

Knowledge & Information Repository

Prevention of Type 2 Diabetes



Reader Page

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Knowledge and Information Repository

The purpose of the knowledge and information repository (KIR) is to provide easily accessible summaries of the latest guidance and important research relating to specific key topics of relevance to NHS Diabetes. The topic areas have been identified by NHS Diabetes staff and the KIR documents will provide readily available information to support and inform Programme Managers and others when attending meetings and other functions. Each KIR topic will include a brief summary introduction to each topic, followed by a short collection of latest key policy papers, national body statements, clinical or care guidelines and the latest key research and evaluation papers.

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Prevention of Type 2 Diabetes

Standard One of the National Service Framework (NSF) for Diabetes (1) states that: 'The NHS will develop, implement and monitor strategies to reduce the risk of developing Type 2 diabetes in the population as a whole and to reduce the inequalities in the risk of developing Type 2 diabetes'. Standard Eight of the NSF for Older People (2) builds upon these intentions to ensure equity of service for the older population. The promotion of health with early intervention is at the heart of standard one of the NSF for Children, Young People and Maternity services (3); this standard is particularly important in the context of preventing childhood obesity, a major risk factor for Type 2 diabetes.

Identifying people at an increased risk of Type 2 diabetes is a key strategy in the prevention of the disease. *The Healthy Lives, Healthy People White Paper* (4), published by the Department of Health in November 2010, highlights the Government's intention to continue with the *NHS Health Check* programme; a vascular risk assessment and management programme aimed to help prevent heart disease, stroke, Type 2 diabetes and kidney disease. Screening for diabetes and diabetes risk factors such as impaired glucose tolerance (IGT) with subsequent lifestyle or pharmacological interventions are probably cost-effective, but more studies are required to assess long-term compliance with interventions (24-26). The World Health Organisation (WHO) and the International Diabetes Federation (IDF) published guidelines on the definition and diagnosis of diabetes mellitus and intermediate hyperglycaemia in 2006 (6); a recent addendum provides guidance on the use of HbA1c for the diagnosis of diabetes, which is not currently recommended for diagnosis of people who are at high risk of developing diabetes (7). Many organisations recommend pre-screening, such as self assessed risk-score or computer based risk-score, before an invasive blood test.

There are many guidelines offering advice for the prevention of Type 2 diabetes, particularly for individuals at increased risk of developing the condition. Primarily interventions focus on modification of lifestyle behaviours to maintain or achieve a healthy weight, and to increase physical activity. However, it is widely recognised that prevention strategies aimed solely at individuals are unlikely to succeed, and wider societal changes are required to reverse the current trend of diabetes prevalence. Following a consensus workshop to assess the increasing worldwide impact of Type 2 diabetes and the need for its prevention, the IDF published its strategy for diabetes prevention, and is based on modifying risk factors in two target groups: high risk individuals and the population as a whole (5). The National Institute for Health and Clinical Excellence (NICE) published *Prevention of Type 2 diabetes: population and community interventions* in May 2011 (8); the guidance focuses on adults aged 18-74 in high risk groups and the general population. Guidelines for the prevention of Type 2 diabetes in people at risk of diabetes (at individual patient level) will be published early in 2012. NICE have published other guidelines relevant to the prevention of Type 2 diabetes including obesity (9), behaviour change (10) and the promotion of physical activity in various settings (11-13). The Welsh Government provides general lifestyle advice and a care pathway for those at high risk of developing Type 2 diabetes in their consensus guidelines (16), and the Scottish Government have detailed strategies for the primary prevention of Type 2 diabetes in their *Diabetes Action Plan 2010* (17). Other societies and associations have also published guidelines aimed at prevention of Type 2 diabetes and reiterate the key messages (18-21).

There is strong evidence to suggest that lifestyle (5, 22, 23, 27-21, 33, 34) and pharmacological (27, 35-41) interventions can be beneficial in preventing Type 2 diabetes in adults at high risk of developing the disease; furthermore, lifestyle interventions appear to be at least as effective as pharmacological interventions (27). There is no definitive evidence endorsing specific dietary components for the prevention of Type 2 diabetes (31-32); therefore, the promotion of general healthy eating is recommended. Surgical interventions have shown to be beneficial in treating obesity (42), a major risk factor for Type 2 diabetes.

1. Policies and guidelines at society level

1.1 **Healthy Lives, Healthy People: Our strategy for public health in England.**

Department of Health White Paper, Nov 2010.

Available at: <http://www.dh.gov.uk/en/Publichealth/Healthyliveshealthypeople/index.htm>

- NHS Health Check (see section 1.2) will continue to be offered to adults (40-75 years), with individually tailored advice and support to help manage the risk of heart disease, stroke and Type 2 diabetes.
- It is expected that NHS Health Check will become part of the proposed new integrated public health service - Public Health England.

1.2 **NHS Health Check**

Website: <http://www.healthcheck.nhs.uk>

Further NHS Health Check resources are available at:

http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_097490

'The NHS Health Check programme aims to help prevent heart disease, stroke, diabetes and kidney disease. Everyone between the ages of 40 and 74, who has not already been diagnosed with one of these conditions, will be invited (once every five years) to have a check to assess their risk of heart disease, stroke, kidney disease and diabetes and will be given support and advice to help them reduce or manage that risk'.

- The proposal for NHS Health Check, formerly 'vascular checks', was set out by the previous Government in April 2008 in '**Putting Prevention First – Vascular Checks: Risk Assessment and Management Programme**'. Available at: http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/documents/digitalasset/dh_083823.pdf.
- The Department of Health and NHS Diabetes and Kidney Care are working together to support the NHS in delivering the NHS Health Check programme.
- Implementation of the programme began in 2009 and is expected to be fully operational by 2012/13.
- The NHS Health Check website contains guidance documents, case studies and a resource library.
- A Learning Network has been established to support the development and implementation of NHS Health Check, and aims 'to learn from, build upon and share the learning and experience of both existing and emerging vascular checks-type programmes across the country'.
- The Learning Network is underpinned by a series of interactive workshops and a regular eBulletin; sign up at: http://www.healthcheck.nhs.uk/_TheLearningNetwork.aspx.
- There are links to all the key documents relating to vascular risk assessment and management, including policy documents, impact assessments, economic modelling, best practice guides and guidance.
- The website also includes tools and guidance on commissioning and implementing relevant lifestyle management services and interventions.
- Tools and guidance on testing devices are also included.

1.3 Alberti KGMM, Zimmet P and Shaw J. International Diabetes Federation: a consensus on Type 2 diabetes prevention *Diabetic Medicine* 2007; 24:451-463.

Overview

- The International Diabetes Federation (IDF) convened a consensus workshop in 2006 to assess the increasing impact of Type 2 diabetes and the need for its prevention in both the developed and developing world.
- The document briefly describes the non-modifiable and modifiable risk factors associated with Type 2 diabetes.
- A review of the studies assessing the effectiveness of preventative interventions is presented.
- A general discussion of the economic benefits of diabetes prevention (and delay of progression) is presented, but no specific economic cost benefits are detailed.

The IDF strategy for diabetes prevention

- The diabetes prevention plan is based on modifying risk factors in two target groups:
 - o people at a high risk of developing Type 2 diabetes
 - o the entire population.
- Both groups should be targeted simultaneously and activities tailored to meet specific local needs.
- For people with an increased risk of developing Type 2 diabetes, a three-step plan is proposed:
 1. **Identification** of those who may be at a higher risk.
 2. **Measurement** of risk.
 3. **Intervention** to prevent the development of Type 2 diabetes.
- For the population approach:
 - o advice relating to maintaining a healthy weight and participating in physical activity is highlighted
 - o approaches need to be culturally sensitive
 - o cultural beliefs (e.g. about obesity) need to be understood and addressed.
- Government initiatives should include:
 - o advocacy
 - o community support
 - o fiscal and legislative.

1.4 World Health Organisation reports

1.4.1 World Health Organisation: Use of glycated haemoglobin (HbA1c) in the diagnosis of diabetes mellitus – abbreviated report of a WHO consultation, 2011.

Available at: http://www.who.int/diabetes/publications/report-hba1c_2011.pdf

- This report is an addendum to the diagnostic criteria published in the 2006 WHO/IDF report Definition and diagnosis of *diabetes mellitus and intermediate hyperglycaemia* (see section 1.4.2), and addresses the use of HbA1c in diagnosing diabetes mellitus. The report states:
 - o *'The WHO consultation concluded that HbA1c can be used as a diagnostic test for diabetes, provided that stringent quality assurance tests are in place and assays are standardised to criteria aligned to the international reference values, and there are no conditions present which preclude its accurate measurement.'*
 - o *'An HbA1c of 6.5% is recommended as the cut off point for diagnosing diabetes. A value less than 6.5% does not exclude diabetes diagnosed using glucose tests. The expert group concluded that there is currently insufficient evidence to make any formal recommendation on the interpretation of HbA1c levels below 6.5%.'*

1.4.2 *Definition and diagnosis of diabetes mellitus and intermediate hyperglycaemia: report of a WHO/IIDF consultation (2006).*

Available at: http://www.who.int/diabetes/publications/Definition%20and%20diagnosis%20of%20diabetes_new.pdf

- Current diagnostic criteria:
 - o **Diabetes:** Fasting plasma glucose ≥ 7.0 mmol/l (126 mg/dl) or 2-h plasma glucose* ≥ 11.1 mmol/l (200 mg/dl).
 - o **Impaired glucose tolerance (IGT):** Fasting plasma glucose < 7.0 mmol/l (126 mg/dl) and 2-h plasma glucose* ≥ 7.8 and < 11.1 mmol/l (140 mg/dl and 200 mg/dl).
 - o **Impaired fasting glucose (IFG):** Fasting plasma glucose 6.1 to 6.9 mmol/l (110 mg/dl to 125 mg/dl) and 2-h plasma glucose* (if measured) < 7.8 mmol/l (140 mg/dl).

