Tabari Biomedical Student Research Journal

OPEN ACCESS

# ORIGINAL: Identification of novel lncRNAs and potential role in cervical cancer

**Faezeh Rafiei**
**Hossein Maghsoudi**

Payame noor university, Tehran, Iran

**ARTICLE INFO**

**Submitted:** 05 Oct 2025
**Accepted:** 11 Nov 2025
**Published:** 21 Dec 2025

**Keywords:**
Cervical cancer
lncRNAs
Lnc2Cancer

**Correspondence:**
**Hossein Maghsoudi**
Payame noor university, Tehran, Iran
**Email:** Hossein_m2002@yahoo.com
**ORCID:** 0000-0002-7173-7863

**Citation:**
Rafiei F, Maghsoudi H. Identification of novel lncRNAs and potential role in cervical cancer. Tabari Biomed Stu Res J. 2025;7(4): 8- 16.

**ABSTRACT**

**Background:** Cervical cancer, considered as common cancer in females and in this case uterus cells begins to grow and reproduce out of control. It is obvious that knowing the molecular factors involved in progression of cervical cancer the diagnosis and treatment process can be more efficient, so in this study, we aimed to investigate LncRNAs related database to provide a collection of LncRNAs in this article for researchers.

**Methods:** In this research the data related to LncRNAs associated with cervical cancer were retrieved from the global databases. The database that was examined in this research include: Lnc2Cancer.

**Results:** Expression pattern of about 369 lncRNA and circRNA genes involved in cervical cancer were obtained.

**Conclusion:** These were only a few examples of the types of lncRNAs that have been collected by bioinformatics databases and it is possible to design new treatment processes for cervical cancer by identifying them.

## Introduction

Cervical cancer, considered as common cancer in females and in this case uterus cells begins to grow and reproduce out of control[1]. Although the causes of this cancer have not been fully understood, scientists still do not know how the cancer grows and develops. Before the growth of cancer cells, the tissue undergoes changes that are different from the normal tissue[2, 3]. In the past several years, many studies have been conducted to find the molecular mechanisms and regulatory networks that play a role in tumorigenesis. Cervical cancer is the most important disease caused by human papillomavirus, which is a major public health problem worldwide[4]. HPV infection can be the origin of pre-neoplastic lesions known as cervical intraepithelial neoplasia. E6 and E7 oncoproteins, which are encoded by high-risk HPVs, affect infected cervical cells, they are able to inhibit P53 and PRb repressors, respectively, and with a large number of cell signaling factors regulating cell cycle, genomic stability and epigenetic changes interact [5, 6]. The gradual accumulation of genetic and epigenetic changes in HPV-infected cells is also very important for the final progression to cervical cancer[7, 8]. The mutational profile of cervical cancer, the presence of a series of non-synonymous somatic nucleotide changes in TP53, PTEN, PIK3CA, STK11 and KRAS genes shows that epigenetic changes, including microRNA, LncRNA and circRNA deregulation, play an important role in cell transformation during specific stages[9]. Long non-coding RNAs are associated with a large number of cellular functions. Long non-coding RNAs that are more than 200 nucleotides in length are a new and emerging class of transcripts that are encoded by the genome but are not usually translated into protein and play a key role in gene expression, growth, development, differentiation, and in regulating chromatin

