early et al. 2006; Peterson et al. 2008). Some researchers focus more on the effect of poor sleep on physical health and the quality of the living environment (Gaultney & Collins-Mcneil 2009; Marques et al. 2017). Others attribute poor sleep quality to emotional disorders such as depression, fatigue, and difficulty concentrating and making decisions (Chen et al. 2019; Giannotti et al. 2002). Most relevant research suggests an association between psychological well-being and sleep quality (Chen et al. 2019; Yao et al. 2008). Specifically, research has witnessed the role of sleep quality in mental consolidation (Okano

et al. 2019). Poor sleep quality can lead to poor concentration and other mental challenges (Luo et al. 2013). In a longitudinal study, Tang et al. (2017) reported that an increase in both sleep duration and sleep quality contributed to the improvement in people's mental and physical health.

Social connections and support have received increasing attention in the literature, which plays a vital role in objective and subjective sleep quality (Troxel et al. 2007). According to Brummett et al. (2006), social support from surrounding family and friends significantly improves sleep quality. Furthermore, social support positively affects psychological and physical health outcomes (Kent et al. 2018). On the other hand, aversive social and family relations tend to predict worse sleep quality (Kent et al. 2018).

Physical activities, sports, and exercise have an increasing role in studying sleep quality. Many studies prove that exercise and physical activities help a person fall asleep more quickly and improve sleep quality (Mahfouz et al. 2020; Reid et al. 2010). For example, in a study by Dubinina et al. (2021), high occupational and physical activity was a significant risk factor affecting sleep quality when controlling for age, gender, and socioeconomic status.

The rapidly growing rate of social media has caused more concern, as online usage adversely affects sleep duration and quality (Duggan et al. 2014). Tahir et al. (2021) demonstrated a strong correlation between internet addiction and poor sleep quality using a multinational cross-sectional survey. Cellini et al. (2020) also showed a significant relationship between spending ample time on the internet and poor sleep quality. After controlling for some sociodemographic covariates, Levenson et al. (2016) showed that participants with higher social media and online use had significantly greater odds of having lower sleep quality. Studies examining different age groups similarly conclude that excessive internet usage could negatively affect physical health and sleep quality (Alimoradi et al. 2019).

Sleep quality correlates with socioeconomic and demographic factors. In an extensive study, Anders et al. (2014) identified that social class and income significantly impact sleep quality and other factors such as anxiety, depression, and health status. Similarly, several other studies (Mackenbach et al. 1997) pointed out that lower socioeconomic strata frequently are exposed to a systematically higher risk of poorer health outcomes and sleeping disorders. Wu et al. (2018) used multiple regression analysis to confirm that income was part of many other variables that affected sleep quality. Their study also revealed that older age, unemployment, lower income, disability, and chronic disease comorbidities were significant factors associated with an increased risk of poor sleep quality for both genders. In addition, certain demographic factors such as gender, age, marital status, education level, and the number of people in residence are found to influence sleep quality (Reid et al. 2006). Gender differences between males and females in physical activities and sleep quality are recorded by many (Wei et al. 2012). Females reported higher poor sleep quality and insufficient sleep (Vajda et al. 2017). Zendels et al. (2021) analyzed the interaction between genders and sleep attitude and argued that women tend to show more positive attitudes towards sleep, despite often having poorer sleep quality and insufficient sleep duration.

Many studies have mainly addressed work-related elements and practices and associated work-life balance with sleep quality (Dahlgren et al. 2016; Nakashima et al. 2011). The roles of lifestyle, shift work, prolonged working hours, and irregular schedules in sleep disorders are often highlighted (Ohayon 2002). For example, a survey conducted by the Sleep Foundation (2022) found that sleep time and quality were reduced during workdays compared to non-workdays and that work schedules and stress were found to play an essential role in affecting sleep quality. Meanwhile, several studies have pointed out that longer working time reduces sleep quality (Basner et al. 2007). Some studies further pointed out that longer working hours are associated with poorer mental health, increased stress levels, higher anxiety, and depression, which result in poor sleep quality (Dahlgren et al. 2006). However, research by Schleupner and Kühnel (2021) revealed a positive relationship between sleep quality and work engagement.

Apart from the shorter sleep and leisure time compared with many OECD countries, many full-time employees in Abu Dhabi also reported an imbalance between work and home responsibilities (Abu Dhabi Department of Community Development (ADDCD), 2020), drawing our research attention to the working population. The UAE government has addressed a healthy work-life balance by introducing four and a half days of the working week and more flexible employment and work arrangements (Badri et al. 2022b). Nevertheless, the causes and correlates of sleep quality warrant further exploration to improve the well-being of Abu Dhabi's working adults.

