# Nutrition and the homeless: the underestimated challenge

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### Abstract

Homelessness is present in most societies and represents a situation in which the basic needs for survival including food are often limited. It is logical to surmise that the homeless person's diet is likely to be nutritionally deficient and yet there is a relative paucity in research regarding this issue with studies varying in both their methodology and homeless population. Despite these differences, diets of the homeless are frequently characterised as high in saturated fat and deficient in fibre and certain micronutrients, all of which can have negative implications for the homeless individual's health and/or mental state. The conclusion from intervention studies is that there is no consensus as to the most effective method for assessing dietary intake. In order to address this, the present review aims to provide a greater understanding of the existing literature surrounding nutrition and the homeless and to act as a foundation from which further research can be conducted. An evaluation of the main findings and challenges surrounding the assessment of the nutritional status of the homeless will be provided followed by a review of the physical and mental consequences of the homeless diet. Current and potential interventions aimed at increasing the nutritional quality of food consumed by the homeless will be addressed with a focus on the role of the nutritional science community in assisting in this endeavour.

**Key words: Homeless: Nutrient intake: Dietary methodology: Nutrition intervention**

## Introduction

Homelessness is a global problem. In autumn 2014, over 60 000 households in England were classified as homeless[1] and a further 2744 were considered to be rough sleepers[2]. This is likely to be an underestimation given the variety of definitions used to characterise homelessness[3]. For example, the term 'statutory homeless' is used by local authorities to categorise individuals or families who are legally entitled to housing and requires the fulfilment of a number of criteria[1]. In contrast many charitable organisations, such as CRISIS UK, advocate a broader definition ranging from individuals staying in temporary accommodation to those 'sleeping rough' on the streets[3]. This wider characterisation encompasses the various homeless populations involved in research studies and so will be used to define homelessness in the present review.

For the homeless individual even the basic survival requirement of food[4] can be limited, resulting in a daily struggle both physically and mentally. The present review seeks to outline the literature on food and nutrient intake in homeless individuals and the difficulties concerning dietary assessment of this often heterogeneous and transient group. The physical and psychological issues relating to nutrient intake will be discussed followed by an examination of interventions to address nutritional deficiencies in the homeless community.

## Homelessness and nutrient intake

Studies which have attempted to determine the food and nutrient intake of the homeless can be categorised into those using either questionnaire, interview or biochemical assessment methods as outlined in Table 1[5–17]. These have provided an insight into the diets of homeless individuals but must be interpreted in light of the inherent methodological limitations of each technique.

### Questionnaire data

FFQ have been used to assess nutrient intake in the homeless. This questionnaire-based method consists of participants self-reporting their frequency and degree of consumption for a variety of food and drink items. For example, the European Prospective Investigation into Cancer and Nutrition (EPIC) Norfolk FFQ has been validated for use in individuals following a 'traditional' UK diet[5,18]. Consequently, the FFQ provides a means of attaining detailed information regarding food and drink consumed over, typically, the preceding 6 months or year[19]. The ease of administration and low cost makes the FFQ an ideal tool to use in an often transient population who may only be willing or able to provide short-term participation in a study. In Germany, FFQ data revealed a reduced consumption of fruit and vegetables in homeless adults (*n* 75) when compared with data from governmental dietary surveys of the general population[11]. Similar findings regarding low fruit and vegetable intake were found following a survey of male rough sleepers in the UK (*n* 79)[14] and homeless individuals staying in temporary accommodation in Ireland (*n* 72)[8]. Such findings demonstrate consistency in the results from FFQ between countries and highlight deviation from current recommendations of a 'healthy diet'[20]. With regard to micronutrient intake, the administration of the FFQ to seventy-one homeless families

