Stages of change and health-related quality of life among employees of an institution

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Abstract

Background Transtheoretical Model of change has been used successfully in promoting behaviour change.

Objective To examine the relationships between health-related quality of life (HRQoL) scores with the stages of change of adequate physical activity and fruit and vegetables intake.

Design This was a cross-sectional study conducted among employees of the main campus and Engineering campus of Universiti Sains Malaysia (USM) during October 2009 and March 2010. Main variables studied: Data on physical activity and fruit and vegetable intake was collected using the WHO STEPS instrument for chronic disease risk factors surveillance. The Short Form-12 health survey (SF-12) was used to gather information on participants' HRQoL. The current stages of change are measured using the measures developed by the Pro-Change Behaviour Systems Incorporation. Statistical analysis: One way ANOVA and its non-parametric equivalent Kruskal-Wallis were used to compare the differences between SF-12 scores with the stages of change.

Results A total of 144 employees were included in this analysis. A large proportion of the participants reported inadequate fruits and vegetable intake (92.3%) and physical activity (84.6%). Mean physical and mental component scores of SF-12 were 50.39 (SD = 7.69) and 49.73 (SD = 8.64) respectively. Overall, there was no statistical significant difference in the SF-12 domains scores with regards to the stages of change for both the risk factors.

Conclusions There were some evidence of positive relationship between stages of change of physical activity and fruit and vegetable intake with SF-12 scores. Further studies need to be conducted to confirm this association.

Background

A number of risk factors (RF) have been associated as being the cause of chronic diseases. Among which are physical inactivity and inadequate fruit and vegetable intake. Most of the reported studies conducted in the Western countries supported the role these two RF played against the occurrence of chronic diseases, particularly cardiovascular diseases.[1–5]

These behavioural RF are modifiable and several health behaviour models have produced much success in changing these behaviours. One of the behaviour models is the transtheoretical model of change which was developed by *Prochaska and DiClemente*. The main construct of this model is the stages of change which characterize a person's readiness to make changes to their current behaviour. According to this model, behaviour changes occur in stages and different interventions are required at each stage of change. The five stages are precontemplation (PC), contemplation (C), preparation (P), maintenance (M) and action (A).[6,7]

Transtheoretical model has been applied successfully in a wide range of health behaviour interventions. Numerous interventions targeting physical activity have produced positive outcomes on increasing the amount of physical activity in the intervention group.[8–14] However, behavioural interventions based on stages of change principles produced mixed results for increasing fruit and vegetable intake.[10,12,14–17]

Much attention has been placed on the clinical aspect of behavioural RF, and the social aspects of it were often neglected. It was found that behaviour modification not only lower mortality and morbidity but also improves the health-related quality of life (HRQoL) of an individual.[18] Short Form 36-item Health Survey (SF-36) instrument and its shorter versions are commonly used in evaluating the effect on HRQoL of health promotion activities.[19] Eight domains were being measured by SF-36, and these domains are divided into physical component score (PCS) and mental component score (MCS). Physical functioning (PF), role physical (RP), bodily pain (BP) and general health (GH) are grouped under PCS, while vitality (VT), social functioning (SF), role emotional (RE) and mental health (MH) are grouped under MCS. When compared with SF-36, Short Form 12-item Health Survey (SF-12) was shown to be able to reproduce at least 90% of the variance in PCS and MCS in large sample studies.[20–24]

An extensive literature search found very few published articles on the relationships between stages of change and HRQoL scores. The available literature mainly studied on physical activity only. Two studies reported positive association between stages of change for regular exercise and HRQoL scores. Those who were in the earlier stages reported lowest quality of life scores.[25,26] One will expect that the HRQoL will improve along the continuum of the stages of change. As physical activity and fruit and vegetable intake improve, physical and mental health is expected to improve and hence an improvement in HRQoL. Results from the current analysis will help to provide a clearer picture on this relationship of both the RF.

Such findings are very useful especially for intervention that seeks to modify risky behaviours. Positive results from this analysis will further justify the benefits of behavioural interventions using stages of change principles to modify unhealthy behaviour and improve HRQoL. Further analysis on the differences in outcomes in terms of socio-demographic characteristics is useful for targeted intervention within an institution so that the scarce resources can be maximized. Therefore, the present study aimed to assess the effect of one's willingness to change in physical activity and dietary habits on their HRQoL scores.

Objective

The objective of the analysis was to examine the relationships between HRQoL scores with the different stages of change of adequate physical activity and fruit and vegetables intake.

