Physical Activity and Healthy Diet
in Patients with Familial Hypercholesterolaemia

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Abstract

Performing vigorous physical activity and taking balanced diet are parts of healthy lifestyles of patients with Familial Hypercholesterolaemia (FH). This study aimed to describe the status of engagement with physical activity and a healthy diet, and their contributing factors. FH patients diagnosed using Dutch Lipid Clinic Network criteria were given validated questionnaires to assess sociodemography, illness characteristics, the status of engagement with physical activity and healthy diet, psychological elements, family support and level of barrier. Significant contributing factors were receiving treatment, level of barrier and intention for behavioural change. The findings may inform the strategy for lifestyle modification of patients with FH.

Keywords:Familial Hypercholesterolaemia; lifestyle; physical activity; healthy diet

1.0 Introduction

Cardiovascular diseases (CVDs) is the leading causes of morbidity and mortality worldwide and Familial Hypercholesterolemia (FH) is one of the important risk factors. Globally, one in every 500 to 200 people may have FH. In Malaysia, recent National Health and Morbidity Survey (2019) indicated that hypercholesterolemia is one of the significant risks for cardiovascular disease. The prevalence of hypercholesterolemia is 38.1%; indicating one in three Malaysians may have this condition (National Institute of Health, Malaysia ,2020). Other major risk factors are diabetes mellitus, obesity and hypertension.   FH is an essential cause of hypercholesterolemia among the Malaysian population. In a recent study among the local community, of the total 4821 participants, 9.1% had severe hypercholesterolemia and the ratio of FH was estimated to be 1:95; which is more common than most that have been reported in European countries (Razman, et al., 2019).

2.0 Literature Review

There are various causes of hypercholesterolaemia; one of the central causes is primary hypercholesterolaemia, including FH. It is primary dyslipidaemia which involved a genetic mutation in cellular transportation and catabolism of LDL-C, such as LDL-receptor (LDLR), apolipoprotein B (APOB), proprotein convertase subtilisin/kexin type 9 (PCSK9) and low-density lipoprotein receptor adaptor protein 1 genes (LDLRAP1) (Al-Khateeb et al., 2016). Secondary dyslipidaemia may also cause hypercholesterolemia, but it is often associated with the increase in LDL-C which most often caused by external factors including taking high-fat diet, lack of physical activity and exercise leading to obesity, smoking or, from other diseases such as hypothyroidism, liver disease or chronic renal failure (Al-Khateeb et al., 2016).

Correct diagnosis of Familial Hypercholesterolemia is crucial for effective intervention. Currently, there are a few acceptable criteria used by clinicians worldwide including the Dutch Lipid Clinic Network (DLCN) criteria, Simon Broome (SB) Register, Make Early Diagnosis–Prevent Early Death, American Heart Association (US MEDPED), Canadian Simplified Definition, and the Japanese FH Management Criteria, Japanese Atherosclerotic Society(JFHMC) (Suraya et al., 2019, Kramer et al., 2019). The most widely used and common preference for Malaysian clinicians is the DLCN criteria. Points are assigned for family history of hyperlipidaemia or heart disease, clinical characteristics such as tendinous xanthomata, elevated LDL cholesterol, and/or an identified mutation. The cumulative score indicates the status of either score of "definite", "probable", "possible" or "unlikely" to have FH (Austin et al., 2004; Haase and Goldberg, 2012; Nordestgaard et al., 2013). Refer to Table 1 for the complete criteria.

Table 1: The Dutch Lipid Clinic Network Criteria for the Diagnosisof Familial Hypercholesterolemia

Criteria		Points
Family History	First-degree relative with known premature* coronary and vascular disease OR First-degree relative with known LDL-C level above the 95th percentile.	1

