Abstract

Objective: To compare dietary intake and lifestyle behaviour in women with polycystic ovarian syndrome (PCOS) and healthy women.

Methods: 160 healthy women (partner with male infertility) were recruited to a control group; 168 women with PCOS (diagnosed on ultrasound) were recruited to a case study group for this cross-sectional comparative study. The case group was classified into three phenotypes based on presence or absence of menstrual disorder (M), hyperandrogenism (HA), and polycystic ovary according to sonography (PCO): HA+PCO (n=53), PCO+M (n=57) and M+HA+PCO (n=66). Dietary intake and lifestyle behaviour were measured using a food frequency questionnaire (FFQ) and a lifestyle questionnaire (LQ).

Results: The mean energy (P<0.001) and fat intake (P<0.001) were greater in PCOS groups compared with the control group. The average energy and fat intake were greater in HA+M+PCO group after age and BMI adjustment compared with other phenotypes (P<0.001). In comparison with the control group, lifestyle scores were lower in the PCOS group in the fields of physical activity, weight and nutrition control after age and BMI adjustment (P<0.001). The average score of lifestyle in the fields of physical activity, weight and nutrition control, and psychological health was lower in the phenotype HA+M+PCO compared with other phenotypes (P<0.001).

Conclusions: Limited energy and fat intake is strongly recommended in Iranian women with PCOS especially in phenotype HA+M+PCO. Consultation on improvement of psychological health and the importance of weight and nutrition control, and appropriate physical activity in patients especially in HA+M+PCO is advocated.

Keywords: Lifestyle, polycystic ovarian syndrome, diet

Introduction

Polycystic ovarian syndrome (PCOS) is a common and complex endocrine disorder that affects women of reproductive age [1]. Three phenotypes are recognized based on the presence or absence of symptoms using the Rotterdam criteria: oligo-ovulation (irregular menses) with polycystic ovary in sonography (M+PCO), hyperandrogenism with polycystic ovary in sonography (HA+PCO) and hyperandrogenism with oligo-ovulation (irregular menses) and polycystic ovary (M+PCO+HA) [2, 3]. Although, PCOS can exist in the absence of obesity, 70 percent of women with PCOS are obese [4].

Obesity can intensify metabolic and fertility outcomes related to this syndrome. For this reason, the treatment of PCOS focuses mainly on weight loss if obesity is present because energy limitation is associated with improved metabolic status and energy intakes [5-7]. However, the relationship between diet and PCOS is not yet well understood and there is limited information available in this field. It is reported that total energy intake and intake of micronutrients is similar in PCOS and control groups (Carmina et al.[8]) and that consumption of certain foods with high glycaemic index is greater in women with PCOS (Douglas et al.[9]). Extensive long-term studies have identified a significant relationship between diet and the risk of hypertension, type 2 diabetes mellitus (T2DM), and cardiovascular disease in a healthy population [10-14]. Most studies which assess the nutritional status of women with PCOS are flawed because they do not allow for the different clinical phenotypes in PCOS which result in significantly different clinical and metabolic parameters. Pikee et al. [15] have reported that women with the hyperandrogenism phenotype have a higher BMI and worse clinical and endocrine status (TG/HDL, LH/FSH, testosterone, LH) compared with other phenotypes. The only study which has investigated the

potential differences between phenotypes in PCOS and their dietary intake has reported that women with phenotype HA+M+PCO had more daily energy intake compared with healthy women [16].

Dietary habits are rooted in the culture of communities, and since the relationship between dietary habits and the prevalence of some cardiovascular disease and T2DM is proven, it seems logical and imperative to compare dietary intake between women with different phenotypes of PCOS in different cultures. To deliver appropriate nutritional interventions in the case of obesity or increased risk factors related to diet, PCOS cardiovascular status is required. The purpose of the present study was to compare dietary intake and lifestyle factors in women with three different phenotypes of PCOS with a control group of healthy women.

Methods

Design and data collection

The present study is a cross sectional study with a control and case group divided into three sub-groups. The study was conducted at an acute hospital in Hormozgan Province, Iran. Women were recruited through the infertility clinic at a provincial hospital. The case group included women with PCOS. The control group comprised healthy women who had been referred to this clinic because of male infertility.

