

[SUPPLEMENTARY MATERIAL]

Mortuary ritual and social identities during the late Dawenkou period in China

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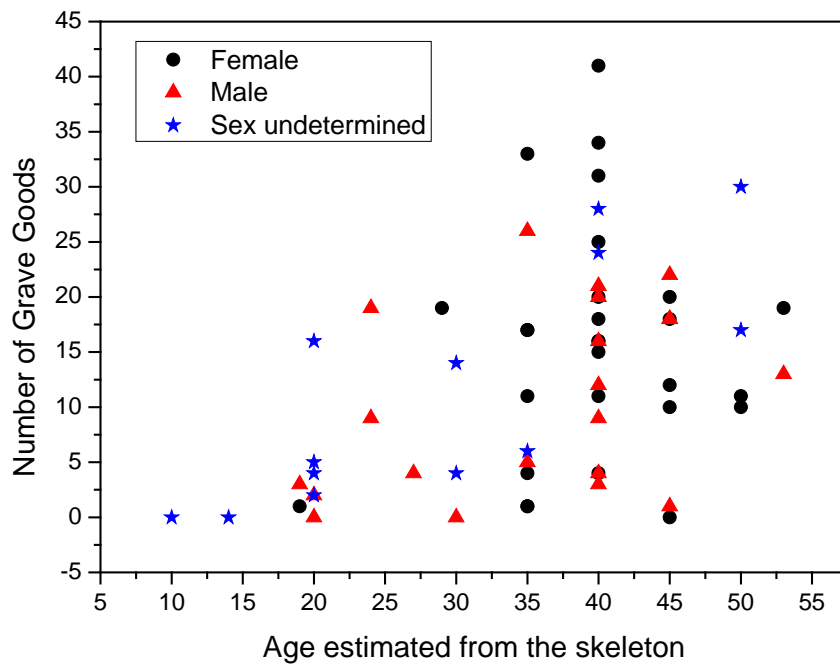


Figure S1. Scatter plot of the age of the deceased and the number of grave goods in single undisturbed pit burials at Liangwangcheng, N=66 (Nanjing Museum et al. 2013). Age estimations of skeletons are not very accurate and are usually given as ranges. We used the most plausible or the minimum age of the individual. For example, if one is estimated as 25±, we use 25; if one is estimated as 40 to 45 years old, we use 40; if one is estimated as adult without specific age, we use 20. We consider individuals aged 40 or older as older adults.

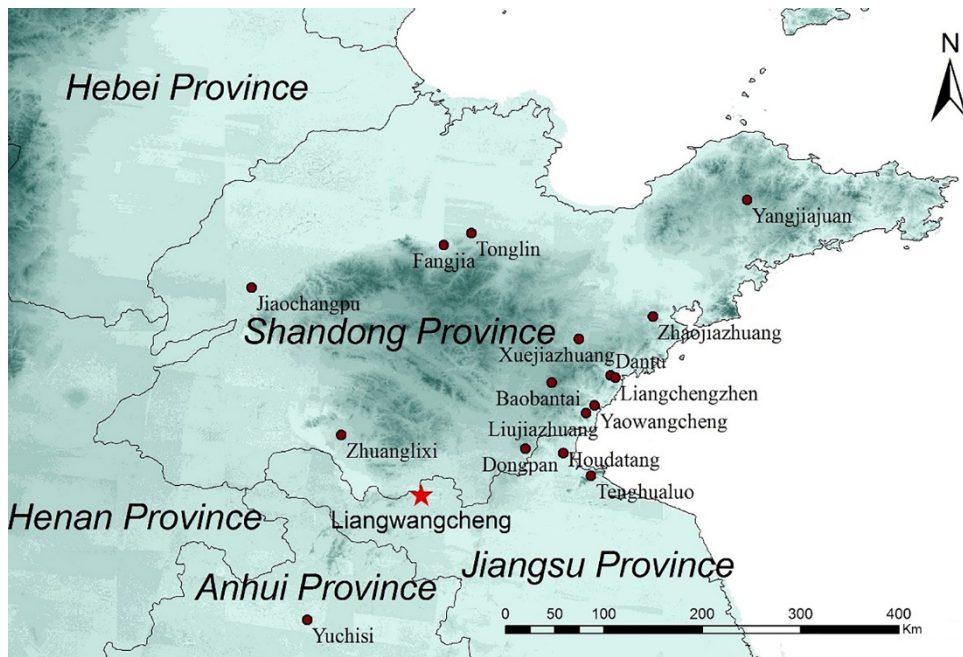


Figure S2. The location of Longshan culture sites with carbonised rice remains and/or rice phytolith in the vicinity of Liangwangcheng (data from Ma & Jin 2017).

