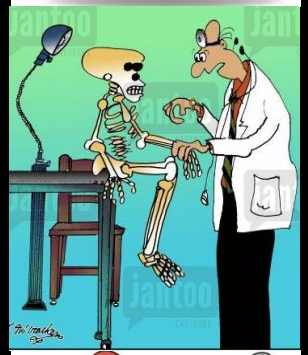
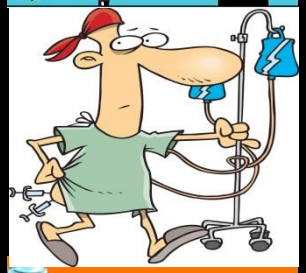
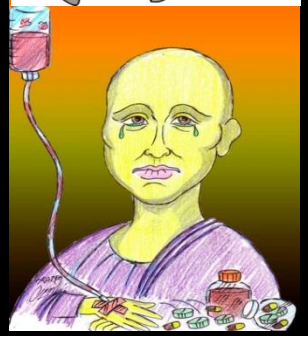






NUTRITION, CACHEXIA, ANOREXIA

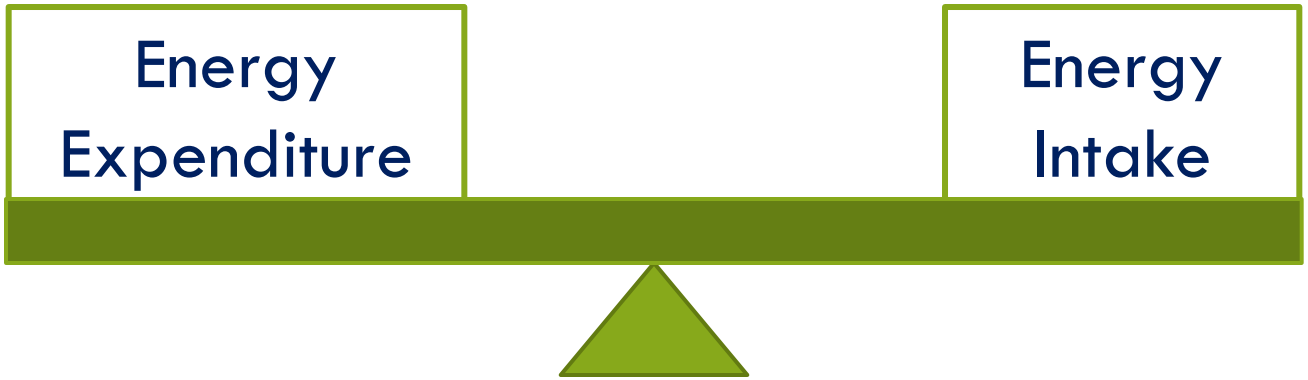
Professor Jeyakumar Henry
Director, Clinical Nutrition Research Center, SICS, A*STAR
Professor, Department of Biochemistry, NUS Yong Loo Lin School of Medicine

A*STAR Singapore Institute for Clinical Sciences

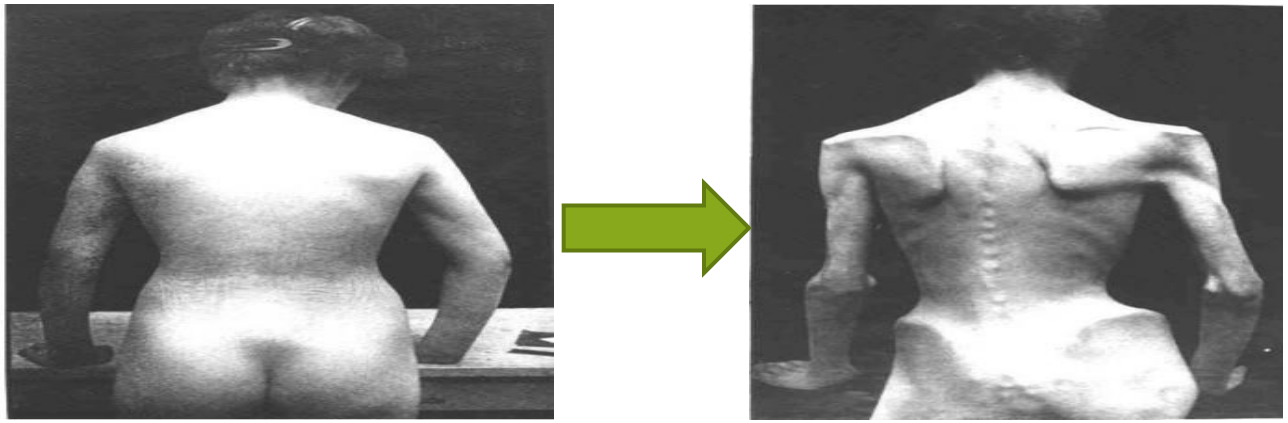
Disclosure slide

- Please state your disclosure (even if you have nothing to declare)
- **I have no potential conflict of interest to report.**

