Maternal dietary patterns and gestational diabetes mellitus

Ellen Alma Tryggvadóttir

Supervisors: Professor Ingibjörg Gunnarsdóttir
and Associate professor Bryndís Eva Birgisdóttir

A thesis submitted to the degree of Master of Science in Human Nutrition
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HÁSKÓLI ÍSLANDS

Fæðuval íslenskra kvenna á meðgöngu og tengsl við meðgöngusykursýki

Ellen Alma Tryggvadóttir

Leiðbeinendur: Ingibjörg Gunnarsdóttir prófessor
og Bryndís Eva Birgisdóttir dósent

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Unit for Nutrition Research, University of Iceland and
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Ágrip

Inngangur: Góð næring á meðgöngu er afar mikilvæg fyrir heilbrigði móður og barns. Rannsóknir hafa bent til þess að fæðuval sé heilsusamlegra hjá þunguðum konum í kjörþyngd fyrir meðgöngu miðað við hjá þunguðum konum sem eru of feitar eða í ofþyngd fyrir meðgöngu. Offita við upphaf meðgöngu er einn áhættuþátta meðgöngusykursýki. Meðgöngusykursýki getur haft verulega slæmar afleiðingar fyrir bæði móður og barn. Markmið: 1) Að kanna hvort tengsl séu á milli fæðumynsturs á meðgöngu og hættu á meðgöngusykursýki. 2) Samanburður á fæðuvali þungaðra kvenna í kjörþyngd fyrir þungun og þeirra sem eru of þungar/feitar fyrir þungun.

Aðferðir: Um er að ræða ferilrannsókn framkvæmda í samtarfi við aðra rannsókn á kvennadeild Landspítalans þar sem íslenskum konum á aldrinum 18 - 40 ára var boðin þátttaka við 20. vikna ómskoðun á Fósturgreiningardeild Landspítalans. Þátttakendur vigtuðu allan mat og drykk í fjóra daga fljótlega eftir þátttöku (19. - 24. viku meðgöngu) og gengust síðan undir sykurþolspróf í kringum 23. - 28. viku meðgöngu. Fæðuupplýsingar voru skráðar í ICEFOOD forritið með kóðum úr ÍSGEM gagnagrunninum. Matardagbækur fengust frá 98 konum í kjörþyngd, 46 konum í yfirþyngd og 39 of feitum konum (n=183) sem voru nýttar í samanburð á fæðuvali. Af þessum konum fóru 86, 44 og 38 í sykurþolspróf (n=168) og hjá þeim síðarnefndu voru skoðuð tengsl fæðumynsturs við meðgöngusykursýki

Niðurstöður: 1) Fæðumynstur sem samanstóð af fisk og sjávarréttum; eggjum; grænmeti; ávöxtum og berjum; jurtaolíum; hnetum og fræjum; pasta; morgunverðarkorni; kaffi og te ásamt neikvæðu samhengi við gosdrykki og franskar kartöflur tengdist minni hættu á meðgöngusykursýki (OR: 0.54 95% CI: 0.30, 0.98). Tengslin voru enn til staðar eftir leiðréttingu ýmissa þátta (OR: 0.36 95% CI: 0.14, 0.94).

2) Konur í kjörþyngd fyrir meðgöngu virðast velja meira af hollum fæðutegundum en konur sem eru of feitar fyrir meðgöngu. Neysla ávaxta, grænmetis, fisks, trefja og Omega-3 virðist ekki vera nægileg meðal þungaðra kvenna á Íslandi. Skortur á D-vítamíni, joði og járni gæti verið til staðar hjá fjölda þeirra.

Ályktanir: Heilsusamlegt fæðumynstur gæti reynst verndandi gegn meðgöngusykursýki, sérstaklega hjá konum sem eru þegar í aukinni áhættu vegna ofþyngdar/offitu fyrir meðgöngu. Stór hluti þungaðra kvenna á Íslandi fylgja ekki ráðleggingum í fæðuvali.

Abstract

Background: A healthy diet during pregnancy is important for mother and child. Studies have implied that pregnant women of normal weight before pregnancy have healthier diets than those overweight or obese before pregnancy. Obesity is one of the risk factors for gestational diabetes mellitus (GDM), which is associated with negative health effects on both mother and child.

Objective: 1) Investigate associations between maternal dietary pattern and GDM. 2) Compare maternal diets for women of normal weight before pregnancy and overweight/obese before pregnancy.

Methods: A prospective observational study performed in cooperation with a separate study at the Gynecology department at the National hospital where Icelandic women aged 18 - 40 years were recruited at routine 20 week ultrasound at the Pre-natal diagnosis department. All participants kept a four day weighed food record as soon as possible following recruitment (weeks 19 - 24). All underwent an oral glucose tolerance test in weeks 23 - 28 Food data was recorded into the ICEFOOD calculating program based on the Icelandic food database (ISGEM). Food records were obtained from 98 normal weight women, 46 overweight women and 39 obese women (n=183), used to compare diets. Not all of these women underwent the OGTT or 86, 44 and 38 respectively (n=168) and only they were included in the study for GDM associations.

Results: 1) A dietary pattern comprising of seafood, eggs, vegetables, fruit and berries, vegetable oils, nuts and seeds, pasta, breakfast cereals, coffee and tea with a negative correlation to intake of soft drinks and french fries was associated with lower risk of GDM (OR: 0.54 95% CI: 0.30, 0.98). The association was still present in the adjusted model (OR: 0.36 95% CI: 0.14, 0.94). 2) Women of normal weight before pregnancy appear to have somewhat healthier maternal diet choices then pregnant women who are obese before pregnancy. Dietary intake of fruits, vegetables, fish, fiber and Omega-3 is lacking among pregnant women in Iceland. A number of the women may be at risk of deficiency for vitamin D, Iodine and Iron.

Conclusions: Adhering to a prudent dietary pattern in pregnancy may prove beneficial in preventing GDM, especially among women already at higher risk due to overweight/obesity before pregnancy. Maternal diet in Iceland could be improved.

Aknowledgements

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Table of contents

Index of tables

Index of figures

Abbreviations

AR	Average requirement
BMI	Body mass index
DASH	Dietary approach to stop hypertension
DHA	Docosahexaenoic acid
EPA	Eicosapentaenoic acid
FPG	Fasting plasma glucose
g	Gram
$\mathbf{G_0}$	Fasting glucose
GDM	Gestational diabetes mellitus
GDM-study	Get diabetics moving-study
GI	Glycemic index
HEI	Healthy Eating Index
WHO	World Health Organization
HOMA-IR	Homeostasis Model Assessment of Insulin Resistance
$\mathbf{I_0}$	Fasting insulin
IOM	Institute of medicine
IPAQ	International Physical Activity Questionnaire
MET	Metabolic Equivalent of Task
mg	Milligram
NTD	Neural tube defects
OGTT	Oral glucose tolerance test
RDI	Recommended daily intake
TAC	Total antioxidant capacity
VIF	Variance inflation factor
µg	Microgram

1 Introduction

A diverse and healthy diet is extremely important during pregnancy for the mother and child. During this time the mother needs to fulfill both her own energy- and nutrient requirements in addition to those of her child. The availability of all necessary nutrients is crucial during this time to ensure a normal and healthy growth process [1, 2]. Maternal diet studies have implied that a large number of pregnant women do not follow dietary guidelines and that in several cases they are not able to reach the recommended intake for many nutrients. The results vary somewhat between different countries [3-11]. A few observational studies have been performed in Iceland assessing dietary intake for pregnant women [12-16], suggesting that fish intake is limited in part of the pregnant population, vegetable intake is low and many women do not reach recommended intake levels of vitamin D [12, 13, 16]. Several studies have emphasized the importance of the maternal diet by demonstrating its associations to the mother's risk for gestational diabetes mellitus (GDM) [17-21]. However most of these studies have focused on specific food groups or nutrients and only a limited number have studied dietary patterns. As foods may have a combined effect these are important additional analyses. It may prove useful to gather information on local dietary patterns as they may vary between different countries. Results of such studies may provide the tools to create successful intervention studies.

The primary aim of this thesis was to investigate maternal dietary patterns and the associations to gestational diabetes mellitus in a group of pregnant women in Iceland (Appendix I). The secondary aim was to compare maternal diets of women who are normal weight before pregnancy and those who are either overweight or obese before pregnancy.

2 Background

2.1 Gestational diabetes mellitus

Gestational diabetes mellitus has been defined as glucose intolerance at any degree that either commences or is diagnosed during pregnancy. The same definition has been used whether insulin treatment is needed in combination to dietary modifications or not, even if symptoms remain after pregnancy. Therefore it is both possible that the glucose intolerance has existed before the pregnancy or that it started during pregnancy [22]. Most people who have impaired glucose tolerance exhibit less glucose uptake stimulated by insulin. To compensate for this the β-cells start secreting more insulin and thus create a state of hyperinsulinemia [23]. β-cells and the liver seem to regulate concentrations of both plasma glucose and insulin levels in a loop of negative feedback. GDM is like other forms of diabetes when insulin levels secreted are not sufficient to meet demands. It has been proposed that the metabolic dysfunctions associated with gestational diabetes begin during the first trimester [24]. However, during the first half of pregnancy it is quite normal for both postprandial and fasting plasma glucose to be lower than normally seen in non-pregnant women [25] as pregnancy is a time of complex metabolic and hormonal changes. These changes involve an increase in insulin resistance which is meant to increase maternal plasma glucose and subsequently its availability to the fetus [26]. When insulin mediated glucose uptake of cells is impaired, the pancreas needs to increase the amount of insulin secreted to prevent hyperglycemia [23].

2.2 Diagnosing gestational diabetes mellitus

There is to date a lack of global uniformity regarding the diagnoses of GDM and screening methods may also differ [27]. One method of screening is a two hour 75 gram oral glucose tolerance test, where fasting blood glucose is first measured, then blood glucose is tested at one and two hours after glucose administration [27]. Screenings for women considered at risk, are usually performed between week 24 and 28 of gestation [25]. According to recent recommendations from the World Health Organization (WHO) there should be two different references used when diagnosing diabetes in pregnancy. One is aimed at identifying those with diabetes mellitus in pregnancy without previous diabetes diagnoses, yet display severely high glucose levels. The other classifies those who have GDM. According to the recommendations from WHO, diabetes mellitus in pregnancy should be diagnosed in cases where fasting plasma glucose is measured ≥ 7.0 mmol/l or the two hour plasma glucose is ≥ 11.1 mmol/l after a 75 gram oral glucose tolerance test. Also if the person displays symptoms of diabetes and a random test of plasma glucose is ≥ 11.1 mmol. The reference for GDM is fasting plasma glucose between 5.1 and 6.9 mmol/l, the one hour plasma glucose measured ≥ 10.0 mmol/l or the two hour plasma glucose is between 8.5 and 11.0 mmol/l after a 75 gram oral glucose tolerance test. If one, two or all of these criteria are met the woman is diagnosed with GDM [25].

2.3 Proposed mechanism

The reasons for the dysfunction of cells in the pancreas leading to the lack of insulin in GDM are not entirely clear. In most women diagnosed with GDM the diminished insulin secretion is because of either β-cell dysfunction caused by genetic reasons, autoimmune dysfunction or a chronic state of insulin resistance [28]. Obese women have higher rates of insulin resistance than normal weight women in the beginning of pregnancy which when added to the insulin resistance accompanying a normal pregnancy (usually an increase of 50-60%) has an effect on the metabolism, leading to an excess of cytokines and nutrients in the environment surrounding the fetus [24, 29]. GDM is thought to display a similar pathophysiology as displayed in the metabolic syndrome in relation to inflammation, hypertension and hyperlipidemia, the link being hyperinsulinemia and an increase in insulin resistance. So it becomes more likely for a woman to develop gestational diabetes when she has pre-pregnancy insulin resistance [24, 29]. Women who have GDM have been shown to have higher concentrations of triglycerides in blood [30] and to demonstrate less insulin secretion when compared to women with normal glucose tolerance. If insulin resistance persists after gestation it may lead to an inability to sustain the excess insulin secretion needed, which can lead to the progression of type 2 diabetes [28]. A woman diagnosed with GDM should undergo testing six weeks or more after pregnancy to determine whether she has normoglycemia, diabetes type 1 or 2, impaired fasting glucose or impaired glucose tolerance [25, 31]. Homeostasis Model Assessment of Insulin Resistance (HOMA-IR) is a calculation method used to assess levels of insulin resistance by using results of fasting glucose and fasting insulin measurements [32]. In GDM there appear to be two forms of insulin resistance. One is a physiological type of insulin resistance beyond what is normally seen in the last trimester of pregnancy in a normal pregnancy, which is displayed by altered insulin signaling that may result in a decrease in glucose uptake stimulated by insulin in the skeletal muscles. Usually the insulin resistance dissipates after gestation which may suggest that it is brought on by factors associated with the pregnancy [24, 28, 31]. The other form of impaired insulin response is associated with pre-pregnancy metabolic dysfunction which in addition to the physiological type of insulin resistance that occurs during normal pregnancy may result in more severe cases of insulin resistance during pregnancy. It involves both increased hepatic production of glucose and a decrease in glucose uptake stimulated by insulin. In the skeletal muscles an insulin signal enables glucose uptake as a result of the insulin receptor tyrosine being phosphorylated. One of the proposed mechanisms leading to the obesity related increased insulin resistance has been a decrease in tyrosine phosphorylation in the skeletal muscles. Another mechanism may be the inhibition of insulin signaling due to an increase in serine phosphorylation of the insulin receptor. An increase in insulin resistance in pregnancy has been associated with cytokine disruptions of insulin signaling [24, 28].

2.4 Negative effects of gestational diabetes mellitus

There are many negative factors that have been associated with GDM for both mother and child. Having GDM has been associated with a greater risk of miscarriage, gestational hypertension, pre-eclampsia, trauma at birth and having infants that are very large, which in turn can lead to a higher risk of caesareans, prematurity and shoulder dystocia [33-37]. Women who have been diagnosed with GDM are also at a greater risk of diabetes later in life [37-40]. GDM may also be associated with a delay in lactation initiation [41]. Infants born to GDM women are at a higher risk of suffering from various malformations and Erb's palsy due to shoulder dystocia [33]. For the child there is also a risk of in utero growth restriction, hypoglycemia [34] and an increased risk of diabetes 2 later in life [37, 42-46]. Any increase in maternal plasma glucose has been demonstrated to have a related increase in birth weight due to hyperinsulinemia [47] and adiposity present in the infant at birth [48]. According to the hypothesis by Pedersen the increase in transference of nutrients to the infant is due to elevated glucose levels because of the presence of diabetes in the mother. Increased glucose transferred to the fetus then results in a hyper secretion of insulin in utero and a subsequent increase of glucose utilization by the fetus [49]. An increase in placental cytokine production and expression in GDM may be related to the insulin resistance developed in pregnancies. It may be possible that fetal insulin can have a modifying effect on gene expression in the placenta, glycogen deposits and expansion of blood vessels [28]. The increase in fetal growth may also be associated with an increase in lipid availability due to changes in maternal metabolism [29]. Children born to obese women are more likely to become obese themselves and develop dysfunctions in metabolism during childhood. And thus if the child is female she may be more likely to be obese herself during childbearing years continuing the cycle of obesity and diabetes risk [50].

2.5 Risk factors

Women who are overweight or obese have a greater risk of being diagnosed with GDM than women of normal weight [14, 40, 51]. According to a recent Icelandic study the rate of GDM was 10% among obese women, 2.7% among women who were overweight and 1.3% among women of normal weight [52]. A higher risk of being diagnosed with GDM is also associated with maternal age, a family history of diabetes 2, previous diagnoses of GDM or glucose in the urine, previous delivery of a large child and having been diagnosed with Polycystic Ovarian Syndrome (PCOS) [28, 53, 54]. Hyperlipidemia may also increase the risk of GDM by influencing cytokine expression. The aforementioned risk factors are all unmodifiable for the women once they are pregnant but additional risk factors that pregnant women are able to modify in an effort to decrease their risk for GDM are gestational weight gain, maternal diet and exercise. Exercise before and during pregnancy is thought to possibly lower risk of GDM [55, 56] although quality evidence is considered limited [57]. However incorporating physical activity in pregnancy for at least 30 minutes a day is recommended for all pregnant women [56, 58].

