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The development, delivery, content and impact of nutrition education in prisons: a systematic review

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Abstract

Introduction: People in prison are at an increased risk of long-term conditions, which have been associated with poor nutrition intake, low levels of physical activity and obesity.

Aim: To identify the necessary components of nutrition education to impact on the health and health behaviours of people in prison.

Methods: The Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines informed the structure of this paper. Our protocol was registered in PROSPERO (CRD42022353925). Electronic databases were searched for relevant studies published in the English language from 01/01/2000 to 31/12/2023. Data were extracted and narrative synthesis completed.

Results: The search identified 394 studies of which 10 studies included nutrition education delivered to and with people in prison. In most cases, nutrition was one element of a complex intervention, with the inclusion of physical activity and/or a focus on health. The outcomes measured varied considerably across studies, therefore, our narrative synthesis explored the 1) development and delivery; 2) content and 3) impact of nutrition education delivered for people in prison.

Conclusion: There remains a need for nutrition education for people in prison, developed through co-production, which encompass their individual needs, with quantifiable outcome measures, through validated tools and/or physiological measures.

Keywords: Dietetics, prison, nutrition education, group nutrition, systematic review

Introduction

The health of people in prison has been acknowledged to be worse than the general population. In England, the prevalence of cardiovascular disease in people in prison was comparable to those living in the community, however, people in prison were 10 years younger at the time of diagnosis (Packham *et al.,* 2020). People in prison have a higher prevalence of diabetes, liver disease, respiratory conditions, depression, anxiety, and suicide than people living in the community (Kosendiak *et al.,* 2022; Sharupski *et al.,* 2018).

The poor health of people in prison has been associated with poor dietary intake and sedentary lifestyles (Kosendiak *et al.,* 2022). Prior to prison almost a quarter of this population reported being overweight, physically inactive, and only eating one portion of fruit per day (Ross *et al.,* 2019). Poor nutrition and a lack of physical activity whilst in prison, contributed to 75 percent of men gaining weight (Choudhry *et al.,* 2018), with obesity rates higher than the general population (Choudry *et al.,* 2019). Undernutrition and malnutrition have also been identified in 15 percent of young men and 18 percent of young women in prison (Theron *et al.* 2023). Furthermore, poor nutrition has been associated with a deficiency in vitamin D (Tripathy *et al.,* 2023), increasing the risk of osteoporosis, cardiovascular diseases, cancer, communicable diseases, and diabetes (Cheseaux *et al.,* 2013).

Globally, there are currently no standardised recommendations for quality, quantity or preparation of food in prisons (Cakal, 2022) and policies vary significantly across countries. A further concern is the high level of food modification, which occurs between people in prison, as it is common practice to swap or trade food. In the UK there is a focus on changing the focus on food from a functional provision within prisons to incorporate both existing activities, such as promoting self-production initiatives and creating healthy recipes, and the development of food-related initiatives, to encompass rehabilitation, learning and skills development (Food Matters, 2024).

The importance of nutrition education is essential to support the health of those in prison (Almoayad *et al.,* 2023; Thomas, 2022). A recent scooping review of nutrition interventions identified the inconsistency in approaches, such as a focus on nutrition alone or nutrition included within a comprehensive health intervention, as well as inconsistent outcomes and outcome measures (Almoayad *et al.,* 2023). The development of a nutrition curriculum to support nutrition education in prisons in the United States of America (USA), has been developed through an evidence-based approach of health education and guidelines from the

Centers for Disease Control and Prevention (Thomas, 2022). The six elements identified as essential within nutrition education focused both on practical elements and national and regional recommendations and resources (Thomas, 2022). However, there remains a need to focus on and understand the practical elements of the development, delivery, content and impact of nutrition education for people in prison,

Aim

The aim of this systematic review is to identify the development, delivery, content and impact of nutrition education for people in prison.

Methods

The updated Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines informed the structure of this paper (Page *et al.,* 2020). The protocol for our systematic literature review was guided by the application of the guidelines (Bettany-Saltikov, 2012) and was registered in PROSPERO (CRD42022353925).

Search strategy

A search of electronic databases including CINAHL, MEDLINE, PsycINFO, Scopus and Web of Science was conducted for relevant studies published in the English language from 01/01/2000 to 31/12/2023. Ethos and Grey Literature websites, and reference lists of all relevant papers were searched. Key nutrition and prison journals were hand searched.

Search terms were identified from our aim and an initial search was undertaken to identify any additional wording or terms within CINAHL, which were related to nutrition, the setting, intervention, and outcomes (refer to Box 1). The terms identified for each concept were combined using the appropriate Boolean Operators such as “AND” for each database.