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dynamics[10]. According to the ENCODE project, the human genome encodes approximately 28,000 LncRNAs, many of which have not yet been discovered, and their expression is inappropriate in various cancers[11]. LncRNAs are important and necessary regulators of gene expression and play a role in all cellular processes, gene expression through expansion or inhibition of translation of mRNA to protein, expansion or inhibition of DNA transcription, affecting mRNA splicing, controlling chromatin density and determines the stability of regulated mRNA[12]. They can bind to proteins, DNA or even messenger and small RNAs. According to recent studies, lncRNAs use a wide range of mechanisms to affect their targets[13]. The mechanism of lncRNAs' effect is on two levels: transcriptional regulation and post-transcriptional regulation. LncRNAs have wide expression patterns in different types of cancer. Dys-regulation of lncRNAs is related to human diseases and cancers[14]. According to the studies conducted, their expression changes are involved in metastasis, tumor formation and tumor progression[15]. LncRNAs can also play a tumor suppressor role and by reducing their expression, they play a role in cancer progression, such as GAS5 and MEG3, and they can also play an oncogenic role, in which case, by increasing their expression, they stimulate cancer conditions, such as HOTAIR and MALAT[16, 17]. It is obvious that knowing the molecular factors involved in progression of cervical cancer the diagnosis and treatment process can be more efficient, so in this study, we aimed to investigate LncRNAs related database to provide a collection of LncRNAs in this article for researchers.

# Material and Methods

## Lnc2Cancer

The updated Lnc2Cancer database is a manually entered, laboratory-validated database. This database presents the relationship between lncRNAs and human cancers. The new version of this database also provides the relationship between circRNAs and human cancers because circRNAs are a unique type of lncRNAs and are importance in many human cancers. In the new version, there are 10,303 associations between 2,659 human lncRNAs, 734 CircRNAs and 216 human cancer subgroups, which are the result of the review of more than 15,000 published articles. In this database, regulatory mechanism (enhancer, transcription factor, methylation, miRNA, diversity), biological function (coding, EMT, apoptosis, autophagy, immune ability, cell growth) and clinical application (circulation, metastasis, recurrence, survival) are presented for lncRNAs and circRNAs in human cancers. To discover and identify the level of expression of circRNAs and lncRNAs in human cancers in this database, RNAi, in vitro knockdown, Western blot, Luciferase reporter assay and scRNA-seq techniques are also used in this database using molecular biology techniques and analyzed lncRNAs and circRNAs associated with cancers based on biological functions, regulatory mechanisms and clinical applications[18]. The Lnc2Cancer v3.0 database is available at http://bio-bigdata.hrbmu.edu.cn/lnc2cancer/. In the menu bar of the home page of this database, by clicking on the "Browse" icon, a new window will open. You can browse by lncRNA/circRNA and select any of the 3 subgroups of regulatory mechanism, biological function and application. Clinical information related to lncRNA and circRNA can be retrieved in different cancers. Also, in the browse by tissue section, lncRNAs and circRNAs related to that cancer can be found by selecting the desired tissue. Also, on the right side of the page, there are three boxes, Cancer, lncRNA, and circRNA. By clicking on cancer and selecting the desired cancer, the lncRNAs and circRNAs of that cancer are retrieved. Also, by clicking on the lncRNA or circRNA box and selecting the desired lncRNA or circRNA, information including the name of the cancer, the identification method, and the expression pattern are retrieved. In this research, by clicking on the "Browse" icon and selecting cervical cancer, cervical intraepithelial neoplasia, and cervical

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squamous cell carcinoma, a new window will open and lncRNAs and circRNAs along with the expression pattern in cervical cancer will be shown.

## Results

The Lnc2Cancer database is a laboratory-approved and updated database that examines the relationship between lncRNAs and circRNAs in various cancers and also interprets their mechanisms. Table 1 showed expression pattern of about 369 lncRNA and circRNA genes involved in cervical cancer. In Table 2, a lncRNA gene involved in cervical intra-epithelial neoplasia is shown along with the expression pattern.