Methods

This was a cross-sectional study involving employees of Universiti Sains Malaysia (USM). Mass electronic mail and letters were sent to all

employees of the main campus and Engineering campus of USM, inviting them to participate in a health promotion programme. This report is a sub-analysis of the baseline results obtained from this health promotion programme.

Participants were required to fulfil the following criteria: not on medication for hypertension, diabetes or dyslipidaemia, thyroid abnormalities, chronic heart problem and not pregnant.

All data were collected between October 2009 and March 2010 using one-to-one interview technique. Three instruments were used for data collection in this study. These were the WHO STEPS instrument for chronic disease risk factors surveillance, SF-12 and stages of change questionnaires.

The WHO STEPS instrument for chronic disease risk factors surveillance questionnaire comprises 99 questions, which aims to collect socio-demographic data as well as four behavioural (tobacco use, alcohol consumption, fruit and vegetable intake and physical activity) and four physiological (overweight/obesity, blood pressure, blood glucose and lipid levels) RF. Participants were required to self-report their number of servings of fruit and vegetable intake and amount of time spent on moderate or vigorous intensity recreational or leisure activity. 'Show cards' were used during administration of the questionnaires to further clarify the meaning of the number of servings of fruit and vegetable intake as well as intensity of the physical activity.

The SF-12 is a generic HRQoL instrument that aims to obtain information on one's perception of health status in the past 4 weeks. Ware *et al.* (2008) provided a norm-based scoring method that is based on the general United States population with a mean of 50 and standard deviation of 10.[19]

The current stages of change are measured using the measures developed by the Pro-Change Behaviour Systems Incorporation (©2008 Pro-Change Behaviour Systems, Inc., Kingston, RI, USA).[27] The algorithm in determining one's current stage was presented in Fig. 1. Prior to determining the participants' willingness to change a behaviour, the criterion for acceptable behaviour was informed to the participants.[27] These criteria were derived from existing clinical practice guidelines.[28–35]

These questionnaires were pilot tested among 23 employees at the main campus of USM to test the acceptability and applicability of the questionnaires, both the English and translated Malay version. At the end of each interview, participants were encouraged to give their feedback on the acceptability and comprehensiveness of the questions asked.

The Cronbach's alpha for the physical health and mental health domains of the SF-12 calculated from the sample of the current analysis was 0.672 and 0.661, respectively. However, because of the single-item measure of the stages of change questionnaire, it is not feasible to calculate its internal consistency (Cronbach's alpha). The reported Cohen's kappa coefficient based on test–retest reliability of the stages of changes of physical activity was 0.52 (fair to good agreement).[36]
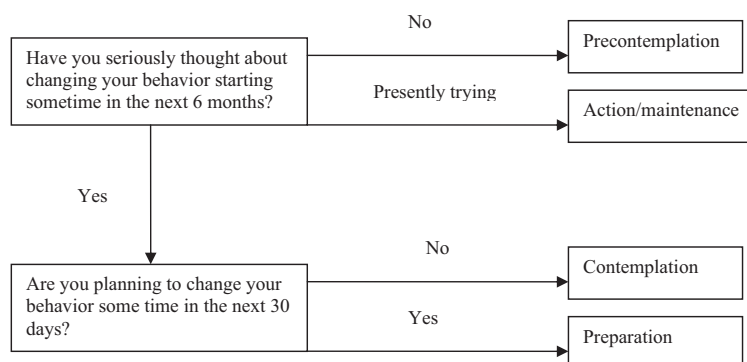

Figure 1 Algorithm for determining stages of change.

Ethical consideration

Ethical approval was obtained from the Joint Ethics committee of the School of Pharmaceutical Sciences, Universiti Sains Malaysia-Lam Wah Ee Hospital, prior to the initiation of the study. Those who agreed to participate in this study were required to give their informed consent.

Statistical analysis

Descriptive statistic was used to describe the socio-demography, stages of change as well as the SF-12 scores of the participants. Assumptions of normal distribution and equal variances were verified before inferential statistics were conducted.

Chi-squared test was used to compare the differences between gender, ethnicity, education level and monthly household income with the stages of change. Student t-test or its non-parametric equivalent Mann–Whitney test was used to analyse the difference between PCS, MCS and the eight domains of SF-12 scores with gender. One-way analysis of variance (ANOVA) or its non-parametric equivalent Kruskal–Wallis test was used to analyse the differences between SF-12 scores with ethnicity, education level, monthly household income and also the stages of change. Spearman rank correlation was used to examine the relationship between SF-12 scores with stages of changes and age.

