

Health-related Quality of Life in Different Trimesters during Pregnancy

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Abstract

Background

Pregnant women experience physiological, anatomical, and biochemical changes. Health-related quality of life (HRQoL) is a relevant indicator of psychological and physical behaviours, which changes over the course of pregnancy. This study aims to assess HRQoL of pregnant women during different stages of pregnancy.

Methods

This prospective study was performed by using the The EuroQoL Group's five-dimension five-level questionnaire (EQ-5D-5L) to assess the health-related quality of life of pregnant women. This study was conducted in the First Affiliated Hospital of Sun Yat-sen University, one of the largest regional university hospitals in South China.

Results

A total of 848 pregnant women were included and examined in this study. We found that pregnant women in the early 2nd trimester had the highest health-related quality of life which was minimally higher than the other trimesters. An increase in the health-related quality of life of pregnant women was observed from the 1st trimester to the early 2nd trimester, then decreased to the lowest in the late 3rd trimester due to some changes among which are physical and mental changes. Health-related quality of life in the late 3rd trimester was the lowest. Reports of pain/discomfort problem were the most common (46.5%) while problems in self-care were the least commonly reported. More than 15% of women had problems in one of the five dimensions in the 1st trimester. In the whole sample, the means \pm SD of EuroQoL Group's visual analog scale questionnaire (EQ-VAS) was 87.80 ± 9.36 . Across the gestational stages, the values were very close during the trimesters but the highest value was observed in the 1st trimester (88.77 ± 9.92) while the lowest was in the late 3rd trimester (87.38 ± 9.86).

Conclusions

During pregnancy, the health-related quality of life had relationship with health-related quality of life to a certain degree. Our findings call for more investigations in this direction with wider participants' diversity and strong statistical hypothesis testing to further elucidate on what factors are responsible for the changes in health-related quality of life across pregnancy trimesters to give information on interventions that will be useful to improve maternal health.

Background

Pregnant women experience physiological, anatomical, and biochemical changes. In general, pregnancy is an exciting and desired event, but it also involves considerable inconvenience, discomfort, and sometimes mood changes or depression due to various physical and physiological changes [1]. These changes tend to increase with time and can significantly affect psychological and physical conditions of pregnancy women in different ways. For example, a larger uterus can cause difficulty with movement or an increased cardiac load which can lead to chest tightness [2]. Therefore, physical and mental health states of pregnant women change over the course of pregnancy. With the increasing focus on mental health, obstetricians have increasingly assessed the psychological status of pregnant women.

The quality of life (QoL) of an individual as defined by the World Health Organization (WHO) is said to be the person's general well-being including mental status, stress level, sexual function and self-perceived health status. The Health-related Quality of life (HRQoL) of an individual encompasses mental health status, physical well-being, psychological well-being and is also a relevant indicator of psychological and physical behaviors [3]. The EuroQoL Group's five-dimension five-level questionnaire (EQ-5D-5L), a reliable instrument developed by the Euro-QoL group, includes a descriptive and evaluative portion that measures health-related quality of life (HRQoL) [4, 5]. Subjects assess the state of their overall health using the EuroQoL Group's visual analog scale questionnaire (EQ-VAS) in the evaluative section and using five dimensions (mobility, self-care, usual activities, pain/discomfort, anxiety/depression) in the descriptive section [6]. The severity of these five dimensions is quantified using a five-level rating scale [6]. The EQ-5D-5L questionnaire has been frequently used to assess the HRQoL of various populations, ranging from general population to patients with mental disorders, cancers, etc [7–11]. The EQ-5D-5L is valid and effective in its Chinese version and is commonly used to measure HRQoL.

The World Health Organization reported that 10% of pregnant women who have recently given birth experienced psychological problems, the most common being depression [12]. To better understand the health of pregnant women, HRQoL is increasingly considered as an important indicator that assesses these women's physical and psychological health. Studies have suggested that prenatal anxiety/depression and/or fear of childbirth could affect the HRQoL of pregnant women [13, 14]. Issues with body image, excessive weight gain, and loss of sexual function during pregnancy all contribute to antepartum depression [15, 16]. Furthermore, complications such as gestational diabetes mellitus and preeclampsia can negatively influence HRQoL, despite most of these complications being short-term and reversible [17–19]. Sut et al. found that pregnancy was significantly related to a more negative HRQoL [20]. Campolong et al. reported that women who received sufficient exercises during pregnancy had a better HRQoL than women who did not meet the recommended guidelines for physical activities [21].

Further formulation of health policies and clinical guidelines associated with pregnancy requires the analysis of health economics and normative values of HRQoL during pregnancy [22]. However, to the best of our knowledge, the relationship between HRQoL and gestational age changes has not been investigated. The aim of this study was to assess the HRQoL of pregnant women and how HRQoL changes during pregnancy. This investigation can provide insight into improving quality of life of pregnant women and supporting health policies in the future.