2.5.1 Weight gain in pregnancy

In Iceland the official recommendation for gestational weight gain is 12-18 kg for normal weight women (BMI <25) and 7–12 kg for women who are overweight or obese (BMI ≥25) before pregnancy [59]. This is similar to recommendations from the Institute of medicine (IOM) where the optimal weight gain in pregnancy is 12.5–18 kg for underweight women (BMI <18.5 kg/ m2), 11.5–16 kg for normal weight women (BMI 18.5–24.9 kg/m2), 7–11.5 kg for overweight women (BMI 25.0–29.9 kg/ m2) and 5–9 kg for obese women (BMI ≥30.0 kg/m2) [60]. A high rate of gestational weight gain, particularly in early pregnancy, has been linked to a greater risk of GDM [61, 62]. Excessive gestational weight gain has also been associated with several adverse maternal and neonatal outcomes [63, 64] and has also been linked to lifestyle factors, although social- and genetic factors are also involved [64]. When women gain excessive weight during pregnancy it increases both birth weight and postpartum weight, in addition to being a likely prediction of obesity in the future for both mother and child [65, 66]. By using different criteria’s for recommended pregnancy weight gain based on a calculated pre-pregnancy BMI (kg/m^2) it may be possible to achieve better pregnancy outcomes [67] as it seems that women who are overweight are more likely to gain excess weight during pregnancy [14]. Being overweight or obese before pregnancy presents an independent risk of adverse pregnancy outcomes and so it is especially important for these women to avoid excessive weight gain in pregnancy [68, 69]. A combination of healthy diet choices and increased physical activity during pregnancy may prove useful in preventing excessive gestational weight gain [70] in addition to lowering weight retention after birth [71].

2.6 Dietary guidelines in pregnancy

The Icelandic guidelines for diet during pregnancy recommend eating a variety of nutrient dense foods and to limit consumption of processed foods and added sugar. The goal is to eat at least 500 grams of fruit and vegetables every day, fish at least two times a week, choose whole grains and fiber rich cereals, choose low fat dairy products, use oil or liquid fats instead of solid fats, use salt conservatively, take cod liver oil or choose another source of vitamin D and drink water [59]. Dietary recommendations for pregnant women in several countries such as: Denmark, Sweden, Norway, Britain and the United states appear to be similar to the Icelandic guidelines [72-77]. However in Denmark the recommendation is six pieces of fruits and vegetables per day and fish and fish products several times a week [75] which is similar to Norway where further a maximum limit of fatty fish has been set to 400g per week. They also recommend eating no more than 500g of red meat per week [73]. All Icelandic women of childbearing age are recommended to take folic acid supplements.

2.6.1 Folate

Folate is a water soluble vitamin-B complex that can be found in foods such as leafy green vegetables, fruit and beans. Folic acid is the oxidized and more active form of this vitamin and has greater bioavailability than folate. Folic acid is the form used as a supplement and food additive [78]. Folate is necessary for many aspects of overall health, normal growth and development. It acts as a cofactor in many biological reactions including roles regarding the genome and gene expression, amino acid metabolism and neurotransmitter synthesis [79]. Women of childbearing age in Iceland are advised to supplement with 400 µg daily. This is especially important one month prior to conception and during the first trimester [79-81]. It has become widely accepted that pre-conceptional supplementing of folic acid can reduce the prevalence of Neural tube defects (NTD) [79, 82-86]. Neural tube defects are thought to be caused by both genetic disposition and environmental factors combined. The result of which is failure of the spine to close during embryonic stage which can be fatal or cause paraplegia with paralysis in the lower extremities [78, 79]. Some research has indicated that folic acid intake may also reduce the risk of cleft lip and palate in the offspring [87-89] although not all studies agree on this and it has been proposed that the risk reduction is rather due to multivitamin supplementation than folic acid alone [90]. In addition folate is thought to have beneficial effects on brain development and function in the offspring [91] and that it may possibly prevent some cardiovascular malformations [92]. Recent studies have also demonstrated a positive association between folate intake and improved birth weight [93, 94]. Some countries have chosen to fortify a number of foods with folic acid since supplementation recommendations have not always been effective [95, 96]. There has been some speculation regarding the safety of folic acid supplementation and fortification as folate may contribute to masking B_{12} deficiency. Some fear that it may also have a negative effect on cancer and tumor growth [97] but this has been refuted by others and the hypothesis is thought to lack sufficient evidence [98]. Recently there has been debate as to whether it may be beneficial to change recommendations toward multivitamin supplementation instead of folate alone [99-101] but more evidence is needed before such suggestions can be formally made [102].

2.6.2 Vitamin D in pregnancy

Insufficient vitamin D levels during pregnancy appear to be a worldwide problem, even in some countries with high levels of sun exposure where clothing habits may interfere [103-105]. Vitamin D is known to have an integral part in the maintenance of calcium homeostasis in the body. That is achieved by its involvement in calcium absorption, reabsorption and bone mineralization. Recent studies have indicated that the role of vitamin D may be more extensive than previously thought and that it may also include a part in immune function and other health related factors [106, 107]. The body is able to synthesize vitamin D from direct exposure to the sun but in northern parts of the world such as Iceland, that option is only viable during the summer and so an alternative source of vitamin D is specifically recommended during the remaining months of the year [81, 108]. Some foods such as fortified milk and cereals, oil, fatty fish and eggs contain a small amount of vitamin D but in Iceland the main source is Lýsi (cod liver oil). Currently the recommended daily dosage in Iceland of vitamin D is 15 µg for women of childbearing age [109]. Because of the involvement vitamin D has in calcium homeostasis it is important to maintain adequate levels during pregnancy to prevent rickets and improve bone health in the offspring [103, 106, 107, 110-112]. A possible link between vitamin D deficiency and abnormal glucose metabolism has also been demonstrated. In a number of studies pregnant women with gestational diabetes appeared to have lower levels of vitamin D [104, 105, 113-115]. In addition some of the recent literature has indicated that low vitamin D levels may be associated with an increased risk of preeclampsia [112, 115, 116] and bacterial vaginosis [112, 115]. In accordance to this some studies have indicated that by supplementing vitamin D during pregnancy it is possible to raise its levels and subsequently decrease the risk of infections and preterm birth [111], atopy and asthma in the child later on [117], preeclampsia [116, 118], bacterial vaginosis [118] and improve fetal growth and infant immune function [116]. But not all researchers agree with the hypotheses on the safety and health benefits of vitamin D supplementation [119, 120] and caution may be warranted regarding over supplementation, since some studies have demonstrated an adverse effect of high levels of vitamin D, such as a higher risk of food allergy in the offspring [121] and pregnancy-associated breast cancer [118]. There seems to be a lack of worldwide consensus regarding the optimal dosage and procedure regarding vitamin D supplementation during pregnancy but most studies highlight the urgent need for more randomized control trials on this subject [106, 113, 114, 120, 122-124].

2.7 Dietary patterns

Recently there has been a greater focus on investigating the combined effect of various foods or food groups on health and health related factors as an addition to investigating isolated foods or nutrients. By ascertaining specific dietary patterns from information on dietary intake in large groups or countries it is then possible to investigate associations between the patterns and available health factors. There are mostly two methods used to find dietary patterns. One is a data-driven statistical methodology or a posteriori and the other is the index methodology or a priori [125, 126]. In the first method dietary patterns are found by using cluster analysis, factor analysis or principal component analysis in datasets to identify any dietary patterns among participants. The second one is when a predefined base such as dietary recommendations for example are used in conjunction with results of dietary data to create an index of adherence to the recommendations. Dietary patterns that have been demonstrated and consequently studied are for example the Mediterranean diet, Western diet and a Prudent diet. However the definitions for foods and food groups within those patterns may vary between different investigating parties [126].

2.7.1 Diet and gestational diabetes mellitus

Some studies have suggested that pregnant women of normal weight have a healthier diet choice than pregnant women who are overweight or obese [127-130]. One study performed in Iceland demonstrated that overweight or obese women were more likely to excessively increase their overall energy consumption and consequently gain excessive weight during their pregnancy [14]. A healthy diet prior to pregnancy is thought to decrease the risk for GDM [131, 132]. Some studies credit certain factors of the diet to be directly associated with the risk of GDM such as higher consumption of soft drinks [133], increased consumption of energy [21], fat especially saturated fat [134] and decreased consumption of polyunsaturated fat and carbohydrates [17-21]. Long chain polyunsaturated fatty acids are thought to have an anti-inflammatory effect [24]. A few studies have been conducted on the association between vitamin D and GDM. Some demonstrate a link between low plasma 25(OH) D and an increased risk of GDM [135, 136] while others do not [137]. Some research suggests that a lack of vitamin D is associated with an imbalance in glucose metabolism [104, 138, 139]. However even though studies point to direct associations between isolated foods or nutrients and GDM it must be considered that the relevant intake may correlate with intake for a different food or nutrient which may have a combined effect. For instance a high consumption of vegetables, nuts and seeds may be strongly correlated to fish consumption which in combination provides good sources of folate, iodine, vitamin D and Omega-3. Following either a healthy-, Mediterranean or DASH diet has been related to a decrease in risk for GDM [140]. One study demonstrated a greater GDM risk for Latin women following an unhealthy Western type diet when compared to a prudent dietary pattern [141].

An overview of studies assessing the relationship between total diet quality and risk of GDM is given in Table 1. More studies are needed in order to define dietary patterns associated with lower GDM [142] and results from observational studies need to be confirmed in interventional studies [143, 144].

Table 1

Author, year, country/Study design	Population subject characteristics/ Dietary assessment method	Exposure/Intervention	Outcome	Results
Karamanos B [143], Greece, 2013 Observational study	1076 pregnant women from ten Mediterranean countries Validated questionnaire	Mediterranean diet index was computed and its adherence associations to GDM investigated	GDM assessed by 75-g OGTT at the 24th-32nd week of gestation	Adherence to a Med Diet pattern of eating is associated with lower incidence of GDM (OR=0.655 *P*=0.004.) and better degree of glucose tolerance, even in women without GDM
Asemi Z [144] 2013 Iran. Randomized ctrl trial	32 pregnant women diagnosed with GDM at 24 to 28 week gestation	Participants were randomly assigned to consume either the control (n = 16) or DASH diet (n = 16) for 4 weeks	Fasting blood samples were taken at baseline and after 4 week of intervention to measure fasting plasma glucose (FPG), serum insulin, and hs-CRP, homeostasis model of assessment-insulin resistance (HOMA-IR), plasma total antioxidant capacity (TAC), and total glutathione levels (GSH)	Consumption of the DASH diet in pregnant women with GDM had beneficial effects on FPG (-7.62 vs 3.68 mg/dL *P*=0.02), serum insulin levels (-2.62 versus 4.32 μIU/mL, *P*=0.03), HOMA-IR score (-0.8 versus 1.1; *P* = 0.03), plasma TAC (45.2 versus -159.2 mmol/L; *P* < 0.0001), and total GSH levels (108.1 versus -150.9 μmol/L; *P* < 0.0001)
Asemi Z [145] 2012, Iran. Randomized ctrl trial	34 women diagnosed with GDM at 24-28 weeks gestation	Subjects were randomly assigned to consume either the control diet (n 17) or the DASH eating pattern (n 17) for 4 weeks	Fasting blood samples were taken at baseline and after 4 weeks of intervention to measure fasting plasma glucose, glycated Hb (HbA1c) and lipidprofiles. Participants underwent a 3 h oral glucose tolerance tests and blood samples were collected at 60, 120 and 180 min to measure plasma glucose levels	Consumption of the DASH eating pattern for 4 weeks among pregnant women with GDM resulted in beneficial effects on glucose tolerance and lipid profiles compared with the control diet

Author, year, country/Study design	Population subject characteristics/ Dietary assessment method	Exposure/Intervention	Outcome	Results
Tobias DK [131], 2012, Boston-Harvard Observational study	15,254 Nurses' Health Study II participants. Pregnancies were free of pre-pregnancy chronic disease or previous GDM Validated food-frequency questionnaire	Pre-pregnancy dietary pattern adherence scores were computed based on participants' usual intake of the patterns' components such as fruit, vegetables, nuts, legumes, white/red meat ratio, fiber, dairy etc	872 incident cases of GDM were documented	Pre-pregnancy adherence to healthful dietary patterns is significantly associated with a lower risk of GDM. MED was associated with a 24% lower risk (RR: 0.76; 95% CI: 0.60, 0.95), DASH with a 34% lower risk (RR: 0.66; 95% CI: 0.53, 0.82), and HEI with a 46% lower risk (RR: 0.54; 95% CI: 0.43, 0.68)
Zhang C [146] 2006 Boston Observational study	13,110 women free of cardiovascular disease, cancer, type 2 diabetes and history of GDM in the Nurses' Health Study II. Validated semi-quantitative food frequency questionnaire	Two major dietary patterns (i.e. 'prudent' and 'Western') were identified through factor analysis	758 incident cases of GDM were documented	These findings suggest that pre-pregnancy dietary patterns may affect women's risk of developing GDM. A diet high in red and processed meat was associated with a significantly elevated risk (RR: 1.63 (95% CI 1.20-2.2 p (trend) 0.001)

Several other studies have demonstrated associations between dietary patterns and other pregnancy related complications [147-149].

2.7.2 Healthy dietary pattern carbohydrates

Carbohydrates should be a part of a healthy dietary pattern. Fiber rich and whole grain carbohydrates are the recommended type for a healthy diet [81]. Foods that are rich in dietary fibers such as: vegetables, whole grain, cereals, legumes, pulses and fruits are believed to have multiple beneficial health effects and may possibly reduce the risk of developing several diseases such as cardiovascular disease, cancer, obesity and type 2 diabetes [150-155]. Grains are considered to be whole grains when they still contain its endosperm, bran and germ. When grains are refined the bran and part of the germ is usually removed [156]. Example of whole grain foods are whole wheat, oats, rye, barley, brown rice, and bulgur [155]. Many fiber rich foods are low-GI foods, but not all and GI of food depends on many other factors such as cell structure. A dietary pattern consisting of low-GI foods has been demonstrated to have a beneficial effect on pregnant women with GDM but more intervention studies on the matter are lacking [157]. Choosing low GI food items is recommended in treatment of diabetes and GDM [158-160].

Whole grain foods contain many health beneficial components such as: dietary fiber, vitamins, minerals, lignans, phenolic compounds, phytic acid, tannins and more [156]. The reasons for the possible protective effects of wholegrain against diabetes 2 still remain under debate. Dietary fiber content is one of the factors that is thought to influence the body´s glycemic response to foods. Whole grain foods tend to lead to slower digestion and absorption of carbohydrates [156] possibly due to enzyme inhibitors [161] and slower absorption of nutrients [155]. It has been demonstrated that increasing wholegrain consumption can lead to lower fasting glucose and –insulin [155, 162] and potentially lower rates of diabetes 2 [163, 164] which is debated [165]. It is also possible that the antioxidants that are found in wholegrain- and other foods rich in dietary fiber could be one reason for the protecting effect by reducing the activity of free radicals and subsequently lowering the risk of diseases [156]. In Iceland the current recommendations are for consumption of at least 25 grams of fiber each day for all adults by means of fruit, vegetables, legumes and wholegrain products [81]. Recent literature has demonstrated that fiber intake during pregnancy is below recommendations in many countries [166]. There is a lack of reliable evidence regarding the role of whole grains and fiber in the prevention of diseases such as gestational diabetes, and there is need for more quality trials [167].

2.8 Benefits of dietary treatment

Identifying and subsequently managing gestational diabetes has been linked to a lower infant mortality and morbidity rate [28]. Women with GDM should receive counseling from a dietitian to assist them in choosing a diet that keeps glucose levels normal in addition to providing all required nutrients for both mother and fetus, without exceeding recommended gestational weight gain [168]. This service is not readily available at this time in Iceland. One reason for this may be that the need has increased greatly over a short period of time, with the steadily growing rate of overweight and obesity making it difficult for the healthcare system to adjust in time. Another possibility is that current information regarding treatments is still limited and if the most effective evidence based treatment is to be found, relevant intervention trials are needed. Previous treatment interventions for GDM have demonstrated a possibility of improving the women's quality of life related to their health in addition to reducing perinatal morbidity [169] and risk of macrosomia, caesarians, shoulder dystocia and hypertension, excessive weight gain, pre-eclampsia, and the need for insulin therapy. Outcomes are also better in regards to macrosomia, neonatal hypoglycemia, and birth weight due to better glycemic control [25, 29, 170, 171]. And thus by diagnosing and properly treating GDM it may be possible to increase the odds of a normal pregnancy outcome [172]. A study comparing adverse outcomes between treated and untreated groups of women diagnosed with GDM, where caloric intake was restricted to 25/35 kcal/kg with recommendations for 3 meals and 4 snacks a day, demonstrated much lower rates of adverse outcomes for the treated group and in some cases similar results for the treated group as seen in a non-diabetic group [173]. If healthy diet choices are successfully implemented during a GDM pregnancy and continued by the women after the pregnancy it may possibly reduce her risk for diabetes mellitus type 2 later in life [140]. The one thing that is clear today is the importance of encouraging all women to choose a healthy and diverse diet. It is also important to study associations of modifiable risk factors to GDM in the aims of providing women with the right tools to possibly prevent its occurrence and subsequently increase their quality of life as well as their offspring's.