All data were analysed using statistical software SPSS package version-16. A two-tailed P-value < 0.05 was considered statistically significant. Results from the analyses were presented with 95% confidence interval.

Results

Socio-demographic data

A total of 144 employees (3% of the total employees of the two campuses) were recruited for the health promotion intervention study. Majority of the participants were women ($n = 102$; 70.8%), Malay ($n = 126$, 87.5%) and

Table 1 Socio-demographic data of the participants ($n = 144$)

	n	%
Gender		
Male	42	29.2
Female	102	70.8
Ethnic		
Malay	126	87.5
Chinese	11	7.6
Indian and others	7	4.9
Education level		
Completed secondary school	45	31.9
Completed high school	16	11.1
Completed college/university	56	38.9
Completed postgraduate degree	26	18.1
Estimated monthly household income		
Less than MYR3000	47	32.8
Between MYR3001 and MYR4500	30	21.0
Between MYR4501 and MYR6000	29	20.3
More than MYR6001	37	25.9

Table 2 Distribution of the stages of change

Stages of change	Fruit and vegetable consumption ($n = 142$)		Physical activity ($n = 143$)	
	n	%	n	%
Precontemplation	4	2.8	18	12.6
Contemplation	54	38.0	51	35.6
Preparation	73	51.4	52	36.4
Action	3	2.1	9	6.3
Maintenance	8	5.7	13	9.1

the highest education achieved being college/university ($n = 56$, 38.9%). The mean age was 37.08 years (SD = 9.1) ranging from 21 to 57 years. The summary of the socio-demographic data of the participants was presented in Table 1.

Stages of change

A large proportion of the participants reported inadequate fruit and vegetable intake and also regular physical activity with prevalence of 92.3 and 84.6%, respectively. The stages of change in which the participants were were summarized in Table 2.

Chi-squared test found statistically significant difference between gender and stages of change

Table 3 Summary of SF-12 scores (*n* = 144)

SF-12 domain	Mean	SD	Minimum	Maximum	Ceiling effects (*n*, %)
Physical component score	50.39	7.69	17.71	71.86	0
Mental component score	49.73	8.64	25.37	70.33	0
Physical functioning	51.76	8.18	22.11	56.47	98 (68.1%)
Role physical	51.77	7.54	29.54	57.18	82 (56.9%)
Bodily pain	50.79	8.37	16.68	57.44	74 (51.4%)
General health	42.79	7.55	18.87	61.99	2 (1.4%)
Vitality	55.44	7.80	37.69	67.88	23 (16.0%)
Social functioning	48.29	9.45	26.27	56.57	70 (48.6%)
Role emotional	48.24	9.48	22.53	56.08	72 (50.0%)
Mental health	50.53	8.22	27.97	64.54	13 (9.0%)

for physical activity (*P* = 0.011). A higher proportion of men engaged in adequate amount of physical activity (26.8%) as compared with women (10.8%). As for fruit and vegetable intake, statistically significant difference was reported among the different ethnic groups (*P* = 0.021). More Chinese reported consumption of at least five servings of fruits and vegetables a day.

There was a weak and non-statistically significant correlation between age and the stages of change for both fruit and vegetable intake and physical activity with reported correlation coefficient of 0.128 and −0.120, respectively.

SF-12 scores

As for SF-12 scores, mean scores for the PCS and MCS were 50.39 (SD = 7.69) and 49.73 (SD = 8.64), respectively. The domains with the highest and lowest mean scores were VT (55.44 ± 7.80) and GH (42.79 ± 7.55), respectively. However, there was evidence of significant ceiling effects in the five domains of the SF-12 with a large proportion of the participants scoring maximum scores in PF, RP, BP, SF and RE. Table 3 presented the summary of the SF-12 scores.

There was no statistically significant difference between PCS, MCS and all the domains of the SF-12 with gender except for RE. Women scored significantly higher in RE as compared with men (49.28 vs. 45.70, *P* = 0.039).