**Table1**. List of lncRNAs and circRNAs involved in cervical cancer retrieved from Lnc2Cancer database

| Expression pattern | lncRNA/circRNA | Expression pattern | lncRNA/circRNA |
|---|---|---|---|
| up-regulated | ARAP1-AS1 | up-regulated | AB073614 |
| up-regulated | ASB16-AS1 | down-regulated | AC017078.1 |
| down-regulated | ASK00420 | differential expression | AC024560.2 |
| up-regulated | AX748340 | up-regulated | AFAP1-AS1 |
| up-regulated | BC200 | up-regulated | AL592284.1 |
| up-regulated | BCAR4 | differential expression | ANRASSF1 |
| up-regulated | BCAR4 | up-regulated | ANRIL |
| up-regulated | BCYRN1 | up-regulated | ANRIL |
| up-regulated | BDLNR | up-regulated | ANRIL |
| up-regulated | BLACAT1 | up-regulated | ANRIL |
| up-regulated | BLACAT1 | up-regulated | C5orf66-AS1 |
| up-regulated | BLACAT1 | up-regulated | CALML3-AS1 |
| differential expressed | circ_103519 | up-regulated | CAR10 |
| up-regulated | circ_103973 | up-regulated | CASC11 |
| differential expressed | circ_104315 | up-regulated | CASC15 |
| differential expressed | circ_400068 | up-regulated | CASC15 |
| up-regulated | circAGFG1 | down-regulated | CASC2 |
| up-regulated | circAKT1 | down-regulated | CASC2 |
| up-regulated | circAMOTL | down-regulated | CASC9 |
| up-regulated | circATP8A2 | up-regulated | CCAT1 |
| up-regulated | circCLK3 | up-regulated | CCAT1 |
| up-regulated | circCSPP1 | up-regulated | CCAT1 |
| up-regulated | circEIF4G2 | up-regulated | CCAT1 |
| down-regulated | circFoxO3a | down-regulated | CCAT2 |
| down-regulated | circITCH | up-regulated | CCEPR |
| up-regulated | circMYBL2 | up-regulated | CCHE1 |
| up-regulated | circSLC26A4 | up-regulated | CCHE1 |
| down-regulated | circSMARCA5 | up-regulated | CCHE1 |
| up-regulated | CRNDE | up-regulated | CDKN2B-AS1 |
| up-regulated | CRNDE | up-regulated | circ8924 |
| up-regulated | CRNDE | up-regulated | circ_0000263 |
| up-regulated | CRNDE | up-regulated | circ_0000285 |
| up-regulated | CSMARCA5 | up-regulated | circ_0000388 |
| up-regulated | DANCR | up-regulated | circ_0000515 |
| up-regulated | DANCR | up-regulated | circ_0000745 |
| up-regulated | DDN-AS1 | up-regulated | circ_0001038 |
| down-regulated | DGCR5 | up-regulated | circ_000284 |
| up-regulated | DLEU1 | up-regulated | circ_0005576 |
| up-regulated | DLG1-AS1 | differential expressed | circ_000596 |
| up-regulated | DLX6-AS1 | up-regulated | circ_0007534 |
| up-regulated | DLX6-AS1 | up-regulated | circ_0018289 |
| up-regulated | DLX6-AS1 | up-regulated | circ_0023404 |
| up-regulated | DSCAM-AS1 | up-regulated | circ_0031288 |
| up-regulated | ENST00000413430 | up-regulated | circ_0067934 |
| up-regulated | ENST00000420168 | up-regulated | circ_0075341 |
| up-regulated | ENST00000430751.1 | differential expressed | circ_101958 |
| down-regulated | ENST00000447565 | up-regulated | circ_101996 |
| up-regulated | ENST00000456944 | up-regulated | ENST00000551152 |
| up-regulated | ENST00000474768 | up-regulated | ENST00000554055.1 |
| up-regulated | ENST00000503812 | up-regulated | ENST00000564977 |
| up-regulated | ENST00000531193 | up-regulated | ENST00000570282 |

