



Daily balance and recommended intake of essential elements

Daily balance figures for 21 elements reproduced from the 1975 International Commission on Radiological Protection's Report of the Task Group on Reference Man

Hydrogen (H)

Atomic number 1

Hydrogen is essential for life, however, because hydrogen atoms are ubiquitous in water molecules and macronutrients, no recommended daily intake is set for this element. Hydrogen is a nonmetal. Pure hydrogen is a colourless, odourless, flammable gas with the lowest density of all gases. The two hydrogen atoms of a H₂O molecule contribute 11.1% of its total mass making pure water 11.1% hydrogen. The human body is approximately 10% hydrogen.

Hydrogen balance in humans (grams/day)¹

	Intake	Losses			
	Food and fluids	Urine	Faeces	Sweat	Insensible losses
70 kg male	350	160	13	72	95
58 kg female	245	120	11	47	67
10 yo child	230	110	8.6	39	64

Carbon (C)

Atomic number 6

Carbon atoms are the basis of life on Earth, however, because carbon atoms are ubiquitous in the macronutrients and vitamins, no recommended daily intake is set for this element. Carbon is a nonmetal. Pure carbon can exist as diamond, graphite, graphene and several other more exotic allotropes. The human body is approximately 23% carbon by weight.

Carbon balance in humans (grams/day)¹

	Intake	Losses			
	Food and fluids	Urine	Faeces	Exhaled	Other losses
70 kg male	300	5	6.7	270	18
58 kg female	210	3.5	6.7	190	13
10 yo child	200	3	5	180	12
1 yo infant	100	0.5	2	95	6

Nitrogen (N)

Atomic number 7

Nitrogen is essential for life, however, because nitrogen atoms are ubiquitous in protein and the B vitamins, no recommended daily intake is set for this element. Nitrogen is a nonmetal. Pure nitrogen is a colourless, odourless gas, non-flammable gas. All amino acids contain at least one nitrogen atom. The human body is approximately 2.6% nitrogen by weight.

Nitrogen balance in humans (g / day)¹

	Intake	Losses			
	Food and fluids	Urine	Faeces	Sweat	Other losses
70 kg male	17	15	1.5	0.3	Trace, fluids, hair, nails
58 kg female	13	13	1.3	0.3	
10 yo child	10	3	5	0.1	
1 yo infant	6	0.5	2	0.05	

Oxygen (O)

Atomic number 8

Oxygen atoms are essential for life, however, because oxygen atoms are ubiquitous in water and the macronutrients and vitamins, no recommended daily intake is set for this element. Oxygen is a nonmetal. Pure oxygen is a colourless, odourless gas that supports fire. Almost all the molecular oxygen on Earth is produced by photosynthesis. Around 100 per billion O₂ molecules (100 ppb) are produced by ultraviolet sunlight splitting of H₂O and CO₂ molecules in the upper atmosphere. The human body is approximately 61% oxygen by weight.

Oxygen balance in humans (grams/day)¹

	Intake		Losses			
	Food and fluids	Airborne	Urine	Faeces	Exhaled	Other losses
70 kg male	2600	920	1300	100	730	580 sweat 750 insensible losses
58 kg female	1800	600	1100	90	510	370 sweat 530 insensible losses

Sulfur (S)

Atomic number 16

Sulfur is essential for life, however, because sulfur atoms are ubiquitous in whole food, no recommended daily intake is set for this element. Sulfur is a nonmetal. Pure sulfur is a nontoxic, brittle yellow solid with the lowest electrical conductivity of all elements. The two amino acids, *cysteine* and *methionine*, each contain one sulfur atom. The sulfur atoms in a polypeptide can form very strong bonds with each other, providing the strength and rigidity of proteins such as hair, nails, hooves and horns. The human body is 0.14% sulfur by weight.

Sulfur balance in humans (grams/day)¹

Intake		Losses			
Food and fluids	Airborne	Urine	Faeces	Sweat	Other losses
0.85	0.001 – 0.004	0.8	0.14	0.026	0.032 hair, nails 0.003 other fluids

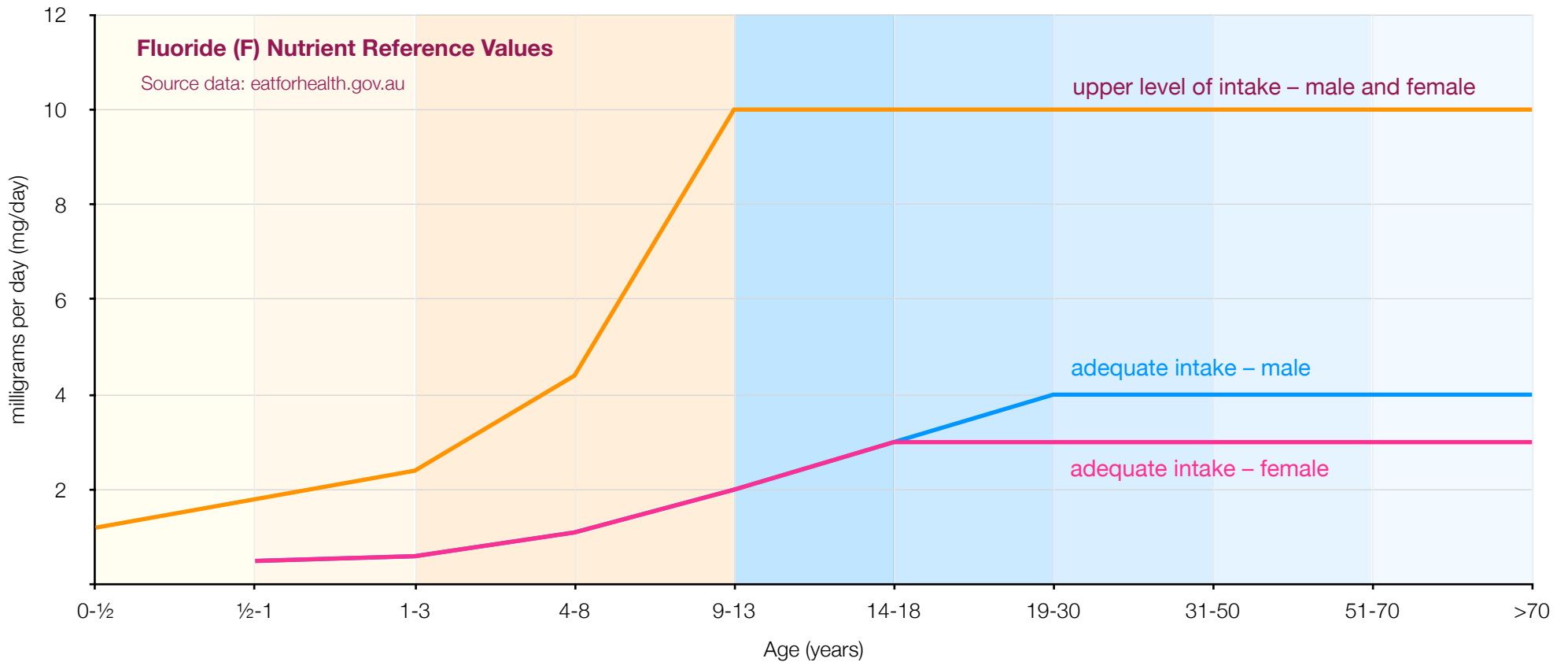
Fluorine (F)

Atomic number 9

Fluorine is not essential for life. Most countries set a recommended intake for fluorine because it plays an important role in dental health and possibly bone health. Pure fluorine is a toxic yellow gas. The fluorine atom readily captures an electron from other atoms to become the negatively charged fluoride ion. Fluoride ions are naturally present in food and water. Fluoride reduces the solubility of tooth enamel in acid, thereby reducing the risk of tooth decay. Excess fluoride cause tooth and skeletal fluorosis. There have been no reports of bone fracture due to fluorosis in Australia. An average 70kg adult contains around 2.6 grams of fluoride.

