IN THE CORONERS COURT
OF VICTORIA
AT MELBOURNE

Court Reference: COR 2020 4299

FINDING INTO DEATH WITHOUT INQUEST

Form 38 Rule 63(2)
*Section 67 of the **Coroners Act 2008***

Findings of:	Caitlin English, Deputy State Coroner
Deceased:	Yunjie Zhang
Date of birth:	11 January 2000
Date of death:	Between 28 July and 7 August 2020
Cause of death:	1(a) Complications of malnutrition in the setting of presumed nitrous oxide use
Place of death:	1010/225 Elizabeth Street, Melbourne, Victoria

INTRODUCTION

1. Sometime between 28 July and 7 August 2020, Yunjie Zhang was 20 years old when she died after inhaling nitrous oxide. At the time of her death, Ms Zhang lived alone at Melbourne.

THE CORONIAL INVESTIGATION

2. Ms Zhang's death was reported to the Coroner as it fell within the definition of a reportable death in the *Coroners Act 2008* (**the Act**). Reportable deaths include deaths that are unexpected, unnatural or violent, or result from accident or injury.

3. The role of a coroner is to independently investigate reportable deaths to establish, if possible, identity, medical cause of death, and surrounding circumstances. Surrounding circumstances are limited to events which are sufficiently proximate and causally related to the death. The purpose of a coronial investigation is to establish the facts, not to cast blame or determine criminal or civil liability.

4. Under the Act, coroners also have the important functions of helping to prevent deaths and promoting public health and safety and the administration of justice through the making of comments or recommendations in appropriate cases about any matter connected to the death under investigation.

5. The Victoria Police assigned an officer to be the Coroner's Investigator for the investigation of Ms Zhang's death. The Coroner's Investigator conducted inquiries on my behalf, including taking statements from witnesses – such as family, the forensic pathologist, treating clinicians and investigating officers – and submitted a coronial brief of evidence.

6. This finding draws on the totality of the coronial investigation into Ms Zhang's death, including evidence contained in the coronial brief. Whilst I have reviewed all the material, I will only refer to that which is directly relevant to my findings or necessary for narrative clarity. In the coronial jurisdiction, facts must be established on the balance of probabilities.[1]

[1] Subject to the principles enunciated in *Briginshaw v Briginshaw* (1938) 60 CLR 336. The effect of this and similar authorities is that coroners should not make adverse findings against, or comments about, individuals unless the evidence provides a comfortable level of satisfaction as to those matters taking into account the consequences of such findings or comments.

MATTERS IN RELATION TO WHICH A FINDING MUST, IF POSSIBLE, BE MADE

Identity of the deceased

7. On 14 August 2020, Yunjie Zhang, born 11 January 2000, was identified via circumstantial evidence.

8. Identity is not in dispute and requires no further investigation.

Medical cause of death

9. Forensic Pathologist, Dr Melanie Archer, from the Victorian Institute of Forensic Medicine (**VIFM**), conducted an examination on 8 August 2020 and provided a written report of her findings dated 22 December 2020.

10. Dr Archer noted that the cause of death could not be ascertained despite thorough examination and ancillary testing. The most likely cause of death was complications of malnutrition in the setting of presumed nitrous oxide use. There was some positive evidence of potential complications of malnutrition, including a pericardial effusion. There was also fluid in the chest cavities, which may be associated with organ failure, although it was possible that this originated at least partially from decomposition.

11. There had been longstanding malnutrition; Ms Zhang had a very low body mass index (11 kg/m2). Dr Archer explained that low body mass index is associated with multiple adverse outcomes, including increased risk of infection (including pneumonia), cardiac arrhythmia (including sudden cardiac death), and metabolic imbalance.

12. There was evidence of a prolonged lie on the ground in the form of developing sacral and buttock pressure ulceration. There was also the finding of Wischnewski spots in the stomach lining. These shallow bleeding erosions can be seen in the setting of prolonged physiological stress, where there is low blood flow to the vessel supplying the stomach, resulting in pinpoint bleeding. In addition, there was a focus of aspiration pneumonia which is a common agonal phenomenon.

13. The reason for Ms Zhang's decline was unclear. Dr Archer noted it was possible that incapacitation had resulted from reduced eating and drinking. It was also possible that drug use had played a role. There was also evidence that Ms Zhang had used a large numbers of nitrous oxide canisters in the relatively short time since she took delivery of them. This raised

the possibility of sustained intoxication, with the possibility of poor attention to self-care (including eating and drinking).