INSERT BOX 1 HERE

Study selection

The inclusion criteria were primary research, nutrition education delivered within adult prisons, qualitative, quantitative or mix method studies reporting related outcomes. The exclusion criteria were nutrition interventions, which were did not include education, or were delivered in young offender institutions, forensic institutions, or halfway houses.

Two authors (XX, XX) individually and independently reviewed the titles of all papers. This process was followed by a discussion of the abstracts of the remaining papers against the inclusion/exclusion criteria, which was repeated for the full manuscripts.

Data extraction

Data extraction was completed by one author (XX) and checked by all authors, through the completion of a data extraction table (refer to Table 1).

INSERT TABLE 1 HERE

Data synthesis

Due to the vast differences in targeted populations, interventions, and outcome measures, a narrative synthesis was completed, which applied the four processes as described by the Economic and Social Research Council (ESRC) Methods Programme (Popay et al., 2006). The first process involved identification and exploration of the components of each nutrition education, which supported the development of our themes exploring the practical elements of the development, delivery, content and impact. The following two processes included the identification of patterns across the included studies and relationships in the data. However, due to the different focus of each nutrition education the identification of patterns and relationships in the data was necessarily descriptive. Finally, the last element of the generalisability of the results are explored within the discussion.

Findings

Study inclusion

The searches of the electronic databases identified 627 papers, which was reduced to 394 when duplicates were removed. No further studies were identified through hand searches of journals, references, and citations of identified papers. All titles were screened and 333 were excluded, 61 abstracts were obtained and screened, and a further 46 were excluded. Finally, the full manuscripts of the remaining 15 papers were screened, of these five were excluded as provided no information on outcome measures (n=3), the intervention was delivered in a halfway house (n=1), or involved prison staff (n=1), refer to Figure 1.

INSERT FIGURE 1 HERE

Critical appraisal

All included studies were critically appraised by applying the Joanna Briggs Institute Critical Appraisal Checklist for Quasi-Experimental Studies (Tufanaru *et al.,* 2017). Only three studies included a comparison or control group (Curd *et al.,* 2013, Firth *et al.,* 2015; Örs, 2018). Limitations included the use of a three-point Likert scale to identify the changes in portions of fruit and vegetables consumed (Curd *et al.,* 2013, Clouse, *et al.,* 2012) or the development of a questionnaire (Martínez-Delgado & Ramírez-López, 2016; Örs, 2018; McKinney & Cotronea, 2011); the dropout rate was high in four studies (Dallaire *et al.,* 2017, Johnson *et al.,* 2018, Martin *et al.,* 2013; Martínez-Delgado & Ramírez-López, 2016); and the majority of studies relied on self-reported data (Curd *et al.,* 2013, Clouse, *et al.,* 2012, Johnson *et al.,* 2018, Martin *et al.,* 2013, Martínez-Delgado & Ramírez-López, 2016).

Study characteristics

The delivery of nutrition education was only one element of complex interventions in seven of the ten studies, refer to Table 1, other elements included exercise programmes (Clouse *et al.,* 2012, Johnson *et al.,* 2018, Martin *et al.,* 2013; Martínez-Delgado & Ramírez-López, 2016; MacLean *et al.,* 2022), provision of vitamin supplements (Dallaire *et al.,* 2017). Interventions included different populations within a prison, such as the whole population (Clouse *et al.,* 2012, Johnson *et al.,* 2018), those who were pregnant (Dallaire *et al.,* 2017), diagnosed with diabetes (Firth *et al.,* 2015) or in a substance misuse programme (Curd et al., 2013).

INSERT TABLE 2 HERE

Results

Research studies of nutrition education in prisons are scarce and vary widely in design, quality, population, and outcomes measured. Due to the nature of the included studies, the results of our narrative synthesis will be presented across three themes focusing on the 1) development and delivery; 2) content and 3) impact of nutrition education implemented for people in prison.

1. *Development and delivery*

The development of nutrition education within the majority of the studies, was informed by existing bodies of knowledge, such as the Wellness Works programme (Curd et al., 2007), William and Mary Healthy Beginnings Programme, My Plate and My Pyramid developed by the US Department of Agriculture (2009), and a community based intervention, Football Fans

in Training (Gray *et al.,* 2013), which was further developed for delivery within a prison (MacLean *et al.,* 2022). Nutrition education was also developed specifically for delivery within a prison, which was developed by the researcher (Örs, 2018), a registered nurse and nursing student (Martínez-Delgado & Ramírez-López, 2016), and by women who were serving a prison sentence (Martin *et al.,* 2013). Although, the development of the nutrition education in one study was not discussed (Firth *et al.,* 2015).