One-way ANOVA and Kruskal–Wallis tests on the SF-12 scores found no statistically significant differences in terms of ethnicity, education level as well as monthly household income except for SF that reached statistically significant difference for educational level (*P* = 0.039). As the highest educational level achieved increased

Table 4 Correlation coefficient of the association between age and HRQoL scores

SF-12 domain	Age	Stages of change of physical activity	Stages of change for fruit and vegetable intake
Physical component score	−0.150	0.102	0.131
Mental component score	0.233*	−0.014	−0.002
Physical functioning	−0.101	0.118	0.177*
Role physical	0.115	0.004	0.066
Body pain	0.155	−0.061	0.121
General health	−0.165*	0.080	0.053
Vitality	0.092	0.028	0.036
Social functioning	0.170*	0.049	0.078
Role emotional	0.206*	−0.067	−0.069
Mental health	0.194*	0.010	0.067

HRQoL, health-related quality of life.
*Statistically significant.

SF-12 domain	Stages of change	N	Mean	SD	Minimum	Maximum	P-value
PCS	PC	4	43.25	4.77	39.00	48.68	0.085*
	C	54	49.52	8.83	17.71	69.98	
	P	73	51.43	6.87	30.58	71.86	
	A	3	48.88	1.91	47.75	49.69	
	M	8	52.76	5.37	46.29	62.96	
MCS	PC	4	49.49	3.99	44.54	53.33	0.954[†]
	C	54	50.10	9.26	25.37	70.33	
	P	73	49.20	8.88	30.11	68.20	
	A	3	51.68	5.99	45.59	57.57	
	M	8	50.97	5.20	41.12	57.33	
PF	PC	4	45.73	8.22	39.29	56.47	0.125*
	C	54	50.58	9.70	22.11	56.47	
	P	73	52.47	7.17	22.11	56.47	
	A	3	56.47	0	56.47	56.47	
	M	8	55.40	3.04	47.88	56.47	
RP	PC	4	45.66	5.95	38.75	52.57	0.147*
	C	54	52.24	7.54	29.54	57.44	
	P	73	52.07	7.39	29.54	57.18	
	A	3	46.43	11.60	34.14	57.18	
	M	8	54.31	5.44	43.46	57.18	
BP	PC	4	42.16	5.88	37.06	47.25	0.157*
	C	54	50.03	9.55	16.68	57.44	
	P	73	51.72	7.59	26.87	57.44	
	A	3	50.65	5.88	47.25	57.44	
	M	8	52.35	5.45	47.25	57.44	
GH	PC	4	40.97	7.55	29.65	44.74	0.784*
	C	54	42.47	8.26	29.54	61.99	
	P	73	43.56	6.32	29.56	55.52	
	A	3	39.71	8.71	29.65	44.74	
	M	8	43.12	10.23	29.65	61.99	
VT	PC	4	55.30	5.03	47.75	57.81	0.920*
	C	54	55.18	8.33	37.69	67.88	
	P	73	55.33	8.00	37.69	67.88	
	A	3	54.46	5.81	47.75	57.81	
	M	8	57.81	5.38	47.75	67.88	
SF	PC	4	43.95	5.05	36.37	46.47	0.509*
	C	54	47.96	10.26	26.27	56.57	
	P	73	48.13	9.37	26.27	56.57	
	A	3	53.20	5.83	46.47	56.57	
	M	8	51.52	7.63	36.37	56.57	
RE	PC	4	44.92	6.43	39.30	50.49	0.377*
	C	54	49.50	10.00	22.53	58.45	
	P	73	47.42	9.51	22.53	56.08	
	A	3	46.76	8.54	39.30	56.08	
	M	8	50.49	6.68	39.30	56.08	
MH	PC	4	49.30	3.52	46.25	52.35	0.876*
	C	54	49.87	8.58	27.97	64.54	
	P	73	50.93	8.41	34.06	64.54	
	A	3	54.38	7.04	46.25	58.45	
	M	8	50.83	6.31	40.16	58.45	

Table 5 Analysis of SF-12 with stages of change for fruit and vegetable consumption

BP, bodily pain; GH, general health; MCS, mental component score; MH, mental health; PC, pre-contemplation; PCS, physical component score; PF, physical functioning; RE, role emotional; RP, role physical; SF, social functioning; VT, vitality.

*Kruskal–Wallis test.

[†]ANOVA.