14. Toxicological analysis was unable to detect nitrous oxide and showed no other significant results. Post-mortem blood showed ethanol (alcohol) at a concentration of 0.02 gm/100 mL. Generation of ethanol during decomposition is the favoured reason for this result, although antemortem ingestion of alcohol cannot be ruled out. There was no detection of common drugs or poisons, and no detection novel psychoactive substances, despite extended testing.

15. Dr Archer noted that nitrous oxide canisters are known as 'nangs' and are legally available due to their main commercial use as 'cream chargers' for whipping cream. Large numbers of nitrous oxide canisters were present at the scene, along with a 'nang cracker' (a device used to break the canisters open for inhalation of the gas). Nitrous oxide is also known as laughing gas and is used as an anaesthetic agent. It is volatile and short acting and produces feeling of euphoria.

16. Dr Archer noted that death from overuse of nangs is rare but has been recorded. Complications include chronic effects of interference with vitamin B12 metabolism, resulting in subacute combined degeneration of the spinal cord. Decomposition prevented meaningful examination of the spinal cord in this case. Excessive use of nitrous oxide has also been associated with psychosis (especially in the setting of vitamin B12 deficiency). Acute deaths involve hypoxia due to concentration of the gas, sometimes with use of a plastic bag (not a factor in this case), or inhalation of large amounts of the gas from a tank or similar (no evidence of this was seen in this case). Death or serious injury from nang use has also resulted from cryogenic and pressure related effects of direct release of the canisters into the back of the throat. There was no evidence that this had occurred here.

17. There was no evidence of significant trauma on examination, and on the post-mortem CT scan. In particular, there was no positive evidence of a substantial physical assault. Probable bruising was mainly clustered around the bony prominences, which may be seen in setting of confusion with multiple falls and collisions with solid objects.

18. There was no evidence of any significant natural disease (apart from the effects of malnutrition) that could have caused to contributed to death.

19. Although Dr Archer provided an opinion that the medical cause of death was *"1(a) Unascertained"*, following my investigation, including consideration of the circumstances in which Ms Zhang was located deceased in the presence of thousands of

nitrous oxide cannisters in her apartment, I am satisfied to the relevant standard her cause of death can be formulated as *"1(a) Complications of malnutrition in the setting of presumed nitrous oxide use*."

Circumstances in which the death occurred

20. In early 2020, Ms Zhang lived in Sydney with her partner while undertaking university studies. In mid-2020 and after the end of their relationship, she relocated to Melbourne alone and transferred her studies to RMIT University.

21. On 13 July 2020, closed-circuit television (**CCTV**) footage at Ms Zhang's apartment building captured two unknown males arriving at her apartment at approximately 1.45pm. CCTV footage subsequently captured them removing a number of black rubbish bags from Ms Zhang's apartment and disposing of them in the basement dumpsters. According to Detective Senior Constable Rhett Killeen, Coroner's Investigator, it is assumed that these bags contained boxes of used nangs. They left Ms Zhang's apartment at 2.50pm. Two food deliveries were also made to Ms Zhang's apartment at 2.07pm and 2.19pm that day.

22. On 21 July 2020, Ms Zhang received a further delivery of food.

23. On 28 July 2020, Ms Zhang spoke to her mother on the phone.

24. By 6 August 2020, Ms Zhang's mother had grown concerned as she had not heard from her daughter again. She contacted Ms Zhang's former partner who passed on the contact details of one of Ms Zhang's friends who resided in Brisbane. After further enquiries another friend, Liwen Chen, was contacted and asked to conduct a welfare check.

25. At 4.00pm on 7 August 2020, Ms Chen and her partner, Haowen Su, attended Ms Zhang's apartment building. There was no answer when they dialled Ms Zhang's intercom. While they were able to gain entrance into the building, they were unable to take the elevator to Ms Zhang's floor. They spoke to a building manager who allowed them to access the relevant floor. When they reached Ms Zhang's apartment, Mr Su's door knocks remained unanswered. Upon discovering the door was unlocked, they returned to the lobby and decided to contact Victoria Police.

26. Victoria Police members conducted a welfare check at 7.30pm that evening and found Ms Zhang deceased in the lounge-room of her apartment. Thousands of nitrous oxide canisters

were found next to her body and strewn throughout the remainder of the apartment. It appeared that Ms Zhang had been deceased for some time.

27. I note that Ms Chen stated she was connected with Ms Zhang on the 'Zenly' phone app, which allowed her to see Ms Zhang's location and the amount of battery left on her phone. She noted that the app showed Ms Zhang's phone battery ran out on 28 July 2020 in the Elizabeth Street area.