The qualifications of the person who delivered the nutrition education varied considerably across studies, only one study supported women within the prison to deliver the intervention (Martin *et al.,* 2013). Most studies identified a nurse practitioner or educator delivered the education (Clouse *et al.,* 2012; Curd *et al.,* 2013; Firth *et al.,* 2015; Johnson *et al.,* 2018; Martínez-Delgado & Ramírez-López, 2016). Although the qualifications of the person who delivered the education was not always clear, as one study identified either a registered nurse or a person with a PhD and had received the necessary training (Dallaire *et al.,* 2017), and two studies identified the researchers delivered the education (MacLean *et al.,* 2022; Örs, 2018).

The number and length of each session delivered as part of the nutrition education varied considerably, as one study implemented a nutrition education counselling session over 45 minutes (Dallaire *et al.,* 2017), whilst three studies implemented three 90-minute workshops (Curd *et al.,* 2013, Johnson *et al.,* 2018; Martínez-Delgado & Ramírez-López, 2016). However, two studies implemented 120 minutes workshops, either on one occasion (McKinney & Cotronea, 2011) or two occasions (Örs, 2018). One study implemented weekly nutritional talks for six weeks (Martin *et al.,* 2013), whilst another study included a 10-week programme, with time allocated for nutrition education (MacLean *et al.,* 2022). The length of workshops have been summarized, however, when nutrition education was embedded in a larger study these workshops included other health related information, so the time allocated to nutrition education is unknown (Johnson *et al.,* 2018; Martínez-Delgado & Ramírez-López, 2016).

2. *Content*

The content of the nutrition education was not presented for all studies (Clouse *et al.,* 2012; Firth *et al.,* 2015) and level of information presented in the remaining studies also varied. An overview of the content of nutrition education is provided in Table 3, which demonstrates the wide range of information provided.

INSERT TABLE 3 HERE

An important element was the inclusion of meaningful interaction and engagement of those who attended the nutrition education, although different approaches to support meaningful engagement were identified. Five studies included engaging people in prison through weekly goals and/or sharing experiences (Curd *et al.,* 2013; Johnson *et al.,* 2018; MacLean *et al.,* 2022; Martin *et al.,* 2013; McKinney & Cotronea, 2011). Other approaches included the provision of homework, and the development of a healthy one-day meal plan (Curd *et al.,* 2013), or choosing the healthiest grocery items to plan menus to organise a weekly shop (McKinney & Cotronea, 2011). Visual aids were also applied to support meaningful interaction through the implementation of prison-specific measuring cups and serving trays, as well as MyPlate posters, a picture of a plate with four food groups, fruits, vegetables, grains, and proteins or an empty plate and pictures of food and were asked to build both healthy and unhealthy meals (Johnson *et al.,* 2018; Dallaire *et al.,* 2017).

3. *Impact*

Measures to identify the impact of nutrition education varied across studies, although the outcome of two studies was the development of the nutrition education (MacLean *et al.,* 2022; McKinney & Cotronea, 2011). Only the impact of the nutrition education on nutrition are discussed, although wider outcomes were explored and reported, due to the nature of the overarching health interventions.

Nutritional intake was a measured outcome within six studies (Curd *et al.,* 2013, Clouse *et al.,* 2012; Dallaire *et al.,* 2017; Firth *et al.,* 2015; Martínez-Delgado & Ramírez-López, 2016; Örs *et al.,* 2018). Two studies applied the same measure, which included choosing one of three options: ‘At least 5 servings/day of vegetables and fruits; Most carbohydrates were from high fibre, whole grain; no-fat dairy; lean meats; rarely eat fried foods’, ‘Between 3 to 4 servings/day of vegetables and fruits. Some carbohydrates from fibre and whole grain; low-fat dairy; some fried foods’, or ‘less than 3 servings/day of vegetables and fruits. White bread and few whole grain foods; high -fat dairy and meats; much fried foods.’ (Clouse *et al.,* 2012, p.187; Curd *et al.,* 2013, p. 146). No significant changes in participants nutritional intake were identified by Clouse et al. (2012). However, Curd et al. (2013) identified a significantly greater proportion of participants who received the nutrition education (23.5%) reported improved nutrition intake compared to the those in the comparison group (3.2%).

Two studies applied and/or validated general nutrition knowledge questionnaires (Dallaire *et al.,* 2017: Örs *et al.,* 2018). One study applied the Nutrition Knowledge Questionnaire (Parmenter and Wardle, 1999), which identified a significantly increase in nutrition- and pregnancy-related knowledge of women in prison post intervention (Dallaire *et al.,* 2017). One study validated a 31 multiple-choice general nutrition knowledge questionnaire, which identified a significant increase between pre-and post-scores following a nutrition education and a nutrition education accompanied with a brochure (Örs *et al.,* 2018).