Methods and materials

The sample

Abu Dhabi had a total population estimated at around 2.9 million people in mid-year 2016, among whom 61.4% were employed (Statistics Center Abu Dhabi 2021). The sample of working adults that this study used was from the third cycle of the Abu Dhabi QoL Survey conducted in 2021. Among other categories, the survey targeted

all working adult populations in Abu Dhabi. The survey utilized large databases of public and private entities. The QoL survey was administered online. It covered all three regions of the Emirate—Abu Dhabi, Al Ain, and Al Dhafra, which vary in geographic, climatic, and socio-economic characteristics. Survey links using Qualtrics (2020) were designed and distributed to more than 100 Abu Dhabi entities with their own databases of employees or residents. The entities included government departments, semi-government and private corporations, business associations, and regional authorities. For low-skilled workers residing in worker-residential cities, stratified random sampling was followed. A team of research assistants from the Statistics Center Abu Dhabi visited residential worker cities and collected data through structured face-to-face interviews. Ethical Committees approved the survey at the Department of Community Development and Statistics Center Abu Dhabi. In addition, informed consent was obtained from all participants.

More than 83,000 residents responded to the survey, among whom the public or private sectors employed 36,515 respondents. Weights were introduced to provide adequate representations of various respondent categories. A large sample size like this affords many advantages for survey-type research. For example, it yields a smaller margin of error, controls the risk of reporting false-negative or false-positive findings, and results in greater precision of results (Blair & Blair 2015).

The QoL survey instrument

In general, quality of life as a concept refers to an individual's well-being of the value, environment, cultural and social context in which they live (de Wit and Hajos 2013; Kuyken et al. 1995). Some analysts categorize it into dimensions and functional status (Fayers & Machin 2000). For example, Felce and Perry (1995) define it as a multidimensional concept comprising emotional, physical, and social well-being and aspects of personal development and activity. Studies focusing on work and employment refer to outcomes such as job satisfaction, growth opportunities, mental issues, and social relations (Lee et al. 2013).

The construction of the survey focused primarily on its design, focusing on gathering statistically valid information about the quality of life in Abu Dhabi. The primary focus in constructing the survey was also to make it a strategic instrument that could provide valuable data about the quality of life that properly fits the cultural background of the specific nature of the communities being surveyed. Many appropriate experts were consulted to examine the questions (i.e., ordering, scaling, format, value, appropriateness). Each question was also reviewed accordingly to ensure that it accurately reflects the views and opinions of the various participants. Many experts from the UAE University also reviewed the survey to review the scalability used for each item. Before its final launch, the research team carried out a small pretest of the questionnaire using a small subset of targeted respondents.

Nevertheless, the QoL survey instrument was developed based on several international social surveys and indices, including the OECD's Better Life Index (Organization for Economic Cooperation and Development (OECD), 2020), Gallup Global Well-being Survey (Gallup 2020), World Happiness Report (Helliwell et al. 2020), and European Quality of Life Survey (Eurofound 2020). As a result, the survey covers a variety of dimensions and factors that are thought to affect the well-being of residents in Abu Dhabi. Those dimensions include housing, household income and wealth, jobs and earnings, work-life balance, health, education and skills, personal safety and security, social and cultural values, social connections, civic engagement and governance, environment, social and community services, access to information, and happiness and life satisfaction.

For the current study, Table 1 summarizes the variables used. Only relevant items from the survey were selected for the study. These included housing satisfaction, income satisfaction, subjective sleep quality, work-life balance, subjective physical health, subjective obesity, subjective mental health, frequency of eating healthy food, physical and sports activities, satisfaction with social connection, and satisfaction with the surrounding environment. These variables were mostly measured on a five-point scale. Additional two items asked about the number of sleeping hours and the amount of time spent online. The data were standardized before carrying on further statistical analysis.

Analysis methods

Literature review and pre-analysis consultation with local researchers and community representatives yielded a list of 33 variables hypothesized to be sleep quality predictors. Further statistical analysis, including correlation and covariance analysis, multicollinearity analysis, and reliability analysis, helped identify a final list of 12 variables to be considered further in the path model to be associated with the variable sleep quality. As presented in Table 1, these 12 variables range from housing satisfaction, income satisfaction, and work-life balance to subjective physical health, subjective mental health, frequency of eating healthy, physical and sports activities, and satisfaction with social connection. A 2-month test–retest reliability assessed by correlation ranged from 0.82 to 0.93 for all 12 variables in the model. Such results lead