Fluorine balance for 70 kilogram adult (mg/day)¹

Intake	Losses			
Food and fluids	Urine	Faeces	Sweat	Other
1.8	1	0.15	0.65	Trace, other fluids



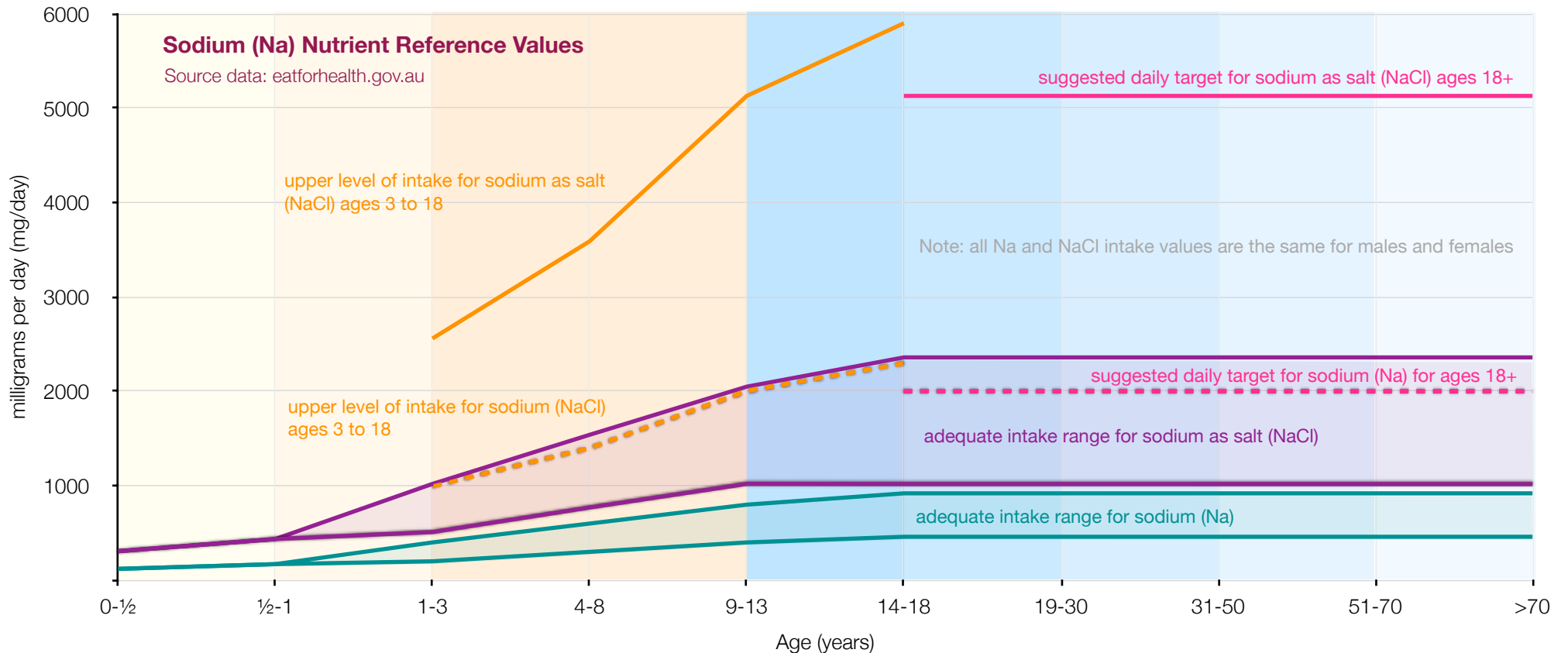
Sodium (Na)

Atomic number 11

Sodium atoms are essential for life. Pure sodium is a soft silvery metal. Sodium metal tarnishes rapidly in air and reacts vigorously with water. The sodium concentration is higher in the extracellular fluid outside cells than the intracellular fluid inside cells. This concentration gradient helps maintain fluid and electrolyte balance. Sodium is largely consumed as sodium chloride, NaCl, or 'salt'. There is strong evidence that excess sodium increases blood pressure. An average 70 kg adult contains around 100 grams of sodium.

Sodium balance for 70 kilogram adult (mg/day)¹

Intake	Losses			
Food and fluids	Urine	Faeces	Sweat	Other
4400	3300	100	870	130 other fluids 1 hair



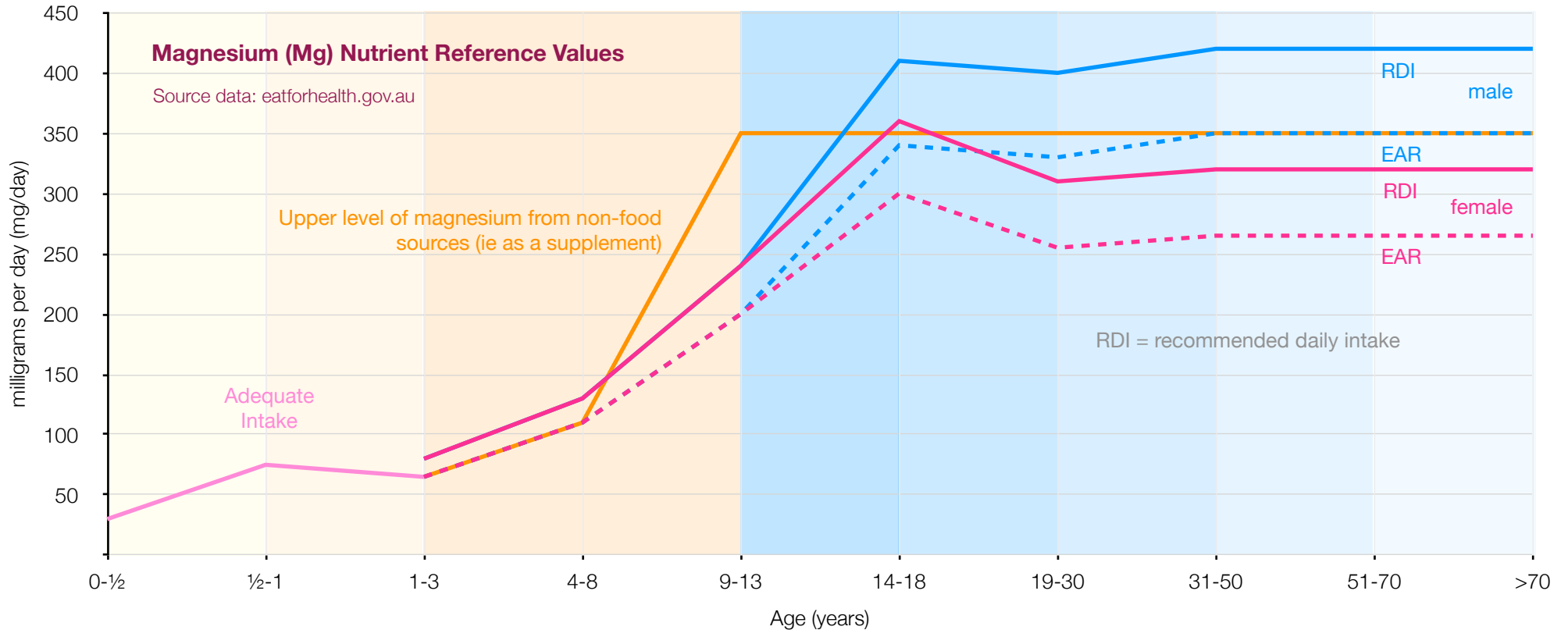
Magnesium (Mg)

Atomic number 12

Magnesium atoms are essential for life. Magnesium atoms are present in more than 300 human enzymes. Pure magnesium is a flammable silvery metal. Chlorophyll molecules contain a single magnesium atom making leafy green vegetables one of the many excellent sources of magnesium. Excess magnesium supplementation can cause diarrhoea. An average 70 kg adult contains around 19 grams of magnesium.