One study identified participants increased their daily consumption of fruit and eating less or eating the food offered by the facility without buying more at the commissary, although the self-reporting measure was not clarified (Martínez-Delgado & Ramírez-López, 2016). One study identified participants in the intervention purchased less food (172 fewer calories per day), than before the intervention, but this trend did not reach statistical significance (Firth *et al.,* 2015).

Discussion

Our systematic review explored nutrition education delivered for people in prison. The studies included in our review incorporated different prison populations, a variety of complex interventions, and subsequently a range of measured outcomes. Therefore, a narrative synthesis was completed and explored the development and delivery, content and impact of nutrition education. These themes will now be discussed, including limitations, wider literature, and recommendations for future nutrition education within prison.

Development and delivery

The development of the nutrition education with engagement and a co-production approach with people in prison was identified in two studies, which both included the delivery of the education on a number of occasions until all concerns and recommendations by those attending had been addressed, and the education was found to be acceptable and appropriate (MacLean *et al.,* 2022; McKinney & Cotronea, 2011). Co-production is a collaborative model, which supports all stakeholders, such as service providers, healthcare professionals, and in this case, people in prison, to work together to design and implement services, improving the quality and the relevance of the service, such as nutrition education (Redfern *et al.,* 2021). This approach is essential within a prison setting, to support the engagement and empowerment of those in prison, and to ensure their individual needs are met.

The majority of studies in our review involved nutrition education delivered through a workshop to a group of people in prison. Dietitians commonly deliver nutrition education to a specified group, (Whelan, 2022), which has been identified to positively impact on patient outcomes (Kirkegaard *et al.,* 2022). The clinical effectiveness of dietitian led group or individual nutrition education, depends on the specific group involved. A significant decrease in the severity of symptoms of people with irritable bowel syndrome occurred across both group and individual nutrition education, although group education was also cost effective (Whigham *et al.,* 2015). However, group and individual nutrition education for people who were obese and diagnosed with hypertension, were not comparable, and individual education significantly improved weight loss, waist circumference, blood pressure, fasting glucose and insulin resistance (Gajewska *et al.,* 2019).

The consideration of the disease and the needs of individuals is essential, which can be achieved by dietitians providing each individual with a Nutrition and Dietetic Diagnosis (NDD) (British Dietetic Association, 2020), to identify and prioritise nutrition education to address the needs for everyone. There is a need to acknowledge the nutrition education delivered within the studies in our review were led by nurses or someone with a PhD or degree or by women in prison. However, dietitians are the best placed healthcare professionals to advise on nutritional needs. These studies demonstrate the majority of nutrition education delivered within prison settings are not being developed or implemented by a dietitian, the rationale for this approach is unknown, but one that needs to be challenged.

Content

The content within each nutrition education included in our review varied significantly, however, a focus on a visual element to support an understanding of food groups, food choices and portion size, was a component of the majority of studies. Visual aids can be classified into three groups, graphic symbols, which are images or a combination of images, such as photographs; pictograms, which portray icons and symbols, which are clear pictorial similarities with the object they represent; multimedia visual aids, which apply a combination of mediums, such as a video and a pamphlet or animations and pictures (Mbanda *et al.,* 2021). All types of visual aids have been identified as effective in health education, for example, graphic symbols and pictograms significantly improved comprehension (Mbanda *et*

al., 2021). Whereas, multimedia visual aids significantly improved knowledge, understanding and the application of knowledge (Mbanda *et al.,* 2021).

Visual aids have been identified as an essential element of health education, especially for those with low health literacy (Mbanda *et al.,* 2021). Therefore, the incorporation of visual aids within nutrition education for people in prison is paramount, especially as 60% of this population have difficulties in basic literacy skills (Clark & Dugdale, 2008). Further considerations are required such as the level of abstractness, simplicity or complexity of graphic symbols and pictograms, as well as the familiarity and cultural appropriateness of images (Mbanda *et al.,* 2021). All these elements need to be considered when developing nutrition education to be delivered within a prison, due to the low literacy level and the diverse cultural heritage of people in prison.