	First-degree relative with tendinous xanthomata and/or arcus cornealis OR Children aged less than 18 years with LDL-C level above the 95th percentile.	2
Clinical History	Patient with premature* coronary artery disease.	2
	Patient with premature* cerebral or peripheral vascular disease.	1
Physical Examination	Tendinous xanthomata	6
	Arcus cornealis prior to age 45 years.	4
Cholesterol levels mg/dl (mmol/liter)	LDL-C >= 330 mg/dL (≥ 8.5)	8
	LDL-C 250 – 329 mg/dL (6.5 – 8.4)	5
	LDL-C 190 – 249 mg/dL (5.0 – 6.4)	3
	LDL-C 155 – 189 mg/dL (4.0 – 4.9)	1
DNA Analysis	Functional mutation in the LDLR, apo B or PCSK9 gene	8
Diagnosis (diagnosis is based on the total number of points obtained)	Definite familial hypercholesterolemia	>8
	Probable familial hypercholesterolemia	6 – 8
	Possible familial hypercholesterolemia	3 – 5
	Unlikely familial hypercholesterolemia	<3
*Premature = < 55 years in men; < 60 years in women LDL-C = low density lipoprotein cholesterol; FH, familial hypercholesterolemia. LDLR = low density lipoprotein receptor Apo B = apolipoprotein B PCSK9 = Proprotein convertase subtilisin/kexin type 9		

Source: This table is adapted from Austin et al., 2004; Haase and Goldberg, 2012; Nordestgaard et al., 2013.

FH causes various severe CVDs and other complications, and if untreated. Patients with FH will suffer reduced life expectancy by up to 30 years compared those without FH (Alonso, Mata, & Mata, 2005). Without early treatment, CVDs and other complications caused patients with FH to have a poor quality of life (Razali, Ismail, Yung et al., 2019). Hence, preventive measures of CVDs including taking lipid-lowering agents, stress management and lifestyle interventions (such as taking healthy diet, performing vigorous physical activities, exercise and smoking cessation) are vital. Moreover, positive illness perceptions and belief on the illness is crucial for adherence to treatment and early preventive measures (Razali, Ismail, & Abdullah et al., 2019).

In order to ensure life-long behavioural modification, the underlying health-related psychological process that shapes the intention for behavioural changes must well be understood to inform effective interventions (Hagger et al., 2016). These underlying psychological processes in behavioural change has been explained by many theories (Bandura, 1986; Prochaska, 1998; Ajzen, 1985). One of the popular theories is the Theory of Planned Behaviour (TPB) which was introduced by IcekAjzen in 1985 and further elaborated in 2011 (Refer Figure 1).
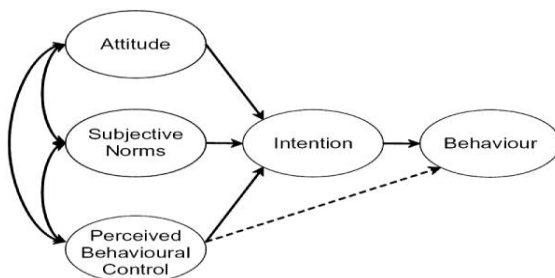
Figure 1: Theory of Planned Behaviour
Source: The diagram is adapted from IcekAjzen (2011)

The theory suggested that a 'behaviour' is dependent on one's 'intention' to perform the behaviour (i.e. engagement with physical activity and healthy diet) and the 'intention' is dependent on the 'attitude' (beliefs and values about the outcome of the behaviour), 'subjective norms' (beliefs about what other people think the person should do or general social pressure) and 'perceived behavioural control' or one's perceptions of his ability or feelings of self-efficacy to perform the behaviour (Ajzen, 1985, 2011). Some of the examples of the 'attitude' for engagement with physical activity and healthy diet include perceptions that practising these lifestyles is vital for the prevention of cardiovascular complications, performing exercise and taking a healthy diet is essential for having appropriate body weight or many others. Examples of 'subjective norms' include common practices of unhealthy diet during festivals, poor diet control when going out together with friends and many others. As part of the general social pressure, experts in behaviour also believe that support and barriers from surrounding social elements may influence patients' decision to perform the behaviour.

To date, there is still sparse knowledge and awareness of the psychological concepts that contribute to the lifestyles of patients with FH among both the public and patients. Hence, this study aimed to i) describe the lifestyle of patients with FH (including engagement with physical activity and taking healthy diet) and, ii) determine the associations between the lifestyles and sociodemographic factors, illness characteristics, the underlying health-related psychological elements (including intention, attitude, subjective norms and perceived behavioural control), family support and level of barrier.