3 Methods

The data for this study was gathered as part of a larger study, called Get diabetics moving (GDM-study), which was conducted at the National university hospital. The aim of the GDM-study is to study the impact of increased physical activity on blood sugar levels, weight, metabolism and oxygen transfer to the fetus for women with GDM. All study participants underwent a 2 hour, 75 gram oral glucose tolerance test (OGTT) at gestation weeks 23 - 28 and a fetal Echocardiography at gestation weeks 31 - 38. Information on both pre-pregnancy and weight gain during pregnancy was gathered. Dietary intake was assessed by a four day weighed food record either from Wednesday - Saturday or Saturday - Tuesday as soon as possible following recruitment (weeks 19 - 24). See also the method section in the attached manuscript.

3.1 Participants

Participants were recruited over a period of 18 months from April 2012 - October 2013 at a routine 20 week ultrasound with the help of staff at the Pre-natal diagnosis department at the National university hospital. Researchers were randomly present during recruitment period at the pre-natal diagnosis department. The department staff introduced the study to eligible women during their ultrasound and if they were interested they were forwarded to meet with a researcher who introduced the study protocol in detail. Initially the criteria for participation were: Age between 18 - 40 years, first - third pregnancy, non smoker, no family history of diabetes or gestational diabetes and BMI between 18.5-24.9 kg/m^2 (normal weight) or 30-<40 kg/m^2 (obese). After six months of recruiting the criteria were altered to include women with a BMI of 25-29.9 kg/m^2 (overweight) and allow women with a family history of diabetes. The main reason for the changed protocol was that the recruitment process was delayed, mainly due to the fact that the participation rate in the obese group was lower than expected. The change in protocol was approved by the steering committee of the GDM-study. A total of 217 women were recruited, 56 women declined participation (participation rate 79%). Food records used to compare diets were obtained from 98 normal weight women, 46 overweight women and 39 obese women (n=183). Of those 86, 44 and 38 respectively (n=168) underwent the OGTT and where thereby eligible for studying the association between dietary intake and GDM. Recent guidelines from the World health organization were used to determine the presence of GDM: Fasting plasma glucose between 5.1 and 6.9 mmol/l, the one hour plasma glucose measured ≥ 10.0 mmol/l or the two hour plasma glucose between 8.5

and 11.0 mmol/l after a 75 gram oral glucose tolerance test. If one, two or all of these criteria were met the woman was diagnosed with GDM [25].

3.2 Dietary assessment

During recruitment participants were provided with both vocal and written instructions on how to properly fill out a four day food weighed food record and were provided with a food scale for weighing. They were instructed to record intake of all food and drink, including all supplements for the duration of four days, either from Wednesday – Saturday or Saturday – Tuesday as soon as possible after recruitment (in weeks 19 - 24). The selection of weekdays was made in order to offer some flexibility while still gathering information regarding dietary intake for two week days and two weekend days, where Friday was considered a weekend day as it has been shown to have similar intake variance as Saturday and Sunday [174]. This decision was based on studies demonstrating that energy intake may vary over the course of the week and is possibly increased on weekends [175]. Participants were instructed to weigh each food type separately and record: time of meal, type of food with brand name and the amount of each separate food type in grams. If they were unable to weigh foods separately, they were instructed to either describe the ratio of different foods or write down the relevant recipe.

3.3 Statistical data

The food data was recorded into the ICEFOOD calculating program version 2.0 that is based on nutritional composition values on 514 ingredients from the Icelandic food database ISGEM and 607 food recipes from the Directorate of Health (Appendix II and III) [176, 177]. The nutritional data from ISGEM anticipates loss of certain nutrients during different cooking methods (Appendix IV). Energy is calculated as: 9 kcal/g for fats, 7 kcal/g for alcohol, 4 kcal/g for protein and carbohydrates and 2 kcal/g for fiber [177]. The results for participants nutritional data is displayed in Microsoft Excel for each recorded day, where the average intake was calculated for each participant. Those results in addition to all information regarding participants gathered during recruiting, and results from the OGTT were transferred to the program IBM SPSS Statistic version 20, where all statistical analysis took place. To determine significance of dietary intake differences Mann Whitney U test was used for comparing two weight groups and Kruskal-Wallis non-parametric test the for all three weight groups. Criteria for recommended daily intake of micronutrients for pregnant women in

Iceland was obtained from the Icelandic Directorate of health [81] and women's average requirements from the new Nordic nutrition recommendations [126].

3.4 Author's contribution

My work on this project was divided into four separate work stages.

1. Recruiting participants

My work on this project began with my assistance in recruiting participants to the study: Get Diabetics Moving, from September 2012 until September 2013. I was situated at the pre-natal diagnosis department at random times to introduce and explain all aspects of the study to possible participants coming from their 20th week ultrasound. Participants were required to sign an Informed consent form, fill out informational forms and a physical activity questionnaire. During the same time I calculated the persons BMI and gestational age and recorded all informational data into a Microsoft excel sheet. I then scheduled the participant's appointment for the OGTT in addition to the next appointment with the Ph.D student Helga Medek. I explained to the participants how to properly fill out a weighed food diary and provided them with all their relevant documents and materials.

2. Recording data from food diaries

All data from food diaries was recorded into excel sheets associated with the ICEFOOD calculating program which is based on values from the Icelandic food database ISGEM. Each day of the four day food diaries is recorded in a separate sheet and named according to the participant's number and day of diary. Specific codes are then assigned to each type of food for the calculating process. Once all diaries were recorded and properly coded, the calculating process is initiated. The results are displayed in an excel sheet where I calculated the average results for all four days. Food groups were created for the analysis, as presented in the method section in the attached manuscript.

3. Statistical analysis and presentations

I transferred all results from the ICEFOOD calculating program an addition to all other gathered participant information to the program IBM SPSS Statistic version 20. There I reviewed the data in an effort to find and correct errors in the data. Subsequently I conducted all relevant statistical analysis for the data, with guidance from my instructors. I presented main results for the scientific article draft in a video recording in April 2014, as a part of Science in spring days at the National university hospital. I also created a poster explaining my master's project and some preliminary results which was displayed at a presentation at a Graduate study gathering for the Food Science- and nutrition department at the University in Iceland.

4. Writing theses

I wrote a thesis including a draft for a scientific paper using the results of the analyzed data. I used mostly Pubmed and Science direct in the search of relevant articles for references although some were retrieved from citations in other articles. Reference searches consisted of search words such as: Pregnancy, Nutrition, Diet, Gestational Diabetes Mellitus, Dietary patterns and Principal Component analysis.

4 Results of secondary aim

Results related to the primary aim of the thesis are presented in Appendix I, in the draft manuscript named: Association of a maternal dietary pattern derived from pregnant women in Iceland to GDM risks.

Results that belong to the secondary aim of comparing maternal diets of women who are normal weight before pregnancy and those who are either overweight or obese before pregnancy are presented below.

4.1 Dietary intake of normal weight, overweight and obese pregnant women

When dietary intake of 27 common food groups was compared between all three weight groups (Table 1) there was a significant difference for intake of potato chips/popcorn ($P < 0.01$).

When comparing the dietary intake between the normal weight - and the overweight women it revealed that overweight women had a tendency towards higher intake of French fries ($P=0.08$), poultry ($P=0.07$), milk and dairy products ($P=0.10$) of borderline significance and lower intake of sugar, candy and honey ($P= 0.06$) compared to normal weight women.

The obese women had a significantly higher intake of milk and dairy products ($P=0.04$), soft drinks ($P= 0.04$), potato chips/popcorn ($P< 0.01$) compared with the normal weight women. They also had a lower intake of vegetable oil ($P= 0.04$), and tended to consume less fruit than the normal weight women, although the difference was not statistically significant ($P=0.08$).

No significant difference was observed in intake of total energy, energy providing nutrients or contribution of energy giving nutrients to total energy intake between the three groups (Table 2 and Table 3) when including both diet and supplements. However, intake of total omega-3 fatty acid, Eicosapentaenoic acid (EPA) and Docosahexaenoic acid (DHA) intake was of borderline significance higher in the diet of normal weight women compared with those who were obese prior to pregnancy ($P= 0.09$, $P= 0.07$ and $P= 0.10$, respectively).

Table 4 is an overview of the intake of vitamins, minerals and other substances from the diet. Intake of different vitamins and minerals is outside the scope of the present thesis and the results are only provided for descriptive purpose and no statistical analysis assessing possible differences between normal weight-, overweight- and obese women have been performed at this point. Possible associations between intake of specific nutrients or other substances and GDM have not yet been assessed.

The total percentage of all the pregnant women able to reach the average requirements of micronutrients, as suggested for non-pregnant women [126] and the recommended daily intakes for pregnant women [81] respectively, can be seen in Figure 1.

Table 2 - Dietary intake (g/day) divided by body mass index (BMI) before pregnancy

	Normal weight n=98 (BMI:18.5-24.9)							Overweight n=46 (BMI: 25-29.9)							Obese n=39 (BMI: 30-40)						
			Percentiles							Percentiles							Percentiles				
	Mean	SD	**10**	**25**	**50**	**75**	**90**	Mean	SD	**10**	**25**	**50**	**75**	**90**	Mean	SD	**10**	**25**	**50**	**75**	**90**
Vegetables	**96**	55	39	56	86	125	168	**116**	72	33	60	105	162	219	**115**	87	45	58	83	152	209
Nuts and seeds	**6**	15	0	0	0	5	23	**5**	8	0	0	0	7	15	**3**	6	0	0	0	2	15
Fruits	**166**	115	22	81	157	234	317	**151**	113	28	61	134	217	285	**133**[x]	100	15	73	119	175	240
Fruit juices, no added sugar	**144**	148	0	0	110	249	348	**106**	111	0	0	91	165	262	**112**	153	0	0	59	124	413
Potatoes[1]	**22**	27	0	0	15	33	60	**22**	24	0	0	13	38	60	**27**	31	0	0	19	47	76
French fries	**10**	18	0	0	0	20	30	**16**[x]	21	0	0	0	29	47	**14**	19	0	0	0	28	42
Bread and crisp bread	**103**	44	51	62	103	131	164	**103**	47	58	69	95	120	161	**102**	34	64	84	103	124	138
Pasta, couscous	**20**	34	0	0	0	29	62	**22**	34	0	0	0	34	82	**18**	28	0	0	0	32	62
Wholegrain cereals	**40**	32	3	18	31	60	90	**37**	30	0	12	31	55	77	**31**	25	2	11	28	50	74
Breakfast cereals	**47**	54	0	12	33	62	101	**55**	55	0	18	43	74	123	**49**	48	0	12	37	74	114
Fish, fish products and shellfish	**26**	26	0	0	20	50	61	**32**	36	0	0	19	50	100	**20**	22	0	0	11	38	50
Poultry	**28**	27	0	0	23	41	63	**38**[x]	37	0	12	37	51	76	**38**	37	0	0	32	58	74
Meat and meat products	**53**	36	7	24	50	79	104	**52**	31	15	27	49	75	104	**61**	43	19	28	50	79	143
Eggs	**15**	18	0	0	9	24	40	**14**	18	0	2	9	19	39	**11**	12	0	0	4	20	32
Milk and dairy products	**291**	196	84	171	258	377	520	**335**[x]	181	133	205	297	448	636	**336***	159	111	207	347	472	535
Cheese	**43**	25	16	25	39	59	77	**45**	25	20	30	41	49	84	**45**	26	16	24	41	59	86

	Normal weight n=98 (BMI:18.5-24.9)							Overweight n=46 (BMI: 25-29.9)							Obese n=39 (BMI: 30-40)						
			Percentiles							Percentiles							Percentiles				
	Mean	SD	**10**	**25**	**50**	**75**	**90**	Mean	SD	**10**	**25**	**50**	**75**	**90**	Mean	SD	**10**	**25**	**50**	**75**	**90**
Solid fats[2]	**11**	12	2	4	8	12	23	**10**	6	2	6	10	13	17	**9**	11	1	3	8	11	15
Vegetable oils	**3**	4	0	0	1	3	9	**2**	3	0	0	1	2	5	**1***	3	0	0	1	1	3
Fish oil, Lysi	**2**	3	0	0	0	0	8	**1**	2	0	0	0	0	3	**1**	2	0	0	0	0	5
Sauces, soups and bread salads[3]	**43**	41	12	18	28	52	92	**36**	27	10	18	31	47	71	**40**	29	13	18	38	54	81
Soft drinks, sports drinks	**183**	194	0	9	123	330	416	**216**	225	0	25	160	313	522	**290***	278	0	83	200	403	746
Coffee, tea and cocoa powder	**95**	155	0	0	17	150	226	**85**	117	0	2	57	125	259	**70**	124	0	0	4	100	231
Nutrition- and protein shakes	**12**	60	0	0	0	0	4	**18**	46	0	0	0	0	125	**5**	18	0	0	0	0	0
Cookies and Cakes	**62**	54	12	29	46	81	140	**57**	49	0	23	43	75	131	**58**	40	22	30	47	81	127
Sugar, honey and candy	**43**	33	8	20	34	59	90	**33[x]**	27	10	14	22	41	72	**41**	31	7	18	38	51	87
Ice cream	**21**	37	0	0	0	30	67	**17**	24	0	0	0	30	52	**17**	28	0	0	0	23	49
Potato chips, popcorn	**6**	11	0	0	0	11	25	**10**	15	0	0	0	17	33	**19***	26	0	0	13	23	61

Data is displayed as mean and standard deviation (SD) and percentiles
** Significantly different from the normal the weight group ($P \leq 0.05$)*
[x] Of borderline significant difference from the normal weight group ($P < 0.1$)
Mann Whitney U test was used to compare differences between groups
[1]Not including French fries
[2] Includes all animal fats (except fish), butter, margarine and hydrogenated fats
[3] Bread salads are mayonnaise based salads

Table 3 - Macronutrient intake divided by body mass index (BMI) before pregnancy

	Normal weight n=98 (BMI:18.5-24.9)							Overweight n=46 (BMI: 25-29.9)							Obese n=39 (BMI: 30-40)						
			Percentiles							Percentiles							Percentiles				
	Mean	SD	**10**	**25**	**50**	**75**	**90**	Mean	SD	**10**	**25**	**50**	**75**	**90**	Mean	SD	**10**	**25**	**50**	**75**	**90**
Energy, total (Kcal/day)	**2157**	405	1543	1880	2140	2408	2687	**2092**	457	1419	1741	2146	2356	2688	**2195**	533	1543	1814	2113	2553	3023
Protein, total (g/day)	**81**	17	59	69	79	89	98	**86***	17	61	76	88	95	106	**84**	20	58	67	84	97	117
Fat, total (g/day)	**84**	20	61	70	83	97	111	**80**	21	54	65	78	95	109	**84**	28	50	64	78	100	116
Saturated fat (g/day)	**34**	9	24	27	32	40	45	**31**	9	19	24	31	35	44	**33**	11	22	24	31	38	50
Monounsaturated fat (g/day)	**27**	7	18	23	27	31	35	**25**	7	17	20	25	30	36	**27**	10	16	20	25	31	42
Polyunsaturated fat (g/day)	**14**	4	9	11	14	17	20	**13**	5	8	10	12	16	21	**14**	6	7	8	13	18	21
Omega-3 fatty acids (g/day)	**0.6**	0.8	0.1	0.1	0.3	1.0	1.6	**0.5**	0.7	0.1	0.1	0.2	0.5	1.5	**0.4**[x]	0.6	0.0	0.1	0.2	0.5	1.6
EPA (g/day)	**0.2**	0.3	0.0	0.0	0.1	0.3	0.6	**0.2**	0.2	0.0	0.0	0.1	0.2	0.5	**0.2**[x]	0.2	0.0	0.0	0.1	0.2	0.6
DHA (g/day)	**0.3**	0.4	0.0	0.1	0.1	0.5	0.9	**0.3**	0.4	0.1	0.1	0.1	0.3	0.8	**0.2**[x]	0.3	0.0	0.0	0.1	0.3	0.8
Carbohydrates, total (g/day)	**258**	60	176	214	257	299	333	**246**	62	171	200	241	296	338	**265**	67	165	217	261	295	391
Added sugar (g/day)	**66**	30	30	41	62	87	113	**62**	30	28	37	56	82	115	**70**	35	33	44	64	87	122
Fiber, total (g/day)	**19**	6	12	14	18	22	26	**19**	6	10	14	18	24	27	**20**	7	13	15	17	24	29