28. Detective Senior Constable Killeen noted that there was no evidence or indication of foul play or any other person being involved in Ms Zhang's death.

29. As part pf my investigation, I asked Detective Senior Constable Killeen whether there was any indication where Ms Zhang may have sourced the nitrous oxide cannisters. Detective Senior Constable Killeen noted that Victoria Police were unable to identify the source of the nitrous oxide cannisters. However, he noted it is relatively easy to source nitrous oxide cannisters from the internet. The cannisters are legal to purchase and sell and companies advertise them for sale on social media with delivery. It is unknown from which of these companies Ms Zhang may have purchased them or if she simply purchased them from acquaintances.

FINDINGS AND CONCLUSION

30. Pursuant to section 67(1) of the Act I make the following findings:

    (a) the identity of the deceased was Yunjie Zhang, born 11 January 2000;

    (b) the death occurred between 28 July and 7 August 2020 at 1010/225 Elizabeth Street, Melbourne, Victoria, from complications of malnutrition in the setting of presumed nitrous oxide use; and

    (c) the death occurred in the circumstances described above.

31. Having considered all of the evidence, I am satisfied that her death was likely caused by the unintended consequence of the deliberate inhalation of nitrous oxide.

COMMENTS

Pursuant to section 67(3) of the Act, I make the following comments connected with the death.

1. The psychoactive effects of nitrous oxide were first documented in 1799, and it has been used recreationally for more than two centuries.[2] Literature shows that cream whipper bulbs (also known as chargers, cartridges, whippets, whip-its, and canisters) have been used as a source of nitrous oxide for recreational inhalation for several decades.[3]

2. According to the Australian Institute of Health and Welfare's *National Drug Strategy Household Survey 2019*, use of inhalants has been gradually increasing – from 0.4 percent in 2001 to 1.0 percent in 2016 and 1.7 percent in 2019. People who disclosed inhalant use also disclosed fairly frequent use (compared to drugs such as ecstasy and cocaine), with 33 percent reporting at least monthly use. The most common forms of inhalants used in 2019 were nitrous oxide and amyl nitrate and other nitrates, used by at least six in 10 people who had used inhalants in the previous 12 months.[4]

3. The Ecstasy and Related Drugs Reporting System reported similar concerning statistics. In 2019, 61 percent of Western Australia participants reported recent use of nitrous oxide; the highest proportion observed since data collection commenced. Nitrous oxide was used on a median of 10 occasions in the preceding six months (increasing significantly from 2018) and one in four consumers reported weekly use. The median amount used in a 'typical' session was 10 bulbs, while the maximum median used in a session was 25 bulbs. Victorian statistics were comparable.[5]

4. The data regarding rates of use, frequency, and number of bulbs used in a single session are concerning. The low cost and ease of accessibility raises the need for further attention in this area.

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[2] For a brief history of nitrous oxide use see: M Jay, "Nitrous oxide: recreational use, regulation and harm reduction", Drugs and Alcohol Today, vol 8, no 3, September 2008, pp.22-23.

[3] See for example Jay M, "Nitrous oxide: recreational use, regulation and harm reduction", Drugs and Alcohol Today, vol 8, no 3, September 2008, p.24; Rosenberg H, et al, "Abuse of nitrous oxide", Anesthesia and Analgesia, vol 58, no 2, March-April 1979, p.105; Gillman M, "Nitrous Oxide Abuse in Perspective", Clinical Neuropharmacology, vol 15, no 4, p.304.

[4] Australian Institute of Health and Welfare, National Drug Strategy Household Survey 2019, p. 42. Available at: https://www.aihw.gov.au/getmedia/77dbea6e-f071-495c-b71e-3a632237269d/aihw-phe-270.pdf.aspx?inline=true.

[5] Grigg, J. & Lenton, S. (2020). Increasing trends in self-reported use of nitrous oxide among WA EDRS samples. Drug Trends Bulletin Series. Sydney: National Drug and Alcohol Research Centre, University of New South Wales. Available at: http://doi.org/10.26190/5f20ea395c544.

Risks of nitrous oxide use

5. Nitrous oxide is generally considered to be a comparatively low-risk drug for two reasons. First, although there is some evidence it might have a positive reinforcing effect in users, it does not appear to be as addictive as most substances considered to be 'drugs of addiction'.[6] Second, its serious toxic effects (including nerve damage and spinal cord degeneration) result only from chronic use.[7]

6. The central risk associated with recreational inhalation of nitrous oxide is asphyxia through displacement of oxygen from the lungs. However, this risk is contingent on how the drug is concentrated and inhaled.

