become a significant problem among elderly worldwide [5, 6]. In Malaysia, findings from the recent National Health and Morbidity Survey, NHMS, in 2015 showed that approximately 52.35% of older adults aged 60 years and above were overweight and obese [7].

Existing evidence indicated that several factors may have influence on nutritional status and healthy eating habit among elderly in the community. Oral health, as one of the associated factors, plays an important role in nutritional intake of older people. Poor oral health may expose the group at risk to underweight [8] or obese [9]. Reduced number of teeth and posterior occluding teeth among this group also had shown to affect their chewing ability leading to altered food choices and compromised nutritional status [10]. In addition to the clinical indicators, the impact of poor oral health on dimensions of quality of life also has been more pronounced among older people. Compromised dentition can lead to functional limitation (trouble biting and chewing food), psychological impacts (uncomfortable eating in front of others), pain and discomfort (discomfort when eating) and behavioural impacts (limit kinds or amount of foods) [11].

In recent decades, researchers have included the subjective assessment of psychological and social impacts as part of the analysis of oral health and nutritional status. Therefore, the oral health-related quality of life (OHR-QoL) instruments can complement the objective clinical measurements and be used as a predictor of malnutrition in the aged population [12]. The Geriatric Oral Health Assessment Index, GOHAI, is one of the OHR-QoL measurements that has been widely used in studies on self-perception of oral health among older population [13]. The internal consistency and validity of GOHAI have been shown to be satisfactory in several languages like Arabic, Japanese and Malay studies [14–16]. Several researchers have also used GOHAI when assessing the association between the impacts of oral conditions to nutritional status, as each of the GOHAI dimension focus on problems related to diet and nutrition like trouble biting or chewing food, discomfort when eating, uncomfortable eating in front of people and limit kinds or amounts of food [12, 17].

Body mass index, BMI, has been widely used for assessing the nutritional status of older adults in epidemiological studies [18, 19]. It is considered as the most practical tool because of its simplicity and low cost [20]. Furthermore, BMI classification of body size like overweight and obese had contributed to increase in awareness of fatness problem, leading to more successful epidemiological and intervention research related to health outcomes [21].

As both oral health and nutritional status are strongly related to healthy behaviours, it is hypothesised that those who have poorer oral health may be less likely to be conscious about their diet. Therefore, the aim of this study was to assess the association between oral health-related quality of life and nutritional status among a group of community-dwelling older adults in the district of Kuala Pilah.

Methods

This cross-sectional study was conducted in the district of Kuala Pilah, Negeri Sembilan. The state of Negeri Sembilan is located at the west coast region of Peninsular Malaysia. Negeri Sembilan comprised of seven districts and is known to have a heterogeneous population in terms of ethnic groups and rural-urban distribution. Based from the 2010 Census of Malaysia, 19.1% of the population in Negeri Sembilan are older adults aged 50 years and above [1]. The district of Kuala Pilah was chosen as it has the highest percentage of older adults more than 50 years of age (25.8%; $n = 16,499$) among other districts in Negeri Sembilan.

Individuals aged 50 years and above, Malaysian, had been living in the selected areas for at least one year and could communicate clearly in Bahasa Malaysia were included in this study. Global studies on health and aging in several lower and upper-middle countries have also included aging adults aged 50 years and above as their respondents [22]. Those who were mentally ill and with other conditions that could affect the history taking and anthropometric measurements were excluded.

Based on a formula [23] used to calculate the adequate sample size in cross-sectional studies, $n = z^2 \times P(1-P)/d^2$, where n is the sample size, z is the level of confidence at 95%, P is the estimated prevalence (51% prevalence of unsatisfactory body mass index among older adults) [24], and d is precision of 5%, the estimated sample size was 384. With estimation of 15% non-response subjects, a sample size of 442 was required for this study.

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and all the respondents provided written informed consent. Data gathered included socio-demographic characteristics, oral health status, oral health-related quality of life and body mass index.

Socio-demographic and oral health-related quality of life
Data on socio-demographic and oral health-related quality of life were attained from the face-to-face questionnaire interview. Demographic variables involved items such as gender, age, ethnic group, educational level, living arrangement and medical conditions like hyper-

proportion of the respondents (74.2%) had poor perception (GOHAI < 57) of oral health. Only 8.1% obtained a maximum score of 60, indicating no impact from oral conditions.

The mean BMI was $26.3\,\text{kg/m}^2$ (SD 4.6). Majority of the respondents were overweight and obese, 40.4 and 19.9% respectively, 35.8% had normal body mass index and only 3.9% were underweight. Table 1 presents the demographic, oral health and nutritional characteristics of the older adults.

Table 2 summarizes the differences between satisfact.07451scn.cs

Discussion

In this study, older adults with poor perception of their oral health had unsatisfactory BMI. Consistent results were also observed in other studies that evaluated the association between OHRQoL and nutritional status in older population [8, 17]. Respondents with poor GOHAI score were shown to be at risk of nutritional deficiencies. However, most of these studies used Mini-Nutritional Assessment (MNA) for measuring nutritional status, thus comparison can only be made on the risk of nutritional deficit and not the actual BMI score.

Association between impacts of oral health on the quality of life with nutritional status have been established in several studies [8, 27]. As most of the impacts were related to eating and chewing, impaired nutrients intake could be evident among the elderly group. GOHAI evaluates the impact of oral conditions on the dimensions of oral

in a couple and have high mean GOHAI score [30]. Similar findings were highlighted in an Australian study in which older adults with better perception of oral health (higher GOHAI score) were among those at least risk of malnutrition (lower MNA score) [31]. As both oral health and nutritional status are strongly related to healthy

Conclusion

In conclusion, this study suggested that older adults with poor perception of oral health were more likely to have unsatisfactory BMI. The application of oral health-related quality of life instruments together with objective clinical measurements need to be emphasized as it could be utilised as oral health predictors that might lead to impaired nutrition in the older population.

Authors' contributions

TIR, YMC, RAK and TAAH contributed equally and have read and approved the final manuscript.

Ethics approval and consent to participate

This study was approved by the Medical Research Ethics Committee, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia (UPM/FPSK/PADS/T7-MJKEtikaPer/F01(IG_Mei(10)03). Written consent were obtained from all the respondents.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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