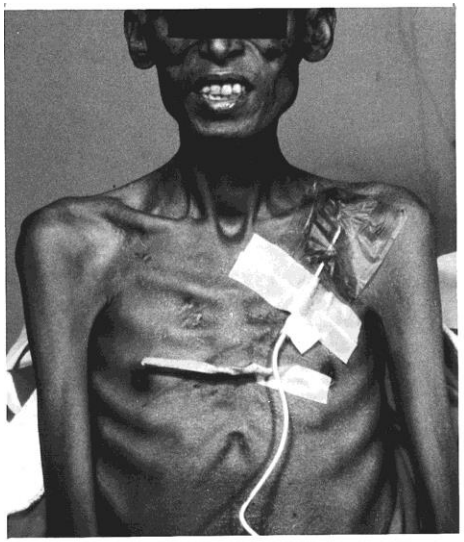
Energy Balance Equation



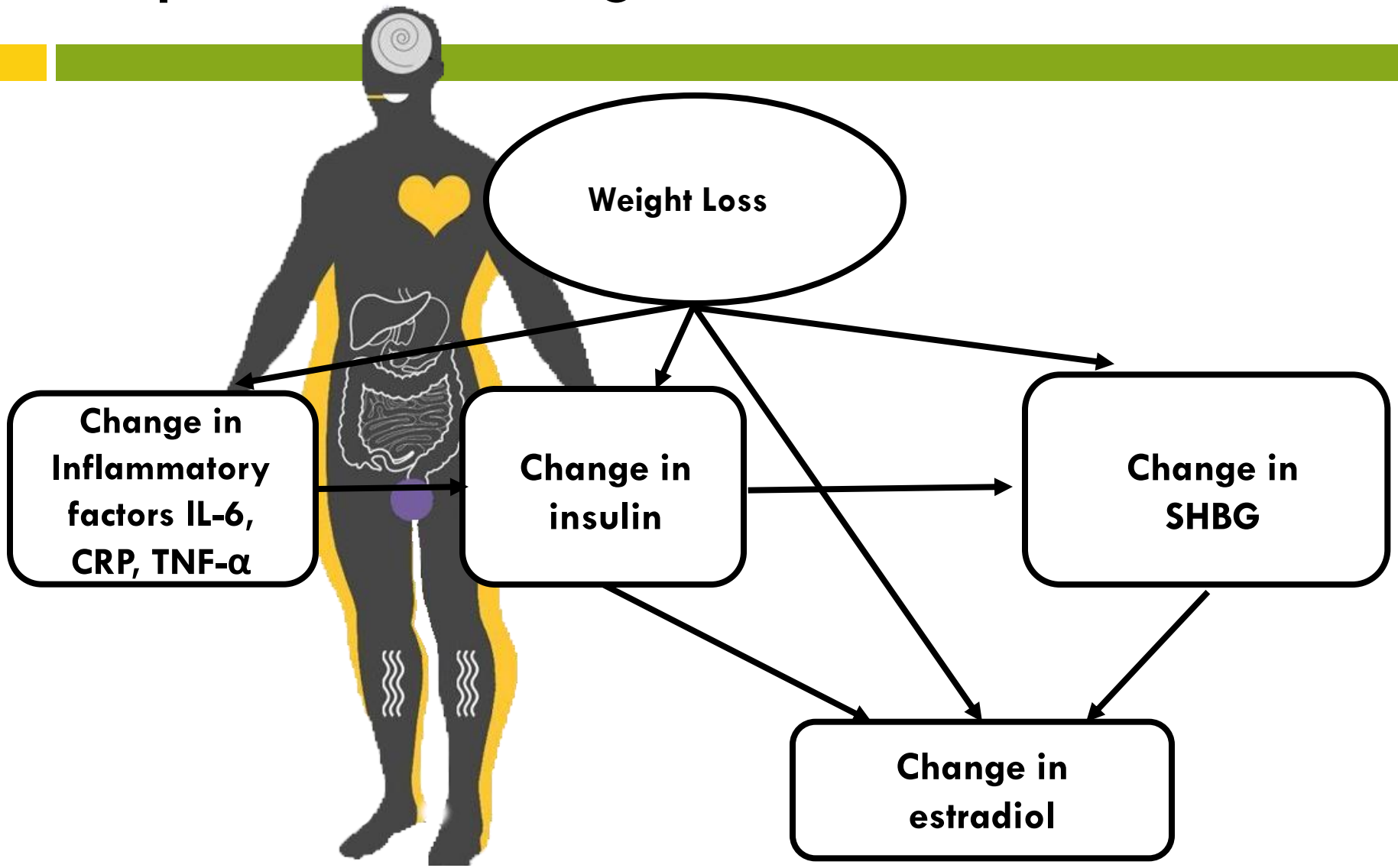
- Most of the cancer patients experience weight loss
- Weight loss is known to be potentially harmful



