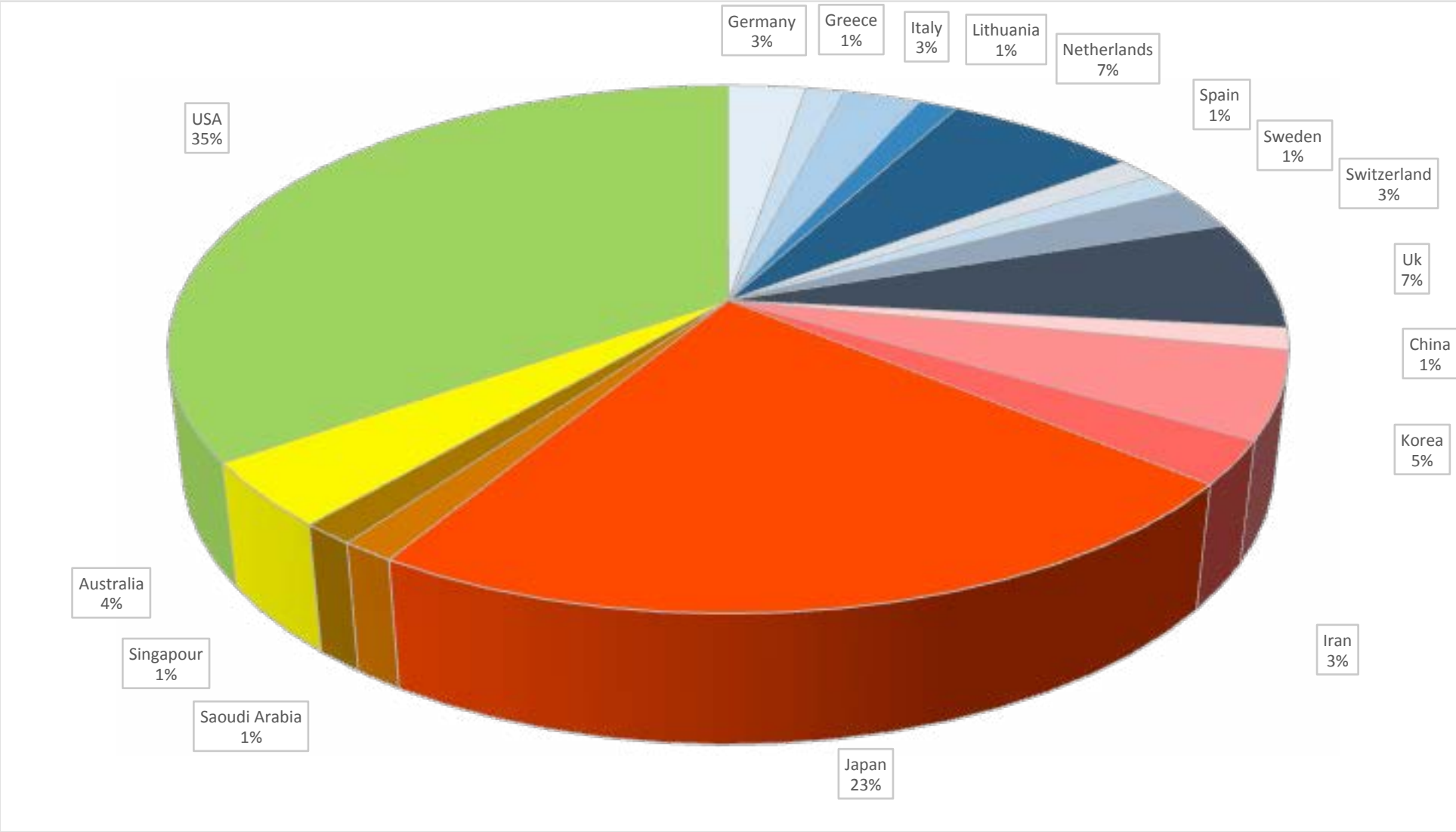


Medical research on
eating slowly correlated to health

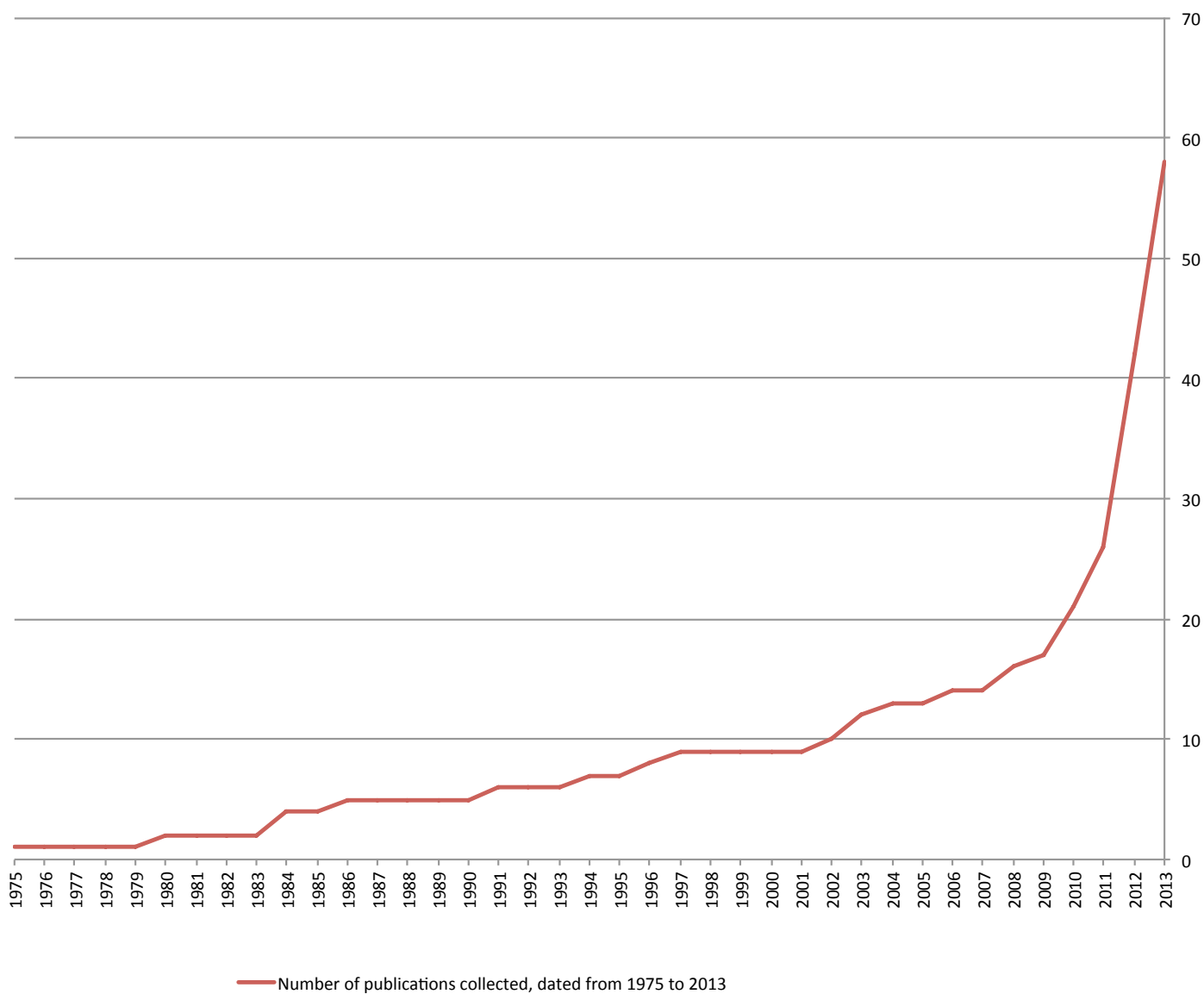


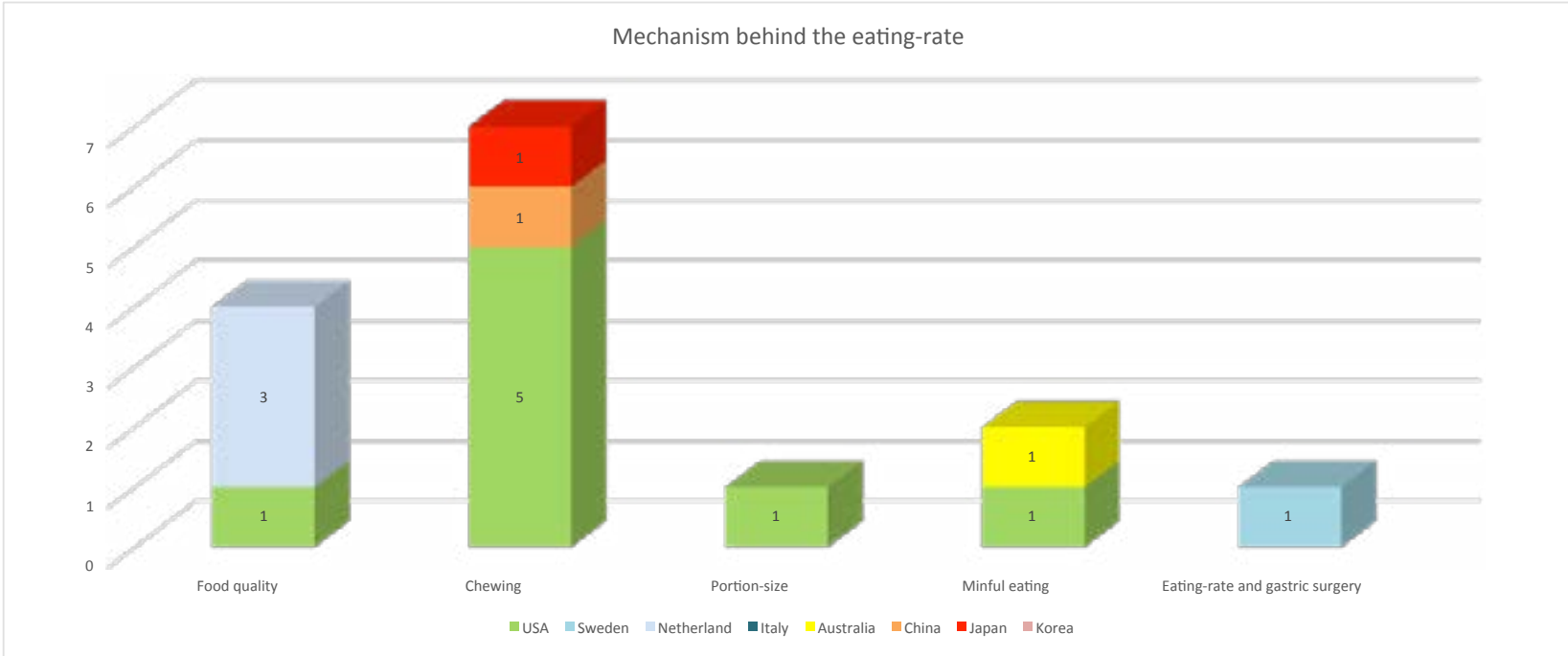
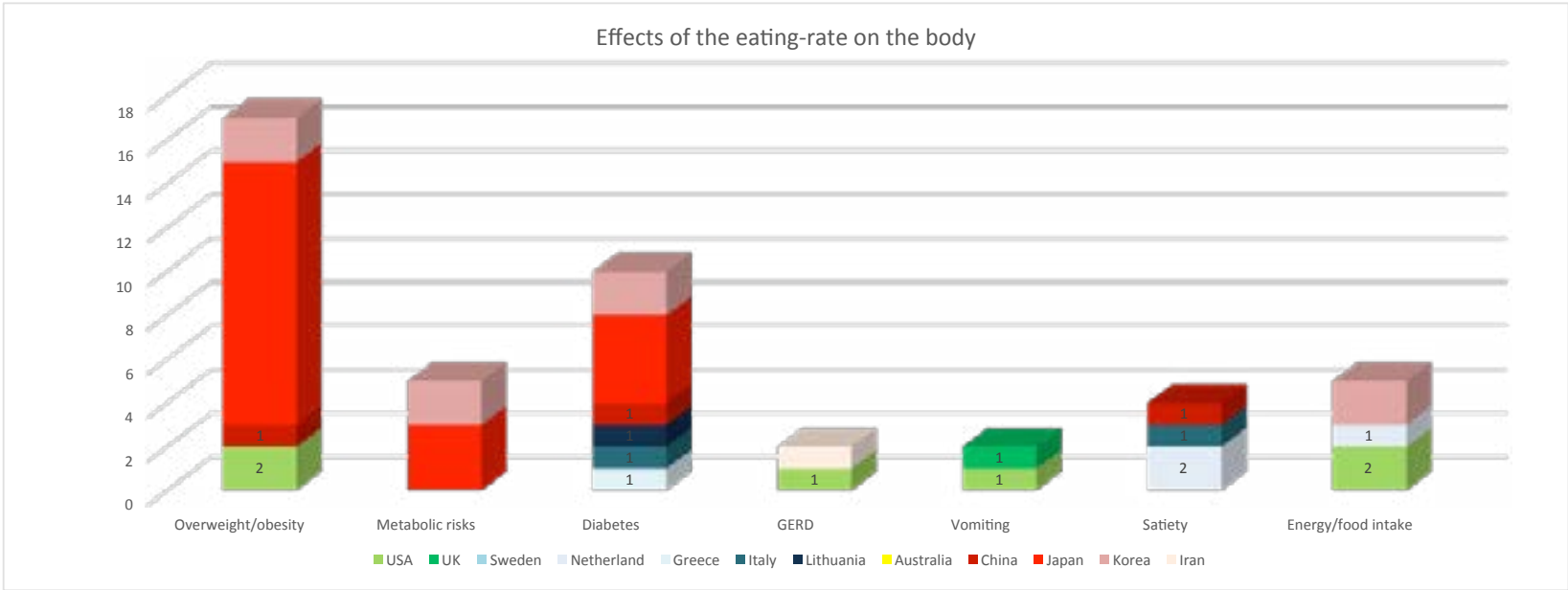
Medical Statistics