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**Table 1.** Summary of the methodology and main nutritional results from studies investigating the nutritional status of the homeless

| Study | Location | Sample size | Homeless group | Methodology | Main nutritional results |
|---|---|---|---|---|---|
| Sprake et al. (2014)[5] | Sheffield, UK | 24 | Charitable meal services | 24 h dietary recall (n 24); interview focusing on food choice (n 12) | Compared with UK RNI: significantly lower Mg, K, Se, vitamin A and Zn intake. Compared with UK population: significantly higher contribution of non-milk extrinsic sugars and saturated fat to total energy intake |
| Kubisová et al. (2007)[6] | Prague, Czech Republic | 201 | Individuals accessing Prague's homeless day centre and homeless recruited from Prague's main railway station | Biochemical markers (n 201); anthropometric measures (n 201) | Compared with general Czech population: low levels of TAG and total cholesterol |
| Food Standards Agency (2006)[7] | Northern Ireland | 72 | Individuals staying in temporary accommodation | FFQ (n 72); interview about food sources, storage and eating habits (n 72); anthropometric measures (n 72); blood pressure (n 72) | Infrequent consumption of fish, fruit, vegetables and wholemeal products. Compared with UK DRV: higher contribution of saturated fat to total food energy. Compared with UK RNI: low iodine and vitamin A intake in men and women. Low Mg and K intake in women only |
| Hickey & Downey (2003)[8] | Dublin, Republic of Ireland | 72 | Individuals accessing night shelters or temporarily residing in hostels and bed and breakfasts. Rough sleepers accessing day centres | FFQ (n 72); interview focusing on food choice, preparation and storage (n 12); anthropometric measures (n 72) | Low consumption of fish, fruit, vegetables and wholemeal products. Compared with Irish RDA: low folate, vitamin A, D and E intake in men and women. Low Fe and Se intake in women only |
| Malmauret et al. (2002)[9] | Paris, France | 87 | Individuals accessing emergency shelters in Paris | 24 h dietary recall (n 87); biochemical markers (n 71) | Serum vitamin C below recommended level in 95 % of subjects. Compared with French DRV: low Ca, vitamin $B_1$, C and E intake in men and women. Low Fe, Mg, vitamin $B_6$ and $B_{12}$ intake in women only |
| Darmon et al. (2001)[10] | Paris, France | 97 | Individuals accessing emergency shelter for homeless men | 48 h dietary recall (n 97); anthropometric measures (n 97) | Compared with European population DRV: low Ca, niacin, K, vitamins $B_1$ and $B_2$, and Zn intake |
| Langnäse & Müller (2001)[11] | Kiel and Hamburg, Germany | 75 | Individuals accessing homeless centres | FFQ (n 75); anthropometric measures (n 75); heart rate, blood pressure (n 75) | Compared with German Society of Nutrition recommendations: low consumption of rice, noodles and fresh fruit and vegetables |
| Evans & Dowler (1999)[12] | London, UK | 423 | Rough sleepers and individuals living in temporary accommodation (hostels, friends' floors) | FFQ (n 420); 24 h dietary recall (n 423) | Low consumption of fruit, vegetables and wholemeal products. Compared with UK DRV: higher contribution to total energy of non-milk extrinsic sugars, total fat and saturated fat. Compared with UK RNI: low K, Se, vitamins A, C and E, and Zn intake in men and women. Low Ca, folic acid, iodine, Fe and Mg intake in women only |
| Silliman et al. (1998)[13] | Northern California, USA | 75 | Individuals accessing emergency feeding sites | 24 h dietary recall (n 75); biochemical markers (n 42); anthropometric measures (n 75) | Elevated serum cholesterol in 40 % of subjects. Compared with US RDA: low energy, fibre, Ca, Mg, Se and Zn intake |
| Rushton & Wheeler (1993)[14] | London, UK | 79 | Rough sleepers using drop-in centres and soup runs | FFQ (n 79); 24 h dietary recall (n 79) | Low consumption of fruit, vegetables, salad, fruit juice and wholemeal products. Compared with UK recommendations: low energy, carbohydrate, folate, NSP, Mg and Zn intake. Elevated Ca, Fe, protein, total fat and vitamin $B_{12}$ intake |
| Wiecha et al. (1993)[15] | Boston, USA | 71 | Homeless families temporarily staying in shelters and hotels | FFQ (n 71) | Compared with US RDA: low Ca, Fe and vitamin $B_6$ intake |
| Wolgemuth et al. (1992)[16] | Florida, USA | 277 | Individuals accessing homeless shelters | 24 h dietary recall (n 277); anthropometric measures (n 277) | Compared with US RDA: significantly lower energy, Ca, vitamin $B_6$ and Zn intake |
| Luder et al. (1989)[17] | New York, USA | 55 | Individuals temporarily housed through a homeless programme run by St Vincent's hospital and medical centre. Individuals using drop-in homeless centres | Sixteen-point dietary score (n 55); 24 h dietary recall (n 11); biochemical markers (n 17); anthropometric measures (n 55) | Elevated serum cholesterol in 92 % of subjects. Compared with US RDA: low Ca, Fe, Mg, B vitamins and Zn intake |