Regulation in Victoria

7. Cream whippers, and the nitrous oxide bulbs used with them, are legal to possess in Australia and are widely available for purchase. Many online retailers sell nitrous oxide bulbs in bulk with postal delivery. However, there are legal restrictions on sale and possession of nitrous oxide bulbs in certain circumstances.

8. Under section 57(1) of the *Drugs Poisons and Controlled Substances Act 1981* (Vic), the term 'deleterious substances' is defined as encompassing the term 'volatile substances', which is in turn defined as follows:

> *(a) plastic solvent, adhesive cement, cleaning agent, glue, dope, nail polish remover, lighter fluid, gasoline, or any other volatile product derived from petroleum, paint thinner, lacquer thinner, aerosol propellant or anaesthetic gas; or*
>
> *(b) any substance declared pursuant to subsection (2) by the Governor in Council to be a volatile substance.*

[6] Gillman MA, "Nitrous Oxide, an Opioid Addictive Agent: A Review of the Evidence", American Journal of Medicine, vol 81, no 1, July 1986, pp.100-101; Gillman M, "Nitrous Oxide Abuse in Perspective", Clinical Neuropharmacology, vol 15, no 4, p.304.

[7] Doran M, et al, "Toxicity after intermittent inhalation of nitrous oxide for analgesia", British Medical Journal, vol 328, 5 June 2004, p.1364; Weimann J, "Toxicity of nitrous oxide", Best Practice and Research in Clinical Anaesthesiology, vol 17, no 1, pp.57-58; Gable R, "Comparison of acute lethal toxicity of commonly abused psychoactive substances", Addiction, vol 99, no 6, p.692;

9. Nitrous oxide appears to satisfy the definition of 'volatile substance'. Therefore, nitrous oxide cream whipper bulbs are subject to the sales and possession controls described in the *Drugs Poisons and Controlled Substances Act 1981*. Section 58(1) provides:

> *Except as otherwise expressly provided in this Act or the regulations, a person shall not sell a deleterious substance to another person if the first-mentioned person knows or reasonably ought to have known or has reasonable cause to believe that the other person intends—*
>
> *(a) to use the substance by drinking, inhaling, administering or otherwise introducing it into his body; or*
>
> *(b) to sell or supply the substance to a third person for use by that third person in a manner mentioned in paragraph (a).*

10. Part IV Division 2 of the Act allows police to search people aged under 18 years for volatile substances and seize any volatile substances found if there are reasonable grounds to suspect the volatile substances will be inhaled.

11. While there are clearly restrictions in place, it is not entirely clear how well they are enforced or whether retailers and consumers are aware of them.

Opportunity for prevention – retailer education

12. As noted above, the *Drugs Poisons and Controlled Substances Act 1981* places certain restrictions upon the sale of volatile substances including nitrous oxide.

13. In the past, the Victorian Department of Health has produced and updated a resource titled *Responsible Sale of Solvents: A Retailer's Kit* to assist retailers to meet their obligations under that Act to ensure they do not sell volatile substances to people who might misuse them through inhalation. The kit addressed glue, paint thinners, lighter fluid, and a range of other volatile substances, but did not mention nitrous oxide.[8]

14. To my mind, a similar kit may be beneficial to retailers of nitrous oxide. I will therefore make a recommendation to the Victorian Department of Health to consider whether a similar kit is

[8] Also see Department of Health, Responsible sale of solvents, https://www2.health.vic.gov.au/alcohol-and-drugs/aod-treatment-services/aod-prevention-harm-reduction/responsible-sale-of-solvents (accessed 4 October 2021).

needed for retailers of cream whipper bulbs and other nitrous oxide sources to alert them to the requirement that they must have a reasonable belief the nitrous oxide will not be inhaled.

Opportunity for prevention – user education

15. The Victorian Department of Health could also consider developing an education resource for recreational users of nitrous oxide, outlining the dangers of the drug in general as well as the specific elevated risks associated with practices such as using tubes and masks. The Victorian Department of Health could distribute this to all Australian online retailers of cream whipping nitrous oxide bulbs, and request that they incorporate the material into their websites in such a way that it is visible to any person seeking to purchase these bulbs. I will also make a recommendation in this regard.