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| | | | |
|---|---|---|---|
| up-regulated | ENST00000531702.1 | up-regulated | ENST00000572284.1 |
| differential expression | HOTAIR | up-regulated | FALEC |
| down-regulated | HOTAIR | up-regulated | FAM83H-AS1 |
| up-regulated | HOTAIR | up-regulated | FEZF1-AS1 |
| up-regulated | HOTAIR | up-regulated | FEZF1-AS1 |
| up-regulated | HOTAIR | up-regulated | FOXD2-AS1 |
| up-regulated | HOTAIR | up-regulated | FOXD2-AS1 |
| up-regulated | HOTAIR | up-regulated | FOXP4-AS1 |
| up-regulated | HOTAIR | up-regulated | FTH1P3 |
| down-regulated | HOTAIR | down-regulated | GAS5 |
| down-regulated | HOTAIR | down-regulated | GAS5 |
| differential expression | HOTAIR | down-regulated | GAS5 |
| up-regulated | HOTAIR | down-regulated | GAS5 |
| up-regulated | HOXA11-AS | up-regulated | GAS5 |
| up-regulated | HOXD-AS1 | down-regulated | GAS5 |
| up-regulated | HOXD-AS1 | down-regulated | GAS5 |
| up-regulated | HOXD-AS1 | down-regulated | GAS5-AS1 |
| up-regulated | HULC | up-regulated | GHET1 |
| up-regulated | HULC | up-regulated | GHET1 |
| up-regulated | LINC-POU3F3 | up-regulated | GIHCG |
| up-regulated | LINC-ROR | up-regulated | GPC3-AS1 |
| up-regulated | LINC-UFC1 | down-regulated | H19 |
| up-regulated | LINC-UFC1 | up-regulated | H19 |
| down-regulated | LINC00037 | down-regulated | H19 |
| down-regulated | LINC00052 | down-regulated | H19 |
| up-regulated | LINC00152 | down-regulated | HAND2-AS1 |
| up-regulated | LINC00152 | down-regulated | HAND2-AS1 |
| down-regulated | LINC00277 | up-regulated | HCP5 |
| up-regulated | LINC00319 | up-regulated | HIPK1-AS |
| up-regulated | LINC00473 | up-regulated | HNF1A-AS1 |
| up-regulated | LINC00483 | up-regulated | HOST2 |
| up-regulated | LINC00511 | up-regulated | HOTAIR |
| up-regulated | LINC00511 | up-regulated | HOTAIR |
| up-regulated | LINC00511 | up-regulated | HOTAIR |
| up-regulated | LINC00518 | NA | HOTAIR |
| up-regulated | LINC00675 | up-regulated | HOTAIR |
| up-regulated | LINC00958 | up-regulated | HOTAIR |
| up-regulated | LINC00958 | up-regulated | HOTAIR |
| down-regulated | LINC01101 | up-regulated | HOTAIR |
| up-regulated | LINC01133 | up-regulated | HOTAIR |
| differential expression | LINC01139 | up-regulated | HOTAIR |
| up-regulated | LINC01305 | up-regulated | HOTAIR |
| differential expression | LINC01503 | differential expression | HOTAIR |
| up-regulated | LINC01535 | up-regulated | HOTAIR |
| up-regulated | LINC01783 | up-regulated | HOTAIR |
| up-regulated | LINCRNA-p21 | down-regulated | HOTAIR |
| up-regulated | PVT1 | up-regulated | LINCRNA-p21 |
| up-regulated | PVT1 | up-regulated | LINP1 |
| up-regulated | PVT1 | up-regulated | LINP1 |
| up-regulated | PVT1 | up-regulated | lnc-CC3 |
| up-regulated | PVT1 | down-regulated | lnc-CCDST |
| up-regulated | PVT1 | up-regulated | lnc-LIF-AS |
| up-regulated | PVT1 | up-regulated | lncRNA-ATB |
| up-regulated | PVT1 | up-regulated | lncRNA-ATB |
| up-regulated | RHPN1-AS1 | up-regulated | lncRNA-CTS |
| up-regulated | ROR1-AS1 | up-regulated | lncRNA-EBIC |
| up-regulated | RP1-93H18.6 | down-regulated | lncRNA-LET |
| down-regulated | RP11-381N20.2 | differential expression | lncRNA-MIF |
| down-regulated | RP11-381N20.2 | up-regulated | lncRNA799 |
| up-regulated | RP11-396F22.1 | up-regulated | LOC105374902 |
| up-regulated | RP11-480I12.5 | up-regulated | LOC554202 |
| up-regulated | RP11-552M11.4 | up-regulated | LUCAT1 |
| up-regulated | Rs11655237 | up-regulated | LUCAT1 |
| up-regulated | RSU1P2 | up-regulated | LUCAT1 |
| up-regulated | SBF2-AS1 | up-regulated | MALAT1 |
| up-regulated | SNHG1 | up-regulated | MALAT1 |
| up-regulated | SNHG12 | up-regulated | MALAT1 |