Studies on eating rate by country



Number of publications collected, dated from 1975 to 2013

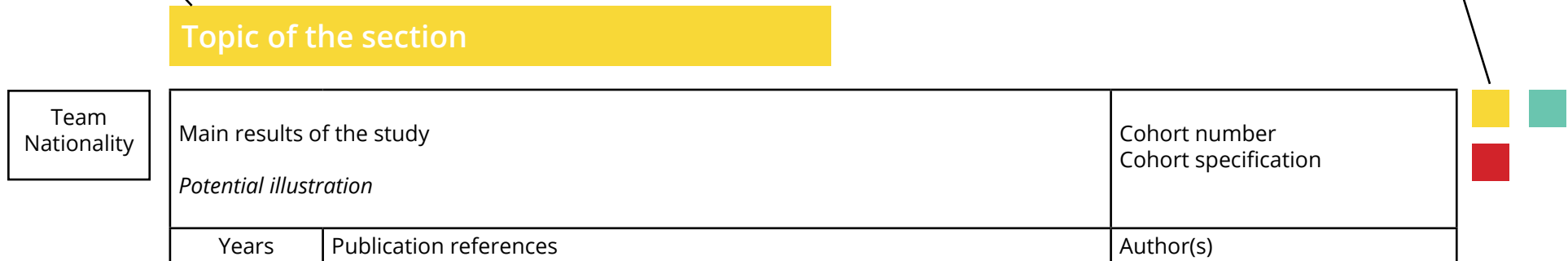




Presentation of the studies

Color of the section

Color of the related topic the study treats



Color by section :

- | | | | | | |
|---|-----------------|--|--------------|---|-------------------|
|  | Satiety |  | Diabetes |  | Portion Size |
|  | Food Intake |  | GERD |  | Mindful eating |
|  | Obesity |  | Food quality |  | Gastric surgery |
|  | Metabolic Risks |  | Chewing |  | Scientific Method |

Chapter 1

The effects of eating fast

Overweight and obesity are characterized by an excess in body fat. The cells found in the adipose tissue are called the adipocytes and are responsible for storing the fat. The fat stored in these cells is in a semi-liquid state and consists of triglycerides and cholesterol ester. A fat cell measures in average 0,1 millimeter in diameter and can grow up to fifty times its size.





It is considered that an adult has an average of about 20 billion fat cells that can weigh up to 13,5 kilograms. In a healthy subject reaching its adult weight, the cells size increases by four and then divides and increases significantly. The number of adipocytes increases during childhood and adolescence while in adulthood the quantity remains rather constant. However when the adipocytes cells reach their maximum capacity, they can grow up to 10 times in order to increase the storage capacity. We can note that an individual becoming obese during adulthood will have less adipocytes than an individual whose pathology was reported in adolescence.



The adipocytes increase or lose their fat content but decreasing their number is not easy. The medical studies on tachyphagia show a strong correlation between the behaviour which consists of « eating quickly » and the fact of suffering of overweight, or obesity at all stages of life.

BMI : We consider that a person is overweight when its BMI (body mass index = weight in kg divided by the height in meter²) is between 25 and 30, obese when its BMI exceeds 30.

Eating-rate and overweight/obesity

	Counseling aimed at slowing the rate of ingestion could be promising behavioral treatments for obese persons	48 (24 males; 24 females) non-obese and pre-obese young adults
2015	Physiology & Behavior Jan;138:69-74.	Park S, Shin WS.
	Increasing portion size led to a larger bite size and faster eating rate, but a slower reduction in eating speed during the meal. Interventions to reduce bite size and slow eating rate may provide individuals with strategies to reduce the risk of overconsumption.	37 overweight women
2015	Physiology & Behavior Feb;139:297-302.	Almiron-Roig E, Jebb SA.
	Irregular meal pattern and more intra-meal drinking were associated with increased odds of general and abdominal obesity among Iranian adults.	7958 adults
2015	European Journal of Nutrition Apr 2.	Saneei P, Adibi P.
	The prevalence of self-reported binge eating was 55% (n=109).	197 women ages 20 to 65 being assessed for bariatric surgery with a BMI greater than 30kg/m ²
2015	Eating Behavior Apr;17:130-5. doi: 10.1016/j.eatbeh.2015.01.014. Epub 2015 Feb 7.	Coker EL, von Lojewski A, Luscombe GM, Abraham SF.



<p>In multiple logistic regression models, eating rate was significantly and positively associated with metabolic syndrome. The multivariable-adjusted ORs (95% CI) for slow, normal and fast were 0.70 (0.62 to 0.79), 1.00 (reference) and 1.61 (1.53 to 1.70), respectively, in men (p for trend <0.001), and 0.74 (0.60 to 0.91), 1.00 (reference) and 1.27 (1.13 to 1.43), respectively, in women (p for trend <0.001). Of metabolic syndrome components, abdominal obesity showed the strongest association with eating rate. The associations of eating rate and metabolic syndrome and its components were largely attenuated after further adjustment for body mass index; however, the association of slow eating with lower odds of high blood pressure (men and women) and hyperglycaemia (men) and that of fast eating with higher odds of lipid abnormality (men) remained statistically significant.</p>		<p>56,865 participants (41,820 male and 15,045 female) who attended a health checkup in 2011 and reported no history of coronary heart disease or stroke.</p>
2014	BMJ Open. Sep 5;4(9):e005241.	Nagahama S, Mizoue T.






<p>Understanding mechanisms of food intake self-regulation (FISR). This review focuses on 4 behavioral indices of FISR in childhood: (1) eating in the absence of hunger; (2) eating rate; (3) caloric compensation and satiety responsiveness, and (4) food responsiveness. Evidence from pediatric samples around the world indicates that these traits are associated with body mass index, are heritable, and are linked to polymorphisms in the FTO gene</p>		<p>Evidence from pediatric samples around the world</p>
2014	Human Heredity 75(2-4):80-9. do	Myles S. Faith a Susan Carnell b Tanja V.E. Kral c






<p>Eating quickly was associated with excess gains in anthropometric variables. Stopping a habit of eating quickly prevents these excess gains.</p>		<p>3182 non-overweight/ obese schoolgirls (9-10 y)</p>
2013	European Journal of Endocrinology Aug 27	Ochiai H, Kokaze A.






<p>Fast eating rates are associated with obesity and other cardiometabolic risk factors</p>		<p>8755 adults</p>
2013	Nutrition Metabolism Cardiovascular Diseases: NMCD. Jul;23(7):635-41	Lee KS, Cho KH.




	The risk of being overweight was 3.93 time higher for male eating quickly than for male eating slowly. This Odds ratio was 1.59 for female students eating quickly. As a comparison, the adjusted odds ratio of being overweight in male students who frequently reported eating a fatty diet was 2.72.		1918 students
	2013	Asia Pacific Journal of Public Health Jul;25(4):326-34	Ekuni D, Morita M.
	Eating quickly had a significantly greater association with risk of metabolic syndrome (risk of abdominal obesity combined with a risk of hypertension, diabetes, or hypercholesterolemia), for both sexes, than eating slowly or at a normal pace This studies also showed that skipping breakfast, eating quickly, and having a late night supper were independently associated with risk.		4912 adults (30-39y)
	2013	Nihon Koshu Eisei Zasshi. Japanese Journal of Public Health Feb;60(2):98-106	Soga Y, Shirai C, Ijichi A.
	The proportions of participants who were obese or who had elevated waist circumference levels increased progressively with increases in eating rate. These associations remained significant regardless of the age, sex, total energy intake, dietary fibre intake, current smoking, current drinking and regular exercise.		7275 individuals aged ≥40
	2013	Diabetologia. Jan;56(1):70-7	Ohkuma T, Kitazono T.