(Sierpina et al., 2015)

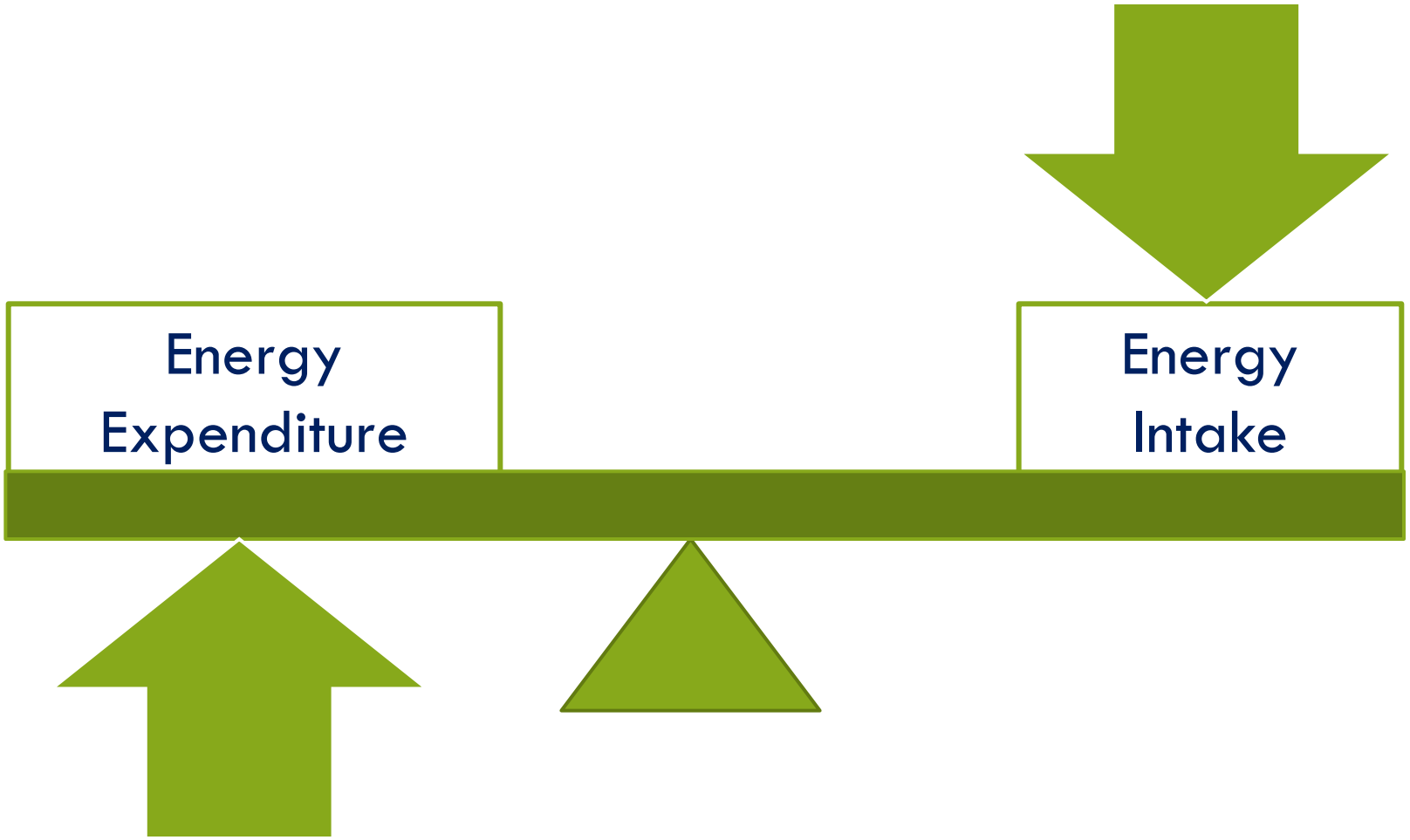


Impact on Weight Loss



(Sierpina et al., 2015)

Energy Imbalance



Energy Expenditure

Diet Induced Thermogenesis

Resting Energy Expenditure

Total Energy Expenditure

Physical Activity Level

Growth

(Moses, Slater, Preston, Barber, & Fearon, 2004; Rock et al., 2012)

Decrease in Energy Intake

- A decrease in food intake will lead to a significant decline in the nutritional status
- Anorexia and severe weight loss along with muscle wasting typically occurs from decreased appetite