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| | | | |
|---|---|---|---|
| up-regulated | SNHG12 | up-regulated | MALAT1 |
| up-regulated | SNHG14 | up-regulated | MALAT1 |
| up-regulated | SNHG14 | differential expression | MALAT1 |
| up-regulated | SNHG16 | up-regulated | MALAT1 |
| up-regulated | SNHG16 | up-regulated | MALAT1 |
| up-regulated | SNHG20 | down-regulated | MALAT1 |
| up-regulated | SNHG4 | down-regulated | MALAT1 |
| up-regulated | SNHG7 | up-regulated | MALAT1 |
| up-regulated | SNHG7 | down-regulated | MALAT1 |
| up-regulated | SNHG7 | up-regulated | MALAT1 |
| up-regulated | SNHG8 | differential expression | MALAT1 |
| up-regulated | SOX21-AS1 | up-regulated | MALAT1 |
| differential expressed | SOX2OT | up-regulated | MALAT1 |
| up-regulated | SOX2OT | up-regulated | MALAT1 |
| up-regulated | SPRY4-IT1 | up-regulated | MALAT1 |
| up-regulated | SPRY4-IT1 | down-regulated | MEG3 |
| up-regulated | SRA | down-regulated | MEG3 |
| down-regulated | STXBP5-AS1 | down-regulated | MEG3 |
| down-regulated | TCONS_00001368 | down-regulated | MEG3 |
| down-regulated | TCONS_00010232 | up-regulated | MEG3 |
| up-regulated | TCONS_00026907 | down-regulated | MEG3 |
| up-regulated | TDRG1 | down-regulated | MEG3 |
| up-regulated | TDRG1 | down-regulated | MEG3 |
| up-regulated | TDRG1 | down-regulated | MEG3 |
| down-regulated | TI09485 | up-regulated | MFI2 |
| up-regulated | TI10124 | up-regulated | MIAT |
| up-regulated | TI13831 | differential expression | MIR100HG |
| up-regulated | TI18318 | up-regulated | MIR205HG |
| down-regulated | TI21327 | up-regulated | MIR205HG |
| down-regulated | TI22687 | up-regulated | MIR210HG |
| up-regulated | TMPO-AS1 | down-regulated | MIR22HG |
| up-regulated | TMPO-AS1 | up-regulated | MNX1-AS1 |
| up-regulated | TMPOP2 | up-regulated | NCK1-AS1 |
| down-regulated | TOB1-AS1 | up-regulated | NCK1-AS1 |
| up-regulated | TP73-AS1 | up-regulated | NCK1-AS1 |
| up-regulated | TP73-AS1 | up-regulated | ncRNA-CCND1 |
| up-regulated | TPT1-AS1 | up-regulated | NEAT1 |
| up-regulated | TTN-AS1 | up-regulated | NEAT1 |
| up-regulated | TUG1 | up-regulated | NEAT1 |
| up-regulated | TUG1 | up-regulated | NEAT1 |
| up-regulated | TUG1 | up-regulated | NEAT1 |
| down-regulated | TUSC8 | up-regulated | NEAT1 |
| up-regulated | uc021zkp.1 | up-regulated | NEAT1 |
| up-regulated | UCA1 | up-regulated | NNT-AS1 |
| up-regulated | UCA1 | up-regulated | NOC2L-4.1 |
| up-regulated | UCA1 | up-regulated | NORAD |
| up-regulated | UCA1 | up-regulated | NR_003679.1 |
| up-regulated | UCA1 | up-regulated | NR_024008.1 |
| up-regulated | UCA1 | up-regulated | NR_034077.1 |
| up-regulated | UCA1 | up-regulated | NR_037645.1 |
| up-regulated | UICC | up-regulated | NR_037793.1 |
| down-regulated | WT1-AS | up-regulated | NR_038940.1 |
| down-regulated | WT1-AS | up-regulated | NR_047677.1 |
| down-regulated | WT1-AS | up-regulated | OGFRP1 |
| up-regulated | XIST | up-regulated | OIP5-AS1 |
| up-regulated | XIST | up-regulated | OIP5-AS1 |
| up-regulated | XIST | up-regulated | OIP5-AS1 |
| up-regulated | XLOC_000303 | differential expression | OIP5-AS1 |
| up-regulated | XLOC_006390 | up-regulated | PANDAR |
| up-regulated | XLOC_006390 | up-regulated | PARROT |
| up-regulated | XLOC_008466 | down-regulated | PCAT1 |
| down-regulated | XLOC_010588 | up-regulated | PCAT6 |
| down-regulated | XLOC_011152 | up-regulated | PCAT6 |
| up-regulated | ZEB1-AS1 | up-regulated | PCGEM1 |
| up-regulated | ZEB1-AS1 | down-regulated | PTCSC3 |
| up-regulated | ZFAS1 | down-regulated | PTCSC3 |
| | | down-regulated | ZNF667-AS1 |