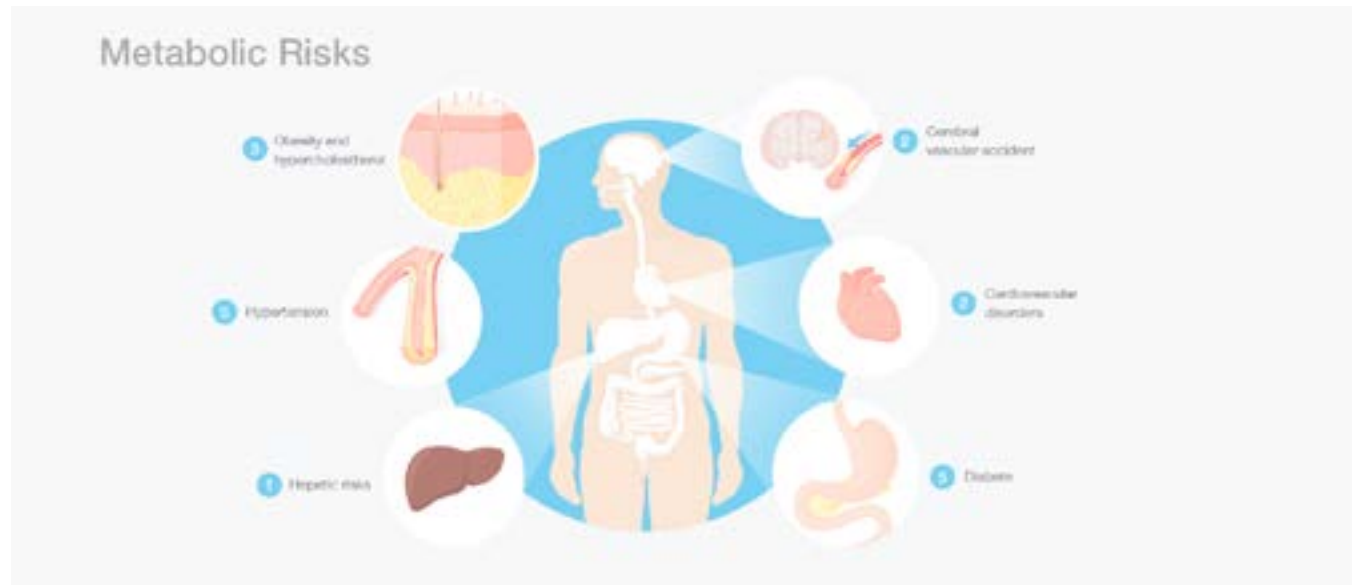
	<p>Among boys, fast eating speed significantly increased the odds ratio for overweight. Among boys eating until full, OR : 2,78 Among those not eating until full : 2,43 Among girls, fast eating speed led to a significant increase in the OR in those eating until full</p>	<p>3138 adolescents</p>
2013	Journal of Obesity 717942doi: 10.1155/2013/717942	Ochiai H, Kokaze A.
	<p>Across the categories of eating speed (slow, medium, and fast) a faster eating speed was associated with a higher prevalence of obesity.</p>	<p>2050 males</p>
2012	Metabolism: clinical and experimental Nov;61(11):1566-71	Sakurai M, Nakagawa H.
	<p>Rapid eating was significantly associated with body mass index. The BMI of those who reported eating quickly was 0.8 kg/m² higher than in individuals who reported eating at medium speed.</p> <p>Illustration : for 1m60 (5'3"), it makes an average difference of weight of about 2kg (4.4 Lbs) between two persons of 1m80 (5'9"), it makes an average difference of weight of about 2,6kg (5,7 Lbs)</p>	<p>762 patients with Type2 Diabetes (30-70 y)</p>
2012	Appetite Oct;59(2):252-5	Saito A, Sone H.

	<p>Rate of eating was positively associated with the risk of overweight, independent of protein, fat, and dietary fiber intakes.</p> <p>Odds ratio for overweight in very fast categories was: 4.49 in male children; 5.69 in female children;</p> <p>3.84 in male adolescents; 1.49 in female adolescents</p>	<p>24176 children (6-11y) and adolescents (12-15 y)</p>
<p>2012</p>	<p>Journal of Nutritional Science and Vitaminology (Tokyo). 58(4):247-52</p>	<p>Murakami K, Arakawa M.</p>
	<p>Compared with lean participants, obese participants had a higher ingestion rate and a lower number of chews per 1 g of food.</p>	<p>30 lean and obese young men</p>
<p>2011</p>	<p>American Journal of Clinical Nutrition Sep;94(3):162-70</p>	<p>Li J, Wang S.</p>
	<p>The group with metabolic syndrome (obesity, high blood pressure, low high-density lipoprotein cholesterol level, high triglyceride level, and high fasting blood glucose level) was more likely to eat quickly (OR 2.23 for fast vs slow) and to overeat frequently (OR 2.37, for more than 4 times a week vs less than once a week).</p> <p><i>Illustration : According to this odds ratio, if in a control group of 100 healthy people, 16 are fasteaters, in an equivalent group of 100 people but with metabolic syndrome 30 will be fast eater. If in the control group 16 overeat frequently, they are 31 in the other group</i></p>	<p>7081 men aged ≥30</p>
<p>2009</p>	<p>Journal of the American dietetic Association Apr;109(4):633-40</p>	<p>Shin A, Kim J.</p>



	<p>For both sexes the highest age adjusted mean values for height, weight, body mass index, and total energy intake were in the eating until full and eating quickly group compared with the not eating until full and not eating quickly group.</p> <p>The multivariable odds ratio of being overweight with both eating behaviours compared with neither was:</p> <ul style="list-style-type: none"> - 3.13 for men - 3.21 for women 	<p>3287 adults aged 30-69</p>
2008	BMJ Oct 21;337:a2002	Maruyama K, Iso H.
	<p>Current BMI steadily increased along with the progress of categorical rate of eating. Both BMI at age 20 and current height are positively associated with rate of eating.</p>	<p>3737 middle aged men and women (39-55y)</p>
2006	Journal of Epidemiology/ Japanese Epidemiological Association May;16(3):117-24	Otsuka R, Toyoshima H.
	<p>The rate of eating showed a significant and positive correlation with BMI. Only dietary fiber intake showed a weak correlation with BMI.</p> <p>Eating quickly = BMI Fiber intake = BMI</p>	<p>1695 18 years old females</p>
2003	International Journal of Obesity and Related Metabolic Disorders Nov;27(11):1405-10.	Sasaki S, Amano K.

	<p>The BMI of the male patients who ate quickly (average 25.4) were significantly higher than those of the patients who ate at a normal rate (average 24.4) or slowly (average 24.1).</p> <p><i>Illustration : Considering 3 patients being 1m70 tall (5'3"), the average weight is 73,4 kg (163 Lbs) for the fast eater, 70,5 (156,7 Lbs) for the normal eater and 69,6 kg (154,7 Lbs). It is an average difference of almost 4 kg between the fast and the slow eater.</i></p>	<p>422 patients with type 2 diabetes or hyperlipidaemia.</p>
<p>2002</p>	<p>Journal of International Medical Research Jul-Aug;30(4):442-4.</p>	<p>Takayama S, Sasaki T.</p>
	<p>Fire fighters who reported eating faster at the station than elsewhere gained 9.9 lb compared with 6.8 lb for all others.</p>	<p>438 firefighters (20-58y)</p>
<p>1996</p>	<p>Preventive Medicine Sep-Oct;25(5):593-600.</p>	<p>Gerace TA, George VA.</p>
	<p>Increased meal length was associated with greater weight loss.</p>	<p>10 obese women</p>
<p>1991</p>	<p>Behavior Therapy Volume 22, Issue 1, Winter, Pages 61-67</p>	<p>Theresa A., Gary D. Foster</p>





We consider cardio metabolic risks, the risks linked to the development of cardiac or metabolism diseases.







The factors are various and often linked to basic occasional behaviours which repeated chronically become problematic.

For instance, unhealthy eating « junk food » is very well known for being related to the risk of developing hypertension, hyperglycemia and excess of cholesterol.


The medical studies demonstrate a strong correlation between the behaviour which consists of « eating quickly » and the cardio metabolic risks.

Eating rate and metabolic risks




	<p>ALT activity is positively associated with faster eating, but is dependent on BMI in middle-aged, apparently healthy Japanese women.</p>	<p>900 apparently healthy women ages 40 to 64 y</p>
	<p>2014 Nutrition. 2014 Jan;30(1):69-74. doi: 10.1016/j.nut.2013.07.016.</p>	
	<p>In multiple logistic regression models, eating rate was significantly and positively associated with metabolic syndrome. The multivariable-adjusted ORs (95% CI) for slow, normal and fast were 0.70 (0.62 to 0.79), 1.00 (reference) and 1.61 (1.53 to 1.70), respectively, in men (p for trend <0.001), and 0.74 (0.60 to 0.91), 1.00 (reference) and 1.27 (1.13 to 1.43), respectively, in women (p for trend <0.001). Of metabolic syndrome components, abdominal obesity showed the strongest association with eating rate. The associations of eating rate and metabolic syndrome and its components were largely attenuated after further adjustment for body mass index; however, the association of slow eating with lower odds of high blood pressure (men and women) and hyperglycaemia (men) and that of fast eating with higher odds of lipid abnormality (men) remained statistically significant.</p>	<p>56,865 participants (41,820 male and 15,045 female) who attended a health checkup in 2011 and reported no history of coronary heart disease or stroke.</p>
	<p>2014 BMJ Open. Sep 5;4(9):e005241.</p>	<p>Nagahama S, Mizoue T.</p>