RNI, reference nutrient intake; DRV, dietary reference value.

in Boston reported low levels of vitamin $B_6$, Ca and Fe when compared with the recommended daily allowances[15]. However, the study consisted of families temporarily residing in hotels or shelters and so limits the extent to which such findings are reflective of the single homeless individual. Additionally, recall and social approval bias[21,22] issues of under-reporting[23] and a poor to moderate[24–27] correlation with biochemical markers are considered to reduce the accuracy of FFQ data.

As an alternative to the FFQ, advocates of 24 h dietary recall argue that this method results in a more accurate reflection of dietary intake[28,29]. Consistency in the nutrient intake of homeless individuals from different studies using 24 h recall has been demonstrated and acts to enhance the reliability of such results. For example, Evans & Dowler[12] reported mean saturated fat intakes above the recommended percentage of energy contribution in a group of London homeless following 24 h dietary recall ($n$ 420), a situation which has also been shown in New York ($n$ 11)[17] using this method. In terms of micronutrients, 24 h recalls have demonstrated insufficient intake of vitamin $B_6$, Zn and Ca for 277 adults staying in an overnight shelter in Florida[16]. Despite using a broader definition of homelessness ranging from individuals accessing day centres to those residing in temporary accommodation, Luder et al.'s[17] New York study reported similar findings using 24 h recalls. In contrast, repetitive 24 h dietary recalls for twenty-four homeless individuals in Sheffield found that vitamin $B_6$ and niacin exceeded the recommended nutrient intake levels[5], a finding which has also been reported in a study using 48 h dietary recall for ninety-seven homeless men in Paris[10]. An increased intake of beer by some homeless has been postulated to account for the elevated levels of these B vitamins[10]. The potential for bias similar to that found for the FFQ[30,31] in conjunction with the presence of under-reporting[32,33] and over-reporting[34,35] highlight limitations associated with the sole use of 24 h recall for assessing the nutritional status of the homeless. Additionally, unlike the FFQ, a single 24 h recall is unable to capture variations in nutrient intake over time[21,31] which may be of particular relevance in a population whose diet is likely to be inconsistent due to their transient circumstances.

In contrast, diet diaries in which individuals prospectively record all food and beverages consumed over a defined period are considered to provide an accurate reflection of an individual's current diet[21,36]. However, limitations of this approach have been reported such as the high responder burden, need for literacy and potential reactivity to the procedure, the latter of which can result in a modification by the participant of their diet as a result of recording[37,38]. Although diet diaries have been infrequently used to assess nutritional intake in homeless individuals residing in temporary accommodation[39], the irregularity of meals and lack of food storage facilities in the street homeless arguably prohibit its use in this group. Consequently, despite their limitations, questionnaires provide a means of attaining, at the very least, an overview of the food and nutrient intake of the homeless community.