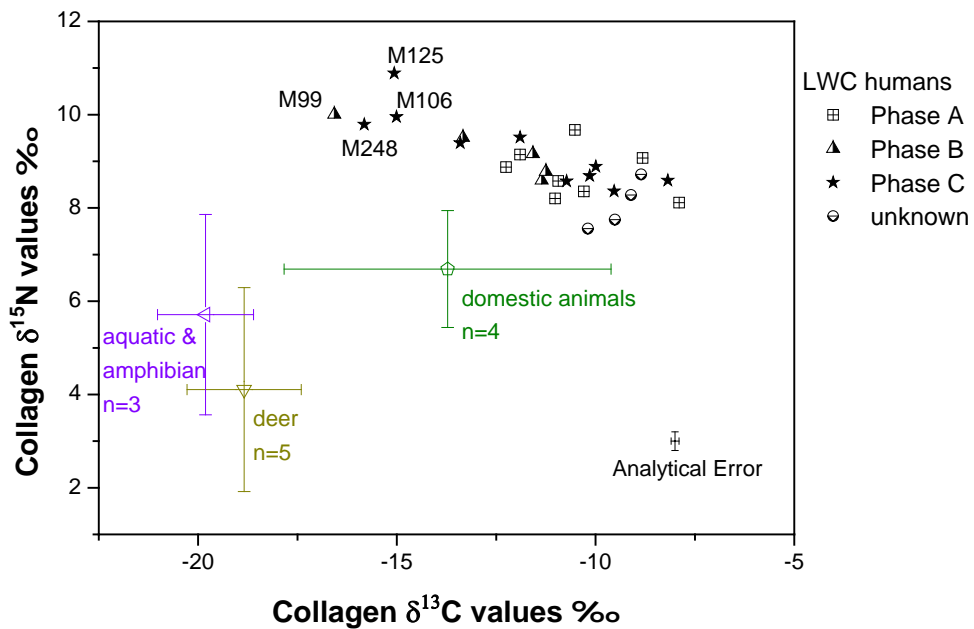


Figure S3. Scatter plot of human collagen $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ values and the mean and standard deviation of fauna collagen $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ values from Liangwangcheng.

Table S1. Radiocarbon dating results of Liangwangcheng site (modelled in OxCal v.4.2.4, using IntCal13 calibration curve (Bronk Ramsey 2009; Reimer *et al.* 2013)). *Phases 8 and 9 were excluded because only three and two burials dates to each phase, respectively.

Phases*	Feature no.	Lab no.	Radiocarbon date, BP	Unmodelled calibrated			Modelled calibrated date		
				date (BC/AD)			(BC/AD)		
				From	To	%	From	To	%
1 (earliest)	M129	A1982	4170±20	-2873	-2701	68.1	-2878	-2775	68.2
2	M120	A1983	4175±25	-2876	-2701	68.1	-2805	-2699	68.2
3	M272	A1984	4125±20	-2856	-2631	68.2	-2747	-2658	68.2
4	M271	A1985	4105±20	-2839	-2583	68.2	-2674	-2626	68.2
5	M238	A1986	4095±20	-2834	-2581	68.2	-2641	-2601	68.2
6	M226	A1987	4055±20	-2620	-2499	68.2	-2621	-2588	68.2
7 (latest)	M225	A2089	4090±20	-2833	-2579	68.2	-2604	-2575	68.2

Table S2. The breakdown of Dawenkou pit burials at Liangwangcheng. Within the 107 pit burials, there are nine multiple burials, hence we are left with 96 burials that contained a single individual (Nanjing Museum *et al.* 2013). *Disturbance means whether later features disturbed the burial. # Individuals aged at and over 18 are considered adults; ones younger than 18 are considered pre-adults.

