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ABSENCE OF EXCESS BODY FATNESS

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2.2.20 *Haematopoietic malignancies of lymphoid origin*

Haematopoietic malignancies are a heterogeneous group of cancers that arise from the blood, the bone marrow, and lymphoid tissue, and the cells of origin are either lymphoid or myeloid. Historically, haematopoietic cancers were grouped into five major categories: Hodgkin lymphoma, non-Hodgkin lymphoma (NHL), multiple myeloma (also referred to as plasma cell myeloma), acute leukaemia, and chronic leukaemia. However, these historical groupings do not reflect the current understanding of etiology and pathogenesis or current clinical practice. In 2001, the World Health Organization (WHO) introduced a new classification system (Jaffe et al., 2001), which was subsequently updated (Swerdlow et al., 2008) and is considered the reference standard for classification of these malignancies. The WHO classification has been adopted worldwide, and the terminology has been incorporated into the third edition of the International Classification of Diseases for Oncology (ICD-O-3) (WHO, 2013).

In 2001, the Working Group of the *IARC Handbook* on weight control and physical activity (IARC, 2002) concluded that the evidence of an association between avoidance of weight gain and cancers of the haematopoietic system (e.g. NHL, multiple myeloma) was *inadequate*. In the current review are included epidemiological studies of BMI, weight, or waist circumference at baseline in relation to risk of the more common types of haematopoietic malignancies for which the body of evidence was substantial enough to review. These include Hodgkin lymphoma, NHL, B-cell lymphoma overall, chronic lymphocytic leukaemia (CLL)/small lymphocytic lymphoma (SLL), diffuse large B-cell lymphoma (DLBCL), follicular lymphoma, multiple myeloma, T-cell lymphoma, leukaemia overall, acute myeloid leukaemia (AML), and chronic myeloid leukaemia (CML). Also included are findings from prospective studies with at least 50 cases for any specific subtype, meta-analyses or pooled analyses from prospective and case–control studies, and findings from case–control studies with at least 50 cases that were not included in a meta-analysis or pooled analysis. For malignancies for which there was evidence suggesting a relationship between BMI or weight at baseline and risk, the Working Group also weighed into their evaluation studies that assessed weight change and weight during young adulthood in relation to risk. Not all studies separated the haematopoietic cancers according to the current WHO classification system. Therefore, findings are presented about relationships between BMI and both individual haematological cancers and groups of cancers.

Table 2.2.20a and Table 2.2.20b (both web only, available at: http://publications.iarc.fr/570) present data for cohort and case–control studies, respectively, for subsites with *inadequate* evidence; Table 2.2.20c and Table 2.2.20d present the corresponding studies for subsites with *sufficient* or *limited* evidence.

(a) Hodgkin lymphoma

There are at least four individual prospective studies and one meta-analysis of BMI at baseline in relation to incidence of Hodgkin lymphoma (Table 2.2.20a, web only, available at: http://publications.iarc.fr/570). Results from three prospective studies in men (i.e. the United States Veterans cohort, the NIH-AARP cohort, and the Swedish Construction Worker cohort) showed increased risks (Samanic et al., 2004, 2006; Lim et al., 2007), none of which were statistically significant, whereas a Norwegian cohort study found a positive association in women but not in men (Engeland et al., 2007). [Most studies had limited statistical power, particularly at the high end of the BMI categories.] However, in the meta-analysis of five studies, obesity was

associated with a statistically significant 41% higher risk of Hodgkin lymphoma compared with normal BMI (Larsson & Wolk, 2011).

Only three case–control studies with at least 50 cases have evaluated the relationship between BMI and risk of Hodgkin lymphoma (Table 2.2.20b, web only, available at: http://publications.iarc.fr/570). The largest study, including 618 cases from the Scandinavian Lymphoma Etiology Study and 3187 population controls, did not find a relationship between BMI and risk of Hodgkin lymphoma in individuals younger or older than 45 years, assessed separately because of the bimodal distribution of the disease (Chang et al., 2005). A second large study, including 567 cases and 697 controls, also did not find a relationship between BMI and risk of Hodgkin lymphoma in subgroups defined by sex and age (Li et al., 2013). However, a smaller study of 216 cases and 216 matched controls, which considered BMI 5 years before cancer diagnosis, found an increased risk of Hodgkin lymphoma with BMI ≥ 30 kg/m^2 compared with normal BMI in men, but not in women (Willett & Roman, 2006).

(b) Non-Hodgkin lymphoma

There are at least 21 individual prospective studies and 4 meta-analyses or pooled analyses of BMI and/or weight at baseline in relation to NHL (Table 2.2.20a, web only, available at: http://publications.iarc.fr/570). There were no associations of either BMI or weight with NHL incidence or mortality in 12 individual prospective studies (Samanic et al., 2004, 2006; Fujino et al., 2007; Maskarinec et al., 2008; Song et al., 2008; Andreotti et al., 2010; De Roos et al., 2010; Kanda et al., 2010; Hemminki et al., 2011; Kabat et al., 2012; Bertrand et al., 2013; Bhaskaran et al., 2014). The other nine studies found positive associations in men and/or women (Calle et al., 2003; Oh et al., 2005; Rapp et al., 2005; Chiu et al., 2006; Engeland et al., 2007; Lim et al., 2007; Reeves et al., 2007; Troy et al., 2010; Chu et al., 2011). Three meta-analyses showed a positive association between BMI and NHL incidence and/or mortality (Larsson & Wolk, 2007a, 2011; Renehan et al., 2008), whereas one pooled analysis found no association (Whitlock, et al., 2009). [The inconsistent evidence from individual prospective studies and meta-analyses may be due to the variation in histological subtypes included in a classification of NHL.]

No association between waist circumference and NHL incidence was seen in the Women's Health Initiative in the USA (Kabat et al., 2012). However, in a cohort in Taiwan, China, high abdominal obesity (waist circumference ≥ 90 cm in men and ≥ 80 cm in women) was associated with an 86% higher risk of fatal NHL compared with lower waist circumference (Chu et al., 2011).

A total of 11 hospital-based or population-based case–control studies have evaluated the relationship between BMI and risk of any NHL (Table 2.2.20b, web only, available at: http://publications.iarc.fr/570). A meta-analysis of six of these reports published in 2004 and 2005 (Pan et al., 2004; Skibola et al., 2004; Bosetti et al., 2005; Cerhan et al., 2005; Chang et al., 2005; Willett et al., 2005) reported a relative risk of NHL of 1.22 (95% CI, 1.00–1.50) in individuals with BMI ≥ 30 kg/m^2 (Larsson & Wolk, 2007a). A subsequent pooled analysis from the InterLymph Consortium included data from 10 000 cases of NHL and 16 000 controls drawn from 18 case–control studies identified through the International Lymphoma Epidemiology Consortium (Willett et al., 2008). That study did not find a relationship between BMI and risk of NHL, with a relative risk of NHL of 0.84 (95% CI, 0.72–0.99) in individuals with BMI of 30–39.9 kg/m^2 and a relative risk of 0.63 (95% CI, 0.40–0.99) in those with BMI ≥ 40 kg/m^2.

(c) B-cell lymphoma

The association between excess body fatness and the incidence of B-cell lymphoma was examined in three individual prospective

studies (Table 2.2.20a, web only, available at: http://publications.iarc.fr/570) [notably, under the current classification, this includes all B-cell malignancies previously included under NHL]. Although no association was found with BMI and/or weight in men or in women in the EPIC cohort (Britton et al., 2008), there were statistically significant positive trends with weight in the California Teachers Study (Lu et al., 2009) and with BMI in the Cancer Prevention Study II Nutrition Cohort (Patel et al., 2013).

In the one study that assessed waist circumference, there was no association with the incidence of B-cell lymphoma in either men or women (Britton et al., 2008).

(d) Subtypes of B-cell lymphoma

(i) Chronic lymphocytic leukaemia/small lymphocytic lymphoma

Most of the individual prospective studies (Table 2.2.20a, web only, available at: http://publications.iarc.fr/570) found no associations of BMI and/or weight at baseline with the incidence of CLL or CLL/SLL (Ross et al., 2004; Samanic et al., 2006; Engeland et al., 2007; Lim et al., 2007; Lu et al., 2009; Pylypchuk et al., 2009; Kabat et al., 2012; Bertrand et al., 2013; Patel et al., 2013; Saberi Hosnijeh et al., 2013). However, in the United States Veterans study, the largest individual prospective study, the risk of CLL was 30% higher in obese White men and 72% higher in obese Black men compared with non-obese men (Samanic et al., 2004). In the Prostate, Lung, Colorectal, and Ovarian Cancer Screening Trial in the USA, baseline weight, but not BMI, was positively associated with risk ($P_{trend} < 0.215$) (Troy et al., 2010). Although an earlier meta-analysis of three cohort studies suggested a 25% higher risk of CLL for obesity versus normal weight (Larsson & Wolk, 2008), an updated meta-analysis of six prospective studies found no association between BMI as a continuous measure and incidence of CLL/SLL (Larsson & Wolk, 2011).

No association between waist circumference and CLL/SLL incidence was found in the three studies that examined this relationship (Ross et al., 2004; Kabat et al., 2012; Saberi Hosnijeh et al., 2013).

Five case–control studies with at least 50 cases assessed the relationship between BMI and risk of CLL/SLL (Table 2.2.20b, web only, available at: http://publications.iarc.fr/570) and found no association between BMI and CLL/SLL risk (Chang et al., 2005; Pan et al., 2005; Morton et al., 2008; Chen et al., 2011; Kelly et al., 2012).

(ii) Diffuse large B-cell lymphoma

Associations of baseline BMI and/or weight with risk of DLBCL have been examined in at least nine individual prospective studies and two meta-analyses (Table 2.2.20c). Most individual prospective studies found no evidence of an association (Lim et al., 2007; Britton et al., 2008; Maskarinec et al., 2008; Lu et al., 2009; Pylypchuk et al., 2009; Kabat et al., 2012; Bertrand et al., 2013). However, two large studies in the USA did report statistically significant trends between baseline weight (Troy et al., 2010) or BMI (Patel et al., 2013) and DLBCL incidence. Both meta-analyses also showed statistically significant positive associations. One meta-analysis reported a relative risk per 5 kg/m^2 increase of 1.13 (95% CI, 1.02–1.26) (Larsson & Wolk, 2011). In the other meta-analysis, both overweight and obesity in men and women were associated with increased risk (Castillo et al., 2014).