## Interview data

Interviews have been used to obtain an in-depth understanding of the issues facing the homeless, predominantly with regard to food choice. Interviews are often semi-structured to enable the participant a greater opportunity to express their views whilst maintaining a degree of control over the questioning format[40]. A recurrent theme from such qualitative data indicates that homeless individuals aspire to consume a diet containing fruit and vegetables but their food choices are constrained by low income and a lack of storage facilities[5,7]. For example, semi-structured interviews with twelve homeless men in Sheffield identified limited cooking and storage space as key drivers of their food choice and consequently a barrier to purchasing raw and perishable food items[5]. Numerous interviews have also highlighted that, despite the desire for a more balanced diet, any food is preferable to no food[5,7]. These data are a useful addition to questionnaire data by providing an insight into the beliefs and attitudes of homeless individuals, both of which need to be addressed in any subsequent nutritional intervention. For example, through interview data, the Irish Food Standards Agency found a lack of nutritional and cooking knowledge in their homeless group, resulting in the suggestion for educational programmes to address this gap[7]. However, when interpreting interview-based results it is important to acknowledge the potential for interviewer bias and the 'interviewer effect' wherein responses from the participant are influenced by their perception of the interviewer[40].

## Biochemical data

The biochemical measurement of various nutrients avoids issues of bias inherent in questionnaire techniques and accounts for individual differences in the absorption of nutrients. The invasive nature and practicalities associated with collecting blood from a largely transient homeless population raise issues regarding the use of biochemical methods to assess for biomarkers of nutrient intake. Additionally, although some biochemical measures, for example those used to assess lipid profile[41,42], are well established, others, such as serum Ca, are poorly correlated with nutritional status[43]. These factors, in conjunction with the effect that smoking, alcohol and/or substance abuse can have on plasma levels of certain nutrients such as vitamin C[44,45], potentially limit the use of biochemical data in the homeless. Nevertheless, the use of biochemical methods can provide corroboratory evidence regarding an individual's reported intake. For example, the finding of elevated serum cholesterol[17] is consistent with increased levels of saturated fat reported for the homeless population using both dietary recall[12] and FFQ[7] techniques. Consequently a mixed methodology can provide a robust means of assessing nutrient intake in the homeless[9,13,17]. For example, Malmauret et al.[9] demonstrated low vitamin C levels following both 24 h recall and blood sample analysis.

## Limitations of research into the nutrient intake of the homeless

In addition to potential weaknesses of the individual methods previously discussed, general limitations surrounding research into the dietary habits of the homeless must be acknowledged. Specifically, small sample sizes and a preponderance of males

in the homeless population and subsequent research studies[46] limit the generalisability of the data obtained. Additionally, studies on the homeless involve individuals accessing a particular service, such as homeless shelters, which raises the potential of selection bias and subsequent omission of a 'silent' demographic who may not visit or use these services[3,47]. It is feasible to surmise that such a group would be at an even greater risk of nutritional deficiencies given that food offered by charitable organizations has been consistently reported to be the main means of obtaining food by the homeless community[5,10,48]. The definition used to characterise homelessness may also influence the extent by which studies are comparable. For example, research by Rushton & Wheeler[14] focused solely on rough sleepers in London whereas Evans & Dowler's[12] London homeless group ranged from people on the street to those temporarily residing in hostels or on friends' floors. Differences in general living circumstances and subsequent access to food and storage facilities are likely to make an impact on the diets of these different groups. In the presence of a variety of homeless definitions, it is therefore important for each study to clearly outline the characteristics of their particular group in order to ensure appropriate comparisons can be made between studies.

It is also debatable as to the extent to which findings from different countries are comparable due to variation of their endogenous diets, culture and available charity services. The demonstration of reduced total cholesterol and TAG levels in the Prague homeless community[6], a finding in contrast to increased dietary saturated fat and serum cholesterol in American homeless[17], was considered by the researchers to reflect such differences between the two countries[6]. Low levels of thiamin evidenced by Darmon *et al.*[10] in their Parisian homeless group was also regarded to be indicative of the traditional French diet consisting of low levels of foods naturally high in thiamin and an absence of flour fortification, the latter of which has occurred in the UK since the 1950s[49]. Even within the same country the extent to which different regions such as urban and rural homeless communities are comparable is unclear. Dietary recall data from seventy-five homeless individuals in rural parts of Northern California did demonstrate similarities in the types of nutritional deficiencies when compared with studies of urban populations[13]. However, in the absence of direct matching between urban and rural populations in a single study, the degree to which such comparisons are accurate is limited in the context of methodological differences[13].

