Table 1. Effect of exposure and genotypes on biomarkers of exposure and effects by occupationally exposed groups.

Group/ sample size	Exposure		Effect of exposure on biomarkers									Effect of biomarkers of susceptibility	Ref.
	Type	Measured	Urine[a]	DNA adducts[b]	Protein adducts[c]	Comet	CAs	SCEs	MN	HPRT	p53/p21 proteins		
Coke oven workes													
Exp = 68; C = 56	PAHs	Personal	–	E	–	–	–	–	–	–	–	*GSTM1* No E *NAT2* No E	(*6*)
Exp = 65; C = 34	PAHs	Personal	–	–	–	–	E	E	–	–	–	*GSTM1* No E *NAT2* No E	(*7*)
Exp = 24; C = 28	PAHs	Personal	–	–	–	No E	–	–	–	–	–	*GSTM1* No E *NAT2* No E	(*8*)
Exp = 75; C = 24	PAHs	Personal, ambient	E	No E	–	–	–	–	–	–	E	*CYP1A1* E *GSTM1* No E	(*9*)
Exp = 80	PAHs	Personal	E	–	–	–	–	–	–	–	–	*CYP1A1* E	(*10*)
Exp = 59; C = 48	PAHs	Personal	–	–	No E	–	–	–	–	–	–	–	(*11*)
Exp = 43; C = 26	PAHs	No	–	–	–	–	–	–	–	No E	–	–	(*12*)
Exp = 45; C = 38	PAHs	No	–	–	–	–	–	E	–	–	–	–	(*13*)
Foundry workers	PAHs												
Exp = 95		Personal	–	E	–	–	–	–	–	–	–	*CYP1A1* No E *GSTM1* No E	(*14*)
Engine workshop	Engine exhaust, PAHs												
Exp = 61; C = 30		No	E	–	–	–	–	E	E	–	–	–	(*18*)
Workers	Bitumen fumes, PAHs												
Exp = 28; C = 28		No	E	–	–	–	–	E	E	–	–	–	(*19*)
Soldiers	Oil well fires, PAHs												
Exp = 20; C = 33		Personal	No E	No E	–	–	–	–	–	–	–	*CYP1A1* No E *GSTM1* No E *GSTT1* No E	(*20*)
Bus garage workers	Diesel exhaust, nitro-PAHs												
Exp = 29; C = 26		No	–	–	No E	–	–	–	–	–	–	–	(*21*)
Airport personnel	VOCs												
Exp = 39; C = 11		Personal	–	–	–	No E	–	No E	No E	–	No E	–	(*23*)
Workers	Traffic fumes, VOCs												
Exp = 32; C = 29		Personal	–	–	–	–	–	–	No E	–	–	–	(*24*)
Workers	Hydrocarbons												
Exp = 44; C = 24		No	–	–	–	E	E	No E	–	–	–	–	(*25*)
Gasoline station attendants													
Exp = 12; C = 12	Benzene	Personal	–	–	–	–	–	–	No E	–	–	–	(*26*)
Exp = 12; C = 12	Benzene	Personal	–	–	–	E	–	–	–	–	–	–	(*27*)
Exp = 22; C = 19	Benzene	Personal	–	–	–	–	–	No E	E	–	–	–	(*28*)
Exp = 45; C = 45	Benzene	Personal	–	–	–	–	–	No E	–	–	–	–	(*22*)
Workers													
Exp = 43; C = 42	Benzene	Personal	–	–	E	–	–	–	–	–	–	–	(*30*)
Exp = 43; C = 44	Benzene	Personal	–	–	–	–	E	–	–	–	–	–	(*31*)
Exp = 43; C = 44	Benzene	Personal	–	–	–	–	E	–	–	–	–	–	(*32*)
Exp = 35; C = 13	Benzene	Personal	–	–	–	–	–	–	No E	–	–	–	(*33*)
Exp = 34; C = 19	Organic solvents	Ambient	–	–	–	No E	–	–	–	–	–	*GSTM1* No E *GSTT1* No E	(*34*)
Viscose rayon plant workers	Acrylonitrile + dimethyl formamide												
Exp = 26; C = 26		No	–	–	–	–	E	E-HFC	–	–	–	–	(*35*)
Furniture workers	Styrene												
Exp = 53; C = 41		Ambient	E	–	–	–	–	E	No E	–	–	–	(*36*)