Energy Intake

Chemotherapy Drugs

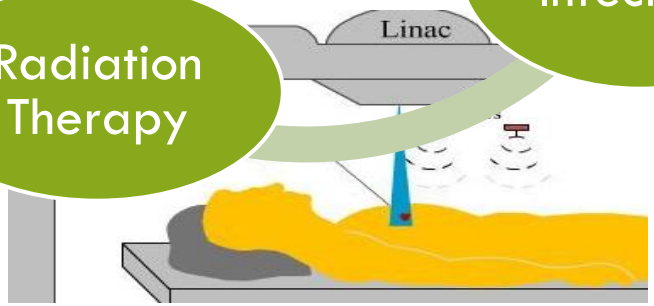
Surgery

Cancer-Related Vitamin Deficiencies

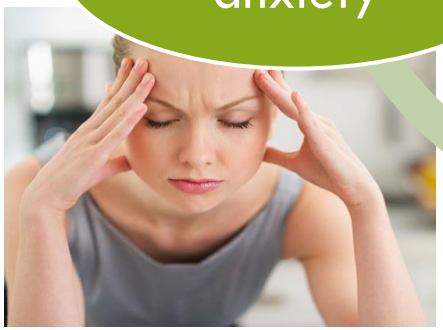
Decrease in food intake

Fungal Infections

Radiation Therapy



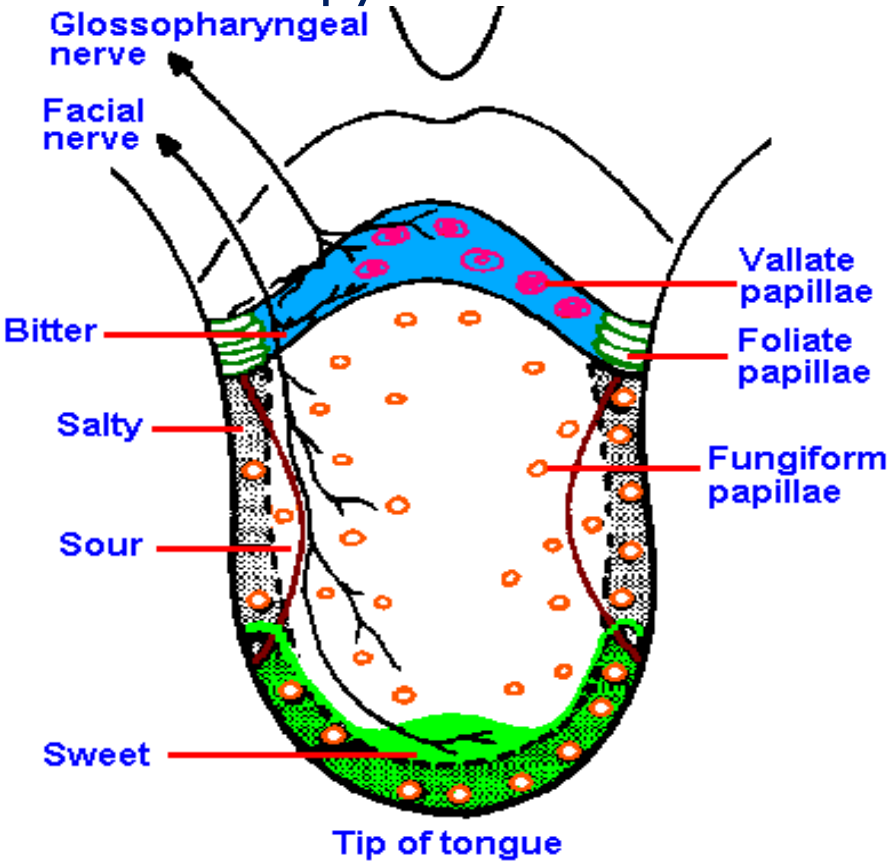
Psychologic anxiety

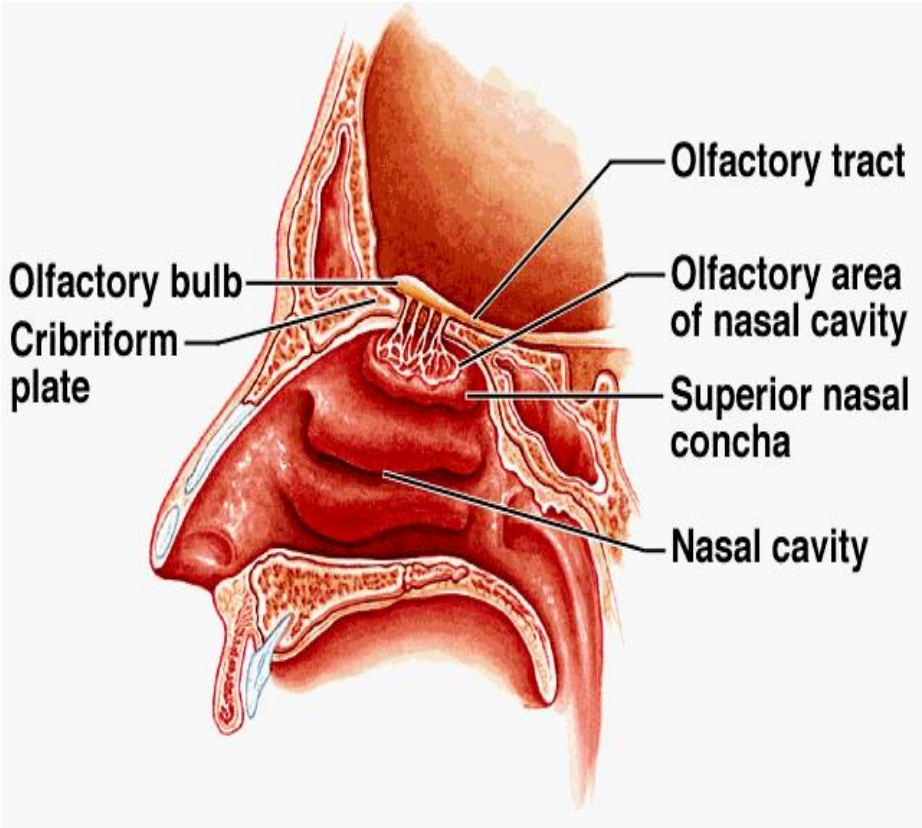


(Boltong & Keast, 2012; Epstein & Barasch, 2010; Farhangfar et al., 2014;Hong et al., 2009; Ijpma, et al., 2015)

Energy Intake – Sensory Changes

- 38-77% of patient reported sensory changes after receiving chemotherapy





(Boltong & Keast, 2012; Epstein & Barasch, 2010; Farhangfar et al., 2014; Hong et al., 2009; Ijpma, Renken, ter Horst, & Reyners, 2015)

Energy Intake – Sensory Changes

Taste-related abnormalities	
Ageusia	Absence of taste perception
Hypogeusia	Decreased sensitivity to taste perception
Dysgeusia	Distortion of taste perception and hedonics experience