A final issue requiring discussion is the frequent use of dietary reference values as a comparator for the nutrient intake of homeless individuals. Dietary reference values are used as guidance for ensuring the adequate consumption of both macro- and micronutrients[20]. For example, in the UK, reference nutrient intakes provide the amount of each nutrient considered to be sufficient to meet the needs of 97·5 % of the group to which it refers[20]. Subsequently these values are tailored to be used in a group setting and so their application to groups of homeless individuals appears reasonable. However, comparison with a nationwide dietary reference value does not account for the potential situation that all individuals in a particular area, homeless and housed, suffer from deficiencies in certain nutrients due to their location and/or general food access. Comparing homeless and housed individuals within the same region would overcome this issue and arguably provide a more accurate assessment of homeless intake in the specific location.

## Implications of nutrient deficiencies on the homeless population

### Physical implications

Elevated levels of acute and chronic disease in the homeless community[50–53], such as HIV and hepatitis C, both of which have long-term physical and psychological sequelae[51], highlight a clear association between homelessness and an increased risk of medical conditions. This is further exemplified by the demonstration of increased visits to emergency departments[54,55] and an average life expectancy in the UK of 42 years in the homeless population[56]. Recent statistics demonstrating that 73 % of 2590 UK homeless people reported physical health problems, 41 % of whom identified a chronic condition, quantifies this situation[57]. The importance of diet in maintaining efficient immune functioning[58] and the evidence-based association between disease development and certain dietary components, such as a low salt diet and hypertension[59,60], indicate diet as a modifiable risk factor. Consequently, in the presence of physiological stresses arising from exposure to harsh environmental conditions, the absence of a nutritionally balanced diet is likely to have a detrimental impact on the health of a homeless individual[17]. It has also been demonstrated that, in the absence of food, individuals are likely to postpone seeking help for medical conditions[61,62] and, if payment for prescriptions is required, will often purchase food instead of their medication[63,64]. Alternatively, a pre-existing medical condition can make an impact upon nutritional needs which may not be easily met in the homeless situation. The report by Hwang & Bugeja[65] that a limited food choice was considered a 'barrier' to adequate glucose control by a group of fifty homeless individuals suffering from diabetes exemplifies the extent to which diet can have an impact on disease management.

In addition to increased levels of disease, skin-fold thickness and muscle mass measurements have frequently demonstrated evidence of 'wasting' in the homeless community[11,16,17]. In contrast, others have found a proportion of homeless who, according to their BMI, are overweight or obese[66,67]. For example, obesity in a large group of 5632 homeless adults in Boston identified 32·3 % as obese (BMI $\geq 30\,kg/m^2$) in comparison with 1·6 % who were underweight (BMI $\leq 18\cdot5\,kg/m^2$)[66]. The similarity of these findings with the BMI distribution of the general US population demonstrates that even a community where food is considered to be restricted is not exempt from the obesity epidemic[66]. An energy-dense, low-nutrient diet in an era characterised by low-cost convenience foods is postulated to be a reason for this paradoxical situation[66]. The problems of obesity for the homeless are two-fold. Specifically, numerous medical complications arise from obesity such as an increased risk of CVD

and diabetes[67], both of which require specific dietary modifications that are often unachievable in the homeless community. Additionally there may be a misperception that an obese homeless individual is not malnourished when in reality they are deficient in micronutrients by virtue of their inadequate diet. The issue of obesity in the homeless not only reinforces the need for a nutritionally balanced diet but demonstrates the importance of assessing dietary intake as opposed to relying on anthropometric measurements when determining nutritional status.