Data is displayed as mean results and standard deviation (SD) and as percentiles
** Significantly different from the normal the weight group (P≤ 0.05)*
[x] Of borderline significant difference from the normal weight group (P< 0.1)
Mann Whitney U test was used to compare differences between groups

Table 4 - Contribution of energy providing nutrients to total energy intake (E%)

	Normal weight n=98 (BMI:18.5-24.9)						Overweight n=46 (BMI: 25-29.9)						Obese n=39 (BMI: 30-40)					
		Percentiles						Percentiles						Percentiles				
	Mean	10	25	50	75	90	Mean	10	25	50	75	90	Mean	10	25	50	75	90
Protein	**15**	14	16	16	15	15	**14**	17	14	17	18	17	**16**	15	16	13	17	16
Fat	**36**	37	36	36	36	37	**35**	34	35	35	35	36	**35**	33	34	34	36	34
Saturated fat	**14**	14	14	14	15	15	**14**	12	13	14	13	14	**14**	15	13	13	14	15
Monounsaturated fat	**12**	11	12	12	11	12	**11**	11	10	11	11	12	**11**	10	11	11	11	12
Polyunsaturated fat	**6**	5	5	6	6	6	**6**	5	5	5	6	7	**6**	5	4	6	7	6
Omega-3 fatty acids	**0.3**	0.0	0.1	0.1	0.4	0.5	**0.2**	0.1	0.1	0.1	0.2	0.5	**0.2**	0.0	0.0	0.1	0.2	0.5
Carbohydrates	**49**	47	48	49	49	49	**48**	49	47	48	49	49	**49**	49	51	50	48	51
Added sugar	**13**	8	9	12	14	17	**12**	8	9	11	14	17	**13**	10	10	12	14	16

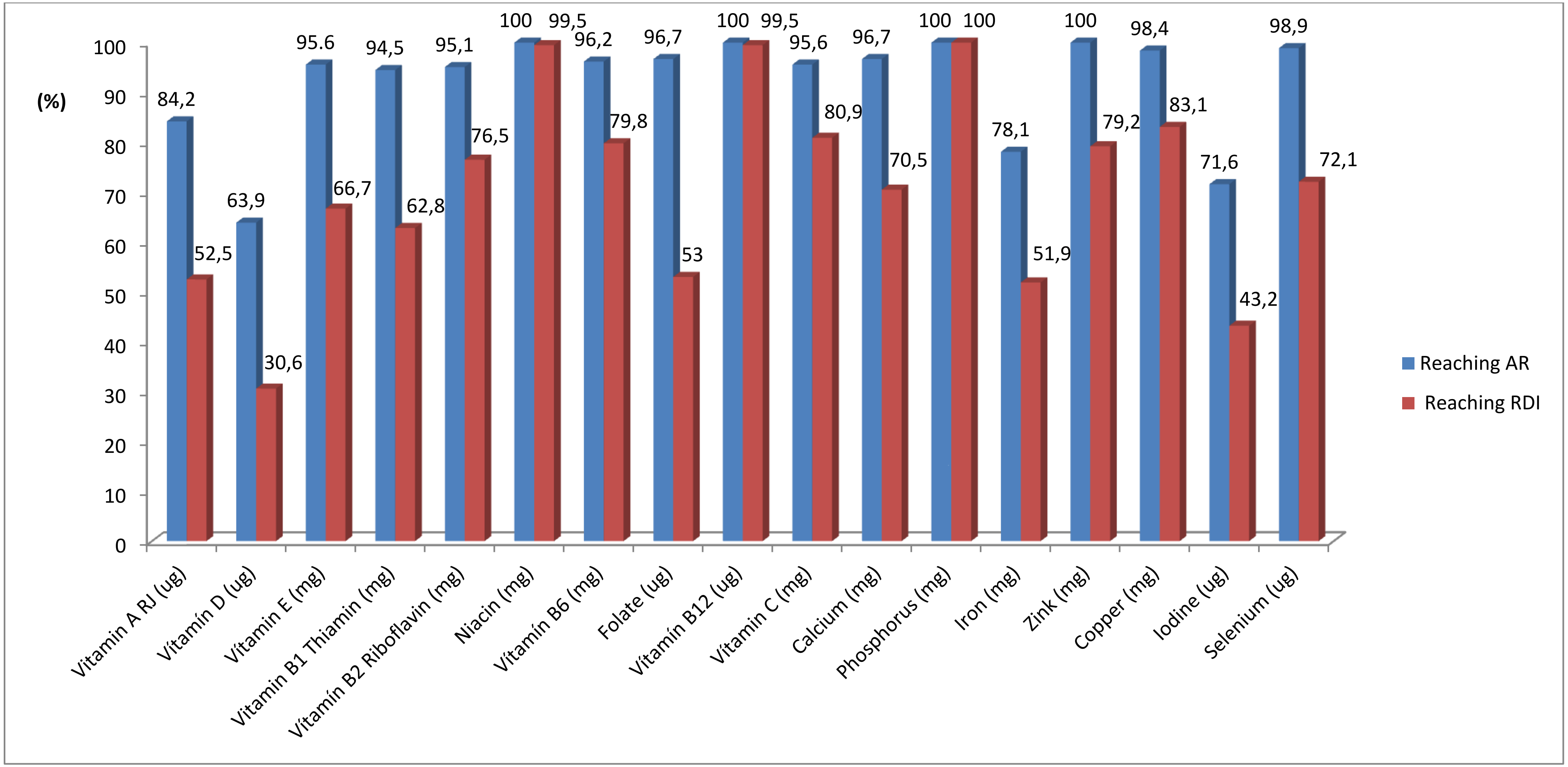
Table 5 - Micronutrient intake as well as intake of selected heavy metals, caffeine and aspartame divided by body mass index (BMI) before pregnancy

	Normal weight n=98 (BMI:18.5-24.9)							Overweight n=46 (BMI: 25-29.9)							Obese n=39 (BMI: 30-40)						
			Percentiles							Percentiles							Percentiles				
	Mean	SD	**10**	**25**	**50**	**75**	**90**	Mean	SD	**10**	**25**	**50**	**75**	**90**	Mean	SD	**10**	**25**	**50**	**75**	**90**
Vitamin A RJ (ug)	**1152**	735	443	613	992	1479	2203	**977**	592	412	549	754	1270	1807	**1057**	681	463	607	775	1375	2147
Retinol (ug)	**932**	701	283	419	739	1255	1827	**825**	583	334	433	579	1108	1747	**859**	651	285	420	613	1217	1838
Beta Carotene (ug)	**2446**	2360	440	907	1809	3198	4725	**1721**	1304	444	735	1272	2532	3382	**2275**	2091	429	787	1561	3799	5109
Vitamin D (ug)	**14**	12	2	4	11	17	29	**12**	9	3	5	11	18	25	**13**	12	2	4	9	20	31
Vitamin E (mg)	**16**	9	7	10	14	20	27	**13**	7	6	8	11	17	21	**15**	9	5	8	14	20	30
B1,Thiamin (mg)	**2.1**	1.2	1.0	1.2	1.9	2.5	3.7	**1.9**	1.2	1.0	1.3	1.4	2.2	3.8	**2.2**	1.1	1.1	1.3	2.0	2.7	3.4
B2,Riboflavin (mg)	**2.6**	1.4	1.3	1.5	2.4	3.1	4.5	**2.4**	1.3	1.4	1.6	2.1	2.9	4.2	**2.7**	1.3	1.4	1.8	2.6	3.3	4.0
Niacin (mg)	**26**	14	12	16	23	33	42	**24**	14	13	17	20	28	41	**28**	15	15	16	26	37	47
Vitamin B6 (mg)	**3**	2	1	2	3	3	5	**3**	2	1	2	2	3	5	**3**	2	1	2	3	4	5
Folate (ug)	**584**	338	232	307	547	738	984	**550**	321	232	334	482	685	973	**607**	285	278	402	602	748	998
Vitamin B12 (ug)	**6**	3	3	4	6	8	12	**6**	3	3	4	6	7	10	**6**	2	4	5	6	8	10
Vitamin C (mg)	**159**	92	75	96	141	205	255	**159**	177	58	87	116	176	296	**177**	125	57	103	157	225	265
Calcium (mg)	**1099**	390	695	837	1060	1264	1608	**1130**	345	674	925	1114	1346	1553	**1100**	332	762	880	1023	1314	1598
Phosphorus (mg)	**1503**	344	1121	1264	1439	1679	1935	**1561**	342	1092	1309	1602	1783	2005	**1564**	358	1095	1336	1520	1781	2185

	Normal weight n=98 (BMI:18.5-24.9)							Overweight n=46 (BMI: 25-29.9)							Obese n=39 (BMI: 30-40)						
			Percentiles							Percentiles							Percentiles				
	Mean	SD	**10**	**25**	**50**	**75**	**90**	Mean	SD	**10**	**25**	**50**	**75**	**90**	Mean	SD	**10**	**25**	**50**	**75**	**90**
Magnesium (mg)	**307**	82	208	243	295	354	419	**308**	79	194	247	296	374	425	**311**	85	210	249	315	354	424
Potassium (mg)	**2723**	617	2008	2245	2618	3147	3618	**2788**	752	1789	2165	2768	3266	3934	**2790**	751	1962	2245	2661	3149	3796
Iron (mg)	**22**	24	8	10	16	22	38	**17**	19	7	9	14	19	28	**18**	8	10	12	17	22	31
Zink (mg)	**17**	10	7	9	12	23	27	**15**	9	7	10	13	18	31	**19**	10	8	12	16	25	33
Copper (mg)	**2**	1	1	1	1	3	4	**2**	1	1	1	1	2	3	**2**	1	1	1	2	3	4
Iodine (ug)	**186**	127	67	89	156	241	348	**180**	112	84	93	151	238	354	**193**	113	84	104	167	251	362
Selenium (ug)	**84**	38	46	59	75	100	130	**82**	34	46	59	75	98	134	**86**	38	48	57	70	112	138
Cadmium (ug)	**10**	3	6	8	9	11	13	**9**	3	6	7	9	11	13	**10**	3	7	8	9	12	13
Lead (ug)	**25**	23	9	11	16	34	55	**18**	12	7	9	15	22	33	**16**	9	7	10	15	21	29
Mercury (ug)	**3**	2	1	1	3	4	6	**4**	6	1	1	2	4	7	**2**	1	1	1	2	4	4
Caffeine (mg)	**48**	44	2	14	33	72	114	**53**	44	3	23	36	93	124	**47**	44	1	14	37	68	119
Aspartame (mg)	**11**	32	0	0	0	0	30	**19**	45	0	0	0	8	96	**35**	74	0	0	0	45	105

Data is displayed as mean and standard deviation (SD) and percentiles

Figure 1 - Percentage of pregnant women (n=183) reaching the estimated average requirement (AR) and recommended daily intake (RDI) of micronutrients, including both dietary intake and supplements.



5 Discussion and future perspectives

The results related to association of maternal dietary patterns of pregnant women in Iceland to GDM risk is discussed in Appendix I, in the manuscript draft named: Association of a maternal dietary pattern derived from pregnant women in Iceland to GDM risks.

5.1 Summary of findings

Only one clear dietary pattern was extracted from the cohort and as it closely resembled the Icelandic dietary recommendations it was referred to as a prudent dietary pattern. It appears that when pregnant women in Iceland adhere to this prudent dietary pattern, their risk of GDM is lower, even when adjusting for weight gain in pregnancy and physical activity. This was most evident in the group of overweight/obese women in this study as they are at a much higher risk for GDM than normal weight women. To confirm these results it would be very interesting to conduct a clinical trial based on the results. Viewing dietary intake of the different weight groups revealed a slightly stronger tendency for healthy food choices among the normal weight women, especially when compared to the obese women. Intake for several foods and nutrients that are strongly emphasized as important in the dietary recommendations for pregnant women is lacking for most of the women.

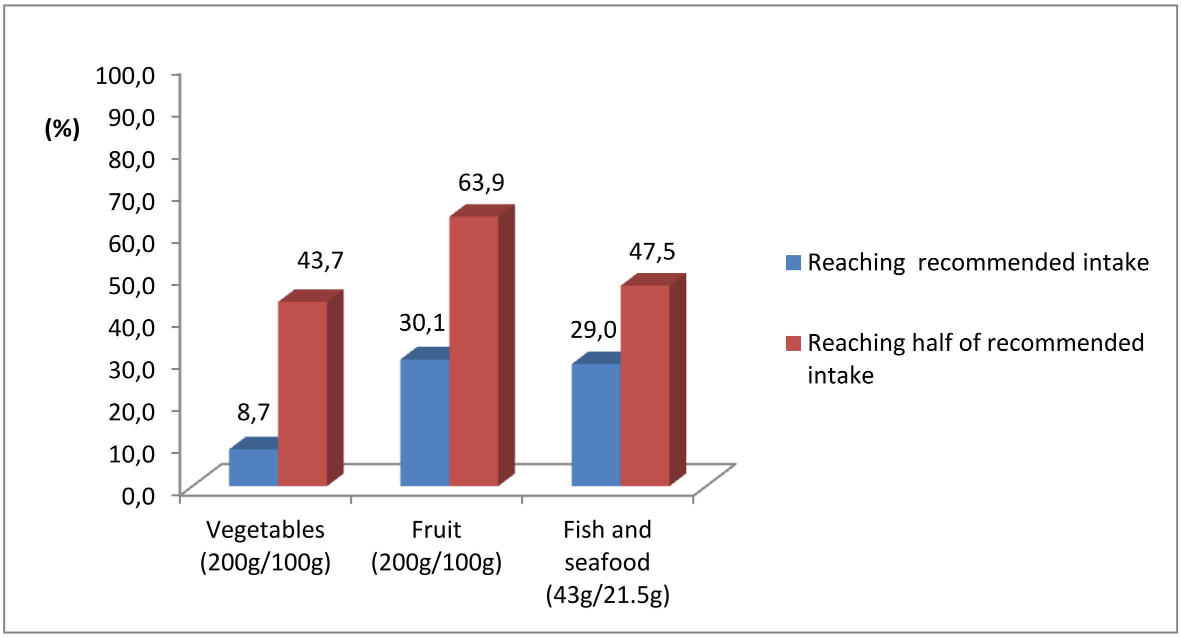
5.2 Discussion

When dietary intake was compared between the different weight groups it did not reveal a number of significant results, especially when comparing the overweight- and normal weight women but despite some of the results not being quite significant ($P < 0.1$) they were deemed as noteworthy due to the fact that both the overweight and obese group consisted of much fewer women and the study might lack statistical power to detect differences in food intake that still might be of relevance. When intake of the overweight – and obese women was added together (n=85) and compared to the normal weight women (n=98) it revealed significant differences in intake of Milk and dairy products ($P = 0.02$), potato chips/popcorn ($P = 0.01$) and poultry ($P = 0.04$) and indicated significant differences ($P < 0.1$) for intake of French fries, vegetable oil, soft drinks and fruit juice. Viewing the differences between the obese women and normal weight women seems to suggest several less healthy dietary choices in the obese group. Their intake of unhealthy foods such as soft drinks and potato chips/popcorn were higher whereas the intake for healthier foods like fruits and vegetable oils was lower. Both the overweight and obese women had a higher intake for milk and dairy products compared to the normal weight group.

Unfortunately an overall view of the women's consumption of foods of special focus in the dietary recommendations [81], is repeatedly demonstrated as inadequate.

Figure 2

Percentage of pregnant women (n=183) reaching the recommended/half of the recommended intake of vegetables (200g/100g), fruit (200g/100g) and fish and seafood (43g/21.5g).



For example hardly any of the women reach the 200g recommended minimum of vegetable intake. Similarly more than half of the women have fruit intake less than 200g per day. So it is perhaps not so surprising that so few women are able to reach the recommended minimum fiber intake of 25g per day. By eating more fruit and vegetables the women could increase their intake of several vitamins, minerals and other protective phytochemicals in addition to a lower risk of excessive weight gain [178]. According to dietary recommendations, daily consumption of fish should be at least 43g per day which is the equivalent of eating 150g of fish twice a week. At least half of all the women report fish consumption well below recommendation. This is in accordance to previous studies performed in Iceland indicating that maternal consumption of fish and fish oil is not in line with recommendations for a large number of women [12, 13, 16] and that vegetable intake is fairly low [16]. Studies conducted in other countries report similar results. In Poland the maternal intake for fish, Omega-3, fruits and vegetables was not sufficient and the consumption of sweets was fairly high [4]. An English study reported very low maternal intakes for both fruits and vegetables [11] and two separate studies regarding diet in pregnancy in Spain indicated an intake lacking in Omega-3 fatty acids whereas the intake for fruit and vegetables exceeded the recommendations [3, 5].