Pit burials with a single individual (n = 96)			
Disturbance*	Undisturbed (n = 66)		Disturbed (n = 30)
Age#	Adults (n = 91)		Pre-adults (n = 5)
Sex	Males (n = 29)	Females (n = 43)	Sex undetermined (n = 24)
Phase	A (n = 26)	B (n = 16)	C (n = 27) unknown (n = 27)

Table S3. Summary information for Liangwangcheng burials discussed in the text (those sampled for isotope analysis and otherwise noteworthy). For burials, the occupation phase determined by associated pottery styles, number of grave goods, grave type, sex and age were given if such information is available. Collagen yield, C and N concentration in collagen, and isotopic composition were provided for all human and fauna samples that were sampled. [§]Burial M82 contained two individuals: M82-N, adult female, and M82-S, adult male. ^{*}Burial M106 contained two individuals: M106-N, the adult female, and M106-S, a child of 4-5 years old. [#]Burial M251 contained an adult female (M251-E) and an infant (1-2 years old, M251-W).

Feature no.	Species	Pottery phase	Radiocarbon phase	No. of grave goods	Grave type	Sex	Age	Collagen yield wt%	wt% C	wt% N	C:N	$\delta^{13}\text{C} \text{ ‰}$	$\delta^{15}\text{N} \text{ ‰}$
M81	Human	2	A	5	Simple pit	Male	35±	3.0	43.1	16.6	3.0	-10.3	8.4
M82-N [§]	Human	2	A	5	Simple pit	Female	35±	1.7	40.8	15.7	3.0	-12.3	8.9
M89	Human	4	B	23	Simple pit	Male	40–44	0.2	36.6	14.2	3.0	-11.2	8.8
M97	Human	2	A	5	Simple pit	Male	40–44	9.5	43.3	16.5	3.1	-8.8	9.1
M99	Human	3	B	19	Simple pit	Female	29-30	2.9	42.2	16.1	3.1	-16.6	10.0
M104	Human	n/a	n/a	1	Simple pit	Female	20±	11.	45.8	17.2	3.1	-8.9	8.7
M106-N [*]	Human	7	C	16	Simple pit	Female	35±	2.3	40.5	15.1	3.1	-15.0	10.0

M110	Human	1	A	28	Pit with <i>ercengtai</i>	N/A	40±		Did not sample for isotope analysis				
M118	Human	1	A	16	Pit with <i>ercengtai</i>	Female	40–44		Did not sample for isotope analysis				
M120	Human	2	A	20	Simple pit	Female	45–50	12.0	43.2	16.0	3.1	-11.9	9.1
M121	Human	4	B	16	Simple pit	Male	40±	2.0	41.0	15.3	3.1	-13.3	9.5
M125	Human	6	C	11	Pit with <i>ercengtai</i>	Female	35±	3.4	43.5	16.1	3.2	-15.1	10.9
M129	Human	1	A	18	Simple pit	Male	45–50	11.2	44.3	16.3	3.2	-10.5	9.7
M140	Human	2	A	41	Simple pit	Female	40–44		Did not sample for isotope analysis				
M146	Human	2	A	17	Simple pit	Female	45–50	3.2	42.7	15.8	3.1	-10.9	8.6
M154	Human	1	A	20	Pit with <i>ercengtai</i>	Male	25±	3.3	42.0	15.9	3.1	-11.0	8.2
M160	Human	1	A	15	Simple pit	Female	40–44	2.3	35.3	13.3	3.1	-7.9	8.1
M223	Human	5	C	5	Simple pit	Female	40–44	3.2	41.8	15.6	3.1	-8.2	8.6
M225	Human	7	C	26	Simple pit	Male	35–39	6.6	44.5	16.4	3.2	-11.9	9.5
M226	Human	6	C	19	Simple pit	Male	24–26	4.0	40.7	15.0	3.2	-9.5	8.4
M238	Human	5	C	10	Simple pit	Female	50–60	5.7	42.7	15.6	3.2	-10.7	8.6
M248	Human	6	C	6	Simple pit	Female	30±	3.1	42.0	15.3	3.2	-15.8	9.8
M249	Human	5	C	8	Simple pit	Female	23±	3.0	38.6	14.2	3.2	-10.0	8.9
M251-E [#]	Human	5	C	5	Simple pit	Female	40–44	3.9	41.9	15.4	3.2	-13.4	9.4