3.0 Methodology

This study was a cross-sectional study which used convenient sampling for recruitment. The study was conducted at the Specialist Lipid and Coronary Risk Prevention Clinics in a Teaching Hospital in Malaysia. The selection criteria include participants aged 18 years or more who were patients diagnosed with FH according to Dutch Lipid Clinic (DLC) criteria. Prior to the commencement of the study, written informed consent was granted from all participants.

Self-reported pro forma questionnaires were used to assess sociodemographic

background, illness characteristics, family support and barrier for performing physical activity and taking healthy diet. Sociodemographic variables include information regarding gender, age, marital status, level of education and their total household income per month. Illness characteristics include the presence of CVDs, type of CVDs (including coronary heart disease, angina, stroke atherosclerosis and peripheral vascular disease) treatment for FH, and risk factors for coronary artery disease (including smoking status, high blood pressure, depression and high stress). The underlying health-related psychological concepts (such as intention, attitude, subjective norms, perceived behavioural control) were assessed using questionnaires constructed based on the TPB (Ajzen, 2011).

Statistical Package for the Social Sciences version 24 was used to analyse the data. Data were mostly recategorised into dichotomous data. The associations between sociodemographic factors, illness characteristics, domains of TPB (attitude, subjective norms, perceived behavioural control and intention), family support and level of barrier and domains of lifestyles (engagement with physical activity and taking healthy diet) were analysed using Chi-Square analysis. Multiple regressions were carried out to identify the determinants of engagement with physical activity and taking healthy diet. The study was approved by the Institutional Research Ethics committee (600-RMI (5/1/6).

3.0 Results
3.1 Background Sociodemography
A total of hundred participants (37% male and 63% female), predominantly in the late forties (mean±SD: 49.8±11.4 years old) and ever-married individuals (92%) participated in the study. They were mainly from a lower socioeconomic position with which 55% of the participants had a total household income less than RM3000 a month, and 52% of studied participants attained only up to the level of secondary education.

3.2 Illness Characteristics
Less than half (41%) of the patients with FH had CVDs; mainly coronary heart disease (n=35; 85.4%), angina (n=8; 19.5%), atherosclerosis (n=4; 9.8%), stroke (n=4; 9.8%) and one participant had peripheral arterial disease. About two-thirds (69%) of the participants received lipid-lowering agents. More than a third (40%) of the participants had hypertension, 13% were smokers, and 8% reported feeling stressed up and complained of feeling depressed.

3.3 Lifestyle Pattern
The majority 66(68.8%) of Patients with FH in the study reported that they had been taking healthy diet. However, less than half of the patients reported that they engaged with physical activity (Figure 2). Only 13 (13%) of Patients with FH in the study were still smoking during the study period.
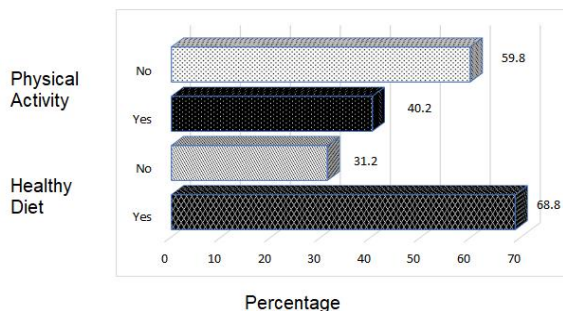
Figure 2. Percentages of the Lifestyles (Engagement in Physical Activity and Healthy Diet)

3.4 Family Support and Level of Barrier

Most of the respondents (63; 63%) did not have the barriers to perform the physical activity, 14 (14%) of respondents complained that time factor as their barrier to perform physical activity, 7(7%) of respondents mentioned that health problem as their barrier and the others described of being lazy, busy with work and bad weathers as their barriers to performing physical activity. In terms of taking healthy diet, most of the respondents, 76(76%) did not have the barriers to take healthy diet, 10(10%) of respondents complained of difficulty to control their appetite as their barrier to take healthy diet and others complained that having friends, family, and attending ceremony and availability of unhealthy food as their barrier to taking healthy diet. For family support, of the total, about 81.8% and 89.5% of respondents had family support to perform physical activity and taking health diet respectively.