A simple sampling method was used. The sample size was calculated using the following formula (Douglas et al.[9]) with CI 95% as at least 145 women in each group.

$$N = \frac{\left(Z_{1-\frac{\alpha}{2}} + Z_{1-\beta} \right)^2 \left(S_1^2 + S_2^2 \right)}{\Delta^2}$$

μ1: 61.5; μ2: 69.2; S1: 21.1; S2: 25.0.

The research team approached 362 women to explain the purpose of study; written consent was obtained from each participant who volunteered to participate and questionnaires were distributed and completed at the same clinic appointment. 34/362 women declined for unknown reasons. Inclusion criteria for all groups were: age 15-40 years, married, Iranian nationality, and absence of linguistic or cognitive problems, lack of underlying disease (diabetes, hypertension, diagnosed anaemia, or any other disease requiring a special diet). Additional inclusion criteria for the case group were women with PCOS based on two of the following three Rotterdam criteria: ultrasound scan of polycystic ovary (>12 follicles in both ovaries and ovarian volume >10 mm); clinical signs of hyperandrogenism: clinical score of hyperandrogenism >7 or obvious acne); menstrual cycles of greater than 35 days or amenorrhea (absence of menstruation for 199 days). And absence of congenital adrenal hyperplasia, thyroid dysfunction, hyperprolactinemia.

The selected participants in the case group were classified into three phenotypes: HA+PCO, M+PCO, HA+M+PCO.

Measures

Menstrual history measured as the interval between two menses during the previous 12 months: <21 days, 21-34 days, 35-60 days, >199 days, variable.

BMI: calculated as an individual's weight in kilograms divided by height in metres^2

Body hair: based on the Ferriman-Gallway hirsutism scoring scale which measures nine androgen sensitive areas in the body. Each area is rated from zero to 4 based on the degree of terminal hair growth. A score of 7 or more indicated hirsutism [(17)].

Acne: a global acne grading system was used to measure acne. This scale includes six body areas of face, chest, and upper back based on the level of involvement, distribution, density, and pilosebaceous units. Each body area is rated from zero to four. The most severe lesion of each area determines the score of that area. The score of each area is multiplied by the factor score which is based on the involved area: forehead, left and right cheek, nose, chin, chest and upper back. The total acne score is obtained by multiplying the factor score by sum score of involved areas [18].

Socio economic status: formal education of women was considered as an indicator of social status [19].

Food frequency questionnaire: dietary intake was measured using a modified food frequency questionnaire (FFQ) based on Iranian dietary questionnaire which contains 168 items. The reliability and validity of the questionnaire are approved in Iran [20]. FFQ included a list of foods with a standard size of a food. Subjects were asked to report the frequency of consumption of each food during the past month on a daily, weekly or monthly basis. The amount of nutritional items consumed was converted to grams using household scales. This dietary information was analyzed using the software Nutrition4 which calculated the amount of energy, macronutrients (carbohydrates, lipid, and protein) and micronutrients (at least 30 micronutrients) including fat soluble vitamins, water soluble vitamins and minerals [20, 21].

Lifestyle questionnaire (LSQ) which compromises 70 items in 10 subscales including physical health (8 items), sports and fitness (7 items), weight management and nutrition (7 items), disease prevention (7 items), mental health (7 items), spiritual health (6 items), social health (7 items), avoidance of drugs, alcohol and opiates (6 items), accident prevention (8 items) and

environmental health (7 items). All items are graded on a four-point Likert scale scoring in range from 0 (=never) to 3 (=always). The higher the score, the better the lifestyle. Lali et al. [22] have confirmed the validity and reliability of this questionnaire for Iranian society.

Ethical consideration

The ethics committee of Hormozgan University of Medical Science approved the present study. After explaining the purpose of the study and securing the confidentiality of information, all subjects gave written consent.

Statistical analysis

The Mean ± SD and n (%) were used for quantitative and qualitative variables respectively. T test and ANOVA test were used for intergroup comparison of PCOS patients for quantitative variables and comparison of PCOS phenotypes respectively. BMI and age were adjusted by co-variance analysis. Data were analyzed using Statistical Package for the Social Sciences 21.0 (SPSS Inc., Chicago, IL, USA). Significance level of $P<0.05$ was accepted.

Results

Study population

Table 1 shows the clinical and demographic information of all participants. There was no significant difference between the control and case study groups in terms of demographic and clinical characteristics except for menstrual cycle interval, hirsutism and acne scores ($P>0.05$). There were no significant differences between three PCOS phenotype groups in terms of demographic and clinical characteristics.