* Venous plasma glucose 2-h after ingestion of 75 g oral glucose load. If 2-h plasma glucose is not measured, status is uncertain as diabetes or IGT cannot be excluded.

1.5 NICE guidance

1.5.1 *Preventing Type 2 diabetes: population and community interventions in high-risk groups and the general population (May 2011).*
NICE public health guidance 35.

Available at: <http://guidance.nice.org.uk/nicemedia/live/13472/54345/54345.pdf>

Quick reference guide available at: <http://guidance.nice.org.uk/nicemedia/live/13472/54347/54347.pdf>

- Type 2 diabetes, the associated risk factors, and types of intervention are defined, briefly:
 - o Type 2 diabetes is diagnosed in adults who are not pregnant by a glycated haemoglobin (HbA1c) level of 6.5% (48 mmol/mol) or above.
 - o Type 2 diabetes diagnosis can also be made by:
 - random venous plasma glucose concentration ≥ 11.1 mmol/l; or
 - fasting venous plasma glucose concentration ≥ 7.0 mmol/l; or
 - 2-hour venous plasma glucose concentration ≥ 11.1 mmol/l 2 hours after 75 g anhydrous glucose in an oral glucose tolerance test (OGTT).
 - In patients without symptoms, the test must be repeated to confirm the diagnosis using World Health Organisation criteria.
 - o Individual risk factors for Type 2 diabetes are discussed, including: weight, waist circumference, physical activity, previous history of gestational diabetes, and family history of diabetes.
 - o Population and community groups at higher risk are also discussed, including people of South Asian, African-Caribbean, black African and Chinese descent and lower socioeconomic groups.
 - o Interventions at an individual level and population/community level are defined.

- o 'Type 2 diabetes shares common risk factors with other non-communicable diseases including cardiovascular disease and some cancers. This means that recommendations made in previously published NICE guidance can also help prevent it', including:
 - supporting behaviour change
 - achieving and maintaining a healthy weight
 - effective weight loss programmes
 - physical activity
 - cultural appropriateness.
- There are 11 recommendations aimed at benefiting the health of adults (aged between 18-74), particularly those from black and minority ethnic groups, and those from low socioeconomic groups.
- The recommendations detail who should take action and what action they should take:
 1. Integrating national strategy on non-communicable diseases.
 2. Local joint strategic needs assessments.
 3. Developing a local strategy.
 4. Interventions for communities at high risk of Type 2 diabetes.
 5. Conveying messages to the whole population.
 6. Conveying messages to the local population.
 7. Promoting a healthy diet: national action.
 8. Promoting a healthy diet: local action.
 9. Promoting physical activity: national action.
 10. Promoting physical activity: local action.
 11. Training those involved in promoting healthy lifestyles.

1.5.2 *Diabetes guidance under development from NICE*

- *Type 2 diabetes: preventing the progression of pre-diabetes to Type 2 diabetes among high-risk groups* is due to be published in May 2012.

1.5.3 *Obesity (Dec 2006, updated Jan 2010) NICE clinical guideline 43.*

Available at: <http://www.nice.org.uk/nicemedia/pdf/CG43NICEGuideline.pdf>

- The guideline highlights that addressing preventable diseases, such as obesity, will lead to the greatest reduction in future healthcare costs.
- The guideline also acknowledges that obesity is a complex issue and it is unlikely to be solved by primary care management alone, and the environment in which we live also needs to be taken into account.
- The guideline contains recommendations at both a strategic and a delivery level.
- The guideline is divided into two key areas: public health and clinical care (see section 2.1).

Public health recommendations, in brief:

a) The public

- 'A person needs to be in 'energy balance' to maintain a healthy weight – that is, their energy intake (from food) should not exceed the energy expended through everyday activities and exercise'.
- Everyone should aim to maintain or achieve a healthy weight to improve health and reduce risk of certain diseases such as Type 2 diabetes.

- Adults should periodically check weight and waist measurement.
- People should follow strategies to help them balance 'calories in' with 'calories out', briefly:

Diet

- o Base meals on starchy foods (e.g. potatoes, rice, pasta, bread) choosing whole grains where possible.
- o Eat plenty of fibre-rich foods (e.g. oats, beans, lentils, peas, grains, seeds, fruit and vegetables).
- o Eat at least five portions of fruit and vegetables everyday.
- o Eat a low-fat diet.
- o Eat as little as possible of: fried foods, drinks/foods high in added sugar and other foods high in fat and sugar (e.g. some takeaways).
- o Eat breakfast.
- o Watch portion size of meals and snacks, and frequency of eating.
- o Minimise calories from alcohol.

Activity

- o Make enjoyable activities part of everyday life (e.g. walking, swimming, gardening, cycling).
 - o Minimise sedentary activities (e.g. sitting for long-periods at a computer, watching TV, playing videogames).
 - o Build activity into everyday life (e.g. walk upstairs instead of using the lift, take a walk at lunchtime).
- People with concerns about their own or their family's weight, diet or physical activity should seek advice from healthcare professionals (GP, practice nurse, pharmacist) or consult reliable sources of information (e.g. FSA, NHS Direct).
 - Weight loss programmes are only recommended if they: are based on a balanced healthy diet, encourage physical activity, expect people to lose no more than 0.5-1kg per week.
 - People with certain medical conditions such as Type 2 diabetes, heart failure, uncontrolled hypertension or angina, should check with their GP before starting on a weight loss programme.
 - Parents/carers of young children should also consider additional strategies to help their children establish healthy eating behaviours and maintain or work towards a healthy weight, for example:
 - o Eating regular meals without distraction (e.g. whilst watching TV) in a pleasant social environment.
 - o Parents/carers should eat with children, with all family members eating the same foods.
 - o Active play should be encouraged.
 - o Try to be more active as a family.
 - o Gradually reduce sedentary activities and consider alternatives.
 - o Encourage children to participate in sport or other active recreational activities.

b) The NHS

- These recommendations are predominantly aimed at healthcare professionals and NHS managers.
- Preventing and managing obesity should be a priority at strategic and delivery level, with resources dedicated to action.
- The delivery recommendations for healthcare professionals are divided by work settings: primary care, broader community settings, pre-school, childcare and family settings and the workplace.

c) Local authorities and partners

- The recommendations in this section apply to senior managers and budget holders in local authorities and community partnerships, who manage plan and commission services such as transport, sports and leisure facilities, open spaces, and to staff providing community-based interventions.
- Local authorities should work with industry and voluntary organisations to create and manage safe places for incidental and planned physical activity, addressing safety, crime and inclusion.

d) Early years settings

- Recommendations in this section are aimed at directors of children's services, strategic partnerships, senior managers, staff, children's trusts, children's centres, Healthy Start and Sure Start centres, childcare staff trainers, childminders and nannies.
- Sedentary activities should be avoided during play times, and regular active play and structured physical activity should be provided on a regular basis.
- Food procurement and healthy catering guidance issued by Department for Education and Skills, Food Standards Agency and Caroline Walker Trust should be implemented.

e) Schools

- The recommendations in this section apply to directors of children's services, staff, school governors, healthcare professionals working in schools, strategic partners and children's trusts.
- 'All schools should ensure that improving the diet and activity levels of children and young people is a priority for action to help prevent excess weight gain. A whole-school approach should be used to develop life-long healthy eating and physical activity practices'.
- The guideline is split into strategic and delivery recommendations.
- School polices should help children lead healthy lifestyles including: weight management, diet and physical activity (e.g. layout of buildings and recreational spaces, catering (including vending machines), taught curriculum (e.g. PE), travel plans (e.g. provision for cycling).

f) Workplaces

- The recommendations in this section apply to senior managers, health and safety managers, occupational health staff, union and staff representatives, employer's organisations, chambers of commerce and health professionals working with businesses.
- The guidelines are divided into two levels of recommendation depending on the size of the organisation and resources that are available to them.
- All work places should ensure that staff have the opportunity to eat a healthy diet and be physically active, through active promotion of healthy choices in restaurants, active travel policies for staff and visitors, supportive physical environment (showers, secure cycle park, improvements to stairwells) and recreational opportunities.

g) Self-help, commercial and community settings

- Primary care organisations should only recommend self-help, commercial and community weight programmes if they follow best practice.

1.5.4 *Behaviour change at population, community and individual levels (Oct 2007)*
NICE public health guidance 6.