(*Continued*)

Table 1. (*Continued*)

Group/ sample size	Exposure		Effect of exposure on biomarkers									Effect of biomarkers of susceptibility	Ref.
	Type	Measured	Urine[a]	DNA adducts[b]	Protein adducts[c]	Comet	CAs	SCEs	MN	HPRT	p53/p21 proteins		
Workers													
Exp = 19; C = 19	1,3-Butadiene	Personal	–	–	–	No E	E	E	No E	–	–	–	(*37*)
Exp = 15; C = 11	1,3-Butadiene	Personal	–	E	–	–	–	–	–	–	–	–	(*38*)
Exp = 24; C = 19	1,3-Butadiene	Personal	–	–	–	–	E[d]	–	–	–	–	–	(*39*)
Exp = 14; C = 14	Epichlorohydrin	Personal	–	–	No E	–	–	E	No E	No E	–	–	(*40*)
Farmers													
Exp = 20; C = 20	Pesticides	No	–	–	–	–	E[d]	–	–	–	–	*CYP2E1* E[d] *GSTM1* E[d] *GSTT1* No E *PON* E[d]	(*41*)
Exp = 29; C = 11	Pesticides	No	–	–	–	E	–	–	–	–	–	–	(*42*)
Exp = 40	Pesticides	No	–	–	–	E	–	–	–	–	–	–	(*43*)
Greenhouse workers													
Exp = 34; C = 33	Pesticides	No	–	–	–	–	–	–	E	–	–	*GSTM1* No E *NAT2* No E	(*44*)
Exp = 57; C = 33	Pesticides	No	–	E	–	–	–	–	–	–	–	–	(*45*)
Exp = 30; C = 32	Pesticides	No	–	–	–	–	No E	–	–	–	–	*GSTM1* No E *GSTT1* No E	(*56*)
Sprayers	Malathion												
Exp = 38; C = 16		No	–	–	–	–	–	–	No E	–	–	–	(*46*)
Phosphate–fertilizers	HF, SiF												
Exp = 40; C = 40		No	–	–	–	–	E	–	E	–	–	–	(*47*)
Welders	Cr, Ni												
Exp = 39; C = 39		No	–	–	–	–	–	E	–	–	–	–	(*48*)
Nurses													
Exp = 20; C = 11	Cytostatics	No	–	–	–	–	E	–	–	–	–	–	(*49*)
Exp = 26; C = 14	Cytostatics	No	–	–	–	–	–	–	E	–	–	–	(*50*)
Exp = 30; C = 30	Cytostatics	No	–	–	–	E	–	–	–	–	–	–	(*51*)
Operating room personnel	Anesthetic gases												
Exp = 66; C = 41		No	–	–	–	E	–	–	–	–	–	–	(*52*)
Workers	Tobacco dust												
Exp = 107; C = 41		No	–	–	–	E	–	–	–	–	–	–	(*53*)
Pilots + crews													
Exp = 192; C = 55	Cosmic radiation	No	–	–	–	–	E	–	E	–	–	–	(*54*)
Exp = 23; C = 23	Cosmic radiation	No	–	E	–	–	No E	–	No E	No E	–	–	(*55*)

Abbreviations: –, biomarker was not analyzed; C, number of subjects in control group; Comet, Comet assay; E, statistically significant effect of exposure and/or genotypes on biomarkers of exposure and effect; Exp, number of subjects in exposed group; HPRT, mutations in the hypoxanthine–guanine phosphoribosyltransferase gene; p53/p21, activation of oncogenes coding for p53 or p21 proteins. [a]Metabolites in urine. [b]By ^{32}P-postlabeling or ELISA. [c]Hemoglobin or albumin adducts. [d]Effect on CAs only using challenge assay.