Table 1 Variables used in the path model

Variable	Explanations
QoL1	*Satisfaction with residence*. The housing satisfaction variable was developed based on responses to the question "How do you rate your overall satisfaction regarding your current residence?" The question used a five-point scale (1 to 5) from very dissatisfied to very satisfied
QoL2	*Income satisfaction*. The income satisfaction variable was based on the question "Is your household able to make ends meet, namely, to pay for its usual necessary expenses?" The question used a five point scale (1 to 5) from very dissatisfied to very satisfied
QoL3	*Number of sleeping hours*. The number of sleep hours variable was based on the question 'How many hours do you usually sleep every day?"
QoL4	*Subjective sleep quality*. The sleep quality variable was based on the question "How do you rate the quality of your sleep at night?" The question used a five point scale (1 to 5) from very bad to very well
QoL5	*Satisfaction with work-life balance*. The work-life balance variable was based on the question "How satisfied are you with the current balance between your job and home life?" The question used a five point scale (1 to 5) from very dissatisfied to very satisfied
QoL6	*Subjective physical health*. The subjective physical health variable is self- assessment of current health status, resulted from the question "In general, how do you assess your current health status?" The question used a five point scale (1 to 5) from poor to excellent
QoL7	*Subjective obesity*. The subjective obesity question asked respondents "In your opinion, to what extent do you consider yourself obese?" The question used a five point scale (1 to 5) from not obese to very obese
QoL8	*Subjective mental health*. This is a composite of eight subjective mental health-related items: worry or anxiety, remembering things, sleeping problems, physical pain, fear, loneliness, boredom, and emotionally stressed. The questions asked "During the past four weeks, how much of a problem did you have with the following?" All questions used a five point scale (1 to 5) from not at all to a great extent
QoL9	*Frequency of eating healthy food*. This variable was based on the question "How often do you think you eat a healthy diet?" The question used a five point scale (1 to 5) from never to all the time
QoL10	*Physical and sport activities*. This variable was based on the question "How often do you do physical exercise (minimum of 30 min) in the last 4–6 months?" The question used a five point scale (1 to 5) from never to daily
QoL11	*Satisfaction with social connections*. This is a composite of three variables focused on satisfaction with social relationship with family and friends. All questions used a five point scale (1 to 5) very dissatisfied to very satisfied
QoL12	*Satisfaction with surrounding environment*. This is a composite of three variables measuring satisfaction with air quality, noise pollution, and surrounding environment. All questions used a five point scale (1 to 5) very dissatisfied to very satisfied
QoL13	*Amount of time online*. This variable was based on the question "On average how many hours do you usually spend online a day?"

us to acknowledge that the items in the current study are reliable measurements in Abu Dhabi for working adults (Lyubomirsky & Lepper 1999).

The study assumes that these variables reflect the quality-of-life associates of life associated with sleep quality and hypothesizes that sleep quality represents a significant direct or indirect outcome of many well-being determinants. A path model was then designed to test the hypothetical associations and mediations. Although the study design cannot express cause-effect relationships, path analysis can reveal direct and indirect pathways of associations separately and portray complicated relationships addressed on a path diagram (Kline 2012).

Table 2 shows the correlations between variables. The highest correlations (0.498) are observed between subjective mental health and satisfaction with work-life balance

Table 2 Correlation between variables

	QoL1	QoL2	QoL3	QoL4	QoL5	QoL6	QoL7	QoL8	QoL9	QoL10	QoL11	QoL12	QoL13
QoL1	1	.364**	.100**	.239**	.297**	.207**	-.062**	.271**	.137**	.114**	.271**	.326**	-.050**
QoL2	.364**	1	.123**	.274**	.373**	.211**	-.070**	.309**	.142**	.128**	.309**	.262**	-.050**
QoL3	.100**	.123**	1	.319**	.184**	.103**	-.055**	.140**	.057**	.071**	.140**	.094**	.004
QoL4	.239**	.274**	.319**	1	.407**	.291**	-.097**	.370**	.196**	.164**	.370**	.281**	-.103**
QoL5	.297**	.373**	.184**	.407**	1	.237**	-.084**	.498**	.174**	.168**	.498**	.307**	-.083**
QoL6	.207**	.211**	.103**	.291**	.237**	1	-.181**	.316**	.217**	.227**	.316**	.228**	-.022*
QoL7	-.062**	-.070**	-.055**	-.097**	-.084**	-.181**	1	-.092**	-.150**	-.16**	-.092**	-.049**	.074**
QoL8	.271**	.309**	.140**	.370**	.498**	.316**	-.092**	1	.194**	.188**	1.000**	.304**	-.065**
QoL9	.137**	.142**	.057**	.196**	.174**	.217**	-.150**	.194**	1	.299**	.194**	.124**	-.072**
QoL10	.114**	.128**	.071**	.164**	.168**	.227**	-.165**	.188**	.299**	1	.188**	.066**	-.070**
QoL11	.271**	.309**	.140**	.370**	.498**	.316**	-.092**	1.000**	.194**	.188**	1	.304**	-.065**
QoL12	.326**	.262**	.094**	.281**	.307**	.228**	-.049**	.304**	.124**	.066**	.304**	1	-.045**
QoL13	-.050**	-.050**	.004	-.103**	-.083**	-.022*	.074**	-.065**	-.072**	-.07**	-.065**	-.045**	1