Available at: <http://www.nice.org.uk/nicemedia/live/11868/37987/37987.pdf>

Quick reference guide available at: <http://www.nice.org.uk/nicemedia/live/11868/37925/37925.pdf>

- The guidance comprises of a set of generic principles ‘that can be used as the basis for planning, delivering and evaluating public health activities aimed at changing health-related behaviours’.
- Each principle sets out the target audience and the recommended action to be taken.
- The eight principles are:
 - **Principle 1: Planning interventions and programmes**
Target audience: Policy makers, commissioners, service providers, practitioners, and others working to change health-related behaviour.
 - **Principle 2: Assessing social context**
Target audience: NHS and non-NHS policy makers and commissioners planning behaviour change interventions or programmes, especially for those aimed at disadvantaged or excluded groups.
 - **Principle 3: Education and training**
Target audience: Policy makers, commissioners, trainers, service providers, curriculum developers and practitioners.
 - **Principle 4: Individual-level interventions and programmes**
Target audience: Commissioners, services providers, practitioners working with individuals.
 - **Principle 5: Community-level interventions and programmes**
Target audience: NHS and non-NHS policy makers and commissioners planning behaviour change interventions or programmes for communities.
 - **Principle 6: Population-level interventions and programmes**
Target audience: National policy makers, commissioners and others whose work impacts on population-level health-related behaviour.
 - **Principle 7: Evaluating effectiveness**
Target audience: Researchers, policy makers, commissioners, service providers and practitioners.
 - **Principle 8: Assessing cost-effectiveness**
Target audience: Policy makers, research funders, researchers and health economists.

1.5.5 *Four commonly used methods to increase physical activity: brief interventions in primary care, exercise referral schemes, pedometers and community-based exercise programmes for walking and cycling (Mar 2006)*
NICE public health guidance 2.

Available at: <http://www.nice.org.uk/nicemedia/live/11373/31838/31838.pdf>

Quick reference guide available at:

<http://www.nice.org.uk/nicemedia/live/11373/31840/31840.pdf>

- The guidance is aimed at professionals in the NHS, local authorities, and the voluntary sector with a direct or indirect involvement in physical activity and is based on six recommendations.

Brief interventions in primary care

- o *Recommendation 1:* Primary care practitioners should identify (whenever possible) inactive adults and advise at least 30 minutes of moderate activity on 5 days a week.
- o *Recommendation 2:* Advice should be tailored to the individual's needs, preferences and circumstances. Agreed goals should be set with appropriate follow-up over a 3-6 month period. Written information on the benefits of physical activity and local opportunities to be active should be provided.
- o *Recommendation 3:* The effectiveness of local strategies and systems to promote physical activity should be monitored. Particular focus should be placed on whether or not opportunistic advice is helping people from disadvantaged groups (e.g. disabled people).
- o *Recommendation 4:* Particular attention should be paid to the hard to reach and disadvantaged communities, including minority ethnic groups, when developing service infrastructure promoting physical activity.

Exercise referral schemes

- There is currently insufficient evidence to support the effectiveness of exercise referral schemes to promote physical activity.
 - o *Recommendation 5:* Exercise referral schemes should only be endorsed when part of a properly designed and controlled research study to determine effectiveness. Outcome measures should include knowledge, attitude and skills, in addition to measures of physical activity.

Pedometers and community-based walking and cycling schemes

- There is currently insufficient evidence to support the use of pedometers and walking and cycling schemes to promote physical activity. However, professionals should continue to promote walking and cycling, amongst other forms of physical activity, as a means of incorporating regular physical activity into people's daily lives.
 - o *Recommendation 6:* Pedometers, walking and cycling schemes should only be endorsed when part of a properly designed and controlled research study to determine effectiveness. Outcome measures should include knowledge, attitude and skills, in addition to measures of physical activity.

1.5.6 *Promoting physical activity, active play and sport for pre-school and school age children and young people in family, pre-school, school and community settings (Jan 2009)* *NICE public health guidance 17.*

Quick reference guide available at:

<http://www.nice.org.uk/nicemedia/live/11773/42885/42885.PDF>

- The guidance is aimed at those with a direct or indirect role/responsibility for promoting physical activity in children and young people, including those working in the NHS, education, local authorities and the wider public, private, voluntary and community sectors.
- The recommendations are based on key themes: promoting the benefits of physical activity and encouraging participation, ensuring high-level policy planning, consultation with and involvement of children and young people, planning and provision of spaces, facilities and opportunities, the need for a skilled workforce, and promoting physical activity and sustainable travel.
- Each recommendation details the target population, who should take the action, and what action they should take.
- There are 15 recommendations divided into five groupings, in summary:
 - a) National policy**
 - 1: National campaign.
 - b) High level policy and strategy**
 - 2: Raising awareness of the importance of physical activity.
 - c) Local strategic planning**
 - 3: Developing physical activity plans.
 - 4: Planning the provision of spaces and facilities.
 - 5: Local transport plans.
 - d) Local organisations: planning, delivery and training**
 - 6: Responding to children and young people.
 7. Leadership and instruction.
 8. Training and CPD.
 9. Multi-component school and community programmes.
 10. Facilities and equipment.
 11. Supporting girls and young women.
 12. Active and sustainable school travel plans.
 - e) Local practitioners: delivery**
 13. Helping children to be active.
 14. Helping girls and young women to be active.
 15. Helping families to be active.

1.5.7 *Workplace health promotion: how to encourage employees to be physically active (May 2008)*
NICE public health guidance 13.

Quick reference guide available at:

<http://www.nice.org.uk/nicemedia/live/11981/40678/40678.pdf>

- The guidance is aimed at employers and professionals in small, medium and large organisations who have a direct or indirect role/responsibility for improving health in the workplace.
- The recommendations aim to help employers and workplace health professionals prevent diseases associated with a lack of physical activity (e.g. Type 2 diabetes).
- There are four recommendation areas which include details of who should take the action, and what action they should take:

1. Policy and planning.
2. Implementing a physical activity programme.
3. Components of a physical activity programme.
4. Supporting employers.

1.5.8 Other NICE guidance under development

- Other guidelines currently in development relating to public health that will have an impact on diabetes prevention are:
 - o Obesity – working with local communities (expected Nov 2012).
 - o Walking and cycling: local measures to promote walking and cycling as a form of travel or recreation (expected Oct 2012).
 - o Using media to promote healthy eating (currently suspended).

1.5.9 Other NICE guidelines that may be of interest:

- **Promoting and creating built and natural environments that encourage and support physical activity. Public health guidance 8.** Quick reference guide available at: <http://www.nice.org.uk/nicemedia/live/11917/38989/38989.pdf>
- **Smoking cessation services. Public health guidance 10.** Quick reference guide available at: <http://www.nice.org.uk/nicemedia/live/11925/41664/41664.pdf>
- **Community engagement. Public health guidance 9.** Quick reference guide available at: <http://www.nice.org.uk/nicemedia/live/11929/39565/39565.pdf>
- **Maternal and child nutrition. Public health guidance 11.** Quick reference guide available at: <http://guidance.nice.org.uk/PH11/QuickRefGuide/pdf/English>

1.6 Diabetes UK. Position statement: Impaired glucose regulation (IGR) / non-diabetic hyperglycaemia (NDH) / prediabetes (2009).

Available at: http://www.diabetes.org.uk/About_us/Our_Views/Position_statements/Impaired-glucose-regulation-IGR-Non-diabetic-hyperglycaemia-NDH-Prediabetes/

- Diabetes UK have made a number of care recommendations relating to impaired glucose regulation (IGR), briefly:
 - o IFG and/or IGT should be known as IGR or non-diabetic hyperglycaemia (NDH); however, prediabetes may be more appropriate to communicate IGR to the public.
 - o Risk factors for IGR should be considered to be the same as the risk factors for Type 2 diabetes.
 - o Diabetes UK supports diabetes and IGR screening programmes, with an initial risk assessment, followed by blood tests if appropriate.
 - o Diabetes UK recommends that screening programmes should be established across the UK.
 - o People diagnosed with IGR (or at risk of developing Type 2 diabetes) should be offered intervention.

- o Lifestyle modification should be the first choice to prevent or delay Type 2 diabetes – in line with NICE guidance.
- o Pharmacotherapy that is not currently licensed for use in the UK for the specific management of IGR is not recommended.
- o Weight loss medications and bariatric surgery may be considered as an option for the management of obese individuals with IGR as per NICE guidance.
- o IGR should be communicated in a clear and consistent manner to minimise misunderstandings, highlighting its seriousness, the risks if it is not managed and outlining ways to prevent progression to Type 2 diabetes.
- o People identified with IGR should be followed up and monitored on an annual basis (at least).

1.7 Diabetes UK and South Asian Health Foundation recommendations on diabetes research priorities for British South Asians (2009). Editors: Khunti K, Kumar S and Brodie J.