Dietary intake

Table 2 shows the comparison of women with PCOS and the women in the control group based on their dietary intake. Energy and fat intake were greater in the PCOS group after adjustment for BMI and age compared with control group ($P<0.01$). Table 3 shows dietary intake in the different phenotypes of PCOS. Energy intake and fat intake were significantly higher in phenotype HA+M+PCO compared with phenotypes HA+PCO and M+PCO. This statistical difference remained after adjustment for age. Other micro/macro nutrient intake was similar across phenotype groups.

Lifestyle

Table 4 shows the comparison of PCOS and control groups based on the domains of lifestyle. Scores of physical activity, nutrition and weight control in the PCOS group were significantly lower than in the control group after BMI and age adjustment, indicating a poorer lifestyle in women in the PCOS group in the mentioned domains above.

Table 5 shows the lifestyle scores across the different PCOS phenotype groups of women. Scores of physical activity, nutrition and weight control and psychological health were significantly lower in HA+M+PCO phenotype after BMI and age adjustment compared with other phenotypes ($P<0.001$) indicating a poorer lifestyle of HA+M+PCO phenotype.

Discussion

160 The results of the present study showed that after BMI and age adjustment, energy, fat, saturated
161 fatty acids and polyunsaturated fatty acids intake were significantly greater in the PCOS group
162 compared with the control group. Given that quality of the diet increases by fibre and
163 micronutrients intake, and decreases by saturated fat intake [23], the quality of diet may be lower
164 in the PCOS group compared with the control group. Our findings suggest that the quality of diet
165 is positively affected by polyunsaturated fatty acids intake. Previous studies show that quality of
166 diet is a dietary intake measure which is associated with unfavourable metabolic outcomes and
167 increased risk of chronic disease mortalities [24, 25]. Wild et al. [26] reported increased fat intake
168 and decreased fibre intake in women with PCOS compared with a control group. Moran et al. [27]
169 showed women with PCOS had a better diet quality as indicated by a higher diet quality score
170 and higher energy, fibre, folate, iron, calcium, magnesium, niacin, phosphorus, potassium,
171 sodium, vitamin E and zinc intake and lower percentage energy from saturated fat intake,
172 glycaemic index and retinol intake than women without PCOS. It should be noted that in this
173 study, diagnosis of PCOS was self-reported and dietary intake was measured using a dietary
174 questionnaire for epidemiological studies. These questionnaires measure 80 types of nutrients
175 consumed during the past 12 months which differs from the present study as the FFQ is an
176 appropriate tool for measurement of diet components in a certain period. However, data accuracy
177 may be limited due to the ability of the responders to remember their intake. Moreover, women
178 with PCOS reported higher carbohydrate (229 vs. 61 g), protein (78 vs. 66.3 g), fat (85 vs. 61.1
179 g), saturated fat (26 vs. 22.5 g) intake compared with reference population [28]. A high energy
180 diet has been reported in Iranian [29] and Brazilian [16] women with PCOS. Using three 24-hour
181 dietary recall questionnaires, Ahmadi et al. [29] reported that daily energy intake (about 300 kcal)
182 was higher in women with PCOS. These women also had more total and saturated fat intake

compared with control group [29]. A 24 hours dietary diary has similar limitations to the FFQ as it also depends on an individual respondent's memory. However, it is an appropriate method which can present accurate information when it is used by a trained interviewer in a standard approach. Furthermore, the results of the present study show for the first time that the energy and saturated fat intake were greater in HA+M+PCO phenotype after age and BMI adjustment compared with other phenotypes. To date, this is the only study to compare dietary intake PCOS phenotypes with healthy women. The results of Graff et al. [16] using a 121 items FFQ showed that energy intake was greater in classic phenotype of PCOS (HA+M+PCO) compared with the control group; however, this statistical difference did not exist after age and BMI adjustment. It should be noted that Graff et al considered only two phenotypes of HA+PCO+M (n=39) and ovulatory PCOS (n=22). In the present study, classification of PCOS phenotype was based on the Rotterdam criteria.