Six individual studies assessed the association between BMI or weight in early adulthood and incidence of DLBCL. In the two large studies in the USA, there were statistically significant positive associations of weight at age 20 years ($P_{trend} = 0.013$) (Troy et al., 2010) and of young adult BMI in men and women combined ($P_{trend} = 0.02$) (Bertrand et al., 2013) with risk of DLBCL. However, in none of the four other studies was BMI and/or body weight at age 18 years (Lu et al., 2009; Patel et al., 2013), at

age 20 years (Pylypchuk et al., 2009), or at age 21 years (Maskarinec et al., 2008) associated with DLBCL incidence. Similarly, adult weight gain was not associated with risk of DLBCL in any of the studies that examined this association (Maskarinec et al., 2008; Troy et al., 2010; Patel et al., 2013).

In the EPIC cohort, there was a 2-fold (RR, 2.03; 95% CI, 0.96–4.28) higher incidence of DLBCL for waist circumference ≥ 102 cm versus < 102 cm in men (based on only 21 cases in the group with high waist circumference), and no association in women (Britton et al., 2008). Similarly, there was no association between waist circumference and risk of DLBCL in the Women's Health Initiative in the USA (Kabat et al., 2012).

A pooled analysis of 19 case–control studies from the InterLymph Consortium of 4667 cases of DLBCL and 22 639 controls found a significant positive association between risk of DLBCL and young adult BMI, but not usual adult BMI (Cerhan et al., 2014). A case–control study from the National Enhanced Cancer Surveillance System in Canada, including 419 cases of DLBCL, found an odds ratio for individuals with BMI ≥ 30 kg/m^2 of 1.35 (95% CI, 0.99–1.83) (Pan et al., 2005). Another case–control study, by Chen et al., (2011), including 245 cases of DLBCL, did not find a relationship between BMI and risk of DLBCL (Table 2.2.20d).

(iii) Follicular lymphoma

None of the nine individual prospective studies (Lim et al., 2007; Britton et al., 2008; Maskarinec et al., 2008; Lu et al., 2009; Pylypchuk et al., 2009; Troy et al., 2010; Kabat et al., 2012; Bertrand et al., 2013; Patel et al., 2013) or the one meta-analysis (Larsson & Wolk, 2011) showed any evidence of an association between BMI and/or weight and the incidence of follicular lymphoma (Table 2.2.20a, web only, available at: http://publications.iarc.fr/570).

Waist circumference was also not associated with the incidence of follicular lymphoma in the two studies that examined this relationship (Britton et al., 2008; Kabat et al., 2012).

The largest study evaluating the association between BMI and follicular lymphoma (Table 2.2.20b, web only, available at: http://publications.iarc.fr/570) was a pooled analysis of 3530 cases and 22 639 population controls from 19 case–control studies in the InterLymph Consortium, which found no relationship between BMI and risk of follicular lymphoma (Linet et al., 2014). Two additional case–control studies not included in the pooled analysis also found no association between adult BMI and risk of follicular lymphoma (Pan et al., 2005; Chen et al., 2011).

Therefore, the relationship between BMI and risk of NHL varies by subtype, with a positive association seen in some studies limited to the risk of DLBCL, but not in studies assessing the risk of any NHL or of follicular lymphoma.

(e) Multiple myeloma

In the individual prospective studies that examined the association of baseline BMI and/or weight with multiple myeloma incidence or mortality (Table 2.2.20c), most found positive associations for at least one measure of excess body fatness at baseline (Calle et al., 2003; Samanic et al., 2004; Blair et al., 2005; Birmann et al., 2007; Engeland et al., 2007; Fujino et al., 2007; Reeves et al., 2007; Troy et al., 2010; Hofmann et al., 2013). In particular, a positive association was observed in the largest studies. In the United States Veterans cohort of more than 4 million men, the risk of multiple myeloma was 22% higher in obese White men and 26% higher in obese Black men compared with non-obese men (Samanic et al., 2004). Similarly, the Million Women Study in the United Kingdom found positive associations between BMI and multiple myeloma incidence and mortality (31% and 56% increase, respectively, per 10 kg/m^2) (Reeves et al., 2007). In a Norwegian cohort study of more than 2 million men and women whose height and weight were measured at baseline in 1963, there

were statistically significant dose-related positive associations between BMI and risk of multiple myeloma in men (RR, 1.14 for overweight and 1.28 for obesity vs normal BMI; $P_{trend} < 0.001$) and in women (RR, 1.12 for overweight, 1.23 for grade I, 1.42 for grade II, and 1.57 for grade III obesity vs normal BMI; $P_{trend} < 0.001$) (Engeland et al., 2007). One study found an inverse association (Samanic et al., 2006), and several studies found no association (Oh et al., 2005; Fernberg et al., 2007; Pylypchuk et al., 2009; De Roos et al., 2010; Lu et al., 2010; Kanda et al., 2010; Patel et al., 2013; Bhaskaran et al., 2014).

Several meta-analyses or pooled analyses of excess body fatness in relation to multiple myeloma incidence and/or mortality have been conducted (Larsson & Wolk, 2007b; Renehan et al., 2008; Parr et al., 2010; Wallin & Larsson, 2011; Teras et al., 2014). No association between BMI and multiple myeloma mortality was found in the Asia-Pacific Cohort Study Collaboration (Parr et al., 2010). However, in the meta-analysis by Wallin & Larsson (2011), which included studies worldwide, overweight and obesity were associated with a statistically significantly increased risk of multiple myeloma incidence (RR, 1.12 for overweight and 1.21 for obesity, based on 15 studies) and mortality (RR, 1.15 for overweight and 1.54 for obesity, based on 5 studies). The two earlier meta-analyses (Larsson & Wolk, 2007b; Renehan et al., 2008) found statistically significant positive associations of a similar magnitude. Consistent with these findings, in a pooled analysis of data from 20 prospective studies (Teras et al., 2014), there was a statistically significant positive association between BMI and multiple myeloma mortality (RR per 5 kg/m^2 increase in BMI, 1.09).

Given the observed associations between baseline BMI and risk of multiple myeloma, associations with young adult BMI and with BMI change were also examined. Several studies found no association between young adult BMI and risk of multiple myeloma (Fujino et al., 2007; Pylypchuk et al., 2009; De Roos et al., 2010; Lu et al., 2010; Patel et al., 2013), whereas in two large studies young adult BMI was positively associated with risk (Troy et al., 2010; Hofmann et al., 2013). In the large pooled analysis by Teras et al. (2014) there was a statistically significant positive association between increasing levels of young adult BMI (beginning in the overweight category) and multiple myeloma mortality, although there was no association for change in BMI during adulthood.

High waist circumference was associated with increased multiple myeloma incidence in one prospective study of postmenopausal women (Blair et al., 2005), but not in two other studies (Britton et al., 2008; Lu et al., 2010). In the large pooled analysis by Teras et al. (2014), there was a statistically significant positive association between waist circumference and multiple myeloma mortality in men and women combined (RR per 5 cm increase, 1.06).

Five case–control studies have evaluated the relationship between BMI and the risk of multiple myeloma, four of which were included in a meta-analysis (Larsson & Wolk, 2007b; Table 2.2.20d). An increased risk of multiple myeloma was reported in individuals who were overweight (RR, 1.43; 95% CI, 1.23–1.68) and those who were obese (RR, 1.82; 95% CI, 1.47–2.26). One additional study reported no significant association (Wang et al., 2013).

(f) T-cell lymphoma

In the Cancer Prevention Study II Nutrition Cohort (Table 2.2.20a, web only, available at: http://publications.iarc.fr/570), there was a positive association between BMI and the incidence of T-cell lymphoma ($P_{trend} = 0.013$) (Patel et al., 2013). However, in two European cohort studies there was no association (Lukanova et al., 2006; Lim et al., 2007). In the Cancer Prevention Study II Nutrition Cohort, BMI at age 18 years was not associated with the incidence of T-cell lymphoma (Patel et al., 2013).

Table 2.2.20c Cohort studies of measures of body fatness and haematopoietic malignancies of lymphoid origin with *sufficient* or *limited* evidence

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Diffuse large B-cell lymphoma							
Lim et al. (2007) NIH-AARP cohort USA 1995–2003	473 984 Men and women Incidence	DLBCL ICD-O-2: 9680–9684, 9688, 9710–9712, 9715	BMI 18.5–24.9 25–29.9 30–34.9 ≥ 35 [P_{trend}]	 119 141 61 21	 1.00 0.92 (0.72–1.18) 1.10 (0.81–1.51) 1.17 (0.73–1.88) [0.42]	Age, ethnicity, education level, alcohol intake, cigarette smoking, height, physical activity	
Britton et al. (2008) EPIC cohort 10 European countries 1993–1998	141 425 Men Incidence	DLBCL	BMI < 25 25–29.9 ≥ 30 [P_{trend}] Weight (kg) < 72.7 72.7–79.8 79.9–87.7 ≥ 87.8 [P_{trend}] WC (cm) < 102 ≥ 102	 24 37 10 19 13 20 19 44 21	 1.00 0.83 (0.39–1.76) 0.94 (0.56–1.59) [0.63] 1.00 0.59 (0.29–1.20) 0.90 (0.46–1.74) 0.86 (0.42–1.77) [1.00] 1.00 2.03 (0.96–4.28)	Age, study centre	Also examined height, hip circumference, and waist-to-hip ratio
	230 558 Women Incidence	DLBCL	BMI < 25 25–29.9 ≥ 30 [P_{trend}]	 30 31 12	 1.00 1.27 (0.63–2.55) 1.54 (0.92–2.57) [0.28]	Age, study centre	Also examined height, hip circumference, and waist-to-hip ratio