Available at: http://www.diabetes.org.uk/upload/Reports/South_Asian_report.pdf

- This report highlights the gaps in current understanding of diabetes in the UK-based South Asian population, and provides recommendations and priorities for future diabetes research in this ethnic group.
- Recommendations for diabetes research priorities for British South Asians are grouped into 16 broad themes. With regard to screening and prevention of diabetes the following recommendations have been made:
 - o Screening for diabetes and non-diabetic hyperglycaemia:
 - Screening high-risk South Asian populations such as those who have had a myocardial infarction or stroke to determine the prevalence of Type 2 diabetes and IGR.
 - Qualitative studies leading to an enhanced understanding of cultural attitudes and beliefs, in order to inform the design of appropriate screening strategies.
 - Studies investigating methods of increasing engagement with these populations and uptake of screening invitations.
 - Studies exploring methods of evaluating some aspects of the impact of screening (for example, psychological outcomes) in populations where traditional methods may be inappropriate.
 - Studies to look at solutions to overcoming literacy and language issues.
 - o Prevention of Type 2 diabetes:
 - Large cohort studies in multi-ethnic populations, using objective measures of physical activity and nutritional status to investigate the extent to which differences in lifestyle factors between South Asians and white Europeans account for ethnic specific differences in metabolic and vascular health.
 - Establishing the efficacy and cost-effectiveness of pragmatic lifestyle diabetes prevention programmes, systematically tailored to the needs of South Asian ethnic minorities.

1.8 Designed for the Management of Adults with Diabetes Mellitus across Wales: Consensus Guidelines 2008.

Available at:

<http://wales.gov.uk/dhss/publications/health/guidance/diabetesconsensus/diabetese.pdf;jsessionid=N6DGMFJXvtmMv1bMCQQNnqh9bkF1kQg1b7dytQLFTRMT0t8QBB4b!2089923233?lang=en>

- General lifestyle advice is provided, including: diet, physical activity, alcohol intake, smoking cessation and weight management (pages 9-18).
- A pathway for the detection and management of people at high risk of pre-diabetes and diabetes is provided.

1.9 Diabetes Action Plan 2010: Quality care for diabetes in Scotland.

Available at: <http://www.scotland.gov.uk/Resource/Doc/321699/0103402.pdf>

- Primary prevention of Type 2 diabetes is discussed in terms of population level interventions, highlighting that tackling obesity is probably the greatest factor in reducing the incidence of Type 2 diabetes (section 2.1, page 16).
- The action plan states: 'NHS Boards to take into account the Obesity Strategy Route Map in their work with Community Health Partnerships and NHS Boards' planning partners'.

1.10 IMAGE Project (Development and Implementation of a European Guideline and Training Standards for Diabetes Prevention)

Further information available at: <http://www.image-project.eu>

- The three year IMAGE project started in 2007 to improve the ability of EU nations to prevent Type 2 diabetes through four specific objectives.
- It is funded by the EU Commission (2003-2008) and industrial sponsorship.
- The objectives of the IMAGE project are to develop:
 1. European practice-orientated guidelines for the primary prevention of Type 2 diabetes.
 2. A European curriculum for the training of prevention managers.
 3. European standards for the assessment, monitoring and quality reporting of Type 2 diabetes prevention.
 4. A European e-health training portal.

2. Policies and guidelines at an individual level

2.1 Obesity (Dec 2006, updated Jan 2010) NICE clinical guideline 43.

Available at: <http://www.nice.org.uk/nicemedia/pdf/CG43NICEGuideline.pdf>

- This section details the recommendations at an individual level, for societal interventions see section 1.4.2.

Clinical Care Recommendations, in brief:

a) Identification and classification of overweight/obesity

Adults

- o BMI to be used as measure of overweight/obesity (Table 1) but needs to be interpreted with caution as it is not a direct measure of adiposity, waist circumference may also be used in those with BMI <35kg/m².

Classification	BMI (kg/m ²)
Healthy weight	18.5 – 24.9
Overweight	25 – 29.9
Obese I	30 – 34.9
Obese II	35 – 39.9
Obese III	≥ 40

Table 1: Classification of overweight/obesity

- o The health risks associated with overweight/obese adults should be based on BMI and waist circumference measurements (Table 2).
- o Adults should be given information about their classification of clinical obesity and associated health risks (including the risk of Type 2 diabetes).

BMI classification	Waist circumference		
	Low	High	Very high
Overweight	No increased risk	Increased risk	High risk
Obese I	Increased risk	High risk	Very high risk
Waist circumference Men: <94cm = low, 94-102cm = high, >102cm = very high Women: <80cm = low, 80-88cm = high, >88cm = very high			

Table 2: Health risks assessment table

o Interventions should be discussed with the patient and based on criteria contained in Table 3.

BMI classification	Waist circumference			Co-morbidities present
	Low	High	Very High	
Overweight				
Obese I				
Obese II				
Obese III				

	General advice on healthy weight and lifestyle
	Diet and physical activity
	Diet and physical activity, consider drug therapy
	Diet and physical activity, consider drug therapy, consider surgery

Table 3: Level of intervention to be discussed with patient

Children

- o For children, BMI (adjusted for age and gender) is recommended as a practical measurement but needs to be interpreted with caution as it is not a direct measure of adiposity, waist measurement is not recommended.
- o Tailored interventions should be considered for children with a BMI at 91st centile, with assessment for co-morbidity considered for those with a BMI at 98th centile.

b) Assessment of overweight/obesity in children and adults

- Recommendations and advice is given for the assessment of overweight/obesity in adults and children.
- Particular reference is made to managing the reaction/response to diagnosis.
- Details of further health assessments (physical and psychological) that should be carried out after overweight/obesity diagnosis are provided, including indicators for referral.

c) Lifestyle interventions

Adults and children

- o Multi-component interventions are the treatment of choice. Weight management programmes should include behaviour change strategies to increase physical activity, improve eating behaviour and quality of diet and reduce energy intake.
- o Further recommendations including choice of intervention and provision of information and support are provided.

Children

- o Interventions for childhood overweight/obesity should address lifestyle in family and social settings.
- o Referral of overweight/obese children to an appropriate specialist should be considered for those with co-morbidities or complex needs (e.g. learning difficulties).

d) Behavioural interventions

- Behavioural interventions should be delivered by appropriately trained staff.
- Details of the content of behavioural interventions are given.

e) Physical activity

Adults

- o Physical activity is recommended for all, irrespective of whether they want to lose weight, due to the health benefits (e.g. reduced risk of Type 2 diabetes and cardiovascular (CV) disease).
- o 30 minutes of moderate-intensity physical activity, at least 5-days a week is recommended, either in one session or multiple sessions lasting at least 10 minutes.
- o People should be advised that to prevent obesity 45-60 minutes of moderate-intensity physical activity, at least 5-days a week may be required (especially if energy intake is not decreased).
- o People should also be advised that if they have been obese and have lost weight they may require 60-90 minutes of moderate-intensity physical activity per day to prevent weight gain.
- o People should be encouraged to reduce the amount of time they spend inactive (e.g. watching TV etc.).

Children

- o All children should be encouraged to increase physical activity.
- o Children should be encouraged to partake in at least 60 minutes of physical activity each day (one session or multiple sessions lasting at least 10 minutes per session).
- o Children should be encouraged to reduce sedentary behaviours.
- o Children should have the opportunity to partake in regular structured physical activity (e.g. football, swimming, dancing), with the choice of activity made with the child.

f) Dietary advice

Adults and children

- o Dietary changes should be individualised and tailored to food preferences with a flexible approach to reduce energy intake.
- o Restricted and nutritionally unbalanced diets should not be used as they are ineffective in the long-term and may be harmful.
- o People should be encouraged to improve diet even if they do not wish to lose weight because of other health benefits.

Adults

- o Energy intake should be less than energy expenditure.
- o Diets with 600kcal per day deficit (i.e. 600kcal less than a person needs to stay the same weight), or low-fat diets, in combination with expert support and intensive follow-up are recommended for sustainable weight loss.
- o Low-calorie diets (1000-1600kcal per day) may be considered but may not be nutritionally complete.
- o Very-low-calorie diets (less than 1000kcal per day) may be used for a maximum of 12 weeks, or intermittently, for people who are obese and have reached a plateau.
- o Diets of less than 600kcal per day should only be used under clinical supervision.
- o In the long-term, people should be encouraged to eat a balanced diet in line with other healthy eating advice.

Children

- o Any dietary recommendations should be part of multi-component intervention (i.e. dietary changes alone are not recommended).
- o Dietary changes should be appropriate for age and consistent with healthy eating advice.
- o For overweight/obese children, energy intake should be below energy expenditure.
- o Dietary changes should be sustainable.

g) Pharmacological interventions

Adults and children

- o Pharmacological interventions should only be considered after dietary, exercise and behavioural approaches have been started and evaluated.

Adults

- o Decisions about starting drug treatment should be made after discussing potential benefits and limitations with the patient.
- o Appropriate information, support and counselling on diet, physical and behavioural strategies should be provided in addition to drug therapy.
- o Information about patient support programmes should be provided.
- o Regular reviews to monitor the effectiveness of drug therapy and to reinforce lifestyle advice should be carried out.
- o The rate of weight loss may be slower in people with Type 2 diabetes.