The overall distribution of macronutrients appears to be fairly similar in all three weight groups. Intake of saturated fats and added sugar is higher than recommended in all three weight groups. According to the new Nordic Nutrition recommendations the intake of the essential Omega-3 acids should represent at least one percent of total energy and thereof 200 mg/day of Docosahexaenoic acid (DHA) for pregnant and lactating women [126]. This is evidently not the case for any of the three weight groups. Not even in the highest percentiles for any of the weight groups, does the total Omega-3 intake represent one percent of total energy. Omega-3 fatty acids are necessary in the early development of the brain and have an essential role in central nervous system functions. Low levels of omega-3 fatty acids have been linked to dysfunctions in brain development and growth impairment [179]. The recommended intake for DHA was not reached by over half of all the women. DHA serves an important role in optimizing maturation of both the brain and retina [180].

This not only indicates that the dietary intake for a large number of pregnant women may be lacking but also that these are the women's dietary habits from before pregnancy. Studies have demonstrated the importance of a healthy pre-pregnancy diet in relation to GDM risk. This stresses the need to implement healthful dietary choices as early as possible as healthful dietary choices are maintained throughout pregnancy [131, 132, 181].

The micronutrient intake for all the participants revealed relatively low intake of some nutrients. When a person is unable to reach the average requirements of a micronutrient it suggests that the person is likely to suffer from deficiency [126]. Since a high percentage of the women are unable to reach the average requirements for vitamin D (36%), iron (22%) and iodine (28%) it would suggest that a number of these women may have a deficiency. These numbers may even be higher since the reference for average requirements used here is aimed at non-pregnant women and should actually be higher for pregnant women. These results are troubling as all these nutrients are of extreme importance in pregnancy, which is clearly emphasized in the dietary recommendations for pregnant women in Iceland [59]. An earlier study in Iceland also reported low vitamin D intakes [16] and results of a Spanish study indicated that a large number of pregnant women did not reach half of the recommended intake for Vitamin D, folate and iron [5]. The signs of iron deficiency are usually well monitored during pregnancy but the same does not apply to Iodine deficiency which if severe may lead to dysfunctions in brain development [182]. Folate and vitamin D are specifically recommended for pregnant women in Iceland but there is obviously a need for more effective means of increasing compliance. Perhaps it is necessary to implement dietary counseling into health- and maternal care in order to achieve this. Some studies have demonstrated such counseling to improve diet choices in pregnancy [183, 184]. It would also prove useful to further analyze the data regarding the intake of vitamins, minerals and other substances from the diet, to see the amount derived from dietary intake and supplements, respectively.

6 Conclusions

Pregnant women who are normal weight before pregnancy appear to have somewhat healthier diet choices then pregnant women who are obese before pregnancy. Dietary intake of various foods such as: Fruits, vegetables, fish, fiber and Omega-3, which are specifically recommended in dietary guidelines is severely lacking among pregnant women in Iceland. Adherence to a healthy or prudent dietary pattern may prove beneficial in preventing gestational diabetes mellitus, especially for women already at higher risk due to overweight or obesity before pregnancy. A number of pregnant women may be at risk of deficiency for several vitamins that are vital during pregnancy such as: vitamin D, iodine and iron.

7 References

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8 Appendices

8.1 Appendix I – Manuscript draft

Association of a maternal dietary pattern derived from pregnant women in Iceland to GDM risks.

Author(s): Tryggvadottir EA[1], Medek H[2], Birgisdottir BE[1], Geirsson RT[2], Gunnarsdottir I[1]

Affiliation(s): Unit for Nutrition Research, National University Hospital and Faculty of Food Science and Nutrition, University of Iceland[1]. Department of Obstetrics and Gynecology, Women's Clinic, National University Hospital, Reykjavik[2].

Corresponding author:

Ellen Alma Tryggvadóttir

Unit for Nutrition Research, National University Hospital and Faculty of Food Science and Nutrition, University of Iceland. Eiriksgata 28, 101 Reykjavik. Iceland. Tel: +354-690-1110

Key words: Diet, Dietary pattern, Pregnancy, Gestational diabetes mellitus

Abstract

Background: Gestational diabetes mellitus (GDM) is associated with negative health effects for both the mother and child.

Objective: To investigate the association between maternal dietary pattern and GDM.

Methods: A prospective observational study including 168 pregnant Icelandic women aged 18-40 years. These were recruited at routine 20 week ultrasound at Landspitali/National-University Hospital in Iceland. All participants kept a four day weighed food record as soon as possible following recruitment (gestational weeks 19 - 24). Food data was recorded into the ICEFOOD calculating program based on the Icelandic food database (ISGEM). Principal component analysis was used to extract dietary patterns from 29 food groups and a healthy eating index was constructed. All women underwent an oral glucose tolerance test in weeks 23 - 28.

Results: One clear dietary pattern (eigenvalue 2.4) was extracted comprising of seafood; eggs; vegetables; fruits and berries; vegetable oils; nuts and seeds; pasta; breakfast cereals; coffee and tea with a negative correlation to intake of soft drinks and French fries. Variance explained was 8.2%. The prevalence of GDM was 2.3% among women of normal weight before pregnancy and 18.3% among overweight/obese women. The pattern was associated with lower risk of GDM (OR: 0.54 95% CI: 0.30, 0.98). When adjusting for age, parity, pre-pregnancy weight, energy intake, weekly weight gain and total Metabolic Equivalent of Task (MET) the association remained (OR: 0.36 95% CI: 0.14, 0.94).

Conclusions: Adhering to a prudent dietary pattern in pregnancy may prove beneficial in preventing GDM, especially among women already at higher risk due to overweight/obesity before pregnancy.

Introduction

The number of women diagnosed with gestational diabetes mellitus (GDM) continues to grow worldwide. Many negative health aspects have been associated with GDM for both mother and child. Having GDM has been associated with a greater risk of diabetes later in life [1-4], miscarriage, hypertension, pre-eclampsia and delivering very large infants. This can in turn lead to a higher risk of prematurity, trauma at birth, caesareans, and shoulder dystocia [2, 5-8]. Infants born to women with GDM are at a higher risk of various malformations [5], growth restriction during gestation, hypoglycemia following the lack of glucose supply through the umbilical cord after delivery [6] as well as diabetes 2 later in life [2, 9-13]. It is well known that women who are overweight and especially obese before pregnancy have a greater risk of being diagnosed with GDM than women of normal weight [4, 14, 15]. Eating a healthy diet, exercise and adhering to the recommended gestational weight gain should be an emphasis for women at risk of GDM [16]. Some studies credit certain factors of the diet to be directly associated with the risk of GDM such as higher consumption of soft drinks [17], increased consumption of energy [18], fat especially saturated fat [19] and decreased consumption of polyunsaturated fat and carbohydrates [18, 20-23]. However, there is still a lack of convincing evidence demonstrating what type of diet might be most effective in preventing GDM [24]. Recently there has been a greater focus on investigating the combined effect of various foods on health and health related factors instead of isolated foods or nutrients, for example by using dietary patterns or healthy eating index [25, 26]. There are few existing studies that have investigated the relationship between dietary patterns and the risk of GDM. The aim of this study was to investigate the association between maternal dietary patterns, using both principal component analysis and a healthy eating index, and GDM.

Methods

The data for this study was gathered in co-operation with a separate study called Get diabetics moving (GDM-study), which was conducted at the National University Hospital in Iceland. The aim of the GDM-study was to study the impact of increased physical activity on blood sugar levels, body weight, metabolism and oxygen transfer to the fetus for women with GDM. All study participants underwent a 2 hour, 75 gram oral glucose tolerance test (OGTT) between 23 - 28 weeks of gestation. All participants were required to keep a 4 day weighed food record either from Wednesday - Saturday or Saturday - Tuesday as soon as possible following recruitment in week 19 - 24.

Participants

Participants were recruited over a period of 18 months from April 2012 - October 2013 at a routine 20 week ultrasound with the help of staff at the Pre-natal diagnosis department at the National University Hospital. Initially the criteria's for participation were: Icelandic women living in Reykjavik with age between 18 - 40 years, first - third pregnancy, non-smoker, no reported family history of diabetes or GDM and a BMI between 18.5-24.9 kg/m^2 (normal weight) or 30 - <40 kg/m^2 (obese). After six months of recruiting the criteria were altered to include women with a BMI of 25-29.9 kg/m^2 (overweight) and to include women with a family history of diabetes. This alteration was made as much fewer obese women were being recruited than normal weight women. A total of 217 women were recruited within the study period, 56 women declined participation (participation rate 79%). A total of 168 women (86 normal weight, 44 overweight and 38 obese) returned food records and additionally underwent the OGTT. All participants answered the International Physical Activity Questionnaire (IPAQ) from which The Metabolic Equivalent of Task (MET) was estimated. Pre-pregnancy weight was self-reported. Weight was recorded at recruitment in gestation week 19 - 24 and again at a fetal Echocardiography at 31 - 38 weeks. Each participant's weight gain is reported as weekly weight gain, due to the variance of recorded weight. To obtain weekly weight gain, the differences between the two recorded weights were calculated and divided by number of weeks passed in each case. Homeostasis Model Assessment of Insulin Resistance (HOMA-IR) is a calculation method used to assess levels of insulin resistance by using results of fasting insulin (I_0) and fasting glucose (G_0) measurements calculated as (I_0 x G_0)/22,5 [27]. Recent guidelines from the World Health Organization (WHO) were used to determine the rate of GDM in the group at 23 - 28 weeks of gestation: Fasting plasma glucose between 5.1 and 6.9 mmol/l, the one hour plasma glucose measured ≥ 10.0 mmol/l or the two hour plasma glucose between 8.5 and 11.0 mmol/l after a 75 gram oral glucose tolerance test. If one, two or all of these criteria were met the woman was diagnosed with GDM [28].

Statistical data and analysis

The food data was recorded into the ICEFOOD calculating program that is based on values from the Icelandic food and nutrient database ISGEM [29]. The average food intake was calculated for each participant divided into 18 main food groups which consist of subgroups as defined in ISGEM [29]. Average intake of energy and nutrients including supplements was also calculated. The dietary pattern was extracted from 29 food groups. Thereof were 11 of the main food groups: Milk and dairy products; cheese; ice cream; meat and meat products; fish/fish products and shellfish; poultry; eggs; potato chips and popcorn; sauces; soups and bread salads; pre-prepared foods; sugar/honey and candy. The subgroups of six of the main food groups were utilized to construct the remaining food groups. Various types of fats were divided into three groups: solid fats; vegetable oils; fish oil. Drinks were divided into three groups: coffee/tea and cocoa powder; soft drinks and sports drinks; pure fruit juices. Vegetables were split into three groups: all vegetables; potatoes; French fries. Fruit subgroups were divided into two groups: nuts and seeds; fruit, berries and jams. Grains were divided into five groups: Grains; breakfast cereals; bread and crisp bread; cookies and cakes; pasta and couscous. The two subgroups of supplement foods were used: diet- and protein shakes; vitamin and mineral supplements.

The dietary pattern was extracted by using Principal component analysis with the orthogonal rotation Varimax with Kaiser Normalization. The suitability of our data was tested with the Bartlett´s test of Sphericity and Kaiser-Meyer-Olkin measure of sampling adequacy. The Bartlett test of Sphericity was significant ($P < 0.01$). However, the Kaiser Mayer Olkin test was 0.5 which is borderline acceptable. To support our findings we determined the highest adherence to the prudent dietary pattern by dividing the associated extracted factor into tertiles where the highest intake for each factor (lowest for the two negative factors) scored highest. Those who ranked in the highest tertile for all factors combined were determined as having the highest total adherence. Furthermore, the same method of tertiles was used to determine best adherence to a healthy eating index using the food based dietary guidelines from the Icelandic Directorate of Health as criteria. The index included fish and seafood; vegetables; fruits; vegetable oils; nuts and seeds; unground/wholeground cereals (i.e. bran, germ, oats, rice and corn); vitamin D intake and soft drinks. The Kolmogorov–Smirnov test was used to test all data for normality. Data is presented as means and standard deviations and also as median and Interquartile range when appropriate.

Differences in maternal characteristics over the three groups of BMI before pregnancy were tested with the Kruskall-Wallis test. The relationship between the results of the pattern analysis and GDM diagnosis was determined using logistic regression. The Chi-square test was used to test significance when comparing the number of GDM diagnoses in groups with highest vs. lower adherence to the prudent dietary pattern or healthy eating index. The association of maternal characteristics to the prudent dietary pattern adhering scores, fasting glucose and HOMA-IR were tested with Mann Whitney U test in the case of parity and Kruskall-Wallis test in other cases. The variance inflation factor (VIF) used to detect colinearity for factors used for adjustment reported no values > 4. All statistical analysis was performed in IBM SPSS Statistic version 20. Significance level was set at P = 0.05.

Results

Table 1 shows the maternal characteristics. Women who were overweight or obese were on average a year older than normal weight women (29 vs. 30 years) (P=0.01). Obese women had gained less weight at recruiting in weeks 19 - 24 of pregnancy than overweight women or normal weight women, 2.7, 5.5 and 4.6 kg, respectively (P=0.02). The difference in weekly weight gain between weeks 19 - 24 and 31 - 38 was also significantly different between the groups where the normal weight women gained more weight than overweight and obese women (P<0.01). The prevalence of GDM for women of normal weight before pregnancy was 2.3% and among overweight or obese women it was 18.3%. None of the women had glucose levels above the GDM criteria which would indicate diabetes mellitus in pregnancy.

In the pattern analysis one clear dietary pattern was extracted (eigenvalue 2.4) (Table 2) positive for seafood, eggs, vegetables, fruit and berries, vegetable oils, nuts and seeds, pasta, breakfast cereals, coffee and tea and negative for soft drinks and French fries. Variance explained was 8.2%. This pattern was labeled as a “Prudent pattern”. The other extracted pattern had eigenvalue < 2 explained variance was 6.6% and was not as clearly defined. Furthermore it did not demonstrate associations to the outcome under investigation. Adherence to this prudent dietary pattern varied somewhat when divided by maternal characteristics (Table 3). Adherence increased significantly for women in the oldest tertile (P=0.03) as did fasting glucose levels (P=0.01). Fasting glucose and HOMA-IR levels were significantly higher with increasing pre-pregnancy BMI (P< 0.01 and P< 0.01).

The prudent dietary pattern was associated with a significantly decreased risk of GDM (Table 4). That difference was still present after adjusting the model for: age, parity, pre-pregnancy weight, energy intake, weekly weight gain and total MET. The final model demonstrated no significant results regarding total MET. However the analysis demonstrated an independent association between weekly weight gain and GDM-risk (OR: 0.02 95% CI: 0.00, 0.54).

We split the participants into a normal weight group (n=86/GDM:n=2) and overweight/obese group (n=82/GDM:n=15). As cases in the normal weight group were too few, no further analysis was made. When performing the same analysis for the overweight/obese group the significant association to the decreased risk of GDM remained (Table 4). Analyzing the effects of each dietary factor separately demonstrated no significant associations with GDM except in the case of seafood consumption and additionally pasta in the overweight/obese group. The related odds ratio for those factors was much higher than observed in the logistic regression for the prudent dietary pattern.

When all participants were divided into tertiles depending on adherence to the prudent dietary pattern HOMA-IR values were lower in the tertile with the highest adherence although of borderline significance (P=0.054). When further split up into normal weight and overweight/obese groups the lower HOMA-IR values were significant only for the overweight/obese group ($P < 0.01$) (Table 5).

Comparing the number of women diagnosed with GDM in the group with the highest adherence to the extracted prudent pattern to the group with lower adherence, for all women and overweight/obese women respectively is shown in Table 6. The results for all the women demonstrated a diagnosis rate of 1.8% for the women with the highest adherence and 14.3% for the women with the lower adherence (P=0.01). The overweight/obese group demonstrated a GDM diagnosis rate of 3.7% for women with the highest adherence to the extracted pattern and 25.5% for women with lower adherence (P=0.02).