** significance at 0.001; * significance at 0.05

and between satisfaction with social connections and satisfaction with work-life balance. Other higher correlation coefficients are observed between work-life balance and subjective sleep quality and between satisfaction with residence and income satisfaction. Sleep quality correlates with work-life balance, subjective mental health, social connections, number of sleeping hours, and subjective physical health.

It should be evident in this regard to adhere to the idea that while correlation looks at identifying the mutual associations among the parameters, path analysis allows the determination of each association's relative magnitude or importance (Hailu et al. 2016). It should be noted, too, that the path coefficient is a representation of multiple variables (through direct or indirect associations).

Table 3 shows the covariance matrix of variables in the model. The statistical distribution of the covariance matrix elements is not the same as that of a correlation matrix since the diagonal elements of a covariance matrix are the variances of the variables. They represent random variables that vary from sample to sample. Values in the table show that variances for all the variables are relatively slight (below 1.0). Only two variables have variances above 1.0.

The subsequent analysis followed a step-by-step path analysis method. One individual variable was introduced at every step by checking the fit-statistic measures. They took the sleep quality variable as the focused variable, and the path analysis aimed to yield a path model and the estimates of associations, which can explain the sleep quality association pattern with other well-being factors. The model represents the statistical fit of a correlation (or covariance) matrix with an association model to be tested. We considered specific statistics to keep the variable in the model or eliminate it. As recommended, three fundamental statistical values were evaluated: the magnitude of the standardized coefficient, the t-statistics, and the significance level (Allen 2017). In addition, variables that did not reflect any significant paths were eliminated from further consideration.

As with other path analysis research, the overall fit statistics include Degrees of Freedom, Maximum Likelihood Ratio Chi-Square, Root Mean Square Error of Approximation (RMSEA), Normed Fit Index (NFI), Non-Normed Fit Index (NNFI), Comparative Fit Index (CFI), and Incremental Fit Index (IFI) (Jöreskog & Sörbom 1996). In the final path analysis, we considered all significant relations and included them in the model for individual variables. The final path analysis model contained only significant paths and represented the best fit model given all fit statistics. LISREL was used in building the final model (Jöreskog & Sörbom 1996).

Results

Table 4 shows the demographic characteristics of the working participants in the survey sample. The sample represents more males (72.6%) and more married respondents (86.2%). Concerning age, the most significant portion is within the 40–44 age bracket (22.6%), followed by those in the 35–39 bracket (21.0%). About 45.5% are holders of bachelor's degrees. Emiratis constitute 40.4% of the sample, while non-Emiratis account for 59.6%.

The working hours categories adopted in the QoL survey are as follows: 35 h or less, 36–40 h, 41–45 h, 46–50 h, and more than 50 h, whereas the 36–40 h category represents standard full-time work hours, 41–45 h and 46–50 h stand for longer full-time work hours, and more than 50 h indicates highly long work hours. As revealed in Table 4, the highest proportion of respondents

Table 3 The covariance matrix

	QoL4	QoL6	QoL8	QoL1	QoL2	QoL3	QoL5	QoL7	QoL9	QoL10	QoL11	QoL12	QoL13
QoL4	0.976												
QoL6	0.283	0.984											
QoL8	0.366	0.312	1.000										
QoL1	0.242	0.210	0.275	1.011									
QoL2	0.272	0.207	0.311	0.370	1.011								
QoL3	0.302	0.092	0.133	0.098	0.118	0.890							
QoL5	0.404	0.231	0.498	0.299	0.377	0.173	0.996						
QoL7	-0.12	-0.20	-0.10	-0.07	-0.08	-0.06	-0.10	0.989					
QoL9	0.206	0.222	0.206	0.144	0.151	0.054	0.179	-0.19	0.969				
QoL10	0.159	0.225	0.184	0.112	0.126	0.056	0.162	-0.19	0.312	0.975			
QoL11	0.366	0.312	1.000	0.275	0.311	0.133	0.498	-0.09	0.206	0.184	1.000		
QoL12	0.271	0.220	0.303	0.327	0.256	0.085	0.304	-0.06	0.131	0.061	0.303	0.985	
QoL13	-0.11	-0.03	-0.07	-0.06	-0.06	0.004	-0.09	0.091	-0.09	-0.08	-0.07	-0.05	0.992