Methods

Study population

We performed a prospective study of pregnant women who received antenatal care at The First Affiliated Hospital of Sun Yat-sen University, a regional teaching hospital in South China. Ethnically Chinese women with live pregnancy were recruited between June 2016 and September 2018 in this study. One of the research assistants invited each potentially eligible participant and explained the objectives, procedure, risks and benefits of our study. Upon verification of eligibility and provision of written informed consent, participants were asked to complete the questionnaire. Among a total of 6720 eligible women, 4911 declined the invitation while 1809 completed the questionnaire. After the exclusion of those without clinical data (n = 961), 848 participants were included in the final analyses.

Variables

Pre-pregnancy body mass index (BMI) was calculated by dividing body weight (kilograms) before pregnancy and by height (meters) squared. The entire pregnancy period was divided into the 1st trimester (from week 0 to week 13), early in the 2nd trimester (between the 14 and 20 gestational weeks), late in the 2nd trimester (between the 21 and 27 gestational weeks), early in the 3rd trimester (between the 28 and 34 gestational weeks), and late in the 3rd trimester (more than 35 gestational weeks). No study subjects were pregnant for more than 42 gestational weeks. The EQ-VAS records the respondent's self-rated health on a vertical, visual analogue scale with endpoints labelled "the best health you can imagine" and "the worst health you can imagine", and it can be used as a quantitative measure of health as judged by the individual respondents [6]. The EQ index value is calculated from the EQ-5D-5L descriptive system via the "EQ-5D-5L Crosswalk Index Value Calculator", and this dimension-based value can also facilitate the calculation of quality-adjusted life years, which are used to inform economic evaluations of health care intervention [6].

Measures

Participants were requested to fill in the EQ-5D-5L questionnaire when they first attended antenatal care sessions. Self-reported indications measure the severity experienced by the participants in the five dimensions, i.e., mobility, self-care, usual activities, pain/discomfort, anxiety/depression. Each dimension was evaluated using a 5-level scale: extreme/unable (level 5), severe (level 4), moderate (level 3), slight (level 2), and none (level 1). Each response pattern was calculated into a single EQ-5D index value (such as 1,1,2,2,1 corresponding to the participant have no problem in walking (mobility) and washing or dressing (self-care), slight problems in work or study (usual activities), slight pain or discomfort (pain/discomfort) and not anxious or depressed (anxiety/depression) through the EQ-5D-5L Crosswalk Index Value Calculator to get a final HRQoL score (range from - 0.224 to 1.000) [6]. The weight 1 means full health, the 0 means dead and the - 0.224 means that participants consider the condition is worse than dead. In addition, the EQ-5D-5L was dichotomized into two categories: "problem" (levels 2–5) and "no problem" (level 1). While assessing EQ-VAS scores, pregnant women self-evaluated their general

health status, with 0 being the lowest (the worst potential health status) and 100 being the highest (the best potential health status) [23]. We then measured the different dimensions and compared the responses among pregnant women, some of whom suffered from complications, over different gestational periods.

Statistical analysis

The EQ-5D-5L index value was calculated using the EQ-5D-5L Crosswalk Index Value Calculator [6]. The algorithm was developed from a general Japanese sample using time trade-off valuation techniques. All statistical analysis was performed using SPSS version 20.0 (SPSS Inc., Chicago, IL, USA). Normally distributed continuous variables were expressed as means \pm standard deviation (SD); non-normal variables were presented as median (interquartile range, IQR), and categorical variables were presented as a number and percentage.

Results

Table 1. Baseline characteristics of the study participants (n = 848).

Table 1
Baseline characteristics of the study sample (N = 848).

	Mean (SD)	Median (IQR)	Range
Age (years old)	32.72 (4.71)	32.43 (29.07, 36.13)	20.96–47.40
BMI (kg/m ²)	24.16 (4.01)	24.17 (21.22, 26.56)	15.07–39.90
Gravidity	1.20 (1.11)	1.0 (0, 2.0)	0–7
Parity	0.53 (0.53)	1.0 (0, 1.0)	0–3
EQ index value ^a	0.836 (0.173)	0.814 (0.740, 1.000)	-0.111-1.000
EQ-VAS ^b	87.80 (9.36)	90 (80, 95)	40–100
^a EuroQol index value			
^b EuroQol-visual analogue scale			
SD = standard deviation; IQR = interquartile range			

A total of 848 pregnant women completed the EQ-5D-5L questionnaire at least once, and 848 questionnaires were compiled and included for further analysis. Table 1 listed the baseline characteristics and overall EQ-5D-5L scores of the pregnant women. The ages of the pregnant women ranged from 20–47 (average: 32.72 \pm 4.71 years). The mean pre-pregnancy BMI was 24.16 \pm 4.01 kg/m².