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**Table2.** lncRNA involved in cervical intraepithelial neoplasia retrieved from LncRNA2Cancer databas

| Expression pattern | lncRNA |
|---|---|
| up-regulated | **lnc-IL7R** |

**Table3.** List of lncRNA/circRNA involved in cervical squamous cell carcinoma retrieved from LncRNA2Cancer database

| Expression pattern | LncRNA/circRNA | Expression pattern | LncRNA/circRNA |
|---|---|---|---|
| up-regulated | GATA6-AS | up-regulated | BLACAT1 |
| down-regulated | HAND2-AS1 | up-regulated | CCAT2 |
| down-regulated | lncRNA-NEF | up-regulated | circ_0101119 |
| down-regulated | lncRNA-SRA1 | up-regulated | circ_0101996 |
| up-regulated | loc285194 | up-regulated | FAL1 |
| down-regulated | NR2F1-AS1 | up-regulated | MACC1-AS1 |
| up-regulated | PVT1 | up-regulated | MAGI2-AS3 |
| up-regulated | SNHG12 | down-regulated | MCM3AP-AS1 |
| up-regulated | TINCR | down-regulated | MIR503HG |
| up-regulated | TINCR | down-regulated | NKILA |
| | | down-regulated | WT1-AS |

## Discussion

MALAT1 was retrieved from lncCeRBase, CLING, LncTarD, Lnc2Cancer, LncRNADisease, LncRNAWiki, GeneCards databases. The results from the LncTarD and Lnc2 Cancer databases show the increased pattern of expression, and the LncRNAWiki database shows the increased and differentially expression pattern. Liang and his colleagues reported in 2021 that MALAT1 increased the proliferation of cervical tumor cells by its potential target, miR-124, thus increasing its expression in cervical cancer[19]. In fact, they found that MALAT1 inhibited the expression of miR-124 and lead to progression of cervical carcinoma Also, MALAT1 suppresses apoptosis and promotes cell proliferation and cell cycle regulation in cervical cancer by sponging miR-145[20]. MALAT1 has been identified as a potential target for improving clinical effects in cervical carcinoma progression[21]. Jiang and colleagues reported in 2014 that MALAT1 is not expressed in normal cells but is expressed in cervical cancer[22]. Sun and colleagues reported in 2016 that the expression level of MALAT1 was significantly increased in cervical cancer cells and tissues and promoted cervical cancer invasion and metastasis through the induction of EMT [23]. In 2021, Wang and colleagues reported that MALAT1 is highly expressed in cervical cancer cells and is associated with cervical cancer metastasis. They also showed that the viral E7 oncoprotein targets the MALAT1 promoter and induces MALAT1 transcription[24]. Liu and colleagues reported in 2016 that MALAT1 can sponge with miR-124 and increase GRB2, which is a target gene of miR-124, thereby increasing the growth and invasion of cervical cancer cells. Also, MALAT1 interacts with miR-375, and miR-375 can target the E6 gene of HPV16 and inhibit its translation, and on the other hand, E6 of HPV16 increases the expression of MALAT1 in cervical cancer cells[25]. Xia and colleagues reported in 2018 that the expression of MALAT1 is increased in cervical cancer and that miR-142-3p inhibits cell proliferation and invasion of cervical cancer cells by targeting FZD7 in cervical cancer, and the expression of miR- 142-3p has decreased expression in cervical cancer, also MALAT1 acts as a sponge with miR-142-3p