Table 2.2.20c (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Britton et al. (2008) (cont.)			Weight (kg)				
			< 72.7	14	1.00		
			72.7–79.8	12	0.78 (0.35–1.69)		
			79.9–87.7	21	1.32 (0.66–2.68)		
			≥ 87.8	26	1.62 (0.81–3.25)		
			[P_{trend}]		[0.06]		
			WC (cm)				
			< 88	47	1.00		
			≥ 88	21	0.88 (0.42–1.85)		
Maskarinec et al. (2008) Multiethnic Cohort 1993–2002	87 079 Men Incidence	DLBCL ICD-O-3: 9675, 9680, 9684	BMI at baseline			Age, ethnicity, education level, alcohol consumption	
			< 22.5	23	0.65 (0.35–1.21)		
			22.5–24.9	44	1.00		
			25.0–29.9	60	0.90 (0.56–1.43)		
			≥ 30.0	23	0.78 (0.40–1.52)		
			[P_{trend}]		[0.69]		
			BMI at age 21 yr				
			< 18.5	14	0.56 (0.27–1.15)		
			18.5–24.9	105	1.00		
			25.0–29.9	17	0.78 (0.41–1.48)		
			≥ 30.0	5	1.03 (0.36–2.91)		
			[P_{trend}]		[0.51]		
			Weight (lb) at baseline				
			< 152.0	47	1.00		
			152.0–170.0	37	1.97 (1.16–3.36)		
			170.1–192.0	32	1.36 (0.75–2.49)		
			> 192.0	35	1.87 (0.95–3.68)		
			[P_{trend}]		[0.12]		
			Weight (lb) at age 21 yr				
			< 130.0	43	1.00		
			130.0–145.0	34	0.87 (0.50–1.53)		
			145.1–165.0	38	1.24 (0.64–2.41)		
			> 165.0	27	1.26 (0.63–2.50)		
			[P_{trend}]		[0.33]		

Table 2.2.20c (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Maskarinec et al. (2008) (cont.)			Annual weight change (lb)				
			0 or loss	32	1.00		
			≤ 1	89	1.07 (0.62–1.86)		
			> 1	31	1.14 (0.56–2.34)		
			[P_{trend}]		[0.69]		
	105 972 Women Incidence	DLBCL ICD-O-3: 9675, 9680, 9684	BMI at baseline			Age, ethnicity, education level, alcohol consumption, age at first birth	
			< 22.5	27	1.41 (0.66–3.00)		
			22.5–24.9	30	1.00		
			25.0–29.9	43	1.06 (0.58–1.96)		
			≥ 30.0	28	1.45 (0.75–2.82)		
			[P_{trend}]		[0.80]		
			BMI at age 21 yr				
			< 18.5	16	1.02 (0.50–2.10)		
			18.5–24.9	91	1.00		
			25.0–29.9	11	1.08 (0.50–2.33)		
			≥ 30.0	4	0.94 (0.25–3.55)		
			[P_{trend}]		[1.00]		
			Weight (lb) at baseline				
			< 125.0	26	1.00		
			125.0–143.0	38	0.74 (0.40–1.38)		
			143.1–167.0	35	1.35 (0.67–2.75)		
			> 167.0	30	1.20 (0.57–2.52)		
			[P_{trend}]		[0.40]		
			Weight (lb) at age 21 yr				
			< 105.0	22	1.00		
			105.0–118.0	34	0.70 (0.35–1.41)		
			118.1–127.0	34	0.97 (0.48–1.96)		
			> 127.0	33	1.10 (0.53–2.29)		
			[P_{trend}]		[0.44]		
			Annual weight change (lb)				
			0 or loss	19	1.00		
			≤ 1	85	0.56 (0.21–1.55)		
			> 1	28	0.93 (0.34–2.54)		
			[P_{trend}]		[0.85]		

Table 2.2.20c (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Lu et al. (2009) California Teachers Study USA 1995–2007	121 216 Women Incidence	DLBCL	BMI at baseline			Weight, height, age at menarche, and physical activity	Also included results for height and physical activity
			< 20	17	1.42 (0.83–2.42)		
			20–24.9	64	1.00		
			25–29.9	41	1.07 (0.72–1.59)		
			≥ 30	26	1.37 (0.86–2.16)		
			[P_{trend}]		[0.50]		
			BMI at age 18 yr				
			< 19.5	37	0.98 (0.62–1.56)		
			19.5–20.7	36	1.00		
			20.8–22.4	32	0.90 (0.56–1.45)		
			> 22.4	43	1.23 (0.79–1.92)		
			[P_{trend}]		[0.30]		
			Weight (kg) at baseline				
			< 56.7	33	1.24 (0.76–2.03)		
			56.7– < 63.5	33	1.00		
			63.5– < 73.0	40	0.90 (0.57–1.43)		
			≥ 73.0	42	1.08 (0.68–1.72)		
			[P_{trend}]		[0.81]		
			Weight (kg) at age 18 yr				
			< 52.6	33	0.88 (0.54–1.41)		
			52.6– < 57.2	45	1.00		
			57.2– < 61.7	30	1.16 (0.72–1.84)		
			≥ 61.7	40	1.23 (0.79–1.92)		
			[P_{trend}]		[0.19]		
Pylypchuk et al. (2009) Netherlands Cohort Study on Diet and Cancer The Netherlands 1986–1999	5000 Men and women Incidence	DLBCL ICD-O-3: 9675, 9680, 9684	BMI			Age, sex	Case–cohort design
			< 18.5	3	1.91 (0.58–6.30)		
			18.5–24.9	112	1.00		
			25–29.9	101	1.16 (0.88–1.53)		
			≥ 30	8	0.62 (0.30–1.30)		
			[P_{trend}]		[0.77]		
			per 4 kg/m^2		0.92 (0.77–1.10)		

Table 2.2.20c (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Pylypchuk et al. (2009) (cont.)			BMI at age 20 yr				
			< 20	39	0.96 (0.61–1.50)		
			20–21.4	43	1.00		
			21.5–22.9	41	0.99 (0.64–1.54)		
			23–24.9	43	1.35 (0.88–2.10)		
			≥ 25	16	1.29 (0.71–2.35)		
			[P_{trend}]		[0.12]		
			per 4 kg/m²		1.20 (0.98–1.47)		
Troy et al. (2010) PLCO Trial USA 1993–2006	142 982 Men and women Incidence	DLBCL	BMI at baseline			Age, race/ ethnicity, education level	
			< 18.5	4	–		
			18.5–24.9	58	1.00		
			25–29.9	87	1.07 (0.76–1.50)		
			≥ 30	63	1.58 (1.10–2.27)		
			[P_{trend}]		[0.056]		
			BMI at age 20 yr				
			< 18.5	17	1.22 (0.74–2.02)		
			18.5–24.9	157	1.00		
			25–29.9	35	1.19 (0.82–1.73)		
			≥ 30	1	–		
			[P_{trend}]		[0.230]		
			Weight change (kg) per 10 yr				
			Loss	10	0.70 (0.35–1.39)		
			Gain 0–2	53	1.00		
			Gain 2.1–4	66	1.13 (0.78–1.63)		
			Gain 4.1–6	46	1.32 (0.88–1.97)		
			Gain ≥ 6	37	1.41 (0.91–2.18)		
			[P_{trend}]		[0.114]		
			Weight (kg) at baseline, quartiles (sex-specific)				
			Men: Women:				
			< 77.4 < 61.5	51	1.00		
			77.4–85.5 61.5–70.0	46	1.05 (0.71–1.57)		
			85.6–95.5 70.1–80.0	54	1.18 (0.81–1.74)		
			> 95.5 > 80.0	63	1.63 (1.12–2.37)		
			[P_{trend}]		[< 0.01]		

Table 2.2.20c (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Troy et al. (2010) (cont.)			Weight (kg) at age 20 yr, quartiles (sex-specific) Men: / Women: < 64.2 / < 51.9 64.2–72.7 / 51.9–54.5 72.8–79.5 / 54.6–59.1 > 79.5 / > 59.1 [P_{trend}]	 40 41 66 65	 1.00 1.26 (0.81–1.95) 1.46 (0.98–2.17) 1.67 (1.12–2.50) [0.013]		
Larsson & Wolk (2011) Meta-analysis Multiple locations 1999–2010	6 studies Men and women Incidence	DLBCL	BMI per 5 kg/m²	NR	 1.13 (1.02–1.26)		
Kabat et al. (2012) Women's Health Initiative USA 1993–2009	158 975 Women Incidence	DLBCL ICD-O-3: 9678–9680, 9684	BMI at baseline < 25 25– < 30 30– < 35 ≥ 35 [P_{trend}] Weight (kg) at baseline < 62.0 62.0– < 70.4 70.4– < 81.6 ≥ 81.6 [P_{trend}] WC (cm) at baseline < 76.1 76.1– < 84.6 84.6– < 95.0 > 95.0 [P_{trend}]	 99 115 55 33 73 79 80 70 70 80 68 84	 1.00 1.23 (0.93–1.62) 1.11 (0.78–1.58) 1.30 (0.85–1.99) [0.25] 1.00 1.09 (0.78–1.51) 1.11 (0.79–1.56) 1.05 (0.72–1.52) [0.77] 1.00 1.13 (0.82–1.58) 1.02 (0.72–1.44) 1.28 (0.91–1.81) [0.25]	Age, smoking, alcohol consumption, education level, ethnicity, physical activity, energy intake, substudy	Also included estimates for height, hip circumference, waist-to-hip ratio, and weight/BMI at ages 18 yr, 35 yr, and 50 yr

Table 2.2.20c (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Bertrand et al. (2013) Nurses' Health Study and Health Professionals Follow-up Study USA 1976–2008	163 184 Men and women Incidence	DLBCL	Adult BMI per 5 kg/m^2 [P_{trend}]	[261]	 1.10 (0.91–1.33) [0.31]	Age, height, smoking, physical activity, race	
			Young adult BMI per 5 kg/m^2 [P_{trend}]	[241]	 1.29 (1.05–1.57) [0.02]		
	46 390 Men Incidence	DLBCL	Adult BMI 15–22.9 23–24.9 25–26.9 27–29.9 30–45 per 5 kg/m^2 [P_{trend}]	 11 25 23 17 10	 1.00 1.57 (0.75–3.28) 1.58 (0.75–3.34) 1.65 (0.75–3.64) 2.18 (0.88–5.40) 1.30 (0.92–1.82) [0.14]	Age, height, smoking, physical activity, race	
			Young adult BMI 15–18.4 18.5–22.9 23–24.9 25–29.9 30–45 per 5 kg/m^2 [P_{trend}]	 4 40 19 17 4	 1.36 (0.46–4.02) 1.00 0.94 (0.54–1.64) 1.16 (0.65–2.08) 2.70 (0.93–7.86) 1.29 (0.89–1.88) [0.18]		
	116 794 Women Incidence	DLBCL	Adult BMI 15–22.9 23–24.9 25–26.9 27–29.9 30–45 per 5 kg/m^2 [P_{trend}]	 60 38 31 23 33	 1.00 0.97 (0.64–1.46) 1.06 (0.69–1.65) 0.85 (0.52–1.38) 1.36 (0.88–2.10) 1.04 (0.88–1.23) [0.65]	Age, height, smoking, physical activity, race	