Table 2. EQ-VAS and EQ index value of women in different conditions cross five gestational stages.

Table 2
EQ-VAS and EQ index value of women in different conditions cross five gestational stages.

Condition	Trimester-specific					Overall
	1st	Early 2nd	Late 2nd	Early 3rd	Late 3rd	
Singleton pregnancy	N = 44	N = 109	N = 199	N = 244	N = 220	N = 816
EQ-VAS ^a	88.77 (9.92)	87.88 (9.53)	88.22 (9.12)	87.90 (8.84)	87.34 (9.80)	87.87 (9.31)
EQ index value ^b	0.773 (0.349)	0.888 (0.122)	0.865 (0.136)	0.831 (0.188)	0.813 (0.145)	0.839 (0.173)
Multiple pregnancy		N = 8	N = 6	N = 12	N = 6	N = 32
EQ-VAS ^a	-	86.50 (10.18)	90.42 (8.43)	81.50 (10.23)	88.75 (13.01)	85.92 (10.59)
EQ index value ^b	-	0.850 (0.131)	0.805 (0.126)	0.711 (0.147)	0.681 (0.122)	0.758 (0.145)
Primipara	N = 25	N = 57	N = 100	N = 118	N = 112	N = 412
EQ-VAS ^a	86.54 (10.96)	87.75 (9.46)	86.84 (9.56)	86.41 (8.90)	87.29 (10.47)	86.95 (9.67)
EQ index value ^b	0.776 (0.349)	0.874 (0.125)	0.835 (0.146)	0.797 (0.207)	0.801 (0.143)	0.817 (0.182)
Multipara	N = 19	N = 60	N = 105	N = 138	N = 114	N = 436
EQ-VAS ^a	91.58 (7.83)	87.82 (9.68)	89.65 (8.44)	88.65 (8.94)	87.36 (9.23)	88.58 (8.98)
EQ index value ^b	0.768 (0.359)	0.896 (0.120)	0.890 (0.119)	0.850 (0.167)	0.817 (0.148)	0.854 (0.162)
Smoking partner	N = 6	N = 19	N = 33	N = 35	N = 30	N = 123
EQ-VAS ^a	94.17 (2.04)	87.24 (7.99)	89.65 (7.56)	89.44 (7.46)	88.31 (9.80)	89.12 (8.05)

^a EuroQol-visual analogue scale

^b EuroQol index value

^c gestational diabetes mellitus

^d preeclampsia

^e including thyroid diseases, thalassemia, obesity, etc.

Condition	Trimester-specific					Overall
EQ index value ^b	0.926 (0.118)	0.881 (0.119)	0.854 (0.131)	0.835 (0.209)	0.811 (0.143)	0.846 (0.158)
Non-smoking partner	N = 38	N = 96	N = 170	N = 219	N = 195	N = 718
EQ-VAS ^a	87.89 (10.42)	88.21 (9.69)	87.99 (9.34)	87.28 (9.18)	87.23 (9.91)	87.59 (9.54)
EQ index value ^b	0.748 (0.368)	0.891 (0.121)	0.865 (0.137)	0.824 (0.186)	0.809 (0.146)	0.834 (0.176)
Drunk partner	N = 1	N = 7	N = 19	N = 20	N = 21	N = 68
EQ-VAS ^a	90.0	91.93 (5.79)	87.0 (6.09)	87.18 (11.35)	86.89 (10.51)	87.57 (9.21)
EQ index value ^b	0.740	0.903 (0.124)	0.838 (0.109)	0.865 (0.140)	0.779 (0.093)	0.833 (0.121)
Sober partner	N = 43	N = 109	N = 184	N = 236	N = 204	N = 776
EQ-VAS ^a	88.74 (10.04)	87.67 (9.59)	88.39 (9.34)	87.66 (8.77)	87.42 (9.84)	87.83 (9.37)
EQ index value ^b	0.773 (0.353)	0.886 (0.122)	0.866 (0.138)	0.822 (0.191)	0.812 (0.150)	0.836 (0.177)
Cardio diseases	N = 0	N = 3	N = 4	N = 7	N = 2	N = 16
EQ-VAS ^a	-	88.33 (7.64)	81.25 (10.31)	89.29 (7.87)	67.5 (38.89)	84.38 (14.48)
EQ index value ^b	-	0.852 (0.137)	0.850 (0.109)	0.884 (0.153)	0.748 (0.356)	0.853 (0.157)
Hepatitis B	N = 0	N = 3	N = 4	N = 3	N = 8	N = 18
EQ-VAS ^a	-	95.0 (5.0)	92.5 (11.9)	80.0 (17.32)	87.77 (6.81)	88.73 (10.32)
EQ index value ^b	-	0.881 (0.103)	0.911 (0.103)	0.762 (0.073)	0.831 (0.129)	0.846 (0.115)

^a EuroQol-visual analogue scale

^b EuroQol index value

^c gestational diabetes mellitus

^d preeclampsia

^e including thyroid diseases, thalassemia, obesity, etc.