Table 6 Analysis of SF-12 with stages of change for physical activity

SF-12 domain	Stages of change	N	Mean	SD	Minimum	Maximum	P-value
PCS	PC	18	50.34	6.61	38.54	62.96	0.620*
	C	51	49.49	1.11	17.71	69.98	
	P	52	50.46	8.29	21.88	71.86	
	A	9	52.90	8.17	33.83	61.79	
	M	13	51.24	5.29	39.00	57.07	
MCS	PC	18	49.55	8.28	31.05	60.27	0.989[†]
	C	51	50.03	9.74	25.37	70.33	
	P	52	49.51	8.51	30.11	67.81	
	A	9	48.89	7.65	34.21	56.74	
	M	13	50.60	6.79	34.90	61.28	
PF	PC	18	50.74	8.33	30.70	56.47	0.731*
	C	51	50.91	9.06	22.11	56.47	
	P	52	52.18	8.07	22.11	56.47	
	A	9	53.61	6.07	39.29	56.47	
	M	13	53.17	6.60	39.29	56.47	
RP	PC	18	52.57	7.90	34.14	57.18	0.786*
	C	51	51.40	7.31	34.14	57.44	
	P	52	51.60	8.13	29.54	57.18	
	A	9	53.08	8.13	38.75	57.18	
	M	13	52.22	6.08	38.75	57.18	
BP	PC	18	52.35	9.41	26.87	57.44	0.201*
	C	51	50.21	9.15	16.68	57.44	
	P	52	49.99	8.09	26.87	57.44	
	A	9	55.18	4.49	47.25	57.44	
	M	13	50.39	6.42	37.06	57.44	
GH	PC	18	41.50	8.58	29.54	61.99	0.466*
	C	51	43.26	6.68	29.65	57.81	
	P	52	41.92	8.58	18.87	61.99	
	A	9	43.78	9.22	29.65	55.52	
	M	13	45.57	2.99	44.74	55.52	
VT	PC	18	56.14	7.12	47.75	67.88	0.726*
	C	51	54.83	9.06	37.69	67.88	
	P	52	55.49	7.08	37.69	67.88	
	A	9	53.34	8.88	37.69	67.88	
	M	13	57.81	5.81	47.75	67.88	
SF	PC	18	47.59	9.73	26.27	56.57	0.852*
	C	51	47.05	10.95	26.27	56.57	
	P	52	49.38	8.56	26.27	56.57	
	A	9	49.84	8.75	36.37	56.57	
	M	13	48.02	6.96	36.37	56.57	
RE	PC	18	49.25	10.43	28.12	56.08	0.776*
	C	51	48.78	9.16	28.12	58.45	
	P	52	47.59	9.94	22.53	56.08	
	A	9	49.87	9.86	33.71	56.08	
	M	13	47.49	7.78	33.71	56.08	
MH	PC	18	49.30	8.43	34.06	58.45	0.722*
	C	51	51.04	9.23	27.97	64.54	
	P	52	50.00	7.93	34.06	64.54	
	A	9	49.64	7.53	40.16	64.54	
	M	13	52.82	5.82	46.25	64.54	

BP, bodily pain; GH, general health; MCS, mental component score; MH, mental health; PC, precontemplation; PCS, physical component score; PF, physical functioning; RE, role emotional; RP, role physical; SF, social functioning; VT, vitality.

*Kruskal–Wallis test.

[†]ANOVA.

from completed high school to completed postgraduate studies, the scores for SF domain increased progressively.

There was a statistically significant association between age with MCS, GH, SF, RE and MH. A summary of the correlation coefficient and its *P*-value was shown in Table 4.

Association between SF-12 scores and stages of change

None of the correlation between stages of change and SF-12 scores was statistically significant except between PF and stages of change for fruit and vegetable intake as shown in Table 4.

Overall, there was no statistically significant difference in the SF-12 domains scores with regards to the stages of change for fruit and vegetable intake and also for physical activity. A summary of the distribution of SF-12 scores across the stages of change was presented in Table 5 and Table 6.

Nevertheless, further analysis on the trend of SF-12 scores with regards to the stages of change of fruit and vegetable intake found that there was an increasing trend on the SF-12 scores as the intention to change increased, for PCS and three of the SF-12 domains (PF, BP and SF). As for the MCS and the other domains (RP, GH and MH), an increasing trend was observed with some exception, whereby there was a sharp decreased in the scores mostly at the latter stages of the stages of change continuum. However, the effect of fruit and vegetable intake on MCS domains such as VT and RE is negligible with no trend observed.

When analysis was conducted on the distribution of SF-12 scores with regards to the stages of change of physical activity, an increasing trend was observed for PCS, PF and GH as the intention to change increased. Other domains showed increasing trend, to some extent. However, MCS and a few of its domains showed a decreasing trend. The decreasing trend was observed along the stages of change continuum for MCS, VT, MH and RE with a sharp increase in scores at the 'Maintenance' or 'Action' stage.