Odour-related abnormalities	
Anosmia	Absence of odor perception
Hyposmia	Decrease sensitivity to odor perception
Dysosmia	Distorted ability to identify odors
Parosmia	Altered odor perception in the presence of another odor
Agnosia	Inability to differentiate perceived odors
Phantosmia	Odor perception without the presence of any odor

(Boltong & Keast, 2012; Epstein & Barasch, 2010; Farhangfar et al., 2014; Hong et al., 2009; Ijpma, Renken, ter Horst, & Reyners, 2015)

Energy Intake – Food Aversion

Most Commonly Reported Aversive Food Items During Chemotherapy.

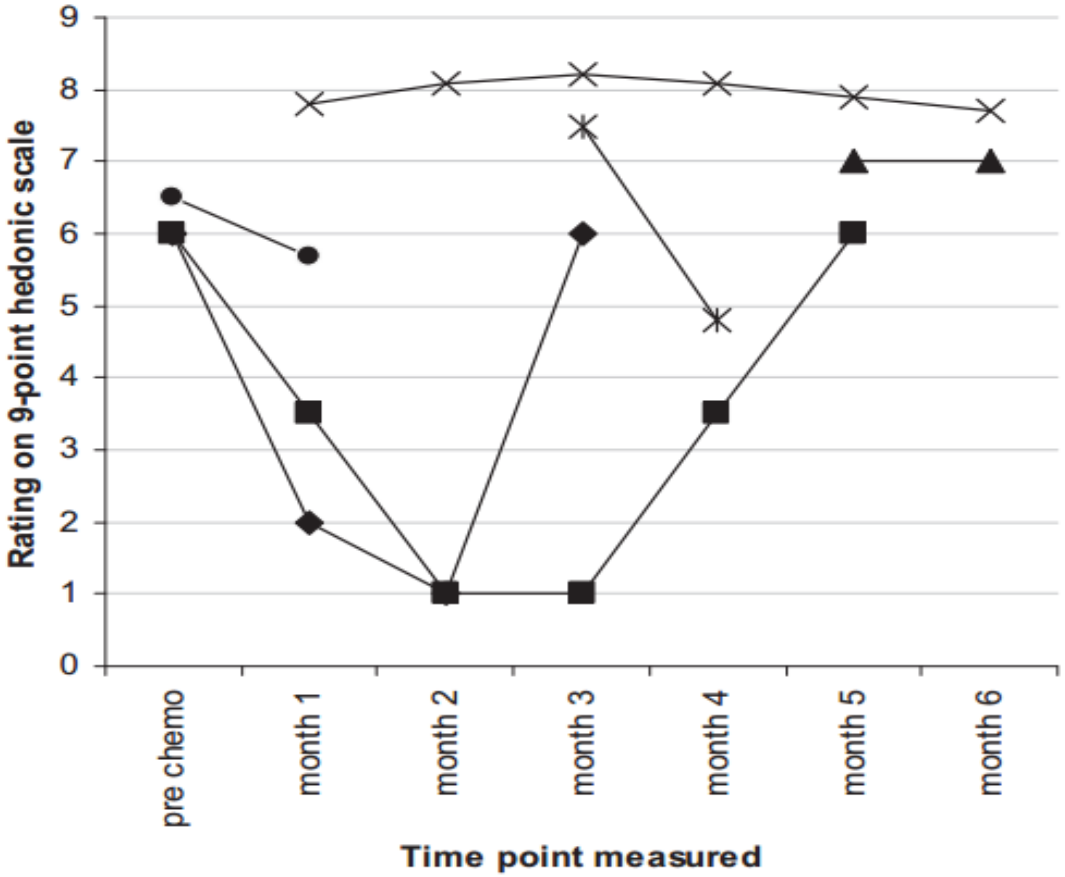
Food item	Total number of aversions reported	Number of studies in which aversive item reported	Corresponding taste quality
Coffee	70	5[1–5]	Bitter
Red meat	60	6[1–6]	Umami
Tea	39	5[1–5]	Bitter
Chocolate	36	4[2-6]	Sweet/bitter
Citrus fruit or juice	29	3[4–6]	Sour