Condition	Trimester-specific					Overall
GDM ^c	N = 1	N = 13	N = 26	N = 40	N = 34	N = 114
EQ-VAS ^a	70.0	87.54 (12.53)	87.40 (11.01)	87.00 (10.89)	87.88 (12.11)	86.97 (11.39)
EQ index value ^b	0.673	0.906 (0.129)	0.850 (0.127)	0.826 (0.134)	0.857 (0.143)	0.849 (0.135)
Scar uterus pregnancy	N = 6	N = 14	N = 46	N = 72	N = 31	N = 169
EQ-VAS ^a	92.5 (7.58)	85.11 (13.82)	89.24 (9.76)	87.78 (10.41)	90.16 (6.57)	50–100
EQ index value ^b	0.760 (0.446)	0.930 (0.116)	0.895 (0.112)	0.843 (0.162)	0.814 (0.137)	-0.111– 1.000
Non-complications	N = 7	N = 33	N = 68	N = 108	N = 70	N = 286
EQ-VAS ^a	89.29 (10.97)	88.56 (10.27)	88.71 (9.80)	87.67 (10.52)	87.93 (11.47)	50.0– 100.0
EQ index value ^b	0.748 (0.409)	0.909 (0.119)	0.877 (0.123)	0.829 (0.179)	0.834 (0.148)	-0.111– 1.000
^a EuroQol-visual analogue scale						
^b EuroQol index value						
^c gestational diabetes mellitus						
^d preeclampsia						
^e including thyroid diseases, thalassemia, obesity, etc.						

Table 2 shows the EQ-VAS and EQ index value of pregnant women in different conditions, with or without complications. There are 3,125 (equals 5 to the power of 5) types of possible response patterns. Among 848 questionnaires in this study, 72 types of patterns occurred at least once. 38.8% of our sample (n = 329) reported the optimal response pattern '11111', followed by the pattern '11121' reported by 145 pregnant women (17.1%).

Table 3. Frequency (percentage) of reporting levels 1 to 5 in EQ-5D dimensions across five gestational stages.

Table 3

Frequency (percentage) of reporting levels 1 to 5 in EQ-5D dimensions across five gestational stages.

EQ-5D DIMENSION		Trimester-specific					Overall (N = 848)
		1st (n = 44)	Early 2nd (n = 117)	Late 2nd (n = 205)	Early 3rd (n = 256)	Late 3rd (n = 226)	
Mobility	Level 1	34 (77.3)	109 (93.2)	185 (90.2)	194 (75.8)	162 (71.7)	684 (80.7)
	Level 2	4 (9.1)	7 (6.0)	19 (9.3)	50 (19.5)	55 (24.3)	135 (15.9)
	Level 3	0	1 (0.9)	0	5 (2.0)	6 (2.7)	12 (1.4)
	Level 4	1 (2.3)	0	0	1 (0.4)	1 (0.4)	3 (0.4)
	Level 5	5 (11.4)	0	1 (0.5)	6 (2.3)	2 (0.9)	14 (1.7)
Self-care	Level 1	37 (84.1)	115 (98.3)	193 (94.1)	224 (87.5)	196 (86.7)	765 (90.2)
	Level 2	1 (2.3)	2 (1.7)	11 (5.4)	24 (9.4)	25 (11.1)	63 (7.4)
	Level 3	0	0	0	1 (0.4)	2 (0.9)	3 (0.4)
	Level 4	0	0	0	0	2 (0.9)	2 (0.2)
	Level 5	6 (13.6)	0	1 (0.5)	7 (2.7)	1 (0.4)	15 (1.8)
Usual activity	Level 1	35 (79.5)	110 (94.0)	179 (87.3)	206 (80.5)	175 (77.4)	705 (83.1)
	Level 2	3 (6.8)	7 (6.0)	24 (11.7)	41 (16.0)	43 (19.0)	118 (13.9)
	Level 3	0	0	1 (0.5)	3 (1.2)	5 (2.2)	9 (1.1)
	Level 4	1 (2.3)	0	0	2 (0.8)	2 (0.9)	5 (0.6)

1st trimester: less than 14 gestational weeks; early 2nd trimester: between 14 and 20 gestational weeks; late 2nd trimester: between 21 and 27 gestational weeks; early 3rd trimester: between 28 and 34 gestational weeks; late 3rd trimester: more than 35 gestational weeks.