## Psychological implications

Studies regarding the homeless have consistently identified high levels of mental illness including depression, anxiety and bipolar disorders[57,68,69]. The association between depression and low plasma *n*-3 fatty acids[70,71], in conjunction with the speculated beneficial effect of *n*-3 supplementation on mood disorder severity[72–74], indicates a means by which diet may influence mental disorders. Although these studies involve non-homeless individuals it is likely that their effects could be replicated in the homeless community. However, the association of depression with low vitamin D[75] and Se[76] intake indicates the involvement of numerous nutrients and consequently makes it difficult to determine which, if any, are involved in its aetiology. Conversely, mental health may affect an individual's diet. For example, the negative impact of depression on appetite and subsequent food intake has been reported in both housed[77,78] and homeless individuals[7]. Medication prescribed to those with psychiatric conditions also often affects appetite[79,80], a situation which is further complicated by the frequent occurrence of alcohol and substance abuse in the homeless[57]. Given this complex interplay and the high level of mental disorders in the homeless community[57] the need to consider mental health issues cannot be overestimated, although numerous studies to date have failed to acknowledge this.

The high rates of addictive behaviours, such as alcoholism[11,81], in the homeless community and the implications this can have on an individual's nutrient intake and/or absorption[44,82] make it an important factor to consider when assessing the dietary status of the homeless. The demonstration that homeless alcoholic individuals are more likely to be malnourished, predominantly due to a substitution of alcohol for food, exemplifies the impact this condition can have on their nutrient intake[11]. Alcoholism results in numerous complications including macrocytic anaemia as a result of reduced thiamin absorption[83], liver disease and osteoporosis[84], all of which have been reported in alcoholic homeless individuals[20]. The association of chronic alcoholism with elevated homocysteine levels[85] and increased oxidative stress[86] demonstrates the destructive effects such behaviour can have at the molecular level and the potential benefit a diet high in antioxidant-rich foods could have for this group. Similar to alcoholism, smoking can also make an impact on the nutritional needs of the individual as evidenced by the increased vitamin C requirements in smokers[45,87]. This effect may, in part, explain the recurrent demonstration of low vitamin C levels in the homeless[9,10] given the high rates of smoking in this population[57,88]. However, the persistence of reduced vitamin C levels following adjustment for the effects of smoking[89] indicates that such behaviour is not the only reason for the low vitamin C reported in this group. The abuse of illicit substances is also an issue for many homeless individuals[57]. The effects on nutrient absorption vary in accordance with the type of drug[90] although this, in addition to the likelihood that drug addicts will use money to feed their drug habit in preference to feeding themselves[57], highlights the detrimental effect of this behaviour on nutrient intake. In light of the aforementioned impact of addictive behaviour(s) on both the consumption and absorption of certain nutrients, it is clear that in some situations malnutrition in the homeless could arise from behaviour as opposed to a deficient diet.

## Current interventions

In response to the issues identified in the literature regarding nutrient intake and the homeless, a number of interventions have been piloted in an attempt to improve nutritional status. Studies focusing on the food supplied by homeless shelters have often identified them as nutritionally inadequate[91–93]. For example, a survey of twenty-two meals provided to the homeless in San Francisco found them to have high levels of saturated fat but low fibre, K, Ca and vitamins A and E when compared with standards designated by the US Department of Agriculture[92]. However, only a selection of meals offered by the charitable organisation was assessed and nutritional analysis was determined indirectly by calculating average content on the basis of recipes which may have resulted in either an under- or overestimation[92]. Nevertheless, the recurrent demonstration of elevated saturated fat content in the presence of inadequate fibre and numerous micronutrients[93–95] in soup kitchen meals has led to the proposition that enhancing the nutritional quality of such food would be an effective way to improve the diet of the homeless[93]. Following assessment of the content of available meals at a food aid organisation in the UK, Pelham-Burn *et al.*[93] made 'subtle' changes to a number of recipes, such as the use of oil as an alternative for butter, in order to enhance the nutritional content. The acceptance of these meals by their homeless group highlights a potentially beneficial role for the nutritional science community through the provision of advice to homeless shelters in how to maximise the nutrient content of their meals. It is important to acknowledge that such recommendations would need to be tailored in accordance with, in particular, the financial resources available and any nutritional improvement would only be beneficial for those who access the services. The provision of benefits such as the Supplemental Nutrition Assistance Program (SNAP) in the USA could provide a means of ensuring individuals who are unable to access these services still have the financial means of obtaining food from participating stores. However, issues surrounding an absence of food storage facilities and the inherent difficulties of ensuring the widespread distribution and monitoring of these programmes in the homeless community would limit this approach. In addition, the provision of such benefits does not guarantee that high-nutrient items will be purchased[96], a concern which has resulted in the suggestion for excluding certain products from the SNAP such as