The inclusion of meaningful interaction and engagement was an important element in the majority of the studies included in our review, which supported people in prison to develop goals, monitor their eating, plan menus and discuss their progress. The promotion of self-monitoring food intake through a diary and the provision of meal plans, have been identified as some of the behaviour change techniques necessary to support people to lose weight (Hawkins *et al.,* 2024). Other techniques include problem solving and identifying barriers and facilitators to changing behaviours, which can occur through individual or group sessions have also been identified as necessary and may prevent a relapse (Hawkins *et al.,* 2024). Therefore, the development of goals, monitoring eating, planning of menus and discussing their progress. are all important elements for inclusion within nutrition education.

Impact

There is a need to acknowledge the difference in outcome measures across the studies included in our review. Future studies, if led by dietitians will be informed by the Model and Process for Nutrition and Dietetic Practice (British Dietetic Association, 2020), and the application of a NDD, which will support both the development of tailored goals and standardised outcome measures. The importance of standardised outcome measures is to ensure equity across patient groups, comparison of health data and trends, and the success of interventions at individual, group, and population levels (Thomas, 2019, Davis *et al.,* 2017). Standardised measures will support collaboration and cohesion across dietetic practice and research, as well as demonstrating the impact of dietetic interventions. This review highlights

the limitations that exist within the current literature regarding the measurement of outcomes following nutrition interventions within the prison service.

Limitations

The limitations of our review include the vast differences in the development, delivery and outcome measures of nutrition education implemented within the included studies, which prevented a robust evaluation of nutrition education in prisons. A further limitation was application of self-reported data, often by a three-point Likert scale or an unvalidated questionnaire. These approaches may not be sufficient to identify real-world changes implemented by those who attended nutrition education.

Recommendations and Conclusion

Recommendations from our systematic review include the need for group nutrition education within the prison setting, which is developed through co-production and encompass the individual needs of those attending, visual aids, food diaries, and meal plans. An important recommendation is the need for quantifiable pre and post intervention outcome measures, through the application of validated tools and/or appropriate physiological measures. Finally, the exploration of the role of the dietitian in prison settings is urgently required to identify barriers and/or challenges, preventing dietetic led research/interventions. Dietitian led research will support future operational plans for dietetic services across prisons and the provision of equitable nutrition and reduce health inequalities.

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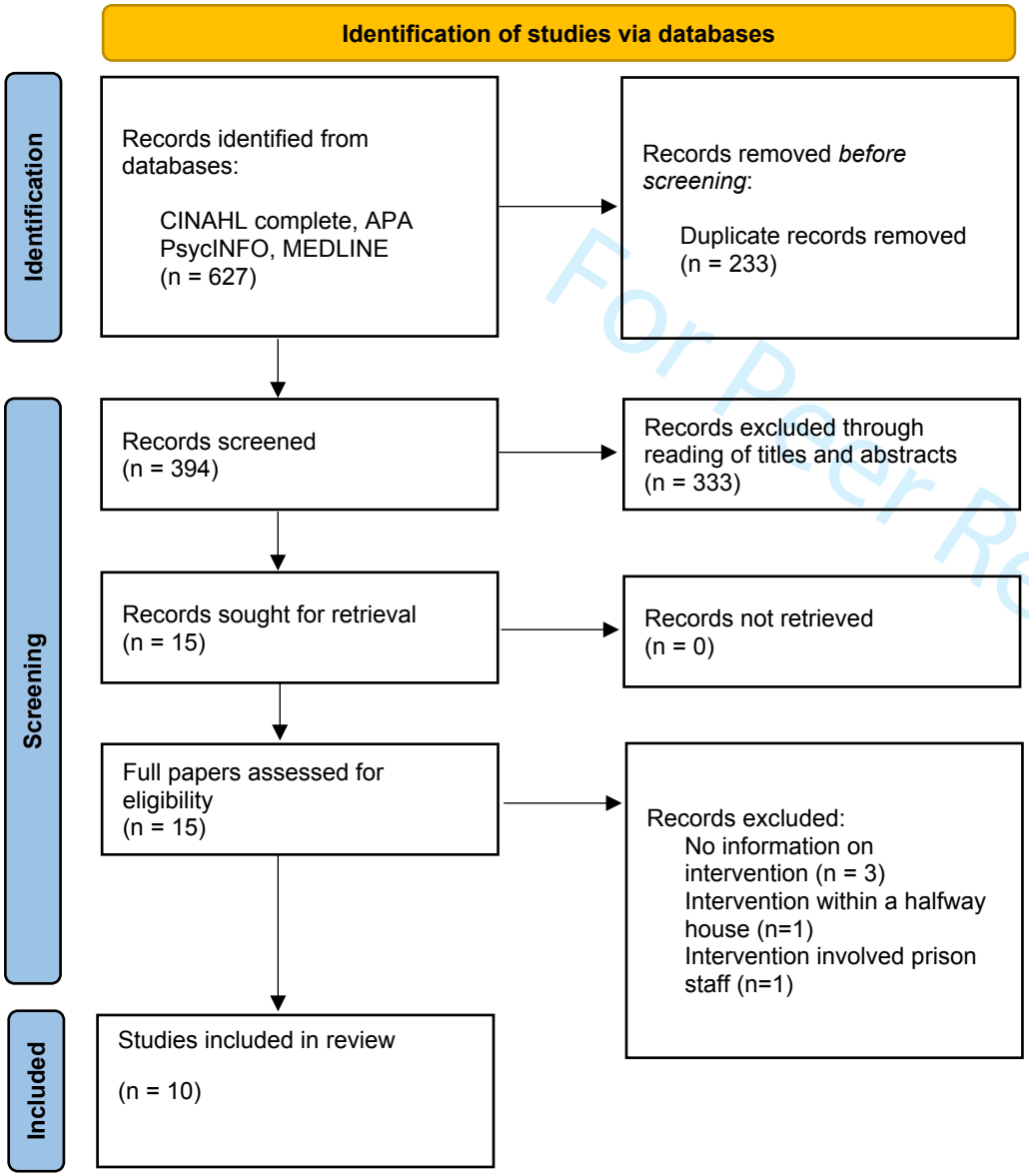
Figure 1: PRISMA Flow chart of search data