[1]Grindel[59]; [2]Andrykowski and Otis[65]; [3]Boakes et al.[69]; [4]Holmes[70]; [5]Jacobsen et al.[66]; [6]Mattes et al..[67]

Notes: Information in this table is compiled from study participant reports of aversive food items during the study period. Information is compiled from a total of 310 participant responses over six studies contained within the hedonics arm of the

(Boltong & Keast, 2012)

Energy Intake – Food Aversion



9-Point Hedonic Scale	
9	Like Extremely
8	Like Very Much
7	Like Moderately
6	Like Slightly
5	Neither Like nor Dislike
4	Dislike Slightly
3	Dislike Moderately
2	Dislike Very Much
1	Dislike Extremely

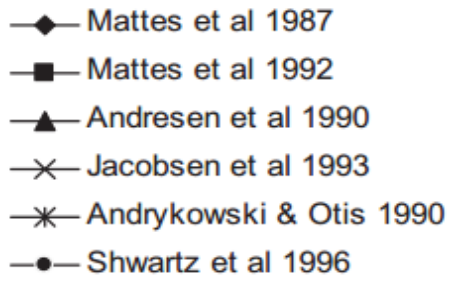
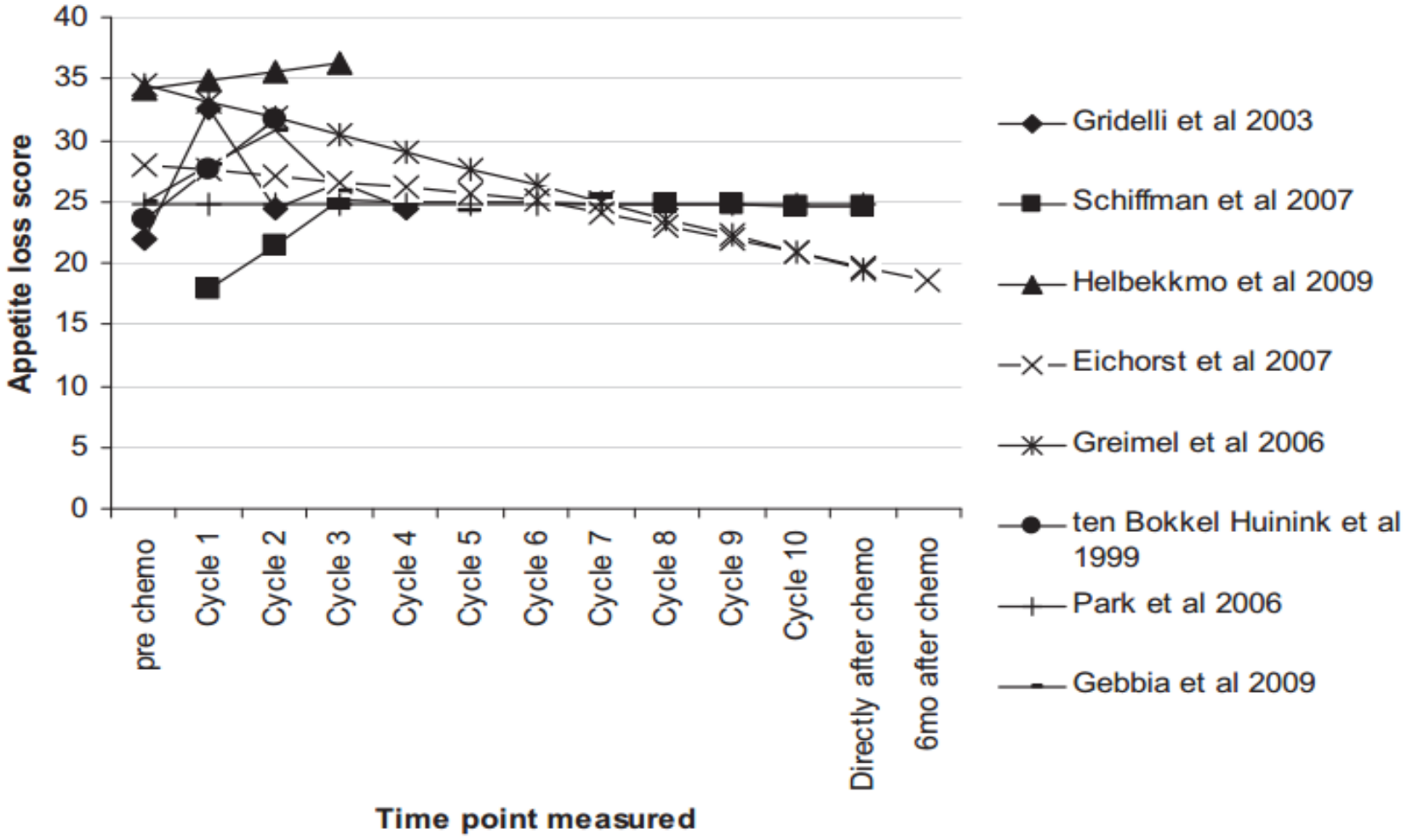