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and miR-142-3p decreases and cancer cells proliferate[26]. According to these studies, the results are consistent with the data retrieved from the databases. CDKN2B is another important lncRNA in cervical cancer, which is retrieved from Lnc2Cancer databases[27]. In 2016, Zhang and colleagues reported that CDKN2B-AS1 contributes to tumor progression in a variety of cancers. According to their findings, CDKN2B-AS1 is increased in cervical cancer cell lines and tissues after inhibiting CDKN2B-AS1. The PI3K/AKT pathway is inactivated. By inhibiting CDKN2B-AS1, the phosphorylated levels of PI3K and AKT significantly decrease in cervical cancer, which indicates that the PI3K/AKT pathway is involved in the proliferation and metastasis of cervical cancer cells caused by CDKN2B-AS1. The PI3K/AKT pathway in proliferation and EMT is an essential intracellular signaling pathway that plays a role during cancer processes. By removing CDKN2B-AS1 in laboratory conditions, cervical cancer metastasis is prevented and leads to inactivation of the PI3K/AKT pathway[28]. These studies are consistent with the data retrieved from the databases. These were only a few examples of the types of lncRNAs that have been collected by bioinformatics databases and it is possible to design new treatment processes for cervical cancer by identifying them. In cervical cancer, apart from lncRNAs and miRNAs, other RNAs have been proven to exist, and researches on them are very limited, including snoRNAs, piRNAs, tRNAs, circRNAs, etc. in cervical cancer. It is suggested that more research should be done on them to use them in the treatment, diagnosis and prognosis of cancer. Some examples of circRNAs predicted in cervical cancer include circ_103519, circ_103973, circ_104315, circ_400068, circAGFG1, circAKT1, circAMOTL.

## Conclusion

In summary, the diverse lncRNAs cataloged within bioinformatics databases represent a rich and rapidly expanding resource for understanding cervical cancer. While only a select few examples have been highlighted here, their documented roles in tumor progression, metastasis, and therapy resistance underscore a significant opportunity. The systematic identification and functional characterization of these molecules is a critical step toward a new frontier in oncology. By leveraging this knowledge, the future holds promising potential for designing novel, targeted treatment strategies that move beyond conventional approaches, ultimately paving the way for more precise and effective interventions against cervical cancer.

## Acknowledgments

Not declared.

## Authorship

All authors contributed to the study's conception and design, conducted the literature review, and participated in drafting and critically revising the manuscript. All authors reviewed and approved the final version for submission.

## Conflicts of interest

No potential conflict of interest relevant to this article was reported.

## Funding

The authors received no financial support for this article's research, authorship, and publication.

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