From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ, 372:n71. doi: 10.1136/bmj.n71.

Box 1: Overview of search terms

Search categories	Search terms
Disease	"nutrition" OR "diet" OR "food" OR "nourishment" OR "food intake" OR "eating" OR "dietetics"
Setting	"Prison" OR "jail" OR "incarceration" OR "imprisonment" OR "correction facilities" OR "Custody'' OR "Custodial"
Interventions	"care" OR "treatment" OR "intervention" OR "management" OR "dietician" OR ''dietitian'' OR ''nutrition'' OR ''nutritional professional''
Outcomes	"knowledge" OR "Weight" OR "Disease control" OR "BMI"

Table 1: Overview of relevant data from included studies

Author Year Country	Aim	Methods Participants	Results	Conclusions
Clouse 2012 USA	To identify differences in the pre- and post- health risk assessment of prisoners within a substance abuse programme (SAP) following the implementation of Wellness Works programme	A quasi-experimental study Pre and post health risk assessment Male prisoners (n=448)	A significant reduction in smoking ($p<0.01$) and depression ($p<0.01$) No changes in nutritional intake	The lack of an increase in fruit and vegetable intake, may have been attributable to the Likert scale measurement and the environment of a prison. Diet may be difficult to change in a prison system when most of the food is provided for the prisoner, and available snacks may not be supportive.
Curd 2013 USA	To evaluate a pilot intervention to improve nutritional choices by prisoners and to describe the relationship among improved nutrition, self-perceived general health, and strength of social ties.	A quasi-experimental study Pre and post health risk assessment Male prisoners (n=19) Matched controls (=37)	Significantly greater proportion of participants than controls reported improved nutrition practices (23.5% vs. 3.2%) Participants were 4 times more likely to report improved general health than controls (52.6% vs. 13.9%)	The limitations of this study have been acknowledged by the authors, such as the small number of participants, the use of un-validated scales, and the need to acknowledge the participant's involvement in a substance misuse programme.
Dallaire 2017 USA	To assess the impact of a nutrition-based counselling program on birth outcomes among pregnant incarcerated women, including birth weight and gestation	A quasi-experimental study Virginia Pregnancy Risk Assessment Monitoring System Questionnaire Intervention sample Postpartum female prisoners (n=116) Comparison sample Postpartum female prisoners (n=51)	A significant increase in the birth weight of babies from mothers in the intervention ($p=.03$) A significant increase in the knowledge of mothers in the intervention of pregnancy- and nutrition-related knowledge ($p< .01$)	Increase in knowledge by mothers was also associated with longer gestational lengths, although this did not reach significance. An element of selection bias was identified, as data on birth outcomes was not complete.
Firth 2015 USA	To revaluate the Healthy Food Access Project, which aimed to change the food	A quasi-experimental study Haemoglobin A1c levels	No statistically significant changes in:	Improvement in haemoglobin A1c was identified in the intervention group, a limitation identified was