Fig. 3. Change in liking as measured by change in hedonic rating given to foods over time.

(Boltong & Keast, 2012)

Energy Intake – Appetite



(Boltong & Keast, 2012)

Energy Intake – Sensory Changes

Detection Threshold (BET) in Renal Patients and Control

	Normal Middle-Aged	CAPD Renal Patients	Non-CAPD Renal Patients	Significance
Sample size	13	19	11	—
Mean age (range)	49 (36–61)	56 (43–70)[a]	52 (37–71)	$P < 0.05$,[a] CAPD vs. middle-aged
Detection threshold				
BET of beef	0.082 ± 0.076	0.074 ± 0.063	0.116 ± 0.166	*ns*
BET of pork	0.065 ± 0.038	0.084 ± 0.092	0.164 ± 0.323	*ns*

BET = best estimated threshold.
[a]$P < 0.05$ compared with normal middle-aged, by Mann-Whitney Test.
ns = Not significant by analysis of covariance (ACOVA) adjusted for age.

Detection Threshold (BET) in Cancer Patients and Controls

	Normal Middle-Aged and Elderly Cancer Patients	RT/CT Cancer Patients	
Sample size	35	36	23
Mean age (range)	69 (36–94)	69 (36–94)	67 (39–82)
Detection threshold			
BET of beef	0.290 ± 0.334	—	0.457 ± 0.0652*ns*
BET of pork	—	0.234 ± 0.326	0.254 ± 0.263*ns*

BET = Best estimated threshold.
ns = Not significant compared with normal middle aged and elderly, either by T-test or Mann-Whitney test.

(Ng et al., 2004)

Energy Intake – Sensory Changes

Detection Threshold of Beef and Pork (BET) in Different Treatment Groups of Patients and Controls

	Normal Middle-Aged and Elderly	Cancer Patients with Different Therapy		Significance
		RT only	RT+CT/CT only	
Mean age (range)	69 (36–94)	70 (54–82)	64 (39–77)	*ns*
Detection threshold				
BET of beef (*n*)	0.290 ± 0.334 (35)	0.419 ± 0.657 (14)	0.515 ± 0.680 (9)	*ns*
BET of pork (*n*)	0.234 ± 0.326 (36)	0.280 ± 0.294 (14)	0.212 ± 0.214 (9)	*ns*

BET = best estimated threshold.

ns = Not significant either by one-way ANOVA, multiple comparison by LSD or Kruskal-Wallis Test.

(Ng et al., 2004)

Energy Intake – Can it be enhanced?

Increase in Energy Intake

Table 2. Total food intake (g) for the control and experimental days

		Experimental days		
Meal	*Control (days 1 and 2)*	*Day 3*	*Day 4*	*Day 5*
Breakfast	123±23	129±31	123±27	127±22
Lunch	251±110	310±83	285±91	266±65
Dinner	218±71	309±156	315±134*	275±129
Total	592±172	748±220*	723±178	668±148

Results are expressed as mean±standard deviation.
Values were significantly higher than the control: $*P < 0.05$.

(Henry et al., 2003)

Increase in Energy Intake

Table 4. Protein intake (g) for the control and experimental days

		Experimental days		
Meal	*Control (days 1 and 2)*	*Day 3*	*Day 4*	*Day 5*
Breakfast	2.1 ± 0.4	2.3 ± 0.4	1.9 ± 0.3	2.2 ± 0.4
Lunch	5.4 ± 1.9	6.6 ± 1.9	6.1 ± 2.2	5.7 ± 1.2
Dinner	8.3 ± 3.8	11.3 ± 7.0	12.0 ± 7.1	10.3 ± 5.0
Total	15.8 ± 5.5	20.2 ± 7.9	20.0 ± 3.3	18.2 ± 5.2

Results are expressed as mean ± standard deviation.