	Level 5	5 (11.4)	0	1 (0.5)	4 (1.6)	1 (0.4)	11 (1.3)
Pain/ Discomfort	Level 1	26 (59.1)	71 (60.7)	118 (57.6)	134 (52.3)	105 (46.5)	454 (53.5)
	Level 2	12 (27.3)	46 (39.3)	83 (40.6)	108 (42.2)	106 (46.9)	355 (41.9)
	Level 3	0	0	3 (1.5)	7 (2.7)	12 (5.3)	22 (2.6)
	Level 4	0	0	1 (0.5)	3 (1.2)	2 (0.9)	6 (0.7)
	Level 5	6 (13.6)	0	0	4 (1.6)	1 (0.4)	11 (1.3)
Anxiety/ Depression	Level 1	28 (63.6)	83 (70.9)	141 (68.8)	190 (74.2)	151 (66.8)	593 (69.9)
	Level 2	10 (22.7)	33 (28.2)	60 (29.3)	55 (21.5)	68 (30.1)	226 (26.7)
	Level 3	0	1 (0.9)	4 (2.0)	2 (0.8)	6 (2.7)	13 (1.5)
	Level 4	1 (2.3)	0	0	4 (1.6)	0	5 (0.6)
	Level 5	5 (11.4)	0	0	5 (2.0)	1 (0.4)	11 (1.3)
1st trimester: less than 14 gestational weeks; early 2nd trimester: between 14 and 20 gestational weeks; late 2nd trimester: between 21 and 27 gestational weeks; early 3rd trimester: between 28 and 34 gestational weeks; late 3rd trimester: more than 35 gestational weeks.							

The response frequencies for each of the five dimensions, classified by gestational stages (i.e., 1st, early 2nd, late 2nd, early 3rd, and late 3rd trimesters) were listed in Table 3. Roughly one fifth (19.3%) of responders had health-related problems (levels 2–5) related to mobility, 9.8% had problems related to self-care, 16.9% had problems with usual activity, 46.5% had problems related to pain/discomfort, and 30.1% had problems related to anxiety/depression.

Table 4. Frequency (percentage) of reported problems by dimension and gestational stage.

Table 4
Frequency (percentage) of reported problems by dimension and gestational stage.

EQ-5D Dimension	Trimester (%)					Overall (N = 848)
	1st (n = 44)	Early 2nd (n = 117)	Late 2nd (n = 205)	Early 3rd (n = 256)	Late 3rd (n = 226)	
Mobility	10 (22.7)	8 (6.8)	20 (9.8)	62 (24.2)	64 (28.3)	164 (19.3)
Self-care	7 (15.9)	2 (1.7)	12 (5.9)	32 (12.5)	30 (13.3)	83 (9.8)
Usual activity	9 (20.5)	7 (6.0)	26 (12.7)	50 (19.5)	51 (22.6)	143 (16.9)
Pain/Discomfort	18 (40.9)	46 (39.3)	87 (42.4)	122 (47.7)	121 (53.5)	394 (46.5)
Anxiety/Depression	16 (36.4)	34 (29.1)	64 (31.2)	66 (25.8)	75 (33.2)	255 (30.1)
EQ-5D level 1: no problems; EQ-5D level 2–5: have problems; 1st trimester: less than 14 gestational weeks; early 2nd trimester: between 14 and 20 gestational weeks; late 2nd trimester: between 21 and 27 gestational weeks; early 3rd trimester: between 28 and 34 gestational weeks; late 3rd trimester: more than 35 gestational weeks.						

The profile of women who reported having “problems” is presented in Table 4. As noted in Table 4, problems related to pain/discomfort were the most common (46.5%); problems related to self-care were the least common (9.8%). Furthermore, more than 20% of women had problems in one of the five dimensions, except self-care, in the 1st trimester. Pregnant women who reported having problems related to mobility, usual activity and pain/discomfort were the most common during the late 3rd trimester. In contrast, problems related to self-care and anxiety/depression occurred the most frequently during the 1st trimester.

Figure 1. Profile of the proportion (%) with problems by dimension and gestational period.

As shown in Fig. 1, the proportion of women reporting problems in mobility, self-care and usual activity fell significantly from the 1st trimester to the early 2nd trimester and then increased again with gestational age. Meanwhile, there was a slight decrease from the 1st trimester to the early 2nd trimester in the proportion of reporting problems with pain/discomfort, and then increased significantly in later stages. Nevertheless, there was no evident change in proportion of women who reported problems with anxiety/depression.

Table 5. The mean and standard deviation of EQ-VAS score and EQ index values.

Table 5
The mean and standard deviation of EQ VAS score and EQ index values.

		1st	Early 2nd	Late 2nd	Early 3rd	Late 3rd	Overall	P
n		44	117	205	256	226	848	
EQ-VAS	Mean	88.77	87.78	88.28	87.62	87.38	87.80	0.816
	SD	9.92	9.53	9.09	8.97	9.86	9.36	
EQ index	Mean	0.772	0.886	0.863	0.826	0.810	0.836	0.001*
	SD	0.349	0.122	0.135	0.188	0.146	0.173	

*p value \leq 0.05 indicates the statistical difference.