Children

- o Pharmacological treatment is not generally recommended for children under 12 years.
- o Drug treatment is only recommended in children over 12 if there are physical or psychological co-morbidities.
- o Drug treatment should only be started in a specialist paediatric setting, by multidisciplinary teams with experience of prescribing to this age group (teams must also have expertise in drug monitoring, psychological support, exercise and diet interventions).
- o Data must be submitted to the proposed national registry.
- o Drug treatment may continue in primary care if local circumstances allow.

h) Surgical interventions

Adults

- o Bariatric surgery is recommended as a treatment option if all the following criteria are fulfilled:
 - BMI >40kg/m², or BMI between 35-40kg/m² with other significant disease that could be improved by weight loss (e.g. Type 2 diabetes).
 - All other non-surgical measures have been tried for at least 6 months and failed.
 - The person is receiving, or going to receive, intensive management from a specialist obesity management service.
 - The person is generally fit for anaesthesia and surgery.
 - The person commits to long-term follow-up.
- o In adults with BMI >50kg/m² bariatric surgery is recommended as first-line treatment option (if surgery is considered appropriate).
- o Other recommendations regarding the use of surgical interventions are given.

2.2 Other guidelines and consensus statements

- Many societies and other bodies have detailed guidelines or recommendations relating to the prevention of Type 2 diabetes, and/or tackling obesity, including:
 - o **Practice Guidance: Obesity. Royal Pharmaceutical Society 2005.** Available at: <http://www.rpharms.com/support-pdfs/rps-practice-guidance-obesity.pdf>.
 - o **Primary Prevention of Cardiovascular Disease and Type 2 Diabetes in Patients at Metabolic Risk: An Endocrinology Society Clinical Practice Guideline.** *Journal of Clinical Endocrinology and Metabolism* 2008; 93:3671-3689.
 - o **Evidence-based nutritional approaches to the treatment and prevention of diabetes mellitus.** **Diabetes and Nutrition Study Group (DNSG) of the European Association for the Study of Diabetes (EASD)** *Nutrition, Metabolism, and Cardiovascular Diseases* 2003; 14:373-394.
 - o **Guidelines on diabetes, pre-diabetes, and cardiovascular diseases: The Task Force on Diabetes Cardiovascular Diseases of the European Society of Cardiology (ESC) and of the European Association for the Study of Diabetes (EASD).** *European Heart Journal Supplements* 2007; 9 (Supplement C), C3–C74. doi:10.1093/eurheartj/ehl261.
 - o **Physical Activity/Exercise and Type 2 Diabetes: A consensus statement from the American Diabetes Association.** *Diabetes Care* 2006; 29 (6): 1443-1438.

3. Prevention of Type 2 diabetes: The evidence

The following sections contain a collection of the latest systematic reviews and primary research studies assessing the effectiveness of various interventions to prevent Type 2 diabetes; interventions to combat or prevent obesity have also been included.

3.1 Interventions at society level

3.1.1 Alberti KGMM, Zimmet P and Shaw J. **International Diabetes Federation: a consensus on Type 2 diabetes prevention** *Diabetic Medicine* 2007; 24:451-463.

- An overview and summary of the main findings of the major diabetes prevention studies is presented in the IDF consensus on Type 2 diabetes. In summary:

Lifestyle interventions

- Most of the studies have been aimed at preventing diabetes in people with impaired glucose intolerance (IGT).
- The interventions commonly aim to achieve and maintain healthy body weight through a combination of dietary and physical activity measures.
- The findings of five studies involving diet and/or exercise interventions are described in the paper. The relative risk reduction of Type 2 diabetes vs. placebo for each of these studies was: Malmö study (63%), Da Qing study (42%), The Finnish Diabetes Prevention Study (58%), Diabetes Prevention Program (58%) and Indian Diabetes Prevention Programme (28%).

Pharmacological Interventions

- The relative merits of drug treatments for the prevention of Type 2 diabetes are discussed, but it is generally recommended that these are used as secondary interventions following, or in conjunction with, lifestyle interventions.
- Metformin was shown to reduce relative risk of Type 2 diabetes by 26-31%, troglitazone by 55-75%, acarbose by 25%, orlistat by 37% and rosiglitazone by 60%.
- Some trials suggest that ACE inhibitors or ARB agents for hypertension, renal or CV disease reduction, may be beneficial in diabetes prevention.

3.1.2 Saaristo T, Moilanen L, Korpi-Hyövälti E, Vanhala M, Saltevo J, Niskanen L, Jokelainen J, Peltonen M, Oksa H, Tuomilehto J, Uusitupa M, Keinänen-Kiukaanniemi S. **Lifestyle intervention for prevention of Type 2 diabetes in primary health care: one-year follow-up of the Finnish National Diabetes Prevention Program (FIN-D2D)**. *Diabetes Care* 2010; 33(10):2146-51.

- The outcomes of a national diabetes prevention programme¹ after one year are detailed.
- 10,149 individuals were identified as at high risk for diabetes in primary care settings.
- One year after beginning the prevention programme, data was available for 2,798 individuals who did not have diabetes at baseline.
- The incidence of diabetes one year after the start of the prevention programme is detailed in Table 4.

Glucose tolerance at baseline	Incidence of diabetes (%)	
	Men	Women
Normal glucose tolerance	2.0	1.2
Impaired glucose tolerance	13.5	7.4
Impaired fasting glucose	16.1	11.3

Table 4: Incidence of diabetes one year into the diabetes prevention programme

- 17.5% of the subjects achieved weight loss of $\geq 5\%$ of body weight (no sex differences).
- Increased weight loss was associated with reduced risk of diabetes (Table 5).

Weight change (%)	Relative risk of diabetes (95% CI)
Lost ≥ 5	0.31 (0.16-0.59)
Lost 2.5-4.9	0.72 (0.46-1.13)
Gained ≥ 2.5	1.10 (0.77-1.58)

Table 5: Weight change and the relative risk of developing diabetes

- The authors report that the methods used for recruiting high-risk subjects were simple and easy to use, and that moderate weight loss in this high-risk group was effective in reducing the risk of diabetes.

¹ Details of the Finnish the prevention programme can be found in: Saaristo T et al. National type 2 diabetes prevention programme in Finland: FIN-D2D. *Int J Circumpolar Health* 2007; 66(2) 101-112.

3.1.3 Williams NH, Hendry M, France B, Lewis R, Wilkinson C. **Effectiveness of exercise referral schemes to promote physical activity in adults: systematic review.** *British Journal of General Practice* 2007; 57:979-986.

- A systematic review and meta-analysis assessing the effectiveness of exercise referral schemes on improving exercise participation in sedentary adults.
- 18 studies met the inclusion criteria (adults referred to exercise referral schemes from primary care, any outcome measure, any language) and were subsequently reviewed (6 RCTs, 1 non-RCT, 4 observational studies (2 surveys and 2 cohort studies), 6 process evaluations and 1 qualitative study).
- Exercise referral schemes were defined as 'referral by a primary care clinician to a programme that encouraged increased physical activity or exercise involving an initial assessment and a programme tailored to individual needs, as well as monitoring and supervision throughout the programme'.
- Five of the RCTs measured the proportion of people who were moderately active, defined as 90-150 mins of moderate intensity exercise per week, and these results were used in the meta-analysis.
- The meta-analysis revealed that exercise referral schemes resulted in a statistically significant increase in the number of sedentary people becoming moderately active; however, the relative risk reduction was small (RR 1.20 (95% CI 1.06-1.35)) and would mean that 17 people would need to be referred for one person to become moderately active.
- The other main findings of the review suggest that uptake of exercise referral schemes is poor and drop-out rates are high, which may account for small benefits revealed by the meta-analysis.
- Barriers to participation in, and adherence to, the schemes are discussed.
- The authors suggest that although exercise-referral schemes have a small effect on increasing physical activity in sedentary people, they may not be an efficient use of resources; future studies will need to address the uptake and compliance of the schemes by addressing the barriers described in the review.

3.1.4 Gillies CL, Lambert PC, Abrams KR, Sutton AJ, Cooper NJ, Hsu RT, Davies MJ, Khunti K. **Different strategies for screening and prevention of Type 2 diabetes in adults: cost effectiveness analysis.** *BMJ* 2008; 336(7654):1180-5.

- There are no definitive trials assessing the effectiveness of screening for Type 2 diabetes or IGT; only modelling studies and two cost simulation models have been carried out for the UK setting.
- A comparison of the cost effectiveness of four screening strategies, and subsequent interventions for the prevention and treatment of Type 2 diabetes.
- Cost effectiveness based on the development and evaluation of probabilistic, comprehensive economic decision analytical model, from screening to death.
- Screening strategies (costs based on 2006 prices – included cost of test and nurse's time but did not include cost of setting-up and running screening programme).
 1. One-off screening for Type 2 diabetes (treatment to prevent micro/macrovascular complications)²
 2. Screening for IGT and Type 2 diabetes with subsequent lifestyle interventions.
 3. Screening for IGT and Type 2 diabetes with subsequent pharmacological interventions.
 4. No screening – current practice.

² Approximately 50% with Type 2 diabetes are not diagnosed and 20-30% of these will already have complications.

Screening strategy	Estimated costs for each quality adjusted life year (QALY) gained	Probability of cost effectiveness at a willingness to pay threshold of £20k/QALY ³ (adjusted for lower compliance with intervention)
1. One-off screening for Type 2 diabetes	£14150	49%
2. Screening for IGT & Type 2 diabetes + lifestyle interventions	£6342	93% (88%)
3. Screening for IGT & Type 2 diabetes + pharmacological interventions	£7023	85% (84%)

Table 6: Estimated costs for each QALY gained, and the probability of cost effectiveness at a willingness to pay threshold of £20k/QALY based on a hypothetical population aged >45 years, with an above average risk of diabetes

- Screening for IGT in people at risk of Type 2 diabetes with lifestyle or pharmacological interventions have a very high probability of being cost effective at a willingness to pay threshold of £20,000 per QALY.
- Screening for Type 2 diabetes alone may not be cost effective.
- Compliance with interventions appears to be high in trials but more information is needed on long-term compliance with interventions, together with their potential harms and benefits.