Magnesium balance for 70 kilogram adult (mg/day)¹

	Intake	Losses			
	Food and fluids	Urine	Faeces	Sweat	Other
70 kg male	340	130	210	1.5	0.0075 hair (♂, ♀)
58 kg female	270	110	160	1.5	Trace, other fluids (♂, ♀)



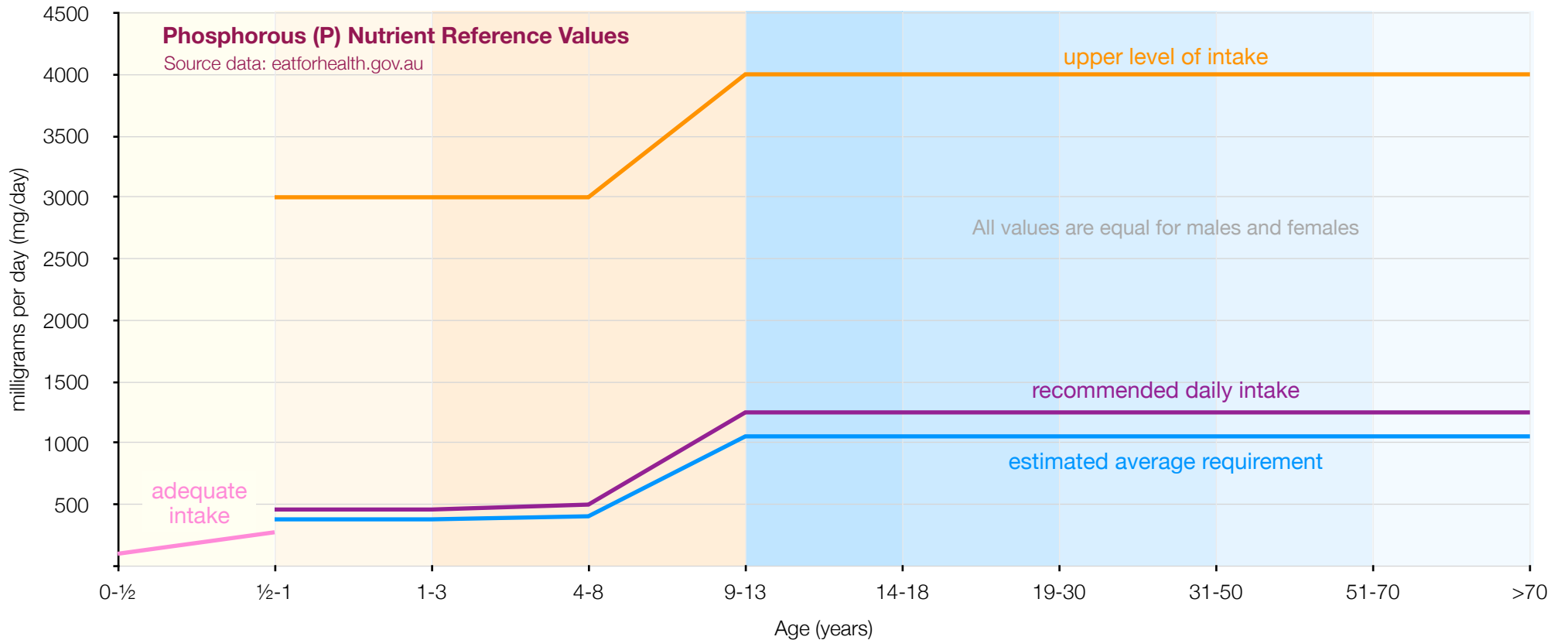
Phosphorous (P)

Atomic number 15

Phosphorous atoms are essential for life. Pure phosphorous is a flammable nonmetal. White phosphorous glows in the dark and spontaneously combusts in air. Red phosphorous is used to make the striker on matchboxes. Phosphorous atoms form the backbone of DNA and RNA. Adenosine triphosphate (ATP) and creatine phosphate are essential for energy metabolism. Phosphorous is the second most abundant inorganic atom in the human body after calcium. An average 70 kg adult contains around 780 grams of phosphorous.

Phosphorous balance for 70 kilogram adult (mg/day)¹

Intake	Losses			
Food and fluids	Urine	Faeces	Sweat	Other
1400	900	500	1	0.1 hair Trace, other fluids



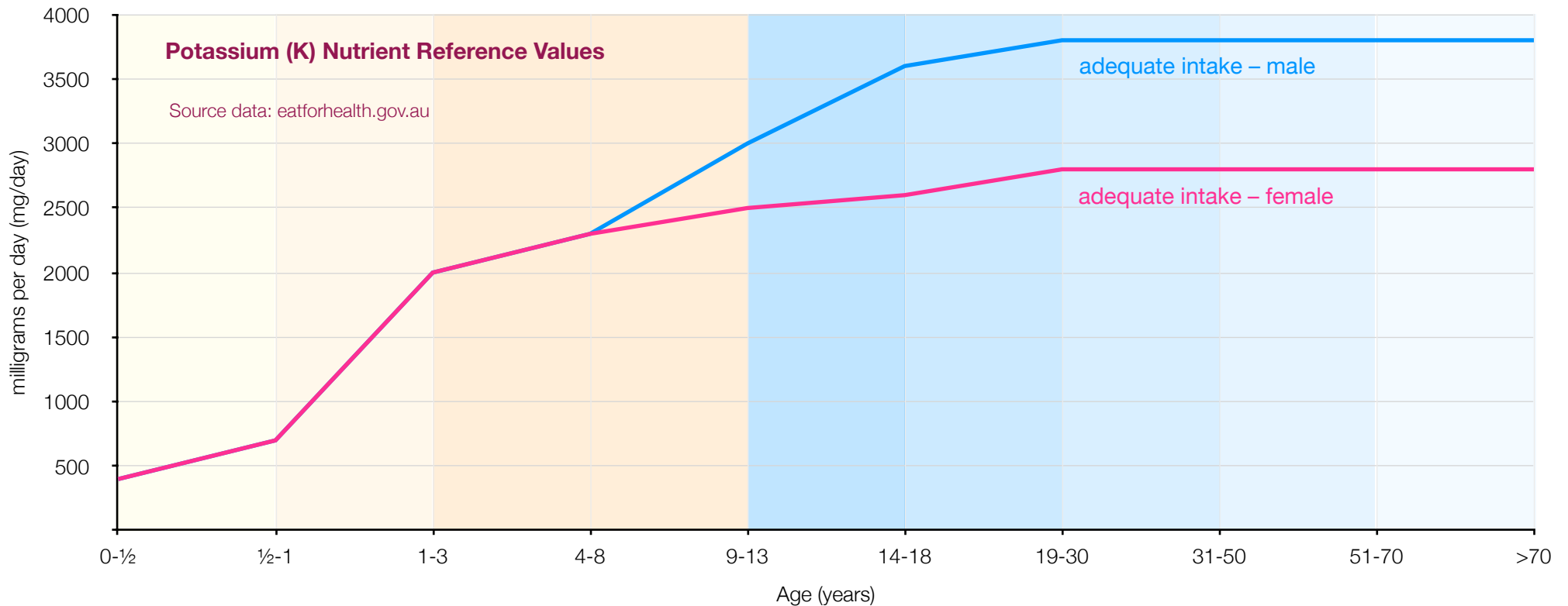
Potassium (K)

Atomic number 19

Potassium atoms are essential for life. Pure potassium is a soft, flammable, metal. Potassium metal reacts vigorously with water to produce hydrogen gas and potassium hydroxide (KOH). Potassium ions are present at almost equal concentrations in all lean body tissues. The concentration of potassium is higher in the intracellular fluid inside cells than in the extracellular fluid outside of cells (the opposite is true for sodium). This concentration gradient helps maintain the body's fluid and electrolyte balance. An average adult contains around 140 grams of potassium.