Table 2.2.20c (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Bertrand et al. (2013) (cont.)			Young adult BMI				
			15–18.4	14	0.71 (0.40–1.24)		
			18.5–22.9	104	1.00		
			23–24.9	18	0.99 (0.60–1.64)		
			25–29.9	17	1.26 (0.75–2.11)		
			30–45	4	1.39 (0.51–3.81)		
			per 5 kg/m^2		1.28 (1.01–1.63)		
			[P_{trend}]		[0.04]		
Patel et al. (2013) Cancer Prevention Study II Nutrition Cohort USA 1992–2007	152 423 Men and women Incidence	DLBCL	BMI at baseline			Age, sex, family history of haematopoietic cancer, education level, smoking status, physical activity, alcohol consumption	
			< 18.5	1	0.28 (0.04–1.97)		
			18.5– < 25	159	1.00		
			25– < 30	199	1.30 (1.05–1.61)		
			≥ 30	85	1.62 (1.23–2.12)		
			[P_{trend}]		[0.0001]		
			BMI at age 18 yr				
			< 18.5	52	0.86 (0.64–1.17)		
			18.5– < 22.5	245	1.00		
			22.5– < 25	88	1.07 (0.83–1.38)		
			25– < 30	44	1.01 (0.72–1.42)		
			≥ 30	7	1.30 (0.60–2.80)		
			[P_{trend}]		[0.32]		
			Adult weight change (lb)				
			Loss > 5	11	0.60 (0.32–1.10)		
			Loss 5 to gain 20	147	1.00		
			Gain 21–40	142	0.97 (0.77–1.22)		
			Gain 41–60	83	0.97 (0.74–1.28)		
			Gain > 60	52	1.11 (0.80–1.54)		
			[P_{trend}]		[0.25]		

Table 2.2.20c (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Castillo et al. (2014) Meta-analysis of 10 cohorts, 6 case–control	NR Men and women Incidence	DLBCL	BMI Overweight Obese		 1.14 (1.04–1.24) 1.29 (1.16–1.43)		
	NR Men Incidence	DLBCL	BMI Overweight Obese		 1.27 (1.09–1.47) 1.40 (1.00–1.95)		
	NR Women Incidence	DLBCL	BMI Overweight Obese		 1.22 (1.07–1.38) 1.34 (1.16–1.54)		
Multiple myeloma							
Calle et al. (2003) Cancer Prevention Study II USA 1982–1998	495 477 Women Mortality	Multiple myeloma	BMI 18.5–24.9 25–29.9 30–34.9 ≥ 35 [P_{trend}]	 341 187 72 20	 1.00 1.12 (0.93–1.34) 1.47 (1.13–1.91) 1.44 (0.91–2.28) [0.004]	Age, race, education level, smoking, physical activity, alcohol consumption, marital status, aspirin use, fat and vegetable consumption	
	404 576 Men Mortality		BMI 18.5–24.9 25–29.9 30–34.9 ≥ 35 [P_{trend}]	 259 368 70 11	 1.00 1.18 (1.01–1.39) 1.44 (1.10–1.89) 1.71 (0.93–3.14) [0.002]		
Samanic et al. (2004) United States Veterans cohort USA 1969–1996	4 500 700 Men Incidence	Multiple myeloma ICD-9: 203	Obesity Non-obese Obese Non-obese Obese	White men: 2817 204 Black men: 1509 89	 1.00 1.22 (1.05–1.40) 1.00 1.26 (1.02–1.56)	Age, calendar year	Obesity defined as discharge diagnosis of obesity: ICD-8: 277; ICD-9: 278.0
Blair et al. (2005) Iowa Women's Health Study USA 1986–2001	37 083 Women Incidence	Multiple myeloma	BMI 18.5–24.9 25–29.9 ≥ 30 [P_{trend}]	 30 37 28	 1.0 1.3 (0.78–2.0) 1.5 (0.92–2.6) [0.10]	Age	Also included analyses of height, waist-to-hip ratio, and hip circumference

Table 2.2.20c (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Blair et al. (2005) (cont.)			Weight (lb) < 138 138–160 ≥ 161 [P_{trend}] WC (in) < 31.75 31.76–36.25 ≥ 36.26 [P_{trend}]	 19 40 36 19 37 39 	 1.0 2.0 (1.1–3.4) 1.9 (1.1–3.4) [0.04] 1.0 1.9 (1.1–3.2) 2.0 (1.1–3.5) [0.02]		
Oh et al. (2005) Korea National Health Insurance Corporation Republic of Korea 1992–2001	781 283 Men Incidence	Multiple myeloma	BMI < 18.5 18.5–22.9 23–24.9 25–26.9 27–29.9 ≥ 30 [P_{trend}]	 2 36 45 14 6 0 	 1.19 (0.29–4.96) 1.00 1.72 (1.11–2.68) 0.96 (0.51–1.77) 0.98 (0.30–3.32) – [0.61]	Age, smoking, alcohol intake, physical activity, family history of cancer, urban/ rural residence	
Samanic et al. (2006) Swedish Construction Worker Cohort Sweden 1958–1999	362 552 Men Incidence	Multiple myeloma ICD-7: 203	BMI 18.5–24.9 25–29.9 ≥ 30 [P_{trend}]	 231 201 20 	 1.00 0.96 (0.79–1.16) 0.58 (0.37–0.93) [0.06]	Attained age, calendar year, smoking	
Birmann et al. (2007) Nurses' Health Study and Health Professionals Follow-up Study combined USA 1980–2002	136 623 Men and women Incidence	Multiple myeloma	BMI < 22 22–24.9 25–29.9 ≥ 30 [P_{trend}]	 28 64 84 39 	 1.0 1.2 (0.8–1.9) 1.3 (0.9–2.0) 1.5 (0.9–2.5) [0.11]	Age, sex, physical activity, cohort	

Table 2.2.20c (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Birmann et al. (2007) (cont.) Nurses' Health Study	89 663 Women Incidence		BMI < 22 22–24.9 25–29.9 ≥ 30 [P_{trend}]	 21 32 53 23	 1.0 1.1 (0.7–2.0) 1.6 (1.0–2.7) 1.2 (0.7–2.2) [0.43]	Age, physical activity	
Health Professionals Follow-up Study	46 960 Men Incidence		BMI < 22 22–24.9 25–29.9 ≥ 30 [P_{trend}]	 7 32 31 16	 1.0 1.3 (0.5–2.9) 1.0 (0.4–2.2) 2.4 (1.0–6.0) [0.07]	Age, physical activity	
Engeland et al. (2007) Norwegian cohort Norway 1963–2001	963 709 Men Incidence	Plasma cell myeloma	BMI < 18.5 18.5–24.9 25–29.9 ≥ 30 [P_{trend}]	 11 1596 1417 209	 0.69 (0.38–1.25) 1.00 1.14 (1.06–1.22) 1.28 (1.10–1.47) [< 0.001]	Age, birth cohort	
	1 038 010 Women Incidence		BMI < 18.5 18.5–24.9 25–29.9 30–34.9 35–39.9 ≥ 40 [P_{trend}]	 24 1161 1125 436 110 26	 0.85 (057–1.27) 1.00 1.12 (1.03–1.22) 1.23 (1.10–1.38) 1.42 (1.17–1.74) 1.57 (1.06–2.31) [< 0.001]		
Fernberg et al. (2007) Swedish construction workers Sweden 1971–2004	336 381 Men Incidence	Multiple myeloma	BMI 18.5–25 25.1–30 > 30	 256 236 27	 1.00 1.04 (0.86–1.24) 0.70 (0.46–1.06)	Attained age, snuff use, daily tobacco smoking	

Table 2.2.20c (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Fujino et al. (2007) Japan Collaborative Cohort Study Japan NR	NR Men Mortality	Multiple myeloma	BMI			Age, area of study	[No information provided on follow-up or number of people in study]
			< 18.5	3	0.96 (0.29–3.16)		
			18.5–24	36	1.00		
			25–29	5	0.70 (0.27–1.80)		
			≥ 30	0	N.A		
			Weight (kg)				
			< 55	12	1.00		
			55–62	20	1.51 (0.73–3.11)		
			≥ 63	15	1.41 (0.64–3.12)		
			Weight (kg) at age 20 yr				
			< 55	25	1.00		
			55–60	12	0.91 (0.38–2.14)		
			≥ 61	10	0.98 (0.40–2.42)		
	NR Women Mortality	Multiple myeloma	BMI			Age, area of study	[No information provided on follow-up or number of people in study]
			< 18.5	2	0.59 (0.14–2.48)		
			18.5–24	31	1.00		
			25–29	7	0.77 (0.34–1.77)		
			≥ 30	4	4.34 (1.51–12.5)		
			Weight (kg)				
			< 49	18	1.00		
			49–54	12	0.93 (0.44–1.96)		
			≥ 55	17	1.17 (0.59–2.33)		
			Weight (kg) at age 20 yr				
			< 47	24	1.00		
			47–52	9	0.76 (0.32–1.81)		
			≥ 53	11	0.87 (0.38–1.97)		
Larsson & Wolk (2007b) Meta-analysis Multiple locations 1994–2007	9 cohort studies Men and women Incidence	Multiple myeloma	BMI per 5 kg/m^2	6987 total	1.11 (1.03–1.19)		