It has been shown that HA+M+PCO phenotype has three times higher levels of androgen which in turns increases the prevalence of glucose tolerance disorder and insulin resistance more than other phenotypes [16]. Testosterone stimulates appetite and an increased level of androgen in women is associated with appetite control disorder [30]. Moreover, hyperandrogenism is essential in determining the risk of cardiovascular disease in PCOS phenotypes [31]. Current clinical evidence suggests that testosterone increases abdominal fat accumulation [32-34]. Increased abdominal adiposity is associated with increased Leptin hormone and Leptin resistance which may be associated with increased energy intake [35]. High fat intake (total and saturated fat) in the present study is a concern for patients with PCOS specially HA+PCO+M phenotype; because fatty acid intake affects the glucose metabolism by making changes in insulin signaling and cell

membrane function. In addition, high saturation fat diet is associated with decrease insulin resistance [36].

However, a high level of physical activity improves the glucose metabolism and sensitivity to insulin, and reduced abdominal obesity [22]; the risk of which is higher in phenotypes HA+PCO+M. Our results showed for the first time that phenotype HA+M+PCO has less physical activity compared with two other phenotypes. Wright et al. [37] have reported no significant difference in self-reported physical activity between American PCOS and non PCOS patients. This finding is similar to the study of Ahmadi et al. [29], Álvarez-Blasco et al. [38] in which there was no significant difference in physical activity between PCOS and non PCOS patients in Iran and Spain. However, it should be noted that similar tools are not used in these studies to measure physical activity. Wright et al. [37] have used Paffenburg physical activity questionnaire that is validated in male and female samples. Álvarez-Blasco et al. [38] and Ahmadi et al. [29] have used interview questionnaires which their validity is uncertain. In the present study, we have used the Iranian version of the lifestyle questionnaire where the validity and reliability are approved [30].

A strength of the present study is that the diagnosis of PCOS phenotypes for allocation to case study groups was done by an expert physician in the infertility clinic and patients were classified to the clinical phenotypes based on the Rotterdam criteria. Moreover, a validated FFQ was used for diet evaluation which is a standard tool for measurement of long term dietary habits in cross sectional and cohort studies. Lifestyle questionnaire was used to evaluate participants' lifestyle. Nevertheless, there are some limitations in the present study. Patients were selected from the

only referral infertility clinic of Hormozgan province which limits generalization of the study results. Furthermore, the association between metabolic and hormonal features of the study population and dietary intake was not included in this study; future studies should consider different phenotypes of PCOS. In addition, since diet analysis was limited to the nutrition database, glycaemic load could not be measured in this study. In the current study, we assess physical activity by a lifestyle questionnaire that was designed by Likert scale. We did not assess physical activity using metabolic equivalents (METS). This should be considered in the interpretation of our findings.

Conclusions

Reduced energy and fat intake is strongly recommended to Iranian women with PCOS especially with the HA+M+PCO phenotype. It is critical to closely examine the metabolic and endocrine status of women with menstrual disorder and hyperandrogenism because the treatment strategies for energy deficit-related menstrual disturbances differ from that of disturbances attributable to hyperandrogenaemia. Further investigation is necessary to explore whether different endocrine etiologies underlay menstrual disorder and hyperandrogenism in different phenotypes of PCOS. Consultation on improvement of psychological health and the importance of nutrition and weight control, and appropriate physical activity in these patients especially HA+M+PCO phenotype is necessary. Future studies on the evaluation of the risk of metabolic side effects, dietary intake and lifestyle is PCOS phenotypes are recommended.

Disclosure statement

The authors report no conflicts of interest.

Transparency declaration

The lead author affirms that this manuscript is an honest, accurate, and transparent account of the study being reported. The reporting of this work is compliant with the STROBE checklist. The lead author affirms that no important aspects of the study have been omitted and that any discrepancies from the study.

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Table 1. Demographic and clinical characterizes of participants

Variable**	Phenotype of PCOS			Control	P value§
	H+PCO (n= 53)	H+PCO+M (n= 66)	M+PCO (n= 57)		
Variable					
Age *	29.30±6.25	28.41±3.49	29.03±9.31	29.85±6.40	0.43
Education *	12.69±3.05	11.63±4.11	11.04±4.92	10.82±4.31	0.62
Weight *	79.43 ±13.1	76.31±15.41	78.35±10	75.3 ±20.8	0.52
BMI*	39.80±6.53	38.43±7.11	35.42±2.34	33.32±2.96	0.87
Acne score*	6.93±1.38	6.58±2.30	6.83±1.10	3.62±0.90	<0.001
Hirsutism score*	11.30±0.84	11.03±0.31	11.17±0.01	9.40±0.18	<0.001
Average menstrual cycle **					
<21	2 (3.77)	5 (7.57)	4 (7.01)	13 (8.1)	
21-35	22 (41.50)	28 (42.42)	30 (52.63)	76 (47.5)	
35-60	15 (28.30)	18 (27.27)	9 (15.78)	8 (5)	<0.001
>199 days	6 (11.32)	8 (12.12)	9 (15.78)	18 (11.3)	
Variable	8 (15.09)	7 (10.60)	5 (8.77)	44 (27.5)	