3.5 Contributing Factors for Engagement with Physical Activities

There were significant associations between the engagement with physical activities, and the status of receiving treatment, the intention to perform the physical activity and the level of barrier. Patients with FH engaged in physical activity were significantly higher ($X^2(1)$ =4.895; p=0.027) among those who were receiving treatment (n=22;56.4%) than those who were not (n=17;43.6%). Those who engaged in physical activity were also significantly higher ($X^2(1)$ =11.379; p=0.001; Yates correction:$X^2(1)$ =9.734; p=0.002) among Patients with FH who had intention (n=37;68.3%) than those who had no intention to perform the physical activity (n=18;32.7%). Moreover, in terms of the level of barrier, the patients engaged in physical activity were significantly higher ($X^2(1)$ =15.303; p=0.000; Yates correction:($X^2(1)$=13.663;p=0.000) among those who had a low level of barrier (n=34;87.2%) than those who had a high level of barrier (n=5;12.8%) (Refer to Table 2).

Multiple logistic regressions were performed to identify the determinants for engagement with physical activity. The independent variables included in the model development were gender, age, total household income, presence of CVD, the status of receiving treatment, intention, family support and the level of barrier. The Omnibus test for model coefficient showed that the model was significant ($X^2(8)$ = 34.929; p<0.001; the Nagelkerke R^2=0.413;

Cox & Snell R^2=0.305) and the predictive accuracy of the model for the training sample was 78.10%. There was no multicollinearity exist between independent variables; the values for tolerance were more than 0.1, and VIF was less than 10 for each variable. The significant determinants for engagement of physical activity of the Patients with FH were the intention to perform (B=2.213; AOR=9.145; p=0.020) and the level of barrier (B=-1.892; AOR=0.151; p=0.002).

Table 2: Engagement with Physical Activity and Possible Contributing Factors

Variable:	Physical activity	
	Yes	No
Sociodemography		
Age	38(49.5 ±13.2)	58(49.9 ± 9.3)
Gender		
Female	12(30.8%)	24(41.4%)
Male	27(69.2%)	34(58.6%)
Marital status		
Ever married	35(89.7%)	55(94.8%)
Unmarried	4(10.3%)	3(5.2%)
Education		
Pre-university and university	34(61.8%)	11(26.8%)
Secondary	17(30.9%)	27(65.9%)
Primary and below	4(7.3%)	3(7.3%)
Income (RM)		
<3000	21(53.8%)	32(55.2%)
3001-10000	17(43.6%)	18(32.1%)
>10000	1(2.6%)	8(13.8%)
Illness Characteristics		
CVD		
Presence	15(87.2%)	26(44.8%)
Absent	24(12.8%)	32(55.2%)
Receiving FH Treatment *		
Yes	22(56.4%)	45(77.5%)
No	17(43.6%)	13(22.4%)
Comorbidity		
Single	14(93.3%)	20(71.4%)
Presence	1(6.7%)	8(28.6%)
Risk Factors		
Single	17(85,0%)	23(71.9%)
Multiple	3(15.0%)	9(2.8%)
Psychological element in the Theory of Planned Behaviour		
Subjective norms		
Yes	38(97.4%)	55(96.5%)
No	1(0.6%)	2(3.5%)
Perceived behavioural control		
Yes	37(94.9%)	55(98.2%)
No	2(5.1%)	1(1.8%)
Attitude		
Good	39 (100.0%)	56 (96.6%)
Bad	0 (0%)	2 (3.4%)
Excited	39 (100.0%)	55 (58.5%)
Boring	0 (0%)	3 (100%)

Fun	39 (100.0%)	53 (94.8%)
Unpleasant	0 (0.0%)	5 (5.2%)
Intention**		
Yes	37(68.3%)	40(95.2%)
No	18(32.7%)	2(4.7%)
Family Support		
Yes	35(89.7%)	45(77.6%)
No	4(10.3%)	13(22.4%)
Level of Barrier**		
Low	34(87.2%)	28(48.3%)
High	5(12.8%)	30(51.7%)

*Chi-square tests were used in the analyses of associations between engagement with physical activity and the possible determinants except for age. Yates corrections were performed when the cell frequency was less than 10. * p-value <0.05.; ** p-value <0.01.*

3.6 Contributing Factors for Taking Healthy Diet

There were significant associations between taking healthy diet and the status of receiving treatment and the level of barrier. Patients with FH taking healthy diet were significantly higher ($X^2(1)$ =8.107; p=0.004) among those who were receiving treatment (n=57;78.8%) than those who were not (n=14;21.2%). Those who were taking healthy diet were also significantly higher (X^2 (1) =7.822; p=0.005; Yates correction:(X^2 (1) =6.465; p=0.011) among Patients with FH who had low level of barrier (n=55;83.3%) than those who had high level of barrier (n=11;16.7%). Refer to Table 3 for further details.