3.1.5 Li R, Zhang P, Barker LE, Chowdhury FM, Zhang X. **Cost Effectiveness of Interventions to Prevent and Control Diabetes Mellitus: A Systematic Review**. *Diabetes Care* 2010; 33 (8): 1872-1894.

- A systematic review of 56 studies from 20 countries assessing the cost effectiveness of diabetes interventions recommended by the American Diabetes Association (ADA).
- Most of the paper relates to the control of diabetes.
- The following interventions relating to the prevention of diabetes were classed as very cost effective, with strong evidence:
 - o Intensive lifestyle interventions to prevent Type 2 diabetes among persons with IGT compared with standard lifestyle recommendations.
 - o Universal opportunistic screening for undiagnosed Type 2 diabetes in African Americans between 45 and 54 years old.

3.1.6 Waugh N, Scotland G, McNamee P, Gillett P, Brennan A, Goyder E, Williams R, John A. **Screening for Type 2 diabetes: literature review and economic modelling**. *Health Technology Assessment* 2007; 11(17).

- The objectives of this review were to:
 - o Reconsider the aims of screening for undiagnosed diabetes, and whether screening should be for other abnormalities of glucose regulation.

³ NICE considers each intervention on a case-by-case basis. In general, however, if a treatment costs more than £20,000-30,000 per QALY, then it would not be considered cost effective. More information on QALY is available at: <http://www.nice.org.uk/newsroom/features/measuringeffectivenessandcosteffectivenessstheqaly.jsp>

- o Review choice of screening test.
- o Consider what measures would be taken if IGT/IFG were identified by screening, and to examine evidence on treatment to prevent progression to diabetes in these groups.
- o Examine cost effectiveness of screening for diabetes.
- o Consider groups at higher risks at which screening might be targeted.
- There is now a stronger case for screening for undiagnosed diabetes primarily because treatments to reduce the risk of CV disease are less costly (statins), prevalence of obesity is rising and consequently Type 2 diabetes.
- There is a good case for screening for IGT:
 - o Evidence suggests that lifestyle measures and pharmacological treatment can reduce the proportion of people with IGT who would otherwise develop diabetes.
 - o Screening could be two-stage: (1) selection of people at higher risk (2) blood test.
- Choice of screening test:
 - o Oral glucose tolerance test (OGTT) is the best, but most expensive, inconvenient and has weak reproducibility.
 - o It is possible that more people would be tested and diagnosed if a more convenient test was used, rather than the OGTT.
 - o Fasting plasma glucose would miss people with IGT.
 - o Glycated haemoglobin does not require fasting, and may be the best compromise.
- This review looked at five economic studies assessing the costs and short-term outcomes of using different screening tests.
 - o The modelling exercise concluded that screening for diabetes appears to be cost effective for the 40 to 70 year age band.
 - o Screening is more cost effective for people in the hypertensive and obese subgroups.

3.2 Interventions at the individual level: Lifestyle and pharmacological

3.2.1 Gillies CL, Abrams KR, Lambert PC, Cooper NJ, Sutton AJ, Hsu RT, Khunti K. **Pharmacological and lifestyle interventions to prevent or delay Type 2 diabetes in people with impaired glucose tolerance: systematic review and meta-analysis.** *BMJ* 2007; 334(7588):299.

- Quantification of the effectiveness of pharmacological and lifestyle interventions at preventing or delaying the onset of Type 2 diabetes in people with IGT.
- High quality RCTs evaluating interventions to delay/prevent Type 2 diabetes in people with IGT, with development of Type 2 diabetes being an outcome measure were included in the review.
- Lifestyle interventions: diet and exercise.
- Pharmacological and herbal interventions: oral diabetes drugs (metformin, acarbose, rosiglitazone⁴), the anti-obesity drug orlistat, and a Chinese herbal remedy jiangtang bushen recipe.
- 21 trials met the inclusion criteria, 17 (n=8084) were included in meta-analysis.
- Trials were heterogeneous in terms of interventions, ethnicity, weight, age, definition of Type 2 diabetes and IGT.
- All meta-analyses provided strong evidence to support the benefit of the interactions.

⁴ Rosiglitazone has been withdrawn from the market (due to side effects) and is no longer available.

Lifestyle intervention	Hazard ratio (95% CI)	Pharmacological intervention	Hazard ratio (95% CI)
Diet	0.67 (0.49-0.92)	Diabetes drugs	0.70 (0.62-0.79)
Exercise	0.49 (0.32-0.74)	Orlistat	0.44 (0.28-0.69)

Table 7: Effect of lifestyle and pharmacological interventions on the risk of developing Type 2 diabetes in people with IGT

Intervention	Numbers needed to treat (95% credible interval)
Lifestyle	6.4 (NNTB 5.0 – NNTB 8.4)
Diabetes drugs	10.8 (NNTB 8.1 – NNTB 15.0)
Orlistat	5.4 (NNTB 4.1 – NNTB 7.6)
Herbal	4.0 (NNTB 16.9-NNTB 24.8)

Table 8: The number of people needed to treat (NNTB indicates beneficial effect of treatment; NNTH indicates harmful effect of intervention)

- Interventions can reduce the risk of developing Type 2 diabetes by half in people with IGT.
- Lifestyle interventions are at least as effective as pharmacological interventions.
- Lifestyle interventions were more effective in trials that recruited participants with higher BMI.
- Concluding points from the authors:
 - o Adverse effects of pharmacological interventions need to be fully understood to ensure potential harms and benefits are fully assessed (details of adverse effects are detailed in the paper).
 - o Strategies to assist compliance with lifestyle interventions need to be thought through and implemented.
 - o ‘Should what is fundamentally a lifestyle issue really be treated with a life-long course of medication?’

3.3 Interventions at the individual level: Lifestyle

- 3.3.1 Orozco LJ, Buchleitner AM, Gimenez-Perez G, Roqué i Figuls M, Richter B, Mauricio D. **Exercise or exercise and diet for preventing Type 2 diabetes mellitus.** *Cochrane Database of Systematic Reviews* 2008, Issue 3. Art. No.: CD003054. DOI: 10.1002/14651858.CD003054.pub3.

- Systematic review and meta-analysis assessing the effects of exercise alone, diet alone or the combination of exercise and diet on the prevention of Type 2 diabetes in people at high risk of developing the disease.
- RCTs of interventions that followed-up participants for at least six months were included.
- Trials containing participants belonging to any of the major risk groups for developing Type 2 diabetes were included (IGT, IFG, previous gestational diabetes, hypertension 140/90mmHg, family history of Type 2 diabetes, obesity, dyslipidaemia, high-risk ethnic groups).
- Interventions included: exercise vs control*, diet and exercise vs control*, diet vs exercise (*standard recommendations/care or no intervention).
- Primary outcomes: development of Type 2 diabetes, diabetes and cardiovascular related morbidity.

- Secondary outcomes: development of: IGT, IFG, anthropometric measures, blood pressure, lipid levels, quality of life, adverse effects, all-cause mortality, costs.
- Eight studies (in 25 publications) met the inclusion criteria:
 - Eight trials had exercise and diet (n = 2241) and a standard recommendation (n = 2509) arms.
 - Two trials had diet only arm (n = 167).
 - Two trials had an exercise only arm (n = 178).
- Study duration was between one and six years.
- The trials were heterogeneous in terms of inclusion criteria (interventions, ethnicity, age, weight and BMI) and in terms of the diagnostic definition criteria of IGT and Type 2 diabetes.
- Diet and exercise intervention groups:
 - There was a 37% reduction in the risk of developing diabetes.
 - Positive effects on weight, BMI, waist circumference and waist-to-hip ratio.
 - Improvement in blood pressure.
- Diet alone and exercise alone intervention groups:
 - There was no significant effect on the incidence of Type 2 diabetes in these groups.
- A combination of diet and exercise interventions can reduce the risk of developing Type 2 diabetes in high risk groups, but more trials are needed to assess the effectiveness of diet only or exercise only interventions.

3.3.2 Nield L, Summerbell CD, Hooper L, Whittaker V, Moore H. **Dietary advice for the prevention of Type 2 diabetes mellitus in adults.** *Cochrane Database Systematic Reviews* 2008, Issue 3. Art. No.:CD005102. DOI: 10.1002/14651858.CD005102.pub2.