We repeated the same analysis for adherence to a healthy eating index based on dietary guidelines and compared the group with the highest adherence to the group with lower adherence for all women and the overweight/obese women respectively. The rate of GDM diagnosis was 3.6% for the women with the highest adherence and 13.4% for those with a lower adherence (P=0.05). The results for the overweight/obese women demonstrated a 3.8% rate of diagnosis for the women with the highest adherence and 25% for women with lower adherence (P=0.02).

Discussion

In our present study we found that adhering to a prudent dietary pattern as well as scoring high on a healthy eating index is associated with a decreased risk for GDM. This was especially true for women who were either overweight or obese before pregnancy, but the rate of GDM diagnosis is several times higher in this group. Similar results have been found previously in an observational study including 1076 women in ten countries where adherence to a Mediterranean dietary pattern was associated with better glucose tolerance and decreased incidence of GDM [30]. Another study based on results from the Nurses' Health Study II indicated that a pre-pregnancy adherence to the Dietary Approach to Stop Hypertension (DASH), a Mediterranean- or Healthy Eating Index (HEI) diet was associated with a lower GDM risk. The strongest relationship was seen for the HEI diet which like the other two patterns includes higher intake of vegetables, fruits, nuts and legumes and additionally cereal fiber and polyunsaturated fats [31]. This suggests that adherence to these dietary patterns continued throughout pregnancy [32]. A prospective study by Chen et al examined the effects of a prudent diet that included vegetables, fruit, fish and poultry and a westernized diet, which includes high intake of red and processed meat, pizza, French fries, candy and refined grains. They discovered an association between the prudent dietary pattern and a decreased risk for GDM as well as an increased risk for GDM associated with the westernized pattern [33]. A randomized control trial also demonstrated the benefits of a healthy diet for women already diagnosed with GDM, where eating according to a DASH diet, which consists of plenty of fruits and vegetables, whole grains and low-fat dairy products, led to a lower number of women needing insulin treatment, fewer caesarians and better pregnancy outcomes [34]. Even though these studies all seem to highlight the combined benefits of healthy foods on GDM risks they are still relatively few and results need to be verified with more intervention studies.

Although our extracted prudent dietary pattern contained pasta which is not necessarily associated with a healthy dietary pattern, it may possibly be explained by the fact that it is a popular food and often consumed by most women in the study. Furthermore most types of pasta are a low glycemic index food (below 55) and pasta including vegetables can also easily be a part of a healthy diet [35, 36]. The fact that adherence to the prudent dietary pattern increased with age points to the possibility that the women become more health conscious with increasing age.

The results for the association between the different food groups included in the pattern indicate that the benefit of the dietary factors combined is stronger than demonstrated by the isolated foods. In this study only two of the 86 women of normal weight before pregnancy were diagnosed with GDM, bedding for low power of any analysis including GDM. Therefore, even though the association demonstrated between the prudent dietary pattern and GDM appeared to be more apparent for the overweight/obese group it is possible that the results would be more similar in a larger group of normal weight women [31]. Weight gain in pregnancy also appears to be an obvious risk factor in association with GDM risk.

Strengths and limitations

Information regarding food intake was acquired through weighed food diaries where intake of all food and drink, including all supplements was recorded for the duration of four days, either from Wednesday - Saturday or Saturday - Tuesday as soon as possible after recruitment at week 19 - 24. The food diaries were filled out and delivered before the diagnosis of GDM. The volume of information available is another strength. As age and overweight/obesity are both risk factors for GDM we adjusted for age and pre-pregnancy BMI in our model. We also adjusted for total MET and a calculated weight gain per week between week 19 - 24 and 31 - 38 where weighing was performed on two occasions. There are a few limitations to this study as well, such as the change in criteria during recruiting. That was due to the fact that it proved difficult to recruit participants that were obese and had no family history of diabetes. However, when the model was adjusted for family history of diabetes it demonstrated no associations and so it appears to be irrelevant in this case. Even though physical activity was adjusted for in the model it may have an association to dietary habits, as the two factors often correlate and increased physical activity is often associated with healthier diet choices [37]. For instance when total MET was substituted with vigorous activity in the regression model, the association between dietary patterns and GDM was somewhat attenuated. Future studies should account for both physical activity and dietary intake when assessing the associations between lifestyle and risk of GDM.

Conclusions: These results indicate that adhering to a healthy or prudent dietary pattern may prove beneficial in preventing GDM, especially among women already at higher risk due to overweight or obesity before pregnancy. Promoting a healthy diet for prevention of GDM, with a special focus on women who are already at an increased risk for GDM due to overweight or obesity might turn out to be meaningful and merits testing with intervention studies. The results could contribute to changes in dietary advice in an effort to lower the rates of GDM.

Table 1 - Maternal characteristics

	Normal weight			Overweight			Obese		
	n = 86			n = 44			n = 38		
	Mean		SD	Mean		SD	Mean		SD
Age (years)	**29.0**	±	4.8	**30.0**	±	4.3	**30.0**	±	4.6
Height (m)	**168**	±	5.6	**167**	±	5.6	**168**	±	6
Pre-pregnancy weight (kg)	**61.1**	±	6.5	**76.2**	±	5.3	**93.6**	±	9.8
Weight at recruiting week 19-23 (kg)[x]	**65.9**	±	6.8	**81.9**	±	7.0	**96.8**	±	10.3
BMI pre pregnancy (kg/m^2) [x]	**21.6**	±	1.6	**27.2**	±	1.2	**33.2**	±	2.7
Gestational age at recruiting (weeks+days)*	**20/2**	±	3.4	**21/0**	±	6.8	**20/4**	±	3.7
BMI at recruiting (kg/m^2)[x]	**23.3**	±	1.8	**29.3**	±	1.7	**33.8**	±	2.3
Weight gain at recruiting (kg)[x]	**4.6**	±	2.7	**5.5**	±	4.1	**2.7**	±	4.1
Weekly weight gain between weight recordings (10-17 weeks) (kg)[x]	**0.7**	±	0.2	**0.6**	±	0.2	**0.5**	±	0.3
Parity	**0.6**	±	0.8	**1.0**	±	0.9	**0.7**	±	0.7
Number of GDM diagnoses (%)	**2**		(2.3)	**4**		(9.1)	**11**		(28.9)

Data is presented as mean ± standard deviation (SD)
[x] *Information about weight at recruiting is missing for 13 normal weight subjects, one overweight subject and 7 obese subjects*
** Gestational age presented as weeks and days ± standard deviation of days*

Table 2 - The extracted Prudent dietary pattern

Dietary pattern food	Factor loading coefficient*
Vegetables	0.58
Eggs	0.56
Vegetable oils[a]	0.47
Seafood[b]	0.47
Soft drinks[c]	-0.45
Breakfast cereals	0.40
Fruit and berries[d]	0.39
Nuts and seed	0.36
Pasta/couscous	0.34
French fries	-0.33
Tea, coffee, cocoa powder	0.33

**The Factor loading coefficient describes the correlation (r) between intake of the food groups and the extracted factor*

[a] *Includes all vegetable oils, peanut and seed butters*

[b] *Includes all fish, shellfish and seafood products*

[c] *Includes soda- and sports drinks (sugar sweetened and sugar-free)*

[d] *Includes all fruit, berries and jams*

Table 3 - Associations between characteristics of the participants and the prudent pattern score, fasting glucose and HOMA-IR**

Characteristics	n (%)	Prudent dietary pattern	Fasting glucose (mmol/l)	SD	HOMA-IR*	SD
Maternal age (years)						
18 – 25	45 (27)	-0.11	4.4	(0.4)	2.6	(2.5)
26 – 33	91 (54)	-0.11	4.5	(0.4)	3.4	(4.6)
34 - 40	32 (19)	0.46	4.6	(0.4)	2.1	(0.9)
P-value		**0.03**	**0.01**		0.70	
Parity						
Para 0	79 (47)	0.03	4.4	(0.4)	2.8	(2.7)
Para 1-3	89 (53)	-0.03	4.5	(0.4)	3.1	(4.3)
P-value		0.87	0.22		0.79	
Pre-pregnancy BMI (kg/m^2)						
18.5 - 24.9	86 (51)	0.1	4.3	(0.4)	2.6	(4.2)
25.0 - 29.9	44 (26)	0.07	4.6	(0.4)	3.2	(3.4)
≥ 30	38 (23)	-0.3	4.7	(0.4)	3.6	(2.4)
P-value		0.68	**< 0.01**		**< 0.01**	
Energy intake (kcal)						
Lowest energy quartile	42 (25)	-0.01	4.5	(0.4)	2.9	(3.3)
Second energy quartile	42 (25)	0.01	4.6	(0.4)	3.4	(4.7)
third energy quartile	42 (25)	-0.11	4.5	(0.4)	2.8	(3.9)
Highest energy quartile	42 (25)	0.11	4.4	(0.4)	2.8	(2.7)
P-value		0.98	0.16		0.59	

Data is displayed as mean and standard deviation (SD)
** The homeostatic model assessment of insulin resistance (HOMA-IR)*

Table 4 - Association between the Prudent dietary pattern and its components, total MET, weekly weight gain and gestational diabetes mellitus

	Unadjusted		Adjusted[1]	
All participants (n=168)	**OR**	**CI**	**OR**	**CI**
Extracted prudent dietary pattern	0.54	(0.30 , 0.58)*	0.44	(0.21 , 0.90)*
Seafood	0.98	(0.95 , 1.02)	0.84	(0.72 , 0.97)*
Eggs	0.99	(0.95 , 1.03)	0.98	(0.90 , 1.06)
Vegetables	1.00	(0.99 , 1.01)	1.00	(0.99 , 1.00)
Fruit and berries	1.00	(1.00 , 1.01)	1.09	(0.99 , 1.01)
Vegetable oils	0.95	(0.78 , 1.16)	0.80	(0.58 , 1.10)
Nuts and seeds	1.01	(0.95 , 1.07)	0.94	(0.76 , 1.17)
Pasta, couscous	0.98	(0.95 , 1.01)	0.89	(0.81 , 0.99)*
Breakfast cereal	1.00	(0.99 , 1.01)	1.02	(0.99 , 1.05)
Coffee, tea and Cocoa powder	1.00	(1.00 , 1.01)	1.00	(0.99 , 1.01)
Soft drinks	1.00	(1.00 , 1.00)	0.99	(0.98 , 1.00)
French fries	1.01	(0.99 , 1.04)	1.02	(0.99 , 1.11)
Overweight/obese before pregnancy (n=82)				
Extracted prudent dietary pattern	0.38	(0.18 , 0.83)*	0.31	(0.13 , 0.75)*
Seafood	0.96	(0.93 , 1.00)*	0.96	(0.93 , 1.00)*
Eggs	0.98	(0.94 . 1.03)	0.98	(0.93 , 1.03)
Vegetables	1.00	(0.99 , 1.00)	0.09	(0.99 , 1.00)
Fruit and berries	1.00	(1.00 , 1.01)	1.05	(0.92 , 1.20)
Vegetable oils	0.96	(0.70 , 1.32)	0.90	(0.67 , 1.22)
Nuts and seeds	0.99	(0.91 , 1.07)	1.05	(0.92 , 1.20)
Pasta, couscous	0.96	(0.92 , 1.00)	0.95	(0.91 , 1.00)*
Breakfast cereal	0.99	(0.98 , 1.01)	0.99	(0.98 , 1.01)
Coffee, tea and cocoa powder	0.96	(0.90 , 1.03)	0.95	(0.89 , 1.03)
Soft drinks	1.00	(1.00 , 1.00)	1.00	(1.00 , 1.00)
French fries	1.01	(0.99 , 1.04)	1.02	(0.99 , 1.05)

[1]*Adjusted for age, parity, pre-pregnancy weight, energy intake (kcal), weekly weight gain and total MET*
**Association is significant*

Table 5 - Relationship between different prudent dietary pattern adherences scores (lowest to highest tertile) and HOMA-IR, 120 min outcomes for glucose and insulin at oral glucose tolerance test and the Metabolic Equivalent of Task (MET).

	All participans (n=168)		**Normal weight (n=86)**		**Overweight/ obese (n=82)**	
			HOMA-IR			
Prudent dietary pattern						
Lowest score tertile	2.34	(2.37)	1.46	(0.94)	3.24	(2.19)
Medium score tertile	2.23	(1.76)	1.73	(1.04)	3.18	(1.65)
Highest score tertile	1.88	(1.04)	1.53	(1.1)	2.18	(1.05)
P-value	0.054		0.73		< **0.01**	
			Glucose 120 min (mmol/L)			
Lowest score tertile	5.8	(1.6)	5.2	(2.0)	5.9	(1.2)
Medium score tertile	5.6	(1.7)	5.3	(0.9)	5.9	(1.3)
Highest score tertile	5.3	(1.6)	5.1	(1.4)	5.9	(1.4)
P-value	0.18		0.92		0.51	
			Insulin 120 min (mU/L)			
Lowest score tertile	56.1	(44)	48.9	(52)	69.2	(46)
Medium score tertile	61.1	(66)	57.9	(33)	99.1	(98)
Highest score tertile	50.3	(44)	50.1	(39)	66.3	(37)
P-value	0.25		0.52		0.06	
			Total MET			
Lowest score tertile	2202	(4878)	2217	(3751)	1680	(5553)
Medium score tertile	1670	(2978)	1665	(2890)	1853	(3275)
Highest score tertile	2319	(2814)	2523	(2891)	2361	(2541)
P-value	0.17		0.14		0.77	

Data is displayed as medians (Interquartile range)
Significance in differences was found using The Kruskal–Wallis test
mU/L: milliunits per liter

Table 6 - Adherence to food based dietary pattern and food based dietary guidelines and rate of gestational diabetes mellitus

	GDM diagnosis	Non-GDM	Total	GDM
Prudent dietary pattern				
	n	N	n	%
All participants (n=168)				
Highest adherence	1	55	56	1.8
Low/medium adherence	16	96	112	14.3
				***P*= 0.01**
Overweight/obese women (n=82)				
Highest adherence	1	26	27	3.7
Low/medium adherence	14	41	55	25.5
				***P*= 0.02**
Healthy eating Index				
	GDM diagnosis	Non-GDM	Total	GDM
All participants (n=168)				
Highest adherence	2	54	56	3.6
Low/medium adherence	15	97	112	13.4
				***P*= 0.05**
Overweight/obese women (n=82)				
Highest adherence	1	25	26	3.8
Low/medium adherence	14	42	56	25.0
				***P*= 0.02**

Chi-squared test was used to define significance of differences

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8.2 Appendix II – Recipes from the Directorate of Health

BRAUÐ, KEX OG KÖKUR

Baguette
Beyglur
Brauð, byggbrauð
Brauð, Fitty, Orkubr.frá Myllunni, Bónus kjarna
Brauð, fjölkornabrauð
Brauð, franskbrauð
Brauð, heilhveitibrauð, heimilisbrauð
Brauð,malt,danskt rúg,Fitty kjarna,Sólkj,Ráðskbr
Brauð, rúgbrauð, seytt
Brauð, speltbr (Myllan), Heilkornabr Mosfelba.
Brauðstangir (á pítsustöðum)
Bruður, fínar
Bruður, grófar
Croissant
Croutons f. salat
Flatkökur
Hamborgarabrauð
Heilhveitihorn
Hrökkbrauð, gróf
Hrökkbrauð, fín
Hvítlauksbrauð
Ítölskbrauð, ciabatta
Kringlur, fínar
Kringlur, heilhveiti
Langloka, gróf
Langloka, fín
Nanbrauð
Ostaslaufur
Pítsusnúðar
Pítubrauð, fín
Pítubrauð, gróf
Pólarbrauð
Pylsubrauð
Rúnstykki, gróf
Rúnstykki, fín
Skonsur
Taco skeljar
Tortilla

Brauðterta
Heitur brauðréttur
Kjúklingaburritos frá Sóma
Langloka m/kjúklingi, léttsósa
Langloka m/kalkúni og beikoni
Langloka m/skinku, eggjum, grænm. og sósu
Langloka m/skinku, osti og sinnepssósu
Nautaburritos
Pítubrauð, Pólarbrauð indverskur kjúklingur
Pítubrauð, Pólarbrauð, m/skinku og salati
Samloka m/eggjum og grænm. heilsubiti
Samloka m/miklu kjöti t.d. American Style
Samloka m/roastbeef
Samloka m/rækjusalati
Samloka m/skinku og osti
Samloka m/túnfisksalati
Subway bræðingur, án sósu
Subway Club, án sósu
Subway klassískur ítalskur, án sósu
Subway m/kalkún, án sósu
Tortilla kjúklingur- Tikka masala
Tortilla, reykt skinka, egg, grænmeti pítusósa