Potassium balance for 70 kilogram adult (mg/day)¹

Intake	Losses			
Food and fluids	Urine	Faeces	Sweat	Other
3300	2800	360	130	Trace, other fluids



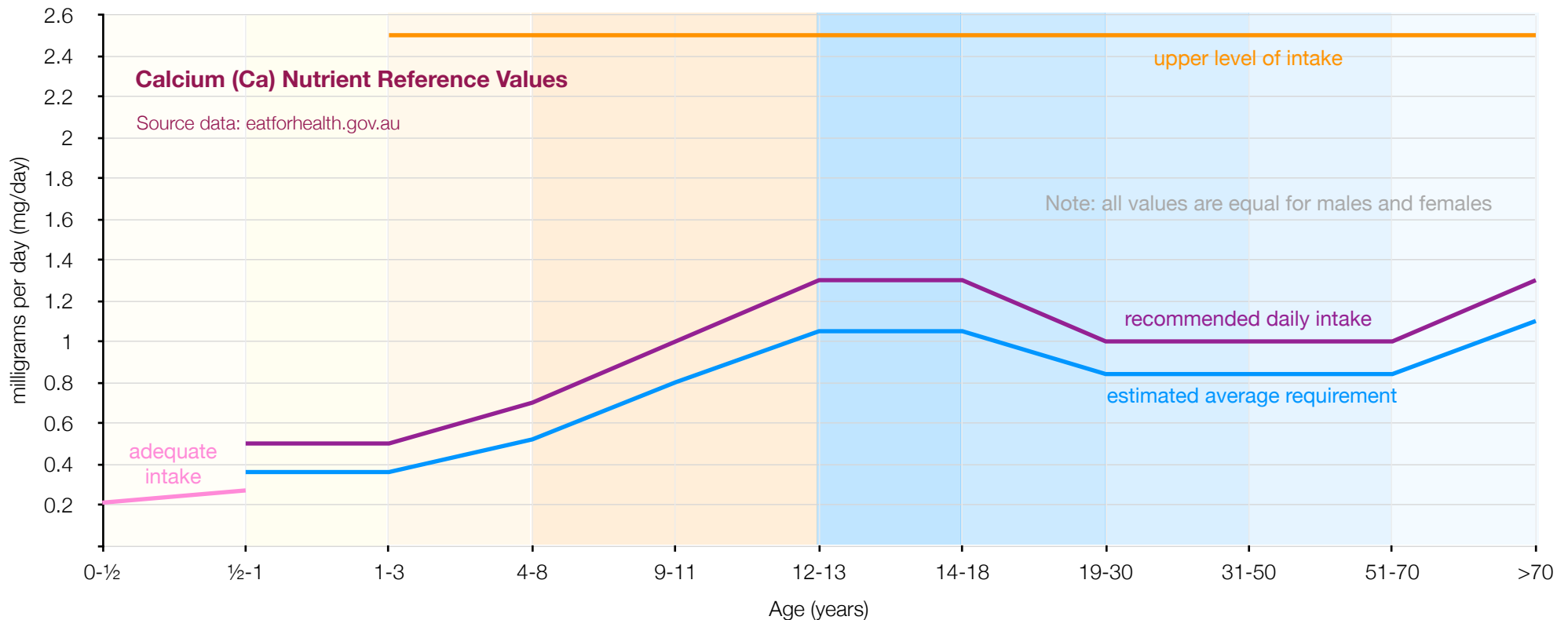
Calcium (Ca)

Atomic number 20

Calcium atoms are essential for life. Pure calcium is a silvery metal and the sixth best conductor of all elements, however it rapidly oxidises in air. Calcium metal reacts vigorously with water to produce hydrogen gas and calcium hydroxide (slaked lime). The calcium atom readily donates two electrons to other atoms to form a calcium ion, Ca^{2+} . Calcium ions are essential for bones and in electrical signalling in nerve cells and muscles. An average 70 kg adult contains around 1 kg of calcium.

Calcium balance in humans (grams/day)¹

	Intake	Losses			
	Food and fluids	Urine	Faeces	Sweat	Other losses
Male (70 kg)	1.1	0.18	0.74	0.032 – 0.15	Trace hair Trace, other fluids
Female (58 kg)	0.9	0.15	0.61	0.030 – 0.12	
Child 10 yo	0.9	0.15	0.61	0.030 – 0.12	



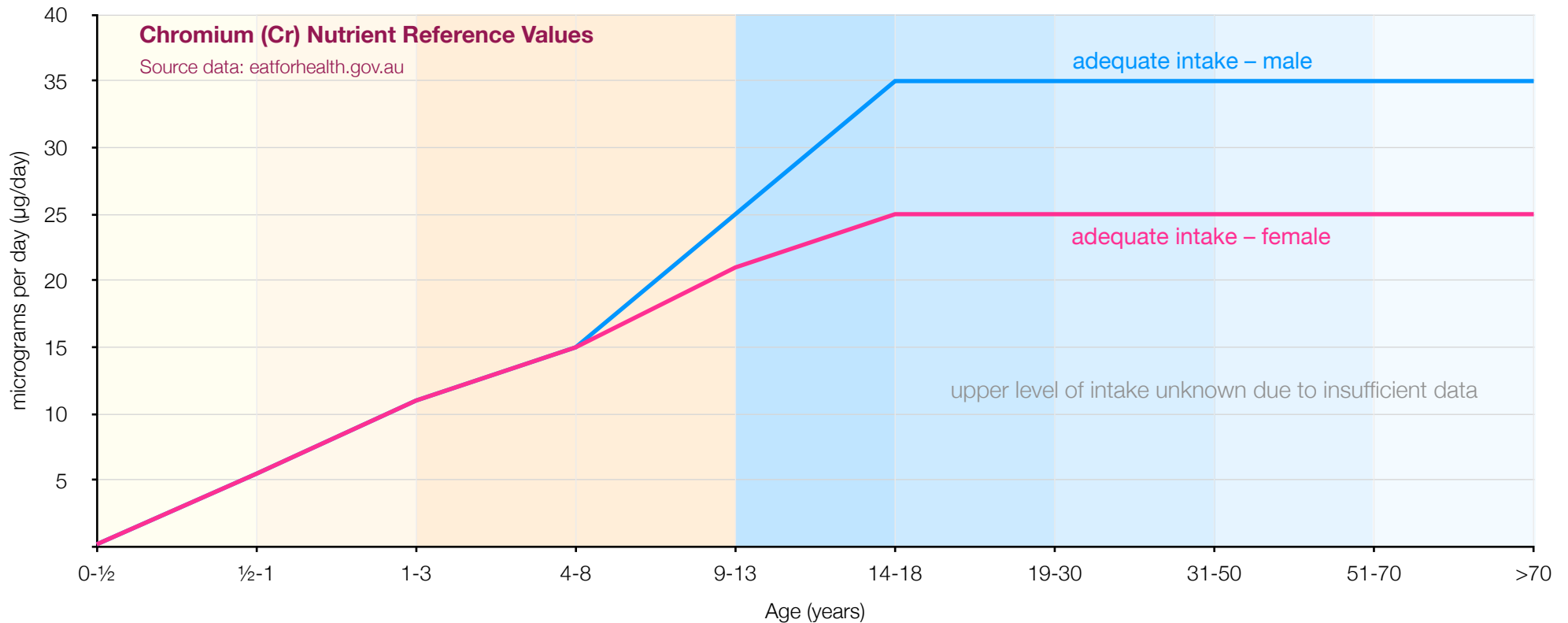
Chromium (Cr)