- A systematic review assessing the effectiveness of the type and frequency of dietary advice for the prevention of Type 2 diabetes.
- Two RCTs met the inclusion criteria (dietary advice only interventions on the prevention of Type 2 diabetes, 1 year+ duration).
- There was insufficient data available for meta-analysis.
- Both of the dietary interventions included a reduction in energy intake and simple sugars, and an increase in fruit and vegetables.
- Study 1: Da Qing IGT and Diabetes study (n=263 participants randomised into two groups).
 - The incidence of diabetes in the dietary advice intervention group was reduced by 33% (p <0.03) over six years.
- Study 2: The Oslo Diet and Exercise Study (ODES) (n=95 participants randomised into two groups).
 - Positive effects on indicators of metabolic control, including reductions in insulin resistance, fasting blood glucose, BMI, blood pressure and fasting triglycerides, and increases in fasting HDL cholesterol.
- The evidence suggests that following an energy-controlled diet, together with a decrease in simple sugar intake and an increase in fruit and vegetable consumption has positive health benefits; however, further well-designed, long-term studies are required before definitive conclusions can be made about the best dietary advice for the prevention of Type 2 diabetes.

3.3.3 Norris SL, Zhang X, Avenell A, Gregg E, Schmid CH, Lau J. **Long-term non-pharmacological weight loss interventions for adults with prediabetes.** *Cochrane Database Systematic Reviews* 2005 Issue 2. Art. No.:CD005270. DOI:10.1002/14651858.CD005270.

- Systematic review assessing the effectiveness of dietary, physical activity, and behavioural weight loss, and weight control interventions for adults with prediabetes.
- Nine RCTs were identified (n=5168 participants), quantitative analysis was limited due to the heterogeneity of the interventions (component, content and intensity), populations and the setting of the studies.
- Characteristics of the interventions:
 - o Duration: 4 weeks – 10 years.
 - o Number of contacts: 4 – 78 (one study involved 28-day residential lifestyle intervention).
 - o Both individual and group interventions were used.
 - o *Dietary Interventions* included: seven studies involved caloric restriction, one study specified proportion of fats and carbohydrates in diet, one study carbohydrate restriction.
 - o *Physical activity* interventions varied and included: encouraging increased physical activity through counselling, supervised sessions several times a week, daily 2.5 hour aerobic session at a residential programme.
 - o *Behavioural interventions* included: goal setting, self-feedback with food or exercise diaries, stress management or improved coping skills. One study involved various high intensity behavioural techniques.
- Weight reduction at:
 - o 1 year follow-up: 2.8kg (95% CI 1.0 – 4.7), 3.3% of baseline body weight, BMI decreased by 1.3kg/m² (4 studies).
 - o 2 year follow-up: 2.6kg (95% CI 1.9 – 3.3) (3 studies).
- Three out of five studies showed an association between weight loss and a significant reduction in the incidence of diabetes at 3-6 years follow-up.
- The review discusses problems associated with attrition and the implication this may have on the interpretation of results.
- The authors suggest that future research needs to focus on developing strategies to sustain lifestyle changes; in addition, the long-term effects of weight loss interventions on morbidity and mortality need to be assessed.

3.3.4 Carter P, Gray LJ, Troughton J, Khunti K, Davies MJ. Fruit and vegetable intake and incidence of Type 2 diabetes mellitus: systematic review and meta-analysis. *BMJ* 2010; 341:c4229. Doi: 10.1136/bmj.c4229.

- A systematic review and meta-analysis assessing the independent effects of fruit and vegetable consumption on the incidence of Type 2 diabetes.
- Prospective cohort studies with independent measures of fruit, vegetable or fruit and vegetable consumption and data on the incidence of Type 2 diabetes were included.
- Six studies met inclusion criteria; four studies included separate data on the intake of leafy vegetables (this includes cabbage, cauliflower, brussel sprouts, lettuce, spinach and herbs).
- Increased consumption of leafy vegetables by 122g per day could reduce the risk of developing Type 2 diabetes by 14%.
- No significant benefits to increased fruit, vegetable or fruit and vegetables were found.
- A number of potential problems were reported, therefore the results should be treated with caution, for example:
 - o Very few studies met the inclusion criteria.
 - o Poor quality of studies e.g. power calculation not reported, some studies did not always adjust for appropriate confounding factors (e.g. age, BMI, family history), reporting of nutritional intake, not all papers used a validated tool to assess fruit and vegetable intake.
 - o Only one study was carried out in the EU (Finland).

o Heterogeneity of the studies – the authors suggest the need for the inclusion of nutritional biomarkers rather than relying entirely on food frequency questionnaires in nutritional observational studies.

3.3.5 Priebe MG, van Binsbergen JJ, de Vos R, Vonk RJ. **Whole grain foods for the prevention of Type 2 diabetes mellitus.** *Cochrane Database Systematic Reviews* 2008, Issue 1. Art. No.:CD006061. DOI:10.1002/14651858.CD006061.pub2.

- The effects of whole-grain foods for the prevention of Type 2 diabetes was assessed using one RCT and 11 prospective cohort studies.
- RCT:
 - o Whole-grain intervention showed a slight improvement of insulin sensitivity in obese hyperinsulinemic participants.
 - o However, the results should be treated with caution as the trial was of short duration, with a small sample size and the risk of bias was high.
- Cohort studies:
 - o The studies consistently report that high intakes of whole grain foods or cereal fibre lowers risk of the development of Type 2 diabetes.
 - o However, some of the studies were of poor quality; in addition, this design of study cannot establish a cause-effect relationship therefore the evidence is considered weak.
- To establish whether whole grain consumption has a protective effect on the development of Type 2 diabetes, well-designed long-term RCTs need to be carried out.

3.3.6 Colberg SR, Sigal RJ, Fernhall B, Regensteiner, JG, Blissmer BJ, Rubin RR, Chasan-Taber L, Albright AL, Braun B. **Exercise and Type 2 Diabetes: The American College of Sports Medicine and the American Diabetes Association: joint position statement.** *Diabetes Care* 2010; 33 (12): e147-e167.

- A large number of statements relating to the effects of exercise and Type 2 diabetes are presented; the quality of the evidence is graded for each of the statements.
- The position statement concludes that exercise plays a major role in the prevention and control of insulin resistance, prediabetes, gestational diabetes, Type 2 diabetes, and diabetes related health complications.

3.3.7 Gong Q, Gregg EW, Wang J, An Y, Zhang P, Yang W, Li H, Li H, Jiang Y, Shuai Y, Zhang B, Zhang J, Gerzoff RB, Roglic G, Hu Y, Li G, Bennett PH. **Long-term effects of a randomised trial of a 6-year lifestyle intervention in impaired glucose tolerance on diabetes-related microvascular complications: the China Da Qing Diabetes Prevention Outcome Study.** *Diabetologia* 2011 54(2):300-7.

- Randomised controlled trial to assess the effects of a 6-year lifestyle intervention for people with IGT on the development of retinopathy, nephropathy and neuropathy over a 20 year period.
- Over a 20 year period, the 6-year lifestyle intervention was associated with a 47% reduction in the incidence of severe, vision-threatening retinopathy, primarily due to the reduced incidence of diabetes in the intervention group. These benefits were not seen for nephropathy or neuropathy.

3.4 Interventions at the individual level: Pharmacotherapy

3.4.1 Alkhenizan AH, Alswes MA. **The role of renin blockers in the prevention of diabetes.**

Database of Abstracts of Reviews of Effects (DARE). Available at:

<http://www.crd.york.ac.uk/crdweb/ShowRecord.asp?LinkFrom=OAI&ID=12007008021>

Full reference: Alkhenizan AH, Alswes MA. **The role of renin blockers in the prevention of diabetes.** Saudi Medical Journal 2007; 28(1): 91-95. (unable to access original paper)

- A systematic review and meta-analysis assessing the effectiveness of renin blockers (angiotension-converting enzyme (ACE) inhibitors and angiotensin-receptor blockers (ARBs)) in the prevention of diabetes.
- Studies comparing ACE inhibitors (ramipril, captopril, trandolapril, enalapril or lisinopril) or ARBs (candesartan, valsartan or losartan) with placebo or other drugs used to treat hypertension (e.g. calcium-channel blockers, diuretics or conventional anti-hypertensives) were included in the review.
- The incidence of diabetes was significantly lower in the following treatment groups:
 - Renin blockers vs placebo (5 studies): relative risk (RR) 0.83, 95% CI 0.77-0.90; numbers-needed-to-treat (NNT) 568
 - Renin blockers vs other agents (8 trials): RR 0.79, 95% CI 0.75-0.84; NNT 436
 - Renin blockers vs calcium-channel blockers (3 trials): RR 0.81, 95% CI 0.74-0.88; NNT 62
 - Renin blockers vs diuretics (3 trials): RR 0.66, 95% CI 0.57-0.77; NNT 62
 - Renin blockers vs traditional anti-hypertensives (3 trials): RR 0.79, 95% CI 0.72-0.87; NNT 153
 - ACE inhibitors vs placebo (4 trials): RR 0.83, 95% CI 0.77-0.91; NNT 56
 - ACE inhibitors vs other agents (5 trials): RR 0.79, 95% CI 0.72-0.86; NNT 290
 - ARBs vs other agents (4 trials): RR 0.78, 95% CI 0.73-0.85; NNT 42
 - ACE inhibitors vs diuretics (2 trials): RR 0.66, 95% CI 0.57-0.78; NNT 95
- There was no significant difference in the incidence of diabetes in the following treatment group:
 - ACE inhibitors vs calcium-channel blockers (2 trials): RR 0.84, 95% CI 0.70-1.01
- The authors conclude that 'renin blockers reduce the incidence of new-onset diabetes and should be used as first-line therapy, where indicated, in patients at high risk of diabetes'.