In the whole sample, the mean EQ-VAS of the 848 questionnaires was 87.80 ± 9.36 (Table 5). Across the gestational stages, the mean EQ-VAS was highest in the 1st trimester (88.77 ± 9.92) and lowest in the late 3rd trimester (87.38 ± 9.86). The average overall EQ index value was 0.836 ± 0.173 (Table 5). The mean EQ index value for each consecutive pregnancy trimester was 0.772 ± 0.349 , 0.886 ± 0.122 , 0.863 ± 0.135 , 0.826 ± 0.188 , and 0.810 ± 0.146 (p value \leq 0.05), respectively.

Figure 2. Fluctuation of the EQ index value with gestational age.

Fluctuations in EQ index value with gestational age are shown in Fig. 2. We observed an increasing in EQ index value from the 1st to early 2nd trimester and gradual decreases thereafter.

Discussion

Our study showed that HRQoL of pregnant women was the highest in the early 2nd trimester and reduced gradually at later times during pregnancy. Early in the pregnancy, women may experience a lower HRQoL due to severe morning sickness, severe vomiting or fear of fetal loss among others. In the early 2nd trimester, HRQoL was at its highest in our study. However, with increasing gestational age, women begin to experience more physical and psychological changes[24, 25], including increased uterine size, weight gain, poor sleep quality, etc [25]. At later stages of pregnancy, problems arise with mobility, self-care, and daily activity due to the progressive distension of the belly and the associated inconvenience.

Furthermore, some pregnant women experience additional physical discomfort, such as pelvic pain and chest distress [26], as a direct result of the enlargement of the uterus. Moreover, complications, fear of childbirth, and the impact of pregnancy on sexual life may elevate anxiety and depression. Therefore, during the late 3rd trimester, pregnant women would face majority of the problems covered by the five dimensions of the EQ-5D-5L questionnaire and this may explain the low HRQoL we observed in the 3rd trimester compared with the early 2nd trimester.

On the other hand, pregnant women who reported having problems with anxiety/depression remained relatively constant throughout the duration of pregnancy and always exceeded 25%, and problems with

anxiety/depression of pregnant women was minimally influenced by gestational age. A possible reason for this trend is that the anxiety/depression of pregnant women is primarily caused by objective factors such as a young pregnancy age, a low education level, and financial dissatisfaction, all of which are weakly related to gestational age associated changes.

More than 15% of pregnant women reported problems in the 1st trimester (i.e., EQ-5D-5L levels 2–5), which seemed contradictory to our result that the HRQoL of pregnant women during the 1st trimester was the second highest, surpassed only by that early in the 2nd trimester. A possible explanation for this finding was that majority of pregnant women who reported problems on their EQ-5D questionnaires had only slight problems, which resulted in a relatively high average EQ index value. Overall, the HRQoL of pregnant women during the 1st trimester was relatively better. Interestingly, the EQ index of women with Gestational Diabetes Mellitus (GDM) was relatively higher than normal pregnant women. A possible reason is that we paid more attention on pregnant women with GDM during regular antenatal care.

Our results were consistent with those of other studies related to the HRQoL of pregnant women. Haas et al. (2005) suggested that health status declined substantially during pregnancy, and then improved after delivery [27]. Sut et al. (2016) found that EQ index scores significantly decreased in the 2nd and 3rd trimesters compared with the 1st trimester [20]. However, to the best of our knowledge, no study has yet investigated how HRQoL changes with the increasing of gestational age. However, in another study on sleep quality and HRQoL during pregnancy, Nevertheless, our study has some limitations. Firstly, when we analysed how HRQoL of pregnant women changed with the increasing of gestational age, it was unable to exclude the effect of complications prior to and during pregnancy on HRQoL which may have a major impact on the HRQoL. In further studies, subgroup analysis and statistical stratifications will be necessary to clarify the contribution of complications or medical conditions in pregnancy. Secondly, our results may not be comprehensive due to some missing data regarding fetal loss, pregnant women who refused to participate, and other reasons that led to follow-up loss or sample gaps. Further studies should bridge these gaps by including data on miscarriage, the number of previous successful (and unsuccessful) pregnancies, maternal education and financial situations. Thirdly, the applicability of our results may be limited because pregnant women from one regional university hospital may not be reflective of all pregnant women in China. Thus, data from multi-center trials would be more representative.

Evaluating HRQoL is becoming increasingly important in healthcare due to the cost-effectiveness of medical decisions. Due to the complexity of pregnancy, medical decisions can be more challenging to make as more factors are needed to be taken into consideration. HRQoL can potentially be used as an indicator to assist in medical decision-making during pregnancy.