In the model development, we included gender, age, total household income, presence of CVD, the status of receiving treatment, and level of barrier in the analysis. The Omnibus test for model coefficient showed that the model was significant (X^2 (6) = 19.086; p<0.001; the NagelkerkeR^2=0.257; Cox & Snell R^2=0.182) and the predictive accuracy of the model for the training sample was 75.80%. There was no multicollinearity exist between independent variables; the values for tolerance were more than 0.1, and VIF was less than 10 for each variable. The significant determinants for taking healthy diet in Patients with FH were the status of receiving treatment (B=1.376; AOR=3.961; p=0.024) and the level of barrier (B=-1.650; AOR=0.192; p=0.003).

Table 3: Status of Taking Healthy Diet and Possible Contributing Factors

Variables	Healthy Diet	
	Yes	No
Sociodemography		
Age	38(49.5 ±13.2)	58(49.9 ± 9.3)
Gender		
Female	12(30.8%)	24(41.4%)
Male	27(69.2%)	34(58.6%)
Marital status		
Ever married	35(89.7%)	55(94.8%)
Unmarried	4(10.3%)	3(51.7%)
Education		
Pre-university and university	34(61.8%)	11(26.8%)

Secondary	17(30.9%)	27(65.9%)
Primary and below	4(7.3%)	3(7.3%)
Income (RM)		
<3000	21(53.8%)	32(55.2%)
3001-10000	17(43.6%)	18(31.0%)
>10000	1(2.6%)	8(13.8%)
Illness Characteristics		
CVD		
Presence	31(47.0%)	10(33.3%)
Absent	35(53.0%)	20(66.7%)
Receiving FH Treatment *		
Yes	52(78.8%)	15(50.0%)
No	14(21.2%)	15(50.0%)
Comorbidity		
Single	26(81.3%)	8(72.7%)
Presence	6(18.7%)	3(27.3%)
Risk Factors		
Single	31(77.5%)	9(75.0%)
Multiple	9(2.25%)	3(25.0%)
Psychological element in the Theory of Planned Behaviour		
Subjective norms		
Yes	64(97.0%)	28(96.6%)
No	2(3.0%)	1(3.4%)
Perceived behavioural control		
Yes	64(97.0%)	28(93.3%)
No	2(3.0%)	2(6.7%)
Attitude		
Good	66 (71.7%)	26 (86.7%)
Bad	0 (0%)	4 (13.3%)
Excited	64 (98.5%)	25 (83.3.1%)
Boring	1 (1.5%)	5 (16.7%)
Fun	62 (96.8%)	24 (80.0%)
Unpleasant	2 (3.1%)	6 (20.0%)
Intention		
Yes	64(97.0%)	22(73.3%)
No	2(3.0%)	8(26,7%)
Family Support		
Yes	62(94.0%)	23(79.3%)
No	4(6.0%)	6(20.6%)
Level of Barrier**		
Low	55(83.3%)	17(56.7%)
High	11(16.7%)	13(43.3%)

*Chi-square tests were used in the analyses of associations between taking healthy diet and the possible determinants except for age. Yates corrections were performed when the cell frequency was less than 10. * p-value <0.05.; ** p-value <0.01.*

4.0 Discussion

This study highlighted the possible factors that influence the lifestyles of patients with FH is essential to inform clinicians of further interventions for their patients. In our study, barriers prevented our patients with FH from performing healthy lifestyles. Though about two-thirds

did not describe any difficulties in performing physical activity or taking healthy diet, other participants in our study complained of external factors (such as bad weathers, friends and family problems) as parts of the hurdles. They also described internal factors (such as being lazy, poor time management, poor self-control) played as important hurdles for healthy lifestyles. These findings were supported by other researchers which indicated that, in terms of physical activity and managing weight problem, the main barriers in performing exercise and physical activity include lack of family and friend's involvement, poor weather, lack of discipline and suitable time as well as a financial problem (Ibrahim et al., 2013). For healthy diet intake, factors such as time, food taste and price were suggested to be the main challenges to comply towards dietary counselling (Sulaiman et al., 2016). Hence, it is critical to minimise barriers to ensure that patients with FH maintain their lifestyle behaviour and modification.