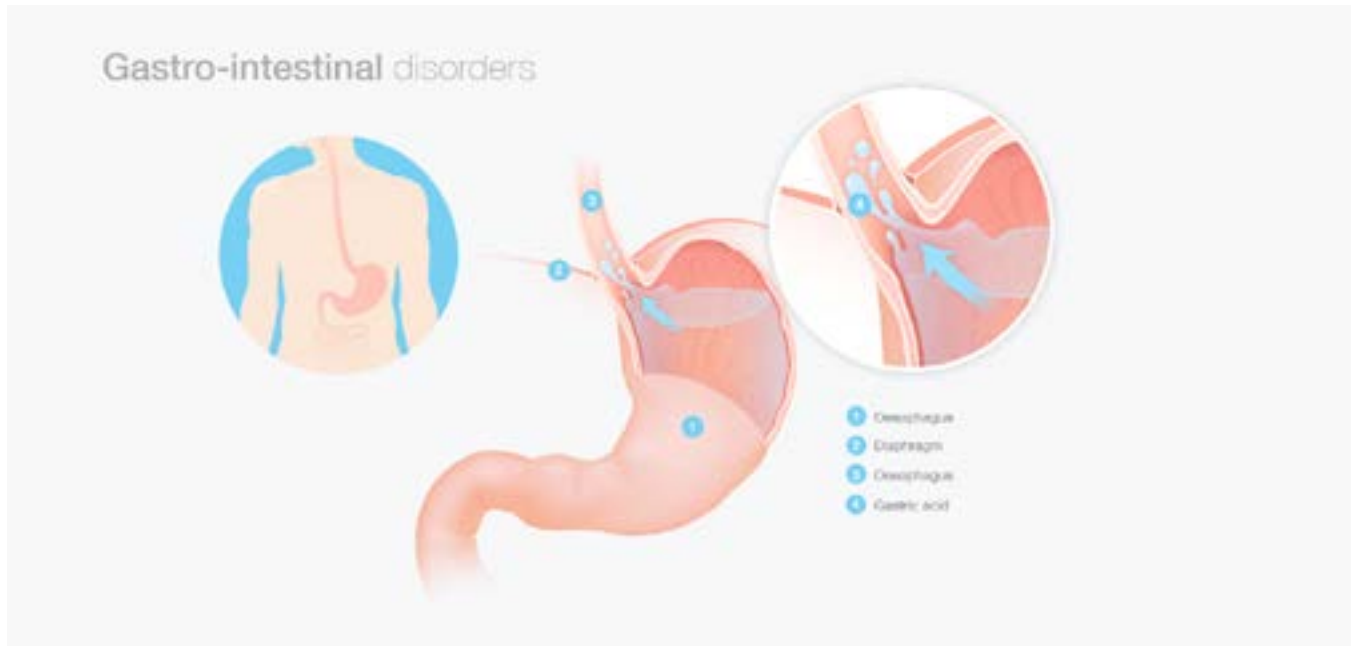
	<p>Compared with the slow eating rate group (>15 min), the fastest eating rate group (<5 min) had significantly increased odds ratios for cardiometabolic risk factors such as high glucose and low HDL-cholesterol levels</p>	<p>8755 Korean adults</p>	
2013	Nutrition Metabolism Cardiovascular Diseases: NMCD. Jul;23(7):635-41	Lee KS, Cho KH.	
	<p>Eating quickly had a significantly greater association with-risk of metabolic syndrome (risk of abdominal obesity combined with a risk of hypertension, diabetes, or hypercholesterolemia), for both sexes, than eating slowly or at a normal pace</p> <p><i>This studies also showed that skipping breakfast, eating quickly, and having a late-night supper were independently associated with risk.</i></p>	<p>4912 adults (30-39y)</p>	
2013	Nihon Kosshu Eisei Zasshi. Japanese Journal of Public Health Feb;60(2):98-t106	Soga Y, Shirai C, Ijichi A.	
	<p>Blood pressure and lipid levels tended to increase in association with eating rate. HbA(1c) rose significantly as eating rate increased in diabetic patients on insulin therapy, whereas fasting plasma glucose did not increase significantly.</p>	<p>7275 aged ≥40 years who had normal fasting glucose levels, impaired fasting glucose or diabetes</p>	
2013	Diabetologia. Jan;56(1):70-7	Ohkuma T, Kitazono T.	



Both eating until feeling full and eating rapidly increase metabolic risk factors (overweight, hypertension, hyperglycaemia, hypertriglycerolaemia, low HDL cholesterol, hyperuricaemia and fatty liver).		13195	
2011	Public Health Nutrition Jul;14(7):1266-9	Hsieh SD, Arase Y.	



<p>The group with metabolic syndrome (obesity, high blood pressure, low high-density lipoprotein cholesterol level, high triglyceride level, and high fasting blood glucose level) was more likely to eat quickly (OR 2.23 for fast vs slow) and to overeat frequently (OR 2.37 for more than 4 times a week vs less than once a week).</p> <p><i>Illustration : According to this odds ratio, if in a control group of 100 healthy people, 16 are fast eaters, in an equivalent group of 100 people but with metabolic syndrome 30 will be fast eater. If in the control group 16 overeat frequently, they are 31 of them in the other group.</i></p>		7081 men aged ≥30	  
2009	Journal of the American dietetic Association Apr;109(4):633-40	Shin A, Kim J.	



Diabetes is a chronic disease that is characterised by a failure in the regulation of glycemia and an excess of sugar in the blood.

For a diabetic person, the pancreas lacks to produce or produces too little insulin which is the hormone that enables the absorption of glucose found in the blood from the cells. Therefore, this leads to a state of hyperglycemia harmful to the health (occlusion of blood networks and more specifically of small capillaries, attack of internal organs including the kidneys, the heart...)

The lithuanian study of 2013 shows that the risk of type 2 diabetes is multiplied by 2,52 for a fast eater.

The pancreas is an organ that intervenes at the end of the digestion process. It appears that eating quickly and overtiring the pancreas participates to its deregulation.

Indeed, eating quickly accelerates the arrival of sugar in the blood whereas eating slowly stimulates naturally the secretion of the digestive hormone GLP1.

Yet this hormone contributes to filter the passing of sugar in the blood by slowing down the gastric emptying and by stimulating the secretions of insulin. Moreover, the GLP1 inhibits the production of glucagon, hormones that stimulate glycemia unlike the insulin.



The results suggest that a higher number of masticatory cycles before swallowing may provide beneficial effects on satiety and facilitate glucose absorption.		21 healthy males
2015	Journal of the Academy of Nutrition and Dietetic Jun;114(6):926-31. doi: 10.1016/j.jand.2013.08.020. Epub 2013 Nov 9.	Zhu Y, Hollis JH.



The present study suggests that eating rice with different feeding tools has different chewing times and amount of food taken per mouthful and then alters the Glycemic Index of the rice.		11 healthy volunteers
2015	Physiology & Behavior Feb;139:505-10	Sun L Henry CJ.



ALT activity is positively associated with faster eating, but is dependent on BMI in middle-aged, apparently healthy Japanese women.		900 apparently healthy women (30-56y)
2014	Nutrition. Jan;30(1):69-74	Mochizuki K, Goda T.









Fast eating rates are associated with obesity and other cardiometabolic risk factors (such as high glucose and low HDL cholesterol levels).		8755 Korean adults
2013	Nutrition Metabolism Cardiovascular Diseases: NMCD. Jul;23(7):635-41	Lee KS, Cho KH.



Higher masticatory performance and slow eating prevent the occurrence of diabetes.		6927 citizens of Nagahama City aged 40-74
2013	PLoS One Jun 5;8(6):e64113	Yamazaki T, Nagahama Study Collaboration Group.



More than two-fold increased risk of type 2 diabetes was determined for subjects eating faster (OR = 2.52) vs. subjects eating slower. <i>Illustration : According to this odds ratio, if in a control group of 100 slow eaters, 12 are diabetic, in an equivalent group of 100 people but fast eaters 25 of them will be diabetic. If in the control group 16 overeat frequently, they are 31 in the other group.</i>		702 people diagnosed with type 2 diabetes and non-diabetic
2013	Clinical Nutrition (Edinburgh Scotland) Apr;32(2):232-5	Radzevičienė L, Ostrauskas R.

	<p>Slow feeding leads to higher concentrations of GLP1 in obese adolescents.</p> <p>Plasma PYY concentrations increased both in obese adolescents and in adults, irrespective of the eating rate, but slowfeeding was more effective in stimulating PYY release in obese adolescents than in adults.</p>	18 Obese adolescents and adults	
2013	European Journal of Endocrinology Feb20;168(3):429-36	Rigamonti AE, Sartorio A.	
	<p>Blood pressure and lipid levels also tended to increase in association with eating rate. HbA(1c) (glucose test considering the average level over 3months) rose significantly as eating rate increased, whereas fasting plasma glucose did not increase significantly.</p>	7275 individuals aged ≥40 years	
2013	Diabetologia. Jan;56(1):70-7	Ohkuma T, Kitazono T.	
	<p>Eating speed was associated with the incidence of diabetes. Eating slowly could be an acceptable lifestyle intervention for the prevention of diabetes mellitus.</p>	2050 male	
2012	Metabolism: clinical and experimental Nov;61(11):1566-71	Sakurai M, Nakagawa H.	



Chewing more resulted in lower energy intake and postprandial ghrelin concentration and higher postprandial GLP 1 and cholecystinin concentrations in both lean and obese subjects.		30 lean and obese young men
2011	American Journal of Clinical Nutrition Sep;94(3):162-70	Li J, Wang S.



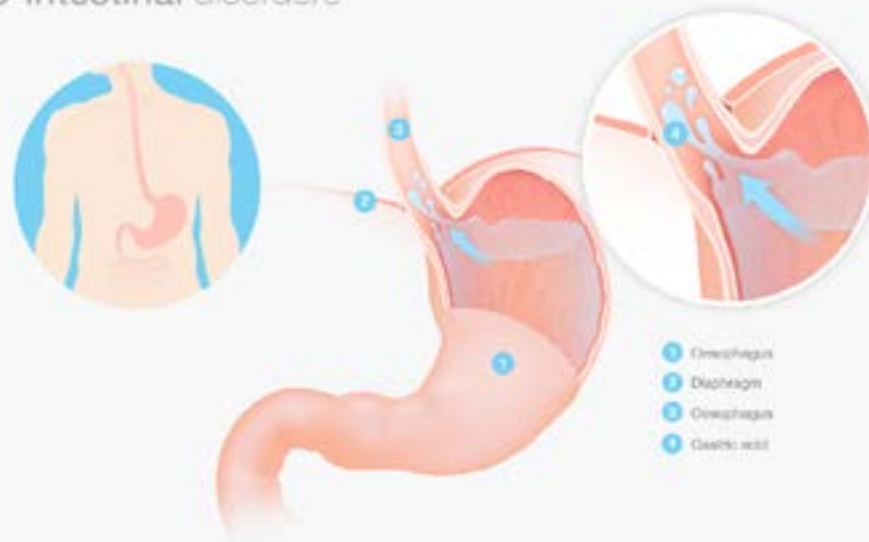
Eating at a physiologically moderate pace leads to a more pronounced anorexigenic gut peptide response than eating very fast. (Peptide YY secretion was higher after the 30-min meal than after the 5-min meal)		17 healthy adult male
2010	Journal of Clinical Endocrinology and Metabolism Jan;95(1):333-7	Kokkinos A, Katsilambros N.



<p>The group with metabolic syndrome (obesity, high blood pressure, low high-density lipoprotein cholesterol level, high triglyceride level, and high fasting blood glucose level) was more likely to eat quickly (OR 2.23 for fast vs slow) and to overeat frequently (OR 2.37 for more than 4 times a week vs less than once a week).</p> <p>Illustration : According to this odds ratio, if in a control group of 100 healthy people, 16 are fast eaters, in an equivalent group of 100 people but with metaboclic syndrom 30 will be fast eater. If in the control group 16 overeat frequently, they are 31 of them in the other group.</p>		7081 men aged ≥ 30
2009	Journal of the American dietetic Association Apr;109(4):633-40	Shin A, Kim J.



Gastro-intestinal disorders



The gastroesophageal reflux disease (GERD) affects 20 to 30% of the population, a number in constant evolution. Stomach burns, acid reflux, bitter taste in the mouth, sleep disorders... The discomfort can be important. The gastroesophageal reflux disease is characterised by the passing of acid reflux in the esophagus after meals. It corresponds to a failure of the anti-reflux system that mainly includes the abdominal segment and the inferior sphincter of the oesophagus.