Hafrakex, heilhveitikex
Hrískökur
Kransakökur
Kremkex
Mjólkurkex, fínt
Mjólkurkex, gróft
Saltkex
Smákökur
Smákökur, lítil fita t.d. marenstoppar
Súkkulaðikex
Tekex

Döðlubrauð, bananabrauð
Eplakaka, paj
Gulrótarkaka
Hjónabandssæla, Figroll
Jólakaka
Kanelsnúður, ömmusnúður
Kleinuhringir
Kleinur
Kleinur Gæðabakstur
Kleinur Ömmubakstur
Kókoskúlur, úr bakaríum
Marengsterta
Muffins
Möndlukaka m/bleiku kremi
Ostakaka
Pönnukökur
Rjómaterta
Rúlluterta, brún
Snúðar, gersnúðar (sænskir)
Snúður (bakarí)
Súkkulaðikaka
Tebolla
Tíramísúkaka
Vínarbrauð, smjörkaka
Vínarterta (randalín)
Vöfflur

Samloka m/hangikjöti og baunasalati
Samloka m/kalkún og beikoni
Samloka m/kjúklingi eða kalkúni
Samloka m/kjúklingi og rauðu pestói

Sulta
Þeyttur rjómi
Þeyttur jurtarjómi

ÁLEGG

Fetaostur, í olíu
Fetaostur, í saltlegi, Fetaostur frá Mjólku
Fjörostur
Gráðaostur
Kotasæla
Léttfeti
Mozzarella ostur 21%
Mozzarella ostur, ferskur í kúlum
Mygluostar (fita ca. 33%), Brie, Dala-hr.,Höfðingi
Mygluostar (fita ca. 25%), Camembert, Hrókur
Mygluostar (fita ca. 36%), Gullostur, Stóri-Dímon
Mygluostar (fita ca. 36%), Dalayrja, Kastali
Mysuostur, smyrjanlegur
Ostur 17%, Létt-Brie, rifinn salatostur
Ostur 26%, rifinn pasta, pizzu og gratin
Ostur, 11%
Parmesanostur
Rjómaostur, til matargerðar í stóru boxi (26%)
Rjómaostur, smyrjanlegur í lítilli dós (19%)
Smurostur 18%, Gotti smurostur
Smurostur, létt 6%
Sojaostur
Steyptir, bræddir ábætisost (ca. 32%)

Egg
Hamborgarahryggur/lúxus skinka, magurt
Hamborgarahryggur/lúxus skinka, m/fiutrönd
Hangiálegg
Hangiálegg, fituskert
Kindakæfa
Kjúklingaskinka, kalkúnaskinka
Lifrarkæfa
Lifrakæfa, fituminni
Lifrarpate
Malakoff
Pepperóní

Roastbeef
Rúllupylsa
Skinka, Hunangsskinka
Spægipylsa
Steik

Áleggspasta (kavíar)
Lax, silungur, reyktur
Rækjur
Síld, maríneruð
Síld, maríneruð í sósu

Ítalskt salat, majónes
Laxasalat, majónes
Laxasalat, sýrður rjómi
Rækjusalat, majónes
Rækjusalat, sýrður rjómi
Skinkusalat

Túnfisksalat, majónes
Túnfisksalat, sýrður rjómi

Hnetusmjör
Hummus
Hunang
Pestó
Sulta/marmelaði
Súkkulaðiálegg

Agúrka
Bananar
Epli
Paprika
Tómatur

MORGUN KORN

All-bran
Bran-flakes, Weetaflakes, Weetos,
Cheerios
Cocoa Puffs,LuckyCharms,Coca pops,Guldkorn
Bran-flakes, Weetaflakes, Weetos
Hafragrautur
Hafragrjón
Honey nut Cheerios
Hörfræ
Hveitikím

Múslí án sykurs
Múslí sætt
Rice Krispies
Sesamfræ
Sólblómafræ
Special K
Sol Gröd m/epli&kanil og m/bláberjum
Weetabix, Spelt flögur
Havre Fras, Crunchy bran
Rug Fras

Kornflögur

SÝRÐAR MJÓLKURVÖRUR

AB-mjólk, lífræn AB-mjólk
AB-mjólk m/ávöxtum
ABT-mjólk hrein
ABT-mjólk með ávöxtum og múslí
Benecol, m/ávöxtum, sykurskert
Bíómjólk
Bíómjólk m/vanillu, sykurskert
Engjaþykkni
FrúTína jógúrt
FrúTína jógúrtdrykkur
Grísk jógúrt
Hrísmjólk m/sætri sósu
Jógúrt m/ávöxtum/bragðefni, lífræn jógúrt

Jógúrt, hrein
KEA skyrdrykkur m/agave sírópi
Krakkaskyr
Létt AB mjólk, hrein
Létt-AB-mjólk m/ávöxtum, fituskert
Létt-AB-mj m/eplum og gulrót. fitu og sykursk.
Létt-ABT-mj m/ávöxt. og músli, fituskert
Létt-ABT-mj m/ávöxt.og músli, fitu og sykursk.
Létt-drykkjarjógúrt, Léttur Ab drykkur
Létt-drykkjarjógúrt, án viðbætts sykurs
Léttjógúrt, fitusk.(m/trefjum), Orkujógúrt f. Mjólku
Léttjógúrt, fitu og sykursk (melónu), LGG+ jógúrt
Létt-súrmjólk
Létt-súrmj m/eplum og peru, fitu-og sykursk.
LGG+
LGG+, epli og perur, án viðbætts sykurs
Pasqual, feitt
Pasqual, fitusnautt
Pasqual, létt
SMS skyr
Skyr, hreint
Skyr m/ávöxtum, Kea skyr, skyr.is
Skyr m/ávöxtum, m. sætuefni
Skyr.is drykkur m/ávöxtum
Skyr.is drykkur m/ávöxtum, m.sætuefni
Súrmjólk
Súrmjólk m/ávöxtum eða bragðefnum
Þykkmjólk m/ávöxtum

GRAUTAR

Ávaxtagrautur, sykurskertur
Ávaxtagrautur, venjulegur
Hafragrautur
Hrísgrjónagrautur, (úr léttmjólk)
Hrísgrjónagrautur, (úr nýmjólk)

ÚTÁLÁT

Fjörmjólk
Léttmjólk, Létt G mjólk
Nýmjólk, lífrænmjólk, G-mjólk
Undanrenna
Kaffirjómi
Matreiðslurjómi
Rjómi

Púðursykur
Sykur
Síróp, agavesíróp

ÍS OG BÚÐINGUR

Dýfa á ís
Ís úr vél
Ís, rjómaís, Skafís
Ís, Hversdagsís Emmess
Ís, Kjörís
Ítalskur ís
Jógúrtís
Íspinni, ísblóm, toppar
Frostpinni, klaki
Snickers, Mars, Kit Kat ís, Ben & Jerry´s ís
Íssósa
Bragðarefur
Mjólkurhristingur
Mjólkurbúðingur
Rjómabúðingur, frómas
Sun Lolly klaki

Þeyttur rjómi
Þeyttur jurtarjómi

SÚPUR

Baunasúpa (kjöt sér)
Brauðsúpa
Grænmetissúpa, heimalöguð
Kjötsúpa (kjöt sér)
Pastasúpa
Sætsúpa, ávaxtasúpa

Grænmetissúpa, heimalöguð m/rjóma
Grænmetissúpa m/kókosmjólk og curry paste
Grænmetissúpa, tær pakkasúpa
Grænmetissúpa, þykkt, pakkasúpa
Kakósúpa
Tómats m/rjómaosti, t.d. fiskisúpa (fiskur sér)
Tómatsúpa, grunnur t.d. fiskisúpa (fiskur sér)

FISKUR OG FISKRÉTTIR

Fiskibollur úr dós
Fiskibollur, búðingur, steikt úr steikingarfeiti
Gellur, kinnar, soðnar
Hrogn, soðin
Humar
Keila, langa, bökuð/grilluð
Lax, silungur, steikt
Lax, silungur, soðið/bakað/grillað
Lifur, soðin
Karfi, rauðspretta, steinbítur, steikt
Karfi, rauðsp, steinb, soðið/bakað/grillað
Plokkfiskur (kartöflur í rétti)
Plokkfiskur m/olíu (kartöflur í rétti)
Rækjur
Rækjur, djúpsteiktar
Saltfiskur, reyktur fiskur
Saltfiskur í tómat-ólífusósu, suðrænn saltfiskur
Skötuselur

Smálúða, grilluð/bökuð
Smálúða, steikt
Stórlúða, soðin/bökuð/grilluð
Ýsa, djúpsteikt, skyndibitastað
Ýsa, ofnbökuð m/lauk og osti

Ýsa, þorskur steikt m/raspi og matarolíu
Ýsa, þorskur, steikt m/raspi og smjöri
Ýsa, þorskur steikt m/raspi og smjörlíki
Ýsa, þorskur steikt m/raspi óþ.steikingarfeiti
Ýsa, þorskur án rasps,steikt/grillað í steikingarf.
Ýsa, þorskur, soðið/bakað/grillað án feiti
Ýsa í malasíu karrí (Hagkaup)
Ýsa í rjómasósu
Ýsa í rjómasósu m/grænmeti (50:50)
Ýsa í tilb.sósu, úr fiskbúð (verslun)
Ýsa í tilb.sósu m/grænmeti, úr fiskbúð (verslun)
Ýsunaggar

Harðfiskur, bitafiskur
Hákarl
Hvalur, súr
Sardínur
Síld, maríneruð
Síld, maríneruð í sósu
Túnfiskur í olíu
Túnfiskur í vatni

Sushi, lax nigiri, lax maki
Sushi, california

KJÖT OG KJÖTRÉTTIR

Chili con carne m/hakki og baunum
Hakk m/tómatsósu án steikingarfeiti
Hakk m/tómatsósu, m/steikingarfeiti
Hakk m/niðurs.tóm, grænm. án steikingarf.
Hakk m/niðurs.tóm, grænm m/steikingarf.
Hamborgari án brauðs án steikingarfeiti
Hamborgari án brauðs, m/steikingarfeiti
Kjötbollur úr hakki, steiktar m/steikingarfeiti
Lasagna m/hakki
Tortilla m/hakk og grænmetis fyllingu

Biximatur
Bjúga, soðin
Kjötfarsbollur, steikt m/steikingarfeiti
Kjötfars, soðið
Pylsur, soðnar

Kjúklingur m/skinni, grillaður/bakaður
Kjúklingur án skinns, grillaður/bakaður/steiktur
Kjúklingabitar, djúpsteiktir
Kjúklinganaggar

Saltkjöt, feitt
Hangikjöt, Londonlamb

Nautakjöt, magurt, steikt/bakað
Nautakjöt, millifeitt, steikt/bakað
Nautakjöt, feitt, bakað/steikt

Svínakjöt, magurt, bakað/steikt
Svínakjöt, millifeitt, bakað/steikt
Svínaköt, feitt (hnakki), bakað/grillað/steikt
Skinka, hamborgarahryggur
Skinka, hamborgarahryggur, magurt

Hreindýrakjöt
Hrefnukjöt
Hrossakjöt, reykt
Hrossakjöt, saltað
Hrossakjöt, soðið
Hrossakjöt, steikt

Raspsteikt kjöt, t.d. snitsel, naggar steikt

Kjúklingaréttur m/sósu, án rjóma, lítið grænmti
Kjúklingaréttur m/rjómasósu, lítið grænmeti
Kjúklingarétt. m/sósu og grænm (50:50) án rjóma
Kjúklingarétt. m/rjómasósu og grænmeti (50:50)
Kjúklingaréttur m/tilbúinni sósu (t.d. Tikka masala), lítið grænmeti

Kjúklingaréttur m/tilbúinni sósu (t.d. Tikka masala) og grænmeti (50:50)

Lambakjöt, magurt, bakað/grillað/steikt
Lambakjöt, læri, bakað (lítil fita borðuð)

Lambakjöt, millifeitt, bakað/grillað/steikt
Lambakjöt, millifeitt, soðið
Lambakjöt,feitt,bak/grill/steikt t.d.kótilettur m/fitu
Lambakjöt, feitt, soðið (t.d.súpukjöt)
Saltkjöt, magurt

Kjötpottur, gúllas m/sósu, án rjóma
Kjötpottur, gúllas m/rjómasósu
Kjötpottur m/sósu og grænm (50:50) án rjóma

Kjötpottréttur m/rjómas. og grænmeti (50:50)
Grænmetispottréttur m/litlukjöti (25%)

Beikon
Blóðmör, soðinn
Lifrarpylsa, soðin

Lifur, steikt
Svartfugl, lundi
Svið, soðin, sviðasulta

PÍTSA, PASTA, EGGJA, GRÆNMETIS- OG BAUNARÉTTIR

Baunir, hvítar niðursoðnar í tómatsósu
Baunir, soðnar, nýrna-, kjúkl.-, linsu- og soyab.
Baunabuff
Bökur m/grænmeti
Chili m/baunum, án kjöts
Egg, soðin
Egg, steikt
Eggjakaka, omeletta
Gratínerað grænmeti
Grænmetislasagna
Núðluréttur, instant
Núðluréttur Nings m/kjúkl., grænm. og egg
Hrísgrjónaréttur Nings m/kjúkl, grænm og egg
Heilsuréttur Nings-brún hrísgr m/egg,kjúkl.og grænm.
Pastar. heitur (feitur),pepperón,grænm,rjómasósa
Pastaréttur heitur m/skinku,grænm.sýrðum rjóma
Pastasalat, kalt m/grænmeti, án sósu
Pastasalat, kalt m/kjúklingi, skinku, án sósu
Pastasalat, kalt m/túnfiski og grænmeti, án sósu
Pítsa, eldbökuð, m/pepperóní, ananas og sveppum
Pítsa, eldbökuð m/kjúkl., hnetum, sólþ.tóm. & svep.
Pítsa m/grænmeti
Pítsa m/pepperóni og lauk
Pítsa m/skinku og ananas
Pítsa m/sósu og osti (margaríta)
Pítsu, hvítlauksbrauð, pitsastaðir
Sojakjöt, tofu
Tortellini
Tortilla, burrito, m/bauna og grænmetisfyllingu
Vorrúllur, Kínarúllur

SKYNDIBITAR

Fylltar pönnukökur (Crepes)
Hamborgari m/brauði, grænmeti og sósu
Hamborgari McDonalds
Kjúklingabitar
Kjúklingaborgari KFC og MacDonalds
KjúklingaTwister KFC
Kjúklingasalat, KFC Zinger salat
Kjúklingaburritos frá Sóma
Nautabúrítós frá Sóma
Núðluréttur Nings m/kjúkl., grænm. og eggjum
Hrísgrjónaréttur Nings m/kjúkl, grænm og egg
Heilsuréttur Nings-brún hrísgr m/egg,kjúkl.og grænm.
Píta m/buffi, grænmeti og sósu
Píta m/grænmeti og sósu
Pylsa í brauði m/tómatsósu og/eða sinnepi
Pylsa í brauði, m/öllu
Rækjur, djúpsteiktar
Tortilla, burrito, m/bauna og grænmetisfyllingu
Vorrúllur, djúpsteiktar
Ýsa, djúpsteikt

KARTÖFLUR OG MEÐLÆTI

Bygg, soðið
Eggjapasta, núðlur
Heilhveitipasta
Hrísgrjón
Hýðishrísgrjón
Kartöflur, franskar, ofnsteiktar, steiktar
Kartöflur, soðnar, bakaðar
Kartöflusalat m/majónesi
Kartöflusalat m/sýrðum rjóma
Kús kús

Kartöflugratín m/rjóma
Kartöflumús
Kartöflur, brúnaðar
Kartöflur, franskar, af skyndibitastað

Rótargrænmeti (sætar kartöflur, kartöflur, gulrætur)
Spaghetti, pasta
Sætar kartöflur

SOÐIÐ, STEIKT GRÆNMETI

Asíur, súrsað grænmeti, relish
Blómkál soðið
Eggaldin, steikt
Grænar baunir
Grænmetisblanda, frosin, soðin
Laukur, papríka, gulrætur, steikt í olíu
Laukur, papríka, gulrætur, steikt, í smjörlíki
Laukur,papríka,gulrætur, steikt, í steikingarfeiti
Gulrófur, soðnar
Gulrætur, soðnar
Hvítkál, soðið
Hvítlaukur í olíu
Kúrbítur, steiktur
Laukur, steiktur, í matarolíu
Laukur, steiktur, í smjörlíki