M252	Human	n/a	n/a	1	Pit with <i>ercengtai</i>	Female	19–23	2.6	40.9	15.1	3.2	-10.2	7.6
M253	Human	n/a	n/a	1	Pit with <i>ercengtai</i>	Male	45–49	1.5	37.6	14.1	3.1	-9.5	7.7
M254	Human	5	C	12	Pit with <i>ercengtai</i>	Male	40±	1.7	40.4	14.8	3.2	-10.1	8.7
M268	Human	n/a	n/a	1	Simple pit	Female	25±	3.9	43.0	15.7	3.2	-9.1	8.3
M271	Human	4	B	16	Simple pit	Female	40–44	2.3	40.8	14.9	3.2	-11.4	8.6
M272	Human	3	B	4	Simple pit	Male	40±	3.9	42.6	15.5	3.2	-11.6	9.2
T4804[9]	Deer							3.2	39.6	14.7	3.1	-18.4	5.6
H394	Deer							11.0	45.8	17.3	3.1	-19.7	3.0
H536	Deer							9.9	45.7	17.4	3.1	-18.1	7.1
H86	Deer							3.6	41.1	16.5	2.9	-20.8	1.9
T4708[9]	Deer							2.5	38.5	14.4	3.1	-17.2	2.8
T4701[9]	Dog							12.7	45.8	17.4	3.1	-17.2	7.9
H394	Pig							9.1	45.3	17.2	3.1	-7.8	7.0
H420	Pig							4.2	44.2	16.0	3.2	-15.6	6.9
T4701[9]	Pig							7.9	44.4	17.0	3.1	-14.2	4.9
H394	Fish							2.3	38.5	14.9	3.0	-20.7	6.5
T4708[9]	Turtle							0.7	30.5	11.6	3.1	-18.4	3.3

T4804[9]

Turtle

0.2

31.1

12.3

2.9

-20.3

7.3

Table S4. The mean and standard deviation of $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values for domestic animals (pig and dog), deer, and aquatic and amphibians (turtle and fish).

	Mean $\delta^{13}\text{C}$ ‰	S.D. $\delta^{13}\text{C}$ ‰	Mean $\delta^{15}\text{N}$ ‰	S.D. $\delta^{15}\text{N}$ ‰
Domestic animals (n = 4)	-13.7	4.1	6.7	1.2
Deer (n = 5)	-18.8	1.4	4.1	2.2
Aquatic and amphibians (n = 3)	-19.8	1.2	5.7	2.1

Table S5. The average number of grave goods in male and female burials during different phases at Jianxin site (n = 42; Shandong Provincial Institute of Cultural Relics and Archaeology & Zaozhuang Municipal Bureau of Culture 1996). Due to the small number of identified female burials in each phase, the average number of grave goods may not be representative.

Phase	Early Jianxin		Middle Jianxin		Late Jianxin	
	Male	Female	Male	Female	Male	Female
Number of burials in each phase	(n = 8)	(n = 2)	(n = 10)	(n = 3)	(n = 14)	(n = 5)
Average number of grave goods per burial	7.1	8	12.3	10.7	32.5	20.6

References

- BRONK RAMSEY, C. 2009. Bayesian analysis of radiocarbon dates. *Radiocarbon* 51: 337–60. <https://doi.org/10.1017/S0033822200033865>
- MA, Y. & G. JIN. 2017. Haidai Longshan wenhua nongzuowu leixing ji quyue tedian fenxi, in F. Luan, F. Wang & Y. Dong (ed.) *Longshan Wenhua yu Zaoqi Wenming*: 161–78. Beijing: Cultural Relics (in Chinese).
- Nanjing Museum, Xuzhou Museum & Pizhou Museum. 2013. *Liangwangcheng Yizhi Fajue Baogao: Shiqian Juan*. Beijing: Cultural Relics (in Chinese).
- REIMER, P.J. *et al.* 2013. IntCal13 and Marine13 radiocarbon age calibration curves 0–50 000 years cal BP. *Radiocarbon* 55: 1869–87. https://doi.org/10.2458/azu_js_rc.55.16947

Shandong Provincial Institute of Cultural Relics and Archaeology & Zaozhuang
Municipal Bureau of Culture. 1996. *Zaozhuang Jianxin: Xinshiqi Shidai Yizhi Fajue
Baogao*. Beijing: Science Press (in Chinese).