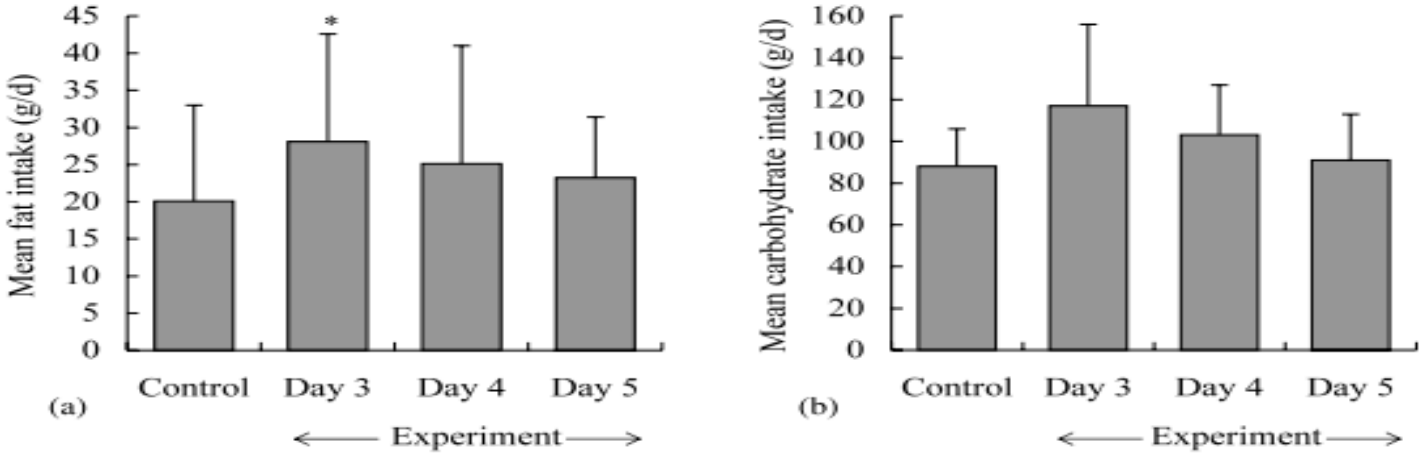
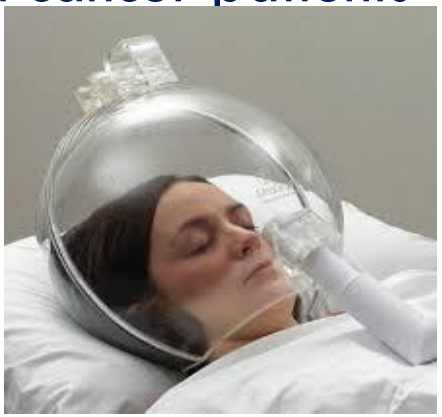


Figure 1. Daily fat (a) and carbohydrate (b) intake for the control and experimental days. Values are means, with standard deviations represented by vertical bars. Value was significantly higher than the control: * $P < 0.05$.

(Henry et al., 2003)

Energy requirements

- Accurate determination of energy requirements in cancer patient is essential to avoid feeding-association complications
- Underfeeding and overfeeding are often common in cancer patients
- Indirect calorimetry is the preferred method for determining caloric need
- Harris-Benedict equation for cancer patients



Males h= 66.4730 + 13.7516W + 5.0033S – 6.7750A

Females h= 665.0955 +9.5634W +1.8496S – 4.6756A

Where h= kcal per day; W= weight in kilograms; S= stature in centimeters; A= age in years.

(Pirat et al., 2009)

Measured Vs Estimated Resting Energy Expenditure

	Clinically Estimated	Harris-Benedict Equation	Measured
Resting energy expenditure (kcal/d)	1,862 ± 330*	1,613 ± 382	1,623 ± 384
Resting energy expenditure (kcal/kg/d)	27.6 ± 6.2†	23.4 ± 3.6	23.8 ± 5.7

(Pirat et al., 2009)

Conclusion

- Estimation of basal metabolic rate provides a useful template to predict energy requirement in cancer patients
- Given the variety of cancer sites and diversify of treatment, no universal diet therapy is available
- Methods to enhance food intake and minimize food aversion should be explored using food and food ingredients.
- Research into locally based food & spices may be a way forward to enhance food intake
- Minimising weight loss & enhancing the pleasure of food intake in cancer still remains a challenge.

Possible Approach

Preventive approach

- Radioprotectants
- Radiation treatment planning
- Avoid familiar food prior to therapy

Targeted approach

- Manage hyposalivation
- Chew gum to cover unpleasant and provide symptomatic relief
- Use of zinc sulfate supplementation

Therapy for taste change

- Dietary counseling
- Dietary modification