3.4.2 Padwal RS, Rucker D, Li SK, Curioni C, Lau DCW. **Long-term pharmacotherapy for obesity and overweight.** Cochrane Database of Systematic Reviews 2003, Issue 4. Art. No.:

CD004094. DOI: 10.1002/14651858.CD004094.pub2.

This review was edited in 2009 with no change to conclusions. A summary of the findings are also available from:

Rucker D, Padwal R, Li SK, Curioni C, Lau DC. **Long-term pharmacotherapy for obesity and overweight: updated meta-analysis.** *BMJ* 2007; 335(7631):1194-9.

doi:10.1136/bmj.39385.413113.25

- A systematic review and meta-analysis to assess the effectiveness of anti-obesity drugs in reducing weight and improving health status.
- 30 trials met the inclusion criteria for the review (double blind randomised placebo controlled trials of approved anti-obesity drugs, used in adults (over 18 years) for 1+ years).
- The findings are summarised in the Table 9.

Drug	Number of participants	Weight loss kg (95% CI)	Incidence of Type 2 diabetes	Other positive outcomes	Adverse effects/events
Orlistat	10,631	2.9 (2.5-3.2)	Reduced from 9% to 6.2%	Improvements in waist circumference, BMI, total cholesterol, LDL cholesterol and blood pressure (BP).	Reduced HDL cholesterol. Gastrointestinal side effects.
Sibutramine ⁵	2623	4.2 (3.6-4.7)	N/A	Reduced waist circumference, BMI, triglyceride concentration, and increased HDL cholesterol.	Increased BP and pulse rate. Insomnia, dry mouth and constipation.
Rimonabant ⁶	6365	4.7 (4.1-5.3)	N/A	Reduced waist circumference, BP and triglyceride concentrations, and increased HDL cholesterol.	Psychiatric disorders (depression, anxiety, irritability, aggression).

Table 9: Effects of anti-obesity drugs on health status

- Other findings and limitations are discussed in the review, including:
 - o Attrition rates were high (30% for orlistat, 40% for sibutramine and rimonabant – most common reasons for early withdrawal were refusal of treatment, loss of follow-up, adverse effects).
 - o All studies demonstrated a positive effect; therefore, there is a possibility of publication bias. In addition, 27 of the studies received funding from the drug manufacturer.
 - o Participants in the studies were predominantly white, non-elderly patients – caution should be taken with regards to extrapolation to other populations.
- The authors conclude that since the average amount of weight loss is modest compared with placebo control, and most patients will remain considerably overweight/obese even with anti-obesity drug treatment; the decision to prescribe needs careful consideration of the risks and benefits.

⁵ Sibutramine has been withdrawn from the market (due to side effects) and is no longer available.

⁶ Rimonabant has been withdrawn from the market (due to side effects) and is no longer available.

3.4.3 *The NAVIGATOR Trial*

NAVIGATOR Study Group. **Effect of nateglinide on the incidence of diabetes and cardiovascular events.** *N Engl J Med.* 2010 22; 362(16): 1463-76.

NAVIGATOR Study Group. **Effect of valsartan on the incidence of diabetes and cardiovascular events.** *N Engl J Med.* 2010 22; 362(16): 1477-90.

Nathan DM. **Navigating the choices for diabetes prevention.** *N Engl J Med.* 2010 22; 362(16):1533-5.

- Double blind randomised clinical trial (two by two factorial design).
- Nateglinide did not reduce the incidence of diabetes.
- There was a weak but statistically significant reduction in the incidence of diabetes with valsartan (14% relative reduction; 3.7% absolute reduction).
- The editorial suggests that the prevention of diabetes is best achieved by lifestyle interventions together with metformin in selected people.

3.4.4 Zinman B, Harris SB, Neuman J, Gerstein HC, Retnakaran RR, Raboud J, Qi Y, Hanley AJ. **Low-dose combination therapy with rosiglitazone and metformin to prevent Type 2 diabetes mellitus (CANOE trial): a double-blind randomised controlled study.** *Lancet.* 2010. 10; 376(9735): 103-11.

- A double blind RCT assessing the effectiveness of low-dose combination therapy of rosiglitazone plus metformin in patients with IGT over a median period of 3.9 years.
- Incidence of diabetes occurred in significantly fewer (14%) individuals in the treatment group compared with placebo (66% relative risk reduction; 26% absolute risk reduction; number needed to treat was 4).

3.4.5 DeFronzo RA, Tripathy D, Schwenke DC, Banerji M, Bray GA, Buchanan TA, Clement SC, Henry RR, Hodis HN, Kitabchi AE, Mack WJ, Mudaliar S, Ratner RE, Williams K, Stentz FB, Musi N, Reaven PD; ACT NOW Study. **Pioglitazone for diabetes prevention in impaired glucose tolerance.** *N Engl J Med.* 2011 24; 364(12): 1104-15.

- A randomized, double-blind, placebo-controlled study to assess whether pioglitazone can reduce the risk of Type 2 diabetes in adults with IGT; median follow-up period was 2.4 years.
- Pioglitazone reduced the risk of conversion of impaired glucose tolerance to Type 2 diabetes mellitus by 72% compared with placebo, but was associated with significant weight gain and oedema.

3.5 **Interventions at the individual level: Surgery to tackle obesity**

3.5.1 Colquitt JL, Picot J, Loveman E, Clegg AJ. **Surgery for obesity.** *Cochrane Database of Systematic Reviews* 2009, Issue 2. Art. No.: CD003641. DOI:10.1002/14651858.CD003641.pub3.

- A systematic review assessing the effects of bariatric surgery on obesity; meta-analysis was not carried out due to the possible risk of bias.
- RCTs comparing different surgical procedures (20 studies), and RCTs (3 studies) and prospective (3 studies) cohort studies comparing surgery with non-surgical management of obesity were included in the review (only studies that reported measures at least one year post-surgery were included).

- Participants in the studies had to fulfil the standard criteria for obesity, i.e. those with a BMI >30kg/m² (current guidelines only recommend surgical interventions for obesity for those with BMI >40kg/m², or BMI >35kg/m² with comorbidities – see section 1.3.2.2).
- Surgical interventions resulted in greater weight loss compared with conventional obesity interventions; in addition, there was a reduction in co-morbidities such as Type 2 diabetes and hypertension, and in the use of medication.
- Improvements in health-related quality of life were reported after two years after surgery, but the effects were unclear 10 years post surgery.
- This paper also compared the effectiveness of different types of surgical procedure; in addition, differences between open and laparoscopic surgery are compared. However, definitive conclusions could not be drawn due to limited and poor quality data.
- The paper also assessed the comparative safety for each of the surgical interventions. All of the procedures were associated with adverse events; however, due to limited data, statistical comparisons could not be made. Therefore the authors conclude that caution should be taken when interpreting the comparative safety and effectiveness of surgical procedures.

3.6 Smoking and the risk of Type 2 diabetes

3.6.1 Willi C, Bodenmann P, Ghali WA, Faris PD, Cornuz J. **Active smoking and the risk of Type 2 diabetes: a systematic review and meta-analysis.** *JAMA* 2007; 298(22):2654-64.

- Systematic review and meta-analysis of studies assessing the association between smoking and the incidence of Type 2 diabetes.
- 25 prospective studies were found (n = 1.2 million), follow-up period between 5-30 years.
- 24 studies reported a relative risk greater than 1 (i.e. an increased risk).
- There was a greater risk for heavy smokers than lighter smokers, and the lighter smokers had a greater risk than ex-smokers – the authors suggest that this mimics the dose-response effect.
- Although the studies suggest that smoking is associated with an increased risk of Type 2 diabetes, a cause-effect relationship cannot be established through observational studies.

4. Commissioning guides and toolkits

4.1 **Commissioning Diabetes Prevention and Risk Assessment Services** from NHS Diabetes: available at: http://www.diabetes.nhs.uk/commissioning_resource/

4.2 NHS Health Check

Various resources and toolkits are available from the NHS Health Check website: Available at: <http://www.healthcheck.nhs.uk/>

Further NHS Health Check resources are available at:

http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_097490

4.3 Preventing Type 2 diabetes: population and community interventions in high-risk groups and the general population (May 2011). NICE public health guidance 35

4.3.1 *Slide set*

Available at: <http://guidance.nice.org.uk/PH35/SlideSet/ppt/English>

- This slide set and notes provides a framework for discussing the NICE guidance with a variety of audiences and can assist in local dissemination of the guidance. The presentation includes a 'questions for discussion' slide which can be used to increase opportunities for participation and interaction with an audience. The slide set can also be tailored for local audiences and circumstances.
- The slide set contains key messages – it does not cover all recommendations.

4.3.2 *Self-assessment tool*

Available at: <http://guidance.nice.org.uk/PH35/SelfAssessment/xls/English>

- The self-assessment tool is for use by any service, organisation or local partnership to determine how close their practice is to that recommended in the guidance and to help with prioritising implementation activity.

4.3.3 *Costing statement*

Available at: <http://www.nice.org.uk/nicemedia/live/13472/54349/54349.pdf>

- A costing statement has been produced as it has not been possible to estimate the national resource impact of implementing the guidance. The statement discusses the potential costs and savings that need to be estimated at a local level.

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