The oesophagus does not have any protection (unlike the stomach that is covered by a mucous that protects the acid effects) therefore the acid reflux that rises from the stomach creates burns and inflammations.

The medical studies show that eating slowly enables to reduce significantly the number of reflux among the people concerned.

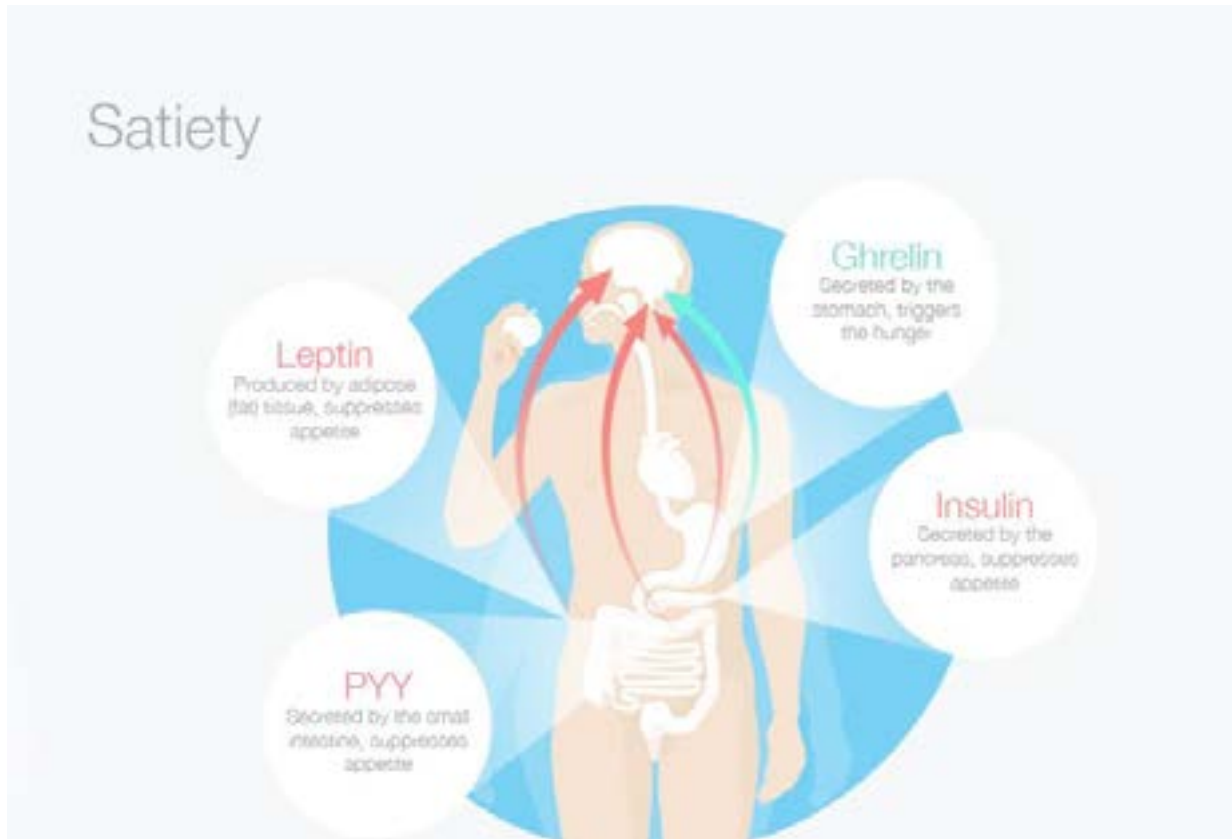
Eating rate and GERD



Subjects with 'irregular meal pattern' had higher odds of GERD compared with subjects with 'regular meal pattern'.		4763 adults
2013	Neurogastroenterology and Motility (The Official Journal of European Neurogastrointestinal Motility Society Oct;25(10):831-e638.	Esmailzadeh A, Adibi P.



Intake of a standard meal within 5 min was associated with more reflux episodes than an intake within 30 min Since rapid food intake produces more GERD in healthy volunteers, studies in GERD patients are warranted to evaluate if eating slowly may represent another life-style modification aimed at reducing GER.		20 healthy volunteers
2004	American Journal of Gastroenterology Sep;99(9):1645-51.	Wildi SM, Tutuian R, Castell DO.



An important number of hormones regulates the food intake and the energy expenditure. To maintain a stable energy intake for the smooth running of the organism, orexigenic signals (stimulating the food intake) and anorexigenic signals (inhibiting the food intake) coordinate.

Ghrelin is the only orexigenic hormone discovered until now. It is secreted by the stomach. Among the anorexigenic hormones, we consider the cholecystokinin, the peptide YY (PYY) and the glucagon-like peptide-1 (GLP1) secreted by the small intestine as well as the leptin produced by the adipose tissue (by the adipocytes).

Complex mechanisms of feedback loop are formed throughout the meal. These messages (hormonal secretions) enable the regulation of food intake.

The medical studies show that eating slowly encourages the concentration of satiety hormones such as GLP1 and cholecystokinin.

Eating rate and SatietyD















The results suggest that a higher number of masticatory cycles before swallowing may provide beneficial effects on satiety and facilitate glucose absorption.		21 healthy males
2015	Journal of the Academy of Nutrition and Dietetic Jun;114(6):926-31. doi: 10.1016/j.jand.2013.08.020. Epub 2013 Nov 9.	Zhu Y, Hollis JH.






Slow feeding evoked a lower hunger and higher satiety compared with fast feeding in normal subjects, this finding being not evident in obese patients.		Normal and obese patients + PWS patients
2014	Clin Endocrinol (Oxf). Oct;81(4):542-50. doi: 10.1111/cen.12395. Epub 2014 Jan 20.	Rigamonti AE, Sartorio A.



Eating slowly significantly lowered meal energy intake in the normal-weight but not in the overweight/obese group... Eating slowly led to lower hunger ratings in both groups and increased fullness ratings in the normal-weight group at 60 minutes from when the meal began.		Thirty-five normal-weight (aged 33.3±12.5 years; 14 women and 21 men) subjects and 35 overweight/obese (44.1±13.0 years; 22 women and 13 men) subjects
2014	Journal of the Academy of Nutrition and Dietetic. Mar;114(3):393-402. doi: 10.1016/j.jand.2013.11.002. Epub 2013 Dec 30.	Shah M, Rhea D.

	Foods that consumed in smaller bites, were chewed more and for longer and expected to impart a higher satiety. We conclude that bite size and oral-sensory exposure time could contribute to higher satiety within a meal for equal calories.	15 subjects consumed 50 g of 35 different savoury food items over 5 sessions	
	2013	Appetite Jan;60(1):208-19. doi	
	Slow feeding leads to higher concentrations of GLP1 and favors satiety.	18 obese adolescents and adults	 
	2013	European Journal of Endocrinology Feb20;168(3):429-36	
	Chewing more resulted in lower energy intake and postprandial ghrelin concentration and higher postprandial GLP 1 and cholecystokinin concentrations in both lean and obese subjects.	30 lean and obese young men	   
	2011	Proceedings of the Nutrition Society May;70(2):162-70	
	The taste system works as a nutrient-sensing system that informs the brain and the gastrointestinal system about what is coming into our body. Slower eating helps the human body to associate the sensory signals from food with their metabolic consequences.	Article review	
	2011	American Journal of Clinical Nutrition Sep;94(3):162-70	

	Foods that can be eaten quickly lead to high food intake and low satiating effects The reason is that these foods only provide brief periods of sensory exposure.	Article review
2010	Nature Reviews. Endocrinology May;6(5):290-3	de Graaf C, Kok FJ.
	Eating at a physiologically moderate pace leads to a more pronounced anorexigenic gut peptide (peptide YY) response than eating very fast. There was a trend for higher fullness subjectiv ratings immediately after the end of the 30-min meal compared with immediately after the 5 min meal.	17 healthy adult males
2010	Journal of Clinical Endocrinology and Metabolism Jan;95(1):333-7	Kokkinos A, Katsilambros N.
	The quick condition of eating showed a lower Satiating Efficiency Index. After meal completion, pleasantness ratings tended to be higher under the slow condition.	30 healthy women
2008	Journal of the America Dietetic Association Jul;108(7):1186-91	Andrade AM, Melanson KJ.



All other things being equal, the studies demonstrate that eating quickly is correlated to a more important absorption of food compared to eating slowly.

Eating-rate and Energy/food intake



High dose, rapid rate of absorption appear to be particularly associated with "food addiction."		120 undergraduates participated in Study One and 384 participants recruited through Amazon MTurk participated in Study Two.
2015	PLoS One Feb 18;10(2):e0117959. doi: 10.1371/journal.pone.0117959. eCollection 2015.	Schulte EM, Avena NM, Gearhardt AN.






Evidence indicated that a slower eating rate was associated with lower energy intake in comparison to a faster eating rate. Subgroup analysis indicated that the effect was consistent regardless of the type of manipulation used to alter eating rate.		22 studies were eligible for inclusion
2014	American Journal of Clinical Nutrition Jul;100(1):123-51. doi: 10.3945/ajcn.113.081745. Epub 2014 May 21.	Robinson E ,Jebb SA



The results confirm the effect of texture on eating rate. We conclude that people consumed more of the meal when the food was simultaneously mashed and savoury. Food texture may be used to produce slower eating rates that result in a reduced overall energy intake within a realistic hot lunchtime meal.		four groups consisted of about 40 subjects (mashed, standard, n=37; mashed, savoury n=39; whole, standard n=40; and whole, savoury n=41) matched for age (average age=44.8 ± 5.3), gender (on average 19 males and 20 females), normal BMI (average 22.6 ± 1.7) and dietary restraint score (DEBQ score=1.74 ± 0.6).
2013	Appetite. Jan;60(1):180-6. doi	Forde CG, van Kuijk N, Thaler T, de Graaf C, Martin N.



	<p>Compared with the standard viscosity meal, high viscosity meal was consumed at a slower eating rate, with postprandial hunger and desire to eat being lower while fullness was higher.</p>	<p>15 healthy males</p>
<p>2013</p>	<p>PLoS One Jun 20;8(6):e67482</p>	<p>Zhu Y, Hsu WH, Hollis JH.</p>
	<p>The taste system works as a nutrient-sensing system that informs the brain and the gastrointestinal system about what is coming into our body.</p> <p>Slower eating helps the human body to associate the sensory signals from food with their metabolic consequences.</p>	<p>Articles review</p>
<p>2011</p>	<p>Proceedings of the Nutrition Society May;70(2):162-70</p>	<p>de Graaf C.</p>
	<p>Foods that can be eaten quickly lead to high food intake and low satiating effects The reason is that these foods only provide brief periods of sensory exposure</p>	<p>Article review</p>
<p>2010</p>	<p>Nature Reviews. Endocrinology May;6(5):290-3</p>	<p>de Graaf C, Kok FJ.</p>



<p>The group with metabolic syndrome was more likely to eat quickly (OR 2.23 for fast vs slow) and to overeat frequently (OR 2.37, for more than 4 times a week vs less than once a week).</p> <p><i>Illustration : According to this odds ratio, if in a control group of 100 healthy people, 16 are fast eaters, in an equivalent group of 100 people but with metabolic syndrome 30 will be fast eaters. If in the control group 16 overeat frequently, they are 31 of them in the other group.</i></p>		7081 men aged ≥30
2009	Journal of the American dietetic Association Apr;109(4):633-40	Shin A, Kim J.