In a study examining the barriers experienced by patients with hyperlipidaemia, a group of health providers have divided the barriers into; i) provider barriers (including poor tracking and patient follow-up, poor understanding of guidelines and the literature, controversy over guideline recommendations, poor understanding of patient needs, and inadequate training in facilitating behavioural change in patients); ii) patient barriers (including poor adherence to referrals, asymptomatic nature of the diseases, linguistic and cultural difficulties, psychosocial challenges blunting efforts to adhere, poor patient's acceptance of the disease, and difficulty of lifestyle changes); and iii) practice/system barriers (including poor multidisciplinary cooperation, documentation burdens, difficulty educating patients at the right educational level, and difficulty coordinating care with the hospital) (Cook et al., 2006). Addressing all these barriers is crucial for the comprehensive management of patients with FH.

Previous experts in psychology have suggested through their proposed theory of the associations between intention and lifestyle behaviour (Fishbein, 1980; Fishbein&Ajzen, 1975; Ajzen, 1985, 1991; Triandis, 1980; Rogers, 1983). Our study supported this link and suggested that patients with FH should have sturdy intention in order to perform physical activities. In other study investigating lifestyle of patients with FH using the integrated psychological model, Hagger and colleagues (2016) have demonstrated that not only the intention but also attitude plays as an essential mediator for lifestyle changes in patients with FH. Given the importance of intention in behavioural modification strategy, clinicians in particular health psychologist should enhance patients with FH understanding of this psychological element when providing counselling on the self-management support service for patients with FH.

We also found that the lifestyle of our patients with FH associates to their illness condition, i.e. their status of receiving treatment. It is easy to assume that those patients with FH who were receiving treatment were among those who have good insight and awareness of the needs for treatment (Eriksson et al., 2006). Perhaps, the intermediating factor is the anxiety of having the consequences may motivate Patients with FH who were receiving treatment to have an improved lifestyle. Patients with FH who received treatment may have continuous counselling on the need for healthy lifestyle every time they visit the clinic for regular

consultations. It is crucial for clinicians to provide counselling on both adherence to medications and a healthy lifestyle as part of the intervention for patients with FH.

The results of this study also supported and added to other determinants that were found by other researchers who examined the lifestyle of general populations (Chan et al., 2015; Cheah&Poh, 2014). In their studies, other factors contributing to lifestyles include age, income, gender, education, marital status, region, house locality, job characteristics, and medical conditions have been suggested (Cheah&Poh, 2014). In order to ensure patients with FH have the optimum quality of life, apart from practising health lifestyle, Patients with FH should also have equipped themselves with positive perceptions and enough knowledge on the illness itself and its complications (Razali et al., 2019).

5.0 Conclusion and Recommendations

We highlighted that patients with FH who engaged with physical activity are those who are receiving treatment, experiencing a low level of barrier and have the intention to perform physical activities. Patients who are receiving treatment and experiencing a low level of barrier are also more likely to take a healthy diet. FH. It is crucial to minimise the barriers and enhance the counselling that instilling psychological resilience, in particular, increasing the intention of performing healthy lifestyles. Further in-depth studies to understand both these elements are crucial. Clinicians should be aware of these elements to ensure effective advice for lifestyle modification of patients with FH. Nonetheless, the results should be interpreted with care because this study is limited with a small sample size, and we used self-perception in describing the level of engagement with physical activities and taking healthy diet. Furthermore, there are many other cultural beliefs and perceptions that may not be captured by the questionnaires that may influence the lifestyles of patients with FH. In future, more improvement in the study methods is required for more impactful findings.

Acknowledgement

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