Table 2.2.20c (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Larsson & Wolk (2007b) (cont.)	9 cohort studies Men and women Mortality		BMI per 5 kg/m²	1492 total	 1.19 (1.12–1.28)		
	9 cohort studies Men and women Incidence and mortality		BMI Normal Overweight Obese per 5 kg/m²	8479 total	 1.00 1.12 (1.07–1.18) 1.27 (1.15–1.41) 1.14 (1.09–1.20)		Similar values for BMI per 5 kg/m² for men and women separately
Reeves et al. (2007) Million Women Study United Kingdom 1996–2005	1 222 630 Women Incidence	Multiple myeloma ICD-10: C90	BMI < 22.5 22.5–24.9 25–27.4 27.5–29.9 ≥ 30 per 10 kg/m²	 76 127 118 73 97	 0.80 (0.64–1.00) 1.00 (0.84–1.19) 1.11 (0.92–1.32) 1.11 (0.88–1.40) 1.16 (0.95–1.42) 1.31 (1.04–1.65)	Age, geographical region, SES, reproductive history, smoking status, alcohol intake, physical activity	
	1 222 630 Women Mortality		BMI < 22.5 22.5–24.9 25–27.4 27.5–29.9 ≥ 30 per 10 kg/m²	 46 63 68 38 69	 0.99 (0.74–1.32) 1.00 (0.78–1.28) 1.26 (0.99–1.59) 1.13 (0.82–1.55) 1.63 (1.28–2.08) 1.56 (1.15–2.10)		
Britton et al. (2008) EPIC cohort 10 European countries 1993–1998	141 425 Men Incidence	Multiple myeloma	BMI < 25 25–29.9 ≥ 30 [P_{trend}]	 43 72 24	 1.00 1.33 (0.79–2.23) 1.17 (0.80–1.72) [0.26]	Age, study centre	Also examined height, hip circumference, and waist-to-hip ratio; analyses by weight and WC gave similar results
	230 558 Women Incidence	Multiple myeloma	BMI < 25 25–29.9 ≥ 30 [P_{trend}]	 59 49 21	 1.00 0.93 (0.55–1.56) 1.06 (0.72–1.58) [0.89]	Age, study centre	Also examined height, hip circumference, and waist-to-hip ratio; analyses by weight and WC gave similar results

Table 2.2.20c (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Renehan et al. (2008) Meta-analysis Multiple locations 1966–2007	7 studies Men Incidence	Multiple myeloma	BMI per 5 kg/m²		1.11 (1.05–1.18)		
	6 studies Women Incidence		BMI per 5 kg/m²		1.11 (1.07–1.15)		
Pylypchuk et al. (2009) Netherlands Cohort Study on Diet and Cancer The Netherlands 1986–1999	5000 Men and women Incidence	Multiple myeloma ICD-O-3: 9731, 9732, 9734	BMI < 25 25–29.9 ≥ 30 [P_{trend}] per 4 kg/m²	 135 126 18 	 1.00 1.23 (0.95–1.58) 1.13 (0.68–1.88) [0.17] 1.13 (0.97–1.31)	Age, sex	Case–cohort design Similar results for BMI at age 20 yr
De Roos et al. (2010) Women's Health Initiative USA 1994–2008	81 219 Women Incidence	Multiple myeloma	BMI at enrolment < 25 25–29.9 30–34.9 ≥ 35 [P_{trend}]	 39 35 10 7 	 1.00 1.03 (0.65–1.63) 0.66 (0.33–1.33) 0.83 (0.37–1.87) [0.37]	Age, minority race, education level, region of the USA, smoking	Similar results for BMI at age 18 yr, age 35 yr, and age 50 yr
Kanda et al. (2010) Japanese men and women Japan 1992–2006	94 547 Men and women Incidence	Plasma cell myeloma ICD-O-3: 9731, 9732	BMI < 18.5 18.5–22.9 23.0–24.9 25–29.9 ≥ 30 per 1 kg/m² Weight (kg), quartiles (sex-specific) Men: / Women: 30–57 / 27–49 58–63 / 50–53 64–69 / 54–59 70–115 / 60–98 per 5 kg	 2 33 29 22 2 22 21 25 20 	 0.56 (0.13–2.36) 0.70 (0.42–1.15) 1.00 0.79 (0.45–1.38) 0.76 (0.18–3.20) 1.01 (0.95–1.09) 1.00 1.05 (0.57–1.93) 1.35 (0.74–2.46) 1.14 (0.59–2.21) 1.06 (0.93–1.22)	Age, sex, study area, pack-years of smoking, alcohol consumption	Also included estimates for height Similar results for weight at baseline and at age 20 yr

Table 2.2.20c (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Lu et al. (2010) California Teachers Study USA 1995–2007	121 216 Women Incidence	Multiple myeloma	BMI at baseline < 20 20–24.9 25–29.9 ≥ 30 [P_{trend}] Weight (lb) at baseline < 131 131–154 ≥ 155 [P_{trend}]	 9 55 28 14 38 36 32 	 0.92 (0.45–1.86) 1.00 0.83 (0.53–1.31) 0.86 (0.48–1.55) [0.55] 1.00 0.85 (0.54–1.36) 0.71 (0.43–1.16) [0.18]	Height, race	Also included estimates for hip circumference, waist-to-hip ratio, waist-to-height ratio, and height Similar results for BMI at age 18 yr, for weight at age 18 yr, and for WC
Parr et al. (2010) Asia-Pacific Cohort Studies Collaboration 1961–1999 Average follow-up 4 yr	326 387 Men and women Mortality	Myeloma ICD-9: 203 ICD-10: C90	BMI < 18.5 18.5–24.9 25–29.9 ≥ 30 per 5 kg/m² [P_{trend}]	 3 12 19 25 10 	 1.94 (0.57–6.68) 1.00 (0.70–1.43) 0.87 (0.54–1.41) 1.20 (0.59–2.43) 1.05 (0.73–1.50) [0.78]	Age, sex, smoking	
Troy et al. (2010) PLCO Trial USA 1993–2006	142 982 Men and women Incidence	Plasma cell myeloma	BMI at baseline < 18.5 18.5–24.9 25–29.9 ≥ 30 [P_{trend}] BMI at age 20 yr < 18.5 18.5–24.9 25–29.9 ≥ 30 [P_{trend}]	 2 57 112 66 12 173 41 12 	 – 1.00 1.45 (1.05–2.01) 1.69 (1.18–2.41) [< 0.01] 0.71 (0.40–1.29) 1.00 1.33 (0.94–1.88) 3.08 (1.71–5.54) [< 0.001]	Age, race/ ethnicity, education level	

Table 2.2.20c (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Troy et al. (2010) (cont.)			Weight change (kg) per 10 yr				
			Loss	16	1.00 (0.56–1.78)		
			Gain 0–2	52	1.00		
			Gain 2.1–4	78	1.40 (0.98–2.00)		
			Gain 4.1–6	51	1.48 (1.00–2.20)		
			Gain > 6	42	1.55 (1.02–2.36)		
			[P_{trend}]		[0.216]		
Wallin & Larsson (2011) Meta-analysis Multiple locations	15 studies Men and women Incidence	Multiple myeloma ICD-O-3: 9732/3	BMI	NR			
			Overweight		1.12 (1.07–1.18)		
			Obesity		1.21 (1.08–1.35)		
			per 5 kg/m^2		1.12 (1.08–1.16)		
	5 studies Men and women Mortality	Multiple myeloma ICD-O-3: 9732/3	BMI	NR			
			Overweight		1.15 (1.05–1.27)		
			Obesity		1.54 (1.35–1.76)		
			per 5 kg/m^2		1.21 (1.13–1.30)		
Hofmann et al. (2013) NIH-AARP cohort USA 1995–1996	305 618 Men and women Incidence	Multiple myeloma ICD-O-3: 9732	BMI at baseline			Age, sex, race	Analyses also for women and men separately
			< 18.5	1	0.30 (0.04–2.17)		
			18.5–22.49	53	1.0		
			22.5–24.9	99	1.02 (0.73–1.43)		
			25–29.9	207	1.09 (0.80–1.48)		
			30–34.9	82	1.26 (0.89–1.78)		
			≥ 35	34	1.55 (1.01–2.39)		
			[P_{trend}]		[0.008]		
			BMI at age 50 yr				
			< 18.5	3	0.78 (0.25–2.49)		
			18.5–22.49	73	1.00		
			22.5–24.9	129	1.14 (0.85–1.52)		
			25–29.9	193	1.16 (0.88–1.54)		
			30–34.9	45	1.23 (0.84–1.80)		
			≥ 35	18	1.77 (1.05–2.99)		
			[P_{trend}]		[0.04]		

Table 2.2.20c (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Hofmann et al. (2013) (cont.)			BMI at age 35 yr				
			< 18.5	7	0.77 (0.36–1.66)		
			18.5–22.49	136	1.00		
			22.5–24.9	159	1.42 (1.12–1.79)		
			25–29.9	131	1.27 (0.99–1.63)		
			30–34.9	22	1.41 (0.89–2.22)		
			≥ 35	8	2.53 (1.24–5.18)		
			[P_{trend}]		[0.004]		
			BMI at age 18 yr				
			< 18.5	55	0.93 (0.69–1.25)		
			18.5–22.49	237	1.00		
			22.5–24.9	86	1.12 (0.88–1.44)		
			≥ 25	64	1.38 (1.04–1.82)		
			[P_{trend}]		[0.015]		
Patel et al. (2013) Cancer Prevention Study II Nutrition Cohort USA 1992–2007	152 423 Men and women Incidence	Multiple myeloma	BMI at baseline			Age, sex, family history of haematopoietic cancer, education level, smoking status, physical activity, alcohol consumption	
			< 18.5	1	0.32 (0.04–2.30)		
			18.5– < 25	144	1.00		
			25– < 30	149	1.00 (0.79–1.26)		
			≥ 30	58	1.17 (0.86–1.60)		
			[P_{trend}]		[0.25]		
			BMI at age 18 yr				
			< 18.5	44	0.89 (0.64–1.24)		
			18.5–< 22.5	197	1.00		
			22.5–< 25	66	1.01 (0.75–1.34)		
			25– < 30	31	0.92 (0.61–1.37)		
			≥ 30	7	1.77 (0.82–3.84)		
			[P_{trend}]		[0.37]		