	environment inside a women's prison to improve health behaviours, decrease weight gain, and improve chronic disease management	BMI Calories consumed from purchased food Intervention Female prisoners with diabetes (n=24) Comparison Female prisoners with diabetes (n=39)	-haemoglobin A1c levels between groups, a reduction of 0.04 per month in the intervention and 0.01 per month in the comparison group -BMI across groups -food purchased, those in the intervention purchased food with an average of 172 fewer calories a day	the significant mental health illness of women recruited to the study and the movement of women across prisons, impacting on the intervention. The need to address the type of food sold within the prison continues, as women supplement their diet with these high calorie foods.
Johnson 2018 USA	To examine the effect of a physical activity and dietary education program on body mass index (BMI) and resilience of female prisoners	Quasi-experimental pilot study Physical activity and dietary education programme BMI and resilience measured: Baseline, week 6 and week 12 Female prisoners (n=29)	A statistically significant difference in BMI between baseline, week 6 and week 12 (p=.023) No statistically significant difference in resilience overtime, although the median resilience was 148.5 at baseline, 149.0 at 6 weeks and 150.5 at 12 weeks	The results demonstrate significant impact on female prisoners BMI, but not on their resilience. However, resilience did increase, and may have continued to increase over time if a prisoners BMI continued to decrease.
MacLean 2022 Scotland	To describe the co-development and exploration of the feasibility of the FFIT (Fit for LIFE) model to support healthy lifestyle group-based intervention for incarcerated men	Co-design of FFIT Qualitative study, observations and interviews Implementation of FFIT (n=4) to ensure appropriate for delivery in prison Male prisoners attending 1st (n=25), 2nd (n=12), 3rd (n=15), 4th (n=29) FFIT Physical education instructors (n=3)	The final 10-week programme was feasible within the operational constraints of two very different high security prisons (one state, one private) and acceptable to prison staff and prisoners taking part in Fit for LIFE. Development of the programme occurred through qualitative feedback of prisoners.	Specific dietary amendments to FFIT included: -how to reduce unhealthy snacks while locked up at the weekend -how to improve their diet within the constraints of prison meal provision -information on reducing sugary drinks intake

Martin 2013 Canada	To describe a pilot nutrition and fitness program, which resulted from a unique prison participatory health research project	Quasi-experimental pilot study Six-week pilot nutrition and fitness programme A pre- and post-program assessment Female prisoners (n=16)	No statistically significant changes in weight (p=.25), BMI (p=.11), waist to hip ratio (p=.06). Statistically significant difference in chest measurements (p=.002) Women prisoners self-reported: Improved energy level 69% Really improved sleep 32% Really improved stress level 56%	Four participants gained weight during the programme had a low BMI pre-assessment. Therefore, was a positive outcome for these participants. This programme was designed and led by women prisoners with an overall positive impact.
Martinez-Delgado 2015 Spain	To promote lifestyle changes to reduce risk factors associated with cardiovascular disease, diabetes, hypertension, and dyslipidaemia	Descriptive study Health education programme, with group workshops over three sessions A post questionnaire Male prisoners (n=33)	Post questionnaire completed by 51% (n=17) of participants identified: -changes in daily consumption of fruit, eating less or eating the food offered by the facility without buying more at the commissary -engaging in more sport -quitting smoking.	Health education supported changes in male prisoner's lifestyle behaviours, although unclear if the group or individual session had the most impact. Recommended the need for health education to be structured, planned and sequentially developed.
McKinney 2011 USA	To incorporate two components of self-determination theory into the development of a nutrition course for male prisoners	Development of nutrition course from the feedback of male prisoners Pre and post questionnaire Male prisoners attending 1st (n=13), 2nd (n=8), 3rd (n=9) course	Significant increase in male prisoners' knowledge post attending the nutrition course: -first iteration (p<0.001) -second iteration (p<0.001) -third iteration (p<0.001)	The inclusion of self-determination theory supported prisoners to feel a level of competence, autonomy and relatedness, and the men expressed enjoyment in the course and supporting the further development of the course.
Ors 2018 Turkey	To determine the impact of nutrition training on adult male prisoners' nutritional knowledge	Experimental study Pre and post questionnaires Prisoners completed one of four conditions:	Significant increase in prisoners' knowledge post nutritional training only through the inclusion of education: -education (pvalue <.000)	The results demonstrate prisoners benefit from nutrition education, which requires more than the provision of a brochure.