Table 4 Respondent's profile

Gender	Percentage
Male	72.6%
Female	27.4%
Marital status	
Married	86.2%
Single	7.8%
Divorced	4.5%
Separated	0.7%
Widowed	0.5%
Education level	
Read and write (no qualification)	0.3%
Primary school	0.5%
Preparatory school	1.7%
Secondary school	12.6%
Post high school training certificate	3.2%
College diploma	9.2%
Bachelor's degree	45.5%
Master's degree	22.2%
Doctorate degree	4.8%
Age	
20–24	0.5%
25–29	4.8%
30–34	13.9%
35–39	21.0%
40–44	22.6%
45–49	16.0%
50–54	10.4%
55–59	5.8%
60 and above	5.0%
Hours of work per week	
35 h or less	13.1%
36–40 h	25.8%
41–45 h	15.3%
46–50 h	22.5%
More than 50 h	23.3%
Nationality	
Emirati	40.4%
Non-Emirati	59.6%

reportedly worked 36–40 h per week (25.8%). About 22.5% followed a 46–50 h scheme per week. About 23.3% reported weekly working hours of more than 50.

Figure 1 shows the final path model. Model accuracy indicators and parameter values suggest that the final derived model structures are acceptable. As presented in Table 5, the final model yielded good fit indicators ($\chi 2 = 14.240$ with 11 degrees of freedom ($\chi 2/d.f = 1.295$, RMSEA = 0.00120, NFI = 0.999, NNFI = 0.999, CFI = 0.999, GFI = 0.999, IFI = 0.999, and RMR = 0.00282).

Table 6 shows the path estimates and their associated t-values for the variables in the path model. Sleep quality is affected by 11 well-being factors: work-life balance, sleep hours, housing satisfaction, social connections, subjective mental health, subjective physical health, subjective obesity, online hours, frequency of eating healthy, environment satisfaction, and income satisfaction. In addition, the factor of subjective physical health plays a significant mediator in exhorting other indirect associations of all those factors with sleep quality.

Table 7 shows the direct, indirect, and total associations between various variables in the path model. Sleep quality has nine paths coming to it (from housing satisfaction, income satisfaction, sleeping hours, work-life balance, subjective health, subjective obesity, mental health, eating healthy, social connections, environment satisfaction, and online hours. The variable subjective health was a mediator in connecting the indirect associations between many of the variables. The highest total association (0.38) is from sleeping hours. The other relatively high total coefficients are related to subjective obesity (0.28), subjective health (0.21), work-life balance (0.26), social connections (0.21), and income satisfaction (0.19). The other associations are concerning housing satisfaction (0.11), eating healthy (0.16), environment satisfaction (0.16), and online time (-0.12). The two variables with a negative association are online time and subjective mental health.

Discussions

In this study, path analysis reveals the associations between sleep quality, sleep duration, mental health, work-life balance, sports activities, healthy eating habits, satisfaction with housing, satisfaction with the surrounding environment, and income. Our findings show that better sleep quality is associated with all of these factors directly or indirectly. Notably, the results portray the significant role of subjective health as an intermediator of critical power regarding sleep quality. Further, sleep quality tends to be associated with well-being factors in a complex manner. The presence of multiple well-being factors and their interactions has been reported in many extant studies on sleep quality (Cohrdes et al. 2018; Tang et al. 2017).

The results provide evidence that the relationship between sleep quality and many well-being factors considered in this research may be indirect, as portrayed in some other studies (Freeman et al. 2017). The results support the argument that more than a single determinant may be needed to explain sleep attributes. Many factors, including environmental conditions, lifestyle, and mental feelings, have all been linked to sleep quality, even if taken separately (Eze et al. 2017).