Atomic number 24

Chromium enhances the action of insulin and therefore aids in the metabolism of sugar. Pure chromium is a hard metal with a blue tinge. Chromium can be used to coat other metals and plastics to produce a polished metallic appearance. Over-consumption of chromium supplements can cause diarrhoea, vertigo, hives and kidney damage, and may interfere with other medications. An average 70 kg adult contains around 0.0066 grams of chromium.

Chromium balance for 70 kilogram adult ($\mu\text{g}/\text{day}$)¹

Intake		Losses			
Food and fluids	Airborne	Urine	Faeces	Sweat	Other
150	0.1	70	80	1	0.6 hair, nails
					Trace, other fluids



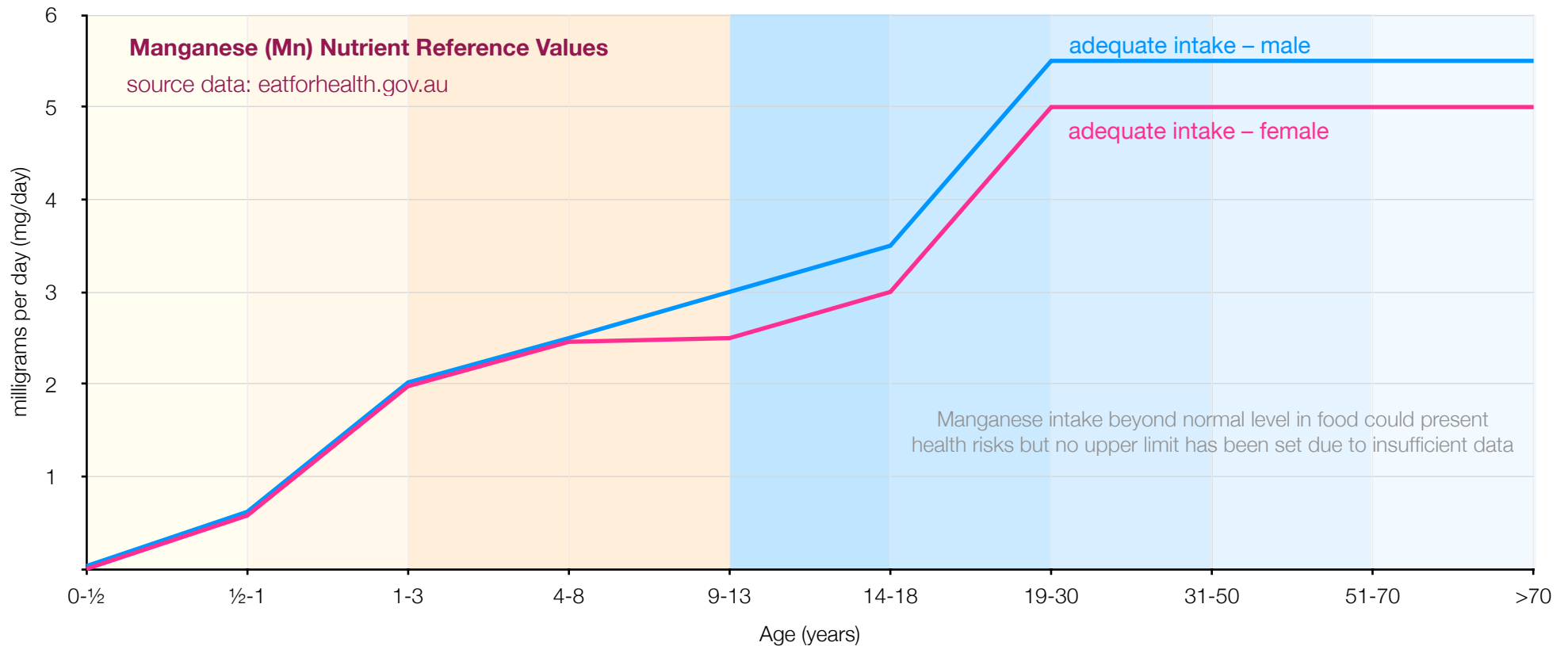
Manganese (Mn)

Atomic number 25

Manganese atoms are essential for life. Pure manganese is a brittle, hard, silvery metal. Manganese atoms are present in enzymes that catalyse the urea cycle, which converts the toxic ammonia molecules produced during protein metabolism into urea for excretion. Manganese atoms are also required for the formation of bone and are involved in the metabolism of carbohydrates and cholesterol. An average 70 kg adult contains around 12 milligrams of manganese.

Manganese balance for 70 kilogram adult (mg/day)¹

Intake		Losses			
Food and fluids	Airborne	Urine	Faeces	Sweat	Other
3.7	0.002	0.03	3.6	0.039	0.002 hair, nails



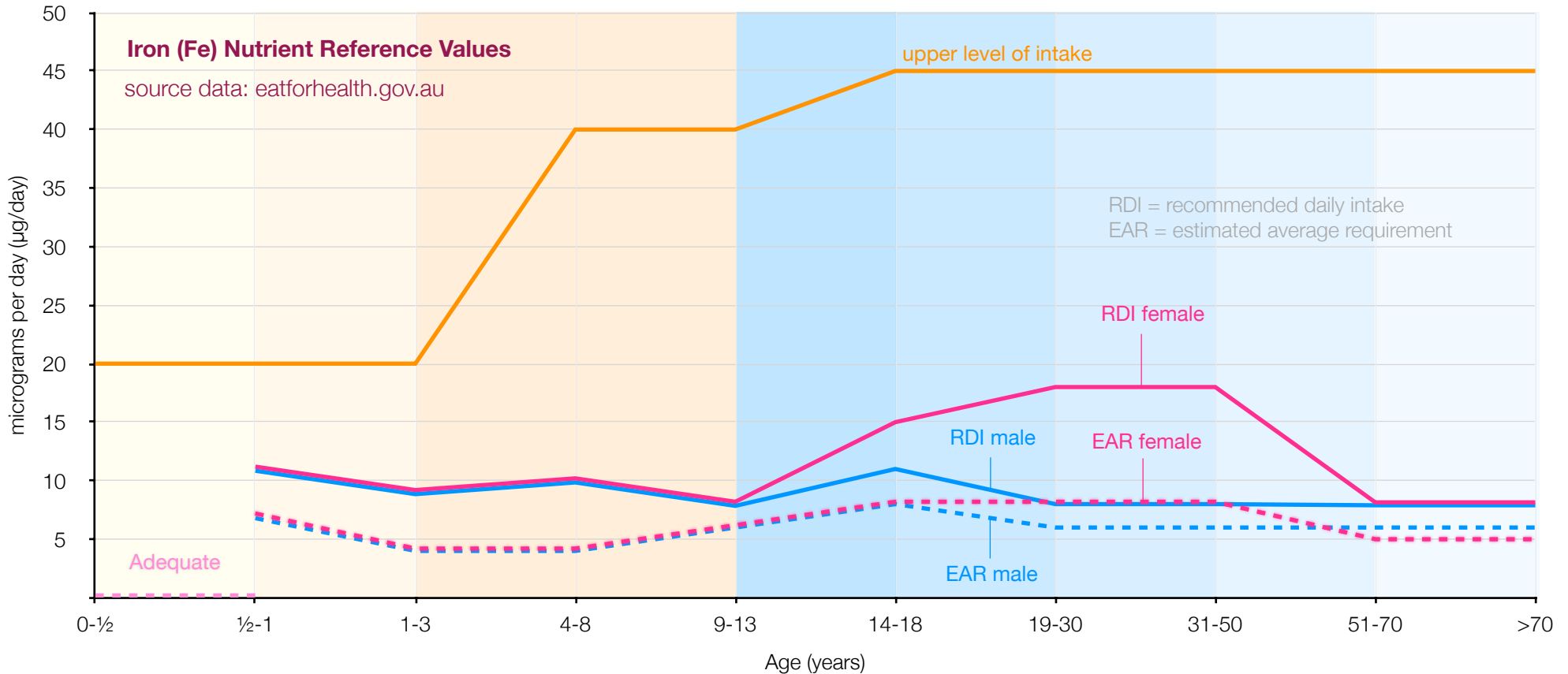
Iron (Fe)