Table 2.2.20c (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Patel et al. (2013) (cont.)			Adult weight change (lb)				
			Loss > 5	10	0.77 (0.40–1.47)		
			Loss 5 to gain 20	105	1.00		
			Gain 21–40	133	1.25 (0.96–1.61)		
			Gain 41–60	68	1.08 (0.79–1.47)		
			Gain > 60	28	0.81 (0.53–1.24)		
			[P_{trend}]		[0.85]		
Bhaskaran et al. (2014) Clinical Practice Research Datalink United Kingdom 1987–2012	5 243 978 Men and women Incidence	Multiple myeloma ICD-10: C90	BMI per 5 kg/m^2 [P_{trend}]	2969	 1.03 (0.98–1.09) [0.15]	Age, sex, diabetes, smoking, alcohol consumption, SES, calendar year	
Teras et al. (2014) Pooled analysis of 20 cohorts Multiple locations 1970–2002	1 564 218 Men and women Mortality	Multiple myeloma ICD-9: 203; ICD-10: C90	BMI at baseline			Race, sex, education level, marital status, alcohol consumption, physical activity, smoking	
			15.0–18.4	15	1.21 (0.71–2.06)		
			18.5–20.9	85	1.02 (0.79–1.32)		
			21.0–22.9	171	1.00		
			23.0–24.9	302	1.22 (1.01–1.47)		
			25.0–27.4	351	1.15 (0.95–1.38)		
			27.5–29.9	215	1.24 (1.01–1.52)		
			30.0–34.9	178	1.23 (0.99–1.52)		
			≥ 35	71	1.52 (1.15–2.02)		
			per 5 kg/m^2		1.09 (1.03–1.16)		
			Young adult BMI				
			15.0–18.4	121	0.99 (0.80–1.23)		
			18.5–20.9	319	0.91 (0.78–1.07)		
			21.0–22.9	275	1.00		
			23.0–24.9	160	1.04 (0.85–1.26)		
			25.0–27.4	92	1.11 (0.87–1.40)		
			27.5–29.9	31	1.49 (1.03–2.16)		
			≥ 30.0	26	1.82 (1.22–2.73)		
			per 5 kg/m^2		1.22 (1.09–1.35)		

Table 2.2.20c (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site (ICD code)	Exposure categories		Exposed cases	Relative risk (95% CI)	Covariates	Comments
Teras et al. (2014) (cont.)			BMI gain					
			≤ –2.5		34	1.12 (0.77–1.64)		
			–2.5 to < 0		67	0.84 (0.64–1.10)		
			0–2.5		221	1.00		
			2.5–4.9		266	1.04 (0.87–1.24)		
			5.0–7.4		220	1.17 (0.96–1.41)		
			7.5–9.9		113	1.10 (0.87–1.38)		
			≥ 10		103	1.17 (0.92–1.50)		
			per 1 kg/m²			1.06 (0.98–1.14)		
	647 478 Men and women Mortality		WC (cm), quartiles (sex-specific)				Race, sex, education level, marital status, alcohol consumption, physical activity, smoking	Also provided estimates for waist-to-hip ratio and height
			Men:	Women:				
			< 90	< 70	112	1.00		
			90–99	70–79	216	1.28 (1.01–1.62)		
			100–109	80–89	153	1.32 (1.02–1.71)		
			≥ 110	≥ 90	108	1.47 (1.10–1.96)		
			per 5 cm			1.06 (1.02–1.10)		
	656 771 Men Mortality		BMI at baseline				Race, education level, marital status, alcohol consumption, physical activity, smoking	Also provided estimates for waist-to-hip ratio and height
			15.0–18.4		1	–		
			18.5–20.9		17	0.97 (0.57–1.67)		
			21.0–22.9		63	1.00		
			23.0–24.9		176	1.37 (1.03–1.83)		
			25.0–27.4		219	1.20 (0.90–1.59)		
			27.5–29.0		130	1.29 (0.95–1.75)		
			30.0–34.9		93	1.28 (0.93–1.78)		
			≥ 35		24	1.48 (0.91–2.38)		
			per 5 kg/m²			1.11 (1.00–1.22)		
			Young adult BMI					
			15.0–18.4		40	0.85 (0.60–1.21)		
			18.5–20.9		136	0.91 (0.73–1.15)		
			21.0–22.9		155	1.00		
			23.0–24.9		92	0.88 (0.68–1.14)		
			25.0–27.4		62	1.00 (0.74–1.34)		
			27.5–29.0		21	1.47 (0.93–2.32)		
			≥ 30.0		10	1.36 (0.72–2.59)		
			per 5 kg/m²			1.15 (0.98–1.35)		

Table 2.2.20c (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Teras et al. (2014) (cont.)			BMI gain				
			≤ –2.5	11	1.04 (0.55–1.97)		
			–2.5 to < 0	33	0.96 (0.65–1.42)		
			0–2.5	117	1.00		
			2.5–4.9	147	1.04 (0.81–1.33)		
			5 0–7.4	108	1.05 (0.80–1.38)		
			7.5–9.9	60	1.18 (0.85–1.64)		
			≥ 10	40	1.20 (0.82–1.76)		
			per 1 kg/m²		1.07 (0.94–1.21)		
			WC (cm)				
			< 90	62	1.00		
			90–99	144	1.25 (0.93–1.69)		
			100–109	83	1.26 (0.90–1.77)		
			≥ 110	38	1.38 (0.91–2.08)		
			per 5 cm		1.06 (1.01–1.12)		
	907 447 Women Mortality		BMI at baseline			Race, education level, marital status, alcohol consumption, physical activity, smoking	Also provided estimates for waist-to-hip ratio and height
			15.0–18.4	14	1.39 (0.79–2.43)		
			18.5–20.9	68	1.01 (0.75–1.38)		
			21.0–22.9	108	1.00		
			23.0–24.9	126	1.08 (0.83–1.39)		
			25.0–27.4	132	1.11 (0.86–1.44)		
			27.5–29.0	85	1.20 (0.90–1.60)		
			30.0–34.9	85	1.18 (0.89–1.58)		
			≥ 35	47	1.51 (1.06–2.15)		
			per 5 kg/m²		1.07 (0.99–1.16)		
			Young adult BMI				
			15.0–18.4	81	1.11 (0.84–1.47)		
			18.5–20.9	183	0.94 (0.75–1.19)		
			21.0–22.9	120	1.00		
			23.0–24.9	68	1.31 (0.97–1.76)		
			25.0–27.4	30	1.28 (0.86–1.91)		
			27.5–29.0	10	1.42 (0.75–2.71)		
			≥ 30.0	16	2.32 (1.37–3.92)		
			per 5 kg/m²		1.27 (1.10–1.47)		

Table 2.2.20c (continued)

Reference Cohort Location Follow-up period	Total number of subjects Sex Incidence/ mortality	Organ site (ICD code)	Exposure categories	Exposed cases	Relative risk (95% CI)	Covariates	Comments
Teras et al. (2014) (cont.)			BMI gain				
			≤ –2.5	23	1.16 (0.72–1.89)		
			–2.5 to < 0	34	0.75 (0.51–1.10)		
			0–2.5	104	1.00		
			2.5–4.9	119	1.02 (0.78–1.33)		
			5.0–7.4	112	1.28 (0.98–1.68)		
			7.5–9.9	53	1.00 (0.71–1.40)		
			≥ 10	63	1.12 (0.81–1.56)		
			per 1 kg/m²		1.04 (0.95–1.15)		
			WC (cm)				
			< 70	50	1.00		
			70–79	72	1.32 (0.90–1.94)		
			80–89	70	1.42 (0.94–2.13)		
			≥ 90	70	1.54 (1.00–2.36)		
			per 5 cm		1.05 (1.00–1.11)		

BMI, body mass index (in kg/m²); CI, confidence interval; DLBCL, diffuse large B-cell lymphoma; EPIC, European Prospective Investigation into Cancer and Nutrition; ICD, International Classification of Diseases; ICD-O, International Classification of Diseases for Oncology; NIH-AARP, National Institutes of Health–AARP Diet and Health Study; NR, not reported; PLCO Trial, Prostate, Lung, Colorectal, and Ovarian Cancer Screening Trial; RR, relative risk; SES, socioeconomic status; WC, waist circumference; yr, year or years

Table 2.2.20d Case–control studies of measures of body fatness and haematopoietic malignancies of lymphoid origin with *sufficient* or *limited* evidence

Reference Study location Period	Total number of cases Total number of controls Source of controls	Exposure categories	Exposed cases	Relative risk (95% CI)	Adjustment for confounding
Diffuse large B-cell lymphoma					
Pan et al. (2005) Canada 1994–1997	419 from National Enhanced Cancer Surveillance System 3106 Population	Adult BMI 2 yr before interview/diagnosis 18.5– < 25 25– < 30 ≥ 30 [P_{trend}]	 162 184 69 	 1.00 1.37 (1.09–1.73) 1.35 (0.99–1.83) [0.015]	Age, province, sex, education level, pack-years of smoking, alcohol consumption, exposure to some chemicals, occupational exposures, physical activity, energy intake
Chen et al. (2011) USA 1996–2000	245 868 Population	Usual adult BMI assessed via interview < 25 25–30 > 30	 77 56 28	 1.0 1.5 (1.0–2.2) 1.1 (0.7–1.8)	Age, race, total energy intake
Cerhan et al. (2014) Pooled analysis from InterLymph Consortium of 19 case–control studies Europe, Japan, North America	4667 22 639	Young adult BMI 15– < 18.5 18.5– < 22.5 22.5– < 25 25– < 30 30–50 [P_{trend}] Usual adult BMI 15– < 18.5 18.5– < 22.5 22.5– < 25 25– < 30 30– < 35 35–50 [P_{trend}]	 64 517 276 226 54 33 722 850 1310 419 175 	 0.93 (0.69–1.24) 1.00 1.11 (0.93–1.31) 1.47 (1.22–1.77) 1.58 (1.12–2.23) [0.002] 0.58 (0.39–0.85) 1.00 0.91 (0.81–1.03) 0.93 (0.83–1.04) 0.95 (0.82–1.10) 1.06 (0.86–1.30) [0.042]	
Multiple myeloma					
Larsson & Wolk (2007b) Meta-analysis of 4 case–control studies Studies published in 1994–2007	1166 total 8247 total	BMI ≤ 25 25–29.9 ≥ 30	 	 1.00 1.43 (1.23–1.68) 1.82 (1.47–2.26)	Note: the reference category was ≤ 25 in all but 3 studies

Table 2.2.20d (continued)