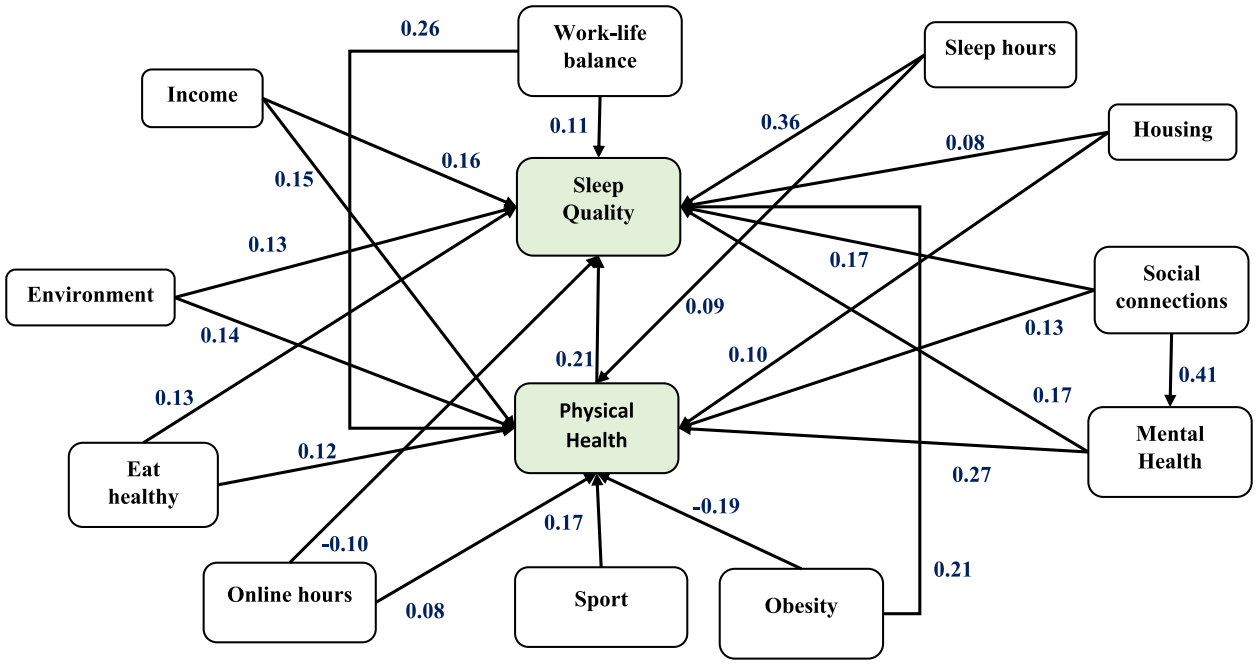

Fig. 1 Path model of sleep quality and well-being factors for working adults

Table 5 Goodness-of-fit statistics

Degrees of Freedom	11
Maximum Likelihood Ratio Chi-Square	14.240 (1.295)
Root Mean Square Error of Approximation (RMSEA)	0.00120
Normed Fit Index (NFI)	0.999
Non-Normed Fit Index (NNFI)	0.999
Comparative Fit Index (CFI)	0.999
Incremental Fit Index (IFI)	0.999
Root Mean Square Residual (RMR)	0.00282
Goodness of Fit Index (GFI)	0.999
Adjusted Goodness of Fit Index (AGFI)	0.999

A significant point to be taken from the current study is the importance of assessing sleep quality while not ignoring sleep-health relationships. Subjective health played a significant mediator between ten well-being determinants and sleep quality. Research elsewhere also consistently shows the association between sleep quality and subjective health (Gaultney & Collins-Mcneil 2009). The positing association of having good sleep quality with longer sleep duration reported better subjective health (Radek & Kaprelian 2013). Other research, as reviewed earlier, also asserts that poor sleep quality could be a significant indicator of health (Marques et al. 2017; Radek & Kaprelian 2013). The combined associations of mental health, subjective physical health, and environment satisfaction on sleep quality, revealed by this study, are consistent with other empirical findings (Gaultney & Collins-Mcneil 2009; Marques et al. 2017). The strong effect of mental health and its effect on subjective physical health leading to poor sleep quality for working adults were also addressed by other studies as vital concerns for work-related policymaking (Gaultney & Collins-Mcneil 2009; Giannotti et al. 2002). Therefore, the multi-factor associations of health and other well-being determinants on producing a combined effect on sleep quality should be taken as dire circumstances that may significantly affect work productivity and output.

As far as individual factors are concerned, sleep duration exhibited the most significant association with sleep quality. This finding is in line with previous studies that associated sleep duration and poor sleep quality (Bin 2016; Kinuhata et al. 2014). Furthermore, as revealed by many similar studies, sleep duration is strongly associated with sleep quality and, as a result, is one of the sources of mental disorders, especially for working adults (Min et al. 2018).