Discussions

Vast evidence has supported the importance of behavioural changes in reducing the risk of chronic diseases. Apart from smoking cessation, increasing physical activity and fruit and vegetable intake are equally important and commonly reported in studies conducted in the Western countries, less so in Malaysia.[1,2,4,5] The current recommendation for physical activity is at least 30 min of physical activity most days of the week, while for healthy diet is the consumption of five servings of fruits and vegetables in a day (preferably two servings of fruits and three servings of vegetables).[28,34,37] In fact, the prevalence of these two RF in Malaysia was at an alarming rate that immediate action should be taken to encourage Malaysians to change these behaviours. A nationwide survey carried out in 2006 to study the prevalence of chronic diseases RF reported that unhealthy diet and physical inactivity were the two most common RF among the 2572 respondents with reported prevalence of 72.8 and 60.1%, respectively.[38] Similarly, the Third National Health and Morbidity Survey which recruited more than 34 539 participants reported a shocking 43.7% of the participants who were not physically active. However, data on diet intake were not collected in this survey.[39] Thus, this analysis is timely as knowledge obtained might be useful when planning behavioural changes initiatives.

Less than 20% of the participants reached the recommended requirement for fruit and vegetable intake and physical activity. Two studies reported approximately 25% of the participants achieving target amount of physical activity.[26,40] However, there were inconsistencies in the definitions of adequate physical activity. In the case of the study conducted by Lee *et al.* (2006),[26] the definition of adequate physical activity is at least 20 min of exercise for 3 days a week. In our case, we adopted the definition from latest primary prevention clinical practice guidelines which recommended at least 30 min of physical activity for 5 days a week.[34,41] Similarly for fruit and vegetable intake, the reported prevalence (7.9%) of inadequate consumption was much

lower than existing studies. Most of the studies reported close to 50% of participants not achieving required target, including a study conducted by Lew and Barlow (2005).[42–44] However, there were inconsistencies in the collection of data on fruit and vegetable intake. Some used food diary and checklist. In this case, responses were based on participant's recall on their fruit and vegetable intake.

As expected, men was the more active group in terms of physical activity.[45] Statistically significance differences in fruit and vegetable intake among different ethnic groups were not supported by existing report.[42]

Mean PCS and MCS in this sample were very similar to the ones of general US population.[19] Similarly, the high ceiling effects seen with the five SF-12 domains (PF, RP, BP, SF and RE) were also frequently reported elsewhere.[25,26,46] However, the domains with the highest and lowest scores in our study differed from those reported elsewhere.[25,26]

A positive correlation was found between age with MCS, GH, SF, RE and MH. Similar results were reported whereby a positive association between age and mental health was seen.[25,26,46] Even though older age is often associated with lower levels of cognitive function, numerous studies have reported slight improvement in mental health in older subjects.[47–49] Walker (2005) provided some insight into the association between HRQoL and old age.[50] According to him, HRQoL is an outcome of combination of life course factors and immediate situational ones. Apart from cognitive function, other themes that were found to have an impact on HRQoL were social relationship, social roles and social activities, health, psychological well-being and financial circumstance.[50] However, it would be expected that physical domains of HRQoL deteriorated in older individuals.[48,49]

No statistically significant difference was reported between stages of change and SF-12 scores for both RF studied. Fruits and vegetables are rich in vitamins, minerals and fibre which are known to reduce the risk of chronic diseases, cancers as well as weight gain.[37] There were mixed reports on the effect of improving fruit and vegetable intake on physical and mental health.[51–53]

The benefits of physical activity were enormous, including reducing the risk of various chronic diseases and cancers, help in maintaining a healthy weight and improving mood and thus release tension and anxiety.[37] Thus, it was expected that adequate amount of physical activity should improve both the physical and mental domains of the SF-12 as reported by studies conducted elsewhere.[25,26,53] However, this was not observed in our study especially for the MCS and some of its domains scores.

Limitations and Recommendations

The limitations while carrying out this study should be taken into account when considering the results of this analysis. The small number of samples included for this analysis, resulting in an unequal distribution of participants in several of the categories being studied. The longitudinal study could have given a better picture on the effect of stages of changes progression on the HRQoL. Lastly, generalizability of the results of this study among Malaysians might be doubtful as we only recruit sample from a localized university environment. However, this analysis can be used as a pilot study prior to conducting a nationwide study on similar issue.

Conclusions

This study found that there are some evidence of positive relationship between stages of change of physical activity as well as fruit and vegetable intake with HRQoL scores. Further studies with a larger sample size need to be conducted to confirm this association.

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Competing interests

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