Atomic number 26

Iron atoms are essential for life. Pure iron is a shiny grey metal that rusts in air. Haemoglobin molecules contain iron atoms which transport oxygen from the lungs to the tissue. Iron atoms often combine and cooperate with other atoms, such as sulfur or copper, to perform their biological functions. Excess iron in the diet can inhibit absorption of calcium and zinc, while excess calcium and zinc can inhibit iron absorption.

Iron balance for 70 kilogram adult (mg/day)¹

	Intake		Losses			
	Food and fluids	Airborne	Urine	Faeces	Sweat	Other
70 kg male	16	0.03	0.25	15	0.5	0.013 hair, nails (♂, ♀)
58 kg female	12	0.03	0.20	11	0.5	0.6 menstrual loss (♀)



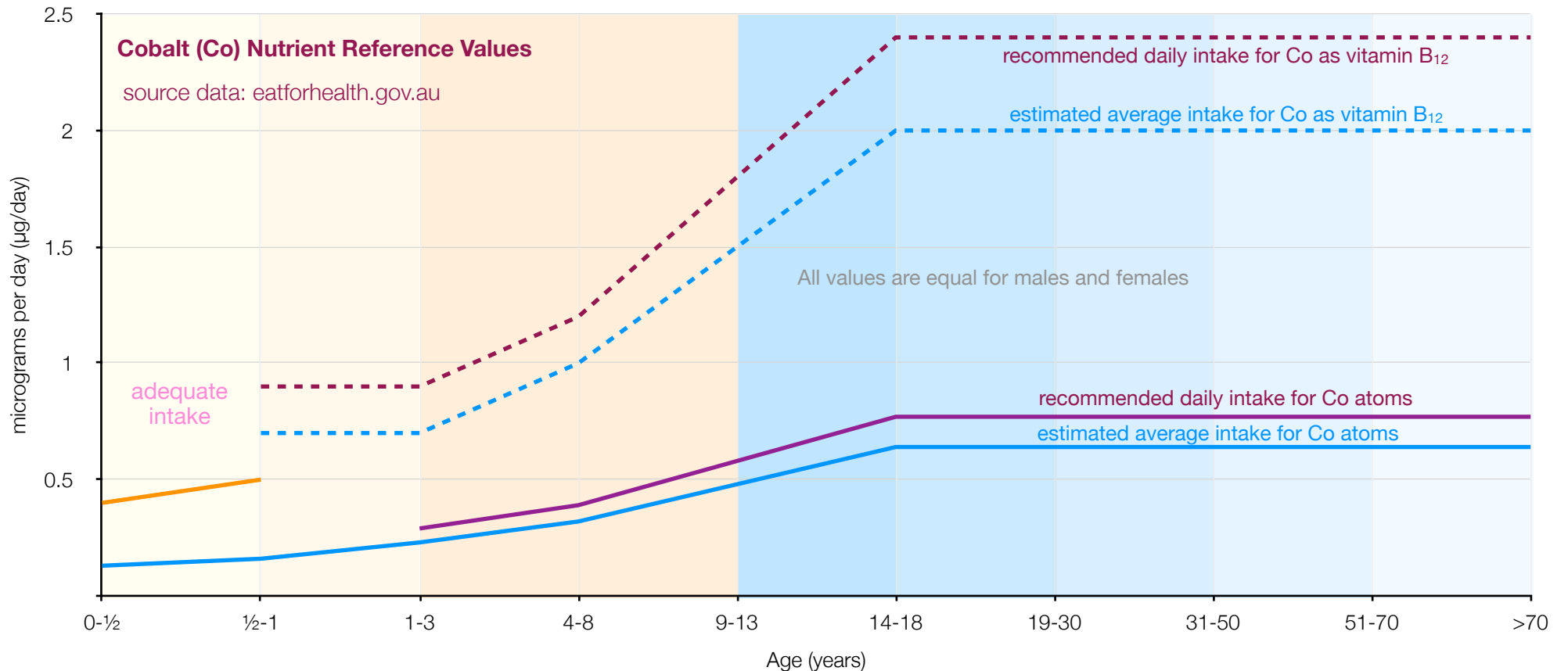
Cobalt (Co)

Atomic number 27

Cobalt atoms are essential for life. Pure cobalt is a lustrous, silvery-blue metal. Cobalt atoms are obtained by the consumption of vitamin B₁₂. Therefore, no recommended daily intake is set for this element because an adequate Vitamin B₁₂ intake provides sufficient cobalt. The single cobalt atom in a B₁₂ molecule (C₆₃H₈₈CoN₁₄O₁₄P) contributes 32% of the mass of this vitamin. An average 70 kg adult contains around 0.0015 grams of cobalt.

Cobalt balance for 70 kilogram adult (µg/day)¹

Intake		Losses			
Food and fluids	Airborne	Urine	Faeces	Sweat	Other
300	< 0.1	200	90	0.04–0.40	4 hair 2.4 hair Trace, other fluids