Conclusions

In our study, HRQoL of pregnant women improved from the 1st trimester and reached the highest level in the early 2nd trimester, and then decreased to the lowest in the late 3rd trimester due to physical and

mental changes. Our study provides evidences that pregnant women should pay more attention to the healthcare in the late 3rd trimester, in which they may have the lowest HRQoL. Therefore, obstetric doctors and other medical institutions should provide more antenatal care to pregnant women and help them to better face the series of changes during pregnancy in that tough phase.

Abbreviations

HRQoL: Health-related quality of life; EQ-5D-5L: The EuroQoL Group's five-dimension five-level questionnaire; EQ-VAS: EuroQoL Group's visual analog scale questionnaire; BMI: body mass index; SD: standard deviation; IQR: interquartile range; GDM: Gestational Diabetes Mellitus.

Declarations

Ethics approval and consent to participate

This study was approved (ICE-2017-296) by the Institutional Review Board of The First Affiliated Hospital of Sun Yat-sen University. All of the procedures were conducted in accordance with the Declaration of Helsinki. All subjects signed informed consent documents prior to participating in the study.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Author's contributions:

H.W., W.S. and S.L. designed the study, collected data, cleaned data, analyzed data and reviewed and edited the manuscript. Y.W., X.H. and W.D. interpreted the data, reviewed and edited the manuscript. H.C.,

H.C., Q.Z., L.Z., J.H., B.A., and C.J.P. Z., interpreted the data, commented and edited the manuscript. W.M. contributed to study design, discussion, and reviewed and edited the manuscript.

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Figures

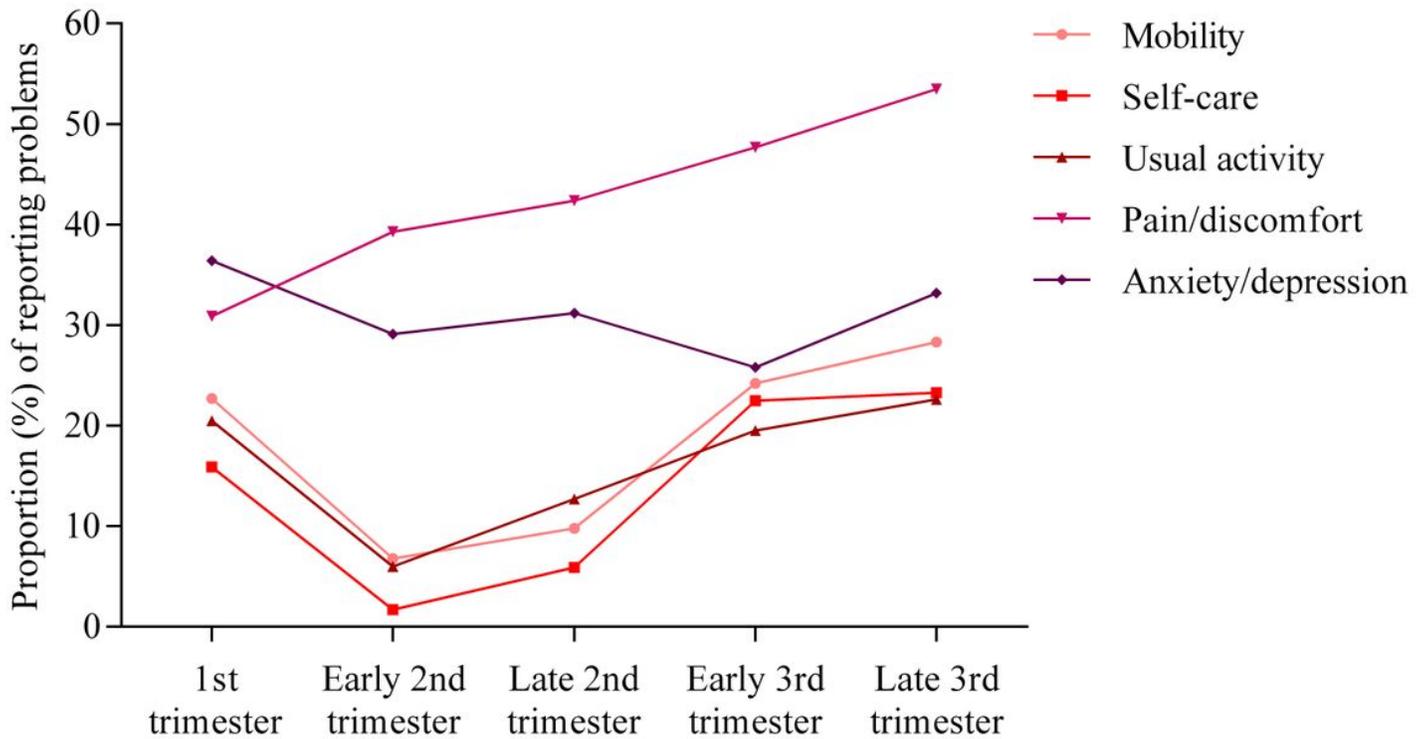


Figure 1

Profile of the proportion (%) with problems by dimension and gestational period. As shown in Figure 1, the proportion of women reporting problems in mobility, self-care and usual activity fell significantly from the 1st trimester to the early 2nd trimester and then increased again with gestational age. Meanwhile, there was a slight decrease from the 1st trimester to the early 2nd trimester in the proportion of reporting problems with pain/discomfort, and then increased significantly in later stages. Nevertheless, there was no evident change in proportion of women who reported problems with anxiety/depression.