Reference Study location Period	Total number of cases Total number of controls Source of controls	Exposure categories	Exposed cases	Relative risk (95% CI)	Adjustment for confounding
Wang et al. (2013) USA 1985–1992	278 from Los Angeles County Multiple Myeloma Case–Control Study 278 Population	Self-reported BMI 1 yr before cancer diagnosis or at time of interview			Sex, age ± 5 yr, race
			All:		
		< 25	116	1.00	
		25–29.9	98	0.75 (0.51–1.10)	
		30–34.9	43	0.98 (0.59–1.62)	
		≥ 35	21	1.86 (0.84–4.14)	
			Men:		
		< 25	58	1.00	
		25–29.9	65	0.85 (0.52–1.39)	
		30–34.9	19	0.96 (0.46–2.01)	
		≥ 35	8	1.80 (0.51–6.30)	
			Women:		
		< 25	58	1.00	
		25–29.9	33	0.62 (0.34–1.17)	
		30–34.9	24	0.92 (0.45–1.88)	
		≥ 35	11	1.56 (0.55–4.40)	

BMI, body mass index (in kg/m^2); CI, confidence interval; yr, year or years

References

Andreotti G, Hou L, Beane Freeman LE, Mahajan R, Koutros S, Coble J, et al. (2010). Body mass index, agricultural pesticide use, and cancer incidence in the Agricultural Health Study cohort. *Cancer Causes Control*, 21(11):1759–75. doi:10.1007/s10552-010-9603-9 PMID:20730623

Bertrand KA, Giovannucci E, Zhang SM, Laden F, Rosner B, Birmann BM (2013). A prospective analysis of body size during childhood, adolescence, and adulthood and risk of non-Hodgkin lymphoma. *Cancer Prev Res (Phila)*, 6(8):864–73. doi:10.1158/1940-6207.CAPR-13-0132 PMID:23803416

Bhaskaran K, Douglas I, Forbes H, dos-Santos-Silva I, Leon DA, Smeeth L (2014). Body-mass index and risk of 22 specific cancers: a population-based cohort study of 5.24 million UK adults. *Lancet*, 384(9945):755–65. doi:10.1016/S0140-6736(14)60892-8 PMID:25129328

Birmann BM, Giovannucci E, Rosner B, Anderson KC, Colditz GA (2007). Body mass index, physical activity, and risk of multiple myeloma. *Cancer Epidemiol Biomarkers Prev*, 16(7):1474–8. doi:10.1158/1055-9965.EPI-07-0143 PMID:17627013

Blair CK, Cerhan JR, Folsom AR, Ross JA (2005). Anthropometric characteristics and risk of multiple myeloma. *Epidemiology*, 16(5):691–4. doi:10.1097/01.ede.0000172135.61188.2d PMID:16135948

Bosetti C, Dal Maso L, Negri E, Talamini R, Montella M, Franceschi S, et al. (2005). Re: Body mass index and risk of malignant lymphoma in Scandinavian men and women. *J Natl Cancer Inst*, 97(11):860–1. doi:10.1093/jnci/dji150 PMID:15928310

Britton JA, Khan AE, Rohrmann S, Becker N, Linseisen J, Nieters A, et al. (2008). Anthropometric characteristics and non-Hodgkin's lymphoma and multiple myeloma risk in the European Prospective Investigation into Cancer and Nutrition (EPIC). *Haematologica*, 93(11):1666–77. doi:10.3324/haematol.13078 PMID:18835833

Calle EE, Rodriguez C, Walker-Thurmond K, Thun MJ (2003). Overweight, obesity, and mortality from cancer in a prospectively studied cohort of U.S. adults. *N Engl J Med*, 348(17):1625–38. doi:10.1056/NEJMoa021423 PMID:12711737

Castillo JJ, Ingham RR, Reagan JL, Furman M, Dalia S, Mitri J (2014). Obesity is associated with increased relative risk of diffuse large B-cell lymphoma: a meta-analysis of observational studies. *Clin Lymphoma Myeloma Leuk*, 14(2):122–30. doi:10.1016/j.clml.2013.10.005 PMID:24360912

Cerhan JR, Bernstein L, Severson RK, Davis S, Colt JS, Blair A, et al. (2005). Anthropometrics, physical activity, related medical conditions, and the risk of non-Hodgkin lymphoma. *Cancer Causes Control*, 16(10):1203–14. doi:10.1007/s10552-005-0358-7 PMID:16215871

Cerhan JR, Kricker A, Paltiel O, Flowers CR, Wang SS, Monnereau A, et al. (2014). Medical history, lifestyle, family history, and occupational risk factors for diffuse large B-cell lymphoma: the InterLymph Non-Hodgkin Lymphoma Subtypes Project. *J Natl Cancer Inst Monogr*, 2014(48):15–25. doi:10.1093/jncimonographs/lgu010 PMID:25174023

Chang ET, Hjalgrim H, Smedby KE, Akerman M, Tani E, Johnsen HE, et al. (2005). Body mass index and risk of malignant lymphoma in Scandinavian men and women. *J Natl Cancer Inst*, 97(3):210–8. doi:10.1093/jnci/dji012 PMID:15687364

Chen Y, Zheng T, Lan Q, Foss F, Kim C, Chen X, et al. (2011). Cytokine polymorphisms in Th1/Th2 pathway genes, body mass index, and risk of non-Hodgkin lymphoma. *Blood*, 117(2):585–90. doi:10.1182/blood-2010-07-295097 PMID:20952689

Chiu BC, Gapstur SM, Greenland P, Wang R, Dyer A (2006). Body mass index, abnormal glucose metabolism, and mortality from hematopoietic cancer. *Cancer Epidemiol Biomarkers Prev*, 15(12):2348–54. doi:10.1158/1055-9965.EPI-06-0007 PMID:17164355

Chu DM, Wahlqvist ML, Lee MS, Chang HY (2011). Central obesity predicts non-Hodgkin's lymphoma mortality and overall obesity predicts leukemia mortality in adult Taiwanese. *J Am Coll Nutr*, 30(5):310–9. doi:10.1080/07315724.2011.10719974 PMID:22081617

De Roos AJ, Ulrich CM, Ray RM, Mossavar-Rahmani Y, Rosenberg CA, Caan BJ, et al. (2010). Intentional weight loss and risk of lymphohematopoietic cancers. *Cancer Causes Control*, 21(2):223–36. doi:10.1007/s10552-009-9453-5 PMID:19851877

Engeland A, Tretli S, Hansen S, Bjørge T (2007). Height and body mass index and risk of lymphohematopoietic malignancies in two million Norwegian men and women. *Am J Epidemiol*, 165(1):44–52. doi:10.1093/aje/kwj353 PMID:17041129

Fernberg P, Odenbro A, Bellocco R, Boffetta P, Pawitan Y, Zendehdel K, et al. (2007). Tobacco use, body mass index, and the risk of leukemia and multiple myeloma: a nationwide cohort study in Sweden. *Cancer Res*, 67(12):5983–6. doi:10.1158/0008-5472.CAN-07-0274 PMID:17575169

Fujino Y; Japan Collaborative Cohort Study for Evaluation of Cancer (2007). Anthropometry, development history and mortality in the Japan Collaborative Cohort Study for Evaluation of Cancer (JACC). *Asian Pac J Cancer Prev*, 8(Suppl):105–12. PMID:18260709

Hemminki K, Li X, Sundquist J, Sundquist K (2011). Obesity and familial obesity and risk of cancer. *Eur J Cancer Prev*, 20(5):438–43. doi:10.1097/CEJ.0b013e32834761c0 PMID:21606843

Hofmann JN, Moore SC, Lim U, Park Y, Baris D, Hollenbeck AR, et al. (2013). Body mass index and physical activity at different ages and risk of multiple myeloma in the NIH-AARP diet and health study. *Am J Epidemiol*, 177(8):776–86. doi:10.1093/aje/kws295 PMID:23543160

IARC (2002). Weight control and physical activity. Lyon, France: IARC Press (IARC Handbooks of Cancer Prevention, Vol. 6). Available from: http://publications.iarc.fr/376.

Jaffe ES, Harris NL, Stein H, Vardiman JW, editors (2001). Pathology and genetics of tumours of haematopoietic and lymphoid tissues. 3rd ed. Lyon, France: International Agency for Research on Cancer.

Kabat GC, Kim MY, Jean-Wactawski-Wende, Bea JW, Edlefsen KL, Adams-Campbell LL, et al. (2012). Anthropometric factors, physical activity, and risk of non-Hodgkin's lymphoma in the Women's Health Initiative. *Cancer Epidemiol*, 36(1):52–9. doi:10.1016/j.canep.2011.05.014 PMID:21816698

Kanda J, Matsuo K, Inoue M, Iwasaki M, Sawada N, Shimazu T, et al.; Japan Public Health Center-based Prospective Study Group (2010). Association of anthropometric characteristics with the risk of malignant lymphoma and plasma cell myeloma in a Japanese population: a population-based cohort study. *Cancer Epidemiol Biomarkers Prev*, 19(6):1623–31. doi:10.1158/1055-9965.EPI-10-0171 PMID:20501768

Kelly JL, Fredericksen ZS, Liebow M, Shanafelt TD, Thompson CA, Call TG, et al. (2012). The association between early life and adult body mass index and physical activity with risk of non-Hodgkin lymphoma: impact of gender. *Ann Epidemiol*, 22(12):855–62. doi:10.1016/j.annepidem.2012.10.002 PMID:23146413

Larsson SC, Wolk A (2007a). Obesity and risk of non-Hodgkin's lymphoma: a meta-analysis. *Int J Cancer*, 121(7):1564–70. doi:10.1002/ijc.22762 PMID:17443495

Larsson SC, Wolk A (2007b). Body mass index and risk of multiple myeloma: a meta-analysis. *Int J Cancer*, 121(11):2512–6. doi:10.1002/ijc.22968 PMID:17680557

Larsson SC, Wolk A (2008). Overweight and obesity and incidence of leukemia: a meta-analysis of cohort studies. *Int J Cancer*, 122(6):1418–21. doi:10.1002/ijc.23176 PMID:18027857

Larsson SC, Wolk A (2011). Body mass index and risk of non-Hodgkin's and Hodgkin's lymphoma: a meta-analysis of prospective studies. *Eur J Cancer*, 47(16):2422–30. doi:10.1016/j.ejca.2011.06.029 PMID:21733676