Laukur, steiktur, í steikingarfeiti
Laukur, steikur þurrkaður
Maískorn
Ólívur
Rauðkál
Rauðrófur
Rósakál
Sólþurrkaðir tómatar í olíu
Spergilkál
Spínat
Sveppir, niðursoðnir
Sveppir, steiktir, í matarolíu
Sveppir, steiktir, í smjörlíki
Sveppir, steiktir, í steikingarfeiti

HRÁTT GRÆNMETI

Agúrkur
Blómkál
Gulrófur
Gulrætur
Hrásalat (hvítkál, gulrætur, rófur)
Hrásalat í majonessósu
Iceberg, kínakál, blaðsalat

Laukur, rauðlaukur, púrrulaukur
Paprika, græn, gul og rauð
Ruccola, spínat ofl. dökkgrænt kál
Salat (iceb, kínak, tómatar, gúrka, paprika)
Salat (ruccola, spínat, tómatar, gúrka, paprika)
Spergilkál
Tómatar

ÁVEXTIR

Ananas
Appelsínur
Ávextir, blandaðir, skornir
Avocado (lárpera)
Bananar
Bláber
Epli

Ferskjur
Greipaldin
Hunangsmelónur
Jarðarber
Kantelópa
Kíví
Krækiber
Mandarínur
Nektarínur
Mangó
Perur
Plómur

Vatnsmelóna
Vínber

Niðursoðinn ananas
Niðursoðnir blandaðir ávextir

Döðlur
Fíkjur
Furuhnetur

Graskersfræ
Hnetur, salthnetur
Hnetur, aðrar
Hörfræ
Möndlur
Rúsínur
Sesamfræ
Sólblómafræ
Sveskjur
Þurrkaðir ávextir, aðrir

VIÐBIT, FEITI, STEIKINGARFEITI

Bertolli (áður Olivio)
Flora Proactive
Klípa
Létt og laggott
Létt og laggott með ólífuolíu
Létta
Kókosolía
Smjör
Smjörvi

Smyrill
Smyrja
Sólblóma 65%
Hamsar
Hörfræsolía
Olíublanda
Ólívuolía
Smjörlíkisblanda
Steikingarfeiti

SÓSUR, SÝRÐUR RJÓMI, SALATSÓSUR

Bernessósa
Brún sósa (soðsósa, lítil fita)
Guacamole
Jafningur (mjólk)
Malasíu karrísósa fyrir fisk
Ostasósa (ca 15%)
Rjómasósa (nær bara rjómi)
Sósa úr tómötum
Sósa úr smurosti (18%) og léttmjólk
Sojasósa
Súrsætsósa
Tikkamasalasósa ofl. tilbúnar sósur úr krukku
Tandori og jógúrtsósa m/grænmeti fyrir fisk
Uppbökuð sósa

Graflaxsósa
Grænmetissósa (58%)
Hamborgarasósa (40% fita)
Hamborgarasósa, eggjalaus (21% fita)
Hvítlaukssósa (53% fita)
Kokteilsósa úr majónesi (70% fita)
Kokteilsósa, eggjalaus (25% fita)
Létt Pítusósa (40% fita)
Majónes
Majónes, létt

Majónes, extra light (5% fita)
Mangó chutney
Kókosmjólk
Kókosmjólk, létt
Olíuediksdressing
Pestósósa
Piparsósa
Pítusósa keypt/búin til úr majónesi (70%fita)
Pítusósa eggjalaus (28% fita)
Remúlaði (58%fita)
Salatsósa, salatbar í Hagkaup
Salsasósa
Sinnep
Sinnepssósa (21% fita)
Súrmjólkursósa, jógúrtsósa
Sýrður rjómi, 5%
Sýrður rjómi 10%
Sýrður rjómi 18%
Sýrður rjómi 36%
Thousand Island dressing
Thousand Island dressing, létt
Tómatsósa (ketchup)

Salt

DRYKKIR

Ávaxtadrykkir (smoothy)
Boozt, skyr.is og ávextir
Boozt, skyr.is án viðbætts sykurs og ávextir
Fjörmjólk
FrúTína jógúrtdrykkur
Kakó úr nýmjólk
Kakó, úr léttmjólk, kókómjólk, Kappi kókómjók
KEA skyrdrykkur, (Agave síróp)
Kókómjólk
Kókómjólk, sykurskert
Létt-drykkjarjógúrt,Léttur Ab drykk. m.ávöxtum
Létt-drykkjarjógúrt (án viðbætts sykurs)
Léttmjólk, Létt-G mjólk
Nýmjólk, lífrænmjólk, G-mjólk
Skyr.is drykkur m/ávöxtum

Gosdrykkir, kóladrykkir sykurlausir
Fresca
Gosdrykkir sykraðir, aðrir
Gosdrykkir sykurlausir, aðrir
Maltöl
Pilsner

Burn orkuskot
Extreme orkuskot, Redfin
Íþróttadrykkir (Aqarius, Gatorade, Leppin, Isostar)
Orkudrykkir (Burn, Cult, Red Bull, Bomba)
Orkudrykkir (Magic, Orkan)
Powerade

Bjór

Skyr.is drykkur m/ávöxtum án viðbætts sykurs
Hrísmjólk, kalkbætt
Sojamjólk
Swiss miss
Undanrenna

Ávaxta-, Berg- og Eðaltoppur m.andox/trefjum
Kolsýrt vatn, Toppur, Egils kristall m/bragðefn.
Kristall +
Kristall sport (m/sætuefnum)
Vatn

Appelsínusafi, greipsafi, hreinn
Ávaxtasafi, vítamínbættur
Eplasafi, hreinn
Engiferdrykkur, My secret
Gulrótarsafi
Heilsusafi
Nektar
Svali/Frissi fríski, djús, sykraður
Svali, djús, sykurskertur

Gosdrykkir, kóladrykkir sykraðir

SÆLGÆTI, SNAKK
Brjóstsykur
Bland í poka
Bounty
Buff, staur
Corny
Hlaup
Hraun
Hrískúlur
Karamellur
Kitkat
Kúlur
Lakkrís
Lakkrískonfekt
M&M's, Smartís
Mars, Snickers
Nizza
Ópal, Tópas, með sykri
Ópal, Tópas, sykurlaust
Pipp
Prince Polo
Rolo
Síríuslengja
Special K bar

Súkkulaði, fyllt
Súkkulaði, rjóma

Bjór lite
Brennd vín
Hvítvín
Líkjör
Rauðvín
Sherry, millisterk vín

Cappuccino m/léttmjólk
Cappuccino m/nýmjólk
Kaffi
Kaffi Latte m/léttmj, Macchiato m/léttmj.
Kaffi Latte m/nýmj, Macchiato m/nýmj.
Te
Kaffirjómi í kaffi, te
Léttmjólk í kaffi, te
Nýmjólk í kaffi, te
Rjómi í kaffi, te

Canderel (aspartam)
Hunang
Nutrasweet í kaffi, te
Síróp, agavesíróp
Sykur í kaffi, te

Súkkulaði, suðu
Súkkkulaði, 70%
Súkkulaði m. karmellu ofl.,
Súkkulaðihnetur, m&m hnetur
Súkkulaðirúsínur
Twix

Tyggjó, með sykri
Tyggjó, sykurlaust

Hnetur, salthnetur
Hnetur - allar teg.
Hnetubar-bland í poka

Kartöfluflögur
Nasl, skrúfur
Poppkorn, heimap
Poppkorn, tilbúið
Poppkorn, örbylgju
Poppkorn örbylgju Popp Secret
Poppkorn, örbylgju, létt
Poppkorn, örbylgju Richfood Light
Saltstangir
Söl
Tortilla, chips

FÆÐUBÓTAREFNI

B-vítamíntöflur
C-vítamíntöflur
D-vítamíntöflur
E-vítamíntöflur
Fjölvítamín án A- og D-vítamíns
Fjölvítamín með A- og D-vítamíni
Fólasíntöflur
FRískamín
Hákarlalýsishylki
Heilsutvenna, lýsishylki (án A og D vítamín)
Heilsutvenna, vítamíntafla
Járntöflur
Krakkalýsi
Lýsi og liðamín, liðamínstafla
Lýsi og liðamín, lýsishylki (án A og D vítamín)

Lýsi+Dvít & kalk, kalktafla
Lýsi + Dvít & kalk, lýsishylki
Omega-3, hylki
Omega-3 forte, hylki
Omega-3 fiskiolía
Sportþrenna, fjölvítamíntafla (karnitín sleppt)
Sportþrenna, Omega-3 hylki
Udo´s Oil 3-6-9
Ufsalýsi
Þorskalýsi
Þorskalýsisperlur
Önnur bætiefni

Próteinduft, Myoplex original,deluxe, Profitt protein
Próteinduft, 100% Whey protein
Próteindrykkur, Myoplex tilbúinn til neyslu
Próteindrykkur, Herbalife, Nupo létt
Próteindrykkur, Hámark
Próteindrykkur, Hleðsla
Próteinstykki t.d. Myoplex, Easy body, Hreysti, Kraftur, OhYeah, Styrkur
Próteinstykki, Herbalife gull
Þyngingarblanda

8.3 Appendix III - Food groups in ISGEM

1. Mjólk, mjólkurvörur

1.1 Nýmjólk, léttmjólk, undanrenna, rjómi, kakómjólk, kakó, bragðbættir mjólkurdrykkir
1.2 Sýrðar mjólkurvörur, sýrður rjómi, jógúrt, jógúrtdrykkir og skyr
1.3 Mjólkurgrautar og –súpur, mjólkurbúðingar, rjómabúðingar, tiramisú
1.4 Nýmjólkurduft, undanrennuduft

2. Ostar

2.1 Allir ostar úr mjólk eða mjólkurvörum
2.2 Ostar úr soja eða öðru jurtapróteini

3. Ís

3.1 Mjólkurís, rjómaís, jógúrtís
3.2 Jurtaís
3.3 Vatnsís

4. Kornmatur, brauð og kökur

4.1 Ómalað og heilmalað korn, kím og klíð. Hrísgrjón, maís og hafragrjón
4.2 Mjöl
4.3 Morgunverðarkorn, mjölgrautar
4.4 Brauð, hrökkbrauð, tvíbökur, bruður, skonsur
4.5 Kex, sætt, ósætt, smákökur
4.6 Kökur, sætabrauð (annað en kex og smákökur), tertur, ostakökur
4.7 Pasta, kús-kús

5. Grænmeti og kartöflur

5.1 Nýir, frystir rótarávextir, nema kartöflur
5.2 Nýtt, fryst grænmeti: stönglar, blöð, aldin
5.3 Nýjar kartöflur
5.4 Nýjar, frystar baunir, ertur
5.5 Nýir sveppir
5.6 Ferskar kryddjurtir
5.7 Niðursoðið og niðurlagt grænmeti, tómatmauk
5.8 Þurrkað grænmeti, kartöfluduft
5.9 Franskar kartöflur

6. Ávextir, ber, hnetur og fræ

6.1 Nýir, frystir ávextir

6.2 Ný, fryst ber
6.3 Hnetur, fræ
6.4 Niðursoðnir ávextir, ber, ávaxtagrautar, ávaxtamauk
6.5 Þurrkaðir ávextir og ber
6.6 Sultur

7. Kjöt og kjötvörur.

7.1 Lambakjöt, kindakjöt, nýtt, fryst, saltað, reykt, hakkað
7.2 Nautakjöt
7.3 Svínakjöt
7.4 Hrossakjöt
7.5 Hreindýra- hvalkjöt
7.6 Fars, farsvörur, pylsur, bjúgu, áleggspylsur
7.7 Innmatur, slátur, svið, kæfa
7.8 Niðursoðin kjötvara

8. Fiskur, fiskafurðir og skeldýr

8.1 Ferskur og frystur fiskur. Fiskhakk, hrogn, lifur
8.2 Þurrkaður og hertur fiskur
8.3 Fiskfars og farsvörur, fiskipate
8.4 Saltfiskur, reyktur fiskur, siginn, kæstur og grafinn fiskur
8.5 Niðurlagður og niðursoðinn fiskur og skeldýr
8.6 Fersk og fryst skeldýr

9. Fuglakjöt

9.1 Alífuglar
9.2 Villtir fuglar

10. Egg og eggjavörur

10.1 Egg, ný, fryst, heil eða fljótandi
10.2 Þurrkaðar eggjavörur

11. Feitmeti: smjör, smjörlíki, olíur o.fl

11.1 Jurtaolíur, jurtafeiti
11.2 Fiskolíur, lýsi
11.3 Tólg, mör, kjötfita
11.4 Smjör, Smjörvi, Létt og laggott, Klípa
11.5 Smjörlíki, hert fita
11.6 Hnetusmjör, fræsmjör

12. Drykkir, nema mjólkurdrykkir

12.1 Te, kaffi, kakóduft

12.2 Gosdrykkir, svaladrykkir

12.3 Blandaðir ávaxta- og berjadrykkir, saft

12.4 Hreinir safar, ávaxtasafar, berjasafar, grænmetissafar

12.5 Íþrótta- og orkudrykkir

12.6 Bjór, pilsner, maltöl

12.7 Borðvín

12.8 Millisterk vín, brennd vín, líkjör

12.9 Vatn, sódavatn með og án bragðefna

13. Matarsalt, edik, ger, krydd og kraftur

13.1 Matarsalt, edik, krydd og kraftur

13.2 Ger og hjálparefni

13.3 Gervisætuefni

14. Snakk: poppkorn, flögur o.fl.

14.1 Poppkorn

14.2 Flögur, skrúfur, kornstangir, annað snakk

15. Sósur, súpur og áleggssalöt

15.1 Allar sósur og ídýfur: Salatsósur, majones og majonessósur, olíusósur, rjóma og ostasósur, sinnep, tómatsósur, sósur úr grænmeti, uppbakaðar, jafnaðar sósur, súr-sætar sósur o.fl.

15.2 Súpur, súpuduft

15.3 Áleggssalöt, majonessalöt, salöt úr sýrðum rjóma

16. Tilbúnir réttir

16.1 Pitsur, samlokur, pítur, brauðréttir, hamborgarar, pylsa í brauði

16.2 Pastaréttir, lasagna

16.3 Kjötréttir

16.4 Fiskréttir

16.5 Grænmetisréttir

16.6 Eggjaréttir

17. Fæðubótarefni, næringardrykkir, sérfæði

17.1 Vítamín, steinefni, önnur fæðubótarefni

17.2 Megrunar- og próteindrykkir, næringardrykkir, próteinstykki

18. Sykur, hunang og sælgæti

18.1 Sykur, púðursykur, flórsykur

18.2 Hunang

18.3 Sælgæti

8.4 Appendix IV – Calculated loss (%) of nutrients due to cooking

	1-3	4	5-6	5.1	5.2	7	8	9	10	11
A-vítamín										
suða	0	10	10	5	5	20	20	45	5	15
steiking	10	10	10	10	10	20	20	25	20	50
bakstur	10	10	10	10	10	5	10	30	20	15
E-vítamín										
suða	20	0	0	0	0	20	0	45	0	25
steiking	20	0	0	0	0	20	0	25	0	80
bakstur	20	0	0	0	0	20	0	20	0	25
B_1-vítamín										
suða	0	15	25	25	40	60	20	60	10	0
steiking	0	20	25	10	10	20	20	30	15	0
bakstur	0	20	25	25	10	20	20	40	15	0
B_2-vítamín										
suða	10	10	35	30	35	30	30	5	5	0
steiking	10	5	35	5	5	20	10	10	10	0
bakstur	10	5	35	5	5	20	10	10	20	0
Níasín										
suða	0	30	35	30	35	50	30	40	0	0
steiking	0	5	35	5	5	20	10	20	0	0
bakstur	0	5	35	10	5	20	10	20	0	0
B_6-vítamín										
suða	10	40	40	20	35	50	30	40	10	0
steiking	10	40	40	10	10	40	20	40	20	0
bakstur	10	10	40	10	10	40	20	35	20	0
Fólat										
suða	20	30	40	50	50	30	30	40	10	0
steiking	20	30	40	30	30	20	20	30	20	0
bakstur	20	50	40	25	30	20	20	30	30	0
B_{12}-vítamín										
suða	5	0	0	0	30	30	20	50	0	0
steiking	5	0	0	15	20	20	10	30	0	0
bakstur	5	0	0	20	30	20	10	30	0	0
C-vítamín										
suða	50	30	50	40	50	20	20	20	0	0
steiking	50	15	50	20	20	20	20	20	0	0
bakstur	50	30	50	15	30	20	20	20	0	0
Steinefni										
suða	5	5	5	5	5	5	5	5	5	5
steiking	0	0	0	0	0	0	0	0	0	0
bakstur	0	0	0	0	0	0	0	0	0	0