§ between PCOS and control group

*ANOVA test

**Kruskal wallis test

£ P<0.05 between H+PCO and H+PCO+M phenotype

€ P<0.05 between H+PCO and M+PCO phenotype

¥ P<0.05 between H+PCO+M and M+PCO phenotype

Table 2. Comparison of PCOS patients and control group based on the dietary intake

Variable **	PCOS (n= 168)	Control (n= 160)	P value *	P value adjusted for BMI and age
Energy (Kcal/day)	2500.2±78.7	2202.8±49.6	<0.001	<0.001
Protein (g/day)	76.09±10.79	74.25±9.36	0.41	0.82
Fat (g/day)	89.06±12.42	65.38±11.75	<0.001	<0.001
Saturated fatty acids (g/day)	35.97±9.24	21.16±5.56	<0.001	<0.001
Polyunsaturated fatty acids (g/day)	27.21±2.48	15.81±2.48	<0.001	<0.001
Linoleic acid (g/day)	33.10±8.91	24.22±9.40	0.21	0.32
EPA (g/day)	0.03±0.002	0.01±0.001	0.45	0.31
Sodium (mg/day)	2223.05± 31.08	1353.93±10.21	0.06	0.09
Iron (mg/day)	24.13±2.27	26.23±6.37	0.43	0.25
Magnesium (mg/day)	395.98±43.09	332.83±26.28	0.51	0.40
Zinc (mg/day)	9.68±3.75	7.75±2.55	0.59	0.41
Manganese (mg/day)	8.64±3.11	9.26±4.91	0.98	0.43
Fluoride (µg/day)	4129.04±60.51	3163.40±23.50	0.61	0.52
Iodine (µg/day)	0.28±0.31	0.02±0.01	0.45	0.31
Vitamin A(µg/day)	2701.59±79.35	1347.72±13.10	0.39	0.15
Vitamin E (mg/day)	3.98±0.67	3.11±0.85	0.92	0.81
Thiamin B1 (mg/day)	2.34±0.57	1.72±0.22	0.35	0.41
Niacin B3 (mg/day)	23.89±5.78	17.84±3.97	0.63	0.51
Folate (µg/day)	410.81±14.33	302.89±51.24	0.51	0.31
Carbohydrate (g/day)	380.26±54.02	622.02±10.13	0.60	0.31
Potassium (mg/day)	5292.19±80.37	4034.62±36.03	0.43	0.22
Calcium (mg/day)	1234.81±12.91	861.700±16.69	0.81	0.12
Phosphorus (mg/day)	1800.16±10.80	1075.22±79.80	0.53	0.72