Work-life balance is the second most significant well-being determinant for sleep quality. Again, it supports other research that relates work-related practices associated with work-life balance to play a significant role in sleep quality (Nakashima et al. 2011; Ohayon 2002; Sleep Foundation 2022). The positive association between work-life balance and sleep quality and the mediation of subjective health is also noted by similar research

Table 6 Final model path estimates and t-values

From	To	Estimate	t-value	Significance
Work-life balance	Sleep quality	0.11	9.963	0.001
Satisfaction with income	Sleep quality	0.16	13.299	0.001
Environment satisfaction	Sleep quality	0.13	10.661	0.001
Eating healthy food	Sleep quality	0.13	9.634	0.001
Online hours	Sleep quality	-0.10	-8.349	0.001
Obesity	Sleep quality	0.21	16.576	0.001
Mental health	Sleep quality	0.17	14.74	0.001
Social connections	Sleep quality	0.17	13.536	0.001
Housing satisfaction	Sleep quality	0.08	4.217	0.021
Sleeping hours	Sleep quality	0.36	30.171	0.001
Subjective physical health	Sleep quality	0.21	16.042	0.001
Sport and activities	Subjective physical health	0.17	13.993	0.001
Satisfaction with income	Subjective physical health	0.15	6.194	0.008
Obesity	Subjective physical health	-0.19	-15.369	0.001
Mental health	Subjective physical health	0.27	20.634	0.001
Social connections	Subjective physical health	0.13	11.824	0.001
Housing satisfaction	Subjective physical health	0.10	8.740	0.001
Sleeping hours	Subjective physical health	0.09	4.112	0.021
Work-life balance	Subjective physical health	0.26	20.395	0.001
Environment satisfaction	Subjective physical health	0.14	11.134	0.001
Eating healthy food	Subjective physical health	0.12	10.196	0.001
Online hours	Subjective physical health	0.08	3.981	0.041
Social connections	Mental health	0.41	77.112	0.001

that used different analysis methodologies (Basner et al. 2007; Dahlgren et al. 2006). The balance between work and home has been suggested by many as a leading cause of sleep quality (Dahlgren et al. 2016). The current study revealed that 23.3% of employees in Abu Dhabi worked more than 50 h per week, while 22.5% worked between 46 to 50 h per week. Such an outcome calls for more stringent work policies in Abu Dhabi to pay attention to sleep quality for working adults to improve their work-life balance. Such policies could also be crucial for boosting the mental health of working adults (Schleupner & Kühnel 2021). In addition, establishing workplace policies to offer working people more flexibility in their working hours could positively affect their well-being and sleep quality (American Academy of Sleep Medicine 2022). Concerned authorities could also provide a sleep education program for employees (American Academy of Sleep Medicine 2022).

Mental health emerged as one of the most negative attributes to sleep quality. The mental determinant exhibited both direct and indirect associations with sleep quality. While this result is consistent with outcomes from similar studies (Chen et al. 2019; Okano et al. 2019), our research did not show a significant bi-directional association between sleep quality and mental health, as did in some research (Luo et al. 2013). Among other attempts, the American Academy of Sleep Medicine (2022) issued simple workplace interventions focusing on reducing employees' mental fatigue and encouraging improved sleep hygiene and healthier habits for working people.

The lifestyle of the working adult demonstrated different relationships with sleep quality. The lifestyle determinants examined in this study included frequency of doing sports and exercise, eating healthy, subjective obesity, and online hours. Consistent with other studies**,** diet, obesity (Kripke et al. 2002), exercise (Dubinina et al. 2021; Mahfouz et al. 2020), and sleep quality are all significant pillars of a healthy life (Wei et al. 2012). As many also suggested, improving working adults' lifestyles could lead to longer lives while improving their physical and mental health (Reid et al. 2010).

A notable result of this study addressed the association of sleep quality with the amount spent on social media and online activities. Similar to Levenson et al. (2016), an adverse effect of social media and online usage on duration and sleep quality was found. Several studies in Abu Dhabi show the rapidly growing rate of social media usage, especially among school-aged children (Badri et al. 2016). Such a high usage rate is also likely the case for Abu Dhabi's working adults. Therefore, when Abu Dhabi

Table 7 Type of effects

Code	From	To	Direct association	Indirect association	Total association
QoL1	Housing satisfaction	Sleep quality	0.08	0.03	0.11
		Subjective health	0.10	----	0.10
QoL2	Income satisfaction	Sleep quality	0.15	0.04	0.19
		Subjective health	0.16	----	0.16
QoL3	Sleeping Hours	Sleep quality	0.36	0.02	0.38
		Subjective health	0.09	----	0.09
QoL4	Sleep quality	----	----	----	----
QoL5	Work-life balance	Sleep quality	0.11	0.06	0.17
		Subjective health	0.26	----	0.26
QoL6	Subjective health	Sleep quality	0.21	----	0.21
QoL7	Subjective obesity	Sleep quality	0.21	0.04	0.28
		Subjective health	0.19	----	0.19
QoL8	Metal health (reversed)	Subjective health	0.27	----	0.27
		Sleep quality	0.17	0.05	0.22
QoL9	Eating healthy	Sleep quality	0.13	0.03	0.16
		Subjective health	0.12	-----	0.12
QoL10	Sport	Subjective health	0.17	-----	0.17
QoL11	Social connections	Sleep quality	0.17	0.04	0.21
		Subjective health	0.13	0.11	0.24
		Mental health	0.41	0.07	0.47
QoL12	Environment satisfaction	Sleep quality	0.13	0.03	0.16
		Subjective health	0.14	----	0.14
QoL13	Online hours	Sleep quality	-0.10	-0.02	-0.12
		Subjective health	0.08	----	0.08