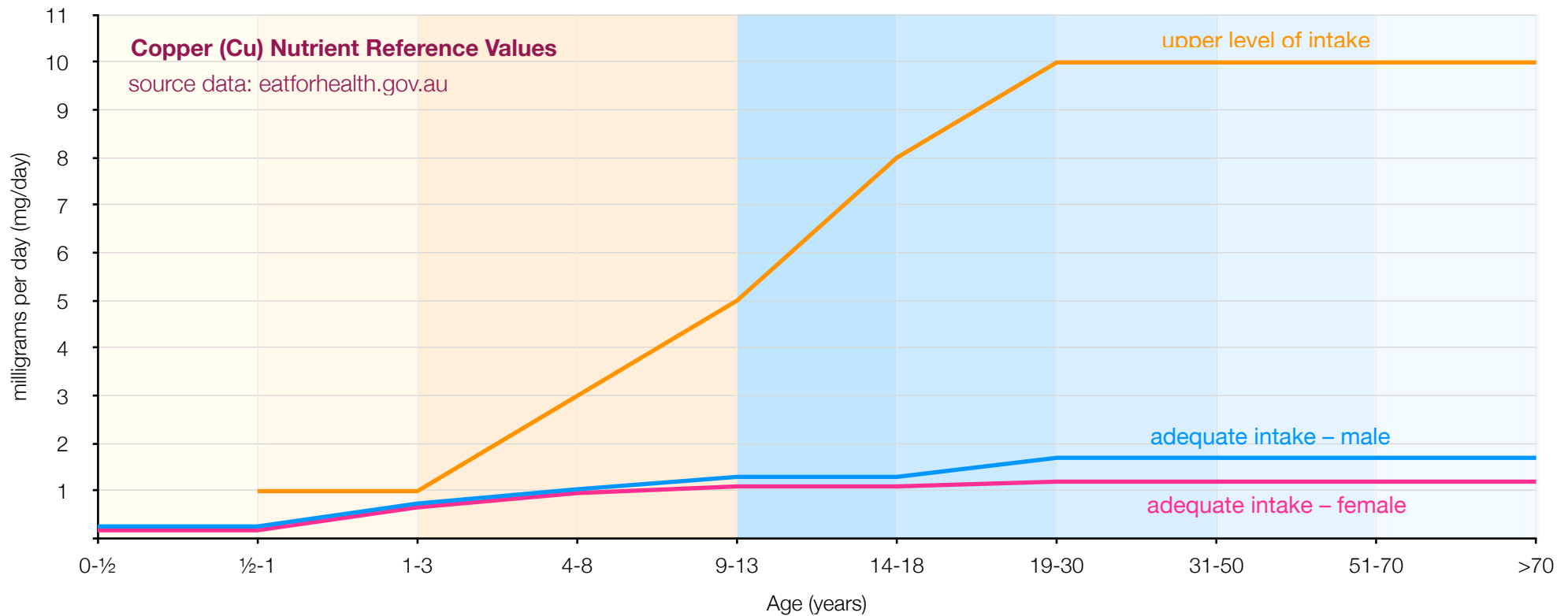
Copper (Cu)

Atomic number 29

Copper atoms are essential for life. Pure copper is a reddish gold metal and the second best electrical conductor of all elements after silver. Copper atoms are used by mitochondria to split O₂ molecules into separate oxygen atoms. The oxygen atoms are then converted to H₂O by the addition of hydrogen atoms obtained from macronutrients. Copper has numerous other biological functions. An average 70 kg adult contains around 0.072 grams of copper. For comparison, the Australian 1 cent coin weighs 2.60 grams.

Copper balance for 70 kilogram adult (mg / day)¹

Intake		Losses			
Food and fluids	Airborne	Urine	Faeces	Sweat	Other
3.5	0.02	0.05	3.4	0.04–0.40	0.003 hair, nails 0.02 menstrual loss Trace, other fluids



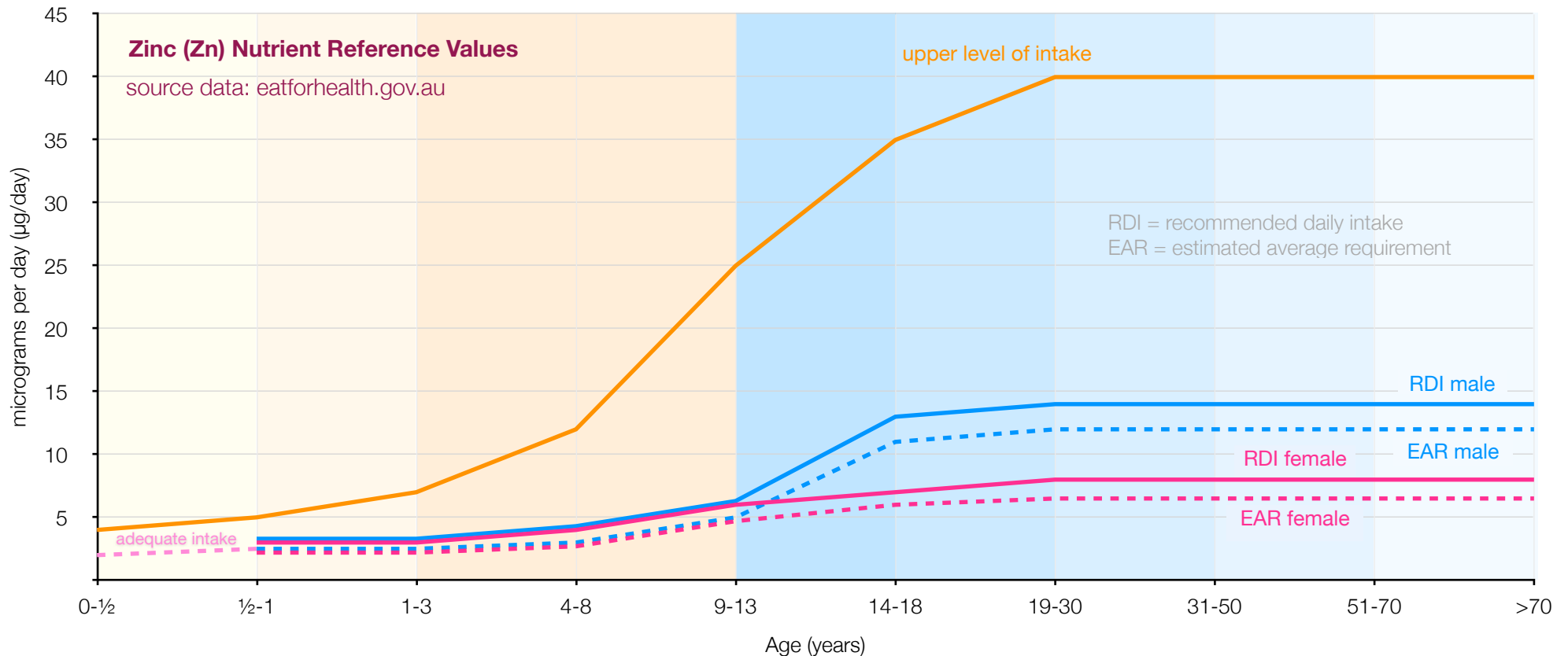
Zinc (Zn)

Atomic number 30

Zinc atoms are essential for life. Pure zinc is a silvery metal that tarnishes in air. Zinc atoms are used to convert CO_2 and H_2O molecules into bicarbonate (HCO_3^+). About 70% of CO_2 is transported to the lungs as bicarbonate where it is converted back to CO_2 to be exhaled and H_2O which is recycled. Zinc has numerous other biological functions, including in the immune system. An average 70 kg adult contains around 2.3 grams of zinc. Excess zinc can be carcinogenic.

Zinc balance for 70 kilogram adult (mg/day)¹

Intake		Losses			
Food and fluids	Airborne	Urine	Faeces	Sweat	Other
13	< 0.1	0.5	11	0.78	0.03 hair, nails 1 menstrual loss