*T test, **Mean±SD

Table 3. Dietary intake in different phenotypes of PCOS

Variable**	Phenotype of PCOS			P value*	P value adjusted for BMI and age
	H+PCO (n= 53)	H+PCO+M (n= 66)	M+PCO (n= 57)		
Energy (Kcal/ day)	2454.2±82.4	2600.8±51.09	2346.80± 4.08	<0.001£€¥	<0.001
Protein (g/day)	85.56 ±81.12	91.69±82.38	65.96±68.30	0.41	0.63
Fat (g/day)	119.27±55.46	89.81±45.38	77.56±49.59	<0.001£€¥	<0.001
Saturated fatty acids (g/day)	29.80±31.67	45.06±10.31	21.75±15.79	<0.001£€¥	<0.001
Polyunsaturated fatty acids (g/day)	41.54±12.97	25.34±13.13	25.11±15.25	<0.001£€¥	<0.001
Linoleic acid (g/day)	39.40±12.46	45.90±16.17	23.59±14.59	0.52	0.35
EPA (g/day)	0.01±0.01	0.05±0.01	0.007±0.01	0.09	0.06
Sodium (mg/day)	1993.41±15.71	2523±38.12	2907.27±34.58	0.31	0.58
Iron (mg/day)	21.94±17.26	28.46±34.87	21.27±24.82	0.38	0.41
Magnesium (mg/day)	431.99±51.47	450.84±64.62	362.05±37.70	0.83	0.96
Zinc (mg/day)	9.74±7.66	12.79±2.96	9.080±.76	0.61	0.82
Manganese (mg/day)	7.74±4.03	10.69±0.12	7.17±.20	0.21	0.35
Fluoride (µg/day)	6454.85±47.21	5030.95±39.90	7064.76±84.99	0.63	0.41
Iodine (µg/day)	0.2±.01	0.38±0.12	.08±.01	0.52	0.51
Vitamin A (µg/day)	1962.76± 16.38	3512.09±12.02	2473.02±52.84	0.35	0.41
Vitamin E (mg/day)	4.30±0.36	4.19±0.66	3.44±0.42	0.31	0.51
Thiamin B1 (mg/day)	2.35±0.40	2.78±0.70	1.82±0.34	0.83	0.62
Niacin B3 (mg/day)	21.09±0.18	30.58±0.91	18.95±0.16	0.34	0.91
Folate (µg/day)	557±74.20	591.36±64.42	377.16±25.36	0.48	0.72
Carbohydrate (g/day)	433.41±57.31	435.06±63.39	345.17±39.45	0.64	0.51
Potassium (mg/day)	5353.94±53.53	6128.09±10.01	4292.63±34.42	0.76	0.43
Calcium (mg/day)	1386.78±18.24	1238.75±11.09	1089.47±79.86	0.62	0.95
Phosphorus (mg/day)	1824.75±16.02	1238.75±11.09	1089.46±79.86	0.52	0.81

*ANOVA, **Mean±SD
£ P<0.05 between H+PCO and H+PCO+M phenotype
€ P<0.05 between H+PCO and M+PCO phenotype
¥ P<0.05 between H+PCO+M and M+PCO phenotype

Table 4. Comparison of PCOS and control groups based on the domains of lifestyle

Variable **	PCOS (n= 168)	Control (n= 160)	P value *	P value adjusted for BMI and age
Physical health	16.32±3.62	16.66±3.01	0.38	0.62
Exercise and fitness	12.05±3.52	15.42±4.82	<0.001	0.04
Weight control and nutrition	12.49±4.02	16.54±3.98	<0.001	0.03
Illness prevention	15.82±3.38	16.23±4.49	0.45	0.59
Psychological health	12.90±4.22	16.34±3.36	<0.001	0.01
Spiritual health	17.62±3.45	18.02±4.28	0.69	0.71
Social health	17.56±4.62	17.38±5.01	0.53	0.73
Drug and alcohol avoidance	16.31±3.42	15.95±3.41	0.42	0.59
Accident prevention	17.43±3.42	17.56±3.51	0.36	0.48
Environmental health	17.36±2.49	17.42±4.32	0.74	0.80

*T test, **Mean±SD

Table 5. The scores of lifestyles in different phenotypes of PCOS

Variable	Phenotype of PCOS			P value*	P value adjusted for BMI and age
	H+PCO (n= 53)	H+PCO+M (n= 66)	M+PCO (n= 57)		
Physical health	16.02±3.44	16.56±3.53	16.45±3.08	0.65	0.55
Exercise and fitness	12.34±3.34	11.02±2.34	13.40±3.29	<0.001£€¥	<0.001
Weight control and nutrition	11.93±2.43	10.42±2.35	13.39±3.86	<0.001£€¥	<0.001
Illness prevention	15.04±3.22	14.93±4.24	15.42±4.42	0.45	0.31
Psychological health	12.42±1.32	10.56±2.94	13.20±3.82	<0.001£€¥	<0.001
Spiritual health	17.53±7.34	16.92±6.42	17.83±5.01	0.33	0.25
Social health	17.32±6.45	17.24±3.56	17.45±5.92	0.45	0.35
Drug and alcohol avoidance	16.42±5.62	16.02±4.41	16.93±4.32	0.56	0.42
Accident prevention	17.05±3.56	16.92±2.39	17.21±4.35	0.71	0.65
Environmental health	17.32±4.23	17.25±1.95	17.28±4.62	0.93	0.83

*ANOVA, **Mean±SD

£ P<0.05 between H+PCO and H+PCO+M phenotype

€ P<0.05 between H+PCO and M+PCO phenotype

¥ P<0.05 between H+PCO+M and M+PCO phenotype