Li Q, Chang ET, Bassig BA, Dai M, Qin Q, Gao Y, et al. (2013). Body size and risk of Hodgkin's lymphoma by age and gender: a population-based case-control study in Connecticut and Massachusetts. *Cancer Causes Control*, 24(2):287–95. doi:10.1007/s10552-012-0100-1 PMID:23208661

Lim U, Morton LM, Subar AF, Baris D, Stolzenberg-Solomon R, Leitzmann M, et al. (2007). Alcohol, smoking, and body size in relation to incident Hodgkin's and non-Hodgkin's lymphoma risk. *Am J Epidemiol*, 166(6):697–708. doi:10.1093/aje/kwm122 PMID:17596266

Linet MS, Vajdic CM, Morton LM, de Roos AJ, Skibola CF, Boffetta P, et al. (2014). Medical history, lifestyle, family history, and occupational risk factors for follicular lymphoma: the InterLymph Non-Hodgkin Lymphoma Subtypes Project. *J Natl Cancer Inst Monogr*, 2014(48):26–40. doi:10.1093/jncimonographs/lgu006 PMID:25174024

Lu Y, Prescott J, Sullivan-Halley J, Henderson KD, Ma H, Chang ET, et al. (2009). Body size, recreational physical activity, and B-cell non-Hodgkin lymphoma risk among women in the California Teachers Study. *Am J Epidemiol*, 170(10):1231–40. doi:10.1093/aje/kwp268 PMID:19822569

Lu Y, Sullivan-Halley J, Henderson KD, Ma H, Horn-Ross PL, Reynolds P, et al. (2010). Anthropometric characteristics and multiple myeloma risk. *Epidemiology*, 21(2):272–3. doi:10.1097/EDE.0b013e3181cc9241 PMID:20160567

Lukanova A, Björ O, Kaaks R, Lenner P, Lindahl B, Hallmans G, et al. (2006). Body mass index and cancer: results from the Northern Sweden Health and Disease Cohort. *Int J Cancer*, 118(2):458–66. doi:10.1002/ijc.21354 PMID:16049963

Maskarinec G, Erber E, Gill J, Cozen W, Kolonel LN (2008). Overweight and obesity at different times in life as risk factors for non-Hodgkin's lymphoma: the Multiethnic Cohort. *Cancer Epidemiol Biomarkers Prev*, 17(1):196–203. doi:10.1158/1055-9965.EPI-07-0716 PMID:18187389

Morton LM, Wang SS, Cozen W, Linet MS, Chatterjee N, Davis S, et al. (2008). Etiologic heterogeneity among non-Hodgkin lymphoma subtypes. *Blood*, 112(13):5150–60. doi:10.1182/blood-2008-01-133587 PMID:18796628

Oh SW, Yoon YS, Shin SA (2005). Effects of excess weight on cancer incidences depending on cancer sites and histologic findings among men: Korea National Health Insurance Corporation Study. *J Clin Oncol*, 23(21):4742–54. doi:10.1200/JCO.2005.11.726 PMID:16034050

Pan SY, Johnson KC, Ugnat AM, Wen SW, Mao Y; Canadian Cancer Registries Epidemiology Research Group (2004). Association of obesity and cancer risk in Canada. *Am J Epidemiol*, 159(3):259–68. doi:10.1093/aje/kwh041 PMID:14742286

Pan SY, Mao Y, Ugnat AM; Canadian Cancer Registries Epidemiology Research Group (2005). Physical activity, obesity, energy intake, and the risk of non-Hodgkin's lymphoma: a population-based case-control study.

Am J Epidemiol, 162(12):1162–73. doi:10.1093/aje/kwi342 PMID:16269580

Parr CL, Batty GD, Lam TH, Barzi F, Fang X, Ho SC et al.; Asia-Pacific Cohort Studies Collaboration (2010). Body-mass index and cancer mortality in the Asia-Pacific Cohort Studies Collaboration: pooled analyses of 424,519 participants. *Lancet Oncol*, 11(8):741–52. doi:10.1016/S1470-2045(10)70141-8 PMID:20594911

Patel AV, Diver WR, Teras LR, Birmann BM, Gapstur SM (2013). Body mass index, height and risk of lymphoid neoplasms in a large United States cohort. *Leuk Lymphoma*, 54(6):1221–7. doi:10.3109/10428194.2012.742523 PMID:23098244

Pylypchuk RD, Schouten LJ, Goldbohm RA, Schouten HC, van den Brandt PA (2009). Body mass index, height, and risk of lymphatic malignancies: a prospective cohort study. *Am J Epidemiol*, 170(3):297–307. doi:10.1093/aje/kwp123 PMID:19478235

Rapp K, Schroeder J, Klenk J, Stoehr S, Ulmer H, Concin H, et al. (2005). Obesity and incidence of cancer: a large cohort study of over 145,000 adults in Austria. *Br J Cancer*, 93(9):1062–7. doi:10.1038/sj.bjc.6602819 PMID:16234822

Reeves GK, Pirie K, Beral V, Green J, Spencer E, Bull D; Million Women Study Collaboration (2007). Cancer incidence and mortality in relation to body mass index in the Million Women Study: cohort study. *BMJ*, 335(7630):1134. doi:10.1136/bmj.39367.495995.AE PMID:17986716

Renehan AG, Tyson M, Egger M, Heller RF, Zwahlen M (2008). Body-mass index and incidence of cancer: a systematic review and meta-analysis of prospective observational studies. *Lancet*, 371(9612):569–78. doi:10.1016/S0140-6736(08)60269-X PMID:18280327

Ross JA, Parker E, Blair CK, Cerhan JR, Folsom AR (2004). Body mass index and risk of leukemia in older women. *Cancer Epidemiol Biomarkers Prev*, 13(11 Pt 1):1810–3. PMID:15533912

Saberi Hosnijeh F, Romieu I, Gallo V, Riboli E, Tjønneland A, Halkjær J, et al. (2013). Anthropometric characteristics and risk of lymphoid and myeloid leukemia in the European Prospective Investigation into Cancer and Nutrition (EPIC). *Cancer Causes Control*, 24(3):427–38. doi:10.1007/s10552-012-0128-2 PMID:23288400

Samanic C, Chow WH, Gridley G, Jarvholm B, Fraumeni JF Jr (2006). Relation of body mass index to cancer risk in 362,552 Swedish men. *Cancer Causes Control*, 17(7):901–9. doi:10.1007/s10552-006-0023-9 PMID:16841257

Samanic C, Gridley G, Chow WH, Lubin J, Hoover RN, Fraumeni JF Jr (2004). Obesity and cancer risk among white and black United States veterans. *Cancer Causes Control*, 15(1):35–43. doi:10.1023/B:CACO.0000016573.79453.ba PMID:14970733

Skibola CF, Holly EA, Forrest MS, Hubbard A, Bracci PM, Skibola DR, et al. (2004). Body mass index, leptin and leptin receptor polymorphisms, and non-Hodgkin lymphoma. *Cancer Epidemiol Biomarkers Prev*, 13(5):779–86. PMID:15159310

Song Y-M, Sung J, Ha M (2008). Obesity and risk of cancer in postmenopausal Korean women. *J Clin Oncol*, 26(20):3395–402. doi:10.1200/JCO.2007.15.7867 PMID:18612154

Swerdlow SH, Campo E, Harris NL, Jaffe ES, Pileri SA, Stein H, et al., editors (2008). WHO classification of tumours of haematopoietic and lymphoid tissues. 4th ed. Lyon, France: International Agency for Research on Cancer.

Teras LR, Kitahara CM, Birmann BM, Hartge PA, Wang SS, Robien K, et al. (2014). Body size and multiple myeloma mortality: a pooled analysis of 20 prospective studies. *Br J Haematol*, 166(5):667–76. doi:10.1111/bjh.12935 PMID:24861847

Troy JD, Hartge P, Weissfeld JL, Oken MM, Colditz GA, Mechanic LE, et al. (2010). Associations between anthropometry, cigarette smoking, alcohol consumption, and non-Hodgkin lymphoma in the Prostate, Lung, Colorectal, and Ovarian Cancer Screening Trial. *Am J Epidemiol*, 171(12):1270–81. doi:10.1093/aje/kwq085 PMID:20494998

Wallin A, Larsson SC (2011). Body mass index and risk of multiple myeloma: a meta-analysis of prospective studies. *Eur J Cancer*, 47(11):1606–15. doi:10.1016/j.ejca.2011.01.020 PMID:21354783

Wang SS, Voutsinas J, Chang ET, Clarke CA, Lu Y, Ma H, et al. (2013). Anthropometric, behavioral, and female reproductive factors and risk of multiple myeloma: a pooled analysis. *Cancer Causes Control*, 24(7):1279–89. doi:10.1007/s10552-013-0206-0 PMID:23568533

Whitlock G, Lewington S, Sherliker P, Clarke R, Emberson J, Halsey J, et al.; Prospective Studies Collaboration (2009). Body-mass index and cause-specific mortality in 900 000 adults: collaborative analyses of 57 prospective studies. *Lancet*, 373(9669):1083–96. doi:10.1016/S0140-6736(09)60318-4 PMID:19299006

WHO (2013). *I*nternational Classification of Diseases for Oncology. 3rd ed., 1st revision. Geneva, Switzerland: World Health Organization.

Willett EV, Morton LM, Hartge P, Becker N, Bernstein L, Boffetta P, et al.; InterLymph Consortium (2008). Non-Hodgkin lymphoma and obesity: a pooled analysis from the InterLymph Consortium. *Int J Cancer*, 122(9):2062–70. doi:10.1002/ijc.23344 PMID:18167059

Willett EV, Roman E (2006). Obesity and the risk of Hodgkin lymphoma (United Kingdom). *Cancer Causes Control*, 17(8):1103–6. doi:10.1007/s10552-006-0042-6 PMID:16933061

Willett EV, Skibola CF, Adamson P, Skibola DR, Morgan GJ, Smith MT, et al. (2005). Non-Hodgkin's lymphoma, obesity and energy homeostasis polymorphisms. *Br J Cancer*, 93(7):811–6. doi:10.1038/sj.bjc.6602762 PMID:16160698