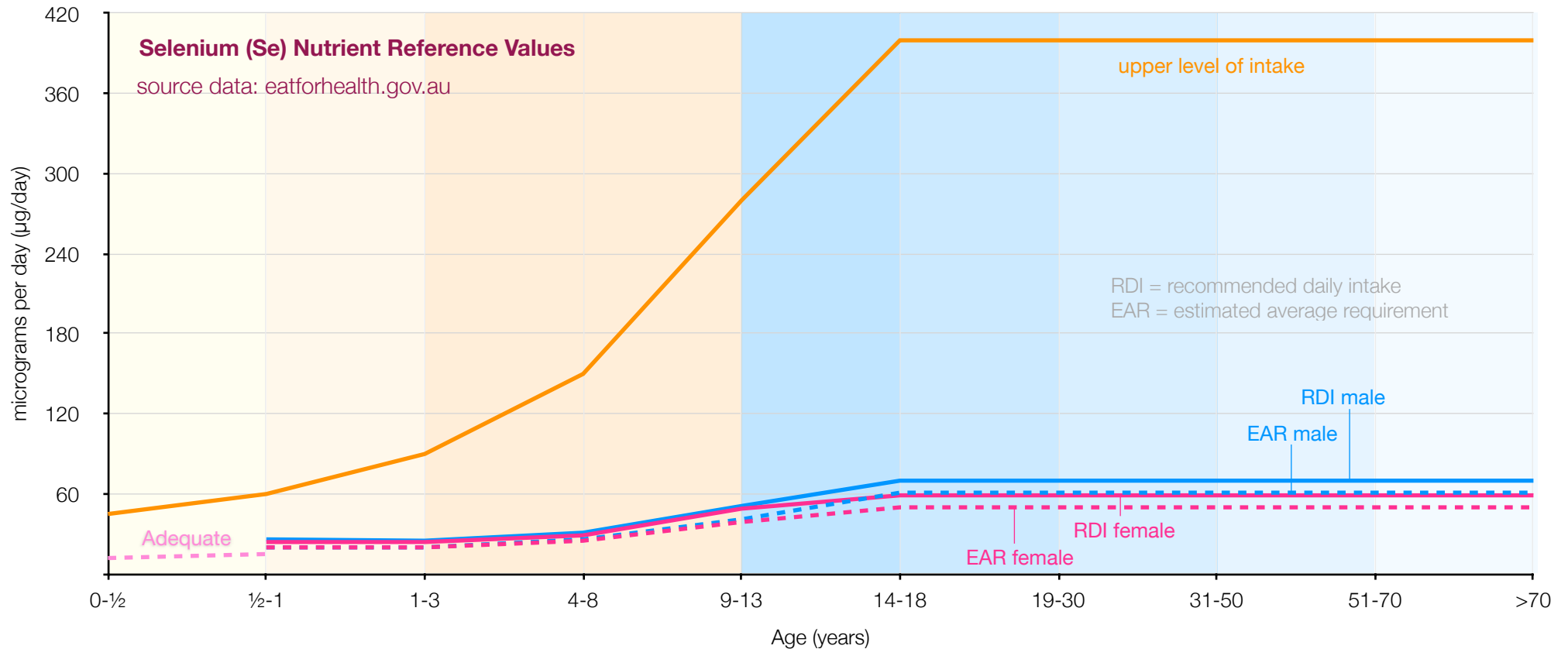
Selenium (Se)

Atomic number 37

Selenium atoms are essential for life. Selenium is present in least 30 human enzymes and every human cell contains more than a million selenium atoms. Pure selenium is a semi-metal that exists as a silvery metal or a red powder. Selenium atoms take part in numerous biochemical reactions. Excess selenium is toxic and teratogenic (disturbs development of an embryo or foetus). An average 70 kg adult contains 0.013 grams of selenium.

Selenium balance for 70 kilogram adult (mg/day)¹

Intake		Losses			
Food and fluids	Airborne	Urine	Faeces	Sweat	Other
150	Unknown	50	20	80	0.03 hair Trace, other fluids



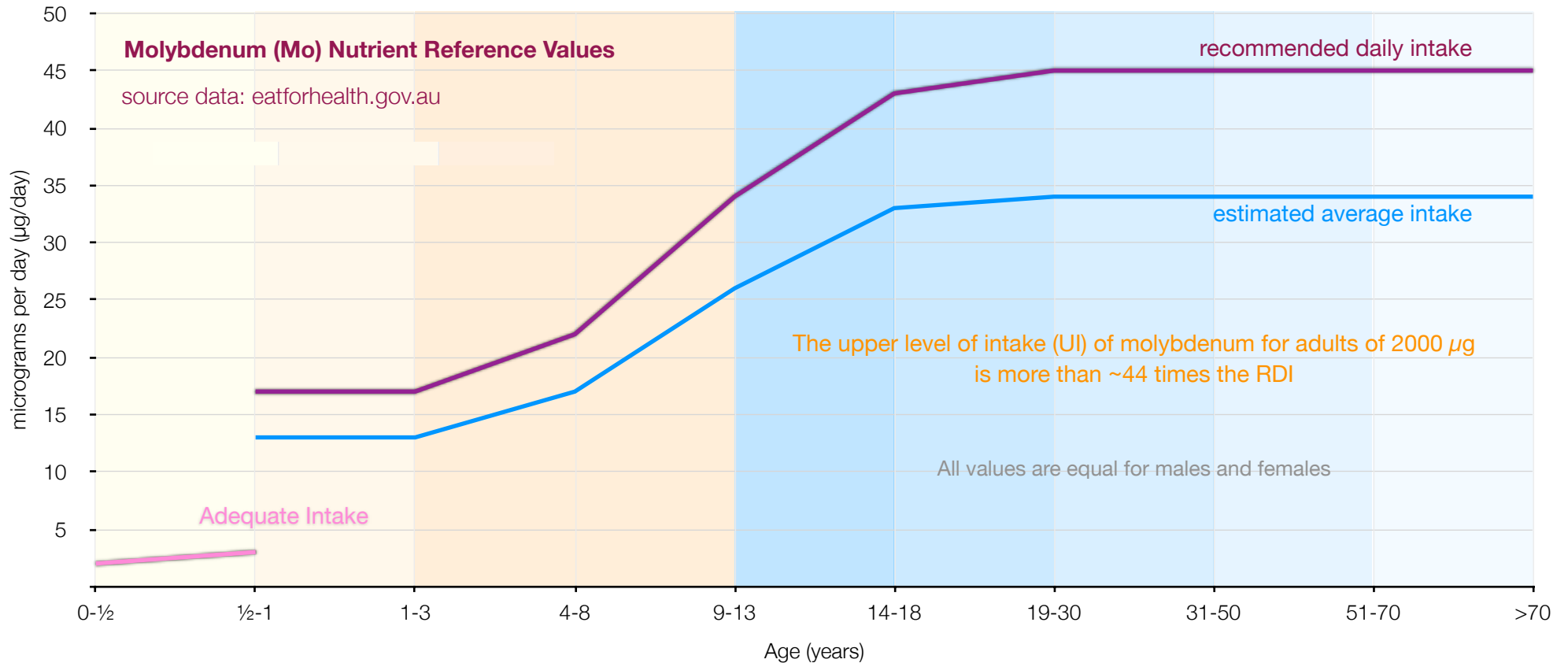
Molybdenum (Mo)

Atomic number 40

Molybdenum atoms are essential for life. Pure molybdenum is silvery metal with the sixth highest melting point of all the elements. Molybdenum atoms are used to metabolise proteins, alcohol, drugs and toxins. The amount of molybdenum in plant foods reflects the molybdenum content of the soil in which those foods were grown. An average adult contains around 0.01 grams of molybdenum.

Molybdenum balance for 70 kilogram adult ($\mu\text{g}/\text{day}$)¹

Intake		Losses			
Food and fluids	Airborne	Urine	Faeces	Sweat	Other
300	< 0.1	150	120	20	0.01 hair Trace, other fluids



Iodine (I)

Atomic number 53

Iodine atoms are essential for life. Iodine is a nonmetal. Pure iodine is a black crystalline solid which forms a purple vapour when heated. Iodine atoms are needed to make the thyroid hormones which regulate normal metabolism. Iodine deficiency can cause swelling of the thyroid gland, known as goitre. An average 70 kg adult contains around 0.013 grams of iodine.

Iodine balance for 70 kilogram adult (µg / day)

Intake		Losses			
Food and fluids	Airborne	Urine	Faeces	Sweat	Other
200	0.5–0.35	170	20	6	2.3 hair Other fluids