sugar-sweetened beverages[97]. The provision of supplements to homeless people who are at risk of one or more nutrient deficiencies is a potential means of specifically targeting those in need[98,99]. However, identification of individuals requiring supplementation is likely to require time-consuming and costly biochemical means given that the homeless are often deficient in a number of nutrients and clinical manifestations are often slow to materialise[5,10,48,100]. Concerns have also been raised regarding the possibility that some homeless may sell their supplements as opposed to taking them[48,99] or, conversely, may take excessive amounts resulting in toxicity[9]. As an alternative to supplements, the development of foods specifically fortified with micronutrients represents a means of ensuring the homeless population in general attain specific nutrients from their diets. The general acceptance by a homeless group in France to a chocolate-flavoured spread fortified with nutrients, including Ca and K, demonstrates a role for fortification in addressing malnutrition in these individuals[101]. However, as previously highlighted, nutrient deficiencies and fortification requirements vary between the homeless which, in addition to cost and accessibility issues, are likely to prove obstacles to the widespread endorsement of this intervention.

An alternative interventional strategy has arisen predominantly from interview data whereupon the homeless have demonstrated a desire to eat healthily but have lacked the knowledge to do so[5,102]. In response, educational programmes have been developed to provide information on nutrition and cooking[102,103]. The finding of increased nutritional knowledge following an educational programme targeted at homeless women demonstrates engagement with these programmes[102] but whether this translates into behavioural change was not determined by this study. Additionally, issues have been raised regarding the cost of such programmes and the ability to maintain continuity in education given the transient nature of the homeless population[5,102]. In order to be effective, educational strategies must be prepared to address these issues and appreciate that, for the homeless individual, food is more likely to represent survival as opposed to the opportunity to obtain their recommended levels of nutrients[5].

## Conclusion

The assessment of nutrient intake in the homeless is complex. Inherent difficulties in using food diaries and biochemical measures have resulted in a dependence on questionnaire- and interview-based methods wherein small sample sizes and selection bias limit the generalisability of the subsequent data. Despite these difficulties, the data obtained do provide an indication of the general nutrient intake of this population. The recurrent finding of high levels of saturated fat, low fruit and vegetable intake and numerous micronutrient deficiencies highlights the presence of malnutrition. The importance of addressing such deficiencies is exemplified by the physical and mental consequences arising, in part, from inadequate nutrition in the homeless. However, the reciprocal nature of this relationship, such that a poor diet can lead to health issues that in turn can make an impact on an individual's diet, highlights the complex interplay between nutrient intake and health in the

homeless community. The added confounder of substance abuse means that many factors require consideration when attempting to determine the nutrient intake of the homeless and the development of potential diet-related interventional strategies. A number of interventions have been suggested but their applicability is likely to vary in accordance with the needs of each particular homeless group. Consequently, future research comparing homeless dietary intake with matched housed individuals would enable identification of nutrient issues specific to the homeless within a certain location. These findings could subsequently be used to characterise the nutritional needs of a specific homeless community and enable the development of a more tailored dietary intervention.

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