<p>More food was ingested at the fast rate, regardless of weight class The reason is that these foods only provide brief periods of sensory exposure</p>		12 Nonobese and obese male
1980	Psychosomatic Medicine Nov;42(6):529-38	Kaplan DL.



<p>Slow rates of ingestion led to significant decreases in energy intake (quick: 645.7±155.9 kcal; slow: 579.0±154.7 kcal) and significant increases in water consumption (quick: 289.9±155.1 g; slow: 409.6±205.8 g).</p>		30 healthy women
2008	Journal of the American Dietetic Association Jul;108(7):1186-91	Andrade AM, Melanson KJ.



Chapter 2

The causes of eating fast

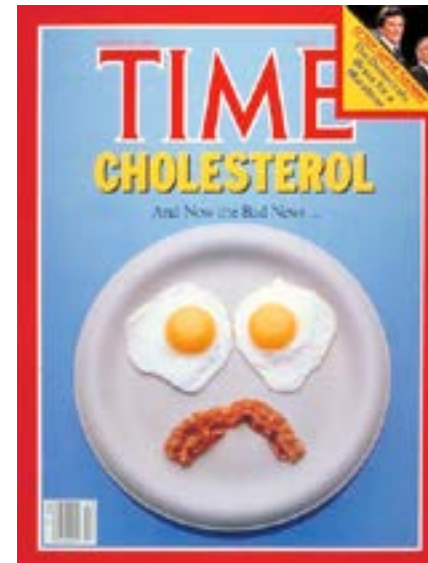
Food quality

According to the WHO (World Health Organisation), nutrition is characterised by food intake that serves the needs of our organism . Two terms are essential to remember : the nutrients and the calories. The nutrients (carbohydrates, proteins, lipids, vitamins, minerals) are elementary components found in food products, or nature necessary for our organism. They cover our physiological needs and allow us to function effectively.

Malnutrition is characterised by an inappropriate consumption of food; it is the result of a deficit or an excess of specific nutrients.

A calorie is a unit of energy. All the food products that we consume contain calories but some of them provide empty calories. These calories contain a lot of energy but very few essential non-energetic components such as fibers, minerals and micronutrients.

The medical studies show that particularly rich food products that need to be consumed with temperance are most of the time low viscosity food products. Yet, the less the food is viscous, the more it will be eaten quickly. On the opposite, high viscosity food is meant to have a better nutritional value and is eaten more slowly. The fibers for instance require an important chewing effort. Note that, food quality is an area of strong investment research backed by the food -processing industry.



Eating-rate and food quality



High dose, rapid rate of absorption appear to be particularly associated with "food addiction."		120 undergraduates participated in Study One and 384 participants recruited through Amazon MTurk participated in Study Two.
2015	PLoS One Feb 18;10(2):e0117959. doi: 10.1371/journal.pone.0117959. eCollection 2015.	Schulte EM, Avena NM, Gearhardt AN.



The results confirm the effect of texture on eating rate. We conclude that people consumed more of the meal when the food was simultaneously mashed and savoury. Food texture may be used to produce slower eating rates that result in a reduced overall energy intake within a realistic hot lunchtime meal.		four groups consisted of about 40 subjects (mashed, standard, n=37; mashed, savoury n=39; whole, standard n=40; and whole, savoury n=41) matched for age (average age=44.8 ± 5.3), gender (on average 19 males and 20 females), normal BMI (average 22.6 ± 1.7) and dietary restraint score (DEBQ score=1.74 ± 0.6).
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Compared with the standard viscosity meal, high viscosity meal was consumed at a slower eating rate, with postprandial hunger and desire to eat being lower while fullness was higher.		15 healthy males
2013	PLoS One Jun 20;8(6):e67482	Zhu Y, Hsu WH, Hollis JH.



<p>This idea fits with the concept of the taste system as a nutrient-sensing system that informs the brain and the gastro-intestinal system about what is coming into our body.</p> <p>With liquid or food that can be eaten quickly, this system is bypassed.</p> <p>Slower eating helps the human body to associate the sensory signals from food with their metabolic consequences.</p>		Article review
2011	Proceedings of the Nutrition Society May;70(2):162-70	de Graaf C.



<p>Depending on the foods, large differences show in eating rate between foods, ranging from 4.2 to 631 g/min.</p> <p>The fattest the food and the lowest his viscosity is, the fastest the food can be ingested.</p> <p>This study showed that when foods can be ingested rapidly, food and energy intake is high.</p>		37 men and women (aged 23.3 (SD 3.4)y, BMI 21.7 (SD 1.7)kg/m(2))
2011	Appetite Feb;56(1):25-31	Viskaal-van Dongen M, Kok FJ, de Graaf C.



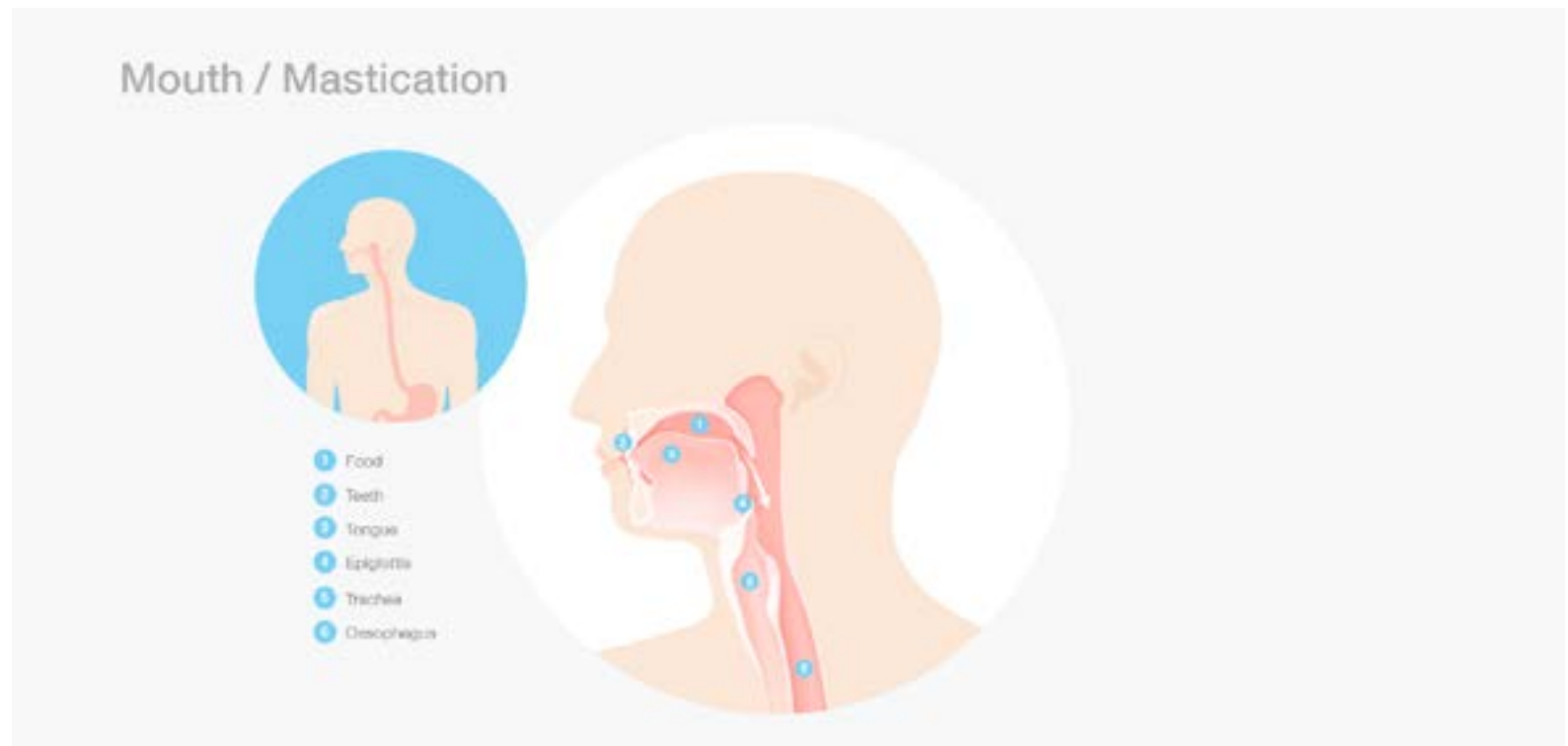
Foods that can be eaten quickly lead to high food intake and low satiating effects—the reason being that these foods only provide brief periods of sensory exposure (mouth, tongue, pallet)		articles review
2010	Nature Reviews. Endocrinology May;6(5):290-3	de Graaf C, Kok FJ.

The first step of digestion takes place in the mouth. It is called mastication. It is defined by the action of crushing food with the teeth.

The mastication process is so composed :

First of all, the incisors cut the food. Then, the canine teeth will tear them off and finally the molars and premolars crush the food. Food products are impregnated by saliva which allows a better passage through the stomach. Another organ intervenes in the chewing process, the tongue. It enables to displace the food that is not yet chewed under the molars in order to crush them. The tongue also permits to enhance the mixture of saliva with the food.

In order to facilitate a good digestion, chewing is essential. Chewing well, enables the body to better assimilate food. Yet the medical studies show that a good



mastication allows to significantly slow down the speed of food intake.

Note that mastication has other « virtues ». Taking time to chew stimulates the secretions of saliva which particularly contributes to a good dental health. Moreover, mastication favors and maintains the maxillofacial muscles that are essential for the effective

development of the jaw for young children. At last, the studies suggest that keeping the food products long enough in mouth helps the brain and body to perceive more signals and the hormonal and enzymatic (gastric juices) responses are enhanced.



The present study suggests that eating rice with different feeding tools has different chewing times and amount of food taken per mouthful and then alters the Glycemic Index of the rice.		11 healthy volunteers
2015	Physiology & Behavior Feb;139:505-10	Sun L Henry CJ.



The results suggest that a higher number of masticatory cycles before swallowing may provide beneficial effects on satiety and facilitate glucose absorption.		21 healthy males
2015	Journal of the Academy of Nutrition and Dietetic Jun;114(6):926-31. doi: 10.1016/j.jand.2013.08.020. Epub 2013 Nov 9.	Zhu Y, Hollis JH.