		-control – no training (n=54) -education (n=54) -brochure (n=54) -education and brochure (n=54)	-brochure and education (pvalue <.000) -brochure alone (pvalue 0.126)	

Table 2: Overview of interventions

Author Year	Intervention	Content	Outcome measures
Clouse 2012	Wellness Works programme	A weekly workshop (n=4) delivered on three separate occasions, which included: -nutrition education on food groups, nutrition labelling, fat, calorie, carbohydrate content of foods -self-management of common chronic diseases -home work such as developing a one-day meal plan -knowledge test at the end with a certificate if a certain level of knowledge demonstrated	Pre and post Health Risk Assessment questionnaire, which included exercise, nutrition, stress, depression and smoking
Curd 2013	Nutritional workshop	A weekly workshop (n=4) delivered on three separate occasions, which included: -nutrition education on food groups, nutrition labelling, fat, calorie, carbohydrate content of foods -self-management of common chronic diseases -home work such as developing a one-day meal plan -knowledge test at the end with a certificate if a certain level of knowledge demonstrated	Pre and post nutrition, self-perceived health and strength of social ties questionnaire
Dallaire 2017	Nutrition-based counselling programme for pregnant women	Individual motivating interview session (n=1), which included: -provision of a nutrition handbook -'What's on your plate?' handout -serving sizes and content -reading nutritional labels -vitamins during pregnancy	Pre and post nutrition and pregnancy-related knowledge questionnaire Birth weight and gestational length
Firth 2015	Healthy Food Access Project	Reduction of calories in menu from 3000 to 2200 Nutrition education – no information or impact of this element was described in this paper	HA1c and BMI

Johnson 2018	Physical activity and dietary education program	Health education classes (n=3) over a 12-week program, which included: Week 1 - dietary recommendations and portion control, MyPlate, and setting weekly goals Week 4 – Healthy food selection at meals and commissary purchases Week 8 – reviewed topics covered with question-and-answer game	7-day step count BMI baseline, week 6 and post intervention
McLean 2022	FFIT for LIFE	Football Fans in Training (FFIT) developed for the prison setting, weekly sessions (n=10), included: -classroom component – healthy eating, self-monitoring and goal setting, and revisiting important elements each week, and addressing any setbacks experienced -coach-led practical physical activity training	No outcome measures, as developing the program for the prison environment through qualitative explorations of those involved
Martin 2013	Nutrition and fitness program	A six-week programme, which included: -nutrition education – provision of Canada Food Guide, personalised food chart for self-monitoring for 6-weeks – no further information provided -a personal fitness program either through group circuit classes or individual exercise plan	Weight, BMI, waist-to-hip ratio, chest, energy, sleep and stress measurements
Martinez-Degado 2015	Health education	Group workshops (n=3), which explored: -aetiology, diagnosis and treatment of diabetes, hyperlipidaemia and hypertension -nutrition and the Mediterranean diet -physical exercise -practical activity of building a nutritional pyramid	Post intervention nutrition and health knowledge questionnaire
McKinney 2011	Nutrition education	Development of a 2-hour interactive group workshop (n=1), which explored: -the food pyramid -nutritional values of different foods -how to read a food label -howe to reduce a food budget and use of coupons -building a seven-day menu	Pre and post-intervention nutrition knowledge questionnaire

Ors 2018	Nutrition training	Workshops (n=2) including nutrition education, brochure, or nutrition education and brochure were delivered over two-hours, which included: -nutrition education – nutrition elements of food groups, habits of drinking, food preparation and cooking rules, recommended changes to eating habits -brochure - focused on presenting nutritional information	Pre and post=intervention nutrition knowledge questionnaire

Table 3: Content of nutrition education

Elements included in nutrition education	Curd 2013	Dallaire 2017	Johnson 2018	McLean 2022	Martin 2013	Martinez-Degado 2015	McKinney 2011	Ors 2018
Nutritional value of foods	-	X	X	-	X	-	X	X
Healthy eating/portion control	X	X	X	-	X	X	-	X
Healthy food selection from prison meals and canteen/commissary	X	-	X	X	-	-	X	-
Food pyramid or food groups	X	-	X	-	X	X	X	X
How to read a food label	X	X	X	X	X	-	X	-
Food preparation, cooking and storage	-	-		-	-	-	X	X
Ways to reduce a food budget	-	-		-	-	-	X	-
Addressing eating and drinking habits	-	-		-	-	-	-	X
Making favourite means healthier	-	-		X	-	-	-	-
Individual and group eating plans	-	-		X	X	-	-	-
Physical representation of sugary drinks				X		-		
Interactive elements								
My Plate	-	X	X	-	-	-	-	-
Weekly goals and/or sharing experiences	X	-	X	X	X	-	X	-
Development of a healthy meal plan	X	X		-	-	-	-	-
Build a food pyramid	-	-		-	-	X	-	-
Question and answer session	-	-	X	-	-	-	-	-

Clouse et al. (2012) and Firth et al. (2015) did not provide any information on the content of the nutrition education and are not represented within this table. Martin et al. (2013) provided people in prison with Canada's Food Guide, and the information presented is from the guide, as the content of the PowerPoint presentations was not reported.