working adults become addicted to social media, their sleep quality might be poorer than their counterparts in other countries.

Our results also confirmed that housing satisfaction, income satisfaction (Early et al. 2006), and environment satisfaction (Peterson et al. 2008) are associated with sleep quality and health. The results echo a growing body of research evidence suggesting that sleep quality is associated with adverse environmental and neighborhood conditions (Chambers et al. 2016). Therefore, policymakers must know that poor housing and neighborhood conditions are high risks leading to poor sleep quality and that suitable housing could improve sleep quality among the working population (Sandberg et al. 2014). In addition, the significant effect of income satisfaction calls for policymakers to develop policies to support the lower-income groups and the more financially vulnerable population.

Conclusions

This present research is one of the first studies that explore sleep quality and its associated factors in Abu Dhabi. The path model developed attempted to consider many essential well-being factors to reveal the most complete and credible results. The results shed new light on the importance of multidimensional linkages between many well-being factors that influence sleep quality and subjective health. The presence of diverse determinants in the current study reflects that a more complex underlying structure of factors contributes to adverse sleep outcomes. Most significantly, subjective health was captured as a significant mediator for sleep quality. As Hale and Do (2007) aspire, research should appreciate cultural factors essential in sleep-related disturbances. The findings from this study could contribute to our knowledge in this respect.

Although the current study went a step further to include the more versatile type of well-being variables in the analysis of sleep quality, its limitations should be acknowledged. Firstly, sleep quality was measured using self-reported perception and did not include any documented medical processes. The same was true for self-reported physical health and mental health. Such results might introduce some risk of biases when explaining the moderating effect of physical health. This concern was also raised by other researchers working on sleep quality (Andreasson et al. 2019, 2021). Nevertheless, our results are generally consistent with those of other studies.

Secondly, the path model did not consider factors that may result in differences between respondent categories. For example, further analysis of variances reveals significant differences in sleep quality between male and female working people, age categories, marital statuses, and nationality groups. Such differences require further analysis of the well-being determinants of sleep quality. Therefore, we suggest that future studies on the potential health risks related to sleep quality be investigated deeper, considering the effect of some demographic attributes. Researchers may need to look more closely at the effect of income on sleep quality. More specifically, regions in Abu Dhabi are of variant socioeconomic strata. As recommended by several authors (Mackenbach et al. 1997), future studies could look into different segments and regions in the Abu Dhabi community to better identify the effects of income, housing, and environment on sleep. It is also worth exploring the potential bi-directional (reciprocal) relationship between sleep quality and other well-being variables in the path model.

Finally, the QoL survey of Abu Dhabi is rich in its content. For example, there are much more items related to work than just income satisfaction. Related items in the survey include, for example, satisfaction with different aspects of work, self-perceived importance of work, and income change from the previous year. Therefore, future studies might expand the path model into a more sophisticated structural equation model.

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Authors' contributions
MB. HA and MA participated in Conceptualization. MA, GY, and MAB participated in the methodology. MB. and AA participated in using the software. MAB, MB, MA, and GY participated in the validation. MB, MAB, and GY participated in the formal analysis. MB and GY participated in a formal investigation. AA participated in data curation. MA and MAB participated in writing-original draft preparation. MA, GY, and MAB participated in writing reviews and editing. MB, MAB, and AA participated in visualization. MA and HA participated in supervision. GY, HA, and AA participated in project administration. All authors have read and agreed to the published version of the manuscript.

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Availability of data and materials
Data available on request from the authors.

Declarations

Ethics approval and consent to participate
The study protocol was approved by the ethics committees of the Department of Community Development and Statistics Center Abu Dhabi. Written informed consent was obtained from all the participants. All the working participants were adults.

Consent for publication
We ensure that the publisher has the authors' permission to publish this research funding, because all participants were signed on consent form by agreeing to participant on this study.

Competing interests
The authors declare no competing interests.

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