Bite frequency is not affected by the confederate, while meal duration s showed a significant effect . It seems that intake was influenced as a result of copying meal termination.		A total of 30 normal weight young adults (m/f = 8/22, age: 21.2 ± 1.9 years, BMI: 21.2 ± 1.6 kg/m(2))
2015	Appetite.2014.08.032. Epub 2014 Aug 27.Mar;86:25-30.	Van den Boer JH, Mars M.



Counseling aimed at slowing the rate of ingestion could be promising behavioral treatments for obese persons		48 (24 males; 24 females) non-obese and pre-obese young adults
2015	Physiology & Behavior Jan;138:69-74.	Park S, Shin WS.

Chewing



Increasing the number of chews also prolonged meal duration and reduced eating rate.		18 Older adults 72±1years, body mass index 25.9±1.2kg/m(2)
2014	Physiology and Behaviour Jan 17;123:62-6	Zhu Y, Hollis JH



Increasing the habitual number of chews reduced significantly the eating rate. Eating rate at 100% HNC : 22.5 g/s Eating rate at 150% HNC : 16,4 g/s Eating rate at 150% HNC : 13.7 g/s		45 normal-weight, overweight, and obese participants (18-45y)
2013	Journal of the Academy of Nutrition and Dietetics Nov 9. pii: S2212-2672(13)01375-0	Zhu Y, Hollis JH



Foods that consumed in smaller bites, were chewed more and for longer and expected to impart a higher satiation. We conclude that bite size and oral-sensory exposure time could contribute to higher satiation within a meal for equal calories.		15 subjects consumed 50 g of 35 different savoury food items over 5 sessions
2013	Appetite Jan;60(1):208-19. doi	Forde CG, van Kuijk N, Thaler T, de Graaf C, Martin N.



Higher masticatory performance and slow eating prevent the occurrence of diabetes.		6927 citizens of Nagahama City aged 40-74
2013	PLoS One Jun 5;8(6):e64113	Yamazaki T, Nagahama Study Collaboration Group.

Chewing



<p>Compared with lean participants, obese participants had a higher ingestion rate and a lower number of chews per 1 g of food.</p> <p>Regardless of status, the subjects ingested 11.9% less after 40 chews than after 15 chews.</p> <p>Compared with 15 chews, 40 chews resulted in lower energy intake and postprandial ghrelin concentration and higher postprandial GLP 1 and cholecystokinin levels.</p>		30 lean and obese young men
2011	American Journal of Clinical Nutrition Sep;94(3):162-70	Li J, Wang S.



<p>Decreasing bite size significantly lowered ingestion rate for the whole meal.</p> <p><i>As bite size decreased from 15 to 5 g, the ingestion rate at the beginning of the meal decreased from 30.0 to 19.6 g/min. Considering the whole meal, the average ingestion rate decreased from 19.4 to 15.9.</i></p>		18 lean and obese women
1993	Appetite Oct;21(2):131-45	Spiegel TA, Stellar E.



<p>Larger bites accounted for the increased rate of the obese, the high preference subjects, and those having a larger body size.</p> <p>The hungry subjects increased their eating rate by taking faster bites.</p>		142 College students
1984	Appetite Jun;5(2):73-83	Hill SW, McCutcheon NB.



<p>Observations revealed that obese Subjects took more bites, performed fewer chews per bite, and spent less time chewing than did nonobese Subjects.</p>		100 obese and nonobese adults
1975	Journal of Consulting and Clinical Psychology 43:123-5	Gaul DJ, Craighead WE, Mahoney MJ

Mindless Eating



Brian Wansink, Ph.D.

Professor Brian Wansink has based his interest on studying the way our immediate environment (supermarkets, packages, households, pantry, setting up, service) influences our food habits and preferences. His work at the « Food and Brand Lab » at Cornell university is recognised for having enabled to improve the scientific knowledge related to what we eat and the way we buy our food. This has led to his nickname « Sherlock Holmes » or « Wizard of Why ».

He puts forward that in order to eat better and less, some slight modifications need to be made in our homes and daily routines.

In his book Mindless Eating, Brian Wansink develops the idea that the best diet is the one we are unaware of following.

Following the studies he has conducted, he showed that moving from a plate that measures 12 inches to 10 inches allows the eater to serve himself and eat up to 22% less and to significantly reduce his speed of food intake (in particular the fork serving size ; we granted him the paternity of the Small Plate Movement=movement in favor of small plates).

An individual consumes in average 92% of food when he helps himself.

Product labels mentioning « low fat » lead people to consume 16 to 23% calories more.

Because of optical illusions, individuals (even Philly bartenders) pour 28% more in a large glass than a tall glass.

50% of the food that we snack bought in bulk (for example the specialised shops) is consumed six days after purchase.

When children choose their portions themselves, they take less food than if a portion was served to them. Furthermore, by doubling the size of a starter they increase the size of the mouthfuls by 25% and the total energy requirements by 15%.

Eating-rate and portion-size

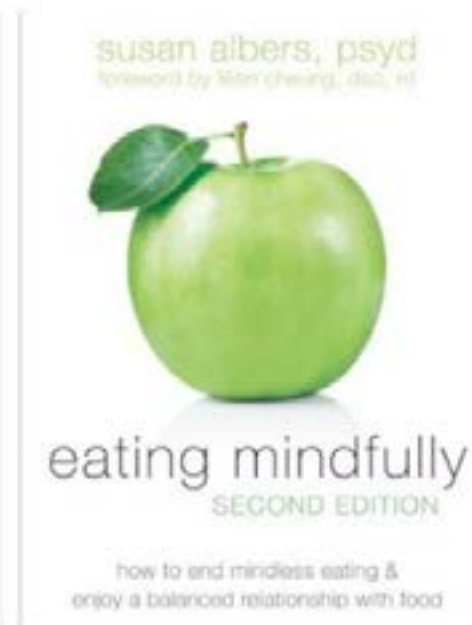
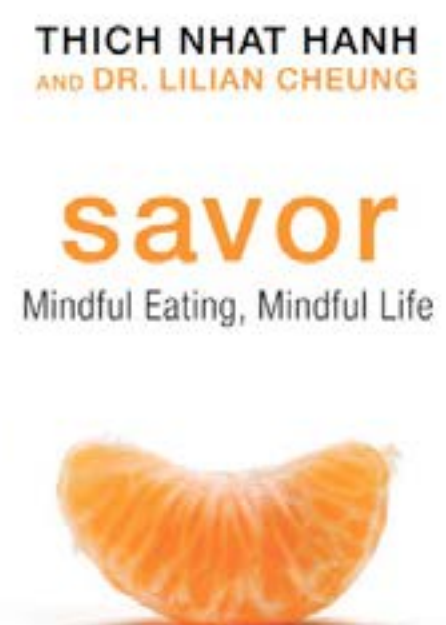
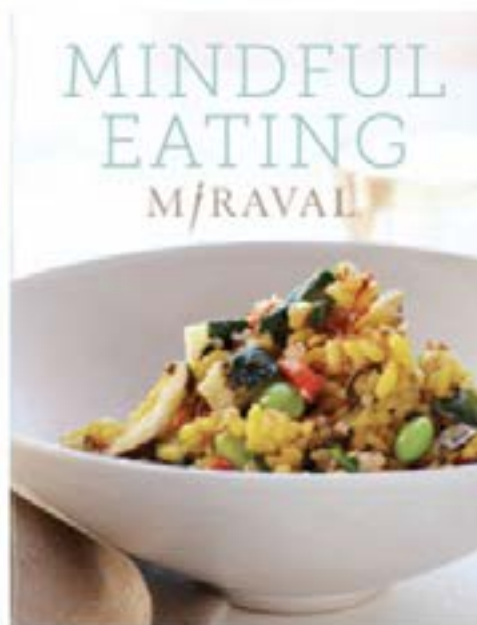
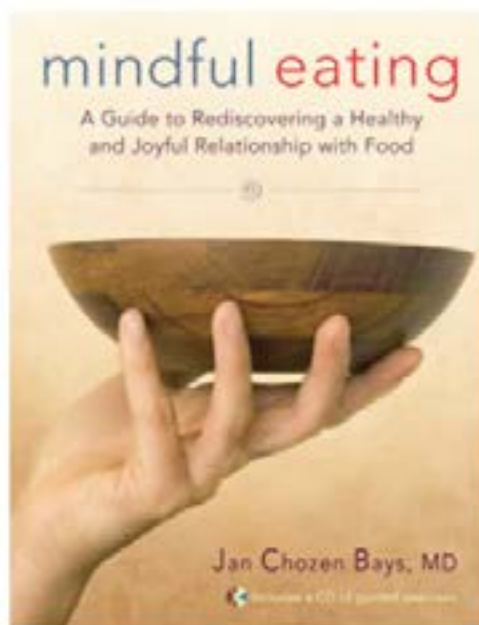


Increasing portion size led to a larger bite size and faster eating rate, but a slower reduction in eating speed during the meal. Interventions to reduce bite size and slow eating rate may provide individuals with strategies to reduce the risk of overconsumption.		37 overweight women
2015	Physiology & Behavior Feb;139:297-302.	Almiron-Roig E, Jebb SA.



<p>Doubling an age-appropriate portion of an entrée increased entrée and total energy intakes at lunch by 25% and 15%, respectively.</p> <p>Greater responsiveness to portion size was associated with higher levels of overeating. The children consumed 25% less of the entrée when allowed to serve themselves than when served a large entrée portion.</p>		30 children
2003	The American Journal of Clinical Nutrition May;77(5):1164-70	Orlet Fisher J, Rolls BJ, Birch LL.

Mindful eating



The concept of Mindful eating finds its roots in the buddhist methods. It consists of building awareness of its eating habits, the feelings that we experience while eating as well as our emotions and thoughts.

This concept puts forward the way we eat in contrast to what we eat. The doctor Jan Chozen Bays, author of the book on Mindful eating : a guide to rediscovering a healthy and joyful relationship to food underlines that the real issue is that we tend to release our attention when we eat, to gulp down rather than to enjoy, take our time and chew.

Some nutritionists of Harvard university, doctor Lilian Cheung and professor Brian Wansink of the Food and Brand Lab at Cornell university are authors of books on Mindful eating. The medical studies show a more significant weight loss from the groups having received awareness lessons on eating « consciously » compared to the « unconscious group ». The conscious eaters better succeed in « controlling » themselves when eating at the restaurant. Finally, people are more likely to « progress » on their eating habits when « mindful eating » lessons are proposed.




Eating rate and mindful eating



High dose, rapid rate of absorption appear to be particularly associated with "food addiction."		120 undergraduates participated in Study One and 384 participants recruited through Amazon MTurk participated in Study Two.
2015	PLoS One Feb 18;10(2):e0117959. doi: 10.1371/journal.pone.0117959. eCollection 2015.	Schulte EM, Avena NM, Gearhardt AN.



Binge eating may function to regulate global negative affect, and more specifically, guilt among obese adults. Targeting negative affect may be an effective strategy for the treatment of binge eating in the context of obesity.		50 obese adults (84% female)
2015	International Journal of Eating Disorder Mar 23. doi	Berg KC, Crosby RD, Cao L, Crow SJ, Engel SG, Wonderlich SA, Peterson CB.