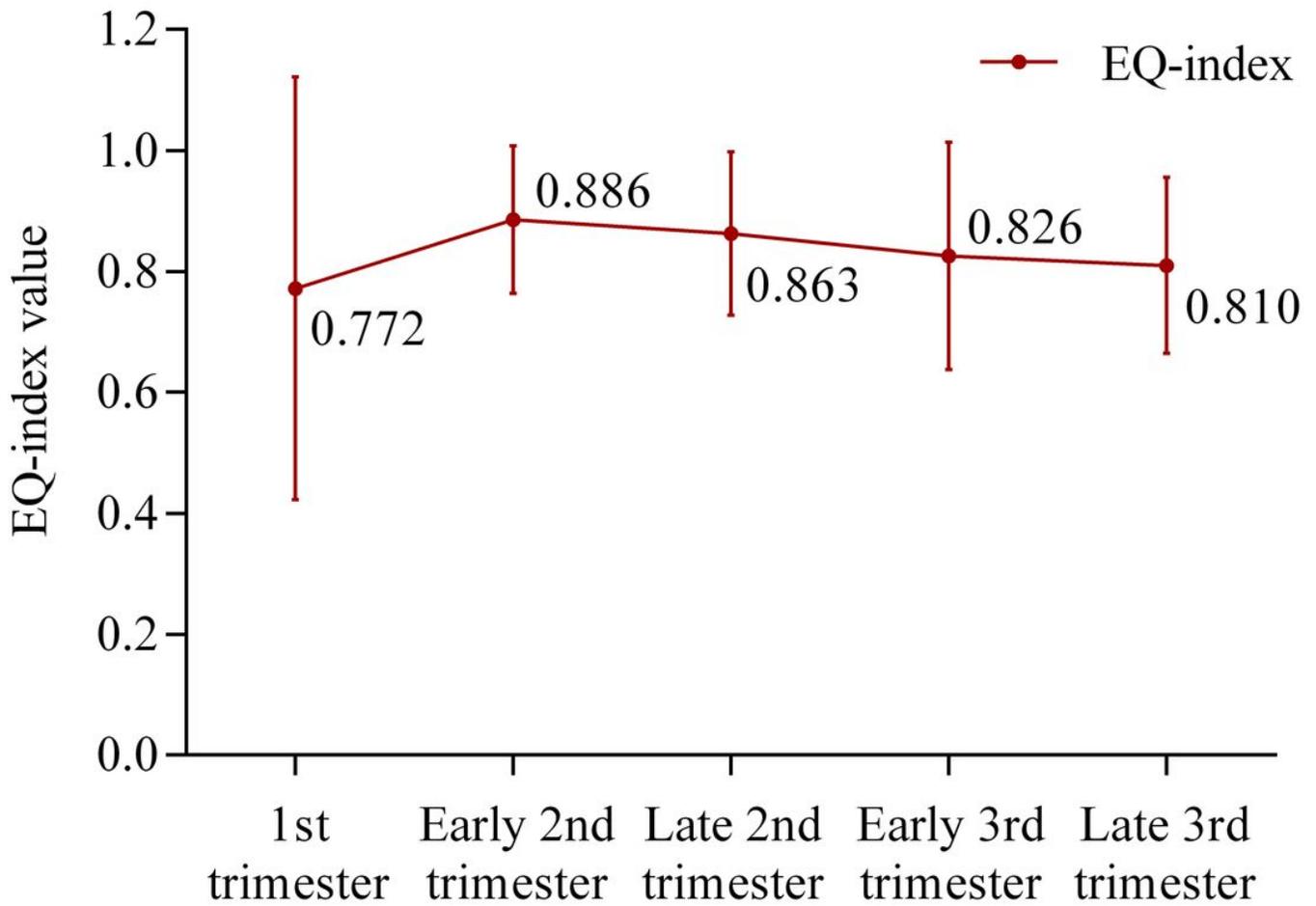


Figure 2

Fluctuation of the EQ index value with gestational age. Fluctuations in EQ index value with gestational age are shown in Figure 2. We observed an increasing in EQ index value from the 1st to early 2nd trimester and gradual decreases thereafter.