Previous coronial recommendations

16. I note that in the *Finding into death of regarding Aaron James McDonald*,[9] dated 11 August 2014, Coroner John Lesser made recommendations to the Department of Health to develop educational resources for recreational users of nitrous oxide regarding dangers and risks as well as resources for retailers and suppliers.

17. On 12 December 2014, Dr Pradeep Philip, Secretary, responded to the recommendation and noted that the Victorian Government published a range of information about inhalants, including nitrous oxide. Dr Philip noted that an update to the Better Health Channel would be considered, along with an intention to raise the issue with the Australian Drug Foundation and the Inter-Governmental Committee on Drugs.

18. I note that the Better Health Channel refers to nitrous oxide inhalation and refers to risk of death and other adverse side effects.[10]

19. However, considerable time has passed since Coroner Lesser's findings and nitrous oxide use has steadily increased. A fresh look at his Honour's recommendations is needed in the context of today's statistics and accessibility.

[9] Accessible at: https://www.coronerscourt.vic.gov.au/sites/default/files/2018-12/20135467_aaronmcdonald.pdf.
[10] Victorian Government, Better Health, Inhalants, https://www.betterhealth.vic.gov.au/health/healthyliving/inhalants (accessed 4 October 2021).

Interstate developments

20. I note that in April 2020, the South Australian government, recognising the growing presence and use of the nitrous oxide canisters in and around youth events, introduced the Controlled Substances (Poisons) (Nitrous Oxide) Variation Regulations 2019. These regulations make it an offence to sell or supply to people under the age of 18 years, sell between the hours of 10.00pm and 5.00am, make nitrous oxide visible or accessible to the public in retail stores, and fail to display a notice on the premises that details the offence of selling to under 18s. Penalties range up to $5,000.[11]

21. Given it is unclear as to how Ms Zhang accessed nitrous oxide cannisters, I will not make a formal recommendation for the Victorian Government to make similar legislative amendments. However, I do encourage the Victoria Department of Health to have regard to South Australia's approach in considering whether legislative changes are needed in Victoria.

RECOMMENDATIONS

Pursuant to section 72(2) of the Act, I make the following recommendations:

1. I **recommend** the **Department of Health** consider whether a kit similar to the previously published *Responsible Sale of Solvents: A Retailer's Kit* is needed for retailers of cream whipper bulbs and other nitrous oxide sources to alert them to the requirement that they must have a reasonable belief the nitrous oxide will not be inhaled. The risk of drawing further attention to nitrous oxide inhalation, and the risk that nitrous oxide users might switch from the relatively safe and pure nitrous oxide in cream whipper bulbs to sources with potentially toxic contaminants will naturally form part of the Department's considerations about whether this resource would be helpful for reducing deaths related to recreational inhalation of nitrous oxide.

2. I **recommend** the **Department of Health** consider developing an education resource for recreational users of nitrous oxide, outlining the dangers of the drug in general as well as the specific elevated risks associated with practices such as using tubes and masks. I also **recommend** the Department consider distributing this resource to all Australian online retailers of cream whipping nitrous oxide bulbs and request that they incorporate the material

[11] Government of South Australia, Attorney-General's Department, Nitrous Oxide regulations, https://www.agd.sa.gov.au/justice-system/nitrous-oxide-regulations (accessed 4 October 2021).

into their websites in such a way that it is visible to any person seeking to purchase these bulbs.

I convey my sincere condolences to Ms Zhang's family for their loss.

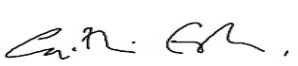
Pursuant to section 73(1A) of the Act, I order that this finding be published on the Coroners Court of Victoria website in accordance with the rules.

Pursuant to section 49(2) of the Act, I direct the Registrar of Births, Deaths and Marriages to amend the cause of death to *"1(a) Complications of malnutrition in the setting of presumed nitrous oxide use"*.

I direct that a copy of this finding be provided to the following:

Yu Zhang and Weijing Zhao, senior next of kin
Professor Euan Wallace, Secretary, Department of Health
Detective Senior Constable Rhett Killeen, Victoria Police, Coroner's Investigator

Signature:



Caitlin English, Deputy State Coroner

Date: 28 October 2021

NOTE: Under section 83 of the ***Coroners Act 2008*** ('the Act'), a person with sufficient interest in an investigation may appeal to the Trial Division of the Supreme Court against the findings of a coroner in respect of a death after an investigation. An appeal must be made within 6 months after the day on which the determination is made, unless the Supreme Court grants leave to appeal out of time under section 86 of the Act.