	Shifting one's concern from the immediate consequences of eating to a more future-oriented perspective may present an interesting target for future interventions aimed at promoting healthy eating and reducing overweight.	152 participants aged from 18 to 60
2015	Appetite Mar 23;91:13-19. doi:	Dassen FC, Houben K, Jansen A.
	Participants in the intervention group (education to mindful eating) lost significantly more weight , had lower average daily caloric and fat intake, had increased diet-related self-efficacy, and had fewer barriers to weight management when eating out at the restaurant.	35 Women, 40-59 years old
2012	Journal of Nutrition Education and Behavior Jan-Feb;44(1):22-8	Timmerman GM, Brown A.
	Significant reductions were found on all subscales of the EAT-26 with large effect sizes. Results suggest benefits of an adjunct mindfulness group intervention when treating a variety of eating disorders.	33
2012	Journal of Substance Abuse Treatment Jul;43(1):94-107	Price CJ, Rue T.

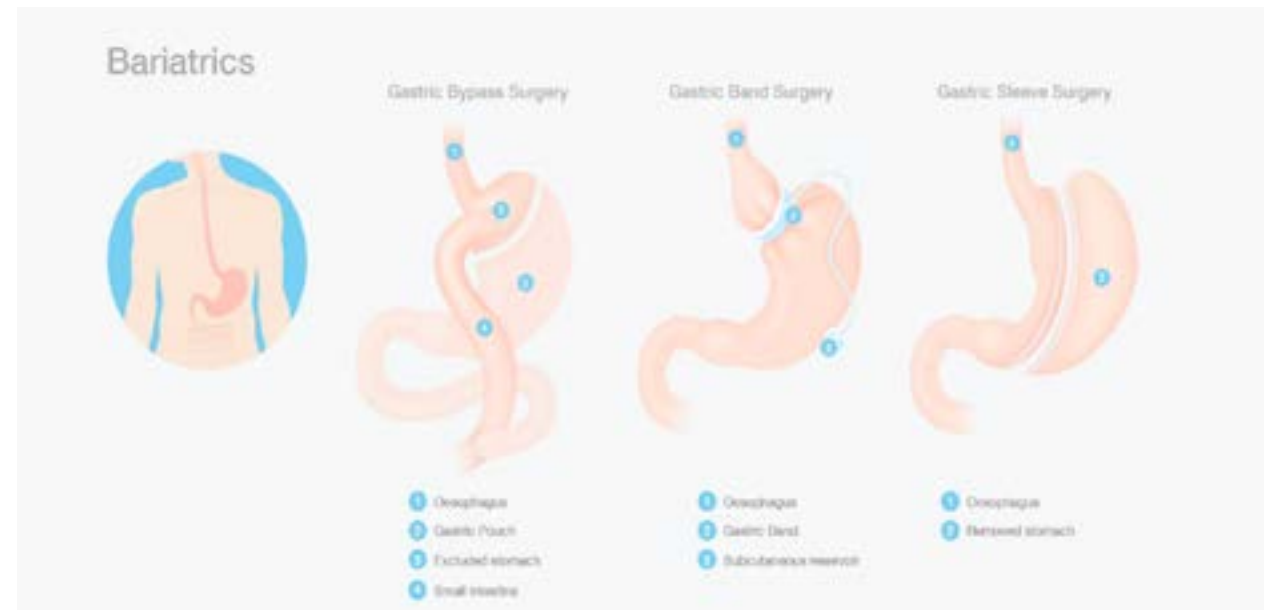
Bariatric surgery is an operation which consists of reducing the absorption of food in severe obesity cases.

Three methods are used : the gastric band, the gastric sleeve and gastric by-pass.

The gastric band works like an hourglass. By surrounding the stomach, the ring will « partition » it.

The gastric sleeve is an operation that consists of removing one part of the stomach. The gastric by-pass consists of reducing one part of the stomach by modifying the food system : a part of the digestive system is by-passed.

Generally, these operations, enable to accelerate the occurrence of the feeling of satiety and thus to reduce the portion size. The operations are serious and require a very specific lifestyle before and after two or three years following the operation in order to maximise the chances of success.



In particular you need to chew very slowly after each meal and to reduce drastically your speed of food intake. Even if these imperatives seem evident at first, they are nonetheless thereafter essential although the physical constraint diminishes gradually.

The following medical study shows how the speed of food intake and the portions size decrease drastically after a bariatric surgery (here with by-pass) but it also demonstrates to what extent these new behaviours can unfortunately be precarious.

Eating-rate and gastric surgery



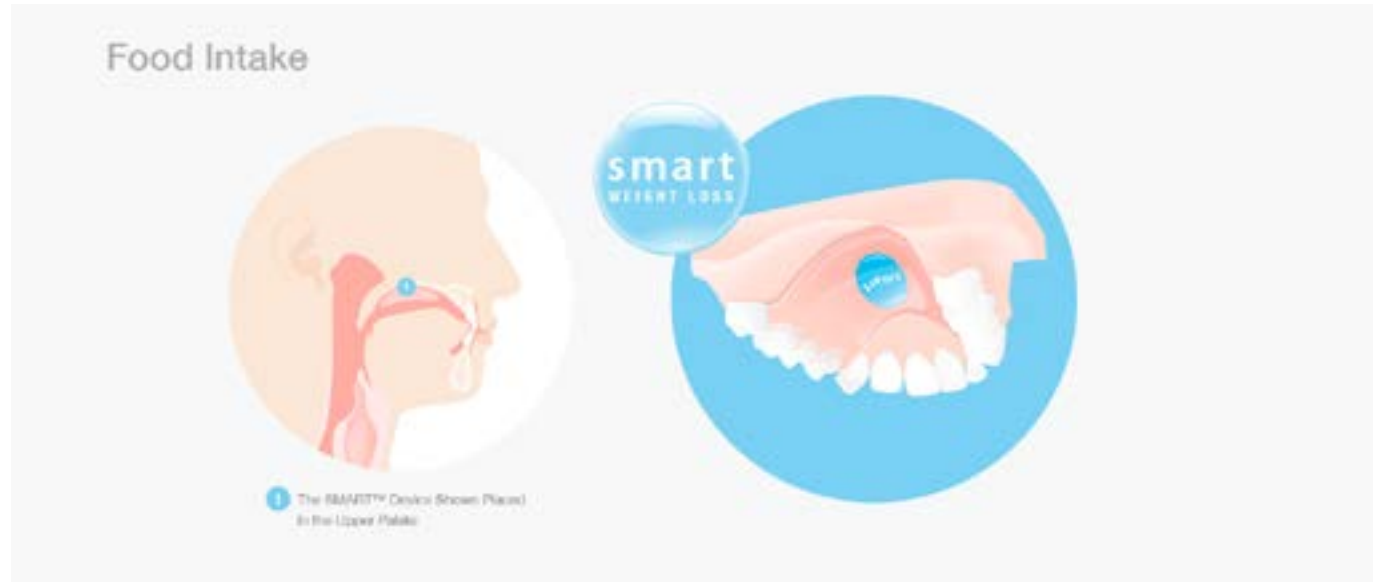
	<p>Six weeks postoperatively meal size was 42% of the preoperative meal size. After 1 and 2 years, meal size increased but was still lower than preoperative size 57% and 66%, respectively.</p> <p>Mean eating rate measured as amount consumed food per minute was 45% of preoperative eating rate 6 weeks postoperatively. After 1 and 2 years, eating rate increased to 65% and 72%, respectively, of preoperative rate</p>	<p>74 patients age 42.6 years, BMI 44.5 kg m⁻². 31 non-obese subjects, 37.8 years, BMI 23.7 kg m⁻² served as a reference group.</p>
2012	International Journal of Obesity (Lond) Mar;36(3):348-55	Laurenius A, Olbers T.

The Sensor Monitored Alimentary Restriction Therapy (SMART™) is a bariatric medical device that has been developed by Scientific Intake.

It is a non-invasive device. It is removable and is placed on the upper palate only when you eat. By restricting the buccal space, SMART™ imposes people to take smaller bites and thus to slower down their speed of food intake.

The following medical study (Australia) puts forward the appropriateness of the device with a strong correlation between weight loss and the compliance of its use by the participants (defined by a minimum use of 5 times per week, representing 80% of the patients).

The participants appreciate the comfort of the device and its effectiveness : chewing is improved, the fork serving size and the speed of food intake are reduced with an equivalent or improved level of satiety, while the meals size has decreased. They also pretend having a better consciousness of their behaviour.



The negative aspect if there is one, apart from small necessary adjustments (in dental office), are the difficulties of speech that has penalised its usage in society.

The second study aims at validating the method used to put in place a certain number of protocols and to consider the speed of food intake reported by the participants.

Scientific method



Evidence indicated that a slower eating rate was associated with lower energy intake in comparison to a faster eating rate. Subgroup analysis indicated that the effect was consistent regardless of the type of manipulation used to alter eating rate.		22 studies were eligible for inclusion
2014	American Journal of Clinical Nutrition Jul;100(1):123-51. doi: 10.3945/ajcn.113.081745. Epub 2014 May 21.	Robinson E ,Jebb SA



Reviewed studies on the Mandometer (Mikrodidakt), a device for training individuals to slow eating rate, and information on a wearable device, the Automatic Ingestion Monitor, which senses jaw motion and/or hand-to-mouth gestures to detect and characterize food intake. His goal is to use the instrument to prevent overeating by providing feedback to the user to stop ingestion at a predetermined limit.		summary of the symposium "Modifying Eating Behavior: Novel Approaches for Reducing Body Weight, Preventing Weight Regain, and Reducing Chronic Disease Risk" held 29 April 2014 at the ASN Scientific Sessions and Annual Meeting at Experimental Biology 2014 in San Diego, CA
2014	Advances in Nutrition Nov 14;5(6):789-91.	Gletsu-Miller N, McCrory MA.



<p>Mean weight-loss was 4.9 ± 0.9 kg, or $5.2 \pm 0.9\%$ initial bodyweight.</p> <p>Compliance (defined as >5 uses/week) was achieved by 80% of participants and correlated positively with weight loss.</p> <p>All reported that the device was comfortable and reduced bite-size, promoted chewing and slowed eating rate. For most, speech difficulties discouraged device use in social settings. Most observed either no change, or increased satiety, despite reduced meal sizes.. All reported greater awareness of food choices, portion sizes and eating-rate. Subjective control of dietary behaviors, measured by the Three Factor Eating Questionnaire (TFEQ), improved significantly.</p>		<p>20 mean age 36 years, BMI 27-33 kg/m(2)</p>
2012	Obesity Jan;20(1):126-33	McGee TL, Dixon JB.



<p>The reliability of the laboratory intake measures is as good as those of personality questionnaires.</p>		<p>125 Male and female</p>
2012	Appetite. Feb;58(1):249